FillCalcWin

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github: https://github.com/eianlei/FillCalcWin

About FillCalcWin, the trimix blending calculator

FillCalcWin is a Windows GUI tool for interactive technical scuba diving gas blending calculations. It will calculate how to blend a technical scuba diving gas mix given the current mix you have in tank and what you want. Several blending methods are available.

The tool also calculates the total cost of gases.

Results can be saved to a file or copied via clipboard to any application.

The tool is open source and available at github. See the GPL license at the end of this help text.

Usage

Use **Current tank mix** controls to enter:

- Current tank pressure in Bar
- Current tank oxygen content %
- Current tank Helium content %

Use **Wanted tank mix** controls to enter:

- Wanted tank pressure in Bar
- Wanted tank oxygen content %
- Wanted tank Helium content %

On the top ribbon there are buttons for quick selections:

- want bar, for quickly selecting
- std.gas: a selection of standard gases for the wanted mix
- **Van der Waals** button to select the gas law

For partial pressure fills, you can select the gas law to be **Van der Waals**. However, Van der Waals calculation implementation is under development and not very well tested.

At the bottom tabs select the tab of your choice for a fill method:

tab label	fill method
Air	You are topping the tank with plain air. Obviously, you will not then get the mix you maybe wanted. The app calculates what you will get.
Nitrox CFM top	You are topping the tank with Nitrox CFM. Obviously, you will not then get more Helium to the tank, but the app tries to calculate the O2% inflow to match your O2% target. You get error if you want something that cannot be done.
Trimix CFM top	You are topping the tank with Trimix CFM. Here we assume you have only one mixing

	chamber and only one O2 sensor.
Partial Pressure	You are doing a partial pressure (decanting) fill. First fill in Helium, then Oxygen, finally top with air. Often Helium and Oxygen fill is done with a booster pump.
He + Nitrox CFM	You are decanting first pure Helium, then top with Nitrox CFM. Standard trimixes can be made this way.

If the mix you want is possible to make, then under the tab you will see the instructions how to make it. Otherwise you get an error.

The application immediately recalculates when you change anything in the GUI controls. The calculation using ideal gas law is simple and you should not notice any delay. Van der Waals solution might take a bit longer. The Spinbox widgets can be used by either entering values from keyboard, or then increase/decrease value by clicking up/down arrows. Some values can be selected with comboboxes from a popout menu.

You can try to "simulate bleeding" your tank, if you are not getting the mix you want. Simply decrease the current tank pressure by as much as you would then be bleeding actually, and you might find a solution.

The application assumes that for CFM fills the following Oxygen and Helium flows cannot be exceeded: - Oxygen max 36%, as your compressor can explode. - Helium max 32% as your compressor can overheat

Fill cost calculation

On the right-hand side there is panel that calculates the cost of your fill.

Target users

The application is intended for certified Trimix gas blenders, who blend gases for technical scuba diving.

It is assumed that anyone daring to use this application knows what they are doing.

Disclaimers

Use this application at your own risk, the author provides no guarantees about the correctness of the application and assumes no liability for the use of it for any purpose!

- In no event should you consider blending breathing gases without proper training!
- In no event should you consider scuba diving with mixed gases without proper training!
- Ignoring these warnings can cause your **death** or **serious and permanent injuries**!

Unit system

- Metric and EU units, Imperial units not supported
- decimal separator is from Windows locale
- Currently only bar can be used as pressure unit, PSI not supported
- Gas mixes as percentages
- Tank size in liters (cu-ft not supported)
- currency unit is Euro

Gas laws used for calculation

The calculation formulas used by default are based on the ideal gas law.

A more accurate physical model is the Van der Waals equation.

Adiabatic heating and cooling due to compression and decompression of gases is not taken into account.

gas law	description
Ideal gas law	Calculations are based on solving P * V = n * R * T, where P is the gas pressure, V is the tank volume, n is moles of gas, R is the universal gas constant, T is the system temperature. The equation reduces in this application to P1* n1 = P2* n2 and we can furthermore use the Dalton's law of partial pressures. This method works fairly well for fills up to 200 bar, and for mixes that do not have much Helium. For fills to 300 bar, and/or with significant amounts of Helium, the ideal gas law produces a significant error. However, the calculation is simple and quick and could be done even manually.
Van der Waals	Calculations are based on solving the Van der Waals equation: (p + (n^2 * a /V^2)) * (V-n*b) = n* R * T for each stage of filling. The coefficients a and b depend on the gas mix. As it is a nasty cubic equation, the solution is done numerically by iteration. For each gas mix the a and b coefficients are calculated separately as Dalton's law is no longer applicable in this case. The calculation is complicated and uses a lot of CPU cycles, but the result is much more accurate. Calculation by hand is not by any means practical.

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