

TankPress Manual

Version 2019.06.18.1620

Requirements

Python 3
matplotlib 2+ (and dependencies)

Note: To install matplotlib and its dependencies on Windows, run the Command Prompt as Administrator and enter the following: *pip install matplotlib*. This will install the most current version of matplotlib and the required dependencies.

Description

TankPress computes the time taken to pressurize a tank of given volume with air. It also reports the mass of air, the specific internal energy, and temperature inside the tank. The air travels from a supply line (pipe) to the tank, with given properties.

Initial Conditions and Constraints

Pipe
p1 > 0 psi
d1 > 0 in.
T1 > -459.67 °F

Tank
p2 > 0 psi
V2 > 0 cu. ft
T2 > -459.67 °F

Time Step
0 s < dt < 1 s

How To Use *TankPress* (GUI)

- (1)** Type in the initial conditions (inputs) in the Input tab, including a unique, unused "Run Name".
- (2)** Click the "Start Run" button (with the Play arrow).

Note: "Waiting..." on status bar will change to "Finished." when the script, TPscript.py, is finished running.


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Exit Program

Input Output Graphs

TankPress computes the time taken to pressurize a tank of given volume with air.

Pipe Pressure, p1 =	0.0	psi	Tank Pressure, p2 =	0.0	psi
Pipe Temperature, T1 =	0.0	°F	Tank Temperature, T2 =	0.0	°F
Pipe Diameter, d1 =	0.0	in.	Tank Volume, V2 =	0.0	cu. ft
Time Step, dt =	0.0	sec	Run Name Input =		

Start Run

Reset All Tabs

Reload Last Inputs

---Instructions---

The values of the pipe and tank pressures, pipe diameter, and tank volume must be greater zero.

The values of the pipe and tank temperatures must be greater than absolute zero (or -459.67°F).

The value of the time step must be between zero and one, not including zero and one.

The run name must be different each run, otherwise there will be an error.

The input file to the script is overwritten each run.

Always input a NEW run name before clicking "Start Run" or loading output or graphs; otherwise, error occurs.

Waiting...



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Exit Program

Input Output Graphs

TankPress computes the time taken to pressurize a tank of given volume with air.

Pipe Pressure, p_1 =	75	psi	Tank Pressure, p_2 =	14.7	psi
Pipe Temperature, T_1 =	80	°F	Tank Temperature, T_2 =	80	°F
Pipe Diameter, d_1 =	1	in.	Tank Volume, V_2 =	70	cu. ft
Time Step, dt =	0.001	sec	Run Name Input =	testA	

 Start Run
  Reset All Tabs
 Reload Last Inputs

---Instructions---

The values of the pipe and tank pressures, pipe diameter, and tank volume must be greater zero.

The values of the pipe and tank temperatures must be greater than absolute zero (or -459.67°F).

The value of the time step must be between zero and one, not including zero and one.

The run name must be different each run, otherwise there will be an error.

The input file to the script is overwritten each run.

Always input a NEW run name before clicking "Start Run" or loading output or graphs; otherwise, error occurs.

Finished.

- (3) Click on the "Output" tab.
- (4) Click the "Load Output" button.


Note: Shows the final values of T_2 (tank temperature), m_2 (mass in tank), u_2 (specific internal energy in tank), and t (time taken to pressurize tank).

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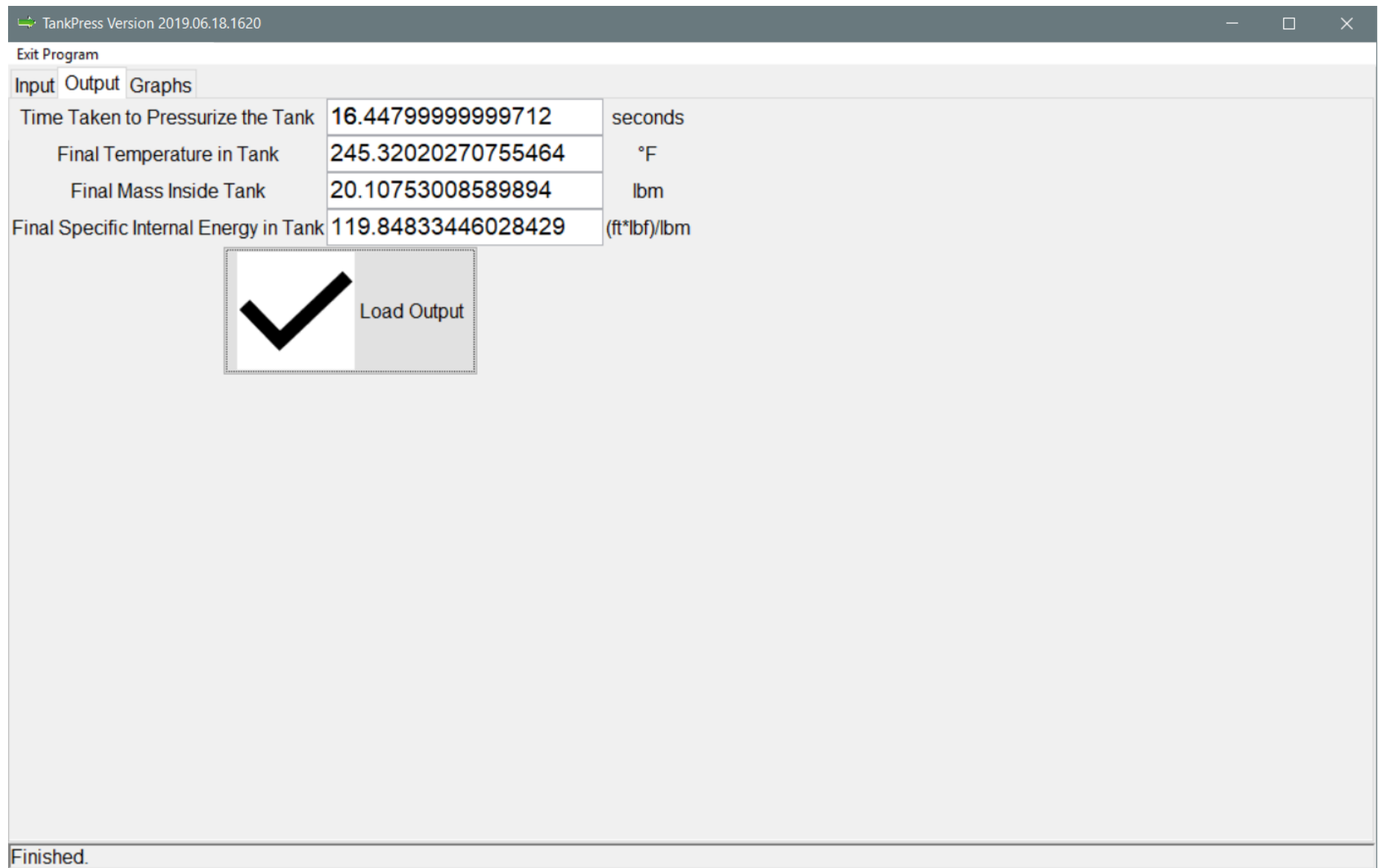
Exit Program

Input Output Graphs

Time Taken to Pressurize the Tank	<input type="text" value="0.0"/>	seconds
Final Temperature in Tank	<input type="text" value="0.0"/>	°F
Final Mass Inside Tank	<input type="text" value="0.0"/>	lbm
Final Specific Internal Energy in Tank	<input type="text" value="0.0"/>	(ft*lb _f)/lbm

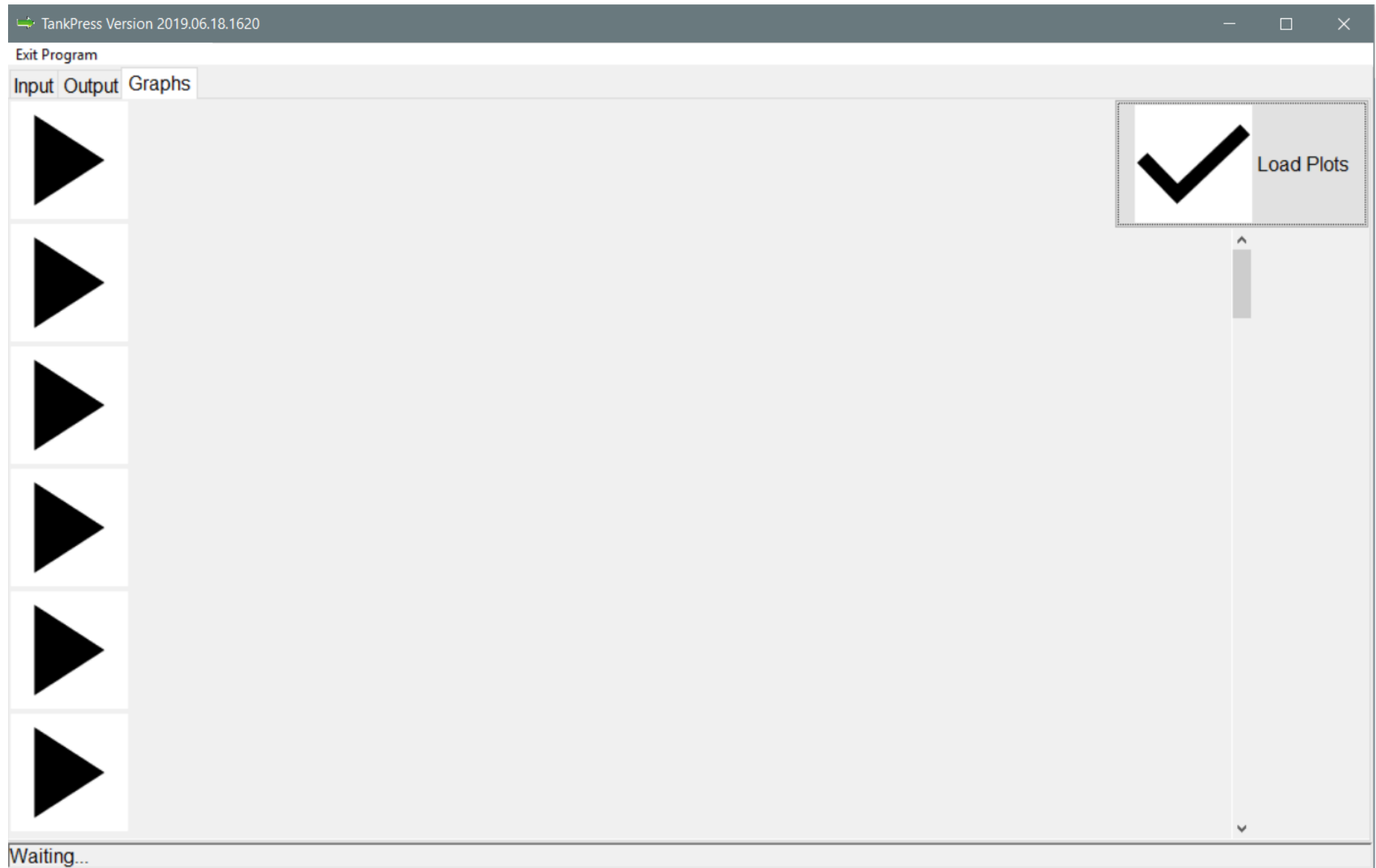
 Load Output

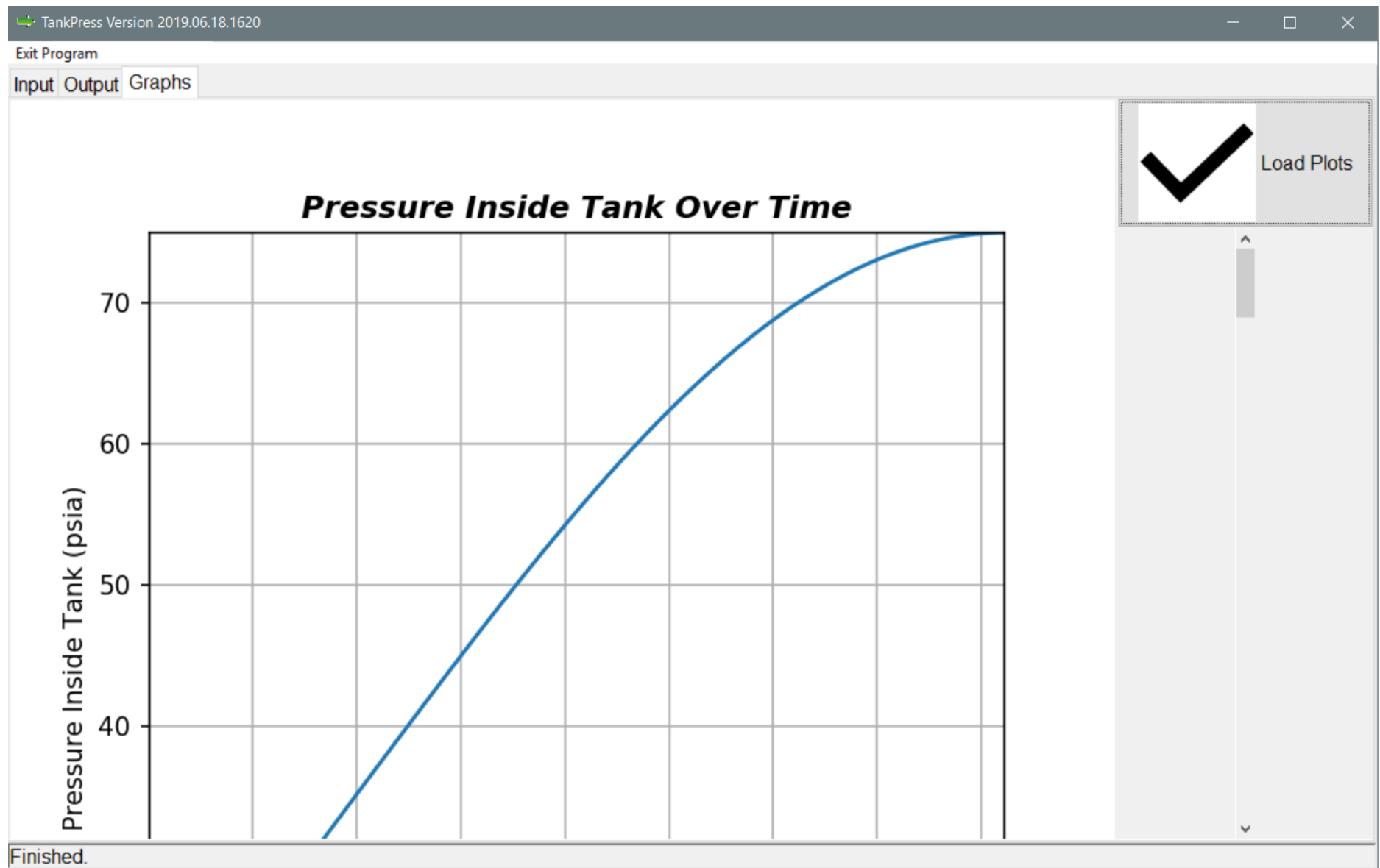
Waiting...



(5) Click the "Graphs" tab; The six graphs generated by the script, TPscript.py, will load. Use the scrollbar to see them in turn.

Note: Maximize the window to see any of the graphs on the screen.





- (6) Click "Reset All Tabs" button to return the "Input", "Output", and "Graphs" tabs to their pre-run states.
- (7) Click on "Reload Last Inputs" button to recall the last inputs to the GUI.

Note: Must put a unique, unused "Run Name" in that input box to do a fresh run with that data.

- (8) Click "Exit Program" button on the menu bar when done.

How To Use *TankPress* (CLI)

(1) Run the TankPress-CLI.py script using the Command Prompt (or terminal) or an IDE such as IDLE.

(2) Follow the prompts on the command line interface to provide the script with the following:

- * "Run Name" as a string [ts]
- * "Pipe Diameter" in inches [d1]
- * "Tank Volume" in cubic feet [V2]
- * "Pipe Temperature" in °F [T1]
- * "Tank Temperature" in °F [T2]
- * "Pipe Pressure" in psi [p1]
- * "Tank Pressure" in psi [p2]
- * "Time Step" in seconds [dt]

(3) If there are any errors in any inputs, the program will provide a statement of what went wrong and ask for that input again. If an error happens with the pressures, both will be asked for again.

(4) Once the program finishes running, the Command Prompt will display some information, including the results.

Note: All outputs are stored in a folder under the current directory (the folder the program is run from). This includes a log file of the command prompt interactions in a "Log" folder, two csv files in a "Data" folder, and a "Figures" folder, with sub-folders "eps" and "png" corresponding to those image file types of 6 different graphs.

(5) Press any button to exit the program.

Note: DO NOT FORGET to check the "TankPress-[ts]" folder of the run for all outputs of the run.


```
Microsoft Windows [Version 10.0.17763.557]
```

```
(c) 2018 Microsoft Corporation. All rights reserved.
```

```
(TankPress) C:\Users\      \PycharmProjects\TankPress>TankPress-CLI.py
```

```
Hello, user.
```

```
Welcome to TankPress version 2019.0618.1620.
```

```
Please select and input a string of characters to distinguish this run. testB
```

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```

Initially, a rigid insulated tank of air at an initial pressure and temperature and a supply line are connected by a valve.

Air flows through the supply line with a pressure and temperature.

When the valve opens, air enters the tank until the pressure equalizes to that of the supply line, at which point the valve is closed.

This program calculates the final values of the pressure, temperature, and mass of air inside the tank, as well as the last mass flow rate before valve closure, the time it takes to pressurize the tank, and the error of the calculation

```
.....
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.....
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.....
```

```
Enter the supply line diameter in inches.      1
```

```
Enter the tank volume in cubic feet.          70
```

```
Enter the supply line temperature in °F.      80
```

```
Enter the initial tank temperature in °F      80
```

```

Enter the supply line pressure in psia.      75
Enter the initial tank pressure in psia.     14.7
Enter the time step in seconds.             0.001

```

```

.....
.....
.....

```

```

It took 16448 iterations to complete this simulation model.
The final pressure inside the tank is 75.000000 psia.
The final temperature inside the tank is 245.320203°F.
The final mass inside the tank is 20.107530 lbm.
The final mass flow rate into the tank is 0.000154 lbm/s.
The final specific internal energy inside the tank is 119.848334 ft * lbf / lbm.
The final error of the calculations is 0.000000 (unitless).
The time taken to pressurize the tank is 16.448000 seconds.

```

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.....

```

```

It took 4.3155 seconds to go through the process after inputting the initial conditions to creating a multipage PDF of
the plots.

```

```

.....

```

```

Press any key to exit.

```

Project Folder Structure

```

./
  HTMLimg/
    TankPressInputScreen.png
    TankPressInputScrAfter.png
    TankPressOutputScreen.png
    TankPressOutputScrAfter.png
    TankPressGraphScreen.png
    TankPressGraphScrAfter.png
    TankPressCLIfirstscreen.png
    TankPressCLIlastscreen.png
  GUIfile/
    Run.png
    Reset.png

```

```
Reload.png
Yes.png
run_program.ico
TankPressInput/
  TankPressInput.csv
TankPress-[ts]/
  Data/
    TankPress-[ts]-full.csv
    TankPress-[ts]-select.csv
    TankPressResults.csv
  Figures/
    eps/
      P2-Time-Rel-[ts].eps
      T2-Time-Rel-[ts].eps
      P2-T2-Rel-[ts].eps
      M2-Time-Rel-[ts].eps
      MFR-Time-Rel-[ts].eps
      INTNRG-Time-Rel-[ts].eps
    png/
      P2-Time-Rel-[ts].png
      T2-Time-Rel-[ts].png
      P2-T2-Rel-[ts].png
      M2-Time-Rel-[ts].png
      MFR-Time-Rel-[ts].png
      INTNRG-Time-Rel-[ts].png
venv/...
TankPress.py
TankPress-CLI.py
TPscript.py
README
Manual.html
```

Note: [ts] denotes the "Run Name" provided to the GUI.

History

This was born out of a Thermodynamics II project to essentially create a program to determine the time it takes to pressurize a tank of given volume with air. First, the algorithm was done in MATLAB. This resulted in a good grade because it did get the time taken to pressurize the tank, but I was not satisfied. After graduating, I decided to revamp the algorithm into another language. First, I explored C. It hit me that Python had all the things I needed to get to where I wanted to go. I began this as a command-line program in Python. I aspired to get it into a GUI. Now it is.

Version 0.0: 28 Mar 2017, CLI working nicely.

Version 1.0: 18 Jun 2019, GUI program and script finally satisfactory, with room for some improvements. Last Version of CLI program file also included.