

Decisions on the outstanding issues to be resolved from:

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EIHP Draft regulations: Uniform Provisions Concerning the Approval of : I Specific Components of Motor Vehicles Using Compressed Gaseous Hydrogen; II. Vehicles with Regard to the Installation of Specific Components for the Use of Compressed Gaseous Hydrogen. Rev. 9 dated 6 May 2002.

ISO/CD 15869-1 to ISO/CD 15869-5 (2002-06)
Gaseous hydrogen and hydrogen blends – Land vehicle fuel tanks

GRPE/ISO N 026 2002-10-28

Replaces: Document GRPE/ISO **N 023**
To be used in conjunction with GRPE/ISO **N 028**

Code ¹	Clause in EIHP draft regulations	Clause in ISO draft standards	Name of expert/ Organization	Comments	Proposed change	Observations on each comment submitted
				<p>Unresolved issue:</p> <p>ISO 15869-2 refers to ISO 9809 and ISO 7866 in their entirety. EIHP refers only to the testing of ISO 9809 and ISO 7866</p> <p>ISO 9809 and ISO 7866 are prescriptive standards and not performance standards.</p> <p>Note: This difference was not identified in the ISO comparative report. It was only brought to the attention of the GRPE/ISO group of experts on 25 October 2002.</p> <p>It was considered that the implications were too large to be resolved at the meeting.</p>		<p>One solution: Both ISO and EIHP are to refer to ISO 9809-1, ISO 9809-2 and ISO 7866 in their entirety for type 1 containers plus the additional type approval test specified in ISO 15869-2 (fire protection and exterior environmental protection).</p> <p>Second solution: The EIHP draft regulations could refer to the applicable parts of ISO 9809-1, ISO 9809-2 and ISO 7866 instead of referencing to the document in their entirety. Craig identified the changes that would be required in the EIHP draft regulations to achieve this (see the proposed change at the end of this table).</p> <p>In both cases, The EIHP table on the change design is to be added to ISO 15869-2.</p>

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C	Annex 7 A2.3	ISO/CD 15869-1, clause 5.2.1.2.3		ISO/CD 15869-1 requires that a stress analysis be performed on all types of tanks. Draft 9 of the EIHP draft regulation does not require a stress analysis report.		Table 7A.1: Add a new line "Stress analysis A2.7" A2.7: Stress Analysis A stress analysis shall be carried out. A table summarising the calculated stresses shall be provided for information purposes only.

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C	Annex 7 A2.4 Table 7A.3 A7 Table 7A.8 B.11			The hydrogen compatibility test is not specified in ISO 15869, as these would be referenced directly by ISO 9809.		New B11.2 and Annex 8 B1.2 of the EIHP draft regulations: Metallic materials: Hydrogen compatibility would not have to be demonstrated if the material comply to ISO 9809-1 or ISO 7866. The hydrogen compatibility of other metallic materials shall be demonstrated in accordance with ISO/DIS 11114-4. For non metallic materials, hydrogen compatibility shall be demonstrated. 6.1.2 of the EIHP regulations cover the general compatibility of materials.

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Code ¹	Clause in EIHP draft regulations	Clause in ISO draft standards	Name of expert/ Organization	Comments	Proposed change	Observations on each comment submitted
C	Annex 7 B1			This section of the EIHP draft regulation has been removed from ISO 15869 with the incorporation of ISO 9809-1 and ISO 7866		<p>EIHP to harmonise with ISO for metallic materials.</p> <p>Non metallic materials requirements are to be kept in both documents</p> <p>B1 includes tests for Plastic Liner Materials and Fibres, and must not be removed completely.</p> <p>Regarding plastic liner materials: Modify B1 text as proposed below – see Change No.4.</p> <p>Regarding fibres: Harmonise A.3.2.5 with ISO by changing text to: “The tank manufacturer shall keep on file for the intended life of the tank design the published specifications for composite materials, the material manufacturer’s recommendations for storage, conditions and shelf life.</p> <p>The tank manufacturer shall keep on file, for the intended life of each batch of tanks, the fibre manufacturer’s certification that each shipment conforms to the manufacturer’s specifications for the product.”</p>

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Code ¹	Clause in EIHP draft regulations	Clause in ISO draft standards	Name of expert/ Organization	Comments	Proposed change	Observations on each comment submitted
C	Annex 7 B2			This section of the EIHP draft regulation has been removed from ISO 15869 with the incorporation of ISO 9809-1 and ISO 7866.		EIHP to harmonise with ISO Incorrect. This test is still referred to in the ISO draft, and should be retained in this draft as well. To be introduced in EIHP as a production test.
C	Annex 7 B24	ISO/CD 15869-1, clause D.9		The EIHP draft regulation requires multiple drops in the vertical and 45-degree orientations. ISO 15869 requires a single drop in these orientations. The EIHP draft regulations also add two drops from a horizontal position while the ISO 15869 does not. Rationale: Containers designed to meet the ISO 15869 requirement, which is the same as in the ISO 11439 for CNG containers, have performed exceptionally in the field. They have demonstrated safety through a number of accidents and incidents in which the containers were subjected to impacts. Note: trying to do two drops on the same area adds non-repeatability, as there is some randomness in the impacts, particularly secondary and tertiary hits.		Both EIHP and ISO are to adopt the requirements given in the Change No. 3 described at the end of this document.

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Code ¹	Clause in EIHP draft regulations	Clause in ISO draft standards	Name of expert/ Organization	Comments	Proposed change	Observations on each comment submitted
C	Annex 8A 5			<p>The EIHP draft regulation requires the PRD to be held at test pressure and 95C for 24 hours with no evidence of extrusion, and that brass components be tested per ASTM B154.</p> <p>Comment: The combined temperature and pressure requirements may cause failure of PRDs which have proven successful in the field. The ASTM B154 test contains environmentally harmful test agents, and has been replaced by testing in a moist ammonia-air environment in other standards.</p>		Covered in the new proposals for Annex 8 (GRPE/ISO Doc. No. N022)

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**PROPOSAL
Change No.3**

B24 IMPACT DAMAGE TEST

B24.1 Sampling

The test applies to *Container Types 2, 3 and 4.*

Number of Finished Containers to be tested: Minimum 1 (All impact tests may be performed on one *Container*, or individual impacts on a maximum of 3 *Containers*).

B24.2 Procedure

The drop tests shall be performed at ambient temperature without internal pressurisation or attached valves. A plug may be inserted in the threaded ports to prevent damage to the threads and seal surfaces.

The surface onto which the *Container* is dropped shall be a smooth, horizontal concrete pad or similar rigid floor.

The *Container(s)* shall be tested in the following sequence:

- i) Drop once from a horizontal position with the bottom 1.8 m above the ground,
- ii) Drop once onto each end of the *Container* from a vertical position with a potential energy ≥ 488 J, but in no case shall the bottom end be more than 1.8 m above the ground,
- iii) Drop once at a 45° angle, and then for non-symmetrical and non-cylindrical *Container* rotate the *Container* through 90° along its longitudinal axis and drop again at 45°, with its centre of gravity 1.8 m above the ground. However, if the bottom is closer to the ground than 0.6 m, the drop angle shall be changed to maintain a minimum height of 0.6 m and the centre of gravity 1.8 m above the ground.

<p>Decisions on the outstanding issues to be resolved from:</p> <p>Comparison between the EIHP Draft Regulations and the ISO Draft Standards on compressed gaseous hydrogen fuel tanks for land vehicles. Discussed at the GRPE/ISO group of experts meeting on 24-25 October 2002 in Vancouver, Canada.</p> <p>EIHP Draft regulations: Uniform Provisions Concerning the Approval of : I Specific Components of Motor Vehicles Using Compressed Gaseous Hydrogen; II. Vehicles with Regard to the Installation of Specific Components for the Use of Compressed Gaseous Hydrogen. Rev. 9 dated 6 May 2002.</p> <p>ISO/CD 15869-1 to ISO/CD 15869-5 (2002-06) Gaseous hydrogen and hydrogen blends – Land vehicle fuel tanks</p>	<p>GRPE/ISO N 026 2002-</p> <hr/> <p>Replaces: Document GRPE/ISO N To be used in conjunction with GRPE/ISO N 028</p>
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- iv) **No attempt shall be made to prevent the secondary impact of Containers, but the containers may be prevented from falling over during the vertical drop test.**
- v) **Pressure cycle the Containers between ≤ 2.0 MPa and ≥ 1.25 times Working Pressure for three times the number of Filling cycles calculated in accordance with Paragraph 2.4.7 of this Regulation.**

B24.3 Requirements

The Container(s) shall not leak or rupture within 0.6 times the number of Filling cycles calculated in accordance with Paragraph 2.4.7 of this Regulation, but may fail by leakage during the remaining test cycles.

B24.4 Results

The number of cycles to failure, along with the location and description of the failure initiation shall be presented in a test certificate, e.g. Table 7A.4 of this Annex.

<p>Decisions on the outstanding issues to be resolved from:</p> <p>Comparison between the EIHP Draft Regulations and the ISO Draft Standards on compressed gaseous hydrogen fuel tanks for land vehicles. Discussed at the GRPE/ISO group of experts meeting on 24-25 October 2002 in Vancouver, Canada.</p> <p>EIHP Draft regulations: Uniform Provisions Concerning the Approval of : I Specific Components of Motor Vehicles Using Compressed Gaseous Hydrogen; II. Vehicles with Regard to the Installation of Specific Components for the Use of Compressed Gaseous Hydrogen. Rev. 9 dated 6 May 2002.</p> <p>ISO/CD 15869-1 to ISO/CD 15869-5 (2002-06) Gaseous hydrogen and hydrogen blends – Land vehicle fuel tanks</p>	<p>GRPE/ISO N 026 2002-</p> <hr/> <p>Replaces: Document GRPE/ISO N To be used in conjunction with GRPE/ISO N 028</p>
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**PROPOSAL
Change No.4**

B1 TENSILE TEST

B1.1 Sampling

**The test applies to *Container Type 4*.
The test applies to plastic *Liner* materials only.
Number of *Liners* to be tested for type approval: 2**

B1.2 Procedure

Mechanical properties for plastic *Liner* materials shall be determined at -40°C in accordance with **ISO 527.**

B1.3 Requirements

The test results shall be within the *Manufacturer's* specifications.

B1.4 Results

The tensile yield strength and ultimate elongation of plastic *Liner* materials shall be presented in a test certificate, e.g. **Table 7A.3 of this Annex.**

<p>Decisions on the outstanding issues to be resolved from:</p> <p>Comparison between the EIHP Draft Regulations and the ISO Draft Standards on compressed gaseous hydrogen fuel tanks for land vehicles. Discussed at the GRPE/ISO group of experts meeting on 24-25 October 2002 in Vancouver, Canada.</p> <p>EIHP Draft regulations: Uniform Provisions Concerning the Approval of : I Specific Components of Motor Vehicles Using Compressed Gaseous Hydrogen; II. Vehicles with Regard to the Installation of Specific Components for the Use of Compressed Gaseous Hydrogen. Rev. 9 dated 6 May 2002.</p> <p>ISO/CD 15869-1 to ISO/CD 15869-5 (2002-06) Gaseous hydrogen and hydrogen blends – Land vehicle fuel tanks</p>	<p>GRPE/ISO N 026 2002-</p> <hr/> <p>Replaces: Document GRPE/ISO N To be used in conjunction with GRPE/ISO N 028</p>
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CRAIG WEBSTER'S PROPOSAL
PROPOSED CHANGES TO EIHP2 TO ACCOMMODATE USING ISO 9809 AND ISO 7866 FOR TYPE 1 CONTAINERS

Note – I found that ISO 7866 and 9809-1 & 9809-2 contain instructions on how to obtain type approval – these requirements would likely conflict with the EIHP draft regulation, so it is better for EIHP that one does not reference the ISO standards in their entirety, but only refer to sections that are relevant.

ANNEX 7: PART A

A1 REFERENCES

Add the following:

“ISO 9809-2:2000 Gas cylinders – Refillable seamless steel gas cylinders – Design, construction and testing – Part 2: Quenched and tempered steel cylinders with tensile strength greater than or equal to 1 100 MPa”

A2.5 CONTAINER SPECIFICATIONS AND TEST DATA

After the first sentence, add the following paragraph:

“For Type 1 aluminum containers, the Type approval tests shall comply with the requirements in 9.2 of ISO 7866. For Type 1 steel containers, the Type approval tests shall comply with the requirements in 9.2 of ISO 9809-1, or ISO 9809-2 if materials are proven compatible for hydrogen service.”

<p>Decisions on the outstanding issues to be resolved from:</p> <p>Comparison between the EIHP Draft Regulations and the ISO Draft Standards on compressed gaseous hydrogen fuel tanks for land vehicles. Discussed at the GRPE/ISO group of experts meeting on 24-25 October 2002 in Vancouver, Canada.</p> <p>EIHP Draft regulations: Uniform Provisions Concerning the Approval of : I Specific Components of Motor Vehicles Using Compressed Gaseous Hydrogen; II. Vehicles with Regard to the Installation of Specific Components for the Use of Compressed Gaseous Hydrogen. Rev. 9 dated 6 May 2002.</p> <p>ISO/CD 15869-1 to ISO/CD 15869-5 (2002-06) Gaseous hydrogen and hydrogen blends – Land vehicle fuel tanks</p>	<p>GRPE/ISO N 026 2002-</p> <hr/> <p>Replaces: Document GRPE/ISO N To be used in conjunction with GRPE/ISO N 028</p>
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A3 CONTAINER DESIGN REQUIREMENTS

A3.1 GENERAL

A3.1.2 - delete reference to Type 1 containers in the first sentence, and add the following statement at the end of the paragraph:

“For Type 1 aluminum containers, the maximum defect size shall be established in accordance with the requirements in 8.4 of ISO 7866. For Type 1 steel containers, the maximum defect size shall be established in accordance with the requirements in Annex B of ISO 9809-1, or ISO 9809-2 if materials are proven compatible for hydrogen service.”

A3.3 BURST PRESSURE RATIOS

After the first sentence, add the following:

“For Type 1 aluminum containers, the minimum burst pressure ratio shall be established in accordance with the requirements of 7 in ISO 7866. For Type 1 steel containers, the minimum burst pressure ratio shall be established in accordance with the requirements of 7 in ISO 9809-1, or ISO 9809-2 if materials are proven compatible for hydrogen service.”

Table 7A.5

Delete the column labeled “Type 1” and the row labeled “All metal”.

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A4.1 METAL CONTAINERS AND LINERS

Add the following sentences at the beginning of this section:

“For Type 1 aluminum containers, the container manufacturing requirements shall be performed in accordance with the requirements in 7 and 8 of ISO 7866. For Type 1 steel containers, the container manufacturing requirements shall be performed in accordance with the requirements in 7 and 8 of ISO 9809-1, or ISO 9809-2 if materials are proven compatible for hydrogen service.”

A5.1 BATCH TEST

A5.1.1 General

At the end of this section, add the following paragraph:

“For Type 1 aluminum containers, the batch test requirements shall be performed in accordance with the requirements in 10 of ISO 7866. For Type 1 steel containers, the batch test requirements shall be performed in accordance with the requirements in 10 of ISO 9809-1, or ISO 9809-2 if materials are proven compatible for hydrogen service.”

Table 7A.6 – Batch Tests

Delete the column labeled “1” under “Applicable to Container Type”.

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A6 PRODUCTION EXAMINATION AND TEST REQUIREMENTS

At the very start of this section, begin with the sentence:

“For Type 1 aluminum containers, the production examination and test requirements shall be performed in accordance with the requirements in 11 of ISO 7866. For Type 1 steel containers, the production examination and test requirements shall be performed in accordance with the requirements in 11 of ISO 9809-1, or ISO 9809-2 if materials are proven compatible for hydrogen service.”

Make the following changes to the rest of A6:

“Production examination and tests shall be carried out on all *other* containers.....”

“iii) For metallic ~~Container(s) and Liner(s)~~, NDE in accordance.....”

“iv) Brinell hardness test for metallic ~~Container(s) and Liner(s)~~ in accordance.....”

“A summary of the required production and tests for ~~each~~ *Type 2, 3 and 4* Containers is provided....”

Table 7A.7 – Production Examination and Tests

Delete the column referring to Type 1 containers.

I think this covers it. The 7866 and 9809 standards do not have a provision for “Minor Change of Design”, so I think we will leave the ones in EIHP to include Type 1 containers.