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Bulletin TB-80030
April, 2011

Proper Air/Fuel Ratio
How Do We Get It?
Part IV

For the final segment of this discussion we'll look at engine exhaust and all of its components. As mentioned in the discussion of getting the proper amount of air into the cylinder (Part II), at some point we would have to expel that air out of the cylinder to get ready for the next event. We are now at that point.

After combustion has taken place and the power stroke completed we now enter the final phase (exhaust stroke), which is getting the left over gasses out of the cylinder. This process is more complex than most realize and there are many factors that affect it. First we'll look at the gas as a whole and how it actually leaves the cylinder and some of the forces that act upon it.

When the exhaust valve opens the first wave of gas is under a great deal of pressure. As the piston forces the gas out that pressure begins to diminish to the point that the end of the wave is actually a negative pressure or vacuum. Valve overlap, whether fixed or variable, will play a large part in the make-up of the end of this wave. This low-pressure component of the exhaust pulse is what we refer to as "scavenging". It helps to move the pulses through the exhaust system and can actually have an impact on how fast air enters the chamber on the next intake stroke.

There are other factors that can modify the flow of these gasses and are a concern from a performance point of view. The header design, size of the pipes, flow rate of the converter, any X or H pipes used and finally the design of the muffler all play a role in how effectively exhaust gasses are expelled from the cylinder. We'll expand this discussion at another time.

Let's look now at the break down of the exhaust gas from an emissions point of view. The mixture that enters the cylinder prior to combustion is made up of Air which contains oxygen (O2) and nitrogen (N2) and gasoline which is a hydrocarbon (HC). What's left after combustion occurs is carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NOx), and traces of oxygen and nitrogen. The catalytic converters job of course is to reduce or eliminate the harmful gases of CO, HC and NOx through a pair of chemical reactions known as Reduction and Oxidation. The catalyst used to do this is a combination of the precious metals Platinum (Pt), Palladium (Pd) and Rhodium (Rd). Under the proper conditions of temperature and A/F mixture a reaction takes place that converts the harmful gasses into carbon dioxide (CO2) and water (H2O). A complete understanding of everything we discussed in Parts I, II and III leads us to a point where we can properly diagnose any issues that develop with the catalytic converter. Whether it is a diagnostic code or failure of an emissions test, knowing how all the systems are interrelated will aid in getting the problem solved.

Just as we discussed in the previous segments, many factors play a roll in how efficiently an engine operates and the same holds true when it comes to exhausting the gas out of the combustion chamber, through the exhaust system and into the atmosphere. The advent of clean air regulations and tighter standards has added yet another component to the puzzle. Our job here at Magnaflow is to not only build the proper components to fit into these systems, but also to help our customers understand the big picture. When problems occur, we can help determine the root cause, make the proper repair and get the customers vehicle back on the road.

Cleaning up the environment…one converter at a time

Gary