



**Gary Stamberger** – Training Director  
Magnaflow Exhaust Products

## Proper Air/Fuel Ratio How Do We Get It?

In this forum we have spent a great deal of time talking about air/fuel ratio and the role it plays in catalytic converter effectiveness. In the next couple of bulletins we will break down this combination and examine what factors contribute to air/fuel ratio variations.

### Fuel Delivery

Certainly much has changed in the process of getting fuel from the tank to the combustion chamber including the fuel itself, but we'll leave that for another discussion. We've moved from carburetion to throttle body injection. Followed by different variations of Port and Sequential Port to the most recent... Direct Fuel Injection.

The first component of any fuel system is the pressure needed to get the fuel from the tank to the combustion chamber. What we have experienced has been a steady increase in pressure with each new system introduced.

Carburetion – 4-6psi

Throttle Body Injection (TBI) – 9-13psi

Port Fuel Injection (PFI) – 30-45psi (includes most SPFI)

Vortec (CPI) – 55-62psi

Continuous Injection (Bosch) – 80-90psi

Direct Fuel Injection (DFI) – 1500-2000+psi

The most significant reason for increasing fuel pressure is the need to better atomize the air/fuel mixture. The result is greater efficiency, producing higher fuel mileage, lower emissions and yet, more power.

The other factor involved in fuel delivery along with pressure is fuel volume. It is possible to have enough pressure and not be delivering the proper amount of fuel to the cylinders. The result could be anything from a poor running engine with little power or poor response to an engine that won't even start. Causes for low volume can range from a clogged fuel filter to a pump that can't deliver the necessary amount of fuel. Generally, the fuel pump should be able to deliver one pint of fuel in 15 seconds with the engine cranking.

Now that we have the proper amount of fuel being delivered at the right pressure we must mix this fuel with air and get it into the cylinders. This is usually accomplished through some type of intake manifold. Generally, carburetors and TBI units used what is referred to as a "wet manifold". This means that the air and fuel are mixed at the top of the manifold and delivered together down to the cylinders. Considering where we are today with the latest technology this process seems almost archaic but actually was with us through the early 90's.

The next logical step was to move away from wet manifolds to – you guessed it – "dry manifolds". Here we inject the fuel much closer to each individual cylinder. This can be accomplished using what is called bank (group) firing or sequential firing. Group firing means the computer will fire the injectors in groups and then the fuel is used up on the next intake valve opening event. With SPFI we are able to inject the fuel just prior to it being needed at any given cylinder and is done in the firing order for that engine (ie. GM 8 cylinder is 1-8-4-3-6-5-7-2). This limits the amount of puddling in the manifold that takes place.

Lastly, we come to the latest technology and that is Direct Injection. In this system we are injecting the fuel in an atomized form under extreme pressure directly into each individual cylinder at the precise time it is needed. This eliminates all the issues we faced with the other systems and as noted earlier creates a much more efficient use of fuel.

In the coming months look for air induction and coming up with proper mixture. Then an in-depth look at what information the computer uses to determine just how much of this mixture the combustion chamber needs to get the desired effect. Eventually we'll tie it altogether and see how it affects the job the Converter was designed to do.

Cleaning up the environment...one converter at a time  
Gary

