

1 2Wet overview



2Wet is an automated fluid dosing device, gas stream humidifier and pure steam generator all in one device. With the 2Flow software it is easy to program dispense rates, ramps and setpoints as function of time, in various units. When working with gases, the software also calculates partial pressures and volumetric units for all constituents.

The device doses H_2O or other low viscosity fluid directly into process or experiment, or into evaporator system to generate steam or vapor, or to mix with a stream of gas. The device's main purpose is to humidify a stream of gas, and with its' companion device

2Mix, forms a gas mixing and humidification system. The devices are modular and all be controlled from one software.

2Wet consist of a power source, the 2Wet device itself, the gas evaporator in the form of heated and insulated gas line, and the 2Wet software.

1.1 Components

1.1.1 Device

Front side of the 2Wet device has inputs for a gas and a fluid. Syringe pump's valve and syringe, power switch and the PID controller to regulate the power of the evaporator. The fluid pump on the 2Wet has its front side exposed, so the user may inspect and change the 2-way valve, and the syringe pump. Syringe pumps come in various volumes. These parts are mechanical repeaters, and as such consumables, that will eventually wear out. Easy access to inspect and replace is essential, as high throughput and high pressures increase their wear.

The back side also has outputs for the gas and the fluid. Thermocouple connector and power connectors in- and out for the evaporator line, for connectivity two USB ports, for daisy-chaining multiple devices and the controlling computer, and finally the main power in.

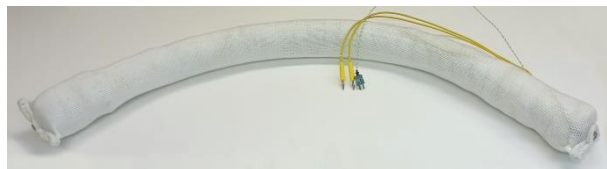


1.1.2 Power source

The power source is by default ~12 ampere, 24 VDC transformer, much like a large laptop charger. For higher steam throughput versions (or those steaming against elevated pressure), the power supply will have more amperes, and grow in size, complexity and price. Nominal power is ~280W, enough for ~5 L of pure steam in atmospheric pressure.

1.1.3 Evaporator / gas carrier line

The fluid evaporator/gas carrier line is 1.2 meters long corrugated (flexible) stainless steel tube, with built-in safe low-voltage heating and insulation. It connects directly to the back of the device leaving the other end to connect to user processes or to further transfer line. The device has manual on/off switch.



1.1.4 2Flow software

The software is meant for Windows PC (computer not included), and can control any number of 2Wet or 2Mix devices, or standalone mass flow controllers.

The user enters desired flow profile for any connected device(s) with freely selectable flows, ramps, steps, delays for gases in 2Mix, and for fluids in 2Mix. If these flows are combined, the software calculates flows in user defined units, in grams, and the resulting partial pressures for each constituent.

2 Specifications

2.1 Dispense and flows

On the low end, with the smallest syringe (12.5 μ L), the pump has resolution of 0.5 nL and can do one dispense in 192 000 steps. At constant speed this takes 50 minutes, and for even lower dispense rates, the pump can pause between each step. In practice this is enough to control pH₂O or such in levels below ppm.

For the high end, largest syringe (12.5 ml) can perform full cycle (valve movement, full retract, valve movement, full dispense) every 2.4 seconds, or ~25 times per minute. At 1 bar, this is enough for 600 l of steam. However, not with the default power supply, which is limited to 5 liters per minute.

The software allows specifying custom fluids as well as the typical, such as H₂O, and it allows user to specify the flows either in total volume in whichever unit, or in grams per minute, as well as based on absolute humidity or relative humidity (in given conditions, also specified by the user).

2.2 Chemical compatibility

The fluid system is exposed to the fluid being used, and the backpressure from the system. The fluid carrying line is additionally exposed to the gas stream. The parts in contact with the fluid are the fluid line, the bulkheads and flanges, the pump valve, and the syringe. The only part in contact with the heat, and the gas stream is the fluid carrying line. Each component has several options, but the default ones are made of PTFE, PEEK, Borosilicate glass, PFA, CTFE, ETFE, UHMW-PE.

Special ceramic valve, and special syringes are available on request.

2.3 Pressure

All mentioned parts are also exposed to the backpressure of the system. Each component has its own rating, but in general all are rated for 5 bar a, and some up to 11 bar a, or even higher.

2.4 Safety

When used with dangerous gas or fluid, the whole system should be in a fume hood with appropriate alarm systems installed.

2.5 Accuracy

±1% of syringe volume for full dispense. In typical use, absolute error is some nanoliters per minute.

2.6 Precision

±0.1% of dispensed volume.

2.7 Interfaces

Fluid input:	Swagelok compression bulkhead 1/16" with 30 cm input line of 1/16" tubing
Gas stream input:	Swagelok compression fitting bulkhead 1/8"
Heated gas line outlet:	Swagelok compression fitting for 1/4" stainless steel tubing
Mains power:	From 100-240 VAC 50/60 Hz 4.5 A, To 12 A 24 VDC (~280 W) Socket for any C13 plug, typically includes CEE 7/7 plug.
Software:	Requires Windows system (computer not included).

3 Options

3.1 Devices

	Standard	Corrosive option	High pressure option	Extreme pressure option
2Mix	11 bar	22 bar	22 bar	275 bar
2Wet	5 bar	5 bar	11 bar	Not possible

3.2 Syringes

Volume μl	Resolution nL	Max dispense mL/min	Max power needed W	Max steam volume L/min
12,5	0.5	0.31	16	0.6
25	1	0.63	31	1.2
50	2	1.25	63	2.4
100	4	2.50	125	4.8
125	5	3.13	156	6
250	10	6.25	313	12
500	21	12.50	625	24
1000	42	25.00	1.25 k	48
1250	52	31.25	1.56 k	60
2500	104	62.50	3.13 k	120
5000	208	125.00	6.25 k	240
12500	521	312.50	15.63 k	601