

## Hydrogen Interface for Trailer to Hydrogen Refueling Station

Hydrogen refueling stations (HRS) are being deployed out of the industrial environment where Industrial Gas Companies are used to operate trailers. It is foreseen that a significant increase in number of deliveries to HRS will be required to support the growth of Hydrogen mobility applications. The connection between Gaseous Hydrogen (GH<sub>2</sub>) trailers and HRS are typical industrial connectors but there is a lack of harmonized standardization of physical connectors and relevant safety systems for interoperability. The aim of this document is to represent EIGA recommendations on this topic.

The scope of the document covers GH<sub>2</sub> trailer usage in Europe, however most of the functional requirements can be extended and adapted for other geographies.

The requirements of this document only apply for new installations.

### Definitions

#### **Transfer panel**

An interface device, between the GH<sub>2</sub> trailer and the HRS. The transfer panel receives hydrogen from the source (e.g tube trailer or Multiple Element Gas Container MEGC) and transfers Hydrogen to the HRS, regardless of the source pressure. The transfer panel can include process equipment and safety functions such as sensors, valves, pressure reducers, check valves, pressure safety valves, vent line, grounding cable etc. It includes connectors for hydrogen and optional instrument gas supply for trailers. One HRS can have one or more transfer panels. This transfer panel can be part of the station or the supply chain.

#### **Working Pressure**

The settled pressure of a compressed gas at a uniform reference temperature of 15 °C (see EN ISO 10286).

#### **Maximum Allowable Working Pressure of the HRS**

The Maximum Allowable Working Pressure (MAWP) is maximum pressure permissible in a system at the temperature specified for the pressure (see ISO 19880-1).

#### **Developed Pressure of the trailer**

Developed pressure is a common term used across gas cylinders, bundles and other packages within the scope of EIGA TB 22. It is a pressure developed in a package during filling as a result of filling pressure and temperature generated due to compression.

#### **Hydrogen Refueling Stations (HRS)**

Facility for the dispensing of compressed hydrogen vehicle fuel, often referred to as a hydrogen refueling station (HRS) or hydrogen filling station, including the supply of hydrogen, and hydrogen compression, storage, and dispensing systems (see ISO 19880-1).

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## Risk management of interfaces between trailers and HRS (example for 200 bar and 300 bar trailers)

For safe operation of the interface between a GH2 trailer and HRS, the following points shall be considered:

1. Compatibility of trailer and HRS connections for gaseous hydrogen, instrument gas, process signals (if applicable).
2. Gas transfer from GH2 trailer to HRS can be performed (valves, sensors, procedures, etc.).
3. Functionalities and devices for safe gas transfer operation (emergency-stops, overpressure protection, vent system, grounding, anti tow-away, etc.).

Main hazards are shown in figure 1.

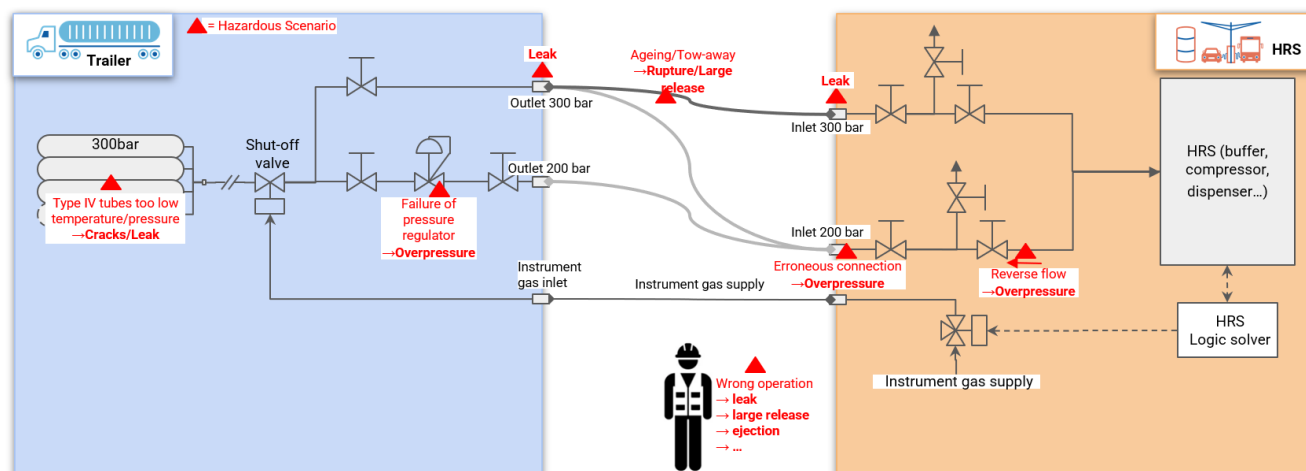


Figure 1: Main hazards at interface between a GH2 trailer and HRS (example for 200 bar and 300 bar trailers)

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| Hazardous events                               | Causes                                                                      | Consequences                                                                                                      | Examples of Safeguards                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| H2 leak on GH2 flexible hose coupling          | Various                                                                     | H2 release / Fire / Explosion                                                                                     | <p><b>HRS:</b> Gas detection safety function= Detection → HRS shutdown + trailer shutdown (Shutdown of Instrument Gas (IG) supply from HRS → closure trailer shut-off valve OR trailer E-stop activated by HRS e-stop function)</p> <p><b>Trailer:</b> Trailer shut-off valve is a normally closed valve (no IG supply from HRS closes it)</p> |
| Rupture of GH2 flexible hose                   | Aging, trailer tow-away, etc.                                               | H2 release / Fire / Explosion                                                                                     | <p><b>Trailer:</b> Anti-tow away device (various designs)</p> <p><b>Trailer:</b> Restricted flow orifice to mitigate consequences</p>                                                                                                                                                                                                          |
| Overpressure at HRS 200 bar inlet              | Trailer outlet 300 bar connected to HRS inlet 200 bar                       | <p>Potential pipe rupture / Process equipment rupture on HRS inlet panel</p> <p>H2 release / Fire / Explosion</p> | <p><b>Trailer:</b> Specific coupling 300bar, specific coupling 200 bar</p> <p><b>HRS:</b> Specific coupling 300bar, specific coupling 200 bar</p>                                                                                                                                                                                              |
| Overpressure at HRS 200 bar inlet              | Failure of trailer pressure regulator 300 bar / 200 bar                     | <p>Potential pipe rupture / Process equipment rupture on HRS inlet panel</p> <p>H2 release / Fire / Explosion</p> | <p><b>Trailer:</b> Safety function: Pressure Switch High (PSH) → closing of trailer shut-off valve</p> <p><b>HRS:</b> Pressure Safety Valve (PSV) on inlet panel (200 bar inlet equipment)</p>                                                                                                                                                 |
| Low temperature of the trailer tubes (type IV) | Too high unloading flow rate combined with low ambient temperature          | <p>Potential cracks / Leak of tube liner (type IV).</p> <p>H2 release / Fire / Explosion</p>                      | <p><b>Trailer:</b> Safety function: Trailer shutdown at low temperature.</p> <p><b>HRS:</b> Safety function: Trailer shutdown at low temperature.</p>                                                                                                                                                                                          |
| Low pressure in the trailer tubes (type IV)    | Too much unloading below required residual pressure. Leakage in the system. | <p>Potential cracks / Leak of tube liner (type IV).</p> <p>H2 release / Fire / Explosion</p>                      | <p><b>Trailer:</b> Safety function: Trailer shutdown at low pressure.</p> <p><b>HRS:</b> Safety function: Trailer shutdown at low pressure.</p>                                                                                                                                                                                                |

Table 1: Main hazards and example of safety barriers

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