



Explorer user guide and technical document



The *Explorer* is an easy-to-carry, versatile and modular, sturdy, and full stainless-steel still/extractor carefully developed and built in Canada (QC) with local partners. This unit has been specially designed for essential oils, hydrolats and plant extracts auto-production and production tests as well as education and research. With this apparatus, you can perform almost all types of plant distillation (detailed in this guide), large scale infusions or decoctions and even reflux extractions with organic solvent.

And before going into technical details, a few personal words:

There are plenty of botanical treasures all around the world and in everyone's living environment. Aromatic plants, medicinal plants, toxic plants, plants we fell connected with, plants we do not... A vast and fascinating world that provides healing substances... and dangerous ones. So, learn as far as you can from reliable sources about the plants around you. Be careful of misidentifications. Grow and/or harvest them with respect and consciousness. Always let enough for others (humans and animals), for next years and for next generations, enjoy the magic of distillation and plant extraction, develop your skills, learn how to use your own essential oils and plant extracts safely and efficiently and if you have any question regarding distillation/extraction and your Explorer, please contact us. We are here to support you in your projects and your quest leading you out in your garden, the fields, and the forests.

Benoit ROGER Ph. D.

Table of content

- About this document	3
- Safety and heating sources	3
- Precautions and maintenance	4
- Technical information	4
- <i>Explorer</i> overview	6
- Unpacking and installation	7
- How to use your still	8
Steam distillation with a propane burner	8
Steam distillation with an internal electric element	12
Steam distillation with an external steam generator	12
Water distillation with a propane burner	13
Extraction	13
Important notes for both steam and water distillation	14
Cleaning your still	14
- Pictures	15

About this document

This document contains the technical information about the *Explorer* and describes how to use it safely and efficiently. It also contains in *italic grey font* some general information about distillation that should help you to get a better understanding of what happens in the still and how the distillation method and parameters may affect the quality and yield of the products you are looking for crafting.

Safety and heating sources

The *Explorer* is primarily designed to be used with a propane burner. However, an electric heating source or an external boiler can be used with some modifications. Please contact us if you need it to be powered by a heating element, a hot plate or if you need to use an external boiler. We do not recommend using this unit on a direct wood/plant fire as it is much less easy to control.

A propane burner can be used both for water distillation and steam distillation. The ideal size for the burner ring is around 25 cm and the ideal power is around 65 000 btu. The burner should be able to easily stand 60 kg. Do not use an oversized burner for safety or a too small burner for stability and efficiency.

Beside the propane burner, you can also use an infrared heater. The ideal power is around 3500 W and as the still may be too heavy for the hot plate, you may need a stand to hold the still and lift the hotplate below the still. If you plan to use an infrared heater, we can paint the bottom of the still with high temperature black paint to increase the heat transfer, thus efficiency.

We can also install a 4 500 W heating element in the tank and provide a power regulator (two models for North America or Europe/Asia). This option may not be ideal for water distillation (especially for resins distillation), but it is very efficient and convenient for steam distillation, and it can be removed for water distillation. Contact us if you need this option.

We can also add an inlet for direct steam injection. As for the electric heating element, you would have to ask for this modification before we ship the unit. If you use an external steam generator, never use it at a higher flow of steam than 6 kg per hour and add a pressure relief valve at the steam inlet.

In all cases, be sure you work on a very stable and levelled burner, stand or surface, and that your stand or burner can stand the weight of the apparatus (approx. 21 kg empty) with plant and water inside (up to 40 additional kg for water distillation or 20 kg for steam distillation).

Do not modify the system, do not overload it, and never block the outlet of the condenser during warming-up, distillation/reflux extraction or cool-down phase! Boiling water or any other solvent in a closed system makes the inside pressure rise and this is very dangerous if the system is not designed for that purpose, which is the case for the *Explorer*. Be careful to steam as well as hot surfaces and use suitable gloves during and after operation. Be sure the condenser gets much more than enough cold water when condensing flammable solvent and never use direct fire to heat the unit when using/distilling flammable solvents (ethanol or other). If you use a propane burner, be sure you have no leak and a good combustion (blue flame), and if you use it outdoor, protect the unit and burner from the wind. When using a propane burner, stay far from any flammable substances (solvent, gas, wood, tissue...).



In the following text you will see some warning pictograms (see in the margins). They indicate some safety reminders or additional explanation in the text.



Precautions and maintenance

The whole unit is built in 304 and 316 stainless-steel. It has been carefully cleaned and passivated to improve the corrosion resistance. However, a few precautions must be taken to keep its aspect as close as possible to the initial one: do not use strong bases or acids, sodium hypochlorite (bleach) and/or steel wool to clean it! Dish soap or isopropanol and microfiber cloth are fine. Avoid contact with salt and non-stainless steel. Wash it and dry it right after each use and do not put it on direct fire or hot plate without any water in it. This could result in a permanent deformation of the unit bottom.

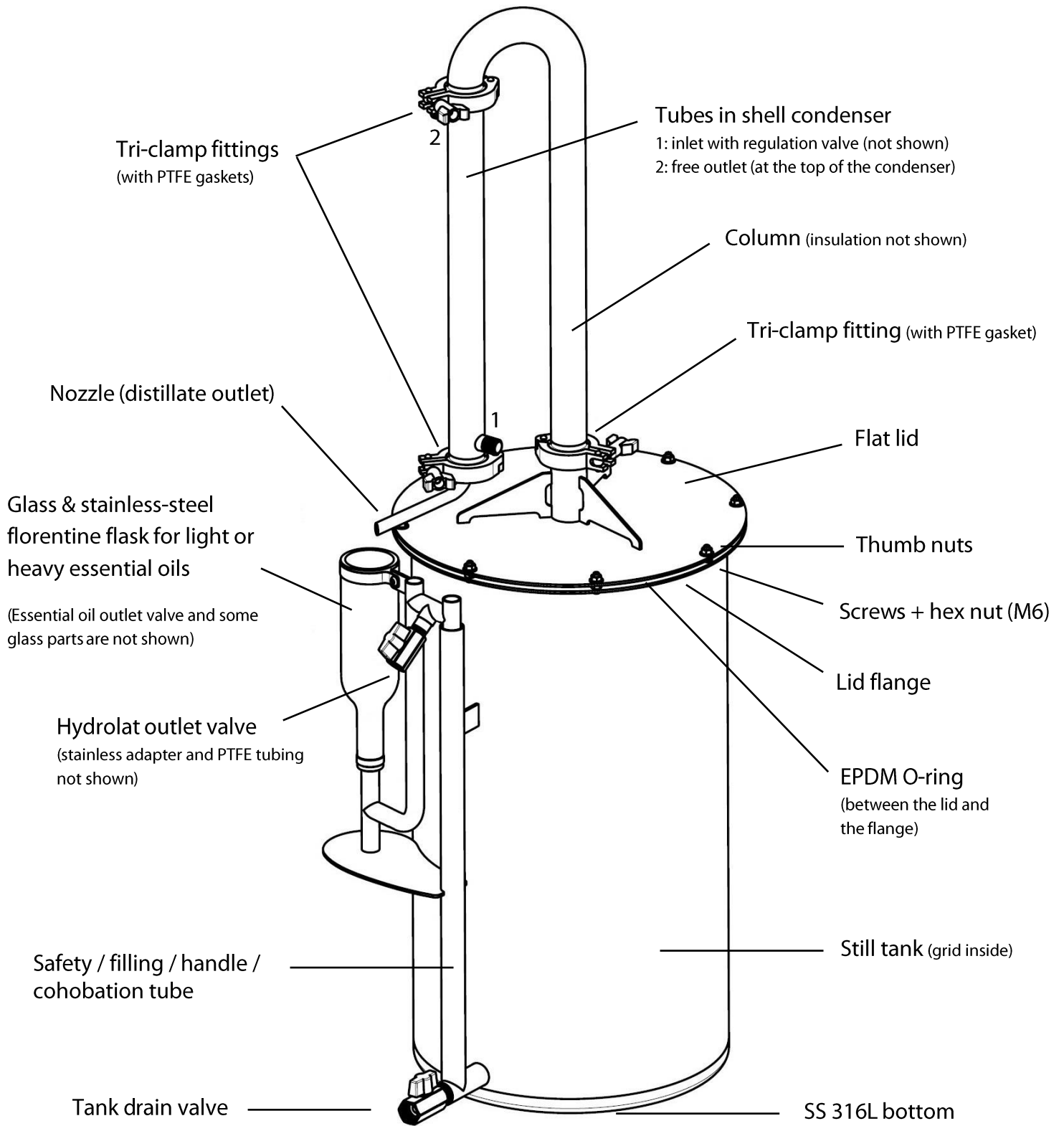
Each part of the unit can be replaced separately but each part including seals and valves should last for years if properly used. Contact us if you need replacement part.

Technical information

- Full construction in 304 stainless-steel (316L for the bottom and the condenser tubes), TIG welded under inert atmosphere with electrochemical cleaning
- Tank side thickness: 16 gauge (1.6 mm), lid: 11 gauge (3.2 mm), bottom: 14 gauge (2 mm)
- The whole unit is cleaned, and the tank is passivated before shipping
- Lid fastening with 6 screws and thumb nuts (M6)
- O-ring material: EPDM; tri-clamp gaskets material: PTFE
- Empty weight: approx. 21 kg
- Volume above the grid and total volume: approx. 54 L / 40 L
- Tank dimensions: approx. 33 cm diameter, 65 cm high
- Still height in operation (without the burner): 122 cm
- Diameter of the tank outlet and column: 1.5" (38 mm)
- Column insulation: fiberglass and cotton wrap
- Straight tubular condenser with 5 condensation tubes, 3/8" (10 mm) OD
- Condenser outlet: 1/2" (12.5 mm) OD
- Glass and stainless florentine flask and essential oil and hydrolate outlet valve, "casse-essence" and heavy oil flask
- Drain valve of the tank: 1/2" ball valve on a NPT fitting of the same size
- This unit can be used to distill up to 10-14 kg / 40 L of plant material per batch by steam distillation



Overview of the Explorer



Unpacking and installation

The unit is shipped with everything inside. As you have some glass parts in it, be careful when you unpack everything. Inside the tank closed with the lid and 6 thumb nuts, you should find:

- A large EPDM O-ring (already installed between the flange and the lid)
- An insulated column, a condenser with a needle valve, two barbed fittings 1/2", two hose clamps for the water hoses fastening (1/2" ID), and a nozzle (distillate outlet)
- A drain valve (1/2") for the tank with Teflon tape
- A grid with three 15 cm and 20 cm screws
- A stainless-steel and glass florentine flask with two mini ball-valves
- A stainless-steel adapter with a 25 cm PTFE tube you can screw to the hydrolat outlet valve of the florentine flask
- A bottom-less glass bottle (replacement part for the florentine flask)
- 3 Glass pipettes of 10 mL with a three ways rubber pipette filler
- 10 Pasteur pipettes with a Pasteur pipette bulb
- 1 glass funnel and a glass tube with a coiled stainless-steel wire (light oil distillation)
- 4 replacement tubes and one spare funnel
- A glass flask with a stainless-steel wire (for heavy oil distillation)
- A stainless wire with a piece of microfiber fabric to clean the condenser and the nozzle
- 2 Additional thumb nuts with screws and hex nuts (replacement parts)
- 2 Stainless-steel screws with conical head
- A replacement O-ring for the florentine flask
- A thermometer
- A replacement rubber for the Florentine flask (to avoid free rotation)

Once unpacked, you will have to screw the drain valve (1/2" ball valve) to the outlet at the bottom of the tank with some Teflon tape. Try to get the valve handle on the top of the valve when it is screwed.

You will also have to turn the lid upside-down to get the tri-clamp fitting upward, then connect the insulated column to the lid, the condenser to the column (inlet valve at the bottom) and the nozzle to the condenser (please refer to the overview). When the column, condenser and nozzle are clamped, connect a 1/2" ID water hose (not included) with the length and fitting you need to the barbed fittings at the inlet (bottom) and the outlet (top) of the condenser and fasten them with the hose clamps (see picture 1 & 2). The water used for the condensation should always run from the bottom to the top of the condenser.

For light essential oils distillation, insert the tube with the coiled wire into the florentine flask and insert the glass funnel into the florentine flask so that the funnel stem enters about 1-2 cm into the tube (this is called a “casse-essence” in French and it is designed to redirect the light essential oils at the surface of the hydrolat during the distillation – see picture 3). For heavy oil, replace the tube with the coiled wire by the glass flask with the coiled wire (see picture 4). Heavy oil will sink and stay at the bottom of this flask during the distillation.

If you plan to collect some hydrolat, you can install the stainless adapter and the semi-clear PTFE hose on the florentine flask, this allows to collect the hydrolat more easily. You can finally install the Florentine flask on the cohobation tube as shown on the overview.

How to use your still



Before starting any distillation or extraction, find a stable, levelled, and open or very well-ventilated place. Stay protected from the wind if you work outside. Stay far from flammable or hazardous products/material if you use a gas burner and far from ignition source for extraction with flammable solvents.

Steam distillation using a propane burner

Steam distillation may not be the oldest technique that has been used to distill aromatic plants, but it is the main technique used nowadays as it generally gives better essential oil (EO) yields and quality than water distillation. In steam distillation, the plant material is not immersed in water. It is loaded as such in the still and stands on a grid above the bottom of the still. No water is added when the steam comes from an external boiler. When the steam is generated inside the still, the grid is higher, and some water is brought to boil at the bottom of the still. This latter technique is sometimes called “water and steam” distillation. In any cases, the steam that rises through the plant volatilizes and drives its volatile compounds out of the tank to the condenser and separator (if using one).

We recommend using this technique (steam or “water and steam” distillation) as it generally gives good results (EO yield and quality), it is faster and requires less energy than water distillation. However, resins, wood/bark sawdust, some crushed seeds or roots and some very fragile flowers cannot easily be distilled by steam distillation because steam cannot go through the plant material homogeneously (they melt or swell and get compact then steam escapes by some channels and the plant material is poorly distilled). In these cases, consider the water distillation (described below).

It should also be noted that some hydrolats distillers sometimes prefer water distillation to steam distillation for some plants even if steam distillation is possible. If you distill for yourself, the best technique is the one that gives the EO and hydrolats you prefer.



- Before starting a steam distillation, make sure that the drain valve is closed, put 8 litres of clean water into the still. The level of the water must be at least 2-3 cm higher than the drain valve at the bottom of the tank, but it must also be at least 5 cm under the grid. If you want to start with more water (up to 12 L), you can use the 20 cm screws instead of the 15 cm ones for the grid (then the total volume available for the plant material is also 35 L instead 40). Important note: if during the distillation you see some **steam escaping from the cohobation tube, it means that the water level is too low**, and you must quickly add some water in the still until the steam escape stops.
- When the right amount of water is in the still, place the stainless-steel grid with the screws down so that the grid stands well above the water level (at least 5 cm).
- Pack the plant as homogeneously as possible into the still (very important point) and compact it by hand (again, as homogeneously as possible).

The compaction is one of the most important parameters the distiller must play with. The most important point is to get a homogeneous compaction so that the steam rises homogeneously through the plant. If the compaction is not homogeneous, the steam will escape using the easiest way and some of the plant material may be poorly distilled resulting in a low yield or a longer distillation. The optimal compaction depends on the plant material, but a good strength can generally be applied on plants with a good "structure" (conifer needles for instance) if they are not turned into a fine powder. On the other side, plants with much less structure (soft leaves or flowers) or finely crushed plant material should not be compacted with too much strength as they already tend to pack during the distillation and may clog more easily.

- If not installed, put the EPDM O-ring on the flange between the tank edge and the lid screws (picture 5). If the O-ring is hard to place, put it a few seconds in hot water and stretch it a bit. Be sure you have nothing (no plant fragment) below or above the O-ring, put the lid on the top of the still (screws in the lid holes) and screw each thumb nuts manually (do not overtighten them, this is not necessary nor recommended).
- Install the Florentine flask on the cohobation tube as shown in the overview picture and put the glass tube (for light oils) or flask (for heavy oils) with the glass funnel into the Florentine flask as shown on picture 3 and 4. Make sure that the hydrolat valve is closed and fill the Florentine flask with fresh and clean water until water level stabilizes. Adjust and tighten the three tri-clamp fittings (column, condenser and nozzle) so that the nozzle (the distillate outlet) arrives just above the funnel in the Florentine flask.
- Connect the inlet hose to the water, open a bit the water regulation valve and start the propane burner (be careful to not burn the water hose with the burner). If the propane burner is well sized and set, the distillation should start within 20-30 minutes. When it starts, be sure your condensing water flow is correct during the firsts 30 minutes and that all the distillate drops into the funnel.





- If you don't want to collect the hydrolat, let the hydrolat valve closed. The hydrolat will return into the still, maintaining the water level in the still for the whole distillation. Again: if during the distillation you see some steam escaping from the cohobation tube, it means that the water level is too low (the plant may absorb some water), and that you must add some more water in the still until the steam escape stops.

This hydrolat recirculation is called "cohobation" and is useful for long distillations or for the distillation of essential oil with difficult separation. It may also maximise your EO yield if the plant contains a lot of water-soluble volatile compounds.

- If you want to collect the hydrolat, make sure to add 1 L of water into the still (using the safety / filling / cohobation tube) for each 1 L of hydrolat you take. To collect the hydrolat, you can use the stainless-steel adapter with the semi-clear PTFE tube.

- Regarding distillation speed/flow, this unit should work between 1.5 and 4 L/hour. You can calculate it by measuring the mass or volume of water you get from the hydrolat valve in one minute and multiply the result by 60 (just let the hydrolat fall for 2 seconds when you open the hydrolat valve before you collect it to get accurate results).

As for the compaction, the optimal steam flow depends on the plant you distill, if it is crushed or not, the amount and nature of volatile compounds it contains, where they are in the plant, (etc.) and whether you primarily distill for essential oil or hydrolat. The ideal flow may also be different at the beginning and at the end of the distillation...The best is to do your own tests, compare 2 or 3 different steam flows for a plant (the other parameters remaining unchanged) and see what gives the best results. It should however be noted that using twice a given steam flow requires more than twice the amount of energy per unit of time, but usually does not give the same amount of oil two times faster. In some conditions, a too high flow (with no cohobation) may also reduce the EO yield as continuous separation could more difficult. On the other hand, with a too low steam flow, you will have to distill longer to get the same amount of oil and the plant will stay longer at 100°C which may result in more chemical degradation. So, the optimal steam flow is a compromise depending on the plant, your still and your purpose.

- The temperature of the distillate can be adjusted by changing the flow of the cold water running through the condenser using the needle valve at the bottom of the condenser (where the water inlet should be connected). A low flow gives a relatively high temperature for the distillate and a high flow gives a relatively low temperature for the distillate. In any case, always use enough water in the condenser to condense all the steam (no steam should escape from the nozzle during a distillation) and don't use a too high flow to not waste water. It may be hard to finely adjust the temperature if the water pressure is not stable. If it is the case, open the water regulation valve a bit more than

necessary to avoid the distillate temperature to rise too much when the pressure (thus flow) of the condenser water decrease.

For some EO that hardly separate from the hydrolat because of their density close to 1 (myrrh and vetiver for instance), the temperature of the distillate is a very important parameter. When temperature rises, the density of water and EO decrease but the EO density generally changes faster than those of the water and the difference in density usually increase. Also, the water viscosity decreases and the coalescence of EO droplets is facilitated. Thus, it is generally recommended to distill the EO that hardly separate at higher temperature, like 50-55 degree (as a reminder, here we talk about the distillate temperature, not the temperature inside the tank). On the other hand, when temperature rises, both evaporation and solubility of organic compounds in water rise too so as always, this is a question of compromise and the better way to know the ideal distillate temperature for a given EO distillation is to test and compare different distillate temperature (the other parameters remaining unchanged).



- If you want to distill at much higher temperature than your condensing water, a simple option is to reduce the exchange area in the condenser, thus its overall efficiency. You can do this by blocking one or two tubes (two maximum) of the condensers with one or two conical head screws (just insert them at the top of the tubes as in picture 6). This reduces the efficiency of the condenser by 20 % (one screw) or 40 % (2 screws). Do not block more than 2 tubes in the condenser, the steam should always be able to escape easily from the apparatus. Another option (which also has the advantage to save water) is to recirculate the condensing water from and into a 100 to 200 L drum of water. This can be done with two or even just one drum if it is big enough and if the distillation is not too long (more or less five hours maximum).
- When the distillation is finished (the distillation time greatly depends on the plant you distill and what you're looking for), you can collect the oil with the drain valve at the bottom of the Florentine flask (drain most of the water first then get the EO) or with the 10 mL pipette and the pipette filler (contact us if you don't know how to use it). Even if it is a bit more difficult, we recommend using the pipette if you have a very low amount of EO (when draining the oil with the valve, you let quite a lot of oil on the inner surface of the Florentine flask; this is not the case with the pipette). Whether you use the drain valve or the 10 mL pipette, you always get some water with the EO when you take it from the Florentine flask, but you will be able to take the water off with a 10 mL pipette or a Pasteur pipette. Finally, for most of the essential oils, it is advised to filter it on a paper filter to remove the tiny droplets of water left.

Steam distillation using an internal electric element

We can install a stainless-steel heating element (4 500 W) in the still before shipping (see pictures 7 to 9) and provide a regulator. If your *Explorer* is equipped with this option, most of what is written in the previous section is valid except that you must be very careful with the water level to not burn the heating element. You cannot wait to see escaping some steam by the cohobation tube to add some water in the tank. **The electric element would be out of the water before this happens and it would burn.** However, this option comes with the addition of a sight glass at the bottom of the still so that you can see the water level when it is low. **Always Keep the water level above the middle of the sight glass. Never below!**



Steam distillation using an external steam generator

By using an external steam generator, you perform a true steam distillation in contrast to the previous case where the steam was generated at the bottom of the still and which is sometimes called "water and steam distillation". The difference lies in the fact that with a steam generator, the steam is dryer or even completely dry depending on your steam generator and may have a temperature above 100 °C (super heated steam).

- If you want to use an external boiler, please contact us so that we can add a steam inlet at the bottom of the still before shipping.
- The way to distill plants using an external steam generator is similar to the previous description with a few variations:
 - You will have to block the cohobation tube (we will provide something for that)
 - You won't be able to distill with cohobation
 - Don't put any water into the still before starting the distillation (just fill the florentine flask as previously)
 - Be careful to not block the nozzle (distillate outlet) and/or send too much steam into the still (6 L/hour maximum).
 - Be aware that this unit is not designed to work under pressure. Thus, if you want to use the steam coming from a pressurized vessel, please install a safety valve (+ 5 psi) between the still and the pressurized steam generator.



Water distillation with a propane burner

Water distillation consists in placing the plant material into the water and boil the mixture. This technique is not recommended for all plants (see why in the previous sections), but it is the only one that can be used for resins, wood/bark sawdust, some crushed seeds or roots and some very fragile flowers.

- In water distillation, you don't need to use the grid in the still as in steam distillation but in some circumstances, it can be good to put it up-side-down or after removing the screws before adding the plants and water to avoid the contact between the plant material and the bottom of the still.
- Put the water and the plant (the ratio water/plant depends on the plant, but the plant should always be able to move freely during distillation) in the still and boil the mixture with the same setup as described previously.
- Don't put more than 40 kg of plant + water into the still, otherwise the water may overflow by the cohobation tube.
- In water distillation, the warm-up phase is longer than in steam distillation but when it starts, it can usually be run similarly to a "water and steam" distillation and as in the latter distillation technique, you can distill with cohobation or not.
- If your plant + water mixture tends to foam, distill slower.
- If you take the hydrolat, add 1 L of fresh water each time you take 1 L of hydrolat.

In water distillation, the plant/water ratio corresponds to the ratio between the mass of the distilled plant and the volume of water used in the still. Example: if you distil 1 kg of rose petals in 5 liters of water, you work with a plant/water ratio of 1 to 5 (= 1/5). This ratio mostly depends on the plant material. It can be relatively high (1/4 - 1/5) if the plant material does not absorb water, or on the contrary relatively low (1/12 - 1/15) if the plant material absorbs a lot of water. With a ratio that is too high for a given plant material, the risk of burning the plant becomes greater and with a ratio that is too low, the yield of essential oil is minimized. Again, although it is possible to find this information in the literature, you may have to determine the ideal ratio experimentally.

Extraction

Beside distillation, the *Explorer* can be used for extraction with water or various solvent. For this application, contact us so that we can guide you to perform safe and efficient extraction of plant material.



Important notes

It is very important to not heat the still with a propane burner or electric hot plate with no water inside. Heating an empty still may result in a permanent deformation of the still bottom. Thus, we highly recommend measuring and note the volume of water you put in the still before the distillation and remember that some of this water will be absorbed by the plant material during the distillation.



When you use a propane burner, **as soon as you hear some noise from the cohobation tube and or see some steam escaping from it, it means that the water level is critically low and that water must be added immediately.** In this case you can add 5 L by this tube. This tube is a safety outlet, a water level indicator, and an inlet to add water in the still when performing a steam distillation.



If you use the *Explorer* with an electric element, **always keep the water level above the middle of the sight glass. Never below!**

Cleaning your still

We recommend you to empty and clean your still after each use. Do not let the water and plant material in the still for days or more after the distillation.

The tank can be cleaned with liquid dish soap and a non-abrasive tissue. In some cases, some isopropanol may also be helpful to remove some sticky residues. Non-stainless-steel wool should be avoided but you can occasionally use other kinds of dish scrubber if you have to. In any cases, rinse well the tank after cleaning and let it dry.

The insulated column can be cleaned with liquid dish soap and a non-abrasive tissue.

For the condenser, you have a stainless-steel wire with a piece of microfiber tissue that comes with the package. You can put some water and dish soap in the 5 tubes of the condenser then put the straight stainless-steel section in a tube and pull the piece of microfiber tissue through it. Repeat in the other tubes and as long as needed. This can also be done with isopropanol. In any cases, rinse well after cleaning and let it dry.

Enjoy distilling and please let us know if there is anything you don't understand about how using your still. We are here to help you.

 Pictures



1

Hose fastening on the inlet barbed fitting



2

Hose fastening on the outlet barbed fitting



3

Florentine flask for light oils
With glass funnel and glass tube



4

Florentine flask for heavy oils
With glass funnel and glass flask



O-ring installation



Condenser restriction with conical-head screws
(no more than 2 tubes!)



Electric heating element installed in the *Explorer*
with the regulator and the sight glass at
the bottom of the tank

