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 30 July 2002 in Munich, Germany.	**GRPE/ISO N 08** 2002-07-30
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	Replaces: Document GRPE/ISO **N 01**

Code[1]	**Clause in EHIP draft regulations**	**Clause in ISO draft standards**	**Name of expert/ Organization**	**Comments**	**Proposed change**	**Observations** on each comment submitted
C	General		Jan Sandström AGA AB	Sweden has earlier constantly, with regard to the ISO 11439 High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles, remarked that the safety factors (Burst ratios) are extremely low and can not be accepted. These safety factors shall not wrongly be introduced and referenced in the GRPE regulation and the draft ISO 15869. Such low safety factors can not be found in any pressure vessel regulations in the world. Especially since the factual pressure at filling is always much higher than the Working Pressure. Further to that we would like to stress the importance of having pressure containers designed to the highest developed pressure and not to the lower Working Pressure.		No support for this proposal at the meeting ISO11439 has equivalent values
C	2.1	ISO 15869-1; 3	Jan Sandström AGA AB	We insist on reintroducing 2.1.15 Design pressure of the 8th Draft Revision 8 23/11- 01	Reintroduce Design pressure The gas pressure at a uniform gas temperature of 85 °C that a component is subjected to. The Design Pessure is equal to the Working Pressure multiplied by 1.25	No support for this proposal at the meeting

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C	2.1.39			The EIHP draft regulation defines a “Safety Device” as a device intended to ensure safe operation. The ISO 15869-1 does not include a definition of a safety device.		Retain definition as it is not used in Annex 7 (which is similar to ISO15869)
C	2.2 6.2.2			The EIHP draft regulation lists a “Type 5 (Other)” as a container type while the ISO 15869 does not.. Comment: There are no stated requirements for such types in the EIHP document and none are known to be in service or development. Type 5 design is not covered under any of the test requirements under Annex 7: Part B. Since these test requirements would need to be defined for any Type 5 design, there is no advantage in including a “Type 5” at this time.		Retain Type 5 in EIHP. Option for Type 5 is not required in the ISO text.
C	2.3			The ISO/CD 15869-1 does not include a classification of fuel tanks according to working pressure.		ISO only have fuel tanks whereas the EIHP document considers other components that may be at medium or low pressure.

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Code[1]	Clause in EHIP draft regulations	Clause in ISO draft standards	Name of expert/ Organization	Comments	Proposed change	Observations on each comment submitted
C	2.4.5	15869-1.2 4.8	Hiroshi Akiyama Techno-Product Center	Hydrogen gas comply with ISO 14687:1999/Cor 1:2001 in EIHP and ISO/CD 15869. Influence of the density of the sulphur compound and the moisture are apprehended in Japan. We are advancing a paper survey. We would like to request the comment of each country.		Add "…., or of greater purity" to the end of EIHP 2.4.5 and include new 2.4.5 in both documents
C	2.4.7 and Annex 7-A2.2 Table 7A.2 Annex 7-A2.7	15869-1.2 4.2 and 6	Hiroshi Akiyama Techno-Product Center	Calculation method of filling cycles that is defined to EIHP 2.4.7 is useful. Relation between maximum service life and maximum number of filling cycles shall be evident. Both of maximum service life (yyyy/mm) and maximum number of filling cycles shall be specified and be listed to container by the manufacturer. We would like to request the comment of each country.		The EIHP philosophy is accepted based on Change No.2 described at the end of this document. ISO will harmonise with EIHP
C	2.4.7	ISO/CD 15869-1, clause 4.5		The intent of this section of the EIHP draft regulation on re filling and pressure cycles is consistent with the intent of the ISO WG, but the implementation is significantly different. In addition, the current ISO 15869 does not permit a reduction in the minimum of filling cycles if a "Usage Monitoring and Control System" is used.		The EIHP philosophy is accepted based on Change No.2. ISO will harmonise with EIHP

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Code[1]	**Clause in EHIP draft regulations**	**Clause in ISO draft standards**	**Name of expert/ Organization**	**Comments**	**Proposed change**	**Observations** on each comment submitted
C	2.4.7	ISO/CD 15869-1, clause 4.5	Jan Sandström AGA AB	These clauses must be co-ordinated	Use the text in EHIP	The EIHP philosophy is accepted based on Change No.2. ISO will harmonise with EIHP
C	2.4.7	ISO/CD 15869-1, clause D 2	Jan Sandström AGA AB	The requirement for the pressure cycling shall be those of clause 2.4.7.of EHIP	Correct ISO Draft	The EIHP philosophy is accepted based on Change No.2. ISO will harmonise with EIHP
C	Annex 7 A2.7	ISO/CD 15869-1, clause 6		The year and month of manufacture have to be marked according to ISO 15869-1 while the EIHP draft requires the marking of the year and month of approval. The identification of the tank content is different.: • EHIP: CGH_2, • ISO: H and blends only		i) Incorrect statement ii) Change EIHP to "H_2 GAS". ISO to adopt "H_2 gas and blends only"
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.		*Further discussion required.* EIHP draft requirement was adopted because it is a performance based requirement

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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.		ISO to check status of document-ISO 11114-4. Retain reference in EIHP draft until GRPE process becomes formal. ISO to include reference in 15869.
C	Annex 7 A 3.3	ISO 15869-1; 3	Jan Sandström AGA AB		Introduce the definitions for Stress ratios and Burst Pressure ratios (see clause 5.5 of Annex 7 of Draft 8) <u>Stress ratios</u> as the stress in the fibre at the specified minimum Burst Pressure divided by the the stress in the fibre at Design Pressure <u>Burst Pressure ratio</u> is the actual Burst Pressure of the cylinder divided by the Design Pressure	Both ISO & EIHP use same definitions, but are based on the working pressure. No support for the proposal to change to design pressure at the meeting

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Code[1]	**Clause in EHIP draft regulations**	**Clause in ISO draft standards**	**Name of expert/ Organization**	**Comments**	**Proposed change**	**Observations** on each comment submitted
C	Annex 7 A3.2.2 B1.2.1	ISO/CD 15869-2, ISO/CD 15869-3, clauses 5.2 and 5.3 ISO/CD 15869-4, clauses 5.2 and 5.3		The EIHP draft regulation indicates that steels have to comply to ISO 9809 while the ISO 15869 refer to ISO 9809-1 only.		Harmonise ISO & EIHP to ISO 9809, pending outcome of ISO11114 development.
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		EIHP to harmonise with ISO
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
C	Annex 7 B3			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
C	Annex 7 B4			This section of the EIHP draft regulation has been removed from ISO 15869 with the incorporation of ISO 7866.		EIHP to harmonise with ISO

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Code[1]	**Clause in EHIP draft regulations**	**Clause in ISO draft standards**	**Name of expert/ Organization**	**Comments**	**Proposed change**	**Observations** on each comment submitted
C	Annex 7 B5			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
C	Annex 7 B6.3	ISO/CD 15869-1, clause D.21		The EIHP draft regulation defines softening (100C) and melting (130C) points for plastic liners. The ISO 15869-1 only requires that the softening temperature of plastic be at least 100 °C. Comment: Existing materials could be used, but still a consideration as to whether the 130C melt requirement is useful, and if it would restrict technology.		EIHP to harmonise with ISO
C	Annex 7 B12	ISO/CD 15869-1, clause D.16		The EIHP draft regulation requires no minimum cycling. ISO 15869 requires 45,000 cycles.		Change ISO15869 to 15000 cycles. EIHP2 B12.3 will adopt final sentence of ISO 15869–1.2 Cl.D16, modified for EIHP pressure cycle concept

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Code[1]	Clause in EHIP draft regulations	Clause in ISO draft standards	Name of expert/ Organization	Comments	Proposed change	Observations on each comment submitted
C	Annex 7 B14	ISO/CD 15869-1, clause D.17		The EIHP draft regulations specify that the test is to be performed with a gas mixture comprising at least 5% H_2 or 10% He. ISO 15869 requires that the gas contains a detectable amount of helium or hydrogen gas. Comment: This adds unneeded expense for a production test on all tanks. With demonstration of capability, lower concentrations or alternate methods should be allowed.		Add ", or a demonstratable detectable amount of helium or hydrogen gas." to the EIHP text. ISO to harmonise with the EIHP text.
C	Ann.7: B14 Leak Test	ISO/CD 15869-1, clause D.17		It is a hardship for manufacturers to perform a leak test at 1.25 times working pressure. A leak test at working pressure is commonly performed for CNG and has proven adequate. Increasing the pressure will not expose any leak that was not already detectable at working pressure. Change.		EIHP to harmonise with ISO
C	Annex 7 B15.2	ISO/CD 15869-3, clauses 10 ISO/CD 15869-4, clauses 10 ISO/CD 15869-5, clauses 10		In the EIHP draft regulation, permanent expansion is specified for Types 2 and 3, Elastic expansion for Type 4. In ISO 15869, we only allowed Option 2 for Type 1 tanks (i.e. Option 1 must be used for all Types 2, 3, and 4 containers).		ISO to harmonise with EIHP.

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C	Annex 7 B21	ISO/CD 15869-1, clause D.8		The EIHP draft regulation allows the manufacturer to establish flaw sizes. ISO 15869 allows the manufacturer to establish flaw sizes, but also requires minimum flaws of 25 mm long by 1.25 mm deep and 200 mm long by 0.75 mm deep. These flaw sizes are reasonable expectations based on field experience. These represent typical flaws found during inspection. Containers should be tolerant of such flaws given the frequency with which they occur.		EIHP to harmonise with ISO
C	Annex 7 B22	ISO/CD 15869-1, clause D.12		The EIHP draft regulation uses a hold temperature of 95C/1000hrs. ISO 15869 uses a hold temperature of 100C/200hrs.		Delete test B22 high temp. creep test from both documents.
C	Annex 7 B23	ISO/CD 15869-1, clause D.1		The EIHP draft regulation requires the container to be exposed to high humidity. ISO 15869 does not. ISO intended only accelerated test via high temperature re Arrhenius rate equation, while introducing humidity may change response mechanisms of the composite.		Harmonise EIHP with ISO for B23 by removing humidity requirements
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		See proposal contained in Change No. 3 described at the end of this document.

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Code[1]	Clause in EHIP draft regulations	Clause in ISO draft standards	Name of expert/ Organization	Comments	Proposed change	Observations on each comment submitted
				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.		
C	Annex 8A 5			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. 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.		
C	Annex 8B	15500-6	Livio Gambone Powertech	Endurance test cycles for automatic valves should be consistent with ISO CNG automatic valve standard	Change cycles to 50,000	Harmonise with ISO

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Code[1]	**Clause in EHIP draft regulations**	**Clause in ISO draft standards**	**Name of expert/ Organization**	**Comments**	**Proposed change**	**Observations** on each comment submitted
C	Annex 8D	14469 and 17268	Livio Gambone Powertech	Receptacle profile should be defined to avoid cross-connection with CNG nozzles and to prevent filling a vehicle by a dispenser with a working pressure higher than the vehicle	Adopt ISO 17268 receptacle profile	ISO17268 if based on SAE J2600 will not cover HGV/PSV. Develop a general requirement in EIHP text covering the following points: Receptacle profile should be defined to avoid cross-connection with other fuel dispenser nozzles and to prevent filling a vehicle by a dispenser with a working pressure higher than the vehicle. Where appropriate compliance could be demonstrated by compliance with, e.g. ISO 17268
C	Annex 8E	15500-9	Livio Gambone Powertech	Endurance test cycles for pressure regulators should be consistent with ISO CNG pressure regulator standard	Change cycles to 50,000	Harmonise with ISO
C	Annex 9 Clause 16	17268	Livio Gambone Powertech	A connect / disconnect test should be specified for receptacles in accordance with the test defined in ISO 17268	Adapt ISO 17268 connect / disconnect test	Ann.9-16 applies to Fittings and not to Receptacles.
I		ISO 15869-1; D14	Jan Sandström AGA AB		Introduce 1.25 times working pressure (equal to design pressure) in the second paragraph	No support for this proposal at the meeting

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I		ISO 15869-3; 6.3	Jan Sandström AGA AB		Change in the first paragraph to 1.3 times design pressure (1.3 times 1.25 times working pressure)	No support for this proposal at the meeting
I		ISO 15869-3; 6.3 Table 1	Jan Sandström AGA AB	Column Burst pressure	Change working pressure to design pressure (1.25 times working pressure)	No support for this proposal at the meeting
I		ISO 15869-4; 6.3 Table 1	Jan Sandström AGA AB	Column Burst pressure The presented figures for the burst pressure can be adjusted accordingly	Change working pressure to design pressure (1.25 times working pressure)	No support for this proposal at the meeting
I		ISO 15869-5; 6.3 Table 1	Jan Sandström AGA AB	Column Burst pressure	Change working pressure to design pressure (1.25 times working pressure)	No support for this proposal at the meeting

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Change No.2

2.1.x *"Filling Cycle"*: A pressure increase of more than 25% of the *Working Pressure* of the *Container* due to an external source of hydrogen.

2.1.45 "*Usage Monitoring And Control System*": A system that counts the *Filling Cycles* and prevents further use of the vehicle when a predetermined number of *Filling Cycles* is exceeded.

2.4.7 Filling Cycles

This section is only applicable to Class 0 *Hydrogen Components*.

2.4.7.1 General

The number of *Filling Cycles* for the *Hydrogen Components* approved in accordance with this Regulation and its Annexes shall be 5000 cycles except as permitted in Paragraphs 2.4.7.2 & 2.4.7.3 of this Regulation.

2.4.7.2 Extended Number of *Filling Cycles*

The vehicle manufacturer may specify an extended number of *Filling Cycles* for the *Hydrogen Components* based on the design lifetime mileage of the vehicle and range with maximum fuel capacity, but shall not be less than 5000 cycles, i.e.:

Design lifetime mileage of the vehicle, L
Range with maximum fuel capacity, R

Number of *Filling Cycles* = L/R but not less than 5000

2.4.7.3 Reduced Number of *Filling Cycles*

Provided that a *Usage Monitoring And Control System* is installed as part of the *Hydrogen System,* the number of *Filling Cycles* for *Hydrogen Components* approved in accordance with this Regulation and its Annexes shall be specified by the vehicle manufacturer and may be less than 5000 cycles and may vary with different applications based on the design lifetime mileage of the vehicle and range with maximum fuel capacity. The *Usage Monitoring And Control System* shall prevent any further use of the vehicle when the specified number of *Filling Cycles* is exceeded, until the *Hydrogen Components* that have exceeded that value are replaced with new *Hydrogen Components*.

The safety concept of the *Usage Monitoring And Control System* shall be approved in accordance with Annex 10 of this Regulation.

Capitalise/change to italics all references to *Filling Cycles* throughout the document.

Replace references to “pressure cycles” with “3 times number of *Filling Cycles* in accordance with Paragraph 2.4.7 of this Regulation*”.*

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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 2 (All drop tests may be performed on each of the 2 *Containers, or* individual impacts on a maximum of 10 *Containers*).

B24.2 Procedure

The drop tests shall be performed at ambient temperature without internal pressurisation or attached valves.

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

Each *Container* 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 one end from a vertical position with a potential energy ≥ 488 J, but in no case shall the bottom be more than 1.8 m above the ground,
iii) Drop once onto the other end from a vertical position with a potential energy ≥ 488 J, but in no case shall the bottom be more than 1.8 m above the ground,
iv) Drop once onto the same dome position at a 45° angle, 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.
v) Pressure cycle 50% of the *Containers* between ≤ 2.0 MPa and ≥ 1.25 times *Working Pressure* for the number of pressure cycles calculated in accordance with Paragraph 2.4.7 of this Regulation.
vi) Burst test 50% of the *Containers* in accordance with Paragraph B16 of this Annex.

B24.3 Requirements

The *Container(s)* pressure cycle tested shall not leak or rupture within 60% of 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.

The *Container(s)* burst tested shall exceed 85% of minimum burst pressure ratio,

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.

The *Burst Pressure* shall be presented in a test certificate, e.g. Table 7A.4 of this Annex.