Advantages of an EVAL™ layer in a multilayer plastic hydrogen tank:

- An outstanding barrier to hydrogen under high pressure – superior to that of other polymers.
- Reduced weight, resulting in greater fuel economy. EVAL™ resins are lighter than metal.
- Multi-layer plastic hydrogen tanks are lighter than metal tanks.
- Environmentally friendly.
  - Fully recyclable.
  - EVAL™ resins are easily processable by (co)extrusion, (co)extrusion blow moulding, rotomoulding, (co)injection.

EVAL™ ethylene vinyl-alcohol (EVOH) copolymer resins are characterised by their outstanding gas barrier properties and by their excellent processing.

EVAL™ M type has the lowest ethylene content and provides the highest barrier for automotive and flexible applications.

EVAL™ F type offers superior barrier performance and is widely used for automotive, bottle, film, tube and pipe applications.
The hydrogen barrier properties of EVAL™ are influenced by several factors: the ethylene content, the temperature, the relative humidity, the thickness of the layer, and the pressure. Whatever the condition, EVAL™ offers outstanding hydrogen barrier properties compared to other materials.

### Influence of the ethylene content

A lower ethylene content results in a better hydrogen barrier.

### Influence of the temperature

The hydrogen barrier performance versus temperature follows the Arrhenius law, i.e. the gas permeability of polymers increases as the storage temperature increases.

### Properties of EVAL™ resins

EVAL™ resins offer outstanding hydrogen barrier properties, superior to those of other polymers.

### Influence of the layer thickness

The gas barrier properties of EVAL™ resins are inversely, linearly proportional to the thickness of the EVAL™ layer. When the thickness of the EVAL™ layer is doubled, the H²GTR is halved.

### Influence of the pressure

A lower pressure results in a better hydrogen barrier.

### Hydrogen permeability coefficient at 23°C and 0% RH (cm³.mm/m².d.atm) at different pressures

<table>
<thead>
<tr>
<th>Pressure (bar)</th>
<th>EVAL™ M100</th>
<th>EVAL™ F101</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>0.12</td>
<td>0.14</td>
</tr>
<tr>
<td>50</td>
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Measurements carried out at Mecadi GmbH.
Measurement of monolayer films: 0.1 mm thick, medium value of three independent specimen; applied pressure difference over the film is 0 bar, 50 bar and 100 bar.

### Reference measurement on sintered metal: < 0.025 for 1 bar, < 0.001 cm³(STP).mm/m².d.atm for 50 and 100 bar.

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EVAL™ for hydrogen fuel cells

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Contact

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Belgium
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Fax: +32 3 250 97 45
www.eval.eu
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**H₂ permeability coefficient (cm³(STP).mm/m².d.atm) at 23-30°C, at 1 atm absolute**

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**Protecting the environment**
EVAL™ EVOH is an environmentally friendly plastic. It contains no chlorine, dioxin, metals or endocrine disrupters. It can be recycled, either as part of a separate coextruded reglar layer or as post-consumer reglar. And it will not disrupt polystyrol or PET recycling streams and processes.

Hydrogen fuel cells do not produce polluting emissions or greenhouse gases. Hydrogen storage and fuel cell systems need to be reliable and must provide an outstanding barrier against hydrogen gas. EVAL™ EVOH resins help ensure very low hydrogen gas permeation.
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Schematic diagram of a polymer-electrolyte-membrane fuel cell (PEMFC) that uses hydrogen as fuel.

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