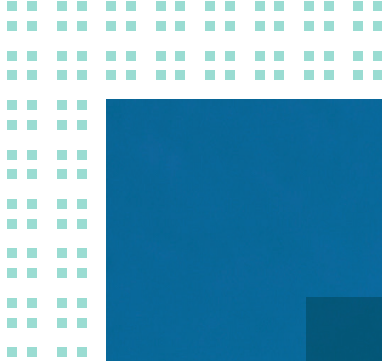




# Solutions for hydrogen



**Pietro  
Fiorentini**



# Hydrogen: the ideal ally for the energy transition

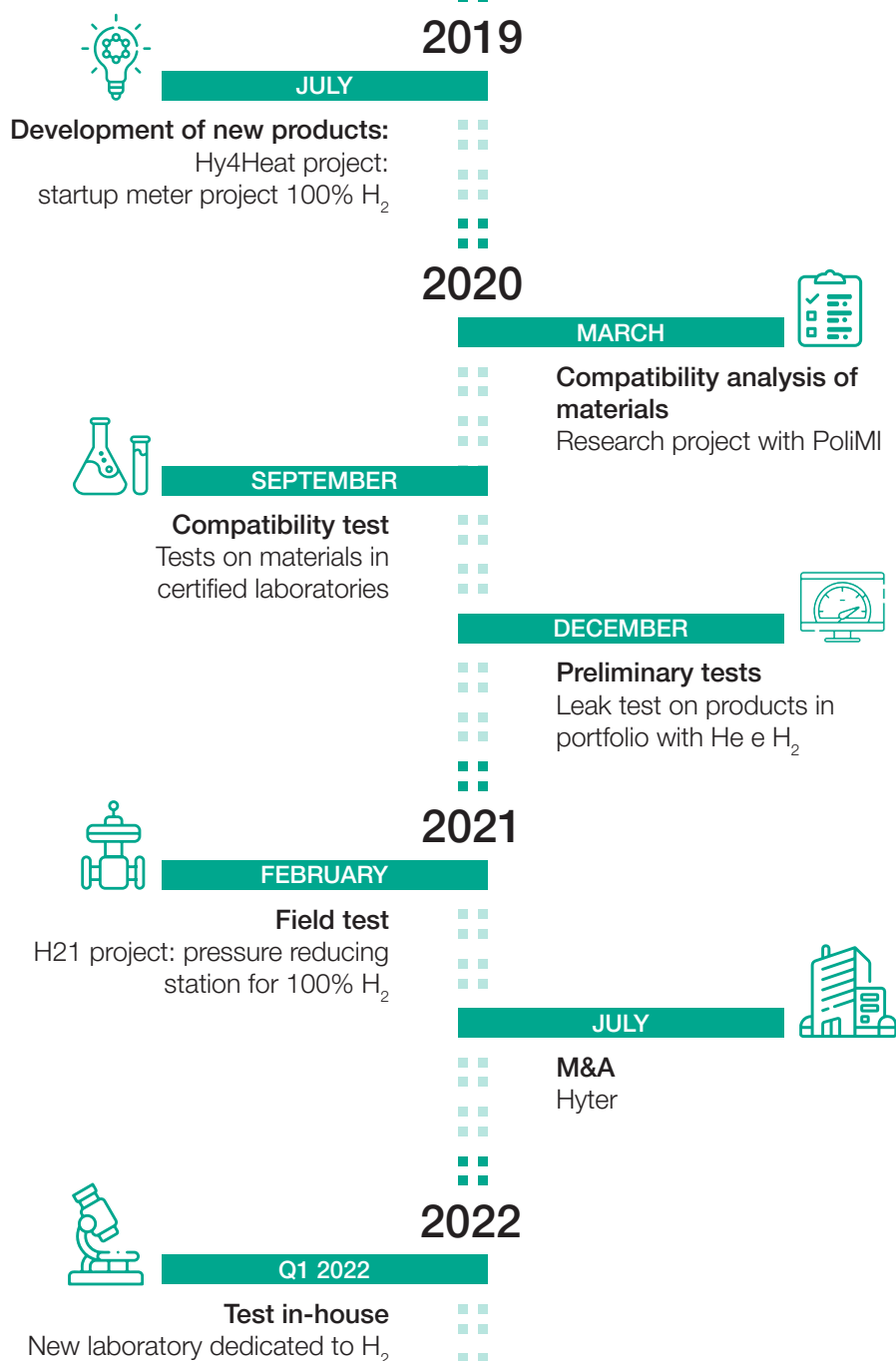


The energy transition is based on using a clean energy mixture, including hydrogen. Our solutions are designed to enable new production technologies and exploit the existing gas networks for its transport and distribution.





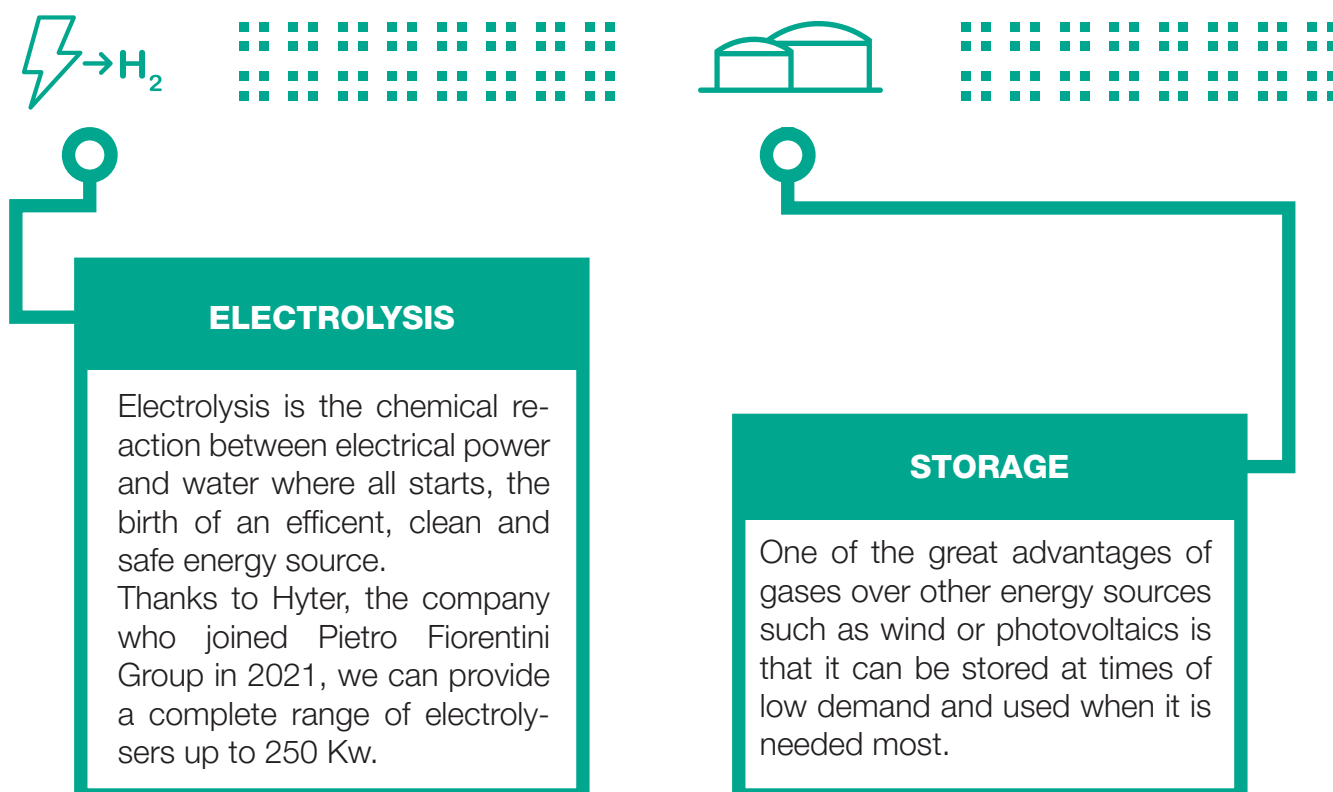
# Pietro Fiorentini **hydrogen journey**



# Pietro Fiorentini **hydrogen value stream**

The need of a large scale use of hydrogen is pushing gas infrastructure to drastically evolve. We are applying our international 80 years experience on gas networks to face this exciting challenge: from designing and testing hydrogen ready solutions up to developing new hydrogen blending stations, our purpose is to **exploit the full potential of existing gas networks to accept and deliver hydrogen**.

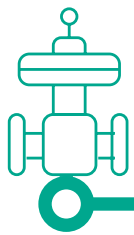
Our set of solutions spans from hydrogen generation through electrolysis up to the end users metering, passing through storage, pressure control and blending with natural gas.



## BLENDING AND INJECTION

Hydrogen networks are on the rise, and especially in the first part of their path, they will have to work together with traditional natural gas transmission and distribution grids.

Depending on various factors, end users may need several degrees of blending, from 20% up to pure hydrogen.



## PRESSURE CONTROL

We define the standard of the pressure regulator with the main purpose of allowing the gas to flow smoothly to the utilisation point, always in total safety. We are bringing our decades long experience with natural gas in the hydrogen field to provide a complete range of reliable pressure regulators.

## METERING

Accurate gas metering is a primary requirement for the energy sector. We provide a complete range of gas meters for residential, commercial and industrial applications.

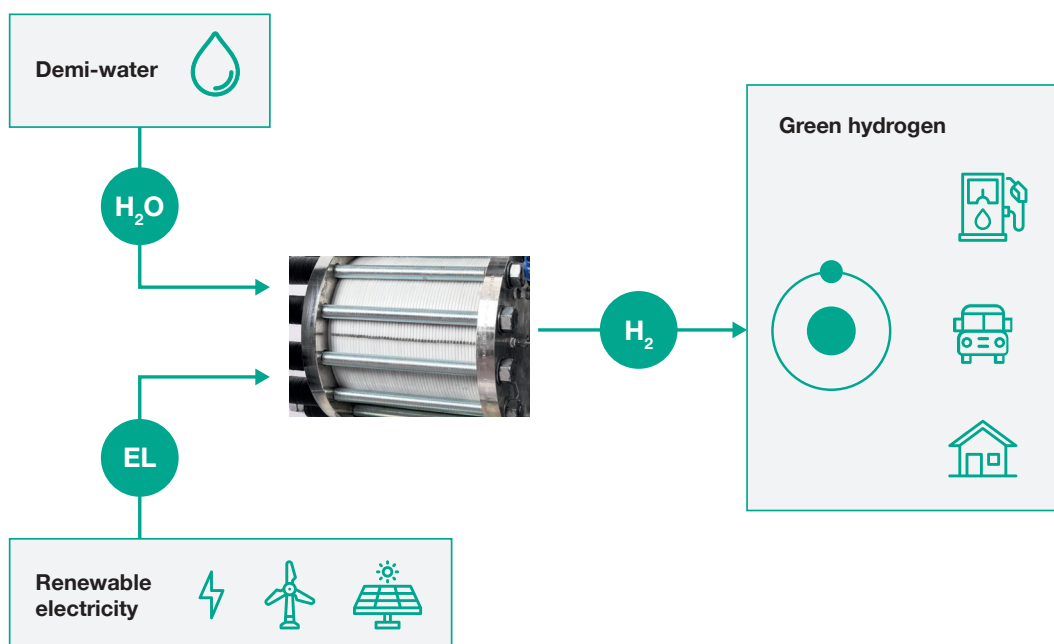


## AEMWE electrolyzers

Hyter is a company operating in the hydrogen sector since 2011. It joined Pietro Fiorentini Group in July 2021. The company develops **solutions to generate green hydrogen through the electrolysis of water**, using a process based on anionic exchange membrane technology (AEMWE).

Using these technologies satisfies multiple needs in the energy transition process. For example, it enables **storing and consuming the hydrogen produced**, thus stabilising the variability of the production of electricity from renewable sources, very often not aligned with consumption. There are also umpteen potential applications, like sustainable mobility, sector coupling or solutions to satisfy residential uses.

### Hyter How it works





| Scope                               | Size                                       | Main features                                                                                                                                                                                                                                  | Time to market |
|-------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Small-mid scale electrolyser</b> | Up to 20 stacks (10 kW in parallel)        | <ul style="list-style-type: none"> <li>- Few rare metals</li> <li>- Efficiency 85%</li> <li>- Up to 25 bar output pressure</li> <li>- H<sub>2</sub> purity 99.95%</li> <li>- 3% of electrolyte</li> <li>- Process water: demi water</li> </ul> | 3 months       |
| <b>Large scale electrolyser</b>     | Multiple stacks in parallel (80 or 250 kW) |                                                                                                                                                                                                                                                | 12 months      |

## Hyter Main features

- |                                                                                                                        |                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
|  Working with direct renewable source |  Minimum usage of rare metal |
|  Compression up to 700               |  Modular solution           |
|  Demi water in the process          |  85% of efficiency         |
|  Purification up to 99.999%         |  Fuel cell integration     |
|  Using 3% of electrolyt             |  Easy maintenance          |

## Hyter Reference list

| Scope                | Size      | Customer        | Country     | Year |
|----------------------|-----------|-----------------|-------------|------|
| Refueling station    | 500 NI/h  | Redam Srl       | Italy       | 2014 |
| Storage PV           | 1500 NI/h | Aquacell GMBH   | Germany     | 2015 |
| Refueling station    | 1500 NI/h | Caldoa GMBH     | Germany     | 2020 |
| Laboratory           | 250 NI/h  | Enea            | Italy       | 2018 |
| Laboratory           | 500 NI/h  | Edison Spa      | Italy       | 2019 |
| Pilot                | 500 NI/h  | Electrohydro BV | Netherlands | 2020 |
| Pilot                | 500 NI/h  | Bareau BV       | Netherlands | 2020 |
| Storage PV           | 2000 NI/h | Enphos Srl      | Italy       | 2021 |
| Biomethanation plant | 4000 NI/h | Micropyros GMBH | Germany     | 2021 |
| Micro-grid           | 2000 NI/h | PLT energia     | Italy       | 2021 |
| Refueling station    | 6000 NI/h | Sera GMBH       | Germany     | 2021 |



# Pressure vessel tanks

## for hydrogen storage

One of the great advantages of gases over other energy sources such as wind or photovoltaics is that it can be stored at times of low demand and used when it is needed most. Moreover, it allows the transportation of gas without expensive pipeline interventions.

Thanks to the expertise of our team, all these traditional advantages of natural gas are applicable to hydrogen on a wide range of pressure vessel tanks, tailored on every customer's need.

| Features            | Values              |
|---------------------|---------------------|
| Capacity*           | from 25 up to 250 l |
| Material            | Stainless steel     |
| Design pressure*    | 80 bar              |
| Design temperature* | +50° C              |

(\*) **REMARK:** Different functional features and/or extended temperature ranges available on request. Stated temperature ranges are the maximum for which the equipment's full performance are fulfilled. Standard product may have a narrower range.

## Vessel tanks certifications



EN13445



ASME VIII  
Div. 1



CE

# Hydrogen: our expertise





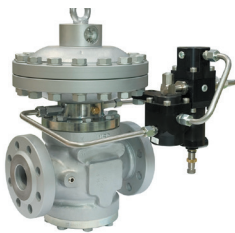
# Pressure control

## for hydrogen networks

We define the standard of the pressure regulator with the main purpose of allowing the gas to flow smoothly to the utilisation point, always in total safety. Thanks to our many decades of experience in the natural gas field, we can provide a complete range gas pressure regulators suitable for all applications, from transmission to residential.

These devices are now being tested to work with hydrogen blends and pure hydrogen, in order to be ready for the future of gas networks.

### Hydrogen ready pressure control devices range



Pilot operated regulators



Direct action regulators



Double stage regulators



Governors



Slam shut valves

### Main application field covered



Gas compression /  
booster stations



Gas storage



City gates



Power generation



Heavy industries



Gas engines



District stations



Medium/small  
industry



Commercial  
users



Residential users



## Pressure regulators compatibility and application

| Range                                                                                                                                                                                  | Model        | Compatibility |      | Main applications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                        |              | 0-20%         | 100% |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Transmission                                                                                                                                                                           | Reflux 819   | ✓             | ✓    |                               |
| Transmission                                                                                                                                                                           | Aperflux 851 | ✓             | ✓    |                               |
| Transmission                                                                                                                                                                           | Staflux 187  | ✓             | ✓    |                               |
| Distribution MP                                                                                                                                                                        | Reval 182    | ✓             | ✓    |                               |
| Distribution MP                                                                                                                                                                        | Norval       | ✓             | ✓    |                               |
| Distribution MP                                                                                                                                                                        | Dival 600    | ✓             | ✓    |                               |
| Distribution LP                                                                                                                                                                        | Dival 500    | ✓             | ✓    |                               |
| Distribution LP                                                                                                                                                                        | FE           | ✓             | ✓    |                     |
| Distribution LP                                                                                                                                                                        | Governors    | ✓             | ✓    |           |
| <b>NOTE: All optionals available with each pressure regulator ( i.e. monitors, slam shut valves, silencers) have the same compatibility degree of the device they are equipped to.</b> |              |               |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## Slam-shut valves compatibility and application

| Range           | Model   | Compatibility |      | Main applications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------|---------|---------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                 |         | 0-20%         | 100% |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Distribution MP | Dilock  | ✓             | ✓    |           |
| Distribution MP | SBC 782 | ✓             | ✓    |           |
| Distribution MP | SCN     | ✓             | ✓    |           |

 Already available
  Upon request

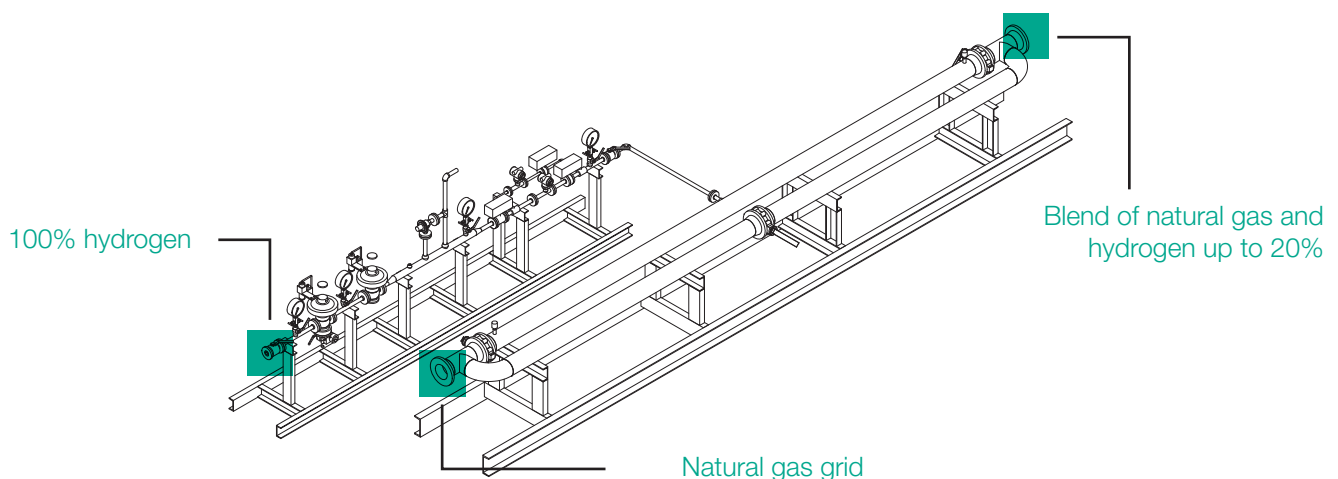


# Blending & Injection

## Hydrogen stations

Hydrogen networks are on the rise, and especially in the first part of their path, they will have to work together with traditional natural gas transmission and distribution grids.

Depending on various factors, end users may need several degrees of blending - up to 20% hydrogen. This means that a reliable, fast-responding system is needed to blend, analyse and control hydrogen flow in the grid.



We can provide tailor designed station for blending & injection, featuring a full scale industrial design that can be easily adapted from low pressure districts up to high pressure transmission networks and industrial applications.



## Pietro Fiorentini hydrogen test laboratory

In order to field test our products in a safe and reliable environment, we created a brand new hydrogen test laboratory.

Based in our headquarter in Arcugnano (Vicenza, Italy), our hydrogen test laboratory is the place where we **test the readiness of our products** and **develop new projects** for both transmission and distribution networks.

**Implementation:** Q1 2022

**Main features:** Inside our laboratory we are able to **test our products with pure hydrogen** and with **natural gas blends from 0 to 100%**, with a blend volume up to 4 Sm<sup>3</sup> accumulation, 200 l at 20 bar.

We are able to test with **flow rates up to 40 Sm<sup>3</sup>/h in closed loop and up to 25 Sm<sup>3</sup>/h in continuous discharge**, with a pressure up to 100 Bar static. To test our residential meters we apply a pressure variation from 20 to 500 mBar, from 4 to 6 bar to test our regulators.

The **purity of the hydrogen** produced by our electrolyzers **reaches 99.95%**.

## Our lab in numbers



**99,95%**  
Hydrogen  
purity



**Up to 100  
Bar**  
Max static test  
pressure



**40 Sm<sup>3</sup>/h**  
Flow rate in  
closed loop



**40 Sm<sup>3</sup>/h**  
Flow rate in  
continuous  
discharge



# Metering

## for hydrogen networks

Accurate gas metering is a primary requirement for the energy sector. Pietro Fiorentini provides a complete range of gas meters for residential, commercial and industrial applications.

### Hydrogen ready meters range



Turbine meters



Rotary meters



Ultrasonic meters



Ultrasonic smart meters



Full hydrogen smart meters

### Main application field covered



Gas compression /  
booster stations



Power generation



Medium/small  
industry



Gas storage



Heavy industries



Commercial  
users



City gates



District stations



Residential users



## Meters compatibility and application

| Type              | Model       | Compatibility |      | Main applications |
|-------------------|-------------|---------------|------|-------------------|
|                   |             | 0-20%         | 100% |                   |
| Turbine           | IM-TM       | ✓             |      |                   |
| Rotary            | IM-RM       | ✓             |      |                   |
| Ultrasonic        | FioSonic    | ✓             |      |                   |
| Ultrasonic static | SSM-iCON    | ✓             |      |                   |
| Ultrasonic static | H2-SSM-iCON | ✓             | ✓    |                   |

## Zero emissions target in the United Kingdom

Our first step in the hydrogen world was taken in the **Hy4Heat** project, wanted by the United Kingdom to achieve the target of being a **zero emissions Country by 2050**. More specifically, the project aims to check the safety and technical-economic feasibility of **replacing methane gas with 100% hydrogen** in the domestic/industrial networks. Working packages were assigned to us in the Hy4Heat project. These include the supply of a **residential meter** and all the upstream and downstream components. The result is **H2-SSM**, the first static, ultrasonic meter developed to measure up to 100% of hydrogen, currently in its preliminary test phase with the Hydrogen Home in the United Kingdom.

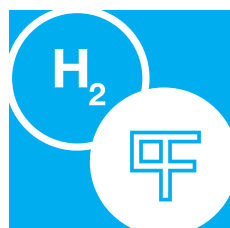




[www.fiorentini.com](http://www.fiorentini.com)



[www.hyter.it](http://www.hyter.it)



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**CT0080ENG**



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hydrogen\_catalog\_ENG\_revB

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