ENGINES:

An engine failure is always bad news. Besides taking away your wheels, it forces you to make a painful financial decision. If the cost to repair, overhaul or replace the engine is more than the resale value of your car or truck, the investment may not be worth it. But if your vehicle is in good condition otherwise, repairing or replacing the engine may be less expense than trading for another used vehicle (always a gamble), or taking on payments for a new car or truck.

Assuming you have gotten past the initial trauma and has decided in favor of fixing the engine, you have to figure out why the engine failed so the repaired engine (or replacement engine) won't suffer the same fate.

A good place to start your postmortem is to review the circumstances that preceded the failure. Sometimes failures occur unexpectedly. One minute the engine is running fine and you're keeping up with traffic, and the next you're sitting along side the road with the hood up wondering what happened. In most instances, though, there is ample warning that something is amiss long before the engine actually fails.

Unusual engine noises, low oil pressure, engine overheating, loss of power, misfiring, hard starting and similar drivability and performance complaints can all be indications of problems that need attention. The underlying cause may be something minor or major. There is no way to know unless somebody checks it out. If a motorist ignores such warnings long enough, it can be a very costly mistake because eventually the engine may succumb to whatever is causing the problem, which is a classic example of the famous preventive maintenance line, "You can pay me now or you can pay me later."

ENGINE OVERHEATING

Overheating can be caused by any number of things. It is often the result of coolant loss or a low coolant level, which is turn, may be due to leaks in hoses, the radiator or the engine itself. A weak radiator cap that leaks pressure can allow coolant to escape from the system. Not getting the cooling system completely filled after changing the antifreeze can allow steam pockets to form that make the engine overheat or run hot. An electric cooling fan that fails to come on due to a faulty thermostat, relay, wiring or motor may be an overlooked cause of overheating. So too can a slipping fan clutch. Even a missing fan shroud that reduces the fan's effectiveness may be a contributing factor.

Another common cause of overheating is a faulty thermostat. When most thermostats fail, they do so in the closed position preventing the flow of coolant from the engine to the radiator. Replacing the thermostat will obviously solve the problem, but may not prevent the same thing from happening again at some point in the future. So you might want to install a "fail-safe" type of thermostat that still allows some coolant flow in the event of failure.

Less obvious causes of overheating can include a clogged radiator that is filled with sediment as a result of coolant neglect, corrosion or using excessively hard water. Incorrect ignition timing and/or a lean fuel mixture (which may be due to air leaks, low fuel pressure, etc.) can also elevate normal operating temperatures. An exhaust restriction (typically a clogged catalytic converter) can also make the engine work harder causing it to run hot.

Too much heat in an engine can cause serious problems because heat causes metal to expand. The hotter the engine gets, the tighter clearances become until there are no more clearances left. Overheating can cause valve stems to gall and stick, and pistons to scuff and seize. So if you see either of these conditions when you tear the engine down, it is a pretty good clue that overheating caused the engine to fail.

Excessive heat can also cause cylinder heads to swell, warp and/or crack. Ford 2.9L heads are notorious for cracking because the thin wall castings can't take the heat. Other heads that often crack include those on Ford 1.5L & 1.6L Escorts, Ford 2.3L and 2.5L, General Motors 2.5L, GM 250 six-cylinder heads with integral exhaust manifolds, and 1987 and later Chevy small block V8 "Vortex" heads.

Aluminum heads are especially vulnerable to warp age and cracking because aluminum has a much higher coefficient of thermal expansion than cast iron. Consequently, when a bimetal engine with an aluminum head gets too hot, the head tends to swell up in the middle, causing it to warp and blow the head gasket. If the engine has an overhead cam, the resulting misalignment in the cam bores created by the warp age can gall or seize the cam bearings, or even break the cam. Anytime you encounter a warped or cracked aluminum head, or an OHC head with a seized cam, chances are the damage was caused by overheating.

In some engines where the center exhaust ports are siamesed together, hot spots can develop in the head between the exhaust ports causing the head to swell so much it crushes the head gasket resulting in a blown head gasket. Replacing the head gasket may temporarily solve the compression problem, but unless the underlying cause of the elevated exhaust temperature is diagnosed and corrected, the replacement gasket may eventually suffer the same fate. Some aftermarket gasket manufacturers have gone so far as to develop special reinforced replacement gaskets for engine applications that have a history of crushing gaskets.

HOW HOT IS TOO HOT?

Most engines today are designed to operate within a "normal" temperature range of about 195 to 220 degrees F. A relatively constant operating temperature is absolutely essential for proper emissions control, good fuel economy and performance.

A 50/50 mixture of water and ethylene glycol antifreeze in the cooling system will boil at 225 degrees if the cap is open. But as long as the system is sealed and holds pressure, a radiator cap rated at 15 psi will increase the boiling temperature of a 50/50 coolant blend up to 265 degrees F. If the concentration of antifreeze to water is upped to 70/30 (the maximum recommended), the boiling temperature under 15 psi of pressure goes up to 276 degrees.

So does this mean a cooling system with a maximum concentration of antifreeze in the coolant (70%) can run as hot as 276 without boiling over? Theoretically yes -- but realistically no. The clearances in most of today's engines are much, much closer than those in engines built in the 1970s and early 1980s. Piston-to-cylinder clearances are much tighter to reduce blowby for lower emissions. Valve stem-to-guide clearances also are closer to reduce oil consumption and emissions, too. Plus, many engines today have aluminum heads with overhead cams. Such engines don't handle higher than normal temperatures well, and are very vulnerable to heat damage if the engine gets too hot.

Anytime temperatures climb beyond the normal range, the engine is running in the danger zone.

CONSEQUENCES OF OVERHEATING

If the engine overheats, the first thing that will happen is a gasoline engine will start to detonate. The engine will ping and start to lose power under load as the combination of heat and pressure exceed the octane rating of the fuel. If the detonation problem persists, the hammer-like blows may damage the rings, pistons or rod bearings.

Overheating can also cause preignition. Hot spots develop inside the combustion chamber that becomes a source of ignition for the fuel. The erratic combustion can cause detonation as well as engine run-on in older vehicles with carburetors. Hot spots can also be very damaging and burn holes right through the top of pistons.

Another consequence of overheating may be a blown head gasket. Heat makes aluminum swell almost three times faster than cast iron. The resulting stress can distort the head and make it swell in areas that are hottest like those between exhaust valves in adjoining cylinders, and areas that have restricted coolant flow like the narrow area that separates the cylinders. The typical aluminum head swells most in the middle, which can crush the head gasket if the head gets hot enough. This will cause a loss of torque in the gasket allowing coolant and combustion leaks to occur when the head cools.

Overheating is also a common cause of OHC cam seizure and breakage.

Wait, there's more. If the coolant gets hot enough to boil, it may cause old hoses or an age-weakened radiator to burst under the increased pressure. Pistons may swell up and scuff or seize in their bores, causing serious engine damage. Exhaust valve stems may stick or scuff in their guides. This, in turn, may cause valves to hang open which can damage pistons, valves and other valve train components. And if coolant gets into the crankcase, you can kiss the bearings and bottom end of the engine goodbye.

A HOT warning lamp should never be ignored. Though a few high tech cars like Cadillac's with the Northstar engine can disable cylinders to "air-cool" the engine and keeps it running at reduced power in the event of coolant loss, most engines will suffer serious damage if they overheat. So advise your customers to stop driving at the first sign of overheating. Turn the engine off, let it cool down and try to find and fix the cause before risking further travel.

CAUSES OF OVERHEATING

Overheating can be caused by anything that decreases the cooling system's ability to absorb, transport and dissipate heat: A low coolant level, a coolant leak (through internal or external leaks), poor heat conductivity inside the engine because of accumulated deposits in the water jackets, a defective thermostat that doesn't open, poor airflow through the radiator, a slipping fan clutch, an inoperative electric cooling fan, a collapsed lower radiator hose, an eroded or loose water pump impeller, or even a defective radiator cap.

One of nature's basic laws says that heat always flows from an area of higher temperature to an area of lesser temperature, never the other way around. The only way to cool hot metal, therefore, is to keep it in constant contact with a cooler liquid. And the only way to do that is to keep the coolant in constant circulation. As soon as the circulation stops, either because of a problem with the water pump, thermostat or loss of coolant, temperatures begin to rise and the engine starts to overheat.

The coolant also has to get rid of the heat it soaks up while passing through the block and head(s). So the radiator must be capable of doing its job, which requires the help of an efficient cooling fan at slow speeds.

The thermostat must be doing its job to keep the engine's average temperature within the normal range. If the thermostat fails to open, it will effectively block the flow of coolant and the engine will overheat.

Your engine may not be overheating at all. Your temperature gauge or warning lamp may be coming on because of a faulty coolant sensor. Sometimes this can be caused by a low coolant level or air trapped under the sensor.

WHEN AN ENGINE WON'T START

Every engine requires four basic ingredients to start: sufficient cranking speed, good compression, adequate ignition voltage (with correct timing) and fuel (a relatively rich air/fuel mixture initially). So any time an engine fails to start, you can assume it lacks one of these four essential ingredients. But which one?

To find you, you need to analyze the situation. If the engine won't crank, you are probably dealing with a starter or battery problem. Has the starter been acting up? (Unusual noises slow cranking, etc.). Is this the first time the engine has failed to crank or start, or has it happened before? Have the starter, battery or battery cables been replaced recently? Might be a defective part. Has the battery been running down? Might be a charging problem. Have there been any other electrical problems? The answers to these questions should shed some light on what might be causing the problem.

If an engine cranks but refuses to start, it lacks ignition, fuel or compression. Was it running fine but quit suddenly? The most likely causes here would be a failed fuel pump, ignition module or broken overhead cam timing belt. Has the engine been getting progressively harder to start? If yes, consider the engine's maintenance and repair history.

STARTING YOUR DIAGNOSIS

What happens when you attempt to start the engine? If nothing happens when you turn the key, check the battery to determine its state of charge. Many starters won't do a thing unless there is at least 10 volts available from the battery. A low battery does not necessarily mean the battery is the problem, though. The battery may have been run down by prolonged cranking while trying to start the engine. Or, the battery's low state of charge may be the result of a charging system problem. Either way, the battery needs to be recharged and tested.

If the battery is low, the next logical step might be to try starting the engine with another battery or a charger. If the engine cranks normally and roars to life, you can assume the problem was a dead battery, or a charging problem that allowed the battery to run down. If the battery accepts a charge and tests okay, checking the output of the charging system should help you identify any problems there.

A charging system that is working properly should produce a charging voltage of somewhere around 14 volts at idle with the lights and accessories off. When the engine is first started, the charging voltage should rise quickly to about two volts above base battery voltage, and then taper off, leveling out at the specified voltage. The exact charging voltage will vary according to the battery's state of charge, the load on the electrical system, and temperature. The lower the temperature, the higher the charging voltage. The higher the temperature, the lower the charging voltage. The charging range for a typical alternator might be 13.9 to 14.4 volts at 80 degrees F, but increase to 14.9 to 15.8 volts at subzero temperatures.

If the charging system is not putting out the required voltage, is it the alternator or the regulator? Full fielding the alternator to bypass the regulator should tell you if it is working correctly. Or, take the alternator to a parts store and have it bench tested. If the charging voltage goes up when the regulator is bypassed, the problem is the regulator (or the engine computer in the case of computer-regulated systems). If there is no change in output voltage, the alternator is the culprit.

Many times one or more diodes in the alternator rectifier assembly will have failed, causing a drop in the unit's output. The alternator will still produce current, but not enough to keep the battery fully charged. This type of failure will show up on an oscilloscope as one or more missing humps in the alternator waveform. Most charging system analyzers can detect this type of problem.

ENGINE CRANKING PROBLEMS

If the engine won't crank or cranks slowly when you attempt to start or jump start the engine (and the battery is fully charged), you can focus your attention on the starter circuit. A quick way to diagnose cranking problems is to switch on the headlights and watch what happens when you attempt to start the engine. If the headlights go out, a poor battery cable connection may be strangling the flow of amps. All battery cable connections should be checked and cleaned along with the engine-to-chassis ground straps.

Measuring the drop across connections is a good way to find excessive resistance. A voltmeter check of the cable connections should show no more than 0.1 volt drop at any point, and no more than 0.4 volts for the entire starter circuit. A higher voltage drop would indicate excessive resistance and a need for cleaning or tightening.

Slow cranking can also be caused by undersized battery cables. Some cheap replacement cables have small gauge wire encased in thick insulation. The cables look the same size as the originals on the outside, but inside there is not enough wire to handle the amps.

If the headlights continue to shine brightly when you attempt to start the engine and nothing happens (no cranking), voltage is not reaching the starter. The problem here is likely an open or misadjusted park/neutral safety switch, a bad ignition switch, or a faulty starter relay or solenoid. Fuses and fusible links should also be checked because overloads caused by continuous cranking or jump starting may have blown one of these protective devices.

If the starter or solenoid clicks but nothing else happens when you attempt to start the engine, there may not be enough amps to spin the starter. Or the starter may be bad. A poor battery cable, solenoid or ground connection, or high resistance in the solenoid itself may be the problem. A voltage check at the solenoid will reveal if battery voltage is passing through the ignition switch circuit. If the solenoid or relay is receiving battery voltage but is not closing or passing enough amps from the battery to spin the starter motor, the solenoid ground may be bad or the contacts in the solenoid may be worn, pitted or corroded. If the starter cranks when the solenoid is bypassed, a new solenoid is needed, not a starter.

Most engines need a cranking speed of 200 to 300 rpm to start, so if the starter is weak and can't crank the engine fast enough to build compression, the engine won't start. In some instances, a weak starter may crank the engine fast enough but prevent it from starting because it draws all the power from the battery and does not leave enough for the injectors or ignition system.

If the lights dim and there is little or no cranking when you attempt to start the engine, the starter may be locked up, dragging or suffering from high internal resistance, worn brushes, shorts or opens in the windings or armature. A starter current draw test will tell you if the starter is pulling too many amps.

A good starter will normally draw 60 to 150 amps with no load on it, and up to 200 amps or more while cranking the engine. The no load amp draw depends on the rating of the starter while the cranking amp draw depends on the displacement and compression of the engine. Always refer to the OEM specs for the exact amp values. Some "high torque" GM starters, for example, may have a no load draw of up to 250 amps. Toyota starters on four-cylinder engines typically draw 130 to 150 amps and up to 175 amps on six-cylinder engines.

An unusually high current draw and low free turning speed or cranking speed typically indicates a shorted armature, grounded armature or field coils, or excessive friction within the starter itself (dirty, worn or binding bearings or bushings, a bent armature shaft or contact between the armature and field coils). The magnets in permanent magnet starters can sometimes break or separate from the housing and drag against the armature.

A starter that does not turn at all and draws a high current may have a ground in the terminal or field coils, or a frozen armature. On the other hand, the start may be fine but can't crank the engine because the engine is seized or hydro locked. So before you condemn the starter, try turning the engine over by hand. Won't budge? Then the engine is probably locked up.

A starter that won't spin at all and draws zero amps has an open field circuit, open armature coils, defective brushes or a defective solenoid. Low free turning speed combined with a low current draw indicates high internal resistance (bad connections, bad brushes, open field coils or armature windings).

If the starter motor spins but fails to engage the flywheel, the cause may be a weak solenoid, defective starter drive or broken teeth on the flywheel. A starter drive that is on the verge of failure may engage briefly but then slip. Pull the starter and inspect the drive. It should turn freely in one direction but not in the other. A bad drive will turn freely in both directions or not at all.

ENGINE CRANKS BUT WILL NOT START

When the engine cranks normally but won't start, you need to check ignition, fuel and compression. Ignition is easy enough to check with a spark tester or by positioning a plug wire near a good ground. No spark? The most likely causes would be a failed ignition module, distributor pickup or crankshaft position (CKP) sensor.

A tool such as an Ignition System Simulator can speed the diagnosis by quickly telling you if the ignition module and coil are capable of producing a spark with a simulated timing input signal. If the simulated signal generates a spark, the problem is a bad distributor pickup or crankshaft position sensor. No spark would point to a bad module or coil. Measuring ignition coil primary and secondary resistance can rule out that component as the culprit.

Module problems as well as pickup problems are often caused by loose, broken or corroded wiring terminals and connectors. Older GM HEI ignition modules are notorious for this. If you are working on a distributor less ignition system with a Hall effect crankshaft position sensor, check the sensor's reference voltage (VRef) and ground. The sensor must have 5 volts or it will remain permanently off and not generate a crank signal (which should set a fault code). Measure VRef between the sensor power supply wire and ground (use the engine block for a ground, not the sensor ground circuit wire). Don't see 5 volts? Then check the sensor wiring harness for loose or corroded connectors. A poor ground connection will have the same effect on the sensor operation as a bad VRef supply. Measure the voltage drop between the sensor ground wire and the engine block. More than a 0.1 voltage drop indicates a bad ground connection. Check the sensor mounting and wiring harness.

If a Hall effect crank sensor has power and ground, the next thing to check would be its output. With nothing in the sensor window, the sensor should be "on" and read 5 volts (VRef). Measure the sensor D.C. output voltage between the sensor signal output wire and ground (use the engine block again, not the ground wire). When the engine is cranked, the sensor output should drop to zero every time the shutter blade, notch, magnetic button or gear tooth passes through the sensor. No change in voltage would indicate a bad sensor that needs to be replaced.

If the primary side of the ignition system seems to be producing a trigger signal for the coil but the voltage is not reaching the plugs, a visual inspection of the coil tower, distributor cap, rotor and plug wires should be made to identify any defects that might be preventing the spark from reaching its intended destination.

ENGINE CRANKS AND HAS SPARK BUT WILL NOT START

If you see a good hot spark when you crank the engine, but it won't start, check for fuel. The problem might be a bad fuel pump.

On an older engine with a carburetor, pump the throttle linkage and look for fuel squirting into the carburetor throat. No fuel? Possible causes include a bad mechanical fuel pump, stuck needle valve in the carburetor, a plugged fuel line or fuel filter.

On newer vehicles with electronic fuel injection, connect a pressure gauge to the fuel rail to see if there is any pressure in the line. No pressure when the key is on? Check for a failed fuel pump, pump relay, fuse or wiring problem. On Fords, don't forget to check the inertia safety switch which is usually hidden in the trunk or under a rear kick panel. The switch shuts off the fuel pump in an accident. So if the switch has been tripped, resetting it should restore the flow of fuel to the engine. Lack of fuel can also be caused by obstructions in the fuel line or pickup sock inside the tank. And don't forget to check the fuel gauge. It is amazing how many no starts are caused by an empty fuel tank.

There is also the possibility that the fuel in the tank may be heavily contaminated with water or overloaded with alcohol. If the tank was just filled, bad gas might be causing the problem.

On EFI-equipped engines, fuel pressure in the line does not necessarily mean the fuel is being injected into the engine. Listen for clicking or buzzing that would indicate the injectors are working. No noise? Check for voltage and ground at the injectors. A defective ECM may not be driving the injectors, or the EFI power supply relay may have called it quits. Some EFI-systems rely on input from the camshaft position sensor to generate the injector pulses. Loss of this signal could prevent the system from functioning.

Even if there is fuel and it is being delivered to the engine, a massive vacuum leak could be preventing the engine from starting. A large enough vacuum leak will lean out the air/fuel ratio to such an extent that the mixture won't ignite. An EGR valve that is stuck wide open, a disconnected PCV hose, loose vacuum hose for the power brake booster, or similar leak could be the culprit. Check all vacuum connections and listen for unusual sucking noises while cranking.

ENGINE HAS FUEL AND SPARK BUT WILL NOT START

An engine that has fuel and spark, no serious vacuum leaks and cranks normally should start. The problem is compression . If it is an overhead cam engine with a rubber timing belt, a broken timing belt would be the most likely cause especially if the engine has a lot of miles on it. Most OEMs recommend replacing the OHC timing belt every 60,000 miles for preventative maintenance, but many belts are never changed. Eventually they break, and when they do the engine stops dead in its tracks. And in engines that lack sufficient valve-to-piston clearance as many import engines and some domestic engines do, it also causes extensive damage (bent valves and valve train components & sometimes cracked pistons).

Overhead cams can also bind and break if the head warps due to severe overheating, or the cam bearings are starved for lubrication. A cam seizure may occur during a subzero cold start if the oil in the crankcase is too thick and is slow to reach the cam (a good reason for using 5W-20 or 5W-30 for winter driving). High rpm cam failure can occur if the oil level is low or the oil is long overdue for a change.

With high mileage pushrod engines, the timing chain may have broken or slipped. Either type of problem can be diagnosed by doing a compression check and/or removing a valve cover and watching for valve movement when the engine is cranked.

A blown head gasket may prevent an engine from starting if the engine is a four cylinder with two dead cylinders. But most six or eight cylinder engines will sputter to life and run roughly even with a blown gasket. The gasket can, however, allow coolant to leak into the cylinder and hydro lock the engine.

Engine Noise Break Down

Symptom

Possible Cause

A cold piston knock for up to a minute and a half after starting a cold engine may be normal. This may be due to increased clearance between the pistons and cylinders. But once the engine warms up, the knocking noise should disappear.

If you hear a low rumble or knocking noise when the engine is warm, the most likely cause may be a bad rod bearing on the crankshaft (which may lead to bearing failure and/or rod breakage or crankshaft damage).

Low oil pressure

Check oil pressure at the oil pressure sending unit port on the engine with a gauge. .

If oil pressure is okay, replace sending unit.

Detonation or spark knock

May be due to low octane fuel, carbon buildup in combustion chambers, overadvanced ignition timing, inoperative EGR, or engine overheating.

Check all of these to determine the cause.

Loose torque converter bolts

Inspect the torque converter bolts and flywheel.

Repair as required.

Cracked flywheel - automatic transmission

Inspect the flywheel bolts and flywheel.

Repair as required.

Excessive connecting rod or main bearing clearance

Inspect connecting rod bearings , connecting rods and crankshaft. Use Plastigage or a feeler gauge to measure assembled bearing clearances.

Excessive Piston clearance

Piston slap may be due to worn cylinders, worn pistons or excessive piston-to-cylinder clearance

TUNE UPS:

If the car is maintained regularly, then a routine tune-up may be all that is required as a continued preventative measure. However, other situations will involve a thorough diagnostic analysis to ensure all components of your engine continue to function properly and prevent you from being left on the side of the road.

AIR CONDITIONING

If your vehicles blows only hot air from the vents or blows cold air sporadically, or loud noises coming from your system - all indicate the need for service or repairs to your vehicle's air conditioning system. Auto air conditioning may be damaged by leakage in the system, low level of coolant or refrigerants, clogging of the condensers, and/or failure of the vehicles air conditioner compressors. Major failures of your car's A/C system can be prevented with regular preventative checks and maintenance performed here at American Pride Automotive.

Major components of an automotive air conditioning system consist of the following:

Compressor - a belt driven pump responsible for compressing and transferring refrigerant gas. Once the refrigerant is drawn into the device, it is compressed and sent to the condenser where it then transfers the heat that is absorbed from the inside of the vehicle.

Condenser - A component that looks much like a small radiator. As hot compressed gasses enter into the top of a condenser, they cool off. As the gas cools, it condenses and exits the bottom of the condenser as a high pressure liquid.

Evaporator - primary duty is to remove heat from the inside of your vehicle. A secondary benefit is dehumidification. As warmer air travels through the aluminum fins of the cooler evaporator coil, the moisture contained in the air condenses on its surface.

Refrigerant Fluid - commonly referred to as Freon or R12, environmental laws for chlorofluorocarbon emissions have made the recharging and handling of an air conditioning system something that is to be performed only by authorized ASE certified automotive technicians

BRAKES

Typical symptoms that signal brake repair is imminent are a grinding noise when brakes are applied, squealing noises that cease when brakes are applied, car tending to pull when braking, and minimal application, or hold, when using the parking brake. Ignoring any of these symptoms will result in more extensive repairs, costs, and even your safety.

SUSPENSION & ALIGNMENT

Your automobile's suspension system needs to be able to absorb bumps smoothly and steer properly, which in turn requires a fully functioning suspension system with proper wheel alignment. Whether your vehicle has a conventional suspension system with shock absorbers or a strut-based system typical of many front-wheel-drive cars, you can trust that A&R Auto & EngineWorks has experienced technicians to service them both.

Recommended alignment intervals:

Every 8,000 miles or 6 months

Alignment is recommended after the first 2,000 miles for new vehicles

After a purchase of new tires

After a collision or accident

After hitting a large pothole

With installation of new suspension or steering parts

Following a transaxle repair on front-wheel-drive cars