AMA Chapter 534,
Medford, Oregon
February 2003

FACTS ABOUT FUEL - Nitromethane, the Mystery Ingredient?

(The following is the third in a series of articles exploring all facets of model engine fuel. The writer is Don Nix, past owner of Powermaster. Printed with permission of POWERMASTER, Inc.)

Nitromethane:

Everybody knows it's there, but few, it seems, really know much about it. Although most seem to know- at least vaguely - that's its primary purpose is to add power, we still get an occasional call or letter asking, "Why do you use it in model fuel?" At best, there is much misinformation regarding this somewhat exotic ingredient. Let's see what we can do to clear some of it up.

Nitromethane is just one of a family of chemicals called "nitroparaffins." Others are nitroethane and 1-nitropropane and 2-nitropropane. Nitroethane can be used successfully in small quantities. (Top fuel drag racers, which generally run on straight nitromethane, sometimes add a little in hot, humid weather to prevent detonation). At one time, nitroethane was only about half as expensive as nitromethane, but its cost now is so nearly the same, using it to lower cost is hardly worth the trouble. Neither of the nitropropanes will work in model engine fuel. Incidentally, nitromethane is made of propane, in case you didn't know (and I'll bet you didn't).

Yes, NITRO = POWER! But, there are conditions and contingencies. First of all, it doesn't add power because it's such a "hot" chemical. Not at all. This may come as a surprise to most readers, but the methanol (methyl alcohol) in the fuel is by far the most flammable ingredient - nearly twice as flammable as nitromethane. As a matter of fact, if nitro were only 4 degrees less flammable, it wouldn't even have to carry the red diamond "flammable" label! In actuality, nitromethane must be heated to 96 degrees F. before it will begin to emit enough vapors that they can be ignited by some sort of spark or flame! (I demonstrated this not long ago to a friend by repeatedly putting a flaming match out in a lid full of nitro. I might add that he insisted on standing about 20 feet away during the demonstration).

So, how does it add power? We all know (I think) that although we think of the liquid part substance we put in fuel tanks (in our automobiles or model airplanes) as the fuel, in truth, there is another "fuel," without which the liquid part would be useless. Remember what it is? Right - just plain old air (in reality, the oxygen in the air). Every internal combustion engine mixes air and another fuel of some sort. In our case, a liquid - glow fuel. The purpose of the carburetor is to meter those two ingredients in just the right proportions, and every individual engine has a requirement for a specific proportion of liquid fuel and air. Try to push in too much liquid without enough air, and the engine won't run at all. That's the purpose of the turbocharger on full-size engines - to cram in a lot more air than a simple carburetor or fuel injection system can handle.

Now, suppose we were to find a way to run more liquid through our model engines without increasing the air supply? That would add power, wouldn't it? Well, guess what - we can! An internal combustion engine can burn more than 2 ½ times as much nitromethane to a given volume of air than it can methanol. Voila! More Power! That's how it works, and it ain't all that complicated. Nor do we have to spend a lot

of time thinking about it in the course of a normal day's sport flying. However, there are some factors we do need to consider. As a practical matter, virtually all our everyday sport flying can be done on model fuel containing from 5% to 15% nitromethane. If you're flying something like a trainer or a Cub or similar model, there's probably no reason why 5% won't work perfectly well. Need a little more power? Move up to 10% or 15%. In most of our sport engines today, I really wouldn't recommend going any higher than that. It probably won't hurt anything, but it won't do you much good, either. We sell more 15% fuel than any other single blend, and for good reason. Most of the popular engines on the market today are built to run on something very near that blend. Typically, European engines will successfully run on lower nitro blends, because they are built to do so.

Why? In Europe, nitro can cost between $150 to $200 a gallon! Reason enough?

Nitro does more than just add power. It also helps achieve a lower, more reliable idle. One good rule of thumb for checking to see if a particular engine needs a higher nitro blend is to start the engine, let it warm up for a few seconds, set throttle to full idle and remove the glow driver. If it drops rpm, move up to a 5% higher nitro blend. If there is no discernible drop, you should be fine right where you are.
One of the most popular misconceptions is that by adding substantial nitro, the user will immediately achieve a huge power jump. Just ain't so. Most will be surprised to learn that in the 5% - 25% nitro range, you will probably only see an rpm increase of about 100 rpm static (sitting on the ground or on a test stand) for each 5% nitro increase. In the air, it will unload and achieve a greater increase, and it will probably idle better, too. My pet rule is this: If you have a model that's doing well, but just isn't quite "there" powerwise, go up 5% in nitro. If that doesn't do it, you need a bigger engine, not more nitro! Most of our popular sport engines in use today aren't set up to run on much more than 15% or 20% nitro.

Increasing the nitro has the effect of increasing the compression ratio, and each specific engine has an optimum compression level. Exceed it and performance will probably suffer, not gain, and the engine will become much less "user friendly." High performance racing engines, for example, are tuned entirely differently - compression ratio, intake and exhaust timing etc. - and are usually intended to run on much higher nitro blends. One exception, of course, is racing engines used in certain international and world competition (FAI). By the rules, these engines are not allowed to use any nitro at all, and they go just as fast as those that run on 60 or 65%! The first question that comes to mind, then, is, "Why aren't all engines designed to run on no nitro, so we can all save a lot of money?" Ask any of the World-class competitors. Those engines are a serious bitch to tune and run, and are definitely not user-friendly! In fact, they are well beyond the skill levels of most average flyers.

There's a price to everything. Another statement we read or hear frequently is that nitromethane is acidic and causes corrosion in engines. It isn't acidic, and the manufacturers say it doesn't happen - can't happen. However, at least one noted engine expert and magazine writer insists that it does. Flip a coin. (I once asked Dave Shadel, 3-time World Pylon Champion, and a fellow who works on more high performance engines than anyone I know, how frequently he encounters rust in engines that have been using high nitro blends. His answer? "Never.")

Why does nitro cost so much? While I have no clue as to the cost of manufacturing, other than it takes a multimillion dollar investment in a large refinery to produce it, there is one pretty good reason: There is only one manufacturer of nitromethane in the Western Hemisphere. Figure it out for yourself. Also (and this will come as a big surprise), our hobby industry only consumes about 5% of all the nitromethane produced; and full-size auto racing about another 5% or so. This means we have no "clout" whatever, and simply must pay the asking price. Where does the rest of it go? Industry, It's used for a variety of things - a solvent for certain plastics, insecticides, explosives (yes, it was an ingredient in the Oklahoma City bombing) and I'm told it's an ingredient in Tagamet, a well-known prescription ulcer medication (no wonder that stuff is so expensive!).

Please note that while nitromethane is an ingredient in making some explosives, under normal use, it in itself, is not explosive. (Remember, the guy used fertilizer, too). Hardly a month passes that someone doesn't call to ask, "I hear more nitro will make my engine run cooler. Is that true?" Nope. The higher the nitro content, the higher the operating temperature. Fortunately, in most of our sport engines, the difference in operating temps between 5% and 10% is negligible, and there are lot of other factors (proper lubrication, etc.), that are much more important.

Finally, remember in the beginning of this, we said that nitro adds power because we can burn more of it than we can methanol, for a given volume of air? This also means that the higher the nitro content of the fuel, the less"mileage" (or flying time) we will get. In a typical .40 size engine using 15% nitro, we can usually get a minute to aminute and a half flying time for every ounce of fuel. The Formula 1 guys are lucky to get 2 minutes out of an 8 oz.tank! What's the practical side of this? If you go to a higher nitro blend, be sure to open your needle valve a few clicks and reset before you go flying. Otherwise, you'll be too lean, and could hurt your engine. Conversely, if you drop to a
lower nitro blend, you'll have to crank 'er in a little.