

**OUTSTANDING ISSUES – GRPE/ISO HARMONIZATION ON THE  
THE GRPE DRAFT ECE COMPRESSED GASEOUS HYDROGEN (CGH<sub>2</sub>) REGULATION  
Version 10 Dated 06.11.02**

**GRPE/ISO N 031**      2002-12-02

**Table 1 — Main Outstanding GRPE/ISO harmonization issue**

<b>Paragraph/ Annex</b>	<b>Related clause in ISO drafts</b>	<b>Organisation</b>	<b>Comments/Proposed Modification</b>	<b>Agreed</b>	<b>Final Modification Or Reason For Rejection</b>
General	ISO 15869-2	Craig Webster	<p>ISO 15869-2 refers to ISO 9809-1, ISO 9809-2 and ISO 7866 in their entirety for type 1 containers and specifies additional type approval tests for vehicle applications (fire protection and exterior environmental protection). GRPE draft regulation refers only to the testing requirements of ISO 9809-1, ISO 9809-2 and ISO 7866</p> <p>NOTE: ISO 9809 and ISO 7866 are prescriptive standards and not performance standards.</p> <p>One solution: Both ISO and GRPE are to use the ISO 15869-2 approach.</p> <p>Second solution: The GRPE draft regulations could refer to the applicable parts of ISO 9809-1, ISO 9809-2 and ISO 7866 instead of referencing the document in their entirety. Craig Webster identified the changes that would be required in the GRPE draft regulations to achieve this (see the proposed change below).</p>		

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**CRAIG WEBSTER'S PROPOSAL  
PROPOSED CHANGES TO THE GRPE DRAFT REGULATION TO ACCOMMODATE USING ISO 9809-1, ISO 9809-2 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

**A2.4 MATERIAL SPECIFICATIONS AND TEST DATA**

This section is to be changed as follows:

"A detailed description of all principal material properties and tolerances used in the Container design shall be provided according to Table 7A.3. The material specifications shall be verified by appropriate materials tests. In the case of steel Containers of Type 1, the materials tests shall include the material tests specified in paragraph 9.2 of ISO 9809-1 or ISO 9809-2, as applicable and the additional tests specified in Table 7A.3. In the case of aluminium Containers of Type 1, the materials tests shall include the material tests specified in paragraph 9.2 of ISO 7866 and the additional tests specified in Table 7A.3. For Containers of Type 2, 3 and 4, the material tests shall include the tests specified in Table 7A.3.

The results from the tests shall be provided. If more samples than required are tested, all results shall be documented"

In Table 7A.3, the footnotes 1 and 2 should no longer refer to metallic containers. The reference should be kept for metallic liners only.

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<b>A2.5 CONTAINER SPECIFICATIONS AND TEST DATA</b>					
After the first sentence, add the following paragraph:					
Modify the second paragraph as follows:					
"The Container design specifications for each test that is required shall be provided. The design specifications shall be verified by appropriate Container tests. In the case of steel Containers of Type 1, the tests shall include the prototype tests specified in paragraph 9.2 of ISO 9809-1 or ISO 9809-2, as applicable and the additional tests specified in Table 7A.4. In the case of aluminium Containers of Type 1, the tests shall include the Container tests specified in paragraph 9.2 of ISO 7866 and the additional tests specified in Table 7A.3. For Containers of Type 2, 3 and 4, the container tests shall include the tests specified in Table 7A.4."					
In Table 7A.4, the following "X" shall be removed from the Type 1 Container column: LBB performance test, burst test, ambient temperature cycling test, penetration test. Only the bonfire test is to be kept. Table 7A.8 would also have to be modified accordingly.					
<b>A3 CONTAINER DESIGN REQUIREMENTS</b>					
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 aluminium 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."					
Add a new paragraph under A3.1. It could be identified as follows:					
<b>A3.1.6 Specific requirements for Container Type 1</b>					
Steel Containers of Type 1 shall meet the design requirements specified in clause 7 of ISO 9809-1 or ISO 9809-2, as applicable. Aluminium Containers of Type 1 shall meet the design requirements specified in clauses 7 of ISO 7866.					

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<b>A3.3 BURST PRESSURE RATIOS</b>					
After the first sentence, add the following;					
“For Type 1 aluminium containers, the minimum burst pressure ratio shall be established in accordance with the requirements of paragraph 7.2 in ISO 7866. For Type 1 steel containers, the minimum burst pressure ratio shall be established in accordance with the requirements of paragraph 7.3 in ISO 9809-1 or ISO 9809-2, as applicable.”					
<b>Table 7A.5</b>					
Delete the column labeled “Type 1” and the row labeled “All metal”.					
<b>A4.1 METAL CONTAINERS AND LINERS</b>					
Add the following sentences at the beginning of this section:					
“For Type 1 aluminium containers, the container manufacturing requirements shall be performed in accordance with the requirements in clause 8 of ISO 7866. For Type 1 steel containers, the container manufacturing requirements shall be performed in accordance with the requirements in clause 8 of ISO 9809-1 or ISO 9809-2, as applicable.”					
<b>A5.1 BATCH TEST</b>					
<b>A5.1.1 General</b>					
Under the first paragraph of A5.1.1, add the following paragraph:					
“For Type 1 aluminium 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, as applicable.”					

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<p>Change the first sentence of the next paragraph (second paragraph of A5.1.1) as follows:</p> <p>"Containers of Type 2, 3 and 4, the following batch tests shall be required (see Table 7A.6):"</p> <p><b>Table 7A.6 – Batch Tests</b></p> <p>Delete the column labeled "1" under "Applicable to Container Type".</p> <p><b>A6 PRODUCTION EXAMINATION AND TEST REQUIREMENTS</b></p> <p>At the very start of this section, begin with the sentence:</p> <p>"For Type 1 aluminium 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, as applicable."</p> <p>Make the following changes to the rest of A6:</p> <p>"Production examination and tests shall be carried out on Containers of Type 2, 3 and 4 ....."</p> <p>"iii) For metallic <del>Container(s) and Liner(s)</del>, NDE in accordance....."</p> <p>"iv) Brinell hardness test for metallic <del>Container(s) and Liner(s)</del> in accordance....."</p> <p>"A summary of the required production and tests for <del>each</del> <i>Type 2, 3 and 4</i> Containers is provided...."</p>					

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**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 the GRPE draft regulation to include Type 1 containers.

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Annex 7 Table 7A.3 Tensile test Footnote 1  Annex 7 Table 7A.6 Tensile test Footnote 1	ISO 15869-2, ISO 15869-3, clause 8.1.1 and 8.1.2  ISO 15869-4, clause 8.1.1 and 8.1.2	ISO/TC 197 Secretariat	Tensile test: As ISO 9809 has two parts, it is not sufficient to refer only to ISO 9809. In addition, in order to avoid confusion, the applicable paragraphs of ISO 9809-1 and ISO 9809-2, ISO 7866 should be referred to.  Proposed change in footnote 1:  For non-metallic <i>Liners</i> refer to Paragraph B1 of this Annex, and for metallic <i>Containers</i> or <i>Liners</i> refer to paragraph 10.2 of ISO 9809-1, ISO 9809-2 or ISO 7866 as appropriate.  The same comment apply to Annex 7, Table 7A.6.		
Annex 7 Table 7A.3 Charpy impact test Footnote 2  Annex 7 Table 7A.6 Charpy impact test Footnote 2	ISO 15869-2, ISO 15869-3, clause 8.1.1  ISO 15869-4, clause 8.1.1	ISO/TC 197 Secretariat	A "√" should be added to indicate that steels are to be subjected to a Charpy impact test. As aluminium does not require that this test be performed, the reference to ISO 7866 should be removed from footnote 2.  Charpy impact test: As ISO 9809 has two parts, it is not sufficient to refer only to ISO 9809. In addition, in order to avoid confusion, the applicable paragraphs of ISO 9809-1 and ISO 9809-2 should be referred to.  Proposed change in footnote 2:  For metallic <i>Containers</i> or <i>Liners</i> refer to paragraph 10.4 of ISO 9809-1 or ISO 9809-2 as appropriate.  The same comment apply to Annex 7, Table 7A.6.		

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Annex 7 Table 7A.3 Corrosion test Footnote 3	ISO 15869-2, ISO 15869-3, clause 8.1.2 ISO 15869-4, clause 8.1.2	ISO/TC 197 Secretariat	Corrosion test: In order to avoid confusion, the applicable paragraphs of ISO 7866 should be referred to.  Proposed change: Add a footnote 3 applicable to the corrosion test:  * <sup>3</sup> – For metallic <i>Containers</i> or <i>Liners</i> refer to Annex A of ISO 7866.		
Annex 7 Table 7A.3 Corrosion test Footnote 4	ISO 15869-2, ISO 15869-3, clause 8.1.2 ISO 15869-4, clause 8.1.2	ISO/TC 197 Secretariat	Sustained load cracking test: In order to avoid confusion, the applicable paragraphs of ISO 7866 should be referred to.  Proposed change: Add a footnote 4 applicable to the Sustained load cracking test :  * <sup>4</sup> – For metallic <i>Containers</i> or <i>Liners</i> refer to Annex B of ISO 7866.		
Annex 7 Table 7A.3	ISO 15869-2, ISO 15869-3, clause 8.1.1 and 8.1.2 ISO 15869-4, clause 8.1.1 and 8.1.2	ISO/TC 197 Secretariat	The ISO 15869-2, ISO 15869-3 and ISO 15869-4 all require that the following a bend test and a flattening test be performed as part of type approval:  Test as per 10.3 of ISO 9809-1, ISO 9809-2 or ISO 7866, as appropriate.  The GRPE draft regulation does not require that these tests be performed.		

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Annex 7 A3.2.2	ISO 15869-2, ISO 15869-3, clause 5.2 ISO 15869-4, clause 5.2	ISO/TC 197 Secretariat	As ISO 9809 has two parts, it is not sufficient to refer only to ISO 9809. In addition, in order to avoid confusion, the applicable paragraphs of ISO 9809-1 and ISO 9809-2 should be referred to.  Proposed change:  Steels for containers and liners shall conform to the material requirements of ISO 9809-1, paragraph 6.1 to 6.4 or ISO 9809-2, paragraphs 6.1 to 6.3.		
Annex 7 A3.2.3	ISO 15869-2, ISO 15869-3, clause 5.3 ISO 15869-4, clause 5.3	ISO/TC 197 Secretariat	To avoid confusion, the applicable paragraphs of ISO 7866 should be referred to.  Proposed change:  Aluminium alloys for containers and liners shall conform to the material requirements of ISO 7866, paragraph 6.1 and 6.2.		

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Annex 7: A3.3  Table 7A.5 Note 2	ISO 15869-3, clauses 6.3  ISO 15869-4, clauses 6.3  ISO 15869-5, clauses 6.3	ISO/TC 197 Secretariat	<p>It was agreed that the wording needed to be adjusted in note 2 of Table 7A.5 to reflect that only the "structural" fiber needs to meet the stress ratio requirements if the "structural" fiber can meet the burst requirements with the "non-structural" fibers are removed.</p> <p>To meet the intent, should the text be written as follows: For <i>Container</i> designs using hybrid reinforcement, i.e. two or more different structural fibre types, consideration shall be given to the load share between the different structural fibres based on the different elastic moduli of the fibres. The calculated stress ratios for each individual <u>structural</u> fibre type shall conform to the unbracketed values. Verification of the stress ratios may also be performed using strain gauges. The minimum <i>Burst Pressure Ratio</i> shall be chosen such that the calculated stress in the <u>structural</u> fibres at the minimum <i>Burst Pressure Ratio</i> times <i>Working Pressure</i> divided by the calculated stress in the <u>structural</u> fibre at <i>Working Pressure</i> meets the stress ratio requirements for the fibres used.</p>		

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Annex 7: A5.1.2 iii) and vi)		ISO/TC 197 Secretariat	It was agreed that to add at the end of Paragraph .5.1.2 vi): “The <i>Manufacturer</i> shall demonstrate that <i>Containers</i> produced since the last <i>Batch</i> test meet all <i>Batch</i> test requirements.” in reply to the following comment: "The concept of batch testing of multiple batches is always difficult and open to uncertainty. Is the test conducted to approve multiple batches in the future or does it approve the previous batches that have already been shipped? If a fault is found what happens to the multiple batches covered by the test? Paragraph 5.1.2 vi) indicates that only one batch is rejected." Even though the above change was introduced in the GRPE draft regulation, the intent is not clear.		
Annex 7 B7.2		ISO/TC 197 Secretariat	B7.2 should be changed to clarify that only steels and aluminium complying with the material requirements of ISO 9809-1 and ISO 7866 are exempted from the hydrogen compatibility test. Proposed change: Use the same wording as in Annex 8, B1.2.		
Annex 7 B9.3		ISO/TC 197 Secretariat	Editorial change. Remove one "fail" from the sentence.		

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Annex 7 B12	ISO/CD 15869-3, clauses 10  ISO/CD 15869-4, clauses 10  ISO/CD 15869-5, clauses 10	ISO/TC 197 Secretariat	<p>ISO allows that type 1 container be verified using option 2 ( proof pressure test). Indeed, ISO 15869-2 refer to ISO 9809-1, ISO 9809-2 and ISO 7866. All of these standards allow that the hydrostatic test be performed using option 2.</p> <p>In order to ensure the harmonization, option 2 that was included in version 9 of the GRPE draft regulation could have been brought back to revision 11. However, while making these verifications, we found that no acceptance criteria had been defined for Type 1 container for the volumetric expansion test. It could have been added as well, but after another verification, we found that the acceptance criteria varies depending on the type of containers (5% for ISO 9809-1 and 10 % for ISO 9809-2 and ISO 7866). Based on this, it was deemed easier to make a reference to the appropriate paragraphs of these standards. The proposed change is as follows:</p> <p>Separate B12.2 in two sections</p> <p>Containers of Type 1              Aluminium containers shall be subjected to the test specified in paragraph 11.2 of ISO 7866. Steel containers shall be subjected to the test specified in paragraph 11.2 of ISO 9809-1 or ISO 9809-2, as applicable.</p> <p>Containers of Types 2, 3, 4              Use the existing text l) to v)</p>		

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Annex 7 B14	ISO 15869-1, clause D.2	ISO/TC 197 Secretariat	<p>The ISO test requires that the test be carried out to failure or a minimum of 45 000 cycles. It also requires that a tank that exceeds the minimum of 15000 cycles fail by leakage and not rupture.</p> <p>The GRPE draft regulation test requires that <i>Containers</i> that do not fail within 3.0 times the number of <i>Filling Cycles</i> specified in Paragraph 2.4.6 of this Regulation be destroyed either by continuing the cycling until failure occurs, or by hydrostatically pressurising to burst. It also requires that <i>Containers</i> exceeding 3.0 times the number of <i>Filling Cycles</i> specified in Paragraph 2.4.6 of this Regulation shall fail by leakage and not by rupture. However, as it is allowed that the tank be destroyed by bursting, this requirement cannot be checked.</p> <p>Suggestion: The GRPE draft regulation should harmonize with ISO for the type approval test. To support this suggestion, it is mentioned in the GRPE draft regulation in Annex 7B, B9.1 that the LBB test does not need to be performed if the container is proven to exceed 9 times the number of filling cycles when tested as per B.14.</p> <p>NOTE: The ISO and GRPE batch tests are the same</p>		

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Annex 7 B18.3	ISO 15869-1 D.8	ISO/TC 197 Secretariat	<p>The acceptance requirement in EIHP is different from ISO.</p> <p>Proposed change: The acceptance requirement could be modified as follows:</p> <p>The container shall not leak or rupture within 0,6 times the number of filling cycles specified in Paragraph 2.4.6 of this regulation, but may fail by leakage during the remaining test cycles.</p> <p>NOTE: This also correspond to the wording used in B20.3 for the impact damage test.</p>		
Annex 7: B21	ISO 15869-1 D.19	ISO/TC 197 Secretariat	<p>A note should be added to explain that "N" refer to standard conditions. In addition, a definition of standard conditions should be added.</p> <p>Example: standard conditions: conditions to which the volume or other properties of a gas are referred and which are represented by a temperature of 15 °C and an atmospheric pressure of 101,3 kPa Before introducing this definition, a verification should be made to make sure that the specified value of 1 cm<sup>3</sup> per hour of hydrogen per litre internal volume of the container corresponds to the standard conditions defined above. If the temperature is different, the definition would have to be modified accordingly.</p>		

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Annex 7 B22.3	ISO 15869-1 D4	ISO/TC 197 Secretariat	The GRPE draft regulation requires that both a leak test and burst test be performed after the boss torque test as part of the type approval. ISO 15869-1 only requires that a leak test be performed.		

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**Table 3 — Issues not related to the GRPE/ISO harmonization**

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Annex 8			In Annex 8, components downstream the pressure regulators shall be pressure tested at a pressure sufficient to accommodate the Maximum allowable working pressure (MAWP) of the system e.g. the set pressure of the pressure relief valve – See the UTC proposal for MAWP.		