

— HYDROXPAND · USER MANUAL

HXS-30

30 kW stack

User Manual



Full-stack validation is in progress (due in H2 2026). Figures and procedures may be revised as results come in.

DOCUMENT CONTROL

Document control

Document information

Document no.	HX-MAN-HXS30-EN-001
Version	ver1.8
Issued	2026-10-05
Product	HXS-30 · 30 kW stack
Language	English

About this manual

This manual is the formal print edition of the HydroXpand web handbook. Its content is the same as the web handbook.

The web handbook is updated first. Where this print and the web differ, the web handbook is current. Each chapter shows its own update date at the top.

Read the safety chapter first. The meaning of the signal words (danger, warning, caution, notice) is in its first section.

Revision history

Rev.	Date	Description
1.0	2026-10-02	First version (built from the web handbook)
1.1	2026-10-04	Lifting points, recommended flow, voltage limit, minimum-current calculation, heat table and draining sequence added
1.2	2026-10-04	Heat example corrected to the measured long-run daily averages (about 360 A, 76.8 to 81.5 V)
1.3	2026-10-04	Safety messages reworked; nitrogen asphyxiation warning and blocked-vent section added
1.4	2026-10-04	Warnings moved ahead of their steps; static ignition and hot-surface warnings added
1.5	2026-10-04	Check and if-not lines added to key steps
1.6	2026-10-04	Drawings added: ports, DC terminals and lifting points; electrolyte loop
1.7	2026-10-05	Korean wording revised
1.8	2026-10-05	Voltage trend drawing (Figure 5-1) added

— CONTENTS

Contents

01	Safety	4
02	Receiving and storage	10
03	Quick start	13
04	Operation and shutdown	21
05	Maintenance	26
06	Decommissioning and storage	30
07	Specifications and reference	33
	Troubleshooting	37

01 Safety

HXS-30 · updated 2026-09-30

The HXS-30 makes hydrogen and oxygen, takes a direct current of several hundred amperes, and has a corrosive electrolyte running through it. It is also far too heavy to lift by hand. The hazards come from several directions, and so do the safety rules.

A stack has no built-in safety functions. Detection, interlocks, overpressure protection and emergency stop all live in the system you build around it.

This chapter covers immediate safety actions only. Diagnosis is in the troubleshooting chapter, and that work happens after the area is secure and only by qualified people.

HAZARDS **Hydrogen · high-current DC · electrolyte · weight** PPE **Depends on the task**

WHEN TO READ **All of it, once, before installing**

HOW TO READ THIS CHAPTER

First time

There is no section here to skip. Read it through once before installing, and keep the emergency response section next to the equipment.

Done this before

Re-read the signal words and the emergency response. Use the rest when checking against your own site safety rules.

Signal words

This handbook uses four signal words. They differ in severity, so read them as such.

SIGNAL WORD	MEANING
 DANGER	A situation that will cause serious injury or death if not avoided
 WARNING	A situation that could cause serious injury or death if not avoided
 CAUTION	A situation that may cause minor or moderate injury if not avoided
 NOTICE	Information that is not about personal injury but prevents equipment damage or loss of performance

What this stack is for

The HXS-30 is for producing hydrogen and oxygen from an alkaline electrolyte, and nothing else. Operate it within the limits in this handbook and the datasheet.

Do not

- Run it on a different electrolyte
- Run it outside the current, voltage, pressure or temperature limits
- Modify its structure, or dismantle or repair it without authorisation

Who should work on it

This document is for system integrators who design their own BoP, power, control and safety systems, and for trained operators running the stack inside such a system. You should be familiar with four things.

- Hydrogen safety, and hydrogen and oxygen venting, ventilation and vent routing
- High-current DC power equipment and electrical hazards
- Alkaline electrolyte handling and chemical safety procedures
- Procedures for lifting and moving heavy loads

NOTICE

Local regulations and site safety rules take precedence over this handbook.

Hydrogen

DANGER

Hydrogen is an explosion hazard.

- It is colourless and odourless, highly flammable, and forms explosive mixtures with air over a wide range. Confined spaces are especially dangerous, and a hydrogen flame is almost invisible.
 - The HXS-30 produces thousands of normal litres an hour. Even a small leak builds up quickly, so size ventilation and detection for that output.
 - Keep the area ventilated and remove ignition sources. Check for leaks with leak-detection fluid or a hydrogen detector.
 - Very little energy is needed to ignite it (about 0.02 mJ), so even a static spark can set it alight. Earth the hydrogen lines and equipment, and where a leak is suspected avoid clothing and plastic tools that build up static.
- Operate only in a well-ventilated area, or connect the vents to an engineered exhaust system.
 - Keep ignition sources away: no smoking, open flames, welding, grinding or spark-producing work near the stack or the vent outlets.
 - Use electrical equipment suitable for the area classification where hydrogen may be present.

- Check for leaks by an approved method, such as a hydrogen detector. Never use an open flame to find a leak.
- Hydrogen collects at ceilings and other high points. Take that into account when placing ventilation and detectors.

Vent lines

DANGER

Never combine a hydrogen vent with an oxygen vent.

- Route each to its own safe discharge point. Mixed vent gases are an explosion hazard.

- Vent lines must stay open. Fit no valve or device that could inadvertently close one.
- Do not restrict a vent line or create backpressure.
- Accumulated condensate can freeze a vent shut. Use slope, drain points, insulation or heat tracing as your site conditions require.
- An oxygen-enriched atmosphere raises the fire risk. Keep combustibles away from the oxygen discharge area.

PRACTICAL NOTES

On this stack the oxygen leaves with the electrolyte.

- The electrolyte circulates on the anode side only. Oxygen leaves through the oxygen and electrolyte outlet with the electrolyte, returns to the tank and separates there, so the oxygen vent belongs to your tank rather than to the stack. The rules above apply to it just the same.

Electrical

DANGER

Risk of electric shock and arc flash.

- The HXS-30 takes a rated 80 V at 360 A DC. At that current a single loose connection generates serious heat and arcing. Contact with a live conductor can cause serious injury or death.
- Contact with a live conductor causes serious injury or death.

- All electrical installation is done by qualified personnel.
- Provide overcurrent protection and a disconnecting device to your local code.
- Earth the DC supply and all connected equipment properly.
- Never connect or disconnect power cables under load.
- Keep electrical components dry and protected from contact with electrolyte.

⚠ WARNING

Voltage can remain at the terminals after shutdown.

- Turn the DC supply off, isolate it, allow time for discharge, and measure the terminal voltage before handling cables or terminals. Do not short the terminals with a tool.
- Touching the residual voltage gives an electric shock; shorting the terminals causes an arc and burns.

Electrolyte

⚠ WARNING

KOH solution is corrosive and can cause severe skin and eye burns.

- Handle it with safety glasses and alkali-resistant gloves. If it touches you, rinse at once with plenty of water.

⚠ CAUTION

In operation the electrolyte, lines and stack reach up to 80 °C. Touching them bare-handed causes burns.

- Wear gloves when touching them in operation or just after a stop. Confirm they have cooled before opening a line or draining electrolyte.
- Handle it according to the SDS and your site procedures.
- Use only KOH-compatible materials, for containers, tubing and fittings alike.
- The loop holds a large volume of electrolyte. Provide secondary containment under the stack and the tank in case of a spill.
- On exposure, flush with water immediately and seek medical attention as required.
- Keep an eyewash station and a safety shower near where KOH is handled.

PPE

i NOTICE

Where your site rules are stricter than this table, follow your site rules.



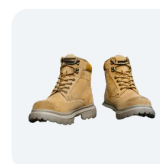
Safety glasses



Sealed goggles



Alkali-resistant gloves



Closed-toe shoes

Routine operation and monitoring	Safety glasses, closed-toe shoes and suitable work clothing
Handling electrolyte	Splash-proof goggles or a face shield, alkali-resistant gloves, and a chemical apron or lab coat
Lifting and moving	Safety boots and work gloves, plus whatever your site lifting procedure requires
Working directly on the stack	Safety glasses and work gloves. Near power cables and terminals, add electrical protection

Emergency shutdown and response

DANGER

Do not delay an emergency shutdown.

- In any abnormal or hazardous situation, personnel safety comes first. If you are unsure, stop at once and evacuate by your site procedure.

A gas or electrolyte leak, an unusual noise, smoke, a nearby fire, or visible damage

1

If it is safe to approach, stop the DC output to the stack and leave it off.

2

Warn the people nearby, evacuate non-essential personnel and restrict access.

3

Do not touch terminals, cables or wetted lines until the area is safe.

4

Follow your site emergency response plan and notify the responsible safety officer.

5

Do not resume operation until qualified personnel have identified and corrected the cause.

A hydrogen leak, or a suspected one

DANGER

Do not operate any switch or device in the area that could make a spark.

- Keep all ignition sources away and increase ventilation by your site procedure.
- Do not re-enter the area until authorised personnel declare it safe.

A vent suspected of being blocked or iced

DANGER

Overpressure and unsafe venting can result.

- Keep personnel away from the vent discharge locations.
- Do not attempt to clear a blockage until the pipework is fully depressurised and isolated.
- This work is for qualified personnel only, following site safety procedures.
- Undoing a blocked line carelessly makes trapped hydrogen and electrolyte spray out and injure you.

A spill or chemical exposure

WARNING

Avoid skin and eye contact with spilled electrolyte.

- Follow your site spill response procedure: chemical PPE, containment and clean-up, and disposal to regulation.
- For personal exposure, rinse with water immediately and follow the first aid in the SDS.

02 Receiving and storage

HXS-30 · updated 2026-09-30

From delivery to the stack in place: transport and handling, storage conditions, unpacking and inspection, and what is supplied against what you provide.

The connection procedure is in the quick start chapter. This one covers everything before it.

MOVING IT **With lifting equipment, never by hand** STORAGE TEMPERATURE **5 °C or above at all times**

PORTS **Caps and plugs left on**

HOW TO READ THIS CHAPTER

First time

Read the transport and handling section and settle the lifting method before delivery. On the day it arrives, do the unpacking and inspection section.

Done this before

Read the storage conditions for a unit that waits. Freezing and port protection are what matter.

Transport and handling

WARNING

This is not a weight to lift by hand.

- The weight is in the specification table on the product page. Use lifting equipment and supports rated for it, and keep people out from under a suspended load.
- Lift at four points with eyebolts in the four M12 tapped holes on top of the two end plates (two per plate). The eyebolts are supplied by you. You can also move it on its pallet with a forklift.
- The two plates standing up on top are the DC terminals. The terminal plates, the tie bolts around the stack and the ports are not lifting points.
- If it falls or tips over it can crush and seriously injure people.
- The lifting points and DC terminals are shown in [Figure 3-1](#).

- Keep the stack in its original packaging for transport whenever you can.
- Follow every handling symbol on the packaging.
- Never lift or support it by the ports, the protective caps and plugs, the fittings, or the electrical terminals and cables.
- Do not drop it or subject it to severe impact. Keep it out of rain, standing water and high humidity.

 WARNING

After a severe shock, a tilt or an accident in transit, do not install or operate it.

- Do the unpacking and inspection below first, and tell us what you find.
- Running a stack damaged in transit can leak hydrogen or electrolyte and lead to fire or burns.

If it waits before installation

 NOTICE

Never let it freeze. Keep it at 5 °C or above at all times.

- Moisture can remain inside the stack. Frozen, it damages the membrane, the seals and internal parts.
- Store it as marked on the packaging, and keep it in its original packaging while stored.
- Leave every port cap and plug fitted.
- Keep it indoors, dry and out of direct sunlight, and avoid condensing conditions.
- Avoid excessive vibration, dust and corrosive gases. Do not stack other loads on the package.

Unpacking and inspection

1

Inspect the outer packaging first.

- Note any visible damage, deformation or signs of impact on the delivery documents and photograph it, for a claim against the carrier.

2

Open the packaging, take the stack out with lifting equipment, and set it on a flat, solid surface.

- Keep the blade shallow when opening the packaging. Port threads and protective caps are easily damaged.

3

Inspect the stack visually.

- Check the end plates and the cell stack for dents, cracks and deformation.
- Check the electrolyte inlet, the oxygen and electrolyte outlet, the hydrogen outlet and their caps and plugs for damage, and that they are secure.
- Look for signs of leakage or residue around the ports and fittings and along the cell edges.
- Check the DC terminals for bending or damage.
- Verify the model and serial number on the product label. You will need them if you contact us later.

 WARNING

If anything is damaged, missing or irregular, do not connect it.

- Record the condition and photograph it, tell us and the carrier at once, and agree the next step before operating.
- Keep the original packaging where you can. You will need it if the stack is moved or sent for service.
- Connecting and running a damaged stack can leak hydrogen or electrolyte and lead to fire or burns.

What is supplied, and the boundary

Included	The HXS-30 stack itself.
On request	A STEP model of the exterior and enclosure. Internal parts and flow fields are not included.
You provide	The DC supply (rectifier), electrolyte circulation and temperature control, cooling, gas-liquid separation with drying or purification to the purity you need, the pressure and safety systems, and the electrolyte and DI water.

 NOTICE

The HXS-30 is a stack-only product.

- Send us your power, circulation and pressure conditions and we will agree the connection specification with you. Contract specifications follow the quotation and the approved drawings.

03 Quick start

HXS-30 · updated 2026-09-30

The sequence from the stack in place to your first hydrogen, in nine steps.

The HXS-30 is a 46-cell, 30 kW stack. You build the rectifier, electrolyte circulation, cooling, gas handling, instrumentation and interlocks around it. The connection specification is in the datasheet, and if you send us your system conditions we will agree the interface with you.

PREREQUISITE An external BoP and a DC supply **RATED INPUT** 80 V · 360 A

RECOMMENDED CONDITION 0.1 M KOH · 50 °C **PPE** Eye protection · alkali-resistant gloves

HOW TO READ THIS CHAPTER

First time

Work through the nine steps in order. This is a bare stack, so the BoP has to exist first. Step 1 lists what you need.

Done this before

Re-check the ports and the loop, then jump to the first run. The operating range and the shutdown sequence are in the operation and shutdown chapter.

1. What you need in place



1 × DC power supply

The rated operating point is 80 V at 360 A. Stack voltage rises during operation, so we recommend a supply able to deliver up to about 92 V. If you plan to run up to the stack voltage limit (2.2 V per cell, 101.2 V), choose a supply that reaches it. It needs a constant-current mode.



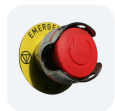
Electrolyte circulation and temperature control

A tank, a circulation pump, a heat exchanger and cooling, all in KOH-compatible materials. Size the cooling from the heat table in the operation chapter, for the highest voltage you will keep running to.



Gas-liquid separation and purification

Gas-liquid separation after the hydrogen outlet, and drying or purification equipment for the purity you need.



Pressure and safety systems

Up to 10 barg on the hydrogen side, with the anode at atmospheric pressure. Provide pressure protection, detection, interlocks and an emergency stop to suit.



Electrolyte and DI water

For the first fill, 0.1 M KOH in DI water; for make-up during operation, DI water.

Photos show the type of item only.

The stack is what ships.

- The BoP and utilities above are all yours to prepare. What is supplied is in the boundary section of the receiving chapter.

2. Identify the ports

Find the labels on the stack and confirm the four connections below. Naming can vary by revision, so follow the labels on the unit you received.

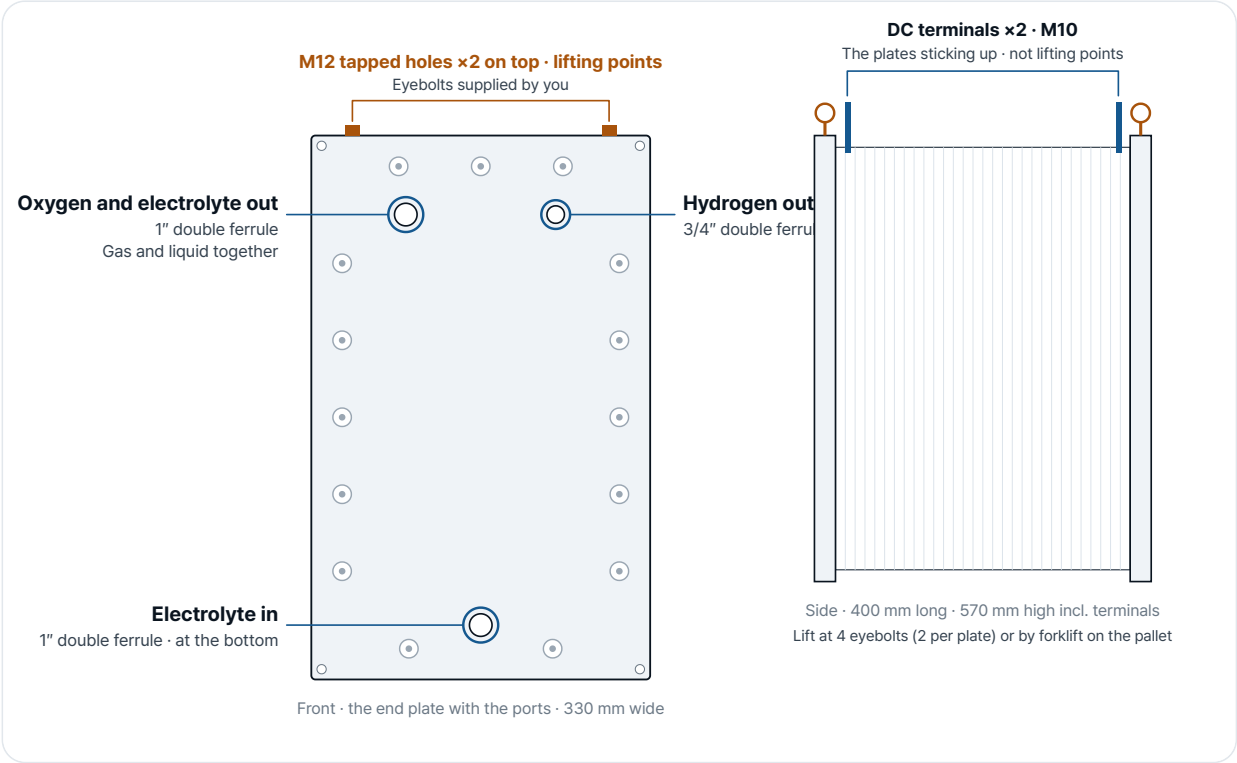


Figure 3-1 HXS-30 ports, DC terminals and lifting points. The front view uses coordinates from the end-plate 3D model; the side view simplifies the cell stack. They can differ between revisions, so follow the labels on your stack.

CONNECTION	WHAT PASSES THROUGH	FITTING
Electrolyte inlet	Electrolyte in	1-inch double ferrule
Oxygen and electrolyte outlet	Oxygen and electrolyte out, together	1-inch double ferrule
Hydrogen outlet	Hydrogen out	3/4-inch double ferrule
DC terminals	DC power in	M10

NOTICE

Prepare fittings in two sizes.

- The two electrolyte ports are 1 inch and the hydrogen outlet is 3/4 inch. All three follow the standard double-ferrule pattern, so off-the-shelf fittings and tubing of the same size fit directly.
- If you need the outline dimensions and port coordinates, ask for the exterior STEP model.

PRACTICAL NOTES

The oxygen and electrolyte outlet is a wet outlet: gas and liquid leave together.

- There is no separate oxygen port. Oxygen returns to the tank with the electrolyte and separates there. A blocked or kinked line here makes the return unstable.

3. Connect the electrolyte loop

A typical arrangement leaves the tank and comes back to it.

- Tank → pump → heat exchanger → electrolyte inlet → oxygen and electrolyte outlet → tank

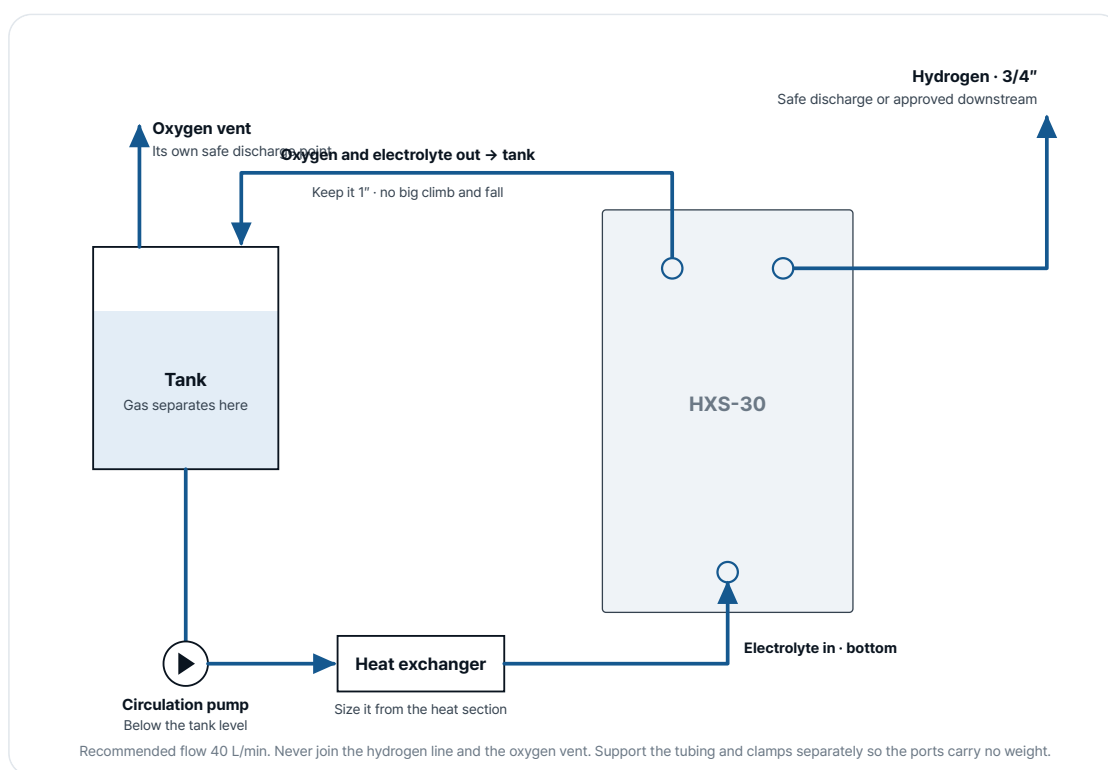


Figure 3-2 HXS-30 electrolyte loop and hydrogen line. Schematic; instruments, valves and interlocks are omitted.

WARNING

Do not let the pipework load the stack ports.

- A 1-inch line full of electrolyte is heavy. Support the tubing and clamps separately. A port carrying the weight of a line starts to weep.
- Electrolyte that leaks out causes chemical burns on contact.

1

Connect the tank outlet to the circulation pump inlet.

- Place the pump below the tank liquid level. With the suction side always flooded, it does not draw in air.
- Do not use the pump to pressurise the anode loop. The anode side runs at atmospheric pressure.

2

Connect the pump outlet through the heat exchanger to the stack's electrolyte inlet.

3

Return the oxygen and electrolyte outlet to the tank.

- The return has to flow smoothly. A line that climbs and falls traps gas and interrupts the return.
- Do not neck the return line down below the port size (1 inch).

i NOTICE

Resistance downstream of the stack raises the anode outlet pressure.

- Past a certain level, electrolyte is pushed across the membrane into the hydrogen side. That makes the line from the outlet back to the tank the one that matters most. Measure the anode pressure close to the stack outlet.

4. Connect the hydrogen line

⚠ DANGER

Never combine a hydrogen line with an oxygen discharge line.

- Route each to its own approved discharge point. Mixed, they are an explosion hazard.
- If the mixture ignites it explodes inside the line and can seriously injure people nearby.

1

Connect a 3/4-inch line to the hydrogen outlet.

2

Route the hydrogen outlet to a safe, well-ventilated discharge point, or to approved downstream equipment.

- Downstream you need gas-liquid separation: moisture leaves with the hydrogen.

i NOTICE

The hydrogen side is rated up to 10 barg.

- The 46-cell measurements in the datasheet were taken at atmospheric pressure. If you plan to run pressurised, tell us in advance and we will go through the conditions with you.

5. Fill the electrolyte

Before filling, check the loop connections and the tightness of the fittings again.

WARNING

KOH is corrosive. It causes severe skin and eye burns.

- Add KOH to water, never the other way round, which spatters. Wear goggles or a face shield, alkali-resistant gloves and a chemical apron while making up and handling it.
- A splash in the eye can cost you your sight.

1

Make up 0.1 M KOH in DI water.

- KOH of 95% purity or better, and water to ASTM D1193 Type II (1.0 µS/cm or below at 25 °C) recommended. The maximum is 30 µS/cm.

2

Fill the tank to a level that suits your circulation loop.

- **Check** There is no leakage at the fittings and ports.
- **If not** If anything leaks, stop circulation and retighten that fitting.

3

Run the circulation to purge air from the loop and the stack, then top the tank back up.

PRACTICAL NOTES

The recommended condition can be changed.

- 0.1 M KOH at 50 °C is both the recommendation and the condition behind the datasheet curves. If you want to run at a different concentration or temperature, tell us the condition and we will look at what changes together.

6. Set flow and temperature

1

Start circulation and confirm the flow is stable.

- **Check** Flow settles near the recommended 40 L/min. A brief wobble at first while air clears is normal.
- **If not** If it keeps fluctuating or will not rise, check that the pump suction is flooded and no gas is trapped in the return line.

2

Control the electrolyte temperature to 50 °C.

i NOTICE

The recommended flow is 40 L/min.

- This is the flow in our 46-cell long-term run; the first-run measurements in the datasheet were taken at 36 L/min. If you want to run well away from it, tell us your pump, piping and cooling and we will settle it with you.

i NOTICE

Do not let the electrolyte exceed 80 °C.

- 80 °C is the upper operating temperature. Higher temperature accelerates degradation and shortens life.

7. Connect the DC supply

⚠ DANGER

Risk of electric shock and arc flash.

- Electrical work is for qualified personnel. Turn the DC supply off and isolate it before connecting.
- Contact with a live conductor causes serious injury or death.

⚠ WARNING

A loose terminal leads to overheating and arcing.

- Never connect or disconnect cables under load. Support the cables so their weight does not hang on the terminals, and keep the terminal area dry.
- Overheating and arcing lead to burns and fire.

1

Connect supply + to stack + and supply – to stack –.

- Size the cables and lugs for 360 A continuous.

2

Tighten the M10 terminals securely.

- Confirm the tightening torque with us on delivery. Over-torque damages the terminal; under-torque overheats the joint.

3

Verify the polarity again before switching on.

- **If not** If it is reversed, do not apply current; reconnect it correctly.

8. Start the first run

1

Confirm circulation is running and flow and temperature are stable before applying current.

2

Set the DC supply to constant current.

3

Ramp the current in steps up to the rated 360 A.

- At each step, confirm flow, temperature control and voltage response are normal before moving to the next.
 - Heat rises with current. Check that the cooling keeps up.
 - **Check** At each step the voltage rises then settles, and flow and temperature hold. The first-run measurement was about 76 V at 360 A.
 - **If not** If the voltage approaches 101.2 V (2.2 V per cell) or you see a leak or a temperature problem, take the current to 0 A and see Troubleshooting.
-

9. First-run checks

Once at rated current and after a short hold, confirm three things.

- No electrolyte leaking at the stack ports, the fittings or the cell edges, by eye.
 - The electrolyte flow and temperature are stable.
 - Stack voltage rises sensibly with current. The first-run measurement in the datasheet is about 76 V for the stack at 362 A (1.660 V per cell).
-

PRACTICAL NOTES

Match the conditions before comparing with the datasheet.

- That measurement was taken at 0.1 M KOH, 50 °C, atmospheric pressure and 36 L/min electrolyte flow, from the power supply's own log, so it includes the voltage drop in the wiring. A different temperature, concentration or measuring point gives a different reading from the same stack.

WARNING

If anything looks wrong, reduce the current or stop at once.

- Keep circulation running briefly to cool down if needed. Inspect the external loop routing, the fittings and the operating conditions before restarting.
- Carrying on in an abnormal state can lead to leaks, overheating or hydrogen and oxygen mixing.

What to record

Once the first run is stable, write that day's values down once. It becomes the starting point when you read the voltage trend later.

ITEM	WHAT TO WRITE DOWN
Identification	Model and serial number, from the label
Operating point	Stack current and voltage, electrolyte flow and inlet and outlet temperatures, at the operating point you have chosen
Cell voltages	If you can measure them, the individual cell voltages and the spread between the highest and the lowest
If instrumented	Hydrogen flow and pressure, hydrogen purity, hydrogen in oxygen
Electrolyte and water	Make-up date and concentration, feed-water quality

PRACTICAL NOTES

Fix one operating point and measure at the same conditions every time.

- If the conditions change each time you get noise, not a trend. These are also the items we ask for when you contact us.

04 Operation and shutdown

HXS-30 · updated 2026-09-30

Running it day to day: what to watch in normal operation, level and water make-up, the operating range, what changes at low current, and the normal shutdown sequence.

The HXS-30 has completed first operation and is under long-term evaluation. Check any operating condition not covered in this chapter with us first.

RATED POINT 360 A · 0.1 M KOH · 50 °C TEMPERATURE LIMIT 80 °C MAKE-UP Yours, by your BoP procedure

HOW TO READ THIS CHAPTER

First time
Read the four sections in order. The first is what you watch every day; the second is what people most often miss.

Done this before
The limits table and the shutdown sequence are enough.

What to watch in normal operation

Keep the circulation steady and watch four things.

Flow and temperature	Confirm the flow is stable and the temperature is near target (50 °C recommended). If it keeps rising despite available cooling, reduce the current or stop.
Voltage	Monitor the stack voltage continuously, and the spread between cells if you measure individual cell voltages. A sudden jump or fluctuation at constant current means reduce the current or stop.
Leaks	Check around the ports, the external fittings and the cell edges periodically. Wetness or white crystals mean stop, correct the cause, then resume.
The wet outlet return	Confirm the return from the oxygen and electrolyte outlet to the tank flows smoothly. Gas trapping or a broken return means inspect the routing and the backpressure and correct it before continuing.

 **WARNING**

Reduce or stop first, then investigate.

- Do not diagnose while it runs. The order of checks is in the troubleshooting chapter.
- Carrying on in an abnormal state can lead to leaks, overheating or hydrogen and oxygen mixing.

Level and water make-up

Electrolysis consumes water; KOH is not consumed. The tank level therefore falls, and make-up depends on your procedure. Water consumption at rated current is in the specification table on the product page.

1 Keep the level high enough for stable circulation and cooling.

2 Add DI water to the tank by your external BoP procedure.

- At the 30 kW scale the level falls quickly. If make-up is manual, keep the interval short or fit automatic make-up.

3 If the level gets too low or the circulation becomes unstable, stop and correct it before continuing.

NOTICE

Insufficient make-up concentrates the electrolyte.

- Only water leaves, so the concentration rises, and a more concentrated electrolyte accelerates degradation. A low level also reduces the volume available for cooling.

NOTICE

Make-up water follows the same quality basis as the first fill.

- The water-quality figures are in the electrolyte fill section of the quick-start chapter.

Limits and recommended values

PARAMETER	RECOMMENDED · RATED	LIMIT AND NOTES
Current	360 A rated	Ask us before running above rated
Stack voltage	80 V rated	Rises during operation; limit 101.2 V (2.2 V per cell)
Electrolyte	0.1 M KOH	Ask us about other concentrations
Electrolyte temperature	50 °C	80 °C maximum
Electrolyte flow	40 L/min	Agree with us before running well away from it
Hydrogen pressure	Atmospheric	10 barg maximum

PARAMETER	RECOMMENDED · RATED	LIMIT AND NOTES
Anode pressure	Atmospheric	Not pressurised

i NOTICE

Where your contract specification sets a lower ceiling, that value applies.

PRACTICAL NOTES

Stack temperature is controlled through the electrolyte temperature.

- There is no way to heat or cool the end plates or individual cells separately. To change the temperature, change the electrolyte temperature with the tank heater and the heat exchanger.

Heat and cooling

The part of the input power that does not go into hydrogen becomes heat: whatever lies above 1.48 V per cell (the thermoneutral voltage). So the heat depends on stack voltage and grows as the stack ages and its voltage rises.

Calculation $\text{Heat (kW)} \approx \text{current (A)} \times (\text{stack voltage (V)} - 68.1 \text{ V}) \div 1000$

STACK VOLTAGE AT 360 A	HEAT
76 V (first run)	about 2.9 kW
80 V	about 4.3 kW
90 V	about 7.9 kW
101 V (2.2 V per cell limit)	about 11.9 kW

i NOTICE

Size the cooling for the highest voltage you will keep running to.

- Sizing it for the first-run voltage leaves it short as the stack ages. In our 46-cell long-term run at about 360 A the stack voltage rose from 76.8 V to 81.5 V over six days and the heat from about 3.1 kW to 4.8 kW. Judging from the stack inlet and outlet temperatures, the electrolyte carried 2.5-3.7 kW of it and the rest left through the stack surface.

Low-current and part-load operation

Running below rated current changes two things: the electrolyte heats less, and the hydrogen-in-oxygen ratio rises.

WHAT	WHY	WHAT TO DO
Electrolyte temperature	Less heat is generated, so it does not reach the recommended temperature	Fit a tank heater, temperature monitoring and over-temperature protection in the external BoP
Hydrogen in oxygen	Hydrogen crossing the membrane barely depends on current, while oxygen output is proportional to it. At lower load the same hydrogen mixes into less oxygen	Measure hydrogen in oxygen and interlock at 2 vol%. Set the minimum current as below

Setting the minimum current

The minimum current differs from stack to stack. Set it from the hydrogen-in-oxygen value measured at the rated 360 A on the first run, so that it stays below 1 % (half the 2 % limit) at low current too.

Calculation	Minimum current $\approx 360 \text{ A} \times (\text{hydrogen in oxygen measured at rated, in \%} \div 1 \%)$
Our example	0.22 % at 360 A at the start of our 46-cell long-term run → about 80 A
When to re-measure	Crossover can grow as the stack ages. Re-measure hydrogen in oxygen at rated current periodically and update the minimum current

NOTICE

This assumes the hydrogen side at about 1.4 bar.

- Pressurising the hydrogen side increases crossover and this calculation no longer holds. Tell us in advance if you plan pressurised operation.

PRACTICAL NOTES

If you run several stacks, stop some of them rather than turning all of them down.

- When demand falls, shut stacks down one at a time instead of taking every stack to low current. The ones still running are easier to keep within the hydrogen-in-oxygen limit near rated load.

Normal shutdown

1

Reduce the current step-wise to 0 A.

2

Turn off the DC output.

3

Keep circulation running as long as needed to cool down.

4

Stop circulation once it has cooled.

5

Turn off the tank heater if you used one, and secure the system by your site procedure.

6

Do a visual leak check around the ports and fittings.

PRACTICAL NOTES

Do not stop circulation first.

- Heat remains in the stack after the current reaches zero, and the circulation is what carries it away. Reversing the order can cause local overheating.

05 Maintenance

HXS-30 · updated 2026-09-30

The check lists, when to change the electrolyte, how to clean, and how to read the stack voltage trend.

The intervals here are guidance. Actual frequencies depend on run hours, load profile, ambient conditions and electrolyte condition.

ELECTROLYTE CHANGE **No fixed interval; judged by condition** RECORD AT MINIMUM **Voltage · current · flow · temperature**
BEFORE ANY WORK **Current to 0 A · DC supply isolated**

HOW TO READ THIS CHAPTER

First time

Print the check lists and remember the three criteria in the electrolyte section.

Done this before

Go to the [performance trend section](#). How to compare your records with ours is there.

Before you start

WARNING

Before any maintenance, stop electrolysis, set the current to 0 A and isolate the DC supply.

- Touching a connection while energised gives an electric shock or an arc burn.

NOTICE

Do not open the stack yourself.

- The bolts around the end plates are the tie bolts that hold the stack in compression. Do not loosen them while working on tubing or cables. Loosening them opens the stack, and large-area cells cannot be closed properly again without the right equipment.
- The HXS-30 is built for MEA replacement. If performance needs restoring, send us the stack: we replace the MEAs and reuse the main hardware. Ask us for the terms.

The check lists

Daily or per shift

- Scan the stack and the external loop: no electrolyte, water or gas leaking at the ports, the fittings or the cell edges.
- No white crystals around the ports or fittings, which can be dried KOH.
- The electrolyte flow and temperature are stable near target.

- The stack voltage is stable for the current setpoint.
- The hydrogen outlet and the oxygen and electrolyte return are unobstructed, and the two paths are not mixed.

Weekly

- Review the records and trends: stack voltage against current, the spread between cells, the stability of flow and temperature, and any recurring abnormal events.
- Inspect the tubing, fittings and supports for wear, discolouration, crystal residue, weeping leaks, and any load on the ports.
- Inspect the DC cable routing and the terminal area for discolouration or signs of heat, looseness and corrosion.

Monthly

- Check the electrolyte condition, and replace it if any criterion in the next section applies.
- Update the maintenance and operating records: run hours, start-stop cycles, electrolyte replacement dates, observations and corrective actions.

Changing the electrolyte

KOH is not consumed by electrolysis. Water is, and you make that up during operation. The electrolyte is therefore replaced by its condition and the performance trend rather than on a fixed interval. Consider replacing it when any of the following appears.

- Cell voltage rises continuously at the same current compared with earlier operation.
- Where you measure individual cells, the spread between them widens over time.
- The colour or clarity changes, or precipitate appears in the tank or the loop.

PRACTICAL NOTES

Measure the concentration first.

- A voltage rise at the same current looks like the stack degrading, but often the electrolyte concentration has fallen. Measure it with a conductivity meter or by titration and replace it if it has moved noticeably from the initial fill. If it falls again after a change, KOH is escaping somewhere, so find the leak first.

WARNING

If hydrogen in the oxygen exceeds 2%, stop and inspect.

- This is a stop-and-inspect condition, not a replacement criterion. Do not restart until you know the cause.
- Hydrogen building up on the oxygen side can explode in the line and separator.

The procedure

1

Perform a normal shutdown and let it cool to a safe temperature by your site practice.

2

Depressurise the external loop and drain the loop and tank into labelled, alkali-compatible containers.

3

Dispose of the used electrolyte to regulation and your site procedures.

4

Make up fresh 0.1 M electrolyte, refill the tank and purge air from the loop.

5

Restart circulation, check for leaks at every fitting and port, then resume electrolysis.

NOTICE

Do not mix old and new electrolyte.

- Label every container with contents, concentration and date.
-

Cleaning

NOTICE

No aggressive solvents and no high-pressure jets.

- Wipe the exterior with a soft cloth dampened with clean water.
- Wipe white crystals off with a water-dampened cloth, since KOH is water-soluble, then wipe again with clean water and dry.
- Deal with a spill by your site spill response procedure.

NOTICE

**If leakage recurs after tightening or replacing fittings,
or comes from the cell edges, stop and contact us.**

Reading the performance trend

Stack voltage rises over time. The point of watching the trend is to separate gradual change from an abnormal change caused by off-nominal conditions.

- Record the stack voltage periodically at one or more fixed operating points. Conditions that change every time give you noise, not a trend.
- If you can measure individual cell voltages, record the spread between cells too. A widening spread matters even when the average holds.
- Keep the run hours, start-stop cycles, setpoints and any abnormal events with it.

WHAT YOU SEE	WHAT IT MEANS
A step change at constant current	Abnormal. Start with the order of checks in the troubleshooting chapter.
A rapid change over a short period	Abnormal either way. If the temperature moves with it, suspect water make-up, concentration and cooling first.
One cell climbing well above the others	Abnormal. Stop operating and contact us with your records.

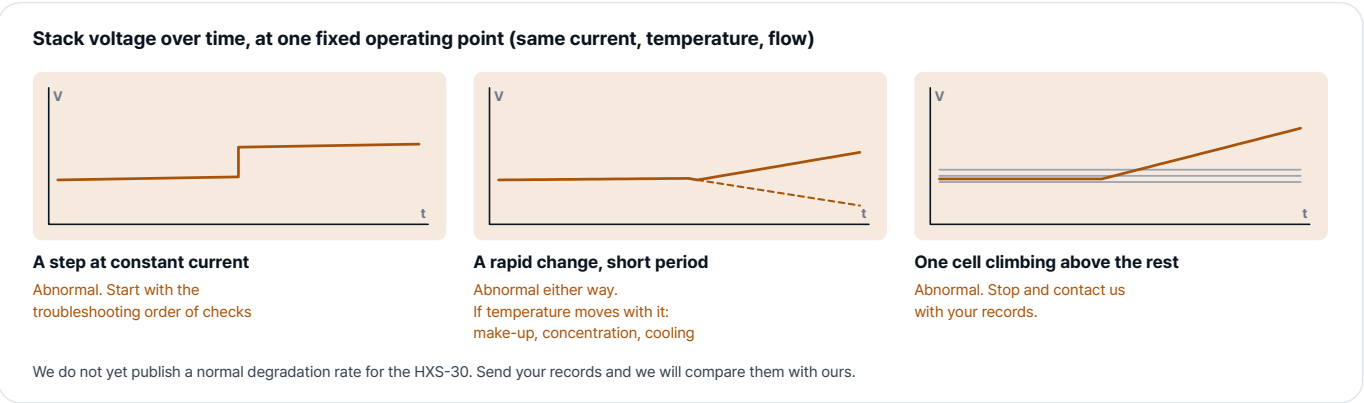


Figure 5-1 Reading the voltage trend. The rows of the table above drawn as shapes; schematic, with no values on the axes.

i
NOTICE

We do not yet publish a normal degradation rate for the HXS-30.

- It has completed first operation and is under long-term evaluation. Send us your records and we will compare them with our own operating data and tell you whether they are in the normal range.

06 Decommissioning and storage

HXS-30 · updated 2026-09-30

The sequence for taking the stack out of the system, whether for a long stand-down, a move, or shipping it in for service.

WHO **Qualified personnel only** ORDER **Stop, depressurise, drain, seal** STORAGE **5 °C or above at all times**

HOW TO READ THIS CHAPTER

First time

Do the three sections in order. Never open a line that is still energised or still pressurised.

Done this before

The draining procedure and the storage conditions are what you need.

Safe shutdown and electrical disconnection

DANGER

Do not decommission a stack that is still energised or pressurised.

- Live power means electric shock; trapped pressure makes hydrogen and electrolyte spray out when a fitting is undone, leading to fire or burns.

1

Reduce the current to 0 A and stop electrolysis.

2

Turn off the DC output, then the external disconnect or breaker.

3

Circulate to cool it down, then turn off the pump and temperature control.

4

Do not disconnect the DC cables straight away.

- Allow time for the charge to dissipate and measure the terminal voltage before disconnecting with tools.

Depressurise the gas paths

WARNING

Flammable gas can remain in the connected lines.

- Depressurise to ambient through the normal vent route used in operation. Do not loosen a fitting to vent gas.
- If the hydrogen side was pressurised, confirm on the pressure indication that no pressure remains.
- Undoing a fitting releases the remaining hydrogen, which can ignite.

Drain the electrolyte and seal it

WARNING

Electrolyte remains in the stack and the lines.

- Wear PPE and follow the electrolyte section of the safety chapter. The volume is large, so use secondary containment.
- It causes chemical burns on contact.

WARNING

If you push it out with nitrogen, do it in a ventilated place.

Breathing where nitrogen has collected can suffocate you.

- Nitrogen has no colour or smell, so you will not notice the lack of oxygen.
- Ventilate so the discharged gas cannot collect indoors. Using dry air removes this hazard.

1

Place labelled, alkali-compatible containers under the discharge point.

2

Stop circulation and drain the electrolyte from the lowest point of the loop.

- With the oxygen and electrolyte outlet at the top open to atmosphere, the electrolyte in the stack runs out through the electrolyte inlet at the bottom.

3

Push the remainder out through the inlet at the bottom with low-pressure nitrogen or dry air fed into the oxygen and electrolyte outlet at the top.

- Keep it to 0.3 bar or less, within the margin by which the anode side normally runs above the hydrogen side. Use a regulator with a 0–1 bar gauge.
- Continue until only gas comes out of the inlet.
- The hydrogen side drains upward, so liquid does not run out of it. Electrolyte does not circulate there and what remains is little more than water that crossed over, so cap it as it is.

- Do not tilt it by hand to drain it; its weight makes that dangerous.

4

Disconnect and cap.

- Disconnect the external lines from the electrolyte inlet, the oxygen and electrolyte outlet and the hydrogen outlet, and cap or plug every port.
- Disconnect the DC cables and protect the terminals from contact and moisture.

5

Confirm every port is securely capped and there is no active leakage.

NOTICE

Even drained, never let it freeze.

- The membrane and electrodes stay wet and residual liquid remains in the internal flow paths. Store it at 5 °C or above with the ports capped.

NOTICE

Shipping it in for service needs prior confirmation.

- Contact us first for a return authorisation and packing instructions. Items arriving in a leaking condition may be refused for safety reasons.

07 Specifications and reference

HXS-30 · updated 2026-09-30

What the HXS-30 is for, how it looks, its specifications, and the terms used in this handbook.

Intended use

The HXS-30 is a stand-alone 46-cell, 30 kW AEM water electrolysis stack. It makes hydrogen once integrated with your DC power, electrolyte circulation, gas-liquid separation and safety systems. Everything before and after the stack is in your design scope.

NOTICE

Long-term full-stack validation is in progress.

- Figures and procedures may be revised as results come in. See the web handbook for the latest.

WARNING

Do not use it like this.

- Passing current without electrolyte circulation
- Running outside the recommended conditions (electrolyte, temperature, current, pressure) without checking with us first
- Joining the hydrogen line and the oxygen vent in one line or vessel
- Opening the stack without authorisation
- Doing so can lead to fire, explosion, electric shock or chemical burns, or damage the equipment.

Product view



Figure 7-1 The HXS-30. Appearance may vary by revision.

Specifications

The specifications below are the same values as the product page and datasheet. They are beginning-of-life values unless stated otherwise.

H ₂ production	6,900 NL/h (15 kg/day · design)
Outlet pressure	Up to 10 barg on the H ₂ side
Efficiency (HHV)	46-cell, 30 kW full-stack design 84% · approx. 47 kWh/kg-H ₂
Recommended operating condition	0.1 M KOH · 50 °C (adjustable)
Operating temperature	Up to 80 °C
DC input	80 V · 360 A (28.8 kW)
Water consumption	6.1 L/h measured (360 A; 18.5 h continuous run, 22-23 September 2026; includes water carried out with the product gas) · electrolysis theory 5.6 L/h

46-cell continuous run	360 A constant current · 93.6 h without interruption (as of 26 September 2026, 13:08 KST; latest figures in the 46-cell technical note)
Number of cells	46
Electrode area · reference active area	Anode electrode area 600 cm ² · cathode active area 512 cm ²
Dimensions	570 × 400 × 330 mm
Weight	120 kg
Structure	Anode-side electrolyte circulation
Instrument calibration	Flow and gas analysers calibrated under KOLAS
End plate	SUS316L
Bipolar plate	Nickel-based metallic plate
Material change	Yes · we confirm the operating window and validation scope together

Terms

TERM	MEANING
AEM	Anion exchange membrane: a membrane that passes hydroxide ions (OH ⁻).
KOH	Potassium hydroxide, used as a 0.1 M solution for the electrolyte.
DI water	Deionised water. Quality is judged by conductivity (µS/cm at 25 °C).
MEA	Membrane electrode assembly: the electrodes and membrane that make up the heart of a cell.
BoP	Balance of plant: everything around the stack, such as power, pumps, tank, heat exchanger, piping, sensors and controls.
barg	Gauge pressure in bar, relative to atmosphere.
NL/h	Gas volume per hour in litres at standard conditions (0 °C, 1 atm).
BOL	Beginning of life. Specifications are BOL values unless stated otherwise.
SDS	Safety data sheet. Check it before handling KOH.

Manufacturer

Manufacturer	HydroXpand Inc.
---------------------	-----------------

Address	3F, 59 Dongtansandan 6-gil, Hwaseong-si, Gyeonggi-do 18487, Republic of Korea
----------------	---

Contact	+82 70-4110-1201 · info@hydroxpand.com · hydroxpand.com
----------------	--

Troubleshooting

HXS-30 · updated 2026-09-30

What to check when something looks wrong with the stack. The cause is usually in the external loop and the operating conditions rather than in the stack.

Repair and replacement of external BoP components is yours. We interpret the stack's behaviour and judge whether stack service is needed.

FIRST **Judge the hazard, then make it safe** ONE AT A TIME **One change, then re-check** RESTARTING **From low current**

HOW TO READ THIS CHAPTER

First time

Start with the order-of-checks section. Jumping straight to the symptoms skips making the area safe.

Done this before

Find the line for what you are seeing in the find-by-symptom table.

The order of checks

WARNING

This work can expose you to live electricity, hydrogen and corrosive electrolyte.

- Follow the safety chapter and apply your site's energy isolation and re-energisation prevention procedures first.
- This can lead to electric shock, fire or chemical burns.

1

Stop and assess the hazard level.

- Any sign of a hydrogen leak, fire, arcing, a burning smell, severe overheating or uncontrolled electrolyte leakage means follow the emergency section of the safety chapter.

2

Make it safe before touching anything.

- Ramp the current to 0 A, turn off the DC output, then isolate the DC supply from the stack.
- Confirm the vent and relief lines are unobstructed, and manage residual pressure and electrolyte by your site procedures.

3

Record the as-found condition.

- Record at minimum the stack current and voltage and the electrolyte flow and temperature, plus the cell voltages and hydrogen in oxygen if you measured them.

4

Check the most likely external causes.

- Flow and heat: valves open, tubing not blocked, no trapped air, tank level adequate, cooling available.
- Wet outlet and backpressure: no restriction or kink in the return line.
- Electrical: cables and terminals tight, no discolouration or marks of heat.

5

Apply one corrective action at a time.

- Change one thing and check whether it helps before changing the next. When you restart, begin at low current.

6

Know when to stop.

- If the issue persists, repeats or suggests hardware damage, stop operating and contact us.

Find by symptom

Find the line for what you see and take the first action. Lines run from most to least severe.

WHAT YOU SEE	SUSPECT FIRST	FIRST ACTION
Signs of a hydrogen leak, fire, arcing, a burning smell, severe overheating	—	Stop at once and follow the site emergency procedure
Hydrogen in oxygen above 2%	Gas crossing the membrane, low load	Stop electrolysis and shut down normally. Do not restart until the cause is found
A terminal or cable discoloured or hot	A loose joint, undersized cable	Stop, isolate, then check the joint and the cable size
One cell voltage far above the others	A fault in that cell	Stop. Do not keep restarting; contact us with your records
Voltage rising fast at the same current	Low temperature, dilute electrolyte, low flow	Reduce current or stop, then check temperature, concentration and flow
Voltage falling fast at the same current	High temperature, concentrated electrolyte	Reduce current or stop, then check temperature, concentration and level

WHAT YOU SEE	SUSPECT FIRST	FIRST ACTION
Temperature keeps climbing although cooling is available	Poor circulation, not enough cooling	Reduce current or stop
Wetness or white crystals at a port, fitting or cell edge	A loose fitting, tubing weight on a port, a cell seal	Stop and correct the fittings and supports. If it comes from a cell edge, contact us
The return gurgles or keeps breaking	Line routing, backpressure, trapped gas	Correct the routing and backpressure before continuing
Pump noise, or the flow wanders	Low tank level, air in the loop	Stop, correct the level, then purge the air
Concentration falls again after a change	KOH escaping somewhere	Find the escape path first. Do not just keep changing it
Raising the flow makes the pump noisy or the flow unsteady	Narrow suction or return tubing, or an abrupt change in diameter	Use larger tubing and put any change in diameter close to the tank

When the voltage behaves oddly

When the voltage moves quickly at the same current, look at the direction first. Up points to dilute or cold, down to concentrated or hot.

CAUSE	CHECK	ACTION
Temperature too low	The temperature reading and the heater	Bring it back to the recommended 50 °C
Temperature too high	Cooling and circulation	If it cannot be controlled, stop and service the cooling
Electrolyte too dilute	Recent make-up and the concentration	Replace with fresh 0.1 M electrolyte
Electrolyte too concentrated	Tank level and DI water make-up	Bring it back to 0.1 M by your site procedure
Flow too low	Pump, valves, blockages, air	Remove the restriction and restore the flow

 WARNING

If the voltage stays abnormal after every external cause is restored, stop operating.

- Membrane damage or internal crossover is not something you can resolve on site. Record the current and voltage trend, the level and the make-up history, and contact us.
- Running with a damaged membrane lets hydrogen and oxygen mix, creating a fire risk.

When to contact us

Having the following ready speeds up diagnosis. If you kept the record at the end of the quick-start chapter, half of it is already done.

GROUP	CONTENTS
Identification	Model (HXS-30) and serial number
Conditions at the time	Stack current and voltage, electrolyte flow, temperature and concentration. If measured, cell voltages, hydrogen in oxygen and hydrogen pressure
Symptom	What you saw, and whether it was during start-up, while ramping, in steady running or during shutdown
Installation	The loop layout, pipe and vent routing, the DC supply and cables
Evidence	Photos, and logs of current, voltage, temperature and flow around the event

 NOTICE

Returns for inspection or service go ahead only after we confirm them.

- Before confirming a return we may ask for more data or troubleshoot remotely first. Do not ship without prior confirmation.