

Cures for the “hot blues”

By Rob Hernandez.

We Mustang nuts are always in search for more performance and speed. Most of our projects relate to adding this or that hot part to squeeze more horsepower and torque out of our pushrod or modular Ford engine.

If you started your project with a new car, chances are the cooling system is in top shape, but if your project car has some years, most likely some of the components already need replacement.

In any case, once you get more HP out of your engine, either by some form of force induction or pure naturally aspirated muscle, you need to take care of cooling issues.

More often than not, most people will replace or upgrade their cooling system once there's a problem; broken radiator, hose or worse, a burned head gasket.

In this article our goal is to take a “tour” around the modern Mustang cooling system (Fox & SN95s), and familiarize you with how all the stuff works.

The Mustang cooling system is a closed system, meaning, little to no coolant will get out of it if everything is in working order. If you have to add coolant pretty often there's definitely something not working right.

The heart of the cooling system is the pump, which pushes the coolant around the system; the radiator is the lungs, it's the part that will exchange the heat trapped in the coolant with the exterior. The veins of the system are the hoses and passages around the block and heads.

These 3 major components have to be in top shape to carry out their work, if something goes wrong in one of them the whole system can collapse.

PRIMARY COMPONENTS

Water Pump



properly, if there's air in it, the pump will not work.

Automotive water pumps are of a centrifugal design, and are limited by the diameter of the impeller and its speed, much like a centrifugal supercharger. In order to move more volume they need to be made larger or turn faster.

Centrifugal pumps also need to be primed (no air in the system) to function

If you double the speed of a centrifugal pump it will require eight times the horsepower to drive it because the capacity will double. This is where hi-flow water pumps come to the rescue of performance. Their improved design will move more volume per-rotation cycle of the pump.

Radiator

The radiator has the function of cooling the heated water/coolant mix. It performs this function through the use of ducts surrounded by very thin metal fins. The coolant will exchange the heat trapped in while it passes the radiator ducts. The heat will then get “radiated” to the atmosphere. To improve it’s function mechanical or electrical fans move that heat away from the radiator pushing or pulling fresh air.



Modern radiators are made of aluminum and plastic, the ease of fabrication has eliminated almost entirely the use of copper/brass radiators.

The whole picture

Now that we explained the function of these basic components, lets explain how to improve its efficiency for performance applications.

Most of the time users will inevitably try to reduce coolant temperatures by using several well-known tricks: low temp thermostats, changing coolant mix and adding “wetter” additives.

All these work to some extent but the fact remains that the system is only as efficient as the primary components allow it to be, the radiator being the most important in this case, as it is only capable of exchanging a certain amount of heat. If more heat is generated the result is inevitable.

But the picture you have right now in your mind is probably not taking into account other real world considerations such as where is the radiator located and the factory design of your front bumper.

Fox and SN95 Mustangs have limited space in the front area, your factory radiator is pretty good but the matter of fact is that there are too many obstructions blocking the air. For starters you have the A/C radiator (condenser) it is right in front of your radiator. Once you start the A/C you

will see temperatures climb as much as 30 degrees, this happens because the condenser is moving heated air into the fins of your radiator.

But the fact remains that many of us can't live without A/C at least for a few months each year, so what to do?

Maintenance

This is the FIRST thing you should do, a complete maintenance plan. If your car has some decent amount of miles this is a 10-step plan:

1. Change your thermostat to a 180 degree unit
2. Replace your radiator cap with a new one
3. Replace the water pump with a new hi-flow or improved replacement one.
4. Replace both upper and lower hoses
5. Check the operation of the electric cooling fan (both high and low speed), and if you have a clutch-based fan replace it with an electric fan, it will free some horsepower and improve cooling a big deal.
6. Have the system flushed, cleaned and checked for leaks by a professional.
7. A 70water/30coolant mix is optimal except for winter where you should use a 50/50 mix.
8. Clean your radiator and a/c condenser. Bugs get trapped between the fins. Oils and dirt will build up with time reducing the efficiency of the system. Spray some tar remover or orange-based cleaner into them; let the cleaner act for 20 minutes and hose off all the dirt. Use a garden hose, no pressure washers! Also get a radiator "comb"; yes this little comb is used to straighten radiator fins. Careful use of a radiator comb will help return bent fins to their proper shape and position. Be careful when using the comb, as the thin walls of the fins are delicate. This is a tedious job, so take your time and be patient.
9. Air Deflector.....say what? Yes most Mustangs come with a factory air deflector under the front bumper, right under the radiator support. Many Mustangs lose this deflector, so get one; it creates a



low-pressure zone after it which helps push air up into the radiator area. This is especially beneficial at high speeds.

10. If using tap water use some type of water softener additive, they improve thermal transfer. Use only products approved for automotive cooling systems. But pure distilled water is the best choice; use it with an anti-corrosion additive.

These basics will help most users with mild modifications, but what if you have maxed out its capacity?

Multi-core Radiators

These radiators have several rows or cores, and each row will help dissipate more heat. But you can install a thicker radiator and experience higher temperatures, this is not because the air can't get through, this happens because of coolant flow, a double core will reduce coolant velocity in half. This loss in pressure can be fixed by using a high flow water pump or using a more advanced radiator that uses wide tubes and less cross section area, which require less velocity to achieve optimum thermal transfer.

Also install a radiator cap of a higher pressure rating (stock is 16), the higher the pressure the lower the boiling point. Most manufacturers will be able to tell you the pressure rating of their radiators.

Thermostats

This has to be the most misunderstood part of the cooling system, the thermostat has two primary functions, one is to allow the engine to get to its operating temperature, and once it gets there the thermostat opens allowing the coolant to pass to the radiator.

In our search for "performance" many will change the thermostat to one with a lower temperature thinking it will reduce temperatures, which they do but at a cost.

For one the engine will get to its operating temperature later, which will induce more wear and higher fuel consumption. Normal operating temperatures are between 180 and 220 degrees Fahrenheit.

Second, the thermostat helps build coolant pressure against the walls of the block passages; this improves thermal transfer, which reduces actual engine block temperatures.



It is important to note that temperature readings in your gauge don't reflect actual coolant temperatures in the block. Here the coolant is "trapped" between the pressure of the pump and the restriction created by the thermostat. Your temperature gauge only reflects the temperature of the coolant on the radiator side.

Also the restriction of the thermostat acts like a "nozzle" through which coolant escapes under pressure at high speed creating an extra cooling effect before it enters the radiator.

When buying a replacement thermostat don't use one with a rating lower than 180, and also get a **balanced** unit, balanced thermostats will open always at the same temperature and pressure, reducing fluctuations in temperature.

Other elements of the cooling system

Now we will focus on other less talked-about parts of the system, such as radiator caps, the coolant, hoses and underdrive pulleys.

Caps more often than not will live their whole life in the same engine, this is a **MUST NOT**, the cap has to be changed at least every 1 to 2 years max. The cap has to withstand high temperatures and pressures for extended periods and its parts will degrade over time.



The radiator Cap has 2 functions, one to keep the system under pressure to reduce coolant boiling point. The second is to relieve excess pressure. This will most likely happen when you turn off the engine. There is still heat trapped in the system and there

is no air flowing to the radiator. At this point temperatures can rise above normal levels and the check valve opens letting coolant flow to the tank. When temperatures drop, pressure in the radiator will be lower than in the tank, this effect will pull the lost coolant back into the system.

If the cap is not in good shape this can happen very often even with the engine running, which will result in a definite loss of pressure and coolant, and the tank will need to be refilled often.

Stock radiators although efficient they are not designed for high pressure, use the cap psi rating recommended by Ford (usually 16psi). But some aftermarket performance radiators are built to withstand 22-24 psi, and racing units can have a higher rating.

Water is the best coolant!!

Yes, using water is the way to go for performance applications, but water promotes rust creation, and salts in tap water will build up residues that can block radiator passages. You can use water and a corrosion inhibitor without coolant, but if winter is a concern use a low concentration around 60% water, 40% coolant. To achieve better results use distilled water, which will have a higher boiling point and will not contain damaging salts or chlorine.



Hoses

Your car is equipped with 2 main hoses, with time both need to be replaced. The upper hose will probably be replaced more often since it is in plain sight, but the lower is just as important and probably more if you race at high speeds.

The lower hose is subject to the negative pressure created by the pump as it pulls the coolant mix, the higher the RPM the more pressure is created, this can result in a collapsed lower hose at sustained high rpms. The hose uses a spring-like core that reduces the chance of this from happening, but the spring metal degrades with time and could collapse or brake into fragments that can go into the pump.



Underdrive pulleys

This great bolt on is probably the most popular, but is it good for your cooling system? Definitely not. As you lower the speed of the pump, you also lower the efficiency of the pump. If you re-read what has been said in this article you already know why it is not such a good idea. If you want to free some horsepower get the underdrive crank and possibly the alternator pulley but skip the pump. In its place install a high volume pump, which are more efficient and rob less horsepower.



Fans



We mentioned it earlier, but if you have a clutch driven fan, replace it with a more efficient electric unit or at least replace the worn out clutch. Also make sure the fan shroud is not broken, it helps the fan do its job by guiding the air where is needed; the radiator.

I think all of the above will help you make a wiser decision; your cooling system is vital to the survival of your expensive engine.