FAQ

Maintenance

WHY CARS NEED "PREVENTIVE MAINTENANCE"?

Manufactures know that a properly maintained car will be more dependable, safer, last longer,and increase your satisfaction with their product. Car makers and owners also have a responsibility to make sure emissions controls receive regular service and are functioning properly. Regular maintenance helps accomplish these goals by keeping your engine running efficiently and eliminating potential problems that may leave you stranded.

WHAT'S IN IT FOR YOU?

- *A more Dependable Car*
- *A car that retains the "new car feel"*
- *Less chance of a costly breakdown*
- *A safer car for you and your family*
- *Doing your part for cleaner air*
- *A car worth more at trade in or sale*
- *An intact warranty*

MANUFACTURER MAINTENANCE SCHEDULES

The manufacturer creates detailed maintenance schedules outlining specific operations to be performed on various components and systems. This is done at different mileage intervals to ensure proper operation premature premature wear. The manufacturer also indicates what services must be done to maintain the factory warranty and extended warranty.

ALLDATA AUTOMOTIVE INFORMATION SYSTEM

This service facility is equipped with an automotive information system that provides this detailed data. The ALLDATA system even lists high-tech specialty lubricants required for your particular car. Other information includes vehicle specific repair and diagnostics information and factory-issued Technical Service Bulletins. The bottom line is efficient, dependable and cost-effective service for you.

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A/C Systems

HEATING AND AIR CONDITIONING: RETROFITTING
Advantages and Disadvantages:

ADVANTAGES

- Cost- R-134a is generally much cheaper than R-12 or any of the other alternative refrigerants currently available.
- Environmentally Friendly- R-134a has been scientifically tested to be safe for the ozone.
- Industry Wide Support and Service- Recycling and service equipment are widely available for R-134a systems.
- Recyclable on Site- R-134a can be recycled on site using designated recycling equipment. If a refrigerant has been contaminated with an unknown blended alternative, the refrigerant can not be recycled on site.
- Stable Mixtures- R-134a is the only approved alternative which is not a blend of other refrigerants. R-134a does not separate or settle out providing for consistent operating characteristics.
- Detectable- R-134a is detectable using current leak detection methods designed for R-12.

DISADVANTAGES

- Less Efficient than CFC-12- In systems originally designed for R-12, retrofitting with R-134a may produce less than satisfactory results. Using R-134a results in higher head pressures and higher compressor outlet temperatures. To provide satisfactory cooling performance a larger condenser or an additional cooling fan may be needed to remove excess heat.
- NOTE: In newer vehicles designed to use R-134a, cooling performance is similar to older R-12 equipped vehicles.
- Higher Pressures- Higher head pressures may hasten the failure of an A/C compressor which is already severely worn.
- Leakage- R-134a is made of molecules which are smaller than that of R-12. After retrofitting a R-12 system with R-134a, the smaller molecules combined with the higher operating pressure may result in leaks which were previously undetectable.
- Retrofitting Cost- If retrofitting requires replacement of the condenser or compressor, the total cost of the job may greatly exceed the cost of continued service with R-12.

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Tune-ups

WHAT SHOULD A "COMPLETE" TUNE-UP INCLUDE?

Electronic ignition, computerized engine controls, and electronic fuel injection have eliminated many adjustments that were once part of a "traditional" tune-up. Most would agree that a tune-up today is a preventive maintenance service and engine performance check.

Call it what you will, a complete tune-up should combine elements of preventive maintenance, adjustment and performance analysis. One of the main reasons people bring a vehicle in for a tune-up is because they are experiencing some kind of drive ability problem.

Things like hard starting, stalling, hesitation, misfiring, poor fuel economy, or lack of power are seldom cured by a new set of spark plugs and a few turns of a screwdriver.

Every tune-up should include a comprehensive performance check to verify that no driveability problems or trouble codes exist. Another item that should be included is an emissions check. Thirty-five states now have some type of annual vehicle emissions inspection program, and all but two include a tailpipe emissions check. Most mechanics will check EGR valve operation, the PCV valve, and make a visual inspection of other emission control components and plumbing. But unless an actual emissions performance check is made at the tailpipe, there is no way to know whether or not the vehicle will meet applicable emission standards. An emissions check is a must.

Taking into account longer service intervals and reduced maintenance requirements of today's vehicles, a tune-up is probably only necessary every 30,000 miles, or once every two to three years. This is altered when a driveability or emissions problem arises that requires diagnosis and repair.

The best guide to tune-up frequency is probably the recommended spark plug replacement interval in a vehicle's owners manual.

Our list of items that should be included in a "complete" tune-up includes:

-Replace spark plugs
-Replace rotor
-Check ignition wires (replace if necessary)
-Check timing (adjust if necessary)
-Check distributor cap (replace if necessary)
-Check choke (carbureted engines)
-Clean fuel injectors
-Check ignition performance (firing voltage and ignition patterns)
-Check compression and/or power balance (identifies bad fuel injectors as well as compression problems)
-Check vehicle computer for trouble codes
-Check manifold intake vacuum (reveals exhaust restrictions)
-Check exhaust emissions (verifies fuel mixture, ignition performance and emissions performance)

-Install new air filter
-Replace fuel filter
-Replace PCV valve
-Check all emission control~ (EGR valve, air pump, etc.)
-Check all vital fluid levels (engine oil, transmission fluid, coolant, brakes, power steering)
-Check belts and hoses
-Check safety items such as lights, wipers, tires (including inflation pressure), horn, etc.

HOW OFTEN SHOULD BELTS AND HOSES BE REPLACED?

Most hose manufacturers recommend replacing hoses every four years. V-belts should be replaced every three years or 36,000 miles. The incidence of failure rises sharply after the fourth year of service for hoses and third year for belts.

The lifespan of a typical serpentine belt is about five years or 50,000 miles. Serpentine belts are thinner and more flexible than V-belts. They run cooler and last longer, but costs are about twice as much to replace.

The hard part is convincing customers to change belts and hoses as preventative maintenance before they fail. Few people do, yet they could save themselves a lot of unnecessary grief and expense if they would.

A visual inspection will often uncover bad hoses. Pinching hoses to check for age cracks, brittleness or mushiness can also help locate hoses that need to be changed.

However, neither technique will reveal all the hoses that might need replacing because hoses wear as much from the inside out as they do from the outside in. A hose that appears okay on the outside may actually be on the verge of failure because of internal deterioration.

Rubber hoses deteriorate with age. Tiny cracks develop in the rubber which eventually cause hoses to split, blister or leak. Oil contamination and atmospheric ozone can accelerate the process. "According to research done by one hose manufacturer, internal corrosion caused by electrochemical degradation is the primary cause of cooling system hose failure". The coolant acts like an electrolyte and allows a current to flow between engine and radiator. This causes micro-cracks to form inside the hose which eventually leads to pinhole leaks and weakening of hose fibers.

The additional friction between belt and pulley will make a belt run hotter. After millions of journeys around the pulleys, even the best drive belt begins to suffer the effects of age. Rubber begins to crack and fray and the internal cords become weak and brittle.

When a belt is replaced, it is important that the belt be properly tensioned. If too loose, it will slip and wear quickly. If too tight, it may damage internal cords as well as overload shaft bearings on accessories it drives.

As a rule of thumb about tightening a belt until there is about half an inch of give between the two furthest pulleys is not always accurate. A belt "gauge" that measures actual tension is the only sure way to know if a belt is tensioned properly. You cannot always determine a belt's true condition by appearances alone. Any belt obviously cracked and frayed should be replaced.

HOW OFTEN SHOULD OIL AND FILTER SHOULD BE CHANGED?

Change oil and filter often enough to protect the engine from premature wear and viscosity breakdown.

For most cars and light trucks, the standard recommendation is to change oil and filter every six months or 3,000 miles, whichever comes first.

Most late model owner's manuals say that except for "Severe Service" applications, oil change interval can be safely stretched to once a year or every 7,500 miles, with filter changes at every other oil change.

Except for Chrysler's 7/70 powertrain warranty, and a few others that go up to 5/50 or 6/60, most new car powertrain warranties don't go beyond 3/36. So where's the risk? There isn't any.

When automakers make such recommendations, one assumes they are based on extensive durability testing. After all, automakers themselves would have to bear the warranty costs should their maintenance recommendations prove inadequate.

With proper maintenance, there is no reason an engine shouldn't go 100,000 miles or more without developing a thirst for oil. That is why most oil companies, as well as aftermarket service professionals, recommend changing oil and filter every six months or 3,000 miles.

They also make such recommendations because many motorists are not aware that they should follow the "Severe Service" maintenance schedule in their owner's manual, calling for oil and filter change intervals of three to six months or 3,000 miles. Severe service (as defined by auto makers themselves) includes:

-Making frequent short trips (less than five miles)
-Making frequent short trips (less than 10 miles) when temperatures are below freezing
-Driving in hot weather stop-and-go traffic
-Extensive idling and/or low speed driving for long periods of time (taxi, police, door-to-door delivery, etc.)
-Driving at sustained high speeds during hot weather
-Towing a trailer
-Driving in areas with heavy dust (gravel roads, construction zones, etc.)

Protective additives in a motor oil do not hold up as well under such driving conditions for several reasons. If the engine is not running long enough to get the oil hot, condensation and fuel vapors will not boil off. Contaminants will accumulate in the crankcase, leading to formation of corrosive acids and sludge.

Excessive idling and high operating temperatures from towing and high speed driving during hot weather accelerate viscosity breakdown. Exposure to dust can put dirt particles in the crankcase. The filter also needs to be changed every time for two reasons. Today's pint-sized filters do not contain as much filter material as their quart-sized counterparts. The filter contains dirty oil that can contaminate fresh oil added during an oil change.

Considering what four quarts of oil and a filter cost, versus the cost of replacing an engine, it is better to change oil and filter a little more often than might be absolutely necessary rather than risk not changing it often enough.

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WHAT TYPE OF MOTOR OIL IS RECOMMENDED?

OWNER'S MANUAL RECOMMENDATIONS

Vehicle owner's manuals give motor oil recommendations based on what works best with the engines made by the company. Choice of viscosity grades is usually provided depending on ambient temperature conditions.

GENERAL RECOMMENDATIONS

10W-30 is best for all engines for year-round driving, 10W-40 is more popular in the aftermarket, but 10W-30 is superior oil because the additive package holds up better over the long haul. General Motors, for example, does not recommend lOW-40 oil for any of its cars.

5W-30 is now approved for most late model engines on a year-round basis. It is not approved for many 'turbocharged or diesel applications, some high output V-8s, or applications that involve driving at sustained highway speeds or towing in hot weather. It may not be the best choice for older engines with high mileage. 5W -30 is the factory fill oil on most new cars because it pumps through the engine more quickly after start-up. It also makes cold weather starting easier and reduces fuel consumption.

Straight viscosity oils have limited temperature ranges and lack the versatility of multiviscosity oils. Even so, some people prefer them. They can be safely used as long as their temperature limits are observed:
Straight 1OW is okay for cold weather starting and driving, but too thin for warm weather driving.
Straight 20W is okay for all around driving, but doesn't provide the temperature protection of straight 3QW (which is too thick at low temperatures for easy cold starting).
Straight 40W and 50W oils are primarily for heavy-duty applications.

Special multiviscosity oils, like 20W-50, are typically formulated for racing or severe duty applications such as towing; they are not usually intended for everyday driving.

Synthetics are a good alternative for any of the above because most provide extended temperature protection and longevity.

WHAT ARE YOUR RECOMMENDATIONS FOR CHANGING FILTERS?

It is best to follow the Severe Service maintenance schedules found in most new car owner's manuals, with a few exceptions:

Air filters need to be inspected regularly and replaced as often as needed, regardless of mileage or time. Dirty air filters can increase fuel consumption and exhaust emissions.

Fuel filters should be replaced yearly and/or at every tune-up, especially on fuel injected cars. The fuel filter in a vehicle with electronic fuel injection passes a much larger volume of fuel than its counterpart in a carbureted application. If the tank is dirty or rusty, constant fuel recirculation can pick up a lot of debris that ends up in the filter. If the filter plugs, the engine is starved for fuel or unfiltered fuel is allowed to bypass the filter. The latter can damage injectors.

Oil filters need to be replaced at every oil change (every six months or 3,000 miles in most cases) despite the advice in many owner's manuals to only change the filter at every other oil change. A new filter is cheap insurance against major engine damage, so why take unnecessary risks?

Few owners' manuals have a suggested change interval for the automatic transmission fluid (ATF) or fluid filter unless the vehicle is used for towing. Most transmission specialists say the best preventative maintenance for prolonging automatic transmission life is to change fluid and filter every two years or 30,000 miles.

Follow the manufacturer's recommendations on the specific type of ATF to use. The type of ATF should match the specs required for the application.

All GMs, most late model Chryslers and many imports use Dexron II. All 1988 and later Fords require Mercon ATF. Most universal ATF fluids are acceptable for either of these. Older Fords or imports require Type F fluid.

High Mileage Vehicle Inspection and Maintenance
FIXING YOUR PRESENT VEHICLE SAYES YOU MONEY

One of the best ways to do this is prolonging the life of your current vehicle. With new car prices in the United States averaging well over $10,000, money invested in keeping your existing vehicle in good shape could save you hundreds (even thousands) of dollars a year. When you consider the real cost of buying a new car (price of the car, sales tax, license, registration fees, and insurance), it is not difficult to rationalize investing a few hundred dollars to repair your present vehicle.

HIGH MILEAGE INSPECTION AND EYALUATION

If your vehicle has passed the 100,000 mile mark and you want to significantly prolong its useful life, it is time to have it thoroughly evaluated by a professional automotive technician who can recommend needed repairs or service. This facility is equipped to perform this

service. We employ technicians who use factory-level information detailing your vehicle's service requirements.

Our high mileage inspection and evaluation goes beyond and is designed to get to the root of potential problems. Ask your service advisor or technician to show you exactly what is involved in this service. He or she will be happy to go over the evaluation form with you before you okay the inspection and provide you with a comprehensive estimate for any work recommended as a result of your vehicle's checkup. They will tell you about repairs that are necessary today, and also alert you to items that are potential problem areas you may want to address today for more trouble-free miles tomorrow. Of course, you make the decision as to what work is actually performed.

Working together, we can add years to the life of your car or truck.

SAFETY AND SCHEDULED MAINTENANCE

The safety aspect of properly maintaining your vehicle, especially with high mileage cars, should not be overlooked. Failing brakes, exhaust leaks and other problems can be prevented by following good car care practices. Unfortunately, most manufacturers only provide maintenance guidelines for the first 100,000 miles or so. Clear and extensive procedures for maintenance beyond this mileage do not exist. If lucky, manufacturers provide interval service schedules, such as every 15,000 miles. These schedules should be followed whenever possible. If they are followed correctly, you can reasonably expect thousands more satisfactory miles from your vehicle.

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Brakes

WHAT SHOULD BE INCLUDED IN A "COMPLETE" BRAKE JOB?

A complete brake job should restore the vehicle's brake system and braking performance to good-as-n60w condition. Anything less would be an incomplete brake job.

Brake components that should be replaced will obviously depend upon the age, mileage and wear. There is no pat answer as to which items need replacing and which ones don't. It's a judgment call.

A complete brake job should begin with a thorough inspection of the entire brake system; lining condition, rotors and drums, calipers and wheel cylinders, brake hardware, hoses, lines, and master cylinder.
Any hoses that are found to be age cracked, chaffed, swollen, or leaking must be replaced. Make sure the replacement hose has the same type of end fittings (double-flared or ISO) as the original. Don't intermix fitting types.

A leaking caliper or wheel cylinder needs to be rebuilt or replaced. The same applies to a caliper that is frozen (look for uneven pad wear), damaged or badly corroded.

Steel lines that are leaking, kinked, badly corroded, or damaged must also be replaced. For steel brake lines, use only approved steel tubing with double-flared or ISO flare ends. Leaks at the master cylinder or a brake pedal that gradually sinks to the floor tells you that the master cylinder needs replacing. The rotors and drums need to be inspected for wear, heat cracks, warpage, or other damage. Unless they are in perfect condition, they should always be resurfaced before new linings are installed. If worn too thin, replace them.

Wheel bearings should be part of a complete brake job on most rear-wheel drive vehicles and some front-wheel drive cars. Unless bearings are sealed, they need to be cleaned, inspected, repacked with wheel bearing grease (new grease seals are a must), and properly adjusted.

Rust, heat, and age have a detrimental effect on many hardware components. It's a good idea to replace some of these parts when the brakes are relined. On disc brakes, new mounting pins and bushings are recommended for floating-style calipers. High temperature synthetic or silicone brake grease (never ordinary chassis grease) should be used to lubricate caliper pins and caliper contact points.

On drum brakes shoe retaining clips and return springs should be replaced. Self-adjusters should be replaced if they are corroded or frozen.

Use brake grease to lubricate self-adjusters and raised points on brake backing plates where shoes make contact. As a rule, tapered roller bearings are not preloaded. Finger tight is usually recommended. Ball wheel bearings usually require preloading.

As a final step, old brake fluid should always be replaced with fresh fluid.

HOW THIN CAN ROTORS/DRUMS BE SAFELY TURNED?

If a customer wants drums turned to a size outside the limits cast into the drum, you must refuse. They cannot be turned thinner than the minimum thickness specifications stamped or cast on the rotor or drum itself. A drum or rotor worn or turned too thin may not be able to absorb and dissipate heat quickly.

This can make the brakes run hot, accelerate lining wear, and reduce braking effectiveness. It can also lead to rotor or drum warpage and a pulsating brake pedal.

Most drums are cast with enough thickness to allow 0.090" of wear. In other words, the difference between a drum's diameter when new and its discard diameter is 0.090," but that doesn't mean you can machine a drum right up to the 0.090" limit. You should never turn a drum that's worn more than 0.060" beyond its original diameter.

The 0.060" limit leaves a 0.030" margin for additional wear. If you turn a drum that's worn more than 0.060," or if the drum ends up being more than 0.060" larger after turning, there may not be enough metal left to handle normal wear until the next brake job.

The 0.090" discard limit is the maximum acceptable wear the drum can safely handle before the metal is too thin. Any drum worn beyond 0.060", or that would be over 0.060" larger after resurfacing, should never be turned on a lathe, it should be replaced.

Like drums, the amount of wear a rotor has experienced will determine whether or not it can be resurfaced. The two-key rotor dimensions to take into account are minimum refinish thickness and discard thickness.

Wear is checked by measuring diameter with a drum micrometer. If the gauge shows enough metal left to safely 'turn it, the drum can be resurfaced to restore and true the surface.

Minimum refinish thickness is the limit for resurfacing the rotor. If the rotor has worn to the point where its thickness will be less than the specified dimension after resurfacing, the rotor should be replaced.

Discard thickness is the maximum acceptable wear limit. Once the rotor is worn beyond discard thickness, it must be replaced. The difference between discard and minimum refinish thickness is the margin the vehicle manufacturer believes is necessary to allow for normal wear between brake jobs. It varies considerably from one vehicle manufacturer to the next, and according to vehicle size and type of brakes used.

The margin specified on most domestic passenger cars is around 0.015." The range is 0.020" to 0.030" for most imports. A few, such as Jaguar, have as much as a 0.050" difference between minimum refinish thickness and discard thickness.

Measuring at various points around the rotor will reveal any variations in rotor thickness or parallelism. Both surfaces of the rotor must be within the manufacturer's specified tolerances for parallelism, otherwise the rotor can cause excessive pedal travel (by kicking the pads too far out as it turns), front end vibration, pedal pulsation, and chatter. Parallelism specs recommended by various vehicle manufacturers range from as low as 0.0001" to as high as 0.0008." Refer to reference charts to determine how much correction, if any, is needed.

Another critical rotor dimension is runout. Lateral runout is the movement of the rotor from side to side as it turns. Excessive runout will kick the pads out as the rotor turns, creating

excessive clearance requiring increased pedal travel when brakes are applied.

Runout is checked with a dial indicator while the rotor is still on the car. If run-out exceeds the recommended limit, the rotor must be resurfaced or replaced.

Drums and rotors should always be inspected for heat cracks, distortion, damage, and hard spots prior to resurfacing. Cracks, damage and hard spots call for replacement. If distortion can't be eliminated within the limits of resurfacing, replacement will also be necessary.

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Engine

WHAT CAN MAKE AN ENGINE OVERHEAT?

Overheating is caused by anything that leads to a loss of coolant, prevents the cooling system from getting rid of heat, or causes excess heat in the engine itself:

-Coolant leaks (water pump, radiator, heater core, hoses, freeze plugs, head gasket, engine internal).
-Weak radiator cap (does not hold rated pressure and allows coolant to boilover). Pressure test the cap to check it out.
-Cooling system clogged (deposits built up in radiator or in engine due to maintenance neglect or use of hard water). Use a cleaner, then reverse flush the system to clean it out. A badly-clogged radiator may need to be rodded out or replaced.
-Inoperative electric cooling fan (check fan motor, relay and temperature switch for correct operation).
-Bad fan clutch (replace if slipping, leaking or loose).
-Thermostat stuck shut (replace)
-Missing fan shroud (reduces cooling efficiency of fan).
-Debris in the radiator (remove bugs and dirt).
-Too low or too high a concentration of antifreeze (should be 50/50 for best cooling). ,
-Bad water pump (impeller eroded or loose -replace pump).
-Slipping fan belt (tighten or replace).
-Collapsed radiator hose (check lower hose).
-Late ignition timing (reset to specs).
-Restricted exhaust system (check intake vacuum readings and inspect converter, muffler and pipes) .
-Radiator and/or fan undersized for application (increase cooling power by installing larger radiator and/or auxiliary cooling fan)

WHY TIMING BELTS NEED REPLACEMENT?

WHAT IS A TIMING BELT?
Timing belts have replaced timing chains on many of today's engines. Both belts and chains ensure that crankshaft, pistons and valves operate together in proper sequence. Belts are lighter, quieter and more efficient than chains.
WHY REPLACE THE BELT?
Like other components, timing belts wear out. Proper maintenance requires belt replacement at regular intervals--before they break.
WHERE ARE BEL TS LOCATED?
Timing belts are on the front of the engine protected by a plastic or metal cover.
WHEN SHOULD BELTS BE REPLACED?
When a timing belt breaks, the engine stops. Replace belts before this occurs. Most manufacturers provide' a suggested service life and replacement schedule for this critical component.
HOW DO I KNOW IF MY CAR HAS ONE?
Your vehicle manual may tell you, but you should ask your technician--he will know for sure.

WHAT IS A "FREE-RUNNING" ENGINE?
If the timing belt breaks on a free-running engine, the engine stops and you will need a tow to the repair shop. No mechanical damage occurs and the installation of a new belt is usually all that is needed to get you on your way.
WHAT IS AN "INTERFERENCE" ENGINE?
If the timing belt breaks on an interference engine, mechanical engine damage occurs. It most commonly involves open valves being struck by pistons, resulting in the need for expensive repairs. In extreme cases, a replacement engine may be required.

EXHAUST SYSTEMS:

The longevity of muffler and pipes depends on what kind of steel the components are made of, how pipes are routed under the car, where the muffler is located, and whether or not the vehicle has a catalytic converter. Original equipment pipes made of stainless steel (which are used from the converter forward on most cars and for the entire exhaust system on some) can last up to 10 years or more.

Original equipment pipes made of aluminumized steel generally last five to seven years, except in areas with a lot of road salt and moisture. In these areas, pipes may need replacing after three to five years.
As a rule, the hotter a muffler runs the longer it lasts. Mufflers on vehicles with catalytic converters run hotter and last longer than those on older vehicles without converters. Mufflers located ahead of the rear axle last longer than those located aft of the rear axle.

Most aftermarket pipes, by comparison, are made of ordinary steel which is good for about three to five years of service. Aluminumized and stainless pipes are better, but cost more.

With mufflers, stainless holds up the best, followed by double sided galvanized steel. Single-sided galvanized and aluminumized hold up fairly well, while plain steel offers little or no corrosion resistance.
Mufflers rust from the inside out. Rust is caused by moisture in the exhaust. Moisture condenses in the muffler when the engine is shut off and the muffler starts to cool. Some mufflers have a small pin hole that allows condensation to seep out.

One aftermarket muffler manufacturer puts a small packet of a special moisture absorbing chemical inside some of their mufflers to fight internal corrosion.

A muffler that needs replacing is an opportunity to sell clamps, pipes, hangers and any special tools that might be needed to complete the job.

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Cooling Systems

WHAT KIND OF MAINTENANCE IS RECOMMENDED FOR COOLING SYSTEMS?

Replacing coolant on a regular basis will prolong the life of the radiator and other cooling system components. Most new car maintenance schedules call for coolant changes every three years or 50,000 miles. Many professional mechanics consider that too long and recommend every two years or 24,000 miles.

There are some who argue that annual coolant changes on late model vehicles with bimetal engines (aluminum heads/iron blocks) and/or aluminum radiators is a good idea.

How can you tell when it is time to change the coolant? The only way to know if the coolant still has adequate corrosion protection is to test it. By dipping a test strip in the coolant and noting its color change, you can determine coolant condition and whether or not it is time to replace it.

It does not really make much difference how often the coolant is changed as long as it is changed before losing its corrosion resistance. Antifreeze is made of ethylene glycol (which never wears out) and various additives (which do wear out).Some additives provide "reserve alkalinity" to neutralize internal corrosion before it can start. As long us the coolant is changed before its reserve alkalinity is depleted, the cooling system should be no worse for the wear. If you wait too long, the result can be expensive internal corrosion in the radiator, heater core and engine.

When coolant is changed, the system should be reverse flushed rather than simply drained. This helps dislodge and remove accumulated debris and debris in the system. It also removes old coolant that would otherwise remain in the engine block.

Use of a cooling system cleaner is not necessary unless the system has been badly neglected and is full of lime deposits.

The cooling system should be refilled with a 50/50 mixture of ethylene glycol antifreeze and clean water. This provides freezing protection down to -34°F and boil-over protection to 265°F. The thermostat does not need changing unless it has been causing trouble or the engine has severely overheated. If a thermostat is replaced, it should have the same temperature rating as the original. This is extremely important on late model vehicles with computerized engine controls. Fuel, ignition and emission functions are all affected by coolant temperature.

When coolant is changed, inspect belts and hoses. Make a visual inspection for leaks. Pressure test radiator and cap. Check operation of heater and defroster.

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Suspensions

WHY REPLACE RACK & PINION STEERING RATHER THAN REBUILD IT?

Overhauling a power rack is not a job for the novice. Special tools are required to remove and install internal seals. The tools are expensive and may not be cost justified for a shop that only does an occasional rack. For a do-it-yourself, the tools could end up costing as much as a new or remanufactured rack.

It is tricky to get seals properly positioned. If a seal slips or is damaged during installation, the rack will leak. For that reason alone, many professional mechanics won't waste their time trying to rebuild questionable racks.

Operating pressures within a power rack generally do not exceed 100 psi when the wheels are in the straight-ahead position. In an easy turn, the pressure can increase to as much as 30,0 psi and it goes up to 700 psi in a tight turn. The highest pressures are usually encountered when parking. If the wheels are up against a curb or if the steering wheel is turned hard against the stop, internal pressures can climb to 700 to 1,400 psi. This is why anybody who overhauls a rack better make sure the seals don't leak.

Time is another important factor to the professional installers. Anything that makes their job easier and faster is money in their pocket. If given a choice, most avoid doing repairs the old fashioned way because overhauling certain components in the shop slows them down and takes too much time. That's why many components (like starters, alternators, front-wheel drive driveshaft assemblies, even brake calipers) are often replaced with new or remanufactured units rather than overhauled in the shop. The same is true for racks.

Time is money and at $40 per hour it doesn't take long for a mechanic's time to add up. By the time a mechanic spends $25 to $30 for a seal kit and several hours overhauling a rack (assuming it can be overhauled), he can end up spending as much of his customer's money as if he had bought a replacement rack in the first place.

If the housing is worn, distorted, cracked or otherwise unusable, a new housing can cost upwards of $125. If the control valve is bad, it will cost $150 to $250 to replace -if you can find the parts. Individual component parts for racks are not readily available in the aftermarket because everyone knows it is cheaper and smarter to go with a new or remanufactured rack if the original rack needs to be overhauled.

Another reason why installers and do-it-yourselfers do not rebuild their own racks is because some racks are not rebuildable -at least not with a seal kit alone. If the teeth in the center of the rack are worn or damaged, a replacement rack bar can run $100 to $150.

Rebuilders can often salvage worn aluminum spool valve housings by boring out the housings and installing a stainless steel sleeve. The sleeve not only restores tolerances, but also prevents the wear problem from reoccurring. In that respect, a remanufactured rack

may actually be better than the original. Most rebuilders also pressure test their racks after reassembly to make certain they function correctly and do not leak.

One mistake installers should avoid when replacing a rack is not flushing out the power steering pump and lines to remove all traces of old fluid. Flushing is a must because it removes contaminants that could ruin the replacement rack. The system also needs to be purged of air by cycling the steering slowly back and forth until there are no more air bubbles in the fluid.

WHY SHOULD SHOCKS AND STRUTS ALWAYS BE REPLACED IN PAIRS?

Unlike some steering and suspension components, there is no significant difference in wear rates between left and right shocks or struts. If one shock or strut is shot, chances are its companion also needs to be replaced.

For front versus rear, there can be differences in wear rates depending on vehicle loading and usage. Generally speaking, when front shocks or struts need replacing, so do those in the rear. Shock absorbers and struts are designed to dampen spring oscillations as the suspension goes through jounce and rebound. This prevents unwanted body gyrations and helps keep the wheels in contact with the road.
The ride control elements inside perform this task by creating resistance, which in turn transforms the energy of motion into heat. The up and down strokes of the piston inside the shock or strut pumps fluid back and forth through metering orifices in the piston and valve body.

After zillions of such cycles, the cylinder bore, piston and shaft seals eventually wear out. Though original equipment shocks have improved in recent years, many still may need replacing in as little as 30,000 miles. With struts, the lifespan is about double that of a shock.

The resistance created by these orifices helps dampen spring oscillations while limiting body and suspension motions. The pumping friction heats the fluid and the heat then dissipates through the shock body into the surrounding air.

Problem is, most people do not notice the gradual deterioration in ride quality until things get really bad: Many shocks and struts are not replaced as often as they should be.
Replacement is needed if any of the following symptoms are noted:
-A bouncy or uncomfortable ride
-Nose dive when braking
-Excessive body sway when cornering
-Tail squat when accelerating
-Fluid leaks
-Physical damage to the shock or strut itself or its mounting hardware
-Cupped tire wear
-Indications of bottoming (check suspension stops)
-Vehicle fails a bounce test (more than two oscillations after rocking and releasing the bumper)
-When the rod on a gas pressurized shock or strut does not extend by itself (indicating it has lost its gas charge)

WHAT ARE THE SIGNIFICANT CAUSES OF EXCESSIVE TIRE WEAR?

Uneven or accelerated tire wear can be caused by wheel misalignment, worn suspension and steering components, and/or improper tire inflation. The most critical alignment angle with respect to tire wear is toe, Camber is also important and can be affected by caster. Misalignment is usually caused by worn, loose or bent suspension and steering parts (bad tie rod ends, idler arms, control arm bushings, ball joints, struts, etc.), but can also be due to spring sag or improper ride height.

With tire inflation, underinflation is just as bad as overinflation. Both can cause uneven tire wear. Underinflation can also make a tire run dangerously hot.

For a tire to roll down the road with the least amount of resistance and maximum directional stability, it must be aligned with the road, parallel to the other three wheels on the vehicle, square with the chassis, and properly inflated.

Rolling resistance is affected by a number of things, one of which is the straightness of the tire with respect to the direction of travel. If the tire is skewed slightly to one side or the other (toed in or out), it will scrub as it rolls. Scrub increases rolling resistance and also wears away the tread, leaving a feathered wear pattern.

Toe refers to the parallelism of a front or rear wheel to its companion on the opposite side. From a bird's-eye view, all four wheels should be parallel to one another and pointing straight ahead.

Toe is measured by comparing the distance between the front edges of both tires on an axle to the distance between the trailing edges. If the distance between the front edge is further apart than that at the rear, wheels have toe-out. If front is closer together than rear, wheels have toe-in. Toe settings may be specified in inches, millimeters or degrees. Toe is most affected by worn tie rod ends, a worn or loose idle arm or center link, or a bent steering arm.

To minimize tire wear, rolling toe should be kept as near zero as possible. To achieve this, the compliance or amount of give in the vehicle's steering linkage and suspension must be taken into consideration.
As a vehicle starts to move, rolling resistance pushes the tires back.

With front-wheel drive, the situation is different because the front wheels pull the vehicle down the road. Engine torque causes the wheels to toe-in under load. Most FWD suspensions have a negative scrub radius built into the steering geometry.

The tire pivots slightly to the outside of its centerline. This helps to offset the tendency to toe-in. Even so, most front-wheel drive vehicles still require toe settings of zero to 1/8" toe out.

Toe also changes as the front wheels turn. Because the inner and outer wheels don't follow the same path (the inner one follows a smaller circle than the outer one), the inner wheel must toe-out to compensate. This is called the" Ackerrnan Principle of Steering" after the engineer who invented the idea.

Toe-out depends on the angle of the steering arms with respect to the steering knuckles and chassis. The amount by which toe changes is called "toe-out on turns." This angle is also listed in alignment specs and is checked by turning the wheels on the alignment rack. If toe-out on turns is off because of a bent steering arm, the tires will squeal and scrub whenever

the wheels are steered.

Camber also affects tire wear. For directional stability, the tires must be perpendicular (straight up and down) with respect to the road. Any tilt to the inside or outside will cause a tire to turn in that direction like a bicycle leaning into a turn. This causes steering to pull to one side and creates uneven wear across the tread face.

Camber is the inward or outward tilt of the wheels as viewed from either front or rear of the car. If wheels lean in, they have negative camber. If they lean out, they have positive camber. The amount of camber is always expressed in degrees and is found by measuring the tilt of the wheels on an alignment rack or by using a level that attaches to the wheel.

Because camber affects tire wear, the ideal situation is to have zero running camber on all four wheels to maintain full tread contact with the road. Like toe, camber changes as the: suspension moves up and down. To keep the wheels vertical once the vehicle is loaded, a small amount of static positive camber may be required.

Camber should generally be within 1/2 degree side-to-side. Otherwise, the vehicle will lean toward the side with the most positive camber.

Camber misalignment can be caused by a sagging spring, a bent strut, bent spindle, worn control arm bushing, worn ball joint, or mislocated strut tower (too far in or out).

Camber corrections are made by replacing worn parts and/or by realigning the suspension using either the factory adjustments (cams, shims or elongated holes) or aftermarket aids.

Related items that may also need replacing include rack mounts and steering input shaft coupling. If the coupling donut is deteriorating with age, it needs to be replaced. Metal swivel couplings also need to be checked for rust and binding. Do not forget to include new power steering fluid (follow manufacturer recommendations as to the proper type of fluid).

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