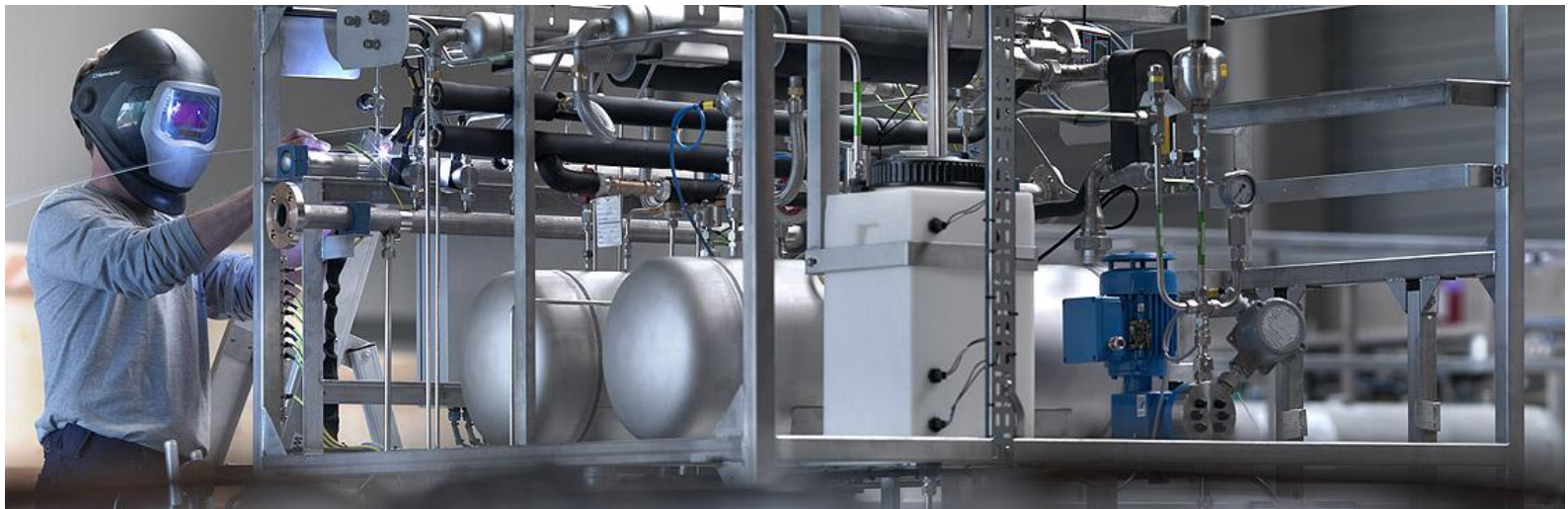


HYDROGENICS

Advanced Hydrogen Solutions



OnSite Hydrogen Generation HyLYZER[®] PEM Electrolysis Technology

Models:

- HyLYZER[®] - 1 Nm³/h
- HyLYZER[®] - 2 Nm³/h

TABLE OF CONTENTS

1. INTRODUCTION	3
2. BENEFITS	3
3. SCOPE OF SUPPLY	4
3.1. ENCLOSURE FOR INDOOR INSTALLATION	4
3.2. HUMAN MACHINE INTERFACE - HMI	5
3.3. PEM ELECTROLYSER STACK	5
3.4. HYDROGEN PURIFICATION SYSTEM (HPS)	5
4. OPTIONS	5
4.1. REMOTE MONITORING PACKAGE	5
4.2. STORAGE TANK	5
4.3. WATER TREATMENT SYSTEM	6
5. OPERATIONAL AND SAFETY SYSTEMS	6
6. TECHNICAL SPECIFICATIONS	7
7. STARTUP SERVICES	8
8. DOCUMENTATION	8
9. EXCLUSIONS	8
10. DISCLOSURE	8

We're Ready.

1. INTRODUCTION

The **HyLYZER®** is a modular electrolyzer which uses deionized (DI) water and either AC or DC electricity to produce up to 1.1 and 2.2 normal cubic metre per hour (Nm³/h) of hydrogen. The electrolysis reaction takes place within a proton exchange membrane (PEM) cell stack. The PEM Electrolyzer features fully automatic hydrogen production and comes installed inside a practical and easy to install cabinet.

Production of hydrogen using this method is a simple and emission-free process that is safe and reliable due to the minimal amount of moving parts and low operating temperatures. In addition, the system is designed to operate with minimal operator intervention. The system is capable of automated start and stop using pressure sensing at the hydrogen outlet.

The **HyLYZER®** versatility and available options makes it very suitable for a wide range of stationary, portable, and back-up power applications



During the run mode, the electrolysis grade feed water is pumped from the DI water storage tank into the electrolytic PEM cell stack where an electric direct current is passed to convert the water from 2H₂O to 2H₂ + O₂. The hydrogen gas is then processed and passed to the hydrogen outlet. The oxygen gas produced is vented to the atmosphere.

The hydrogen produced by the HyLYZER™ electrolyser is delivered at a quality of at least 99.998%.

2. BENEFITS

- Automatic operation
- Compact footprint
- Ease of Installation
- Quick start-up
- Rapid dynamic response
- High system efficiency
- Low maintenance : Virtually no moving parts
- Diagnostic and local monitoring software included
- Clean - the only by-products are oxygen and moisture.
- Minimal number of parasitic loads

3. SCOPE OF SUPPLY

Each HyLYZER features:

Enclosure for indoor installation
Control interface and HMI
PEM electrolyzer stack
Hydrogen Purification System (HPS)

Optionally, the HyLYZER can include:

Remote monitoring package
Storage tank
Water treatment system

3.1. Enclosure for Indoor Installation

The Hylyzer comes installed inside an indoor enclosure that is mounted on wheels to simplify installation. It comes with clear interconnection points on the cabinet.

All controls are located on the front side of the cabinet, as shown on the picture on the right.

The electrical connection is on the right side and the hydrogen and DI water plumbing is on the left side, as shown below.



Power Interface (AC Version, Right View)



DI Water Input and Drain Ports (Left View)



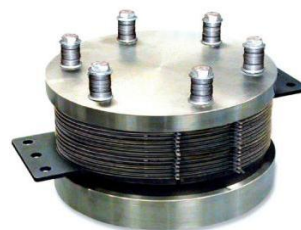
Hydrogen Output and Vent Ports (Left View)

3.2. Human Machine Interface - HMI

The HyLYZER comes equipped with an HMI that is visible from the front side of the cabinet. The HMI allows for the operator to operate the HyLYZER, view the status, read alarms and guide you through the startup phase. This also includes a diagnostic and local monitoring software package with HMI and event log.

3.3. PEM Electrolyser Stack

The advanced proprietary cell stack consists of circular electrolytic cells, each containing two electrodes, the PEM membrane assembly and bipolar plates. The bipolar plates separate the cells in the stack and provide flow channels for the deionized water, hydrogen and oxygen. Hydrogen and oxygen are generated when current is applied on the cell stack. The gases are then sent to the gas purification system.



3.4. Hydrogen Purification System (HPS)

The HPS consists of a PSA Dryer and deoxo vessel for oxygen removal. It is installed inside the same enclosure as the Hylyzer®.

4. OPTIONS

4.1. Remote Monitoring Package

This option includes the following features:

- Ethernet port with integrated web server with web interface.
- Email notifications of events such as system start, system stop, and alarms.
- Event log.
- Data logging to an SD flash card, or customer server.

4.2. Storage Tank

Hydrogenics can offer hydrogen storage tanks designed to ASME, PED or any other code. We also include the required safety valves, pressure gauges and other equipment needed for direct tie-in to the HyLYZER. Please contact us should you require a quotation for this optional storage system.

4.3. Water Treatment System

We can include a feed water treatment system that will convert incoming drinking water into deionized water required to produce hydrogen in the HyLYZER. The customer is responsible to provide water meeting or exceeding the following specifications to the water treatment system at all times.

FEED WATER AND PROCESS WATER REQUIREMENTS

FEED WATER REQUIREMENTS (BEFORE WATER TREATMENT SYSTEM)

Operating Pressure	bar (psi)	2.75 – 5.50 (40 – 80 psi)
pH	Range	3 – 11
Maximum Temperature	°C	38 °C
Maximum Turbidity	NTU	1.0 NTU
Maximum Silt Density	Index	5.0 (based on 15 min. test time)
Chlorine	ppm	< 0.1 ppm
Maximum TDS	ppm	2000 ppm
Hardness	grains (ppm)	10 grains (170 ppm as CaCO3)
Iron	ppm	< 0.1 ppm
Manganese	ppm	< 0.1 ppm
Hydrogen Sulfide	ppm	0 ppm
Langelier Saturation	Index	LSI must be negative

PROCESS WATER (AFTER WATER TREATMENT SYSTEM , TO THE HYLYZER)

Inlet Water consumption	L/h	~1 L of deionized water per Nm3 of H2 produced.
Required inlet water quality	MΩ.cm	> 1 (ISO 3696 scale 2)
Required inlet water pressure	barg (psig)	0.7 – 6.9 (10 – 100)

5. OPERATIONAL AND SAFETY SYSTEMS

• H ₂ Leak Detector Inside the Cabinet	• H ₂ De-Pressurizing Timeout
• Internal Hydrogen Level High	• O ₂ De-Pressurizing Timeout
• Over-Pressure	• CVM Cell Voltage Out of Limits (optional)
• Over-Temperature	• CVM Cell Voltage Offset Over-Limit (optional)
• Low Water Cutoff	• De-oxo Overtemperature
• Low Flow Cutoff	• H ₂ in O ₂ detection
• Differential Pressure	• Ventilation Loss

6. TECHNICAL SPECIFICATIONS

PROPERTY	UNIT	HYLYZER™-1	HYLYZER™-2
ELECTROLYSER			
Model	-	HyLYZER™-1	HyLYZER™-2
Type	-	Proton Exchange Membrane Electrolyser	
System efficiency	kWh/Nm ³	6.7	
Net Production after Dryer	Nm ³ /h (scfh)	1 Nm ³ /h (38 scfh)	2 Nm ³ /h (76 scfh)
Turndown Ratio	%	0 to 100% (user selectable)	
Electrolyser Output Pressure	barg (psig)	0 – 7.9 (0 – 115)	
Hydrogen Purity	%	>99.998%	
O ₂	ppm	< 2	
N ₂	ppm	< 2	
Atm. Dew Point After Dryer	°C	< -57 (15 ppm v/v)	
Power Supply		208/120,3 phase,4 wire+gnd,50/60 Hz 200-260,1 phase,2 wire+gnd, 50/60 Hz Direct connection to DC possible upon request.	
Cooling Requirements	-	Air-cooled	

OPERATING CONDITIONS

Site	-	Indoor, in a non-hazardous, non-classified area	
Ambient Temperature Range	°C	+5 to +40	
Relative Humidity	%	0% to 90% - non condensing	
Altitude	m	1520 (higher altitudes available on request)	

ENCLOSURE DIMENSIONS

Cabinet (WxDxH)	m	0.75 x 0.66 x 1.17	1.30 x 1.00 x 1.25
Total Mass	kg	250	275

7. STARTUP SERVICES

Field services of one (1) supervisor for three (3) days on site is required for the verification of the installation (done by others), start-up, commissioning of the complete system and training of staff on the operation of the system.

All Hydrogenics expenses for travel, accommodation and living are not included in this proposal. Delays beyond the control of Hydrogenics shall be billed at standard daily rates. Commissioning consumables are not included.

8. DOCUMENTATION

Standard documentation in English language to be provided includes

- One (1) printed and one (1) electronic version (.pdf format) via CD of Technical File with:
Operation and Maintenance manual(s),
- Quality documentation (pressure vessel documentation and factory test report)
- Electrical drawings
- Mechanical drawings

9. EXCLUSIONS

Unless stated otherwise in the quotation, the following items are not included in the scope:

- All utilities
- DI Water Supply System (optional – quoted upon request)
- Site design of civil, electrical, and mechanical systems, where applicable
- Site preparation work including foundations, utilities, and setting of equipment, where applicable
- Management of site preparation activities including permitting, zoning, inspections, and approvals
- Integration of System with utilities or other components (optional)
- Installation, commissioning, and training (optional)
- Consumables, Spare & Wear parts (optional)
- Any material/equipment outside the limit
- Drawings, data or calculations of a proprietary nature
- Testing or test equipment at site beyond Hydrogenics standard factory and site testing

10. DISCLOSURE

The copyright in this document is exclusive property of Hydrogenics Corporation and this document may not be copied, translated, modified or disclosed without the written authorization of Hydrogenics and must be kept in confidence.