Nitrous and Fuel Response Time

"Chemically Correct Ratios" or the point at which we have exactly the amount of oxygen to burn a given amount of fuel: Gasoline (C8H18)-9.649 / 1; Methanol (CH3OH)-4.13 / 1; Ethanol (C2H5OH)-5.74 /1; Nitromethane (CH3NO2)-1.09 / 1……yet we cannot run our engines at these lean mixtures.

Gasoline being the most popular fuel utilized with nitrous, let us focus in this area for this exercise. Some of the professionals run nitrous/fuel curves at 6.0/1 and even 6.5/1. Others run on the rich side at 5.0/1. The average tuner is usually in the 5.5/1-5.8/1 range.

(**Example:** 1/8th mile race car for 4 seconds…..300 hp direct port injection system.)

- 5.5/1 ratio, we will use approximately 1.2 lbs of nitrous in 4 seconds.
- 5.5/1 we divide 1.2 by 5.5 which = .218 lbs of fuel.
- If the fuel weighs 6 lbs/gal (Specific Gravity of .72) we then divide .218 (lbs of fuel) by 6 which = .03633.
- We also know that 1 US gallon = 3785 cc's……therefore, 3785 x .03633 = 138cc's of fuel.

This is exactly what our system must flow in 4 seconds with our 1.2 lbs of nitrous oxide. This simple formula also should show us how our fuel curve can get off with changes in fuel specific gravity (.69-.78 for most gas). Consider this 300hp scenario as a 1st and 2nd stage on most systems. Wrap your mind around 1.2lbs of nitrous and 138cc's of fuel in 4 seconds. With this being our number for 4 seconds, we can divide by 4 and we now have 0.3lbs of nitrous and 34.5cc's of fuel. We can carry this further and divide by 10 to see what we flow in one tenth (1/10th) of a second. Now we have .03lbs. of nitrous and 3.45cc's of fuel. This is a very small amount of product for conventional high volume systems.

Years ago we figured out that we could move solenoids further away, put on timers and delay the nitrous, richen the carburetors, or pull out more timing. We know we have a delay problem and we have learned to live with it. Many great engine builders and tuners elected to make 3rd stage kits with smaller diameter tubing which helped. In the U.S. we get 3/16 (.187) tubing from many places, some from Germany, some from Japan, some from China, and some from the U.S. From mild steel to stainless steel these materials range in I.D. from .102-.125 and some even as large as .130 I.D. Each nitrous company uses something different. On each side of the engine we can have 24-30 inches of tubing and fittings not counting the distribution block for just the fuel and the same for the nitrous. Multiply this by 4 and we have between 8 and 10 feet of tubing to flow through on 1 stage. This is why we get 16 one foot joints of tubing in our kit, yet we do not understand that each foot holds 2.6cc's of volume if the diameter is .130. Some distribution blocks are large and some are small.

Looking back at the averages, if you pull all of the plumbing for one stage, pull off the solenoids, push a rubber hose over the nozzles and measure the amount of fluid it takes to fill the system…..you will see that the entire system can hold up to 20cc's (10cc's nitrous/10cc's fuel) for a small block and up to 24-26 cc's for some big blocks. In the

case of the fuel, if the fuel side holds 10cc's and we go back to our fuel flow for 300hp, we see that our fuel rate is 3.45cc's each tenth of a second. We have found that for the fuel to come out of the nozzles it will take .2-.3 seconds.

Another way to look at it is that we fill the system 13.8 times in 4 seconds and its time for the parachutes. The reason that we get by with this is that our nitrous oxide is also hitting slightly late. For this exercise and application, it takes approximately .045-.055 seconds for a good shot of nitrous to hit the engine. If we take our lower numbers and subtract .045 from .2, we still have as much as a .155 second difference, and believe me this is seen when properly monitored. The fuel curve will momentarily go crazy. It's the 2nd and 3rd stages of going lean that hurt parts. Our hats are off to the compromises in the past. It seems that racers always prevail, yet at O2 Technology, we believe that if the nitrous and fuel are distributed in a more precise manner with a more precise fuel curve, the racer can make greater and more reliable power. One to two tenths of a second can make all the difference in the world. These problems are compounded with critical phase nitrous oxide. When fuel is not there, we cannot burn it, and when we have too much fuel, power suffers.

Our intent is to help educate in these critical areas. Hopefully as new technology in hardware comes to the forefront, combined with the fuel chemistry that O2 Technology has to offer, nitrous cars can became more competitive with the blower cars.