PROPEP 3 INTRODUCTION   October 1, 2017

ProPep traces back to the mid 1980's and a group of people at Martin Marietta in Orlando, Florida. It was a state of the art DOS program with very little documentation. Its database, PEPCODE.DAF, had its last official update on September 29th, 1986 by John Cummingham. Since that time there have been a multitude of undocumented updated versions.

In the early 1990's Art Lekstutis, of New York, created a Graphical Interface to make it easier for the average user to run. GUIPEP ran in Windows as a frontend for the "original" PROPEP. The current version, 0.04 alpha, is dated November 17, 1996. Art has ceased any further evolution of GUIPEP.

In 2012 NASSA member Dave Cooper, after completing NASSA's TC LOGGER USB Data Acquisition Project, wanted to create a program that would characterize Propellant fired on the TC LOGGER System. ProPep was required for the calculation of some pertinent data required for the characterization process.

PROPEP 3 was begun to convert the original DOS based PROPEP to a true windows based program which would easily install and run on all the Windows based systems from Windows XP to Windows 7 (32 and 64 bit) and hopefully beyond.

Once the initial DOS based PROPEP, written in FORTRAN, was converted to •Net, NASSA members began to ask that other things be added to aid in the characterization of propellants. This included calculation of the values of a and n from BATES grain test burns and the ability to create a file which could be read by BURNSIM to directly input the propellant information into the program.

PROPEP 3 contains the process of the original ProPep and will actual provide a ProPep Report the same as the original ProPep. While this Report is an exact duplicate of the original hard to understand report, and of value to only the most versed propellant scientist, it is not really needed by the user and remains only to provide data on the propellant formulation.

PROPEP 3 was designed to read TC LOGGER Files however if you collected your propellant data using another system you have the option to manually enter that data and receive the same end results.

To install the program run ProPEP3.msi. Once the program is installed you should find a new Icon on the desktop and a new item in the program list. The default location for all the program files is in your computers My Documents/PROPEP 3. This location was chosen to comply with the new windows security rules which were introduced with old Vista and Windows 7.

To run the program double click on the icon and the program should open.

PROPELLANT INFORMATION Tab

When PROPEP 3 opens you are viewing the main page, the Propellant Information Tab, which has an area to enter your propellant recipe. Across the top you will see four tabs: Propellant Formulation, Grain Information, Test Burns and Compute A & N. You will see six values near the bottom of the page which should all be reading zeros. On the left hand of the screen is a boxed area called Operating Conditions; the values here are set at default settings which are general. These can be changed once you know what you're doing. You will also see three buttons on the page: Calculate, Display Results and Display Nozzle Graphs.

This is where it all starts.

Enter your Propellant Formula by clicking on the down arrow box of each Ingredient window. This will drop a selection of chemicals from the built-in data base. Select a chemical for that box then add the recipe weight in grams in the smaller box to the right.

This list of chemicals is created from the PEPCODED.DAF file in the My Documents/PROPEP3 directory. This file is identical to the original PROPEP file so if you have your own 'favorite' PEPCODED.DAF file you can easily replaced the one supplied with yours.

Up to 10 ingredients can currently be selected. To remove an ingredient simply select the ingredient to be removed and select the blank item at the top of the Drop Down list.

Continue down through each box until you have your recipe complete.

Once all the ingredients are added press the Calculate button and PROPEP 3 calculations will be run. The six values at the bottom of the page will populate.

To see the detailed results, press the Display Results button and a ProPep Report will be displayed. Users of the old ProPep will recognize this report and be able to utilize it as they would normally. The beauty of ProPep 3 is while this is available it is not required you understand it or use it, the program does that.

If you have checked the Boost Velocity and Nozzle Design before pressing the Calculate button you can press the Display Nozzle Graphs button to view a graph of Impulse vs Expansion Ratio. You can select the Boost Velocity and Nozzle Design after calculating but you must recalculate before selecting the Display Nozzle Graph button. A Right mouse click on the graph will show you some options for printing or viewing data points on the graph. The default Window's Graphic .emf can be changed to your preferred file type.

GRAIN INFORMATION Tab

This screen is used to define the grains for each test burn. A max of 6 burns can be entered. A minimum of 2 grains should be entered to allow for calculation of the A and N values.

Enter the number of Grains for each test motor. Enter the individual Grain Length, Diameter and Core Diameter, then select either Solid Grain Wt or Cored Grain Wt.

Next select the Casting Tube used from the dropdown menu.

NOTE: Casting tubes can be defined by selecting OPTIONS/ Casting Tube from the top menu. A window will open displaying all previously defined casting tubes and their weights. To define a new one select an empty line and enter an identifying name, make it easy to identify, and then enter its weight per inch in grams. The hit SAVE.

Now that casting tube is available in the Casting tube dropdown box. The program will now remove the Casting tube weights from the total grain weight to calculate Propellant density.

IF you have already subtracted the casting tube weight from your entered grain weights select NONE in the Casting Tube drop down box.

Once density is calculated you should go back to the Propellant Tab and double check against the Propellant Density computed there. They should be relatively close. If they are grossly different

there seems to be a problem. Double check your work. You may have entered information incorrectly or you have a formulation problem, or even a mixing problem, that you need to research and address.

TEST BURN Tab

There a two ways to enter data on this screen. If you have run your test burns on the TC LOGGER–USB system, then you can press the Read File button under the appropriate column to locate and select the LOGGER file for that burn. The default directory should be located, under normal conditions, in your computer's My Documents/TCLUSB.

The second method, if you did not used TC LOGGER-USB to collect your data, is to simply enter the values by hand into each of the boxes from data you have collect with other acquisition software. No adjustment of burn time is calculated if the values are entered manually.

If you use TC LOGGER Files you should have already used the Selected Area Analysis function in the TC LOGGER software to select the Plateau region of the curve. This is all explained in the TC LOGGER documentation If the burn file has this selected data PROPEP 3 will recalculate the burn time from the Impulse and Selected Average Thrust and provide optimum data for the burn.

If you have not pre selected the Plateau Region for that burn in TC LOGGER a warning will pop up. You can go into TC LOGGER and perform the task and resave the file or ignore the warning.

If you have not selected this plateau area then the overall average thrust and burn time will be used.

NOTE: The motor in Burn 1 must coincide with the information for Motor 1 in the Grain Information Tab. The same applies for Burn 2, Burn 3, etc.

COMPUTE A&N Tab

Once all information is entered in the first three tabs selecting the Compute A & N Tab will produce data. All data is grayed as they cannot be edited, these are RESULTS.
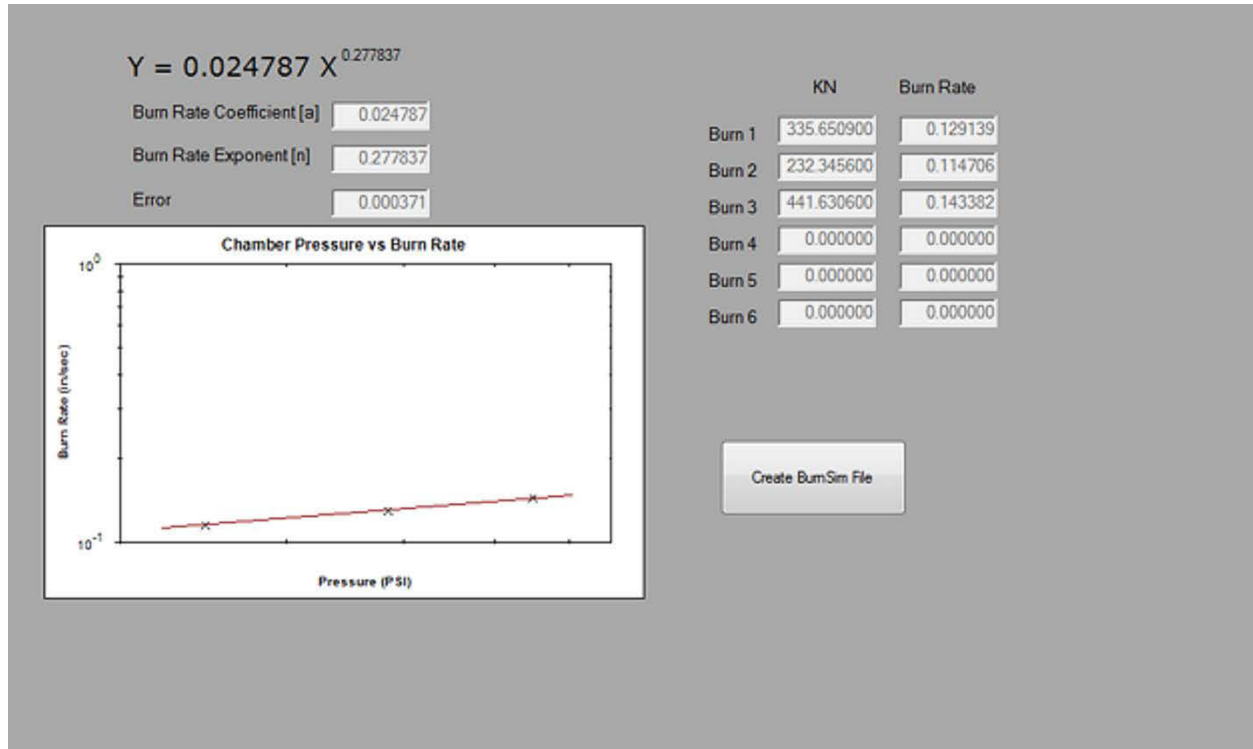
A chart is shown for Chamber Pressure vs Burn Rate. A least squares approximation line is then calculated and drawn on the graph. The a and n values are computed from the line and displayed. If the error of the line is too large (look in the ERROR Window, it should not be >0.009) then a warning message is displayed on the screen. This probably means that one or more of the test burns is suspect and should be rerun.

If you right click on the chart a dropdown menu will appear where you can Copy, Save Image As, Page Set Up, Print or Show Burn Points. Show Burn Points will produce point data for that point selected. Which burn that specific point is for can be found by comparing information against the Burn Rate information on the right.

BURNSIM FILE

With everything finalized you can create a BurnSim file by simply clicking the Create BurnSim File Button. It will send you into the normal Window's Save File window where you can select the folder you wish to save it in and the name of the BurnSim BSX file. A file is then created which can be read by BurnSim and will include the Propellant Name entered on the Propellant Formulation tab, actual Avg. Propellant density, Molecular Wt., Chamber CP/CP, a, n, and Avg. ISP* computed from the burns.