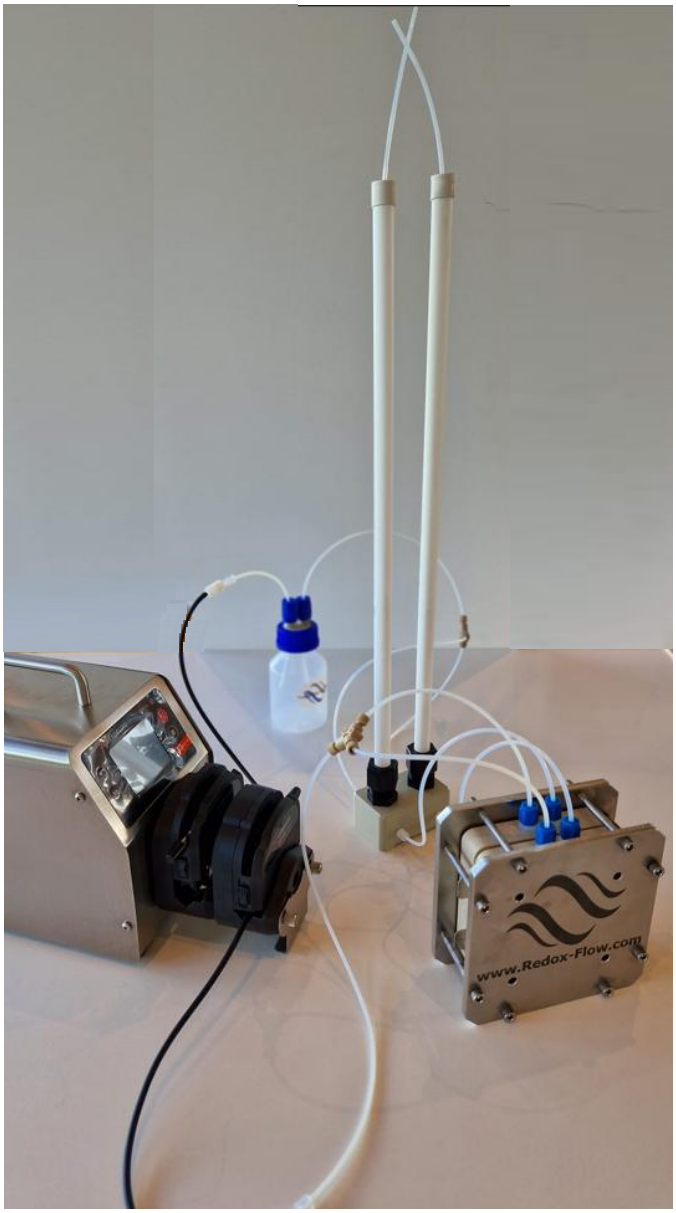
Gas seperation unit

Overview & assembly manual

Redox Flow
www.redox-flow.com



Notes

This electrolyser gas separation unit is intended for research purposes only and can be used for many different purporses.

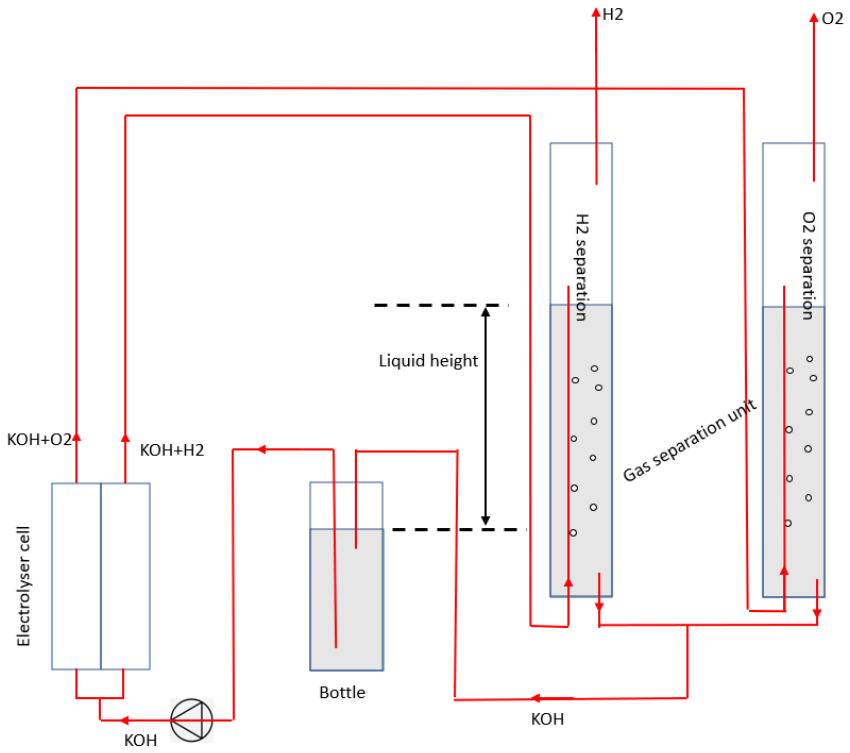
There is no warranty on performance, corrosion or lifetime on the items. It is purely for research purposes.

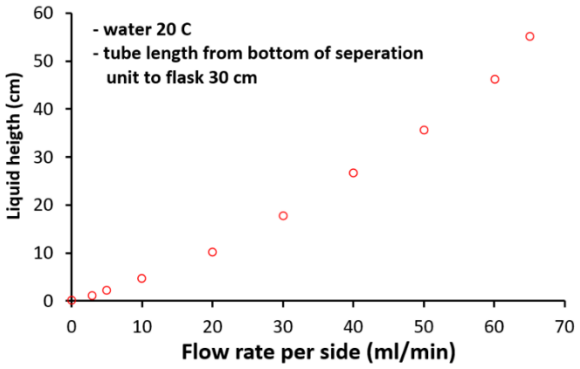
IMPORTANT NOTE ABOUT GOOD SAFETY PRACTICE WHEN OPERATING ELECTROLYSERS THAT GENERATE H2 AND O2: No matter if two separation units or bottles are used for separating out H2 and O2 on each side, there will always be a transfer of gases from one side to the other (either through solubility in water if the water from both sides is mixed at some point or by cross-over through the membrane/separator). This has the consequence that the head space in bottles with time can become a mix of both H2 and O2 that can reach explosive limits. For this reason it is strongly recommend to:

- Keep the head-space in bottles as low as possible - if an explosion occurs the gas volume is as small as possible
- Ensure proper ventilation and suction from gas separation units/bottles
- Keep setup in enclosures to prevent personal injuries if either a tube burst or an explosion happens - HOWEVER IT IS STRICTLY NEEDED TO HAVE VENTILATION IN THE ENCLOSURE TO AVOID BUILD-UP OF EXPLOSIVE GAS CONCENTRATIONS
- ALWAYS make an independent safety assessment of the experimental setup - Recommendations includes
    - Always to follow your own guide lines for safety
    - Always to follow ATEX rules/guidelines
    - Assessment of the amount of gas produced
    - Risks for reaching explosive gas limits
    - Always assume that all fittings/bottles etc are not gas tight
    - Measures to prevent/remove personal injuries if worst case scenario happens

Version 3.0 – Dec 22, 2024

Flow rates & operation principle





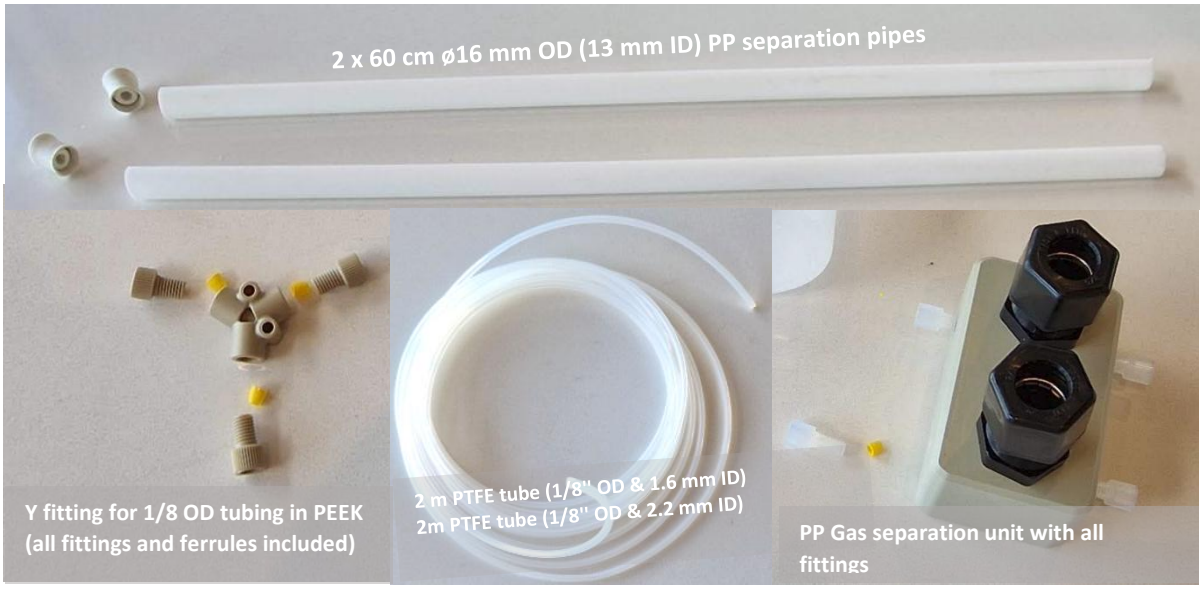
Picture shows a schematic drawing of the working principle of the gas separation unit. The liquid from each of the H2 and O2 separation compartments are gravimetrically transferred to the bottle. In this case the liquid height in the separation unit is determined by the flow rate and hydraulic resistance of tube from separation unit to the bottle (i.e length of tube).
Top graph shows the liquid height in the separation unit as function of the flow rate on each side of the cell.
NOTE: Liquid height is determined by viscosity and thereby temperature and concentration of KOH for this reason above graph is indicative only.

After the cell, the liquid with H2/O2 gases enters into the gas separation unit at the top and exits at the bottom, where after the liquid from the two separators enters into a common electrolyte bottle (typical for alkaline electrolysis with porous separators). The flow rate from the gas separation unit into the bottle is determined by (1) the liquid height difference between the bottle and the height in the gas separation unit (2) length and hydraulic resistance of the tubes between the gas separation unit and the bottle (3) Viscosity/temperature of the liquid and (4) the 'suction of the pump', head space of the bottle and how leak tight all fittings are. As an example lower left graph shows the liquid height inside the separation unit vs the flow rate for 1.6 mm ID tubes and 20 cm length (between separation unit and bottle) as function of flow rate. In general a relatively high liquid height is wanted as it ensures efficient gas separation, on the other hand too high levels will lead to an over-flow in the unit.

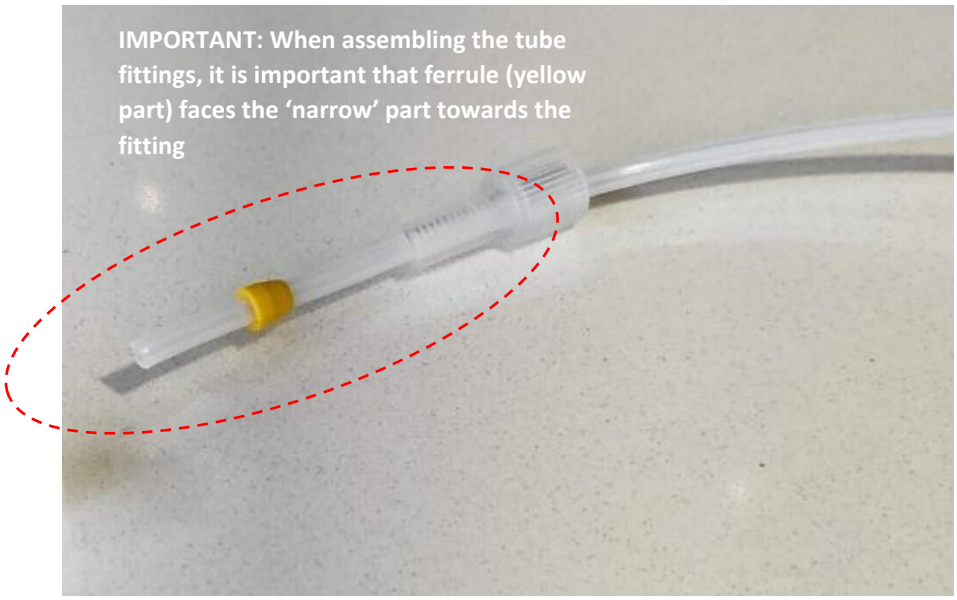
To ensure that the unit can work in many different configurations (flow rate, temperature etc) it comes with tubes (intended as connection between gas separation unit and bottle) that has both 1.6 mm ID and 2.2 mm ID. Going from 1.6 mm ID to 2.2 mm has a non-linear (exponential) increase of the hydraulic conductivity, while the length of the tube has a linear dependence. I.e. use of this unit requires some experimental work to calibrate the flow rate.

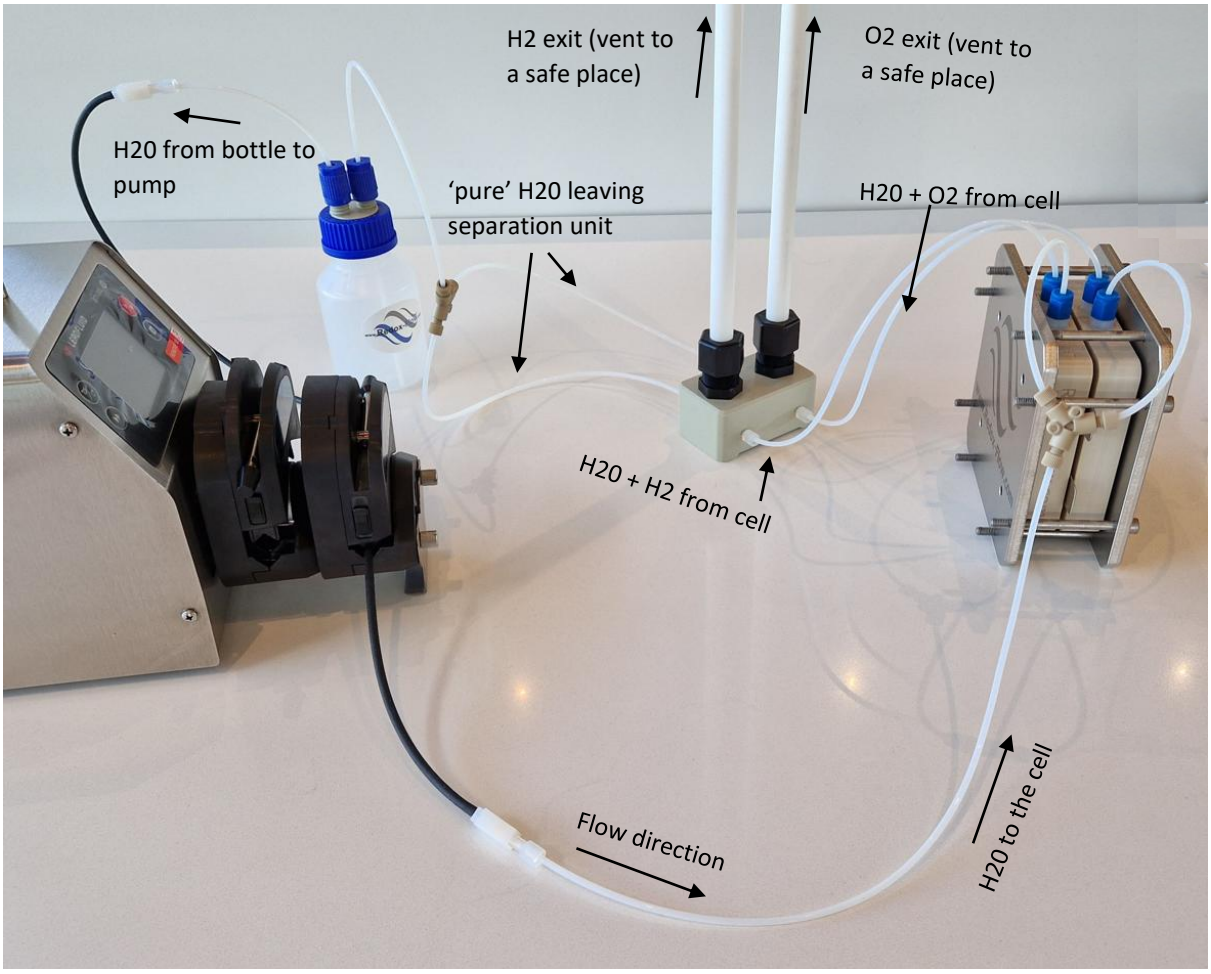
Overview of included components

- 1 x Gas seperation unit in PP (with all fittings and ferrules)
- 2 x 60 cm PP pipes for gas separation (OD ø16 mm ID ø13 mm) - for longer heights please make an inquiry
- 1 x Y fitting for 1/8 OD tubing in PEEK (including fittings/ferrules etc) - enables full integration with 'Hydraulic Connection Package for Flow Cells (Fittings, Lids, Tubings, Bottles) 1/8'' '
- 2 m PTFE tube (1/8'' OD & 1.6 mm ID)
- 2m PTFE tube (1/8'' OD & 2.2 mm ID)

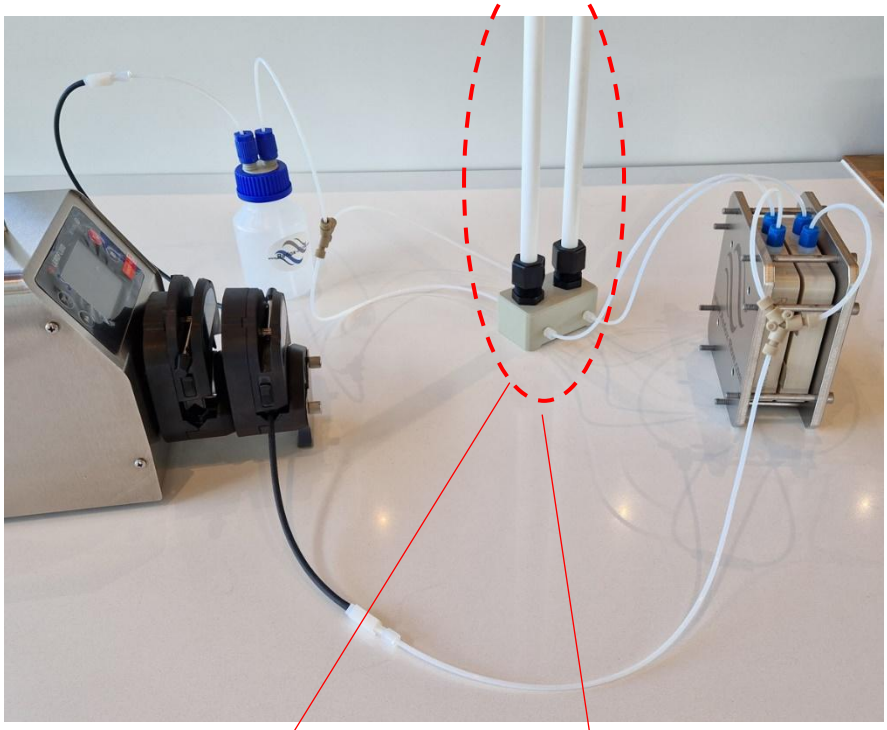


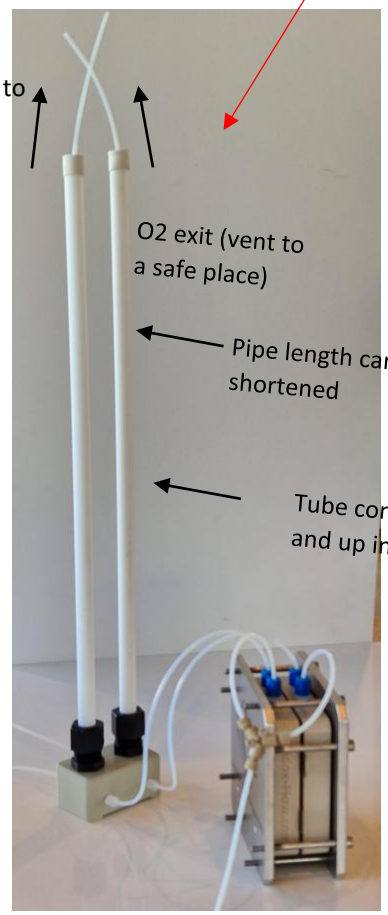
Assembly


IMPORTANT: When assembling the tube fittings, it is important that ferrule (yellow part) faces the 'narrow' part towards the fitting


H2 exit (vent to a safe place)
O2 exit (vent to a safe place)
H20 from bottle to pump
'pure' H20 leaving separation unit
H20 + O2 from cell
H20 + H2 from cell
Flow direction
H20 to the cell

Details on separation unit





Mounting of tube inside pipe