BEAT THE HEAT

Engine heat is the enemy: proper heat management is your first line of defense

By Jim O'Clair and Craig Fitzgerald
Photography courtesy of manufacturers

Last summer, several members of the Hemmings editorial team competed in the Great Race, a competition for vintage cars that began in Washington, D.C., and ended two weeks later in Tacoma, Washington. We ran our 1934 Dodge panel truck. It's not a muscle car, obviously, but our experiences with it illustrate our point.

For the entire length of the race, the ambient air temperature was in the high 90s, cracking into the 100s. Our on-board thermometer told us that the temperature on the floor of the truck was a blistering 130 degrees. The temperature was even higher where the exhaust pipe ran closest to the floor. Within 100 miles, the heat on the floor would burn your feet through a pair of heavy shoes. It got so hot, for so long, that our navigator, Janet Thompson, suffered heat exhaustion and dehydration after six days in the cabin.

The engine in your car, when subjected to extreme heat, can experience similar problems. Heat is robbing you of engine performance and causing premature failure of internal engine components. Not only that, proper heat management can make the cabin of your muscle car much more comfortable in the summer months. There are a few things you can do to make your engine run cooler in hot weather, which will improve performance and fuel efficiency.

Your engine is one big heat converter. Air and fuel are combusted to create heat, which is converted to power. According to the folks at Design Engineering, Inc. in Ohio, the standard internal combustion engine converts only about 30 percent of the engine heat it creates into horsepower. This leaves 70 percent of that heat with no place to go, and its tendency is to sit there in the engine compartment.

As your engine produces more horsepower, it creates more heat. Because heat rises, there is a limit to how much can be removed by the motion of the vehicle cutting through fresh air. The fan is designed to pull air in from outside the grille to aid in cooling, but it does not always pull in enough outside air to offset the heat created in the combustion process, especially if the outside air you are pulling in is already hot.

The addition of more and more accessories under the hood on newer cars also exacerbates the engine cooling process. All that extra heat has to go somewhere, and your options for heat dispersal are limited to the cooling system, the exhaust pipes or the standard radiant heat which is shed by metal surfaces such as the block, cylinder heads and manifolds. Helping to reduce or manage this heat, by one of several different means, will add performance to your engine and reduce wear and tear on the drivetrain and your starting and electrical systems. Keeping both the fuel and intake air cooler will aid in combustion. Because cooler air is denser, this density allows for better fuel atomization, which contributes to a more combustible air/fuel mixture and allows the engine to burn that air/fuel mixture more efficiently. In a nutshell, a cooler-running engine will produce more horsepower and waste less energy.

There are several things to think about when talking about heat management. Part of the equation is lowering engine temperature, of course. But you'll also want to figure out how to keep residual heat from damaging other components under the hood, and intruding into the passenger cabin.

First and foremost, let's look at your vehicle's cooling system. Many aftermarket radiator manufacturers have developed new cooling technology for their replacement radiators, which makes them more efficient than the original equipment designs. In these days of miniaturization, manufacturers have discovered that doubling the number of fins per inch in the radiator core allows them to make radiators with shorter fins. This enables them to incorporate the cooling capacity of a triple-row radiator into the same space as the original double-row radiator core. In cars not equipped with air conditioning, the upgrade to a radiator for A/C-equipped cars will often increase your cooling capacity significantly too.

Some radiator specialists build race-ready radiators for various muscle car applications. If you're concerned about an original look, several manufacturers, like Alumitech Reproductions build high-performance aluminum radiators that look stock, but provide much better cooling than the original equipment. We checked in with Don Kyte from Alumi-

Alumitech builds aluminum copies of original GM Harrison radiators

tech and he's sold on the benefits of an aluminum radiator. "All aluminum-core radiators tend to cool about the same," he said, "but what we found was that they never fit as well as they should have. We thought if you could make a reproduction of a Harrison radiator in copper, why can't you make one just like it out of aluminum?" Alumitech builds aluminum Harrison reproductions for many GM muscle cars.

Eric Christie is from Richmond, Texas, a place where they know a thing or two about heat management. He chose an Alumitech radiator for his 1970 Chevelle SS 454 clone. He posted his results on the Team Chevelle tech Q and A forum. "I took it for a drive in low 90-degree weather in Houston. The temp stayed at 170 to 175. While sitting in traffic at a light, the temp rose to 180 or 185 degrees," Christie said. "Previously, the car would run 200 degrees on the highway. In traffic, it would heat up to 220, sometimes a little higher."

Flex fans are an inexpensive way to increase cooling capacity, at least at idle. Stainless steel flex fans are designed to change blade pitch when the engine's RPM increases. This design means that while the engine idles, the more the fan blades "dig" into the surrounding air, resulting in more cool ventilation being pulled into the engine compartment. At higher revs, the blades flatten out, providing less cooling action, but since the car is theoretically moving through the air faster, the fan's action is somewhat redundant. Plus, with the added mass of a stock fan, engine parts are working harder than they really need to at high rpm.

Electric fans seriously increase airflow

Additional cooling capacity can be realized with the installation of a pusher-type electric fan. These are available in various sizes and are thermostatically controlled. Operating on the same principle as OEM electric radiator coolant fans, add-on pusher-type fans only activate when the engine is getting too hot, and will only run until the engine has cooled sufficiently. This can often be well after the engine has been turned off. Pushers mount to the front of the radiator and assist your stock fan blade in pumping fresh cool air towards the front of the engine. Pull-type electric fans can be bought as well, which replace the stock belt-drive fan entirely. Puller fans work thermostatically and work in the same manner as your steel fan blade, but in addition to aiding with fresh-air cooling they will save you engine horsepower. This is because they are driven by their own electric motor instead of mechanical horsepower from the engine pulley system. And aftermarket electric fan units come with their own fan shroud and mounting hardware for easy installation.

The use of the original or an aftermarket fan shroud is another factor in providing sufficient outside air. A shroud should be used whenever possible. The shroud collects incoming air and channels it towards the area where it will do the most good, chiefly to the fan and toward the front of the block.

Once engine operating temperature reaches about 220 degrees, the intake air is warm enough to atomize the fuel mixture, and the engine operates at maximum efficiency. Manufacturers have learned that increasing the pressure in the cooling system will also raise the boiling point of the engine coolant. The boiling point of the water is raised approximately 3 degrees for each additional pound of pressure your radiator cap is rated for.

This is why, even though water boils at 212 degrees, most temperature gauges do not show you are in any danger of a boil-over until around 240 degrees. In fact, with newer "closed" cooling systems using a recovery tank, temperatures of 245 to 265 degrees are generally accepted as optimum for normal driving. If your car was not originally equipped with a coolant recovery tank, installing an aftermarket add-on unit is well worth the investment. Closing the cooling system by adding a recovery tank will help eliminate air pockets, which are forced out as the coolant circulates. Air pockets will cause your coolant to heat up faster (because air heats faster than coolant). Another advantage to the use of a recovery tank is that less coolant is lost out onto the ground because it is recirculated into the radiator after the engine has cooled sufficiently. As cooling at rest continues, a vacuum is created in the closed system, drawing expelled coolant back into the radiator.

Once you have taken steps to make the engine run as cool as possible, there are several other tricks at your disposal to channel the excess heat away from critical engine components.

Heat can also be the nemesis of modern electronic devices. A variation in milliamps in the electrical wiring can cause sensors to give false readings and

Exhaust wrap keeps heat where it's supposed to be: inside the header instead of under the hood.

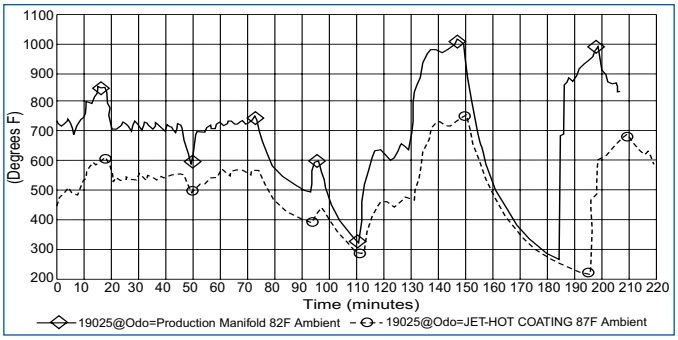
Resources:

Alumitech Reproductions
517-404-6262
www.chevellecooling.com

Design Engineering
Thermal Tuning Products
604 Moore Rd.
Avon Lake, OH 44012-2315
800-264-9472
www.designengineering.com

Flex-A-Lite Fans
P.O. Box 580
Milton WA 98354
253-922-2700
www.flex-a-lite.com

Jet-Hot Coatings
Technical Information Line
610-277-5646
www.jet-hot.com



A U.S. auto manufacturer's graph showing that ceramic coating can drop exterior exhaust temps by 300 degrees F.

can cause computer-activated control devices to fail. Heat can easily cause these electrical current variations. To help prevent the problem of current breakdown, underhood electrical wiring can be protected by the installation of a heat-resistant wiring loom.

Spark plug boot wraps are available for your spark plug boots to safeguard them from the extreme exhaust temperatures that surround them. Some engines run so hot today that spark plug boots are now being made of ceramic in many applications to combat this problem. But the addition of an external thermal boot protector will ensure that the spark traveling to the plug will not break down due to the high temperatures in such a close proximity. They also prevent burning, hardening or cracking of your plug boots. Design Engineering's Protect-A-Boots can handle a continuous 1,200 degrees of heat.

As we stated earlier, engine performance is at its peak when temperature conditions are warm enough to atomize the air/fuel mixture, but not so hot that the mixture pre-detonates. Keeping the engine compartment as cool as possible will take care of the air portion of that mixture, and the addition of a thermal loom to your fuel lines will help to keep the fuel at a cooler temperature as well. Steel fuel lines can conduct heat and bring gas to the point of vapor lock, while traveling in proximity to the manifolds. We've also heard of brake fluid being so superheated by residual heat from the headers that it actually boils in the lines, which becomes less of a performance and comfort issue than one of occupant safety.

One place where you want the heat to hang around is in the exhaust pipes. Superheated exhaust gases, which are exiting the combustion chamber, will evacuate the exhaust system faster if they are less dense. One way to ensure they stay less dense is to channel them through an exhaust system that can maintain a hotter internal temperature, without dissipating the heat underneath the hood.

Stock exhaust manifolds are made of very thick material, both to handle the heat of these exhaust gases upon exit from the engine and to try to maintain a high temperature to aid in exhaust scavenging. Headers are larger in diameter and length than stock exhaust manifolds, but this means they have more cooling surfaces on them too.

Coating headers, manifolds and other exhaust parts with a ceramic coating is a good start to keeping the heat where it needs to be. For example, an independent U.S. auto manufacturer found that just by coating their exhaust components with Jet-Hot's Sterling coating, they saw surface heat readings drop by 300 degrees F.

Using a good-quality exhaust wrap on either the stock manifolds or headers will not only keep heat from collecting in the engine compartment, but will keep your exhaust system hotter. This will maintain the lower density in your exhaust gases and they will exit the exhaust system faster. So you can actually make your engine compartment 50 degrees cooler by making it hotter in places where that heat is necessary.

Shop carefully for exhaust wrap, because all wraps are not created the same. For example, Design Engineering's exhaust wrap is rated for 2,000 degrees. Exhaust wrap need not be limited to the manifolds either. The wrap is just as effective in retaining heat in the exhaust pipes further downstream on your car. Although you would not want to wrap a muffler in it or a catalytic converter, it will make a difference on pipes before and after them. For the fashion conscious who don't like the look of traditional white exhaust wrap, DEI also manufactures a black wrap for a stealthier look.

You don't have to settle for white exhaust coating... other finishes are available

While we are speaking of heat management, we do not want to neglect driver comfort. It goes without saying that heat can be even more of a concern for you than it can be for your engine. Anything you can do to deflect some of that heat away from the passenger compartment will be a big help. That's why it's also a good idea to insulate or shield the interior of the car from hot temperatures too. Installation of a good-quality firewall thermal shield will aid in keeping interior temperatures down as well as lending some sound deadening characteristics. Specific thermal shields are available for the shifter tunnel and the floorboards. These will lend protection against heat (and cold) as well as help as a sound barrier as an added bonus.

With a big mill churning out high temps under the hood, you've got no choice but to do something with that excess heat. It has to stay away from vital components or from your car's interior. And with exhaust parts, thermal protection can be used to your advantage too. None of these modifications are particularly expensive, and they can be done as money and time becomes available to do so. Many of the additional cooling products are as close as your local auto parts store or speed shop, and we've also provided a few additional resources.

Given our experiences with the '34 Dodge last summer, staying cool is high on our list of stuff to do for next year's Great Race. We'll keep you updated as