What is Propep?

Propep is freeware that will calculate certain useful propellant parameters. It was written about fifteen years ago by several scientists at Martin-Marietta.

What is GUIpep?

GUIpep is a wonderful graphic interface for Propep, written by the Landshark, Art Lekstutis. The following URL has links to both Propep and GUIpep:

http://members.longisland.com/~artlex/Hobbies/Rocketry/Software.htm#GPINTRO

Thank Art profusely, as his interface has made Propep (literally) a hundred times easier to use. Buy him a beer or ten when you see him.

How do I use GUIpep?

Instructions for installing GUIpep are on the page noted above. It requires Windows 3.1 or higher and a math coprocessor.

Propep alone (w/o GUIpep) can run on any IBM with a coprocessor, but take my word for it, you don't want to.

To use the program after installing, just double-click on the little chemical icon. After a few moments a window will appear, with ten slots for entry of your propellant combination. The arrow to the right of each slot will bring down the complete list of substances available.

A default AP formulation loads when you run the program. For practice, run that formulation.

Once you've entered the mixture, click on "Run" {Single Run}. A DOS window will appear, and you have to hit {Return} once. The DOS window will disappear after a while and the results will appear in Windows Notepad.

If you delete the "amount" of an ingredient, the ingredient disappears too. Just select it again.

You can change chamber pressure as desired before a run.

What parameters does GUIpep provide?

Among other things it calculates propellant density, chamber/exhaust temperature, composition of the chamber/exhaust gases, specific heat ratio, specific impulse (frozen and shifting), characteristic impulse, and density impulse. There is an option to calculate optimal nozzle expansion.

GUIpep results should be viewed with caution. The equilibria used to perform its calculations are somewhat arbitrary and may be outdated. And some entries are erroneous.

GUIpep is probably at its best when comparing similar compositions, rather than in figuring impulse of a new comp.

Can I enter other substances in GUIpep?

Yes. To do so:
-Copy the PEPCODED.DAF file to another directory. Just in case you mess up, as I did.
-Load the PEPCODED.DAF file into your word processor. The WP will convert the file from ASCII to its own type of file.
-Change to a monospaced font, with small font size so that the columns line up properly. I use 9 or 8 point Courier New on WordPerfect.
-Go to the bottom of the file. The last entry in my file is:

1097 HEXAMETHYLENE TETRAMINE 12H 6C 4N 0 0 0 236 .0481]

-The next entry should be 1098, of course. Be sure to space properly to get the columns lined up. Then enter the name of the compound, then the number and type of atom in its formula. The next-to-last entry is the heat of formation in calories per gram (no decimal point). The last is the density in pounds per cubic inch.
-When you've entered the new substance, save the file (as an ASCII or TEXT file, not a Word Perfect file!). Be sure to close that file in your word processor before running GUIpep or you'll get an error.
-If you try a run with the new file and the results are garbled, you probably messed up the file. Load the emergency copy of the PEPCODED.DAF file you saved, and try again. Been there, done that.

What does the "multiple calculation" do?

It's very useful for examining effect of oxidizer-fuel ratios and such. For example, you can select a mixture of nitrous oxide and nylon, and select a range of nitrous concentrations to determine which one will give the best impulse.

The best impulse isn't necessarily the best practical performance, especially in model and hobby motors. Standard black powder (75/15/10 potassium nitrate, charcoal, sulfur) is much lower in impulse than, say, an 85-15 mixture of KN and charcoal. But standard black powder performs better, normally, because it's faster burning.

I got a density of zero for my propellant. What happened?

You probably have at least one ingredient that has an entered value of zero for density. Go to the PEPCODED.DAF file and change that density to its correct value. Many densities can be found in the CRC Handbook of Chemistry and Physics, or the Merck Index.

I see only one entry for ammonium perchlorate. Does the particle size matter?

No. Particle size will affect the burn rate but not the (calculated, theoretical) impulse.

There are several entries for R45/PBAN/Al/Mg. Which one do I use?

For R45 I use the one labeled "R45 HTPB (UTC)". Its density is closest to that of my HTPB and the heat of formation is comparable to that published elsewhere. For PBAN I use the first "POLYBUTADIENE/ACRYLONITRILE CO" entry, for the same reason. For aluminum use the "pure crystalline" entry, likewise for magnesium. The "non-reactive" entries will give the correct density but incorrect impulse and other parameters.

There's no entry for Tepanol, DER331 epoxy, PSAN, 2-ethylhexyl acrylate, etc. What do I do?

Generally, the lower the amount of a component, the less important its effect will be. It's probably safe to omit Tepanol, PDMS, lecithin, etc. entirely, or just substitute that amount of extra HTPB in the calculation. For DER331 epoxy I use the "EPOXY 201" entry. CP Technologies' PSAN is about 3% nickel complex, so you might use "AMMONIUM NITRATE" and "NICKEL OXIDE", and make the nickel oxide about 3% of the ammonium nitrate content. For 2-ethylhexyl acrylate or other ester plasticizers, you're probably safe to substitute dioctyl adipate or dibutyl phthalate. Most such plasticizers are fairly similar in structure and will give similar results in Propep.

For Isonate 143, use the "PAPI" entry. IPDI is in the file already. And DDI-1410 is listed under "DI-ISOCYANATE (DDI)."

How do I get burn rate coefficient and exponent from GUIpep?

You don't. Sorry. GUIpep gives thermodynamic results. Burn rate coefficient and exponent are kinetic (rate) data. The two are unrelated. To get burn rate coefficient and exponent, you must...burn your propellant.