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# Hydrogen fuel tank standards

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# Agenda

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- 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

### EC Regulation

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

### JARI S001

Covers types 3 & 4 fuel tanks up to 35 MPa

### SAE J2579

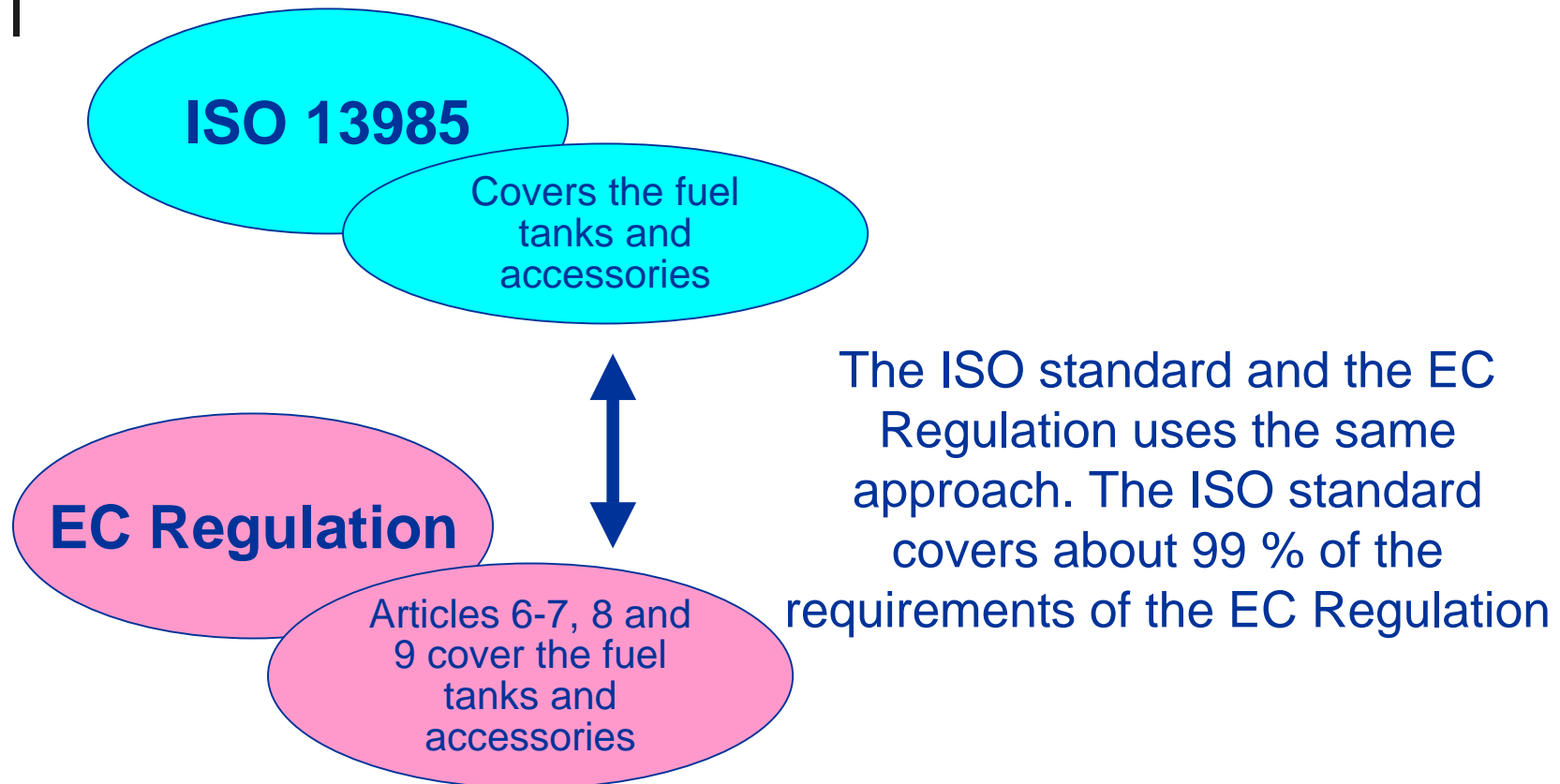
Section 5.2 covers fuel tank requirements (all types) up to 70 MPa



# Liquid hydrogen fuel tank standards



# Overall similarities/differences — Liquid hydrogen standards





# 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

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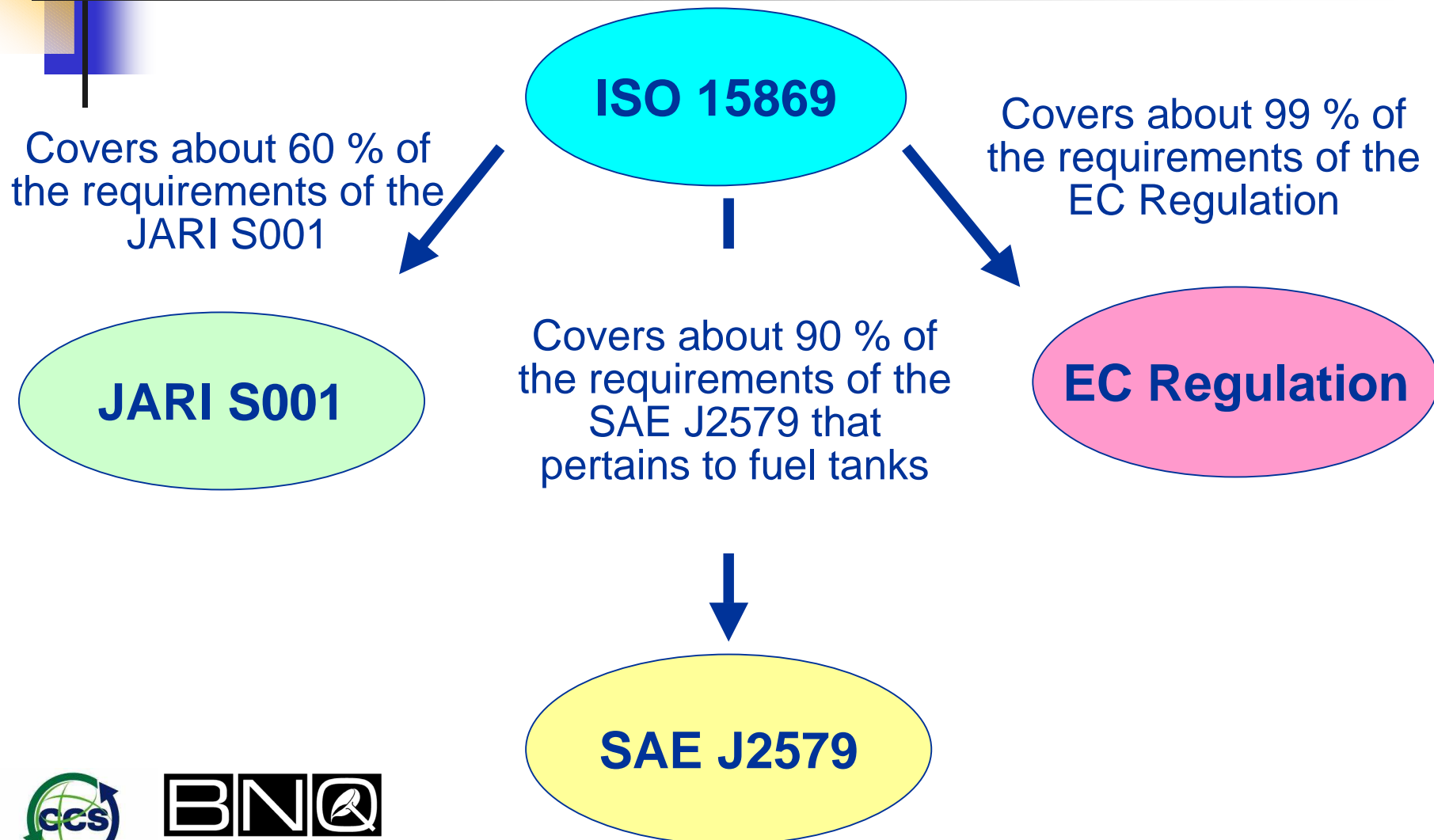
## EC Regulation

Articles 10 and 11  
cover types 1, 2, 3  
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## SAE J2579

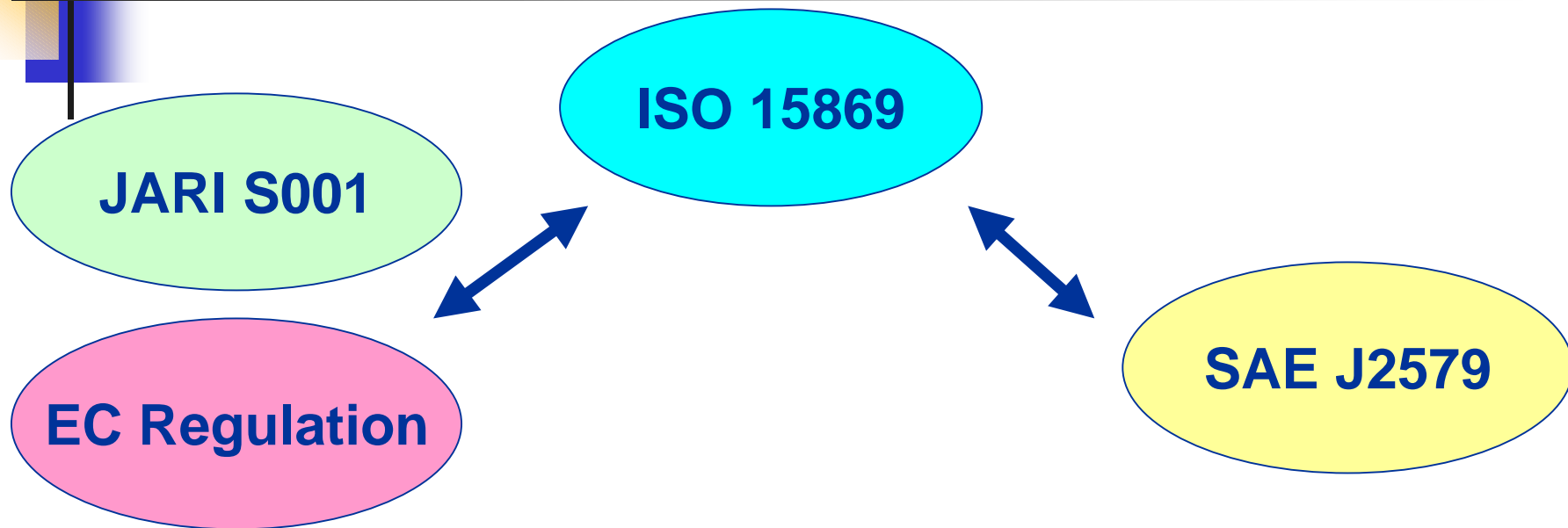
Section 5.2 covers  
fuel tank  
requirements (all  
types) up to 70 MPa

# Overall similarities/differences — Gaseous hydrogen standards





# 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

## 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 °C to 85 °C

# Description of ISO 15869



## 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

## 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



## 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

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## ■ 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

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