Tech Talk Article 55

"Keeping Cool"

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As seen in... NATIONAL DRAGSTER

With winter fast approaching, it's the time of year when people start thinking about preparing their cars for cold weather. Anyone who lives in the Snow Belt knows that antifreeze is an essential part of winter survival. But I'm going to make the recommendation that you should *never* use antifreeze in a drag race engine.

I'm amazed that so many racers use antifreeze in their motors. I think that some racers have the mistaken belief that antifreeze improves cooling efficiency. In fact, the exact opposite is true: antifreeze reduces cooling capacity compared to plain water.

I'm certainly not Mr. Science when it comes to chemistry, but the facts on antifreeze are readily available. Automotive antifreeze is typically ethylene glycol or its less toxic relative, propylene glycol. Both of these alcohols have lower freezing points and higher boiling points than pure water. While these are important qualities for street-driven automobiles, they are irrelevant to a dedicated drag race car.

Here is a comparison of the properties of water and ethylene glycol antifreeze:

	Water	Ethylene Glycol	50/50 water/glycol solution
Freezing Point	32F	8.6F	-36F
Boiling Point	212F	387F	225F
Specific Heat	1.00	.57	.81
Latent Heat of Vaporization	540 cal/g	226 cal/g	374 cal/g
Thermal Conductivity	.60	.25	.41

Obviously antifreeze protects an engine at extremely cold and extremely hot temperatures; that's why it is used in street-driven engines. But a racing engine doesn't sit overnight in a subzero parking garage in Minnesota, and it isn't driven across the Nevada desert with the air conditioning turned on. If you're going to store your race car in an unheated garage for the winter or transport it in freezing temperatures, simply drain the coolant.

Characteristics that are much more important for racers are the coolant's specific heat, latent heat of vaporization and thermal conductivity. These qualities are directly related to the cooling capacity, and it's clear that water is an excellent coolant.

The specific heat capacity of a liquid is defined as the heat required to raise its temperature by one degree. A liquid with a high specific heat has more capacity to absorb heat than a liquid with a lower specific heat. In the table shown here, pure ethylene glycol has a specific heat value that is only 57 percent of water. A 50/50 water/antifreeze mixture has a heat capacity that is almost 20 percent less than plain water. Auto manufacturers compensate for this lower cooling capacity of water/glycol mixtures by increasing the volume of the cooling systems in production cars, but drag racers don't want or need big, heavy radiators and pumps.

Another important property of coolant is latent heat of vaporization, which is the energy required to change a liquid into a vapor. It takes nearly 2.4 times as much energy to boil water as it does to boil antifreeze. This high latent heat of vaporization is desirable because it draws heat from localized hot spots that occur around the exhaust valves, exhaust ports and combustion chambers. Even though the overall temperature of the cooling system may be below the boiling point, this phenomenon of localized boiling is important in controlling temperatures and preventing preignition in areas of intense heat. The efficiency of water as a coolant can be made even better by using a wetting agent to reduce its surface tension, improving heat transfer from the metal to the liquid.

If the scientific argument doesn't convince you to use plain water in your drag race engine, then all you have to do is see what happens when antifreeze gets into the oil. It doesn't take much glycol seeping into the engine through an internal leak to wipe out the bearings and gall the piston skirts. Antifreeze is very nasty stuff when mixed with motor oil.

The best way to keep your race car cool is simply not to warm up the engine excessively. I shake my head when I see racers running their engines for minutes in the pits and staging lanes. Maybe that's a holdover from the days when everyone ran heavyweight oil. If you're using appropriate light viscosity oil, you simply don't need to warm up the engine for an extended period.

Some racers think a warm engine improves throttle response, but that's only a factor if you're a foot-brake racer. Virtually every drag race car that uses a transbrake or a two-step rev limiter leaves the starting line with its throttle blades open, so response is a non-issue.

A cool engine makes more power than a hot engine. We know that from dyno tests, and we know that from time slips and lap times. If you walk through a NASCAR garage before Nextel Cup qualifying, you'll need hip boots because the teams use shock cooling systems to lower their engines' temperatures to 60 degrees before a qualifying run. If you're a Top Sportsman, Top Dragster or Quick 32 racer who needs every bit of e.t., then you want a cold engine on the starting line.

My recommendation is to bring the engine to the line at around 100 degrees. Depending on the volume and efficiency of your cooling system, the coolant temperature will probably be around 140 degrees at the finish line. The goal is to keep the coolant temperature under control; once an engine gets hot, then it is much more difficult for the cooling system to bring the temperature back down. This is especially important in the late rounds when cars are called back to the staging lanes quickly.

When you're trying to run as quick as you can, you don't want a heat-soaked engine –

and you certainly don't want antifreeze in it.

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