Hydrogen fuel tank standards

Prepared by Randy Dey,
President of The CCS Global Group and Chair of ISO/TC 197
Sylvie Gingras, BNQ, Secretary of ISO/TC 197
Agenda

- Available standards and scope
- Overall similarities/differences between the standards
  - Liquid hydrogen standards
  - Gaseous hydrogen standards
- Overview of ISO 15869
- Recommendations
Picture at a glance

**Liquid hydrogen**

- **ISO 13985**
  - Covers the fuel tanks and accessories
- **EC Regulation**
  - Articles 6-7, 8 and 9 cover the fuel tanks and accessories

**Gaseous hydrogen**

- **ISO 15869**
  - Covers types 1, 2, 3 & 4 fuel tanks up to the working pressure specified by the manufacturer
- **JARI S001**
  - Covers types 3 & 4 fuel tanks up to 35 MPa
- **SAE J2579**
  - Section 5.2 covers fuel tank requirements (all types) up to 70 MPa
Liquid hydrogen fuel tank standards
Overall similarities/differences —
Liquid hydrogen standards

ISO 13985
Covers the fuel tanks and accessories

EC Regulation
Articles 6-7, 8 and 9 cover the fuel tanks and accessories

The ISO standard and the EC Regulation uses the same approach. The ISO standard covers about 99% of the requirements of the EC Regulation.
Gaseous hydrogen fuel tank standards
Overall similarities/differences — Gaseous hydrogen standards

**ISO 15869**
Covers types 1, 2, 3 & 4 fuel tanks up to the working pressure specified by the manufacturer

**JARI S001**
Covers types 3 & 4 fuel tanks up to 35 MPa

**EC Regulation**
Articles 10 and 11 cover types 1, 2, 3 & 4 fuel tanks

**SAE J2579**
Section 5.2 covers fuel tank requirements (all types) up to 70 MPa
Overall similarities/differences — Gaseous hydrogen standards

ISO 15869
- Covers about 99% of the requirements of the EC Regulation

JARI S001
- Covers about 60% of the requirements of the JARI S001

SAE J2579
- Covers about 90% of the requirements of the SAE J2579 that pertains to fuel tanks

EC Regulation
Overall similarities/differences — Gaseous hydrogen standards

The ISO standard proposes two methods for qualifying designs:

- One that is aligned with JARI S001 and the EC Regulation
- One that is aligned with SAE J2579
Description of ISO 15869

- Performance based standard, reflecting the state-of-the-art

- **Scope**
  - Lightweight refillable fuel tanks intended for the on-board storage of high-pressure compressed gaseous hydrogen or hydrogen blends on land vehicles
  - Applies to Type 1, 2, 3 and 4

- **Service conditions**
  - Working pressure (WP) to be specified by the manufacturer
  - Maximum filling pressure: 125 % of WP
  - Filling cycles:
    - 11250 cycles, representing a 15-year life of use in a commercial heavy-duty vehicle
    - a reduced number of 5500 cycles may be specified
  - Design temperature: -40 ºC to 85 ºC
Description of ISO 15869

- **Materials**
  - Requirements on hydrogen compatibility, exterior coatings, metal fuel tank and liner materials, plastic liner materials, resin properties

- **Design requirements**
  - **Minimum burst pressure and fibre stress ratio**
    - Requirements vary with the type of tank (Type 1, 2, 3 & 4) and the type of fibre
    - From 2,0 up depending on fibre
  - Stress analysis
  - Maximum defect size
  - Fire protection

- **Construction and workmanship**
Description of ISO 15869

- **Qualification of new design**
  - Material tests
  - Hydrostatic burst
  - Ambient temperature pressure cycling
  - Leak-before-break (LBB)
  - Bonfire
  - Penetration
  - Chemical exposure
  - Composite flaw tolerance
  - Accelerated stress rupture
  - Extreme temperature pressure cycling
  - Impact damage
  - Permeation
  - Boss torque
  - Hydrogen gas cycling

- **Alternate method of qualification of new design**
  - Extreme temperature gas pressure cycle test (Fuelling / De-Fuelling)
  - Accelerated static stress test (Parking)
  - Leak/Permeation
  - Proof pressure
  - Residual burst strength
  - Material tests
  - Impact damage
  - Combined chemical exposure and composite flaw tolerance
  - Leak-before-break (LBB)
  - Boss torque
  - Bonfire
  - Penetration
  - Hydrostatic burst
  - Ambient temperature pressure cycling
Description of ISO 15869

- **Batch tests**
  - Material tests
  - Hydrostatic burst
  - Periodic ambient temperature pressure cycling

- **Production tests**
  - Dimensional inspections
  - NDE and hardness test of metallic tanks and liners
  - Inspection of plastic liners
  - Hydraulic test
  - Leak test

- **Markings**
Recommendations

The ISO international standards represent the consensus of stakeholders on a worldwide basis

- 156 countries

W.29 has recognized that the reference to ISO standards in the GTR simplify the regulatory process

- Nov. 2003 WP.29 decision to refer to international standard instead of reproducing them in the regulations
Recommendations

- **Liquid hydrogen**
  - The ISO 13895 covers the needs of the EC regulation and liquid hydrogen tank requirements are not covered by the Japanese regulations, nor the SAE J2579
Recommendations

- Gaseous hydrogen
  - The comparison analysis of ISO 15869 has revealed that it is close to the Japanese regulations, the EC Regulation and the SAE J2579
    - ISO 15869 represents the harmonization of the Japanese regulations, the EC regulation and the SAE J 2579
    - As the SGS progresses with its task, ISO would be pleased to perform a more thorough comparison
Thank you