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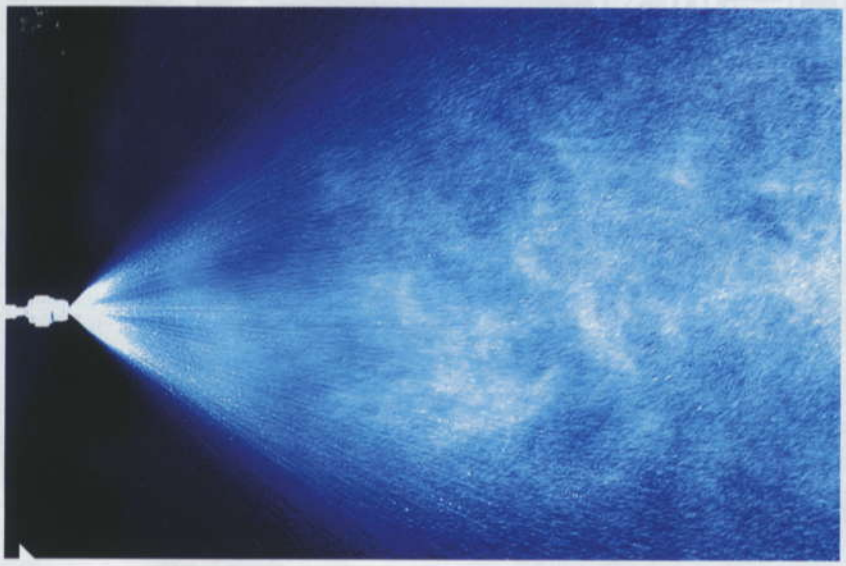
PHOTOS: MRT

DE-MYSTIFYING H2O INJECTION

QUESTION
I have just started modifying my WRX and I am on the hunt for some more power. Basically it is standard at the moment except for the stereo. Without a lot of spare money to spend right now I have been contemplating what I should do. I'm planning to up the boost and do intake and exhaust mods but my friend's brother suggested water injection, but I don't even know what this does and how it will give my engine any more power. What does it do?
Fran
Email

" WATER INJECTION HAS BEEN USED IN ALL KINDS OF RACING VEHICLES, INCLUDING MODERN DAY WRC CARS.



WATER INJECTION IS NOT EXACTLY A POWER ADDING MODIFICATION, but rather a method used to avoid the occurrence of detonation - which as you may know is extremely bad for your engine. When used by itself, and if your engine is currently running adequately, this modification won't be of much value. In fact, fitting a water injection system to a standard car will generally cause it to lose power if engine management system settings aren't recalibrated to suit! However, when used alongside other modifications, water injection can allow higher cylinder pressures (as created by something such as an increase of boost pressure from your turbocharger), through the reduction of inlet air charge temps and the chance of detonation.

A water injection system utilises a small nozzle (or multiple small nozzles) to atomise a fine mist of water into the intake system where it mixes with the air and fuel. There are a number of ways to setup a system such as this, with designs ranging from very cheap DIY setups, through to purpose manufactured systems designed by aftermarket parts companies. More complicated systems will allow activation of the system via a pulse width modulated output from an aftermarket engine management system, allowing very accurate control over when and how much water is injected. Injection systems can be as simplistic or as complicated as your budget and planned application allow, and like everything else in life you get what you pay for.

Generally, the long term use on a road going, daily driven vehicle is often questioned. Because the benefits from such a system are to be had from increasing cylinder pressures to what were previously dangerous zones, if the water injection system was to fail (blocked nozzle, or empty reservoir), entry level systems without relevant safe guards allow the potential for engine damage.

Having said that, when setup properly, a water injection system can be an effective way of maintaining increased power levels. Indeed, such systems have been used in all kinds of racing vehicles (including WRC cars) and were also engineered into supercharged aircraft used in WWII.

So how does water injection actually work? The idea is based around trying to reduce the temperature of the air:fuel mixture as much as possible in order to prevent detonation. The water mist mixes with the air and fuel, and ultimately ends up in the combustion chamber where it evaporates. This process absorbs energy which would have otherwise been acting on the fuel.

Remembering that increasing cylinder pressures (through changes in boost pressure or ignition timing) will produce elevated heat levels, and elevated heat levels will lead to greater chances of detonation, then you can hopefully understand how adding a small amount of water mist to the combustion process will benefit power production. Since increased cylinder pressures equate to more torque per stroke, obtaining higher cylinder pressures whilst avoiding detonation (thanks to the water injection setup), will yield power gains from your engine.

Having said that, a water injection system on its own is not an ultimate solution. Water injection doesn't assist outright air flow through an engine (like a well designed exhaust system or intake mods), nor does it make up for inadequately sized injectors, turbo or intercooler setups. Substantial changes are required to fuel, ignition timing and boost control (generally through an aftermarket management system) in order to integrate water injection and reliably achieve the gains mentioned.

Often water injection is only seen on heavily modified cars; these vehicles have gained as much as feasible from mechanical changes and now need to cater to fine changes in cylinder pressure for those last few valuable kw. In most cases with a mildly modified car the well recognised path such as exhaust, intake mods or ECU changes will yield better results for the money. ■

Thank you to MRT for their assistance with this article.