# Making your own 2 Stroke glow fuel
# Fuel Blending 101 - By Paul Gibeault

Some people in rural areas are on occasion finding themselves without suitable fuel. As somebody who has blended his own C/L & R/C championship fuels for many years, here are some ideas on to how to blend your own custom glow fuel and never again be caught short. Homemade fuel is an especially useful tool to use as a "Reference Standard" if you suspect trouble when using your usual commercial fuel or when trying a different fuel brand.


Your first task is to obtain the fuel **ingredients.**

**Oils:** I use two types of oils. Straight (first pressing) castor oil is most easily available from your local SIG dealer. The best of which is called "**Benol**" as is sold by Klotz. Benol is pure castor oil with a film strengthener additive. Although not technically legal for FAI use, it is a bit ***better*** than straight castor. Some bike & go-cart shops also stock castor oil under the names of Bakers AA, Blendzall and others. Any castor oil sold for Internal Combustion (IC) engine use is suitable for our purposes. The negative of using drugstore bought (USP) castor oil is that it is not de-gummed & although it will work, tends to cause a **rapid buildup of carbon varnish** inside the engine. This means you will need to do regular de-varnishing of your piston, cylinder & head which is a hassle most of us are better off avoiding.

**Synthetic oil:** Is also available from SIG sold under the Klotz label. A note about Klotz who offers several types of oil. We are mainly interested in Klotz Techniplate KL-200 which is their 100% synthetic oil. Super Techniplate is a **blend** with 80% synthetic & 20% castor oil. The full 100% synthetic oil is what I use. Going to the Klotz website can give you more insight into their various oils and oil numbering system. https://klotzlube.com/

There are other synthetics available from Union Carbide such as their UCON LB625, as well as several in Europe from Model Technics. The key here to remember is: Ball bearing ABC/AAC engines **need no castor oil,** and all synthetic oil blends run fine and run much cleaner. Any engine with iron pistons, iron piston rings and or plain bearings really do need to use **some** castor oil for engine and bearing longevity. Most of our old C/L engines fall into this category. (Cox, Fox, K&B, Super Tigre & older O.S Max's) It turns out that an **oil blend** of both synthetic & castor oil offers better protection & higher performance than either one individually.

For best performance, the ratio (obtained from the late Bill Wisniewski) is 3->1 synthetic to castor, with a 20% total oil content. Bill once told me that even the all-synthetic oil K&B fuels **still contained 2% castor oil.** Total oil content is a contentious issue in some C/L circles, but I have found that 20% half & half castor synthetic runs very well and will do no engine damage in any of the above-mentioned engines.

It is the **regulation standard** in most all classes of AMA racing and speed. This oil blend (confirmed by a Klotz Technical Rep at the 1999 AMA Nats) has properties **superior** to either straight castor or straight synthetic oil blends. As well, the oil blended fuels run much cleaner & deposit much less carbon inside the engine, because the synthetic oil acts as a detergent whilst keeping the superior high temperature protection provided by the castor oil. As well the synthetic oil acts as a stabilizer to keep fuels with high percentages of nitro in solution. Win-Win as I see it.

It turns out the very popular and excellent running SIG Champion fuels (and several others) use just this 50-50 castor/synthetic oil blend in their fuels (unless specifically stated otherwise). Some fliers find bumping up the oil content advantageous, but that is mostly because they are looking for a certain kind of a stunt run. 25+% total oil fuels are preferred on very old engines such as the Fox 35 Stunt and Super Tigre 46 stunt engines to yield a nicer 2 -> 4 break type of run in Stunt.

They will also run **more stable** using an all castor fuel or a higher 25% total oil content blended fuel. Fox .35 Stunt engines for example have poor cooling fins and are thermally unstable. Higher oil content fuels often allow their run to become more stable. CD's in the Northwest USA allow 2 fuel types in Sport Racing. One with 20% all castor & one with half & half castor/synthetic. Both work fine & neither causes any engine damage for racing purposes. They do this to satisfy both camps, which is thoughtful of them.

**Nitromethane:** This appears to be the most expensive ingredient to obtain. Cities that have drag race strips can be a source. Chemical supply houses are another (but more expensive) source. Some fuel manufacturers in the USA (i.e. Excalibur Fuels out of Tucson) will often sell you straight nitro & components, but of course you must make an inquiry (or know somebody there) to go that route. I am lucky to be able to use a network of model friends who help me with nitro. My last nitro came from a contact in Calgary who supplies the r/c boat racing community with fuel. So, you may have to get creative and make some phone calls.

**Methanol:** This is the easiest component to source locally. Available easily from chemical supply houses, methanol comes in several grades with various impurities. I recommend a minimum of reagent grade 98.9% pure methanol. Lab grade is the very purest, but much more expensive & not necessary for our purposes. Methanol is also an ingredient available at some racetracks as well. Methanol is hydroscopic (water absorbing) so its storage containers must be very well sealed.

If not, the methanol absorbs moisture from the air and soon becomes watered down and unusable for our purposes. If I am unsure, I use a **Nurnberg's Hydrometer** to read the specific gravity of the chemical. For methanol we are looking for a S.G. of .795 and for nitromethane a S.G. of 1.124 @ 25 degrees C.


**Other chemicals & additives:** For special purposes, other components can be added in small amounts, such as Acetone, Ether, and Propylene Oxide. Those additives are used by advanced fuel blenders for specific purposes that are beyond the scope of this general article. 1-2% of Ether (or Di-ethyl ether) can be added to make for **a quite easy starting** glow fuel for **Winter Flying**. Acetone can be used to extend the flight time of a model that is short on range when the tank size is limited. Propylene Oxide is a power additive that allows nitromethane to liberate more oxygen and is sometimes used in very high-performance Vintage Speed and racing applications. It is a carcinogen, and so must be treated with great care. Prop. Oxide also tends to lose its effectiveness over time and so (like diesel fuel) does not store very well at all.

**Mixing Containers:** Shown are chemistry graduated cylinders of various sizes. I have achieved consistent results using laboratory graduate measuring cylinders. 250 and 500 ml sizes are my favorite ones.

Glow fuel needs to be mixed preferably at room temperature (20 degrees C) in a **clean area in a well-ventilated room** or preferably outdoors. Rubber gloves are used to prevent any harmful raw fuel chemicals from touching your skin.


It should be noted that the **bottom** of the fluid **meniscus** is what should match the desired line on the measuring graduate. I normally add the oil first, followed by the alcohol, then the nitro. Once done I seal the top of the graduate with a clean plastic sandwich bag tied on with rubber bands.

I then turn the sealed graduate upside down and shake until the solution is homogeneous. I allow the mixed fuel to settle then look at the solution through a **bright light** to ensure the entire mixture is clear & homogeneous. If it turns a milky color, that's indicative that moisture has somehow gotten into the solution, rendering the batch no good. (Mixing fuel outdoors when it is very humid or raining can cause this to happen). From there, I pour the final mixed fuel solution through a Coleman felt fuel filter or coffee filter paper into its final container.

Properly sealed **metal** containers are the preferred container with which to keep fuel in for long time storage. I have found the ones for acetone or lacquer thinner from *Canadian Tire* to work excellent. Polypropylene plastic containers are a second choice. In any case they must have **well sealing caps.**

After the new fuel blend is in its container, I lay it down on a clean paper towel for a while and come back to see if there is any dampness which would indicate a leaky cap.


**Other interesting applications:** If you have a given fuel and wish to change the oil or nitro content, I find going to an online fuel calculator makes it simple. When adding extra nitro, you end up lowering the oil (and less importantly methanol) percentage content in the process. There are several calculators online, but the two listed below work well enough for me.

http://www.nitrorc.com/default2.asp?Introduction=http://www.nitrorc.com/fuelws

www.coxengines.com/files/castor.xls

***PROBLEM: How do I change my Gallon of SIG Champion 35% nitro fuel (w/ 20% oil) to increase the nitro content to 40% while still keeping my oil at 20%, and still keeping my final mix quantity to less than 128 oz. total, so that it all fits in my regular one gallon container?***

According to the figures you just gave us, your current fuel has, **35%** nitro content and **20%** oil content, leaving **45%** methanol.

You have indicated that you wish to increase your nitro content by **5%** to a new total percentage of **40%** and your oil by **0%** to a new total of **20%**

To accomplish this, you will simply need to add **11.3** ounces of nitro and **2.8** ounces of castor/synthetic oil to your **113** ounces of fuel.

When you are done, you should end up with **127.1** ounces (0.99 U.S. gallons) of newly blended, custom fuel.

**Note than to stay within your 1-gallon container restriction, you will **first** need to withdraw 15 oz. of fuel from your gallon jug. So (1 U.S. Gallon) 128 oz. – 15 oz. of fuel leaves 113 oz. left in the jug, **before adding the extra nitro & oil**. **

Be aware that 4 litres are just a bit too much fuel to pour into an American 1-gallon fuel jug, so plan your mix accordingly. I hope this has been of interest

For those who have always wondered what was in the Original Cox "Red Can" Racing Fuel? Below are the Cox factory specification sheets, courtesy of Cox International. I believe "Dow Lube" is equivalent to Klotz 100% synthetic oil.

DWG. NO. 51000
REV. *

| INGREDIENT | % OF MIX BY VOLUME | SPECIFIC GRAVITY @ 60° F. | SPECIFIC GRAVITY @ % OF MIX |
|---|---|---|---|
| METHANOL | 50% | .7955 | .39775 |
| CASTOR OIL | 18% | .9635 | .17343 |
| NITRO METHANE | 30% | 1.1290 | .33870 |
| * DOW LUBE XA-1180-6 | 2% | .9095 | .01820 |
| | | | .9281 T. |

| FUEL CHECK - SPECIFIC GRAVITY |
|---|
| .9281 = SPECIFIC GRAVITY @ 60° F. |
| .9181/.9381 = ±.01 TOLERANCE |
| 19/22 = CONVERSION TO BAUMÉ SCALE |

CASTOR OIL 8.0326 LB. PER GAL.
NITRO METHANE 9.487 LB. PER GAL.

* NOTE: DOW LUBE SHIPPED TO US UNDER LABEL "KLOTZ KL-201".

| MIXING FORMULA | |
|---|---|
| START WITH | 700 GAL. #50000 FUEL |
| ADD | 38 GAL. CASTOR OIL (305 LB.) |
| | 168 GAL. NITRO METHANE |
| | 4 GAL. DOW LUBE |
| TOTAL | 910 GAL. FUEL MIX |

PROOF

| | 700 GAL. OF #50000 CONTAINS | 910 GAL. OF #51000 CONTAINS | ADD TO #50000 |
|---|---|---|---|
| METHANOL | 455 GAL. - 65% | 455 GAL. - 50% | ∅ |
| CASTOR OIL | 126 GAL. - 18% | 164 GAL. - 18% | 38 GAL |
| NITRO METHANE | 105 GAL. - 15% | 273 GAL. - 30% | 168 GAL |
| DOW LUBE | 14 GAL. - 2% | 18 GAL. - 2% | 4 GAL |
| TOTAL | 700 GAL. - 100% | 910 GAL. - 100% | 210 GAL |

FLASH POINT 61° F. REF U.S. TESTING CO
REPORT # LA 70216, DTD. 4-12-77

| ECO NO. | SYM. | DESCRIPTION | DATE | BY |
|---|---|---|---|---|
| 2780 | * | RELEASED | 4/14/77 | KWN |

REVISIONS

MATERIAL
FINISH
HEAT TREAT

TOLERANCES UNLESS OTHERWISE NOTED
ANGLES ± 1/4°
FRACTIONS ± 1/64 IN.
DECIMALS
.XX ±
.XXX ±

DRAWN KWN DATE 4-11-77
CHECKED DATE

**L. M. COX MFG. CO., INC.**
1505 E. WARNER AVE. SANTA ANA, CALIFORNIA

TITLE: RACE POWER FUEL
SCALE
DWG. NO. 51000
SIZE A REV. *

DWG. NO. 50000
REV. *

| INGREDIENT | % OF MIX BY VOLUME | SPECIFIC GRAVITY @ 60° F. | SPECIFIC GRAVITY @ % OF MIX |
|---|---|---|---|
| METHANOL | 65% | .7955 | .51707 |
| CASTOR OIL | 18% | .9635 | .17343 |
| NITRO METHANE | 15% | 1.1290 | .16935 |
| DOW LUBE XA-1180-6 | 2% | .9095 | .01820 |
| | | | .8781 T. |

| FUEL CHECK - SPECIFIC GRAVITY |
|---|
| .8781 = SPECIFIC GRAVITY @ 60° F. |
| .8681/.8881 = ±.01 TOLERANCE |
| 27/31 = CONVERSION TO BAUMÉ SCALE |

CASTOR OIL 8.0326 LB. PER GAL.
NITRO METHANE 9.487 LB. PER GAL.
OZ/GAL = % INGREDIENT × 1.28

* NOTE: DOW LUBE SHIPPED TO US UNDER LABEL "KLOTZ" KL-201".

| MIXING FORMULA | | OZ/GAL |
|---|---|---|
| ORDER | 6000 GAL. METHANOL | 83.20 |
| | 1661 GAL. CASTOR OIL (13,392 LB.) | 23.04 |
| ADD | 1384 GAL. NITRO METHANE | 19.20 |
| | 185 GAL. DOW LUBE | 2.56 |
| TOTAL | 9230 GAL. FUEL MIX | 128.00 OZ = 1 GAL. |

FLASH POINT 61° F. REF U.S. TESTING CO.
REPORT # LA 70216, DTD. 4-12-77.

| ECO NO. | SYM. | DESCRIPTION | DATE | BY |
|---|---|---|---|---|
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REVISIONS

MATERIAL
FINISH
HEAT TREAT

TOLERANCES UNLESS OTHERWISE NOTED
ANGLES ± 1/4°
FRACTIONS ± 1/64 IN.
DECIMALS
.XX ±
.XXX ±

DRAWN KWN DATE 4-6-77
CHECKED DATE

**L. M. COX MFG. CO., INC.**
1505 E. WARNER AVE. SANTA ANA, CALIFORNIA

TITLE: FLIGHT POWER FUEL
SCALE
DWG. NO. 50000
SIZE A REV. *