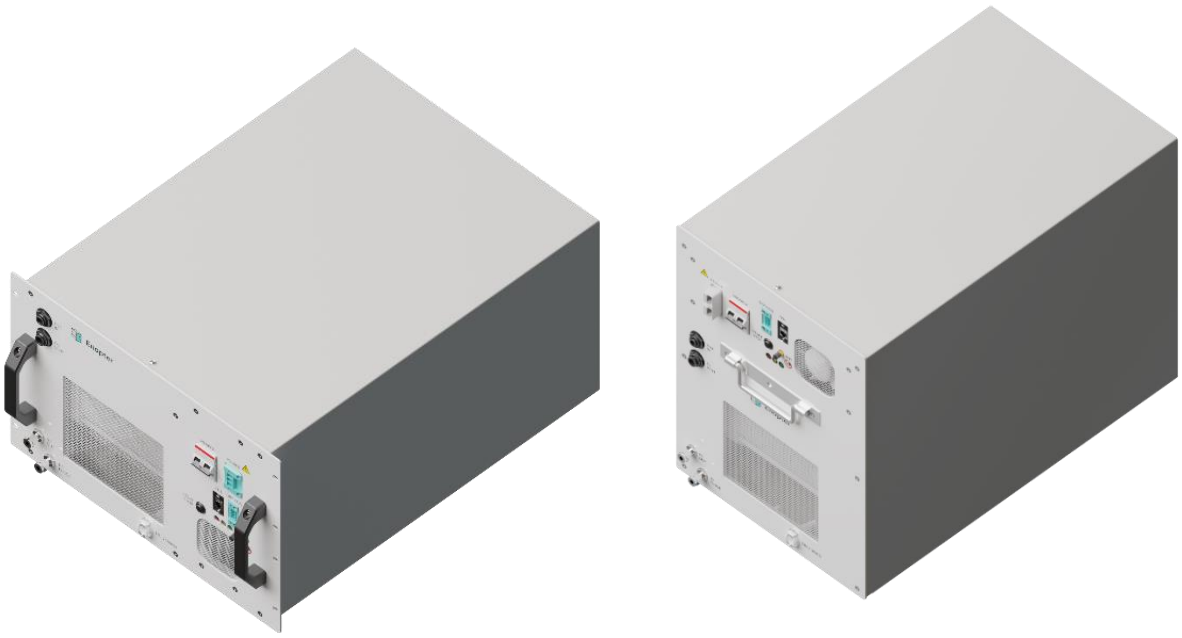

Owner’s Manual
Electrolyser

Enapter

Rev. 03 – April 2022

CHANGE HISTORY

A black triangle on the left side of the page indicates changes since the last revision. The number inside the triangle indicates the revision which includes the changes the first time.

1

Rev.	Status	Date	Revision memo	Created/changed by
00	IFP	21/09/2021	First approved version	Philipp Endres
01	IFP	19/10/2021	Updated Purge, Vent line and LC circuit, DryCon	Philipp Endres
02	IFP	10/11/2021	Corrected Dry Con Chapter	Philipp Endres
03	IFP	07/04/2022	Added - device specifications (1.1), - how to update device (8.1), - recommended device operation (5.1), and visual update all over the document Updated the recommended coolant operation range diagram and the overall formatting of the document	Philipp Endres

PREFACE

Thank you for choosing Enapter. Please study this manual carefully before unpacking, installing, and operating the device.

If you have any further questions, please contact the Enapter customer support team. Quote the device serial number and hardware number on the back of the device to help identifying your product quickly.

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SCOPE OF THE DOCUMENT

This manual provides information needed to carry out the installation and usage of your Enapter device safely and as intended.
Keep this document in a safe place and readily available. Always follow its instructions. It is the operator's responsibility to ensure that an installed device is always in proper conditions. Please observe any additional local requirements applicable to the installation and operation of hydrogen devices.

APPROVED USE

This device must only be operated for its intended purpose, according to the specifications and instructions provided in this document.
Observance of this document is part of "normal use".

Improper use of the device can result in serious injuries and damage to the environment.

- Always use the device according to the specifications described in this document. Ensure that the manual is always accessible.
- Make sure you have read and understood this document in its entirety.
- Comply with all safety instructions and warnings.
- Store the manual and other documentation in a safe and accessible place and pass them on to future owners and operators of the device.
- Comply with all local regulations.
- Enapter is not guaranteeing efficiency, safety, and functionality in case of modifications not described in this document.

- Enapter is not responsible for any damage caused by the device or to the device based on wrong operation or setup.

TERMS

The following terms are used in this document:

- **Device**: Device means the unit, including its hardware and software as well as contained materials and substances. It also includes directly attached tubes, pipes, and other equipment from Enapter if not stated differently.
- **System**: System means the combination of devices, tubes, pipes and equipment from Enapter and other manufacturers which are connected physically, logically or in any other way to produce, store, use, transfer or convert hydrogen and related substances.
- **Operator**: The operator is the responsible person in charge who operates, installs, connects, maintains, and/or owns the device, its subcomponents, and additional components. To simplify reading, this document only refers to the operator to distinguish from Enapter but may also include the user, customer, client, owner, installer, instructor, system integrator or persons who are responsible for a safe operation of the device.

TABLE OF CONTENTS

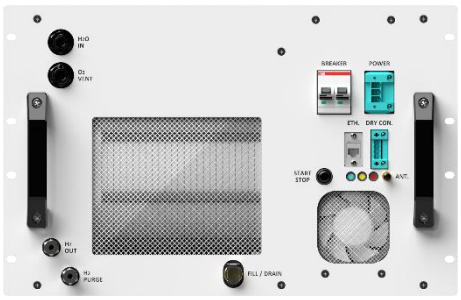
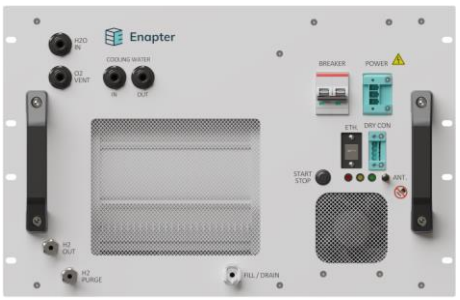
1. OVERVIEW OF THE ELECTROLYSER

Enapter's patented anion exchange membrane (AEM) electrolyser is a standardised, stackable, and flexible device to produce hydrogen. The modular, easily maintainable design – paired with advanced software integration – allows set up in minutes and remote control and management.

1.1 SPECIFICATIONS

3

The specifications of the electrolyser can be found in the datasheet. It can be downloaded here: Datasheet of the electrolyser. See the battery limits for more detailed information about the interfaces and connections of the device: Battery limits of the electrolyser.

Versions	Air Cooled:	Liquid Cooled:
Standard Body:		
Narrow Body:		n.a.

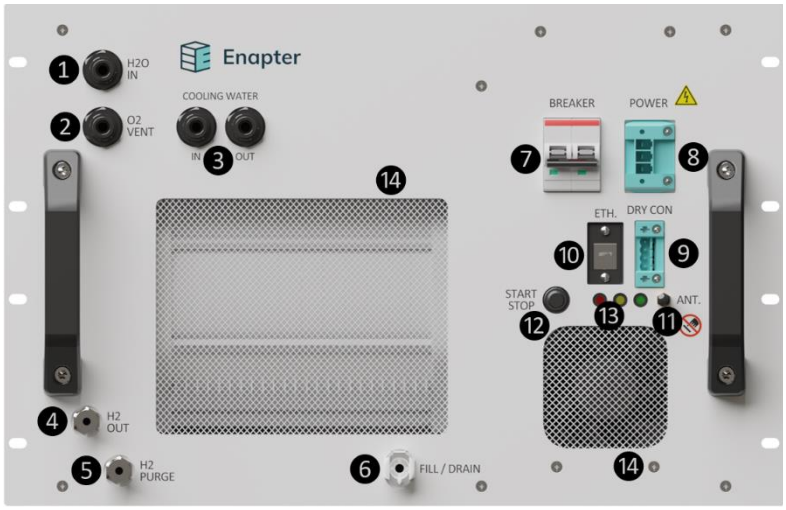
	EL2.1
Nominal Hydrogen Production	0.5 Nm^3/h 1.0785 kg/24 h
Output Pressure	Up to 35 barg
Hydrogen Output Purity	35bar: ~99.90 % (H_2O ≈ 1000 ppm) 8bar: H_2O > 1500 ppm
Water Consumption	400 ml/h
Water Input Conductivity	< 20 µS/cm (at 25 °C)

Water Input Pressure Range	1 – 4 barg
Process Liquid	1 % KOH solution
Operative Power Consumption	2.4 kW (max. 3.1 kW)
Nominal Power Consumption per Nm^3 of H_2 produced	4.8 kWh/Nm^3 (beginning of life)
Stand-by Power Consumption	15 W
Power Supply	200 V – 240 V (AC), 50/60 Hz [5] 48 V – 60 V (DC) [6]
Circuit Breaker	C13
Dimensions (W x H x D)	482 mm x 307 mm x 634mm [1] 358 mm x 465 mm x 627mm [2]
Space inside cabinet	7 U
Weight	55 kg (empty)
Control System Included	EMS
Communications	Wi-Fi - 802.11a/b/g/n (2.4 GHz only) - 802.12 WEP, WPA, WPA2 Personal (Pre-shared key) - Wi-Fi client isolation must be disabled Bluetooth Modbus TCP via Ethernet
Remote Control	Enapter Cloud Service, Enapter App, Modbus TCP, Safety chain (dry contact)
Safety	
Maximum H_2 contained within	20 NL
Conformity	CE mark according to the machine directive 2006/42/CE [15] S.E.P. Classified as per 2014/68/EU PED [15] ISO 12100 [15] IEC 61000-6-3 [15] IEC 61000-6-2 [15] ISO 13849 [15] IEC 61010-1 [15] ASME B31:12 [15]
Noise level at 1 m	≈ 65 dB
Ventilation and Safety Recommendation	Indoor: Ventilation depends on room size, Hydrogen detection system with a safety circuit is recommended Outdoor: Protect from outside environmental influences, if integrated into a cabinet. Ensure the safety concept of each integrated module is respected.
Environmental	
Operating Conditions	5 °C to 45 °C, up to 95 % humidity, non-condensing [3] 5 °C to 50 °C, up to 95 % humidity, non-condensing [4]
IP Rating	IP 20
Interfaces	
H_2 Outlet	¼" Swagelok Tube Fitting
Vent Outlet	10 mm push fit
Purge Outlet	¼" Swagelok Tube Fitting

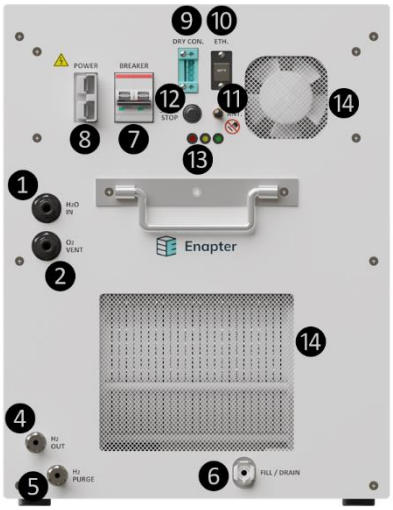
Water Inlet	8 mm push fit
Fill and Drain Port	CPC quick connector 10 mm
Cooling Water Inlet [4]	10 mm Push-fit female bulkhead connector
Cooling Water Outlet [4]	10 mm Push-fit female bulkhead connector

[1] Standard body only (Narrow body versions excluded)
[2] Narrow body only (Standard body versions excluded)
[3] Air Cooled electrolysers only (Liquid cooled versions excluded)
[4] Liquid Cooled electrolysers only (Air cooled versions excluded)
[5] AC power supplied only (DC version excluded)
[6] DC power supplied only (AC version excluded)

1.2 FRONT PANEL



EL2.1 LC front side



EL2.1 NB DC front side

The front panel of the electrolyser includes all physical connections of the device.

1. H_2O In – please refer to the section Water Inlet Connection Guide
   - Push-fit female bulkhead connector (8 mm outer diameter pipes)
   - Input: Filtered water input with a conductivity < 20 µS/cm at 25°C, input pressure between 1 and 4 bar
2. O_2 Vent – please refer to the Vent Connection Guide
   - Push-fit female bulkhead connector (10 mm outer diameter pipes)
   - Output: O_2 with water vapour and traces of H_2
3. Cooling Water IN/OUT – please refer to the Cooling Loop Connection Guide
   - Only available in the liquid cooled electrolysers (LC versions)
   - Push-fit female bulkhead connector (10mm outer diameter pipes)
   - Input/Output: cooling water to cool down the device
4. H_2 Out – please refer to the Hydrogen Outlet Connection Guide
   - ¼" double ferrule Swagelok tube fitting bulkhead (SS-400-61)
   - Output: 500 NL/hr of H_2, up to 35 barg
5. H_2 Purge – please refer to the Purge Connection Guide
   - ¼" double ferrule Swagelok tube fitting bulkhead (SS-400-61)
   - Output: Periodical purge of up to 20 NL, H_2 and water
6. Fill / Drain Port
   - CPC quick connector 10 mm
   - Only used during routine maintenance for filling the electrolyte into the device or for draining and preparing it for transport.
7. Breaker – please refer to the Electrical Connection Guide

- Integrated magnetothermal circuit breaker to protect the electrolyser from overcurrent and short-circuits.

8. Power – please refer to the Electrical Connection Guide
9. Dry Contacts – please refer to the Dry Contact Connection Guide
10. Ethernet – Connection to access external Modbus control features of the electrolyser. Find more in the chapter below.
11. ANT. – Antenna port SMA male
    - The device can be connected to the local network via Bluetooth and Wi-Fi, enabling real-time updates and monitoring for the operator via the Enapter App and cloud. A miniature antenna can be attached to this port to increase the amplification.
    - Do not touch the port when the device is powered on!
12. Start/Stop – please refer to the Manual Start/Stop section below
    - Manual start and stop button to start and stop the device
13. LEDs – please refer to the Appendix IV
    - Status LEDs to show device status
14. Air Inlets – please refer to the Routine Maintenance

1.3 BACK PANEL

EL2.1 back side

EL2.1 NB DC back side

The back panel of the device is used to blow out warm air. Please leave at least 30 cm space behind the module to allow for adequate airflow. Never obstruct the ventilation openings!

2. SAFETY INSTRUCTIONS

2.1 WARNINGS AND HAZARDS

The following terms and symbols are used in this manual to indicate important text passages which must be given particular attention:


Warns of fatal/serious injury


Warns of injury


Warns of physical damage to the product


Do not open or dismantle


Keep away from sources of heat and ignition.
No naked flames


No smoking


Minimum two persons required to handle the item


Wear Personal Protective Equipment


Wear hearing protection

2.2 GENERAL SAFETY

The operator must be aware of the following:

1. **The device is not intended to be used in a potentially explosive area**
2. **Enapter is not responsible for improper use:**
   - Caused by wrong inputs
   - Caused by wrong input pressures
   - Caused by improper mounting or tubing (e.g. leaking gas connections)
   - Caused by connecting the wrong power supply (e.g. wrong voltage)
   - Caused by improper installation
3. Regarding design and installation, the operator must follow Enapter's installation rules, and ensure full compliance with local safety guidelines and regulations.

4. It is the operator's responsibility to **regularly check and maintain all outlet lines**, as well as to **keep the pipes free of ice or other obstructions**.
5. It is the operator's responsibility to **regularly check and clean the air intakes and outlets** of the device, as well as to keep the air inlets/outlets free of obstructions.

The following rules should always be observed:

1. **Keep the work area clean**. Clutter can create hazards around the device. Keep the work area well illuminated.
2. **Do not use the device in explosive atmospheres**. Do not use the device near flammable substances.
3. **Handle the power supply cable with care**. Do not pull the electric cable to disconnect it from the plug without removing power from it first. Keep the electric cable away from heat, oil, water, and sharp edges.
4. **Protect yourself from electric shocks.** Avoid any contact with earthing surfaces.
5. **Never expose the device to rain or very damp conditions**.
6. **Keep children and people without explicit knowledge of the device and its function away** at a safe distance.
7. **Never operate the device in confined spaces** without additional safety infrastructures, such as active ventilation or hydrogen detection systems.
8. **Always protect yourself:**
   - **Wear protective goggles and nitrile gloves** when handling the electrolyte solution.
   - **Wear ear muffs or plugs** in noisy areas.
   - **Wear gloves** when handling the device.
   - **Wear appropriate footwear** when handling the device.
   - **Use lifting aids** if available when lifting the device. Never lift the device alone. Know your local and site-specific health and safety rules and act accordingly.
9. **Always disconnect the device from electricity before cleaning, disassembly, and transport.**
10. **Only use the device in the way and for the purposes mentioned in this manual.** If the device is employed for uses other than what is specified in this manual, unforeseen hazards may occur.
11. **Use the handles when lifting and moving the device.**
12. **Never attempt to repair the device** by yourself. The device must be repaired only by qualified specialists who use original spare parts.
13. Any maintenance activity, excluding the ones listed in the routine maintenance and installation sections, are only allowed to be performed by authorized **trained technicians**!
14. Any person working on the device must be familiar with the hazards and risks associated with installing, commissioning, and running the device and attached devices.
15. **Do not store the device at temperatures below 1°C.**

2.3 ADDITIONAL SAFETY FOR THE ELECTROLYSER

The following rules should always be observed. It is the operator's responsibility to ensure that every person, working with the device is following these rules:

1. Do not attach filled tanks or other equipment with **pressures higher than the device's maximum outlet pressure** to the H_2 outlet of the device.
2. Do not provide water which does not meet the **minimum purity requirements**.
3. Do not provide water with a pressure higher than the **maximum allowed pressure**.
4. Make sure that the H_2 purge line and the O_2 vent line are **never obstructed**.

3. LIST OF HAZARDS

The operator who operates, services, maintains, or installs this device must be aware of the potential dangers associated with its use and set up, the required materials, as well as the inputs and outputs, to implement sufficient countermeasures and processes to prevent accidents and act correctly in case of emergencies.

Always ensure that the device is installed and operated in compliance with local code, regulations, and standards. Do not install, operate, or maintain the device without explicit knowledge or help from experienced and licensed system integrators, the manufacturer, or external certifying bodies.

3.1 HYDROGEN HAZARD

It is the operator's responsibility to implement a safety system to manage the devices inputs and outputs – more information about this is below.

Hydrogen can explode!
Hydrogen can leak, ignite, and burn!
Do not inhale hydrogen!
Hydrogen can cause asphyxiation!
Do not handle hydrogen without a suitable ventilation and safety system!
Incorporate the device, especially the hydrogen and the purge lines, into the operational safety concept!
Avoid heat in the vicinity of the device.
Do not smoke and do have naked flames in the vicinity of the device.
Do not have hydrogen, not even in low concentrations in the vicinity of the device.
Comply with local safety regulations.
Comply with regulations for the handling of compressed hydrogen cylinders.
In the case of escaping gas, stay away and keep inflammable materials away.
Prevent electrostatic charging of the device.
Ensure proper installation of the supply pipes.
Check the hydrogen lines and connectors regularly for leakages.

3.2 MECHANICAL HAZARDS

It is always necessary to wear appropriate Personal Protective Equipment (PPE) and to use suitable tools when handling the device and packaging material.

A general training with regards to lifting heavy loads and general safety briefings are required to perform the tasks described in this manual safely.

Operators must comply with the general safety principles during the handling phases. In particular:

Caution!

Before handling, moving, and commissioning the device – assess the hazards of the operation and study the manual. Appropriate PPE must be worn, such as cut resistant gloves, safety shoes, protective goggles, etc. depending on the activity.

Clear the area of work before starting to mount the device.

The device is heavy and must be lifted by at least 2 people – plan around this and allow ample space to move around.

Do not lift the device over your head.

Caution!

During handling of the device, be cautious and use the handles on the device to minimise the mechanical risks, such as:

- Impacts and crushing injuries due to uncontrolled movements of the load.
- Dropping the device, causing crushing injuries
- Loss of stability, leading to entanglements and other injuries.

The packaging/device must be handled by at least two people.

3.3 ELECTRICAL HAZARDS

Do not touch the antenna when the device is powered on. The device poses no special electrical hazards, if the following instructions on safety measures are observed and the Electrical Connection Guide below is applied correctly:

Caution!

- Handle the electrical installation with care. Ensure that the power plug is fastened correctly into the socket to avoid any loosening of the wiring.
- Use only the supply voltage specified on the rear of the device.
- Do not short-circuit inputs and outputs.
- Do not reverse the polarity of inputs and outputs.
- Do not insert any mechanical parts, especially metal parts, into the device through the ventilation slots or other openings.
- Do not use liquids near the device.
- Never use the device if any part of it has been immersed in water.
- Do not touch the antenna when the device is powered on, ensure you are electrostatically discharged when mounting/dismounting the antenna.

Warning!

Always turn off the power supply when the device is being cleaned, maintained, or transported. Any servicing, other than cleaning and routine user maintenance, must be performed by trained, Enapter-endorsed technicians.

3.4 CHEMICAL HAZARDS

Potassium Hydroxyde is used in the electrolyser as the main process liquid (electrolyte). In case of failures, it can also be present inside or outside connected or nearby devices.

The electrolyte is typically delivered pre-mixed with the electrolyser but is sometimes provided as a powder to be diluted. For more information on this process, please refer to Appendix II below.

Warning! Refer to the Material Safety Data Sheet (MSDS) of all chemicals used before handling them. All persons mixing, draining, and handling the electrolyte must be informed about any potential hazards involved with these activities.

Attention: Wear appropriate Personal Protective Equipment (PPE). Avoid any contact with eyes and skin.
If you got in contact with the solution, immediately wash the affected area and refer to the material safety data sheet of potassium hydroxide supplied with the electrolyser.

Ensure all material used to store and contain your electrolyte solution is chemically compatible with it.

In the event of physical contact with the undiluted substance, refer to the material safety data sheet of potassium hydroxide and follow the instructions below.

First Aid Recommendations

- In the event of skin contact, take off contaminated clothing immediately. Wash off with soap and plentiful water. Consult a doctor.
- In the event of eye contact, rinse carefully with plentiful water for at least 15 minutes, and consult a doctor.

If ingested, do not administer anything to people that have fainted. Rinse mouth with water. Consult a doctor immediately.

3.5 CHEMICAL INFORMATION

Substance: Potassium Hydroxide
CAS no.: 1310-58-3
EC no.: 215-181-3
Classification: C.
R Phrases: R22, R36/38, R43, R42
S Phrases: S24-37, S39, S62
(see Safety Material Data Sheet included in the shipment)

3.6 THERMAL HAZARDS

Thermal hazards such as burns and scalds from contact with high-temperature surfaces can be prevented by following the following safety instructions:

- Never open the device unless you have been specially trained for service by Enapter.
- Ensure the device can only be accessed by authorised and trained personnel.
- Operators and maintenance personnel must wear appropriate Personal Protective Equipment (PPE) when handling the device.
- Remove the supply of power before any service, transport, and installation of the device.
- Any servicing, other than cleaning and user maintenance must be performed by specialist personnel and with the power supply switched off.

3.7 ENVIRONMENTAL HAZARDS

The device has been designed for use in standard ambient conditions, respecting stability requirements (in the absence of seismic or hydrogeological events).

The device has not been designed for outdoor use. It is the operator's responsibility to protect the device and all its accessories against atmospheric phenomena such as direct sunlight, rain, snow, and lightning.

3.8 ACOUSTIC HAZARDS

According to the requirements stated into the Machine Directive 2006/42/EC, the following topics have been considered:

During regular operation, the device emits a noise level below the maximum acceptable threshold for long time exposure (80dBA).
However, a sudden purge (either caused by device shut down or unforeseen error) can be louder than 85 dB, depending on the purge line installation. Due to this, Enapter recommends wearing PPE (earplugs) while working around the device.

4. INSTALLATION OF THE ELECTROLYSER

Any person working on the device must be familiar with the hazards and risks associated with installing, commissioning, and running it.

4.1 UNPACKING

The device has been carefully inspected and tested before shipping. Visual checks for damage and functional tests should be performed upon receipt. Please remove the thin foil that covers the chassis before mounting the device in its final position. Make sure, to not remove the warranty labels on the backside when removing the foil.

Please do not dispose the original shipping materials. Enapter will not accept devices if they are returned without the original shipping boxes or equivalents for a safe transport. In case that you cannot keep the shipping boxes, please recycle responsibly.

Attention! If any damage has occurred during transport, please report this immediately to the shipping agent and supplier. Afterwards, the device should be returned according to the shipping instructions provided in this manual, in the section "Transport, Maintenance and Recycling".

Warning!

Never lift the device out of the packaging alone. The device weights over 50 kg. Please see the datasheet for more details.

Use lifting aids if available.

Due to their weight and size, it is recommended to use a pallet cart or similar devices to manoeuvre the box upon delivery.

If the box must be lifted somewhere, always lift with at least two persons.

4.2 TOOLS, MATERIAL AND ACCESSORIES REQUIRED

The following tools, equipment, and material are needed to connect the device successfully. Ensure the material chosen for this task is compatible with hydrogen operation.

4.2.1 TOOLS

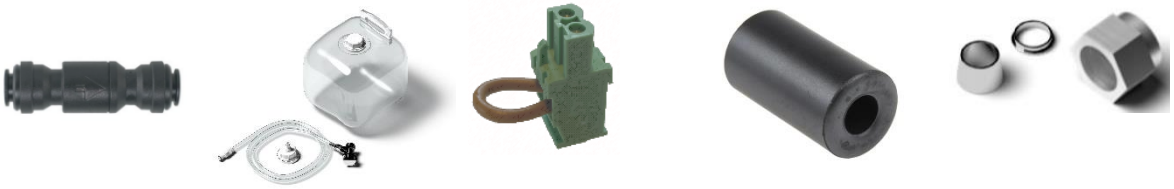
- 9/16" combination wrench
- 5/8" combination wrench
- Plastic pipe cutter
- Slotted screwdriver
- Stainless steel pipe cutter
- ¼" tube bender

4.2.2 MATERIAL

- Push-fit locking clips (8 mm + 10 mm)
- 8 mm + 10 mm diameter LDPE tubing (ensure the 8 mm tubing is pressure-resistant to at least 4 bar!)
- Stainless steel AISI 136- ASTM A269 -¼" outside diameter X 0,89 mm w.t.

4.2.3 ACCESSORIES (INCLUDED IN THE BOX)

- 10 mm Check Valve **only needed when connecting multiple electrolysers in parallel**
- Electrolyte filling bag (labelled)
- Dry contact jumpers
- Ferrite cylinder for power input cable
- Swagelok Nut and Ferrule set



4.3 IMPLEMENTING SYSTEM SAFETY

Each connection to and from the device must be inspected and tested. Additional system engineering might be required to ensure safe operation.

Always follow best practices, apply your local codes of regulation (if applicable), and follow industry standards for the implementation of safety systems to manage the risks of running electrolysers and storing hydrogen.

Gas containing pipes must be properly connected to the specific ports, tested by the operator, and directed to separate safe areas. If this is not possible, the operator must find another safe solution,

such as using a flare stack, burn box, or forced dilution. When forced dilution is utilised, all components used in this process must not be able to ignite the hazardous substances.

Warning!

It is the operator's responsibility to ensure good engineering practices are applied to the hazardous substances which are released during the operation of the device!

The operator must ensure that the outlet satisfies all relevant local rules and regulation, in terms of the safe dispersion of the purged gas, noise emission, risk assessments, maintenance, a satisfactory safety concept being utilised, and all other relevant areas.

It is the operator's responsibility to **regularly check and maintain all pipes**.

4.3.1.1 SAFETY AREAS AROUND THE PURGE AND VENT OUTLET

Generally, there are two options. The extents of this safety area depend on different parameters, for example, the diameter and the length of piping leading to the safe area, the vent spout design, exit velocity and wind conditions.

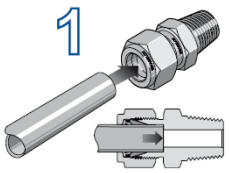
Preferably, the operator:

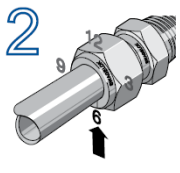
1. calculates the measurements of the safety area based on the provided data for each specific output and applies industrial standards such as the following to their system design, safety concept and site documentation.
   - EIGA Doc 211/17: Hydrogen Vent Systems for Customer Applications
   - CGA G5.5: Hydrogen Vent Systems
   - ISO/TR 15916:2015: Basic considerations for the safety of hydrogen systems
2. Or follows the recommendations of Enapter for systems consisting of up to ten electrolysers and two dryers. The safety area is cylindrical and has a height of 10 meters and a radius of 5 meters. Note that depending on the design of the purge piping and exit velocity, this area also extends in the direction of the ground by at least 1 meter. Never place the vent outlet near the purge outlet to minimise the risk of explosion. Leave at least 3 meters of space between the gas outlets.

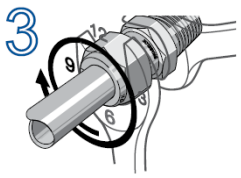
4.4 INSTRUCTIONS FOR CONNECTING STAINLESS STEEL TUBES

All pressurised hydrogen gas connections are Swagelok tube fittings for ¼" outside diameter (OD) tubes. The outlets to be connected according to these instructions are labelled "H_2 Out" and "H_2 Purge" on the front panel of the device.

Follow the below instructions carefully – please refer to the Swagelok manufacturers installation guide for any further details: An Installer's Pocket Guide for Swagelok® Tube Fittings (MS-13-151).







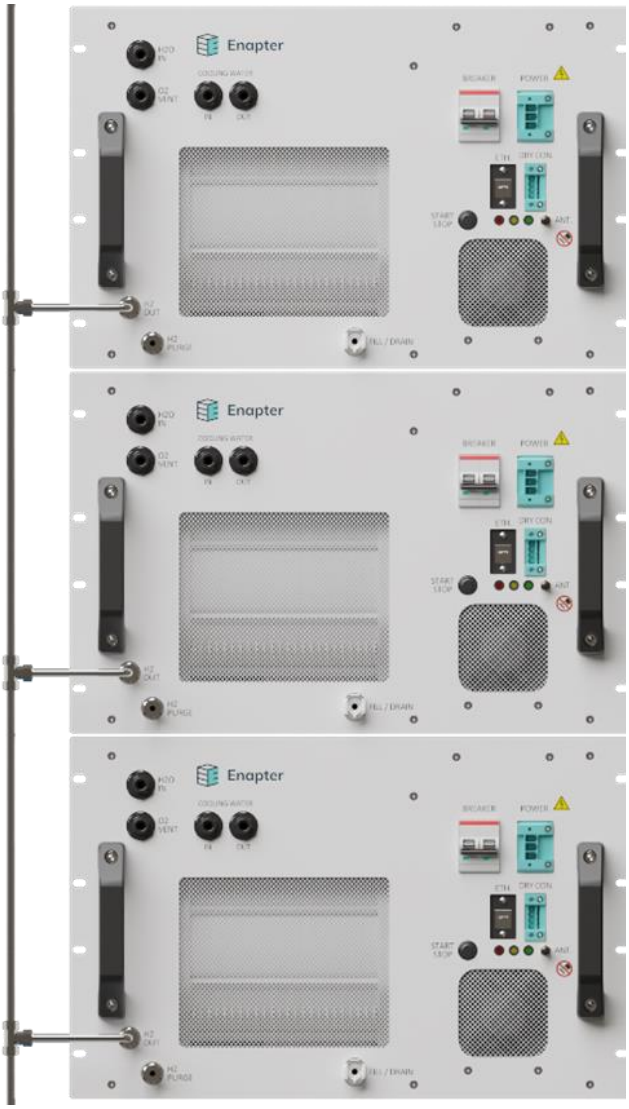
1. Fully insert a ¼" stainless steel tube into the bulkhead union, with the nut and ferrule in place on the fitting.
2. Rotate the nut finger-tight, then mark the 6 o'clock position on the nut.
3. Hold the fitting body steady on the device using the 5/8" open key wrench.
4. While holding the fitting body steady, tighten the nut one and one quarter turns to the 9 o'clock position with the 9/16" open key wrench.
5. To ensure a leak-proof connection is made, another quarter-turn of the nut (to the 12 o'clock position) is recommended.

Always check each connection for leaks! For more information, please refer to Appendix I below.

4.4.1 HYDROGEN OUTLET CONNECTION GUIDE (H2 OUT)

Connect the H_2 Out port, located at the bottom left of the front panel, to a hydrogen storage or the Enapter Dryer. It is recommended to fit a shut-off valve between the tank and the dryer to be able to isolate each component during maintenance.

Multiple electrolysers can be connected to a common line by combining the electrolysers in a 19" rack via a common output line to the left of the devices and then connecting this H_2 line with the lines of other racks.



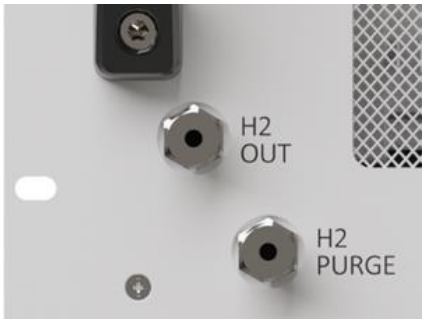
Three EL2.1 LC with common H2 OUT

Three EL2.1 DC with common H2 OUT

Warning!

All pressurised connections must be inspected and checked for leakages.
Failure to do so significantly increases the risk of explosion.
Enapter is not responsible for any damage caused by improperly installed equipment.

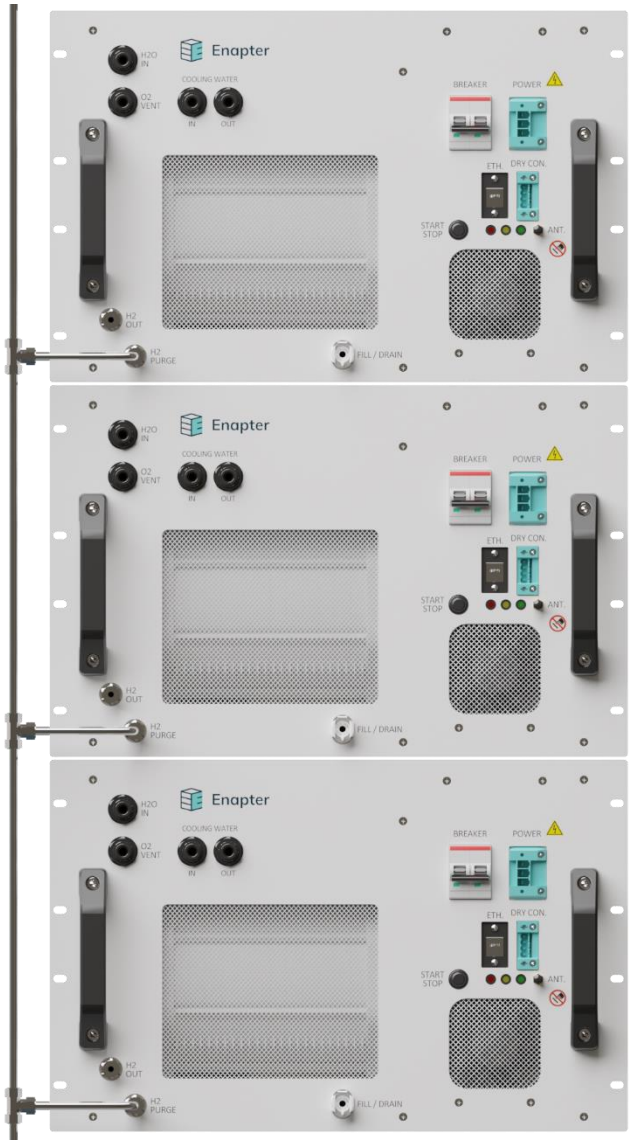
4.4.2 PURGE CONNECTION GUIDE (H2 PURGE)



H2 OUT and H2 PURGE

Connect the H_2 purge port, located at the bottom left of the front panel, to your hydrogen purge outlet.

During ramp-up, after ramp down and in regular intervals during operation, the electrolyser depressurises and releases up to 20 litres of hydrogen within 2 seconds with a loud noise through the purge line. Please wear PPE earplugs when being close to the devices. Purging is necessary to release the water which has been extracted from the hydrogen.



EL2.1 LC with common H2 PURGE

EL2.1 NB DC with common H2 PURGE

The released hydrogen will pose a risk of explosion – therefore, it must be led into a safe area at a height of at least 3 m, without any source of possible ignitions. For more information, see the section Safety areas around the purge and vent outlet. If this is not possible, manage the purge in other ways, such as using a flare stack, burn box or forced dilution.

Never obstruct the output of the H2 Purge line – do not place any check valves, or other system components which might block or close the line.

Ensure that the condensed water is not allowed to accumulate in the purge line and can drain safely. Make sure that no obstacles are blocking the line. This includes condensed water freezing inside the pipes.

Regularly check the purge line for a build-up of obstructions.

It must always be open at atmospheric pressure. If necessary, use a water trap and heater to avoid pressure from building up.

Please be aware that when larger hydrogen systems are created by putting together several modules, the piping downstream may have to be sized accordingly. It is the operator's responsibility to ensure adequately sized piping is selected, which does not limit the air flow.

1

The operator must ensure that the outlet satisfies all relevant local rules and regulation, in terms of the safe dispersion of the purged gas, noise emission, risk assessments, maintenance, a satisfactory safety concept being utilised, and all other relevant areas.

It is the operator's responsibility to **regularly check and maintain all pipes.**

Please contact the Enapter customer support team for questions regarding the vent line setup.

Attention!

If a backpressure or underpressure inside the line builds up, the device will get permanently damaged.

Enapter is not responsible for any damage caused to the device from mismanaged piping arrangements.

4.5 INSTRUCTIONS FOR CONNECTING PLASTIC TUBES

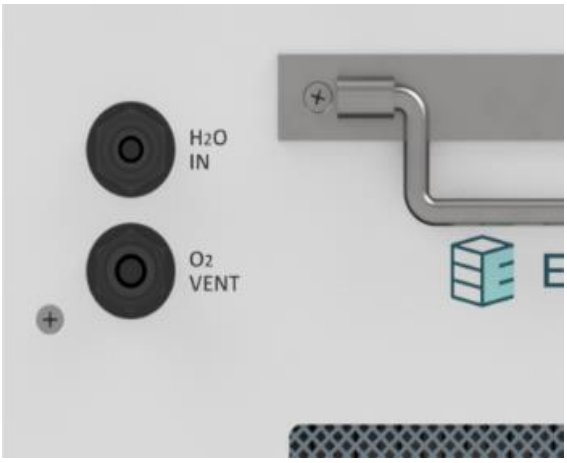
1. Cut the tube perpendicular to the axis and remove sharp edges. Ensure the outside diameter is free of score marks, and the cut is perpendicular across the tube. Fully insert the tube into the fitting. The inserted pipe diameter must match the fitting.
2. Pull the tube to check it is firmly held in place, then secure the connection by inserting a red fastening clip.
3. To disconnect, ensure that the line is depressurised. Then, remove the red fastening clip and push the collet against the fitting, while simultaneously pushing the tube into the fitting. Holding the

collet in this position, pull the tube out of the fitting in one smooth motion.

4.5.1 VENT CONNECTION GUIDE (O2 VENT)

Connect the "O_2 Vent" port, located at the top left of the front panel to your oxygen vent outlet.

EL2.1 H2O IN and O2 VENT



EL2.1 NB DC H2O IN and O2 VENT

The O2 vent line requires the most demanding line management. Please study this section carefully.
The oxygen vent line carries around 0,25Nm³/h of oxygen out of the electrolyser. Additional components are water vapour and a maximum concentration of 3%vol hydrogen if the production rate is above 60%. Under normal conditions with production rates between 60% and 100%, the flammable limit will never be reached. The water vapour sums up to around 10-25 ml/h.

Never obstruct the output of the O_2 vent line – do not place any check valves, or other system components which might block or close the line. Instead, use KOH resistant check valves with a maximum cracking pressure of 0,02 barg downstream of every vent outlet to avoid damages of the devices.
Ensure that the condensed water is not allowed to accumulate in the vent line and can drain safely. Make sure that no obstacles are blocking the line. This includes condensed water freezing inside the pipes.
Regularly check the vent line for a build-up of obstructions.
It must always be open at atmospheric pressure. If necessary, use a water trap and heater to avoid pressure from building up.
Please be aware that when larger hydrogen systems are created by putting together several modules, the piping downstream may have to be sized accordingly. It is the operator's responsibility to ensure adequately sized piping is selected, which does not limit the air flow. The operator must ensure that the outlet satisfies all relevant local rules and regulation, in terms of the safe dispersion of the purged gas, noise emission,

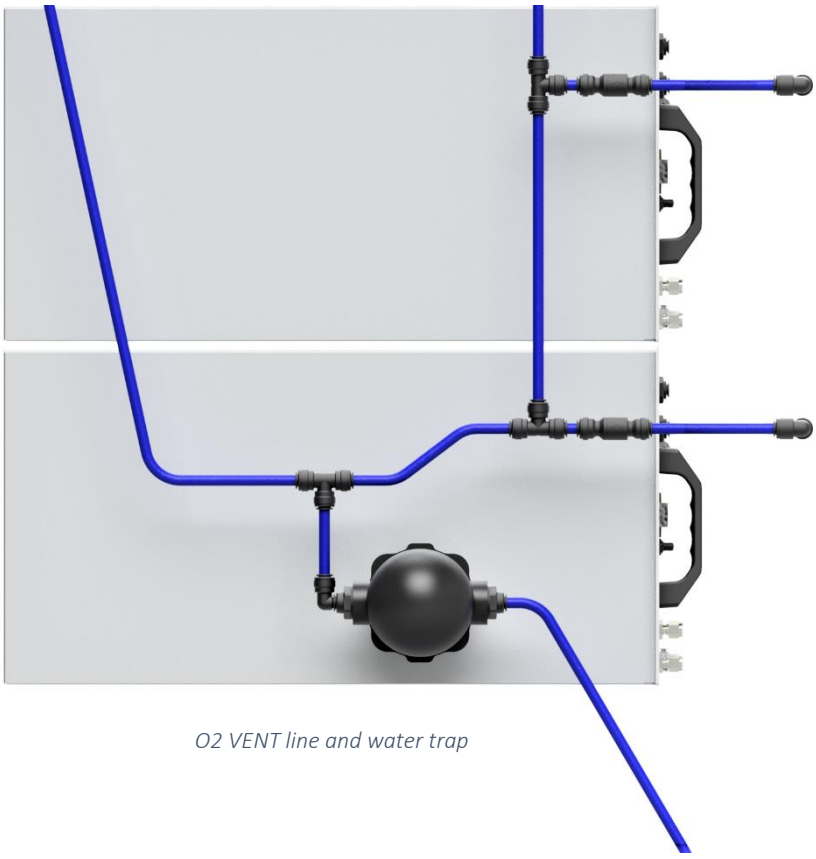
risk assessments, maintenance, a satisfactory safety concept being utilised, and all other relevant areas.
It is the operator's responsibility to **regularly check and maintain all pipes.**
Please contact the Enapter customer support team for questions regarding the vent line setup.

1

Attention!
The total pressure inside the line must never exceed 0.5 bar. If a backpressure or underpressure inside the line builds up, the device will go into error mode and get permanently damaged.
Enapter is not responsible for any damage caused to the device from mismanaged piping arrangements.

To connect a device, create a connection using 10 mm LDPE pipe to the port labelled "O_2 Vent". If connecting several devices to a common vent line, make sure the diameter of the line is sufficient and that it always runs vertically. As water is condensing inside the vent lines, there must not be any horizontal or sagging sections. The condensing water would block the pipe.

At the lowest point of the vent line, a drain trap or similar device must be installed to separate the condensed water from the oxygen (see picture).



O2 VENT line and water trap

The oxygen vent outlet must lead to a safe area. The water from the water trap can be drained safely.

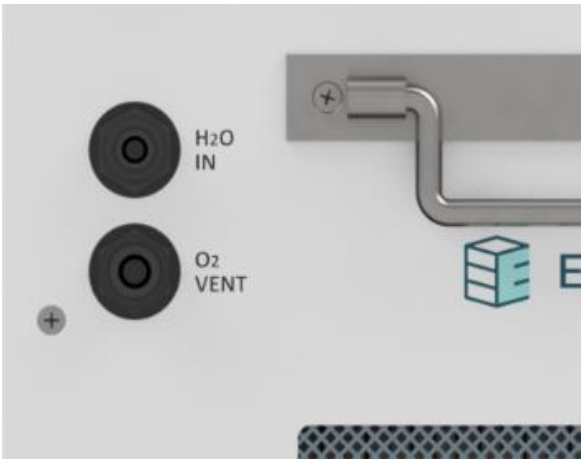
Warning!

The gaseous outputs from the oxygen vent and the hydrogen purge must be kept separated. Mixing of these outputs results in an explosive atmosphere.

4.5.2 WATER INLET CONNECTION GUIDE (H2O IN)

The water inlet connector is a push-fit bulkhead, for an outside pipe diameter of 8 mm. This inlet port is used for the automatic refilling of demineralised water from a pressurised source.

EL2.1 H2O IN and O2 VENT



EL2.1 NB DC H2O IN and O2 VENT

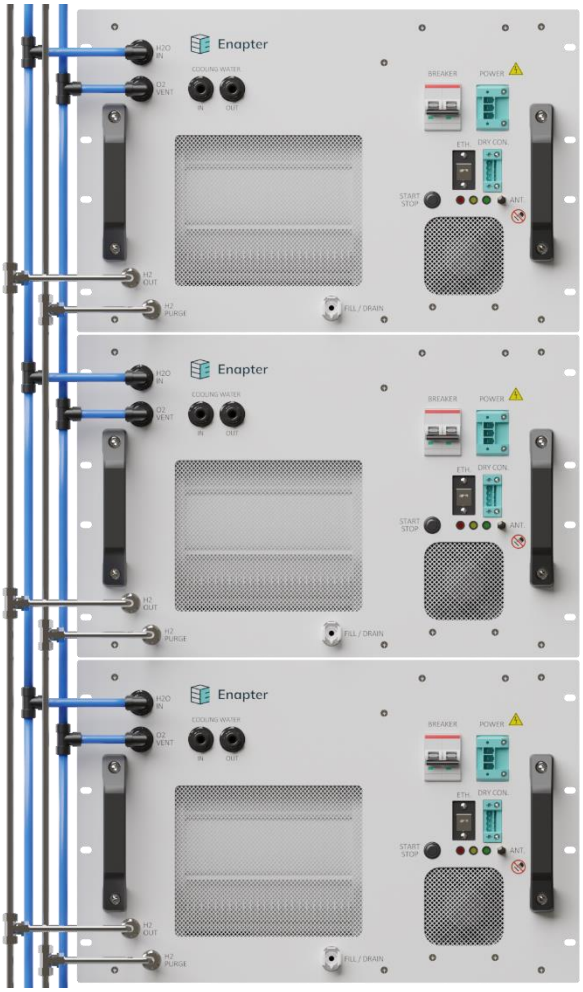
Warning!

Ensure water pressure on the input line never exceeds the maximum allowed pressure. This can cause irreparable damage to the device and create significant leakages. Enapter is not responsible for any damage or injury resulting from the misuse of the device.

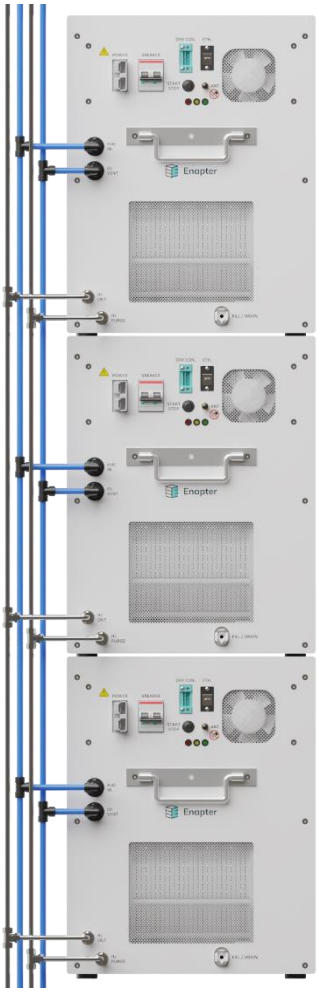
Attention!

Ensure your water input quality is sufficient. Demineralised water with a higher conductivity than stated in the datasheet will irremediably damage the stack. The same applies for particles and debris in the demineralised water. Install filters at the water inlet of the device and clean them regularly to ensure that the water is free of particles. If a device is damaged from using low-quality water, Enapter is not responsible for any damage caused.

Flush all water pipes with demineralised water before connecting your device to ensure no debris is in the lines. Then connect the "H_2O IN" port located at the top left of the front panel directly to your water supply.



EL2.1 all pipes connected

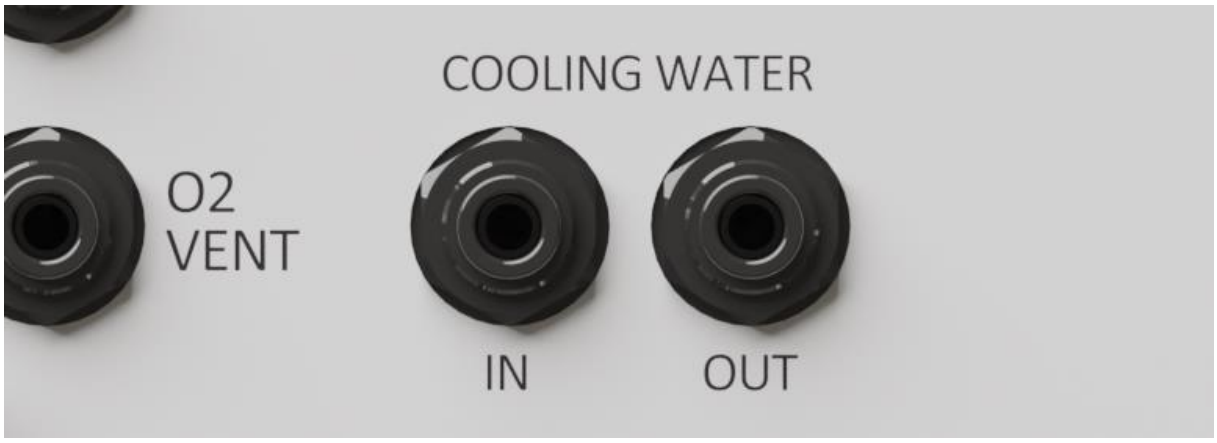


EL NB DC all pipes connected

After performing the first-time filling (filling the device with the supplied electrolyte solution), the device will consume water during operation, at a rate of around 400 mL/hr. The refilling is triggered automatically from the "H_2O IN" port. This occurs periodically during operation, or directly after ramp down.

4.5.3 COOLING LOOP CONNECTION GUIDE (COOLING WATER IN/OUT)

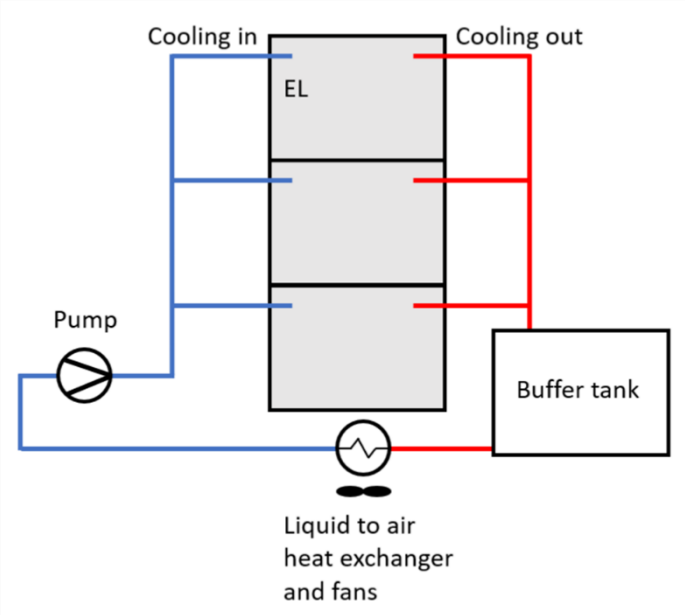
For connecting the cooling loop of the EL2.1 LC please consider the following instructions. For air-cooled devices, these instructions are not relevant. Flush all water pipes with clean water before connecting your device to ensure no debris is in the lines.



EL LC COOLING WATER

For the cooling of the device, Enapter recommends setting up a closed, non-pressurised cooling loop using water or a water glycol mixture as cooling agent. At an external heat exchanger, the waste heat can either be transferred to another medium for further use or be dissipated to the ambient by a fan. A pump is needed to circulate the cooling agent.

The "COOLING H_2O IN" and "COOLING H_2O OUT" connectors are push-fit bulkheads, for an outside pipe diameter of 10 mm. Connect the ports, located on the top of the front panel, to your cooling circuit. When connecting several electrolysers to the same cooling loop, the electrolysers must be connected in parallel. Enapter recommends to connect a maximum of five electrolysers (respectively one cabinet) to the same cooling agent feed pipe in order to avoid high pressure drops and ensure equal cooling water flow to the individual electrolyers. If the pump is sized accordingly, several cooling agent feed pipes can be connected in parallel.



Enapter recommends to set up the cooling loop according to the schematic on the left. The return line should be connected to a non-pressurised buffer tank. This reduces back-pressure stresses on the valve inside the device and will prolong its lifetime. In case the waste heat of the device will be used, a heat exchanger for this purpose can be integrated into this buffer tank. Connect the pump downstream of the external heat exchanger. When positioning it at a lower part of the cooling circuit, gravity can be used to feed the pump with water.

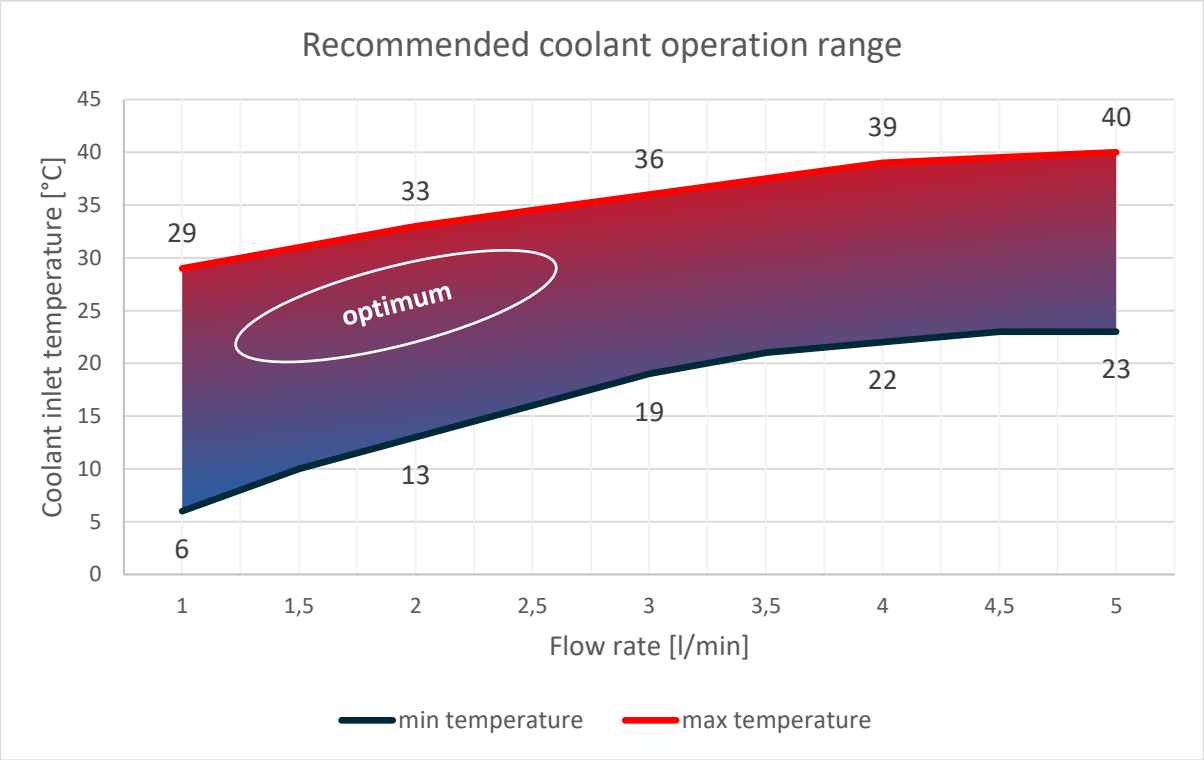
The cooling agent must be compatible with 1.4301 stainless steel and LLDPE, free of particles and be usable at up to 60°C. Depending on the ambient temperature, a frost protection agent may need to be added. To further increase device reliability, install the filter supplied by Enapter on the cooling line inlet of the device.

EL LC with filter

The external heat exchanger must be sized to be able to transfer up to 1000 W out of each electrolyser connected to the cooling loop.

The graph below indicates the operating range of the cooling circuit in terms of allowable inlet temperature of the cooling agent depending on its flow rate. The flow rates shown refer to the instant flow rate per electrolyser. The cooling operation of the devices is intermittent so the average flow rate will be lower. Keep in mind that these values are based on water. When using another cooling agent with a different heat capacity, the required flow rate needs to be adapted accordingly. The pump used must be suitable for intermittent operation and able to build up pressure against the closed solenoid valves inside the electrolysers. The pump must be correctly sized to provide the necessary flow rate against the pressure drop induced by the piping and electrolysers. The pressure drop inside the device is up to 800mbar at 5l/min (at the worst conditions). It is the operator's responsibility to correctly size the liquid-liquid/liquid-air heat exchanger and cooling agent pump.

3



Cooling loop operating range by temperature and flow rate

Please be aware that the device generates more heat as it degrades. At the beginning of life, a maximum of 490 W per electrolyser can be extracted from the electrolyte. At the end of life, this value increases to ca. 700 W per electrolyser. This waste heat is available at up to 50 °C and can then be used for any customer-specific heating purposes. Depending on the ambient temperature and the setup of the cooling system, especially the piping, the heat losses from the cooling pipes might be significant, resulting in a lower heat recovery. The chart is therefore not to be used as an indication of how much waste heat can be captured for usage.

Warning!

Ensure water pressure on the input line never exceeds 7 barg. This can cause irreparable damage to the device and create significant leakages. Enapter is not responsible for any damage or injury resulting from the misuse of Enapter products.

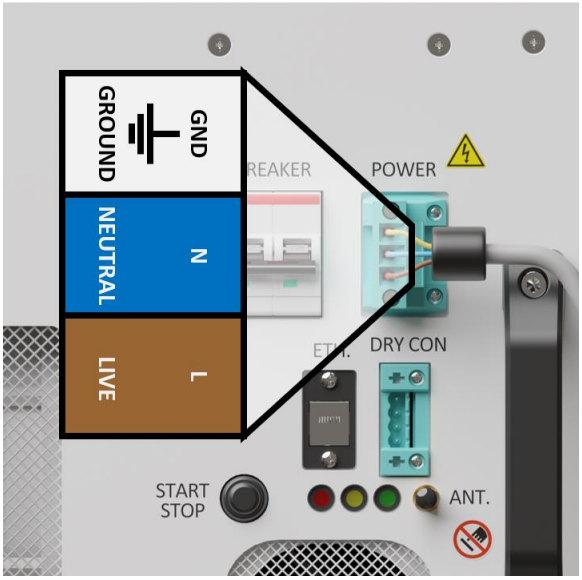
Ensure the cooling agent pump can supply at least the minimum required flow rate. Shortage of cooling can cause irreparable damage to the device.

4.6 ELECTRICAL CONNECTION GUIDE (POWER)

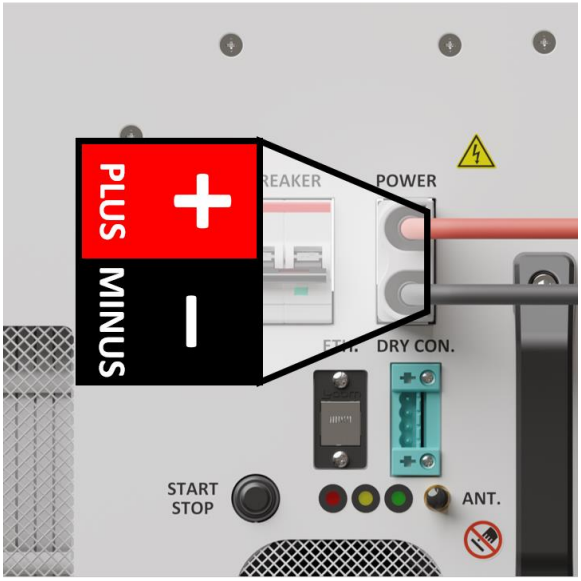
Attention!

Double-check all the wiring connections **before** supplying power to the device. Failure to adhere to the following instructions can damage the device and lead to hazardous conditions in and around the device!

Never handle the electrical connections with wet hands!



EL2.1 Power connector & Breaker



EL NB DC Power connector & Breaker

The AC versions of the electrolyser requires a ferrite on the power input cable. For the DC version, no ferrite is needed. Before mounting the power input cable to the male connector, ensure the ferrite (included with the shipment) is in place around the cable as close as possible to the male connector. The ferrite has an internal diameter of 13.77 mm (350 Ohm, 150 MHz) and can simply be slid over the cable.

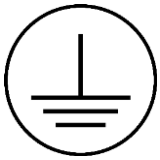
Connect the device as shown below to the socket labelled "Power". In the image below, brown is live, blue is neutral, and the yellow/green is the ground. In the DC version, there is a 2 pins connector compatible with a cross section cables of 16mm². The upper one is the positive voltage input (usually red cable). The lower one is the negative voltage input (usually black cable). Follow the relevant safety standards and ensure compliance with local and national regulations. Ensure that the male connector

is used in the correct orientation, as shown below. Do not exceed the specified voltage and amperage (see datasheet for more details).

The device has a thermomagnetic circuit breaker (C13 for AC, B63 for DC) on the front panel, which protects the device from overcurrent. Switch the level of the breaker to the upper position to power supply the device.

However, Enapter still recommends installing a protective device against overload and short circuits on the power supply line; it must be selected in relation to the devices maximum power consumption and in compliance with all local and national safety requirements. To further increase electrical safety of the device, it is recommended to install an SPD (Surge Protection Device) to protect the device from potential over-voltages generated by lightning strikes, as well as an appropriately sized differential breaker for the installation.

In the DC version, the chassis needs to be grounded separately to prevent contact with dangerous voltage and to allow the correct functioning of the device. The grounding system must comply with local and national regulations. Remove the screw and the washer from the labelled spot on the back side of the electrolyser and use them to connect the ground cable.



Grounding symbol on device

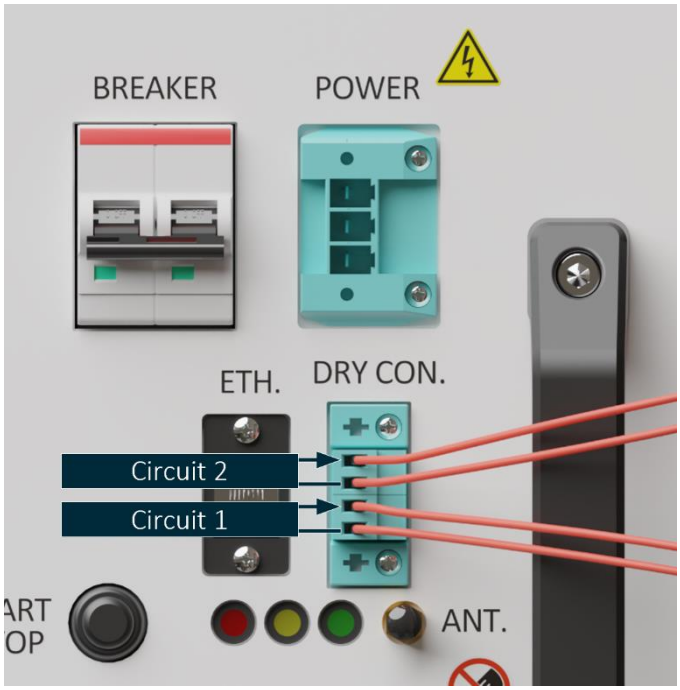
4.7 DRY CONTACT CONNECTION GUIDE (OPTIONAL) (DRY CON.)

The device can be integrated into existing dry contact chains. If no dry con chain needs to be integrated, please jump to the section below.

Connect the male connector to the female port on the device, labelled "DRY CON". The dry contacts are normally-closed type.

2

The pins are, from top to bottom, S2, COM2, S1, COM1. This allows the device to not only receive a dry contact signal but also to pass it on to the next Enapter device, allowing the operator to daisy chain as many Enapter devices as wanted to a common safety signal. To use the dry contact to shut down the hydrogen production, connect a normally open dry contact circuit to Circuit 1 (as shown in the picture), using the specially supplied plug. This circuit is generally achieved by a relay system that is triggered to open by signals sent from a switch or sensor used to ensure system safety. If the circuit is interrupted (i.e., the dry contact is opened), the device will immediately stop all hydrogen production and release the internal hydrogen by purging.

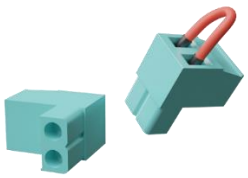


DRY CON circuit

To pass the signal on to the next Enapter device, connect the two free contacts (Circuit 2) to the Circuit 1 of the nearest Enapter device. If the dry contact circuit is triggered by an opened contact, all connected devices will stop. Opening the Dry Contact circuit will cause the stack to be immediately de-energised and the device to depressurise and to go into fatal error. **Dry contacts should not be used for normal start and stop operation.** Unexpected power cuts to the stack without normal ramp downs can shorten the device's lifetime and damage the device!

4.7.1 DRY CONTACT CONNECTION BYPASS

To disable the dry con chain functionality, insert the dry con jumper with the red connection cable in the lower part of the socket labelled with "DRY CON" like shown in the picture.



DRY CON connectors

DRY CON connector

4.8 ETHERNET PORT (ETH.)

The front panel features an ethernet port.

EL2.1 Ethernet Connector

EL2.1 NB DC Ethernet Connector

This Ethernet port allows Modbus access. The Modbus command interface table can be accessed online via Enapter handbook.

4.9 INITIAL OPERATION OF THE ELECTROLYSER

4.9.1 PREPARING FOR H2 PRODUCTION

Now that the device is connected, here is what to do next to get it running.

4.9.2 PAIRING THE DEVICE TO THE CLOUD

It is time to power on the device for the first time. Switch the breaker at the top of the front panel in the upper position to switch the device on.

Using the Enapter app, add your device to a site. For detailed information on this, please refer to the mobile application handbook.

1. To start using the application, you need an account in the Enapter Cloud. If you already have an account, simply skip this step.
   - To create an account, click on the create account button of the first screen.
2. After logging in on the Enapter app, create a site – a virtual environment which will house all the telemetries collected from the devices connected to the cloud via UCMs (Universal Communication Modules).
3. Add the device to the site by scanning the QR code located on the front panel.

4.9.3 MANUAL REFILLING OF ELECTROLYTE

Your device is now ready to be commissioned for its first use. Once it is successfully paired to the cloud, you will notice that the device has started in maintenance mode and is prompting you to perform the first-time filling.

Time required	5 minutes
Materials required	Safety Glasses Nitrile Gloves 3.6L of 1% KOH solution

To prepare the electrolyser for operation, before demineralised water is added automatically, it must be filled with the electrolyte which is included in the shipment. If it is not included, it can typically be procured or purchased locally. Please refer to Appendix II below.

Warning! Refer to the Material Safety Data Sheet (MSDS) of all chemicals used, before handling them. All persons using, preparing, and filling the electrolyte into the device must be informed about any potential hazards involved with their activities.

Attention: Follow industrial hygiene and safety practice and wear appropriate Personal Protective Equipment. Avoid any contact with eyes and skin.

Attention: Ensure all material used to store and contain your electrolyte solution is chemically compatible with its contents.

Push CPC connector in to connect

Push clip on top of socket and pull connector to disconnect

1. Put on PPE. The minimum required equipment are safety goggles to protect from splashes and nitrile gloves. Ensure your working area is clean to avoid chemical contamination and potential exposure hazards.
2. Make sure the "O2 VENT" has no tube or fitting attached to it.

3. The electrolyser must be in "Maintenance" mode and the internal electrolyte tank must be empty. You can check this by looking at the status of LSL102D_in (Low electrolyte level) in the Cloud: it is "false" (red) if the tank is empty. If not – please contact the Enapter customer support team. Do not leave the device powered on and unattended while in Maintenance mode.
4. Screw off the original cap from the electrolyte bag and replace it with the threaded puncture seal cap. To connect the refilling pipe to the electrolyte bag, pull and hold the movable part of the connector and push it against the electrolyte bag.
5. Fully insert the supplied male CPC quick connector into the "Fill/drain" port as shown in the left picture above.
6. If you are using the mobile app, you can press "Start refilling" now.
7. Carefully raise the first-time filling solution above the device. Never lift the electrolyte above your eye level. The solution will start filling immediately, if this does not occur, ensure the vent line is not obstructed.
8. **Follow the steps provided by the App: pour until the App shows full tank**.
9. **If the App prompts you to stop, stop filling immediately by lowering the bag below the electrolyser and unplugging the connector as shown in the right picture above!**
10. If it is not stopped quick enough, the electrolyte can exceed the maximum level. This will prompt the electrolyser to go into error mode - if this happens, the tank must be drained, the electrolyser must be put back in Maintenance Mode and the process needs to be repeated.
11. Ensure all the solution (3.6L) has been filled into the device if not requested differently by the app.
12. Confirm finish of refilling by pressing the button in the App "Touch to Exit Maintenance Mode".
13. To disconnect, push the button and pull the connector out of the bulkhead as shown in the right picture above.

You are done!

The device is ready to be used and no other action is required. The electrolyser will automatically refill demineralised water whenever it needs it. **Do not leave the device powered on and unattended while in Maintenance mode.**

4.9.4 DRAINED SOLUTION

Before draining the device through its dedicated port, wear appropriate personal protective equipment. For more information, refer to Appendix III below. Collect the liquid in an appropriate container and place in a chemical waste container. Do not flush to sewer. Dispose of the liquid in compliance with applicable local regulations.

5. CONTROL, FUNCTIONS AND SYSTEM STATES OF THE ELECTROLYSER

Before powering on the device, ensure the power cable and all pipes are properly connected and secured as described in this manual. Then, switch the breaker to the upper position.

5.1 MANUAL START/STOP

When the device is in standby mode, push the start/stop button, this will start the device. Remember that it may take some minutes to warm up, purging the humidity and ramping up before hydrogen flows out of the H_2 outlet.

To stop the device, simply push the start/stop button again. The device then ramps down and purges the contained H_2 to return itself to a safe state.

Warning!

Do not unplug/disconnect the power to the device without either manually or via software control shutting it down safely first. Unexpected power cuts can shorten the device's lifetime and damage it!

3

The device works most efficiently and is most durable when operating continuously.
As with all electrochemical devices, the stack's lifetime is shortened with frequent start/stops. Enapter recommends to limit the device's operative cycles to a maximum of five on/off cycles per day, and one on/off cycle per hour. This helps to ensure the longevity of the device.

5.2 REMOTE START/STOP

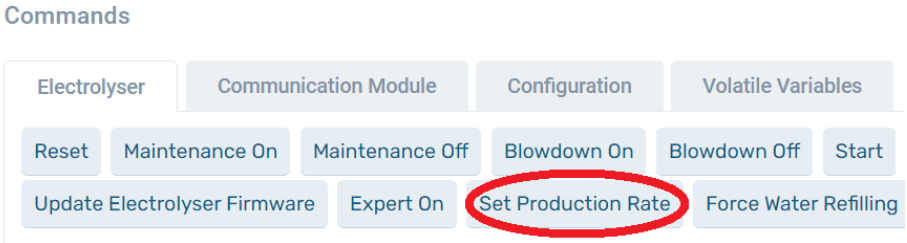
The device can be started/stopped remotely using the Enapter app or cloud as well as remotely via the Modbus interface. For more information on this, please refer to the online Enapter handbook.

5.3 MAINTENANCE MODE

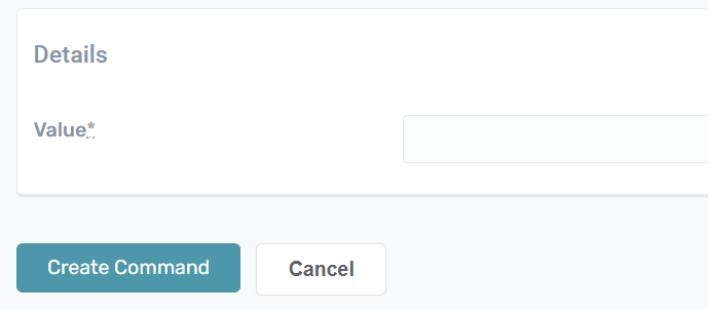
Maintenance mode can be manually enabled using the Enapter App. It is used to safely fill and drain the device, as well as to guide you through inspection and other routine maintenance tasks. Please see the chapter Maintenance of the Electrolyser to know more.

5.4 SET PRODUCTION RATE

Setting the production rate on the Cloud can be done in a very simple way on the main page of the electrolyser. On the "Commands" section click on the button "Set Production rate".



Enter a number between 60 and 100 to set the production rate to a desired percentage (60%-100%). Then click on the button "Create Command". The production can be adapted in 1% steps.



Attention: Please note that if a lower value is set (for example 50), the production rate will be set at the smallest possible value (60%). Accordingly, higher numbers than 100 will result in 100% production rate.

5.5 RAMP UP

The ramp up time of the device depends on the electrolyte temperature (the ramp up is slower at low ambient temperatures). Typically, the device will start with a hydration period of 60 seconds, and then ramp up to the nominal production rate with the following values:

- **Warm-up time (time taken for the electrolyte to heat up to 55 °C):** The electrolyser can reach a heating ratio of 1 °C/min. If starting the device with an electrolyte temperature of e.g. 25 °C it will take about 30 min to be fully operational and perform at its maximum efficiency at 55°C.
- **Ramp up time (time to reach nominal production rate):** Usually, the 500 NL/hr production rate is reached in about ⅔ of the total warm-up time (the warmup time is 30 min, so if starting at 25 °C, it will need 20 min to reach max production rate).
- **Build pressure time:** The heat up and the hydrogen production start immediately. With standard set-points, the pressure is completely built in ⅙ of the total warm up time (if starting at 25 °C, the warm-up time is 30 min, so it will need 5 min to build pressure).

During ramp up, the device performs periodical purges to guarantee high purity H_2 on the outlet, as well as to release condensed water from the produced H_2.

5.6 RAMP DOWN

Like the Ramp Up, the Ramp Down slowly switches off the stack and the other components and moves the device into a safe state. The device should always be ramped down via the start/stop button or via the app/cloud to preserve the components. Switching it off via the breaker, the Dry-Con or switching off the power supply should be performed in emergency cases only.

5.7 BLOWDOWN ROUTINE

This routine runs if the electrolyser has not been in STEADY or RAMP UP mode for a longer time. A warning appears that notifies the operator when the routine starts: WARNING "WO_20". The blowdown routine does not interfere with the normal ramp up routine.

If the pressure on the hydrogen line outside the electrolyser is higher than 25 barg the blowdown routine will not take place.

5.8 ANTI-FREEZING ROUTINE

The anti-freezing routine is an automatic routine which will check the temperature on the internal electrolyte tank to prevent the electrolyte from freezing. If the temperature is below 6 °C the heater and circulation pump will be turned on. It switches off, once the electrolyte reaches 10 °C again. This routine also checks the flow of the circulation pump and verifies that there are no obstructions in the inner piping system.

5.9 SAFETY HEARTBEAT

The Safety Heartbeat functionality is a periodic signal transmitted between the device and the gateway to detect if the device is still connected to the cloud. If the device does not receive the signal anymore, it will undergo a normal ramp down. This allows the operator to always access the cloud data if the device is running. This feature is optional and can be switched off as well. Find further information on Safety Heartbeat in the handbook.

To activate Safety Heartbeat via Gateway:

1. Connect the device to the Gateway
2. Configure Safety Heartbeat on the Gateway

To activate Safety Heartbeat via Modbus, follow the heartbeat instructions for Modbus.

6. ENAPTER MONITORING TOOLS

The device can be monitored and controlled remotely by authorised users by logging into Enapter's cloud services on a web browser (https://cloud.enapter.com/login).

The device comes with a preinstalled UCM (Universal Communication Module), to monitor and manage the device. Various sensor data from the devices is stored in the Enapter Cloud in a time-series database and provides real-time or on-demand visualisation of collected data on customisable dashboards. To support the latest protocols and security fixes, the UCM can be updated over-the-air.

Every device can be directly integrated with the Enapter Software-Defined EMS (Energy Management System). The UCM inside the device connects either directly to the Enapter Cloud, or via an Enapter Gateway which readies your device for Industry 4.0 – to find out more, please visit the Enapter handbook.

Any user of Enapter products can now integrate a wide range of devices and analogue inputs into the hydrogen production environment. System data of integrated devices is read continuously and is then securely transmitted to the cloud, which can be accessed from anywhere in the world via the web interface or with the Enapter mobile application.

After the setup of the device is finished, it can be managed via the mobile or web dashboard, which includes Automated Control and Monitoring functionality by customisable logic of the Enapter Rule Engine (requires an Enapter Gateway on the site).

6.1 MOBILE APPLICATION

Enapter's mobile application makes the installation of any energy system quick and easy. If any part of the hydrogen system encounters an issue, the mobile app can send push notifications to alert the operator. This functionality is available via Wi-Fi or mobile network, all over the world.

To find out more, please refer to the Enapter handbook.

7. MAINTENANCE OF THE ELECTROLYSER

This device is designed to provide **many hours of service with minimal and easy maintenance. Proper care and maintenance by qualified personnel help to maximise the operating life of the device.**

7.1 UPDATES

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Enapter provides firmware updates to include new functionality and to fix and improve system stability and performance. It is recommended to check for updates using mobile phone app or the cloud web interface regularly and install them. In some cases, interfaces or compatibility with other devices might change due to an update. To make sure, that an update is not negatively affecting the overall setup, please read the release notes beforehand and inform Enapter in case of doubts: support@enapter.com

7.2 ROUTINE MAINTENANCE

The device should be inspected at least once a year for apparent signs of physical deterioration. All hydrogen connections must be tested for leakages regularly; Enapter recommends using one of the techniques listed in the Appendix I.

After commissioning, the process tank must be emptied at least once a year and new electrolyte filled into the device. For more information, please refer to Appendix III, which details the draining process of the device, and then follow the instructions for the Manual refilling of electrolyte. It is recommended to clean the device at the same time as described in the chapter Cleaning.

Depending on the frequency of use it is possible that the process tank needs to be emptied and refilled more often than once a year. By connecting your device to the cloud, it is possible to receive alerts when the device voltages start increasing – this typically signifies a needed electrolyte change. After the electrolyte change, the electrolytic stack will return to a lower voltage, decreasing power consumption of the device and increasing its efficiency and lifetime.

Warning!

Any maintenance activities, excluding the ones listed in the Routine Maintenance and installation sections, are only allowed to be performed by trained technicians!

Shut down the device, remove the power and wait until the device is cooled down before working on it in any way.

Wear PPE always during the maintenance of the device.

Do not open the device!

During maintenance, avoid heat in the vicinity of the device and the hydrogen source.

No smoking, no naked flames.

Prevent electrostatic charging of the device.

Before starting to work on the device, ensure you are aware of the local health and safety rules and regulation, as well as action plans if an accident occurs.

7.3 CLEANING

When performing the routine maintenance processes and checks, the device should be inspected and cleaned. Start by carefully using a vacuum cleaner (not included) to clean out the ventilation openings/grills. Afterwards, use a damp cloth (no acids, aggressive or abrasive substances) to clean the outside of the device.

Warning!

Remove the supply of power **before** cleaning the device. Never handle the electrical connections with wet hands. Ensure the device is dry before returning the supply of power to it.

Attention!

The internal components of the device do not need to be cleaned and must not be accessed by the user for cleaning.

Only trained and authorised personnel is allowed to open and inspect the device for maintenance reasons.

7.4 DISPOSAL

Enapter is fully committed to **recycling** the devices and its components.

Please return the device to Enapter at the end of life, where the device will be fully recycled.

By ensuring this product is correctly recycled, you will help to further reduce your impact on the environment and aid us in making the world cleaner and greener.

7.5 TRANSPORT

For returns, please contact the Enapter customer support team to receive the Return Material Authorization form and the packaging instructions.

Before transport, verify the electrolyte tank has been emptied according to Appendix III, and seal the connections on the front panel of the device. To seal the connections, simply insert the red plugs that were supplied with the device into their respective bulkheads and place the plastic caps on the hydrogen outlet and purge. Ensure the device is transported in an upright position, and that an indicator for this is clearly visible on the outside of the packaging.

Attention!

Enapter may not accept the device if returned without the original shipping boxes or equivalent for safe transport. If damage occurs during the return of a device under warranty, Enapter will not cover the costs of repair.

Warning!

Never lift a device alone, as it weighs over 50 kg. Use lifting aids if available.
Due to their weight and size, it is recommended to use a pallet cart or similar devices to manoeuvre the box upon delivery. If the box must be lifted somewhere, always lift with at least two persons.

Attention!

During winter, or when outside conditions are below freezing temperature, the shipping box must be additionally marked with a label informing the shipping agent that the package may not be exposed to temperatures below 1°C at any time.

8. APPENDIX

Appendix I. Hydrogen Leak Testing

As part of a hydrogen device, it is of vital importance to check every connection made for leaks. For more information on this matter, please refer to the appendix of ASME B31.12.

There are three main ways recommended to check for leaks:

1. Surface hydrogen detection
2. Soap bubble testing
3. Pressure drops testing

Surface hydrogen testing

Using a calibrated hydrogen sniffer, slowly check for leaks around each connection.

PROS

- Precise, it can pinpoint even small leakages
- Can grade leakages according to leakage rates

CONS

- Does not work when there are elevated levels of hydrogen in the atmosphere

Soap bubble testing

Using a mixture of soap and water (please ensure the soap used is compatible with the device and the materials used), the solution is dropped on individual connections using a small pipette. If the connection bubbles, a leak is present.

PROS

- Can be fast for larger leaks on small parts when testing multiple at one time
- Low-cost
- Best method for detecting exact leak location detection
- Accurate, it works even with elevated background H_2 levels

CONS

- Cannot detect tiny leakages
- No leak rate or test result information
- Slow: Detecting small bubbles on typical parts can take much longer than other methods.
- Risky: An extremely operator dependent technique with a high possibility of passing actual failures.

Pressure drop testing

This test is performed by isolating individual sections of a pipe while monitoring the pressure contained within over time and should be performed at the maximum operating pressure of the device. If a drop in pressure is observed, which cannot be attributed to changes in temperature, a leak exists.

PROS

- Useful for final verification during device commissioning
- Can verify several connections at the same time

CONS

- Cannot detect exact leakage source
- Cannot grade leakage rates accurately

Appendix II. Preparing the electrolyte solution

Time required	5-10 minutes
	Safety Glasses
	Nitrile Gloves
	Clean 5L container
	3.6 L of demineralised water (Conductivity < 20 µS/cm at 25°C)
Materials required	Chemical scales
	40 g of KOH (85% purity) (CAS-N°:1310-58-3)
	We recommend to contact Enapter at support@enapter.com to make sure that the purchased product is compatible.





For routine maintenance, new electrolyte solution must be prepared. Regular changing of the electrolyte in the electrolyser helps to prolong the lifetime of the device. This solution can generally be purchased locally. However, if you are struggling to source the materials involved, please contact the Enapter customer support team. For more information please take a look here.

Warning! Refer to the Material Safety Data Sheet (MSDS) of all chemicals used, before handling them. All persons using, preparing, and filling the electrolyte into the devices must be informed about any potential hazards involved with their activities.


Attention: Mix the electrolyte solution in accordance with good industrial hygiene and safety practice and wear appropriate Personal Protective Equipment as specified by the relevant Material Safety Data Sheet (MSDS). Avoid any contact with eyes and skin.

Attention: Carefully read the instructions below before beginning work. Follow the instructions – in case of questions, please contact the Enapter customer support team. **Ensure** all material used to store and contain your electrolyte solution is chemically compatible with its contents.

1. Put on PPE. The minimum required equipment are safety goggles to protect from splashes and nitrile gloves. Ensure your working area is clean to avoid chemical contamination and potential exposure hazards.
2. Ensure the selected KOH resistant container is large enough to contain the solution entirely. Verify the container is clean, and no debris is visible inside. If you are unsure – go to step 3, otherwise, skip to step 4.
   - If you are preparing the solution in advance – clearly mark and label the solution. Keep out of the reach of children and untrained persons. Never store chemicals above eye-level.

3. Thoroughly rinse the container with demineralised water, at a minimum three times. Before continuing to step 4, perform another visual check to see if any other debris may be visible.
4. Fill 3.6 L of demineralised water with a conductivity below 20 µS/cm at 25°C into the KOH resistant container.
5. Carefully weigh the required amount of KOH. Add 40g of KOH (with 85% purity) into 3.6L of demineralised water to create a 1% KOH solution.
   - **Attention:** Do not use KOH with less than 85% purity. Adjust the amount of KOH pellets according to the KOH purity.
6. Fill the KOH into the container with the demineralised water. **The solution will get warm!** Immediately stir the solution or mix it around the container with the lid firmly closed.

Appendix III. Draining the electrolyser

Time required	5-10 minutes
Materials required	Safety Glasses Nitrile Gloves Clean 5L container



The module must be drained for transport, installation and before the routine changing of the electrolyte in the device to prolong its lifetime. To do this the device must be first switched into Maintenance Mode, using Enapter mobile app or cloud. Follow the steps outlined on the app or use the instructions below.

Collect the liquid in an appropriate container and place in a chemical waste container. Do not flush to sewer! Dispose of the liquid in compliance with local and national regulations.

Warning! Refer to the Material Safety Data Sheet (MSDS) of all chemicals used, before handling them. All persons draining and handling the electrolyte from the devices must be informed about any potential hazards involved with their activities.

Attention: Wear appropriate Personal Protective Equipment. Avoid any contact with eyes and skin.

If you get in contact with the drained solution, immediately wash the affected area and refer to the material safety data sheet of potassium hydroxide and potassium carbonate.

Attention: Carefully read the instructions below before beginning to work. Follow the instructions – in case of questions, please contact the Enapter support team.

Ensure all material used to store and contain your electrolyte solution is chemically compatible with its contents.

1. Put on PPE. The minimum required equipment are safety goggles to protect from splashes and nitrile gloves. Ensure your working area is clean to avoid chemical contamination and potential exposure hazards. **Enable maintenance mode using the Enapter App.**
2. Attention: the device should be kept powered on, if possible.
3. Prepare the container to catch the drained liquid and insert the end of the drainpipe into it.
4. Take out any tube or fitting attached to the "O2 VENT" to let the air fill into the tank when the solution is drained.
5. Fully insert the supplied male CPC quick connector into the valve bulkhead labelled "FILL/DRAIN". The solution will start pouring out immediately.
6. Collect the drained liquid in an appropriate container and place in a chemical waste container. Do not flush to sewer. Dispose of the liquid in compliance with local and national regulations.
7. Once electrolyte stops pouring, safely remove the drain connector. To disconnect, push the button and pull the connector out of the bulkhead.

Appendix IV. LED States

EL2.1 LEDs

EL2.1 NB DC LEDs

The three LEDs located next to the right handle on the front panel and help to indicate the device status and operating condition.
During normal operation, the LEDs indicate the status of the device. Please visit the Handbook for the status LED indication of the electrolyser and the dryer.

Appendix V. Error Codes

Here you can find a list of all the errors that can be triggered while using the electrolyser. The list covers all firmware versions.
Check, which firmware is installed on your device and then chose "Modbus TCP Communication Interface" and then "Warning, Error and Fatal Error Codes" to access all warning and errors. E.g. the warnings and errors for the firmware version 1.6.1 can be found here.

For the warnings and errors, which can appear while using the dryer, use this list.