Fuel Facts Part #2

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The following is a series of articles exploring all facets of model engine fuel. The writer is Don Nix, former President of GBG Industries, Inc., manufacturers of POWERMASTER model fuel.

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FACTS ABOUT FUEL No. 3 - Nitromethane, the Mystery Ingredient?

Nitro Methane

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.

Nitro methane is just one of a family of chemicals called "nitro paraffins. " Others are nitro ethane and nitro propane. Nitro ethane can be used successfully in small quantities.

(Top fuel drag racers, which generally run on straight nitro methane, sometimes add a little in hot, humid weather to prevent detonation.) -at one time, nitro ethane was only about half as expensive as nitro methane, but its cost now is so nearly the same, using it to lower cost is hardly worth the trouble. Neither of the nitro propanes will work in model engine fuel. Incidentally, nitro methane 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 nitro methane. 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, nitro methane 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 ful 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 bum more than 2 1/2times as much nitro methane 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% nitro methane. 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. Also, competition (FAI) is different. 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 nitro methane 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. Ms answer? "Never.")

Why does nitro cost so much? I have no clue as to the cost of manufacturing, other than it takes a multi-million dollar investment in a large refinery to produce it, there is one pretty good reason: There is only one manufacturer of nitro methane 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 nitro methane 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 nitro methane 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 bum 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 a minute and a half flying time for every ounce of fuel. The Formula I 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.

FACTS ABOUT FUEL No. 4

2-Stroke vs. 4-Stroke Fuels. Is There Really A Difference?

(The following is the fourth in a series of articles exploring all facets of model engine fuel. The writer is Don Nix, former President of GBG Industries, Inc. Readers are invited to contact Don directly via e-mail - FLYERDON@aol.com.)

Well, what do you think? Is there really a difference, or is this merely a big hype by the fuel manufacturers to sell more products? Let's see a show of hands…..ah, yes…about evenly divided. Well, let's explore the facts.

Fact: Most 4-stroke model fuels contain less oil than comparable 2-stroke fuels.

The most common response to this is, "But 4-stroke engines have more moving parts….they should need more oil, not less!" Well, that sounds reasonable, but it doesn't stand up under close examination. The number of moving parts has nothing to do with it. What is important? Think about it.

Fact: With rare exceptions, 4-stroke engines run at substantially slower rpms than a comparable 2-stroke engine…most in the under-10,000 rpm range vs. 12,000, 13,000 or more for a typical 2-stroke of the same size. They are engineered to deliver maximum power at slower rpms, with bigger props. What does this have to do with it? One of the main factors used in determining the proper oil content of fuel is heat. To use the well-worn term, it doesn't take a rocket scientist to figure out that the more slowly an engine turns, the less heat it generates from friction. If you don't believe that, rub your palms together slowly, then as fast as you can.

So….lower rpms = less heat = less need for oil.

Fact: 4-stroke engines only fire every other stroke, vs. every stroke by a 2-stroke engine. Firing, or combustion, burns fuel, which creates heat. Logically, it may be deduced that if there is fire in the chamber only every other stroke, the engine has time to cool off a bit between combustion cycles. Let's take that a little further: Using a hypothetical 4-stroke engine turning 10,000 rpm = 5,000 combustion cycles per minute, vs. a hypothetical 2-stroker turning 13,000 rpm…with the same number of combustion cycles per minute….the gap widens.

The 2-stroker has 160% more combustion cycles than the 4-stroker. Even though this is partially offset by the fact that at least some 4-strokers have a higher exhaust gas temperature, the message is clear: 4-strokers remain cooler, and need less oil.

Fact: Oil doesn't burn (or shouldn't) - methanol does. Using a little logic, we arrive at the conclusion that a properly made 4-stroke fuel will deliver better performance than a 2-stroke fuel in the same engine.

Why? Remember…the 4-stroker is only firing every other stroke. This results in the plug element wanting to cool down between strokes, resulting in a "colder" plug. Excess or unnecessary oil, constantly dousing the element, is going to make it more difficult to achieve a slow, smooth idle. Those who contend that, "Well, using too much oil can't hurt anything" are wrong. In addition to causing undue friction in the engine, keeping the metal parts from properly mating, etc., too much oil in 4-stroke fuel is constantly trying to cool a plug element that is already having problems. Sort of like pouring a bucket of cold water on a poor guy who is already shivering.

Again, since oil doesn't burn, it's doing nothing to help us develop power….it simply lubricates and goes right out the exhaust and all over everything. However, suppose we don't put unnecessary oil in the fuel, and replace it with methanol, which does burn. Well, what do you know…greater top end power! Hey, I think we're on to something here! Remove unnecessary oil from 4-stroke fuel, and we get a "twofer" - two benefits for the price of one….a slower, more reliable idle plus greater top end power!

Conclusion: For reasons that should be clear above, a properly blended 4-stroke fuel should deliver better all-around performance in a 4-stroke engine than a regular 2-stroke fuel in the same engine.

While it's not going to actually harm anything to run 2-stroke fuel in a 4-stroke engine, never, ever run 4-stroke fuel in a 2-stroke engine. It's not going to have enough oil. Now, for those of you will say that you have done it with no problems, I'll agree…..if you have a real good ear and keep the needle valve "fat" (rich), it will probably work just fine…but the official word is DON'T! It reduces your margin of error unacceptably.

Finally: Because engine manufacturers have been burned in recent years by some fuel makers' attempt to lower the cost of their products by using either too little oil or a cheap grade, most manufacturers today are recommending that you run a 2-stroke fuel only in their 4-stroke engines, or will specify what would seem to be an abnormally high oil content (and it probably is). Who could blame them? Since they know they have no control over the oil used in someone else's fuel, they're just trying to cover their fannies. So would I.

Note: I believe it's commonly known that the manufacturers of YS engines…among the most powerful 4-stroke engines available….mandate that only fuels containing oil contents in the normal 2-stroke range be used. Their engines are unique, and the manufacturer's recommendations should be followed, although, as with anything, there are exceptions.

FACTS ABOUT FUEL No. 5

Storing Fuel for Maximum Shelf Life

(The following is the fifth in a series of articles exploring all facets of model engine fuel. The writer is Don Nix, former President of GBG Industries, Inc.Readers are invited to contact Don directly via e-mail - FLYERDON@aol.com.)

During the Q&A part of countless "Dog & Pony Shows" at hobby clubs all over the U.S., one of the frequently asked questions is, "What's the shelf life of fuel?" The answer if both simple and easy: Properly stored, model engine fuel will last almost indefinitely. So….what constitutes "properly stored"? Let's take a look.

Contrary to many things you might have read or heard, just about the only thing that adversely affects model fuel is the absorption of moisture from the air. Keep the air away from it, and your fuel will likely be potent longer than you are! Methanol - the major ingredient in model fuel - is hygroscopic. This means it's virtually 100% soluble in water, and absorbs moisture from the air like a vacuum cleaner sucking up dirt.

Most modelers have no idea how rapidly this can - and does - happen, and tend to be rather skeptical about the idea. Let me paint a picture for you: Almost everyone has spilled a little fuel on the top of their fuel can in their flight box. If so, you've no doubt noticed that the shallow film of raw fuel takes on a cloudy, milky look. What you are seeing is the methanol sucking moisture right out of the air. Since the quantity of fuel is thin with a lot of surface area, the absorption is rapid, the water won't mix with the oil and the fuel turns cloudy. Just remember how quickly this happens…..almost immediately….and it might give you an idea of just how quickly your fuel can be ruined if you leave the cap off, allow a vent tube to remain open, etc.

The wide surface area relative to the quantity of the fuel exposed is disproportionate, of course, to leaving the cap off the fuel jug, but I think you get the idea. In a humid condition such as exists in parts of the U.S., it doesn't take very long at all to adversely affect your fuel. And it doesn't take a large opening….a cross-threaded cap, a small vent line, etc. is all that's needed to do the damage.

The solution is simple, of course….just keep it tightly sealed. And yet, sometimes that's not enough. Most of us have seen small droplets condensed inside our fuel jugs after it's become partially empty. This is the result of condensation of moisture as the air trapped inside the jug cools. Until about a year ago, there was little we could do about this, but there is now a method to take care of this problem. Since it's not the purpose of this column to commercially promote our own products, those interested are invited to contact the writer at the e-mail address above, and we'll be happy to tell you about the product that will solve the problem.

For the reasons above, it's our opinion that it is rarely a good idea to buy model fuel in 55 gallon drums. Unless all the fuel is poured up the first time the drum is opened, a substantial volume of air is trapped inside the drum each time it's opened. Steel containers of any kind warm and cool much more readily and rapidly than plastic, and condensation is much more evident in this type container. The result is that the last portion of the drum of fuel is quite likely to be contaminated with moisture, sometimes to the point of being unusable.

There is another downside to buying fuel in drums, especially if more than one person is using it. With no control over the type container the fuel is dispensed into….perhaps not bearing sufficient or proper warnings, etc., the liability is incredibly high if an accident of any sort should occur. Model clubs considering this type of fuel purchase for their members should be particularly aware of the potential liability….which is huge!

While it's true that the UV in sunlight (or in fluorescent lights, for that matter) will cause pure nitro methane to deteriorate over time, it's our experience that once the nitro is in solution and substantially diluted, the deteriorative effect is relatively minor.

To test this, some years ago we put a gallon of 10% fuel out in direct sunlight (in sunny Southern California) for a month. At the end of that time, we tested that fuel in an engine vs. fresh product and could see no difference. While it certainly won't hurt anything to store fuel away from direct sunlight, etc., it's our personal opinion that the adverse effect of sunlight on fuel under normal operating conditions is too little to worry about