

VOLVO

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Contract N° : ENK6-CT2000-00442

**EUROPEAN INTEGRATED HYDROGEN PROJECT – Phase II
(EIHP2)**

Sub-task 4.1

DRAFT ECE COMPRESSED GASEOUS HYDROGEN REGULATION

Sub-task leader:

- Volvo Technology Corp.

Partners:

- DaimlerChrysler AG
- Adam Opel AG
- Raufoss Alternative Fuel Systems AS

Project co-funded by the European Community under the 'Energy, Environment and Sustainable Development and Nuclear Energy Framework Programme V (1998-2002)

EXECUTIVE SUMMARY

During phase 1 of the EIHP, initial proposals were developed for a compressed gaseous hydrogen (CGH₂) regulation for motor vehicles. In EIHP2, the goals of Sub-task 4.1 with respect to the CGH₂ regulation were to:

- i) Submit the draft regulation to the relevant committees,
- ii) Collect and discuss comments from the committees,
- iii) Where appropriate revise the wording of the draft according to comments received.

Following the initial meeting of the GRPE¹ Informal Group “Hydrogen/Fuel Cell Vehicles” (IGH) in November 2001, the EIHP2 CGH₂ working group assisted with further development of draft ECE² CGH₂ regulation within the IGH and activities included:

- i) Compiling comments received on the draft ECE CGH₂ regulation,
- ii) Developing draft responses to comments received,
- iii) Chairing & administering IGH expert working groups.

The draft ECE CGH₂ regulation covers the hydrogen refilling, storage and supply system up to and including the last pressure regulator upstream of the fuel cell system or internal combustion engine.

To date it has taken 6 years and substantial EC and private finance to develop the draft ECE CGH₂ regulation to the current status. During the course of EIHP2 the draft ECE CGH₂ regulation has been significantly improved based on initiatives of the Partners. The technical content of the current version of the proposal has wide support from authorities and industry in Europe and North American industry, and it is harmonised to a significant degree with related ISO drafts and the US SAE standardisation activities. In terms of harmonisation with ISO, the goal was to harmonise those technical requirements where related ISO drafts (CGH₂ container standards) covered similar areas to the draft ECE CGH₂ regulation, whilst taking into account that an ECE regulation is a legal requirement and an ISO standard represents industry best practice. The draft ECE CGH₂ regulation has a much wider scope than the ISO drafts and applies to a wider range of container materials and constructions. The main difference being that the ISO drafts refer to design prescriptive standards for Type 1 (all metal) pressure vessels that are not in line with the performance requirement philosophy of ECE regulations. It was decided that the draft ECE CGH₂ regulation would retain its own performance based requirements for Type 1 containers. In addition while the draft ECE CGH₂ regulation covers only hydrogen, the ISO draft covers hydrogen and natural gas blends.

At present there is uncertainty as to if and when an ECE CGH₂ regulation will be adopted. The ultimate goal of all parties at the GRPE is a Global technical regulation (GTR) to open up a global market at the lowest cost. However, there is disagreement in how to reach this goal. The position of the European Commission, many European countries, Canada and ISO is to introduce an ECE regulation and in parallel to start development of a GTR. This approach permits practical experience to be gained using the requirements and provides a reliable interim means of vehicle approval. Japan, supported by the USA, wants to move directly to the development of a GTR.

The main issue with Japan is the philosophical approach behind the regulations. The draft ECE hydrogen regulations were drafted on the basis of traditional European vehicle regulations requiring type approval of individual components with some system requirements, i.e. based on a containment philosophy that if all individual components are safe, the system will be safe. The Japanese approach is based on a containment philosophy

¹ GRPE: See Section 2.

² ECE: See Section 1.

for the high-risk sections of the system, i.e. the fuel storage, plus a detection philosophy for the remainder of the system, i.e. the system reacts to a hydrogen release. Japan will only accept type approval of a limited number of critical components, i.e. for the draft ECE CGH₂ regulation the container, cylinder valve and pressure relief device. Although many manufacturers support the Japanese stance, it was acknowledged that it would need a significant movement from the traditional European approach. At present the draft ECE CGH₂ regulation is close to the Japanese position in that it requires type approval only of high-pressure components and safety systems. From the perspective of the USA as stated by the National Highway Traffic Safety Administration the focus for a GTR should be on accident situations, whole vehicle safety, and minimising restrictions to technological advances.

Industry has expressed a need for a GTR to be in force by 2010. However, there are many uncertainties related to GTR development including scope, start date, sponsoring government, fundamental technical philosophy, as well as the fact that no experience has been made with GTRs yet. Any one of these concerns could delay the GTR development sufficiently to miss the target date. In the meantime Japan is developing national regulations, and the USA is expanding its natural gas vehicle (NGV) standards to cover CGH₂. Without an ECE regulation, or possibly an EC directive, national regulations will probably be introduced in Europe based on the current draft ECE CGH₂ regulations.

The current IGH version of the draft ECE CGH₂ regulation is Rev.12b, dated 12 October 2003.

The current GRPE version of the draft ECE CGH₂ regulation is Working Doc. No. TRANS/WP.29/GRPE/2004/3 with minor amendments in Informal Doc. No. GRPE-47-5.

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1 INTRODUCTION

During phase 1 of the EIHP, initial proposals were developed for a compressed gaseous hydrogen (CGH₂) regulation.

After a survey in 1998 highlighted that there were no existing regulations available for the use of hydrogen in vehicles, the aim of EIHP1 became the development of flexible harmonised regulations. The regulations were to be based on performance requirements rather than historical technical solutions, which would encourage rather than stifle the development and introduction of safe, new hydrogen technologies. Consequently a solid foundation based on harmonised research was necessary, see Figure 1. The EIHP partners undertook various systematic analyses to improve the knowledge of hydrogen technologies and related safety issues, and of existing regulatory requirements. The research programme provided a base from which to develop the harmonised regulations. The aim of the draft regulations was to enhance the safe and economic manufacture and use of hydrogen fuelled vehicles.

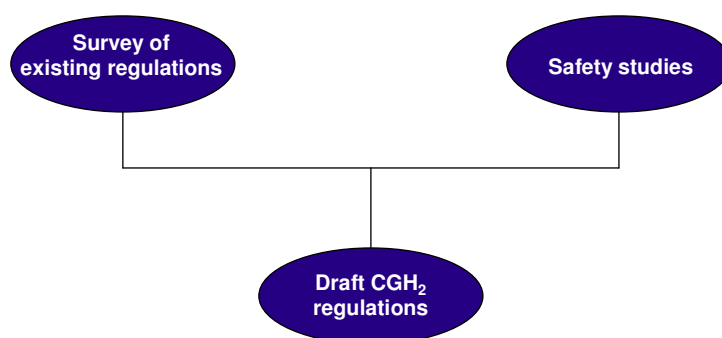


Figure 1
Research Basis For The Draft Hydrogen Regulations In EIHP1

Working Party 29 “World Forum For The Harmonisation Of Vehicle Regulations” (WP29) of the United Nations’ Economic Commission For Europe (UN ECE) is the platform for global harmonisation of legal requirements for motor vehicles. WP29 was the drafting body for the related alternative fuel vehicle regulations for compressed natural gas (CNG) and liquefied petroleum gases (LPG) that were used as the framework for the EIHP1 draft hydrogen regulations.

Due to technological differences, separate drafts were developed for CGH₂ and liquid hydrogen systems.

In EIHP1 the draft hydrogen regulations were validated in two stages:

- i) A workshop was held in March 1999 to discuss the basis of the draft regulations, to which representatives were invited from national authorities, industry and research institutions.
- ii) When the draft represented sufficient consensus within EIHP1, comments on it were obtained from national authorities and a wide range of external CGH₂ experts. Where appropriate, the comments collected from this exercise were integrated into the draft proposals.

The version of the draft CGH₂ regulation available at the end of EIHP1 was:

Uniform Provisions Concerning The Approval Of

1. *Specific components of motor vehicles using compressed gaseous hydrogen*
2. *Vehicles with regard to the installation of specific components for the use of compressed gaseous hydrogen*

Revision 7 (Dated 20.04.00)

In EIHP2, the goals of Sub-task 4.1 with respect to the CGH₂ regulation were to:

- i) Submit the draft regulation to the relevant committees,
- ii) Collect and discuss comments from the committees,
- iii) Where appropriate revise the wording of the draft according to comments received.

2 EIHP2 CGH₂ REGULATION WORKING GROUP

During Spring 2001 the Partners agreed a strategy for approaching governments and non-governmental organisations to provide them with information about the drafts that had been developed in EIHP. Subsequently the drafts and an information package were circulated to a wide range of authorities, non-governmental organisations and companies throughout Europe. Almost 150 organisations were informed in Europe, North America, Japan and elsewhere.

The German Federal Ministry of Transport, Building & Housing (BMVBW) was approached and agreed to sponsor the promotion of the draft regulations. Subsequently the EIHP drafts were presented by Germany to WP29, which agreed to examine the interest in establishing the new regulations and forwarded them to one of its subsidiary bodies, the Working Party on Pollution and Energy (GRPE). At the 42nd GRPE meeting (29 May–1 June 2001) an ad hoc working group “Hydrogen Vehicles – Onboard Storage Systems” was established, chaired by BMVBW. More recently the ad hoc working group has become known as the GRPE Informal Group “Hydrogen/Fuel Cell Vehicles” (IGH). A wide range of countries and organisations volunteered to take part in the group. The approach was confirmed in the 124th session of WP29 (26–29 June 2001).

Since the publication of Rev.7 of the draft ECE CGH₂ regulation in 2000, Volvo had collected all comments that had been received. At an EIHP2 CGH₂ working group meeting on 4 July 2001 it was agreed to develop a new version of the draft before development was taken over by the IGH. The new version was based on all comments received by 13 August 2001. On 5 July DaimlerChrysler’s experience with CGH₂ systems and regulations was discussed.

At the EIHP2 liquid hydrogen working group meeting on 28 August 2001, efforts were made to realign the liquid and CGH₂ drafts where there was common ground. All comments were compiled and distributed within the EIHP2 CGH₂ working group by Volvo prior to the group’s first meeting on 8-10 October 2001. The EIHP2 CGH₂

working group consisted of Volvo, DaimlerChrysler, Opel and Raufoss (Vandenborre Technologies attended the first meeting). Subsequent meetings were necessary on 18-19 October & 19-21 November 2001 because of the need to establish the new group and to reach agreement on the large number of comments that had been received. Revision 8 of the draft CGH₂ regulation was published on 23 November 2001.

On 25 October 2001 Volvo presented the activities of EIHP2 and the vision for globally harmonised technical requirements and standards at the plenary meeting of ISO TC197 “Hydrogen Technologies”, see Figures 2 and 3. Subsequent discussion clearly showed the difficulties faced with globalisation:

- i) Little appreciation of “regulations” by North American participants,
- ii) The “ECE” title was very misleading for North American participants even in connection with Global Technical Regulations (GTR),
- iii) It was stated that there had been no US input into the initial development of the EIHP proposals, which were viewed as being at a very advanced state.

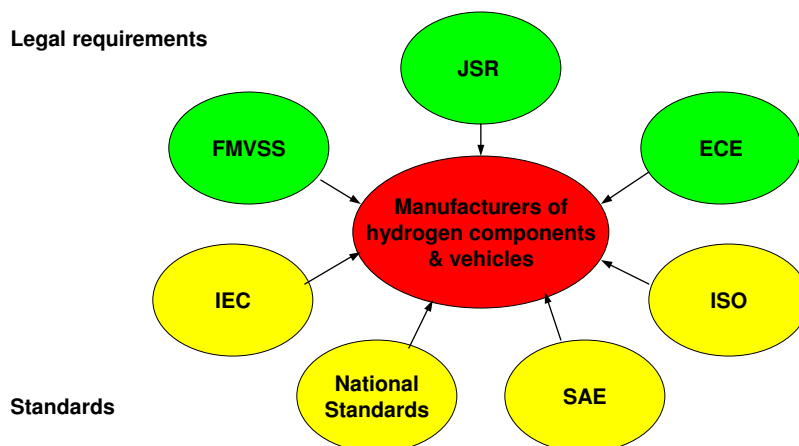


Figure 2
Undesirable Position For Hydrogen Vehicle Regulations & Standards

In late 2001 and early 2002, a number of misleading statements were published in North America about EIHP2 particularly in articles related to the US Fuel Cell Summit (Vol.2, Issue 4) and the US National Hydrogen Association’s Hydrogen Safety Report. To explain the goals and activities of EIHP2 in the context of vehicles an article was drafted by Volvo and published in the July 2002 edition of Hydrogen Safety Report (<http://www.hydrogensafety.info/articles/02-july-06.asp>).

Following the first meeting of the IGH in November 2001, the EIHP2 CGH₂ working group became a support group for the IGH.

Throughout the development work on the draft ECE CGH₂ regulation, the EIHP2 Partners have constantly provided feedback into its development from experiences in other projects. In particular DaimlerChrysler with their CGH₂ buses for the Clean Urban

Transport In Europe (CUTE) project and Raufoss with CNG homologation experience based on ECE CNG regulation 110 (R110).

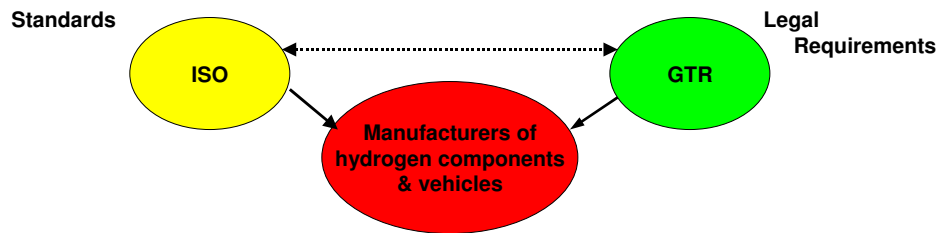


Figure 3
Desirable Position For Hydrogen Vehicle Regulations & Standards

3 GRPE INFORMAL GROUP “Hydrogen/Fuel Cell Vehicles” (IGH)

Following the initial meeting of the IGH in November 2001, the EIHP2 CGH₂ working group assisted the continuing development of the draft ECE CGH₂ regulation within the IGH and activities included:

- i) Compiling comments received on the draft ECE CGH₂ regulation (Volvo),
- ii) Developing draft responses to comments received (all),
- iii) Chairing & administering IGH expert working groups (Volvo).

At the initial IGH meeting on 29 November 2001 it was agreed that the EIHP2 CGH₂ working group would undertake a substantial redevelopment of the detailed test requirements for containers (Annex 7 of the draft). Raufoss undertook the initial restructuring of Annex 7 to reflect its role as a regulation rather than a standard, from which the requirements were originally derived. Raufoss also proposed changes based on lessons learnt from recent experience with ECE R110 for CNG. Subsequently the proposals were discussed within the EIHP2 CGH₂ working group along with other comments that had been received regarding Revision 8. Revision 9 was published on 6 May 2002.

At the 1st IGH meeting, the participants had expressed a wish to hold a workshop on high-pressure systems and techniques before detailed discussions of the drafts took place. While the 2nd IGH meeting focused on liquid hydrogen systems, the 3rd IGH meeting held on 4 & 5 June 2003 included a CGH₂ workshop with presentations by DaimlerChrysler, Raufoss and Volvo. At the meeting it was agreed that the drafts should be harmonised with appropriate ISO draft standards where they cover the same areas, and as a result a GRPE/ISO CGH₂ expert working group was established. ISO

prepared a comparative report highlighting differences between the draft ECE CGH₂ regulation and the draft ISO container standard (ISO15869).

A global cooperation group meeting was held in Montreal on 12 June 2002 in association with the ISO TC197 plenary meeting on 13 & 14 June.

The EIHP2 CGH₂ working group compiled all comments received regarding Revision 9 of the draft ECE CGH₂ regulation and circulated them to participants in the GRPE/ISO CGH₂ expert working group. In July 2002 ISO presented a report containing comparative differences between the EIHP text and the related ISO standards. Additional unnecessary work was generated as the ISO report contained both comparative differences and an incomplete list of other general comments. For ease of management in the meeting Volvo prepared new documents separating the comments into comparative ones (the actual purpose of the joint meeting) and a complete list of other comments. Volvo held three days of pre-meetings with Raufoss to develop proposals with the aim of increasing the efficiency of the meeting, including one day with additional technical experts invited by Raufoss. All comparative comments were addressed at the 30 July GRPE/ISO CGH₂ expert working group meeting that was chaired by Ford. All comments and agreements were compiled and published on the IGH website which is hosted and managed under the EIHP2 website by LBST.

It was also agreed that the EIHP2 CGH₂ working group would restructure Annexes 8 & 9 (detailed test requirements for components other than containers) in a similar manner to what had previously been undertaken for Annex 7. The EIHP2 CGH₂ working group invited Powertech, a Canadian EIHP2 Supporter and component testing specialist, to participate in these activities. Initial ideas were discussed at a meeting chaired and hosted by Volvo on 13 and 14 August 2002. Opel then developed the initial restructuring proposals and the group agreed a revised version at a meeting on 9-11 October 2002, which was circulated within the IGH on 16 October.

On 24-25 October 2002, Volvo chaired the 2nd meeting of the GRPE/ISO CGH₂ experts. A pre-meeting was held with Raufoss and technical experts from their suppliers to develop draft responses to the comments to be addressed at the main meeting, and subsequently with Powertech. Agreement was reached on the harmonisation of the remaining differences identified in the ISO comparative report, and in particular on the key issues of stress analysis reports and impact damage tests. However, a major new harmonisation issue was identified during the meeting, which had not been identified in the ISO comparative report; the draft ISO15869 referred exclusively to ISO7866 and ISO9809 for Type 1 (all metal) containers. The group addressed other comments relating to Revision 9 of the draft ECE CGH₂ regulation with an impact on harmonisation, i.e. affecting Annex 7 container requirements. The results of the meeting are contained in GRPE/ISO Docs. N26, 27 & 28. Based on the results of the meeting Volvo prepared Rev.10 of the draft ECE CGH₂ regulation, crosschecked the changes with ISO and distributed the document to the IGH on 6 November 2002.

Despite having accepted the results of the 4th meeting of the IGH, ISO subsequently reopened the discussion to try and achieve acceptance of including the design prescriptive ISO7866 and ISO9809 as the requirements in the regulation for Type 1 (all metal) containers. Volvo engaged in a number of discussions with ISO to identify a process for resolving what was now the only major outstanding harmonisation issue. An agreement was reached with ISO and the IGH chairman to establish a further meeting of the GRPE/ISO CGH₂ experts on 22 January 2003 prior to the GRPE CGH₂ experts meeting on 23-24 January 2003. Except for the Type 1 issue, all container

related issues were successfully harmonised at this meeting. It was decided that the draft ECE CGH₂ regulation would retain its own performance based requirements for Type 1 containers. A new version of the draft ECE CGH₂ regulation was not prepared as there were also some outstanding issues from the GRPE CGH₂ experts meeting.

A 2nd follow up meeting of the GRPE CGH₂ experts was held on 13 February 2003 (the results of the meeting are contained in GRPE Doc. 015) immediately prior to the 5th meeting of the IGH on 13-14 February 2003. At the 3rd GRPE CGH₂ experts meeting on 5 March 2003 all outstanding component related issues were resolved (the results of the meeting are contained in GRPE Docs. 020, 021, 022, 023 & 024). On 26 March 2003 Volvo hosted a meeting with RDW in an attempt to resolve a discussion over container assemblies, the results then being presented to ISO and DaimlerChrysler for further consideration. Rev.11 of the draft ECE CGH₂ regulation was distributed to the IGH on 29 March 2003.

All GRPE expert working group documents and GRPE-ISO expert working group (both CGH₂ & liquid hydrogen) documents were added to the IGH's website.

The 6th meeting of the IGH was held on 10-11 April 2003 with associated pre-meetings on 9 April. At the meeting it was agreed that Raufoss in cooperation with Dynetek (a EIHP2 supporter) would revise Annex 7 (container requirements) to include a wider range of materials and methods of construction, e.g. welding. The changes were made by a consultation exercise with the industry. Volvo prepared Rev.12 of the draft ECE CGH₂ regulation including the revised container requirements and distributed the document to the IGH on 14 May 2003.

Volvo made a presentation to support the introduction of Rev.12 of the draft ECE CGH₂ regulation as an informal document at the 46th GRPE meeting on 23 May 2003. No decision was made as to whether or not to support the draft ECE CGH₂ regulation as an ECE regulation under the 1958 agreement, as this was against the wishes of the delegates from Japan and USA who wanted to progress straight to a GTR under the 1998 agreement. This was despite an earlier statement that the GRPE would support a 2-step approach by first publishing ECE hydrogen regulations. The IGH was requested to develop an action plan for the goal of reaching a GTR. A meeting between EIHP2 partners and the chairman of the IGH was held on 2 July 2003 to discuss European industry needs.

At the request of the IGH Chairman, Volvo collated minor comments on Rev.12 of the draft prior to a GRPE CGH₂ expert working group meeting in September. The GRPE CGH₂ expert working group meeting was held on 11 September to agree responses to minor comments and requests for clarifications of some requirements, and to resolve the container assembly issue. Rev.12a of the draft ECE CGH₂ regulation was distributed to the IGH on 14 September 2003. Subsequently Volvo prepared a proposal to improve the "container assembly" concept in the draft ECE CGH₂ regulation and gained consensus from the majority of key experts. The 7th meeting of the IGH was held on 6-7 October 2003. Rev.12b of the draft ECE CGH₂ regulation was distributed on 12 October 2003 including the container assembly revisions.

Volvo and BMW were involved in subsequent discussions in the GTR action plan drafting group and made major contributions to the emerging action plan.

The main issue at the 8th IGH meeting on 12 & 13 January 2004 was the agreement of a GTR action plan. 2 principle options were identified:
Option 1 - Start work on GTR and abandon the draft ECE regulations

Supported by Japan & USA

Option 3 - Introduce the ECE regulations and in parallel start work on GTR

Supported by EC, Canada, Germany, Netherlands & ISO

There was no IGH recommendation, however, appendices were provided giving the views of Japan, USA & the Option 3 supporters.

Rev.12a of the draft ECE CGH₂ regulation was presented as a formal working document at the 47th GRPE meeting on 16 January 2003, and the few changes necessary to upgrade Rev.12a to 12b were presented as an informal document. The principle results of the meeting were:

- i) There were no technical comments on the draft.
- ii) No decision was taken on which option to take for the development of a GTR. The decision was considered to be too political and was passed to WP29. A decision is not expected before late June 2004.
- iii) The IGH was requested to continue working on open questions:
 - Sponsor of the GTR,
 - Scope and content of the GTR,
 - Additional research and testing required to support the development,
 - Time schedule for the GTR development,
 - Interim solutions for approval of hydrogen/fuel cell vehicles.

4 SUMMARY

The draft ECE CGH₂ regulation covers the hydrogen refilling, storage and supply system up to and including the last pressure regulator upstream of the fuel cell system or ICE.

To date it has taken 6 years and substantial EC and private finance to develop the draft ECE CGH₂ regulation to its current status. During the course of EIHP2 the draft ECE CGH₂ regulation has been significantly improved based on initiatives of the Partners. The technical content of the current version has wide support from authorities and industry in Europe and also from North American industry, and it is harmonised to a significant degree with related ISO drafts. Successful efforts were made to harmonise with the US SAE. With respect to the detailed technical requirements consensus has always been reached within the working groups prior to agreeing changes with the exception of the Japanese approach to the basic philosophy and the ISO Type 1 container issue discussed below.

The goal of harmonisation with ISO was to harmonise technical requirements where ISO drafts and the draft ECE CGH₂ regulation covered similar areas, though in practice this was later extended to all issues directly affecting the container. At working group level cooperation with the ISO working group was excellent. The final status of the level of harmonisation achieved with ISO is shown in Figure 4.

Goal: Harmonisation where both documents covered similar areas

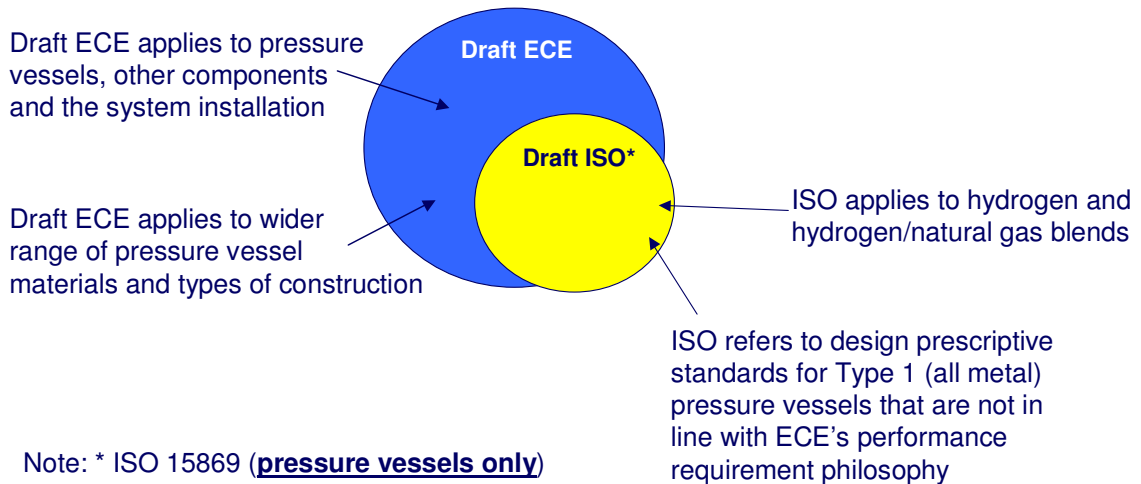


Figure 4
Harmonisation With ISO

At present there is uncertainty as to if and when ECE hydrogen regulations will be adopted. The ultimate goal of all parties at the GRPE is a GTR to open up a global market at the lowest cost. However, there is disagreement in how this goal will be reached. The position of the European Commission, many European countries, Canada and ISO is to introduce ECE hydrogen regulations and in parallel to start development of a GTR. This approach permits practical experience to be gained using the requirements and provides a reliable interim means of vehicle approval. Japan, supported by the USA, wants to move directly to the development of a GTR. In addition Japan will not accept the draft ECE CGH₂ regulation as even a basis for discussions on the development of a GTR, instead preferring its own draft national regulation. The USA has stated that it would be willing to reuse elements of the draft ECE hydrogen regulations in a GTR. Japan is a signatory to the 1958 Agreement permitting the establishment of ECE regulations, and the 1998 Agreement permitting the establishment of GTR. The USA is a signatory only to the 1998 Agreement permitting the establishment of GTR.

The main issue with Japan is the philosophical approach behind the regulations. The draft ECE hydrogen regulations were drafted on the basis of traditional European vehicle regulations requiring type approval of individual components with some system requirements, i.e. based on a containment philosophy that if all individual components are safe, the system will be safe. The Japanese approach is based on a containment philosophy for the high-risk sections of the system, i.e. the fuel storage, plus a detection philosophy for the remainder of the system, i.e. the system reacts to a hydrogen release. Japan will only accept type approval of a limited number of critical components, i.e. for the draft ECE CGH₂ regulation the container, cylinder valve and pressure relief device. Although many manufacturers support the Japanese stance, it was acknowledged that it would need a significant movement from the traditional

European approach. At present the draft ECE CGH₂ regulation is close to the Japanese position in that it requires type approval only of high-pressure components and safety systems. On the basis of the GRPE/ISO and GRPE expert working group meetings it seems that Japan agrees with the technical requirements for the various components in the draft ECE CGH₂ regulation, the difference being which components are individually type approved. During the meetings the European authorities made very significant compromises, but these were not matched from the Japanese side, in fact the Japanese would not move from their original position. In the final draft ECE CGH₂ regulation type approval is required for all components in the high-pressure section of the system, with additional system approvals for safety systems and approval of the installation in the vehicle. The different positions are illustrated in Figure 5.

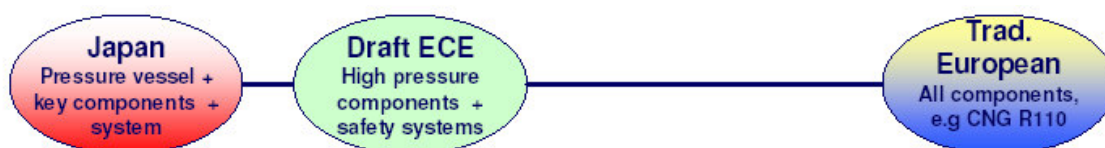


Figure 5
Harmonisation With Japan: Type Approval Requirements

From the perspective of the USA as stated by the National Highway Traffic Safety Administration the focus for a GTR should be on accident situations, whole vehicle safety, and minimising restrictions to technological advances.

Industry has expressed a need for a hydrogen GTR to be in force by 2010. However, there are many uncertainties related to GTR development including scope, start date, sponsoring government, fundamental technical philosophy, as well as the fact that no experience has been made with GTRs yet. Any one of these concerns could delay the GTR development sufficiently to miss the target date. In the meantime Japan is developing national regulations, and the USA is expanding its natural gas vehicle (NGV) standards to cover CGH₂. Without an ECE regulation, or possibly an EC directive, national regulations will probably be introduced in Europe based on the current draft ECE CGH₂ regulations.

The current IGH version of the draft ECE CGH₂ regulation is:
Draft ECE CGH₂ regulations, Rev.12b, dated 12 October 2003
http://www.eihp.org/unece/drafts/cgh2/GRPE_12a&b/CGH2R-12b.pdf

The current GRPE version of the draft ECE CGH₂ regulation is:
Working Doc. No. TRANS/WP.29/GRPE/2004/3 (Rev.12a)
<http://www.unece.org/trans/doc/2004/wp29grpe/TRANS-WP29-GRPE-2004-03e.doc>

Plus
Informal Doc. No. GRPE-47-5 (changes from Rev.12a to 12b)
<http://www.unece.org/trans/doc/2004/wp29grpe/TRANS-WP29-GRPE-47-inf05e.doc>

Further information and the results of the various meetings can be found at:
GRPE
<http://www.unece.org/trans/main/wp29/wp29wgs/wp29grpe/grpepage.html>
IGH
<http://eihp.org/unece/index.html>

5 FURTHER ACTIVITIES

From a European perspective the following issues must be addressed:

- i) A strong and harmonised European view in the coming WP29 hydrogen GTR discussions,
- ii) A strong and harmonised European view in future hydrogen GTR activities,
- iii) An official authority willing to lead an informal European hydrogen regulations group,
- iv) A permanent group of European experts, with a long-term mandate and commitment for continued work on regulatory matters related to hydrogen vehicles,
- v) Financial support for industry involvement,
- vi) To consider a fallback position in the event that WP29 adopts Option 1 of the hydrogen GTR action plan.

6 LIST OF MEETINGS

Date	Purpose	Location
12.02.01	Project kick-off meeting	Brussels, Belgium
28.03.01	Sub-task 4.1/2 meeting	Cologne, Germany
04/05.07.01	Sub-task 4.1/2 meeting	Stuttgart, Germany
28.08.01	Sub-task 4.1 LH ₂ regs. meeting	Munich, Germany
19/21.09.01	6-Month project meeting	Athens, Greece
09/11.10.01	Sub-task 4.1 CGH ₂ regs. meeting	Gothenburg, Sweden
18/19.10.01	Sub-task 4.1 CGH ₂ regs. meeting	Stuttgart, Germany
19/21.11.01	Sub-task 4.1 CGH ₂ regs. meeting	Stuttgart, Germany
29.11.01	1 st IGH meeting	Bonn, Germany
21/22.02.02	12-Month project meeting	Seville, Spain
20.03.02	1 st Global Cooperation Meeting	Sacramento, USA
17/19.04.02	Sub-task 4.1/2 CGH ₂ regs. meeting	Gothenburg, Sweden
24/25.04.02	Sub-task 4.1/2 CGH ₂ regs. meeting	Mainz, Germany
03/05.06.02	3 rd IGH meeting + pre-meeting	Nabern, Germany
12.06.02	2 nd Global Cooperation Meeting	Montreal, Canada
17/18.07.02	Pre-meeting to GRPE/ISO experts meeting	Gothenburg, Sweden
29.07.02	Pre-meeting to GRPE/ISO experts meeting	Munich, Germany
30.07.02	GRPE/ISO CGH ₂ experts meeting	Munich, Germany
13/14.08.02	Sub-task 4.1/2 CGH ₂ regs. meeting	Gothenburg, Sweden
01/02.10.02	18-Month project meeting & MTW	Brussels, Belgium
09/11.10.02	Sub-task 4.1/2 CGH ₂ regs. meeting	Mainz, Germany
22/25.10.02	GRPE/ISO CGH ₂ experts mtg. & pre-mtg.	Vancouver, Canada
13/15.11.02	4 th IGH meeting + pre-meeting	Cologne, Germany
14/15.01.03	Sub-task 4.1/2 CGH ₂ regs. meeting	Gothenburg, Sweden
22/24.01.03	GRPE/ISO & GRPE CGH ₂ experts meetings	Munich, Germany
13.02.03	GRPE CGH ₂ experts meeting	Mainz, Germany
13/14.02.03	5 th IGH meeting	Mainz, Germany
24/25.02.03	24-Month project meeting	Porsgrunn, Norway
05.03.03	GRPE CGH ₂ experts meeting	Munich, Germany
26.03.03	Volvo/RDW disc. of container assemblies	Gothenburg, Sweden
09/11.04.03	6 th IGH meeting & pre-meetings.	Gothenburg, Sweden
29.04.03	GEPE meeting for CGH ₂ regs	Paris, France
22/23.05.03	46 th GRPE Meeting	Geneva, Switzerland
02.07.03	Sub-task 4.1/2 meeting	Köln, Germany
08/09.09.03	30-Month project meeting	Grenoble, France
11.09.03	GRPE CGH ₂ experts meeting	Gothenburg, Sweden
06/07.10.03	7 th IGH meeting	Munich, Germany
12/13.01.04	8 th IGH meeting	Geneva, Switzerland
16.01.04	47 th GRPE Meeting	Geneva, Switzerland
29/30.01.04	Final project meeting	London, UK

7 LIST OF DOCUMENTS

Draft Regulations

Draft ECE CGH₂ regulations:

- Rev.8, Dated 23 November 2001
- Rev.9, Dated 6 May 2002
- Rev.10, Dated 6 November 2002
- Rev.11, Dated 29 March 2003
- Rev.12, Dated 14 May 2003
- Rev.12a, Dated 14 September 2003
- Rev.12b, Dated 12 October 2003

UN ECE, WP.29, GRPE Working Doc. No. TRANS/WP.29/GRPE/2004/3 (Rev.12a)

and

UN ECE, WP.29, GRPE Informal Doc. No. GRPE-47-5 (changes from Rev.12a to 12b)

EIHP2 CGH₂ Working Group Documents

1. Agreed working group responses to the comments received on Rev.7 of the Draft ECE CGH₂ Regulation
2. Agreed Changes Between Revisions 7 & 8 Of The Draft ECE CGH₂ Regulations

GRPE IGH CGH₂ Expert Working Group Documents

See <http://www.eihp.org/unece/docs/index.html>

GRPE No.	Date	Title
001	18.12.02	Comments On The GRPE Draft ECE Compressed Gaseous Hydrogen (CGH ₂) Regulation Version 10 Dated 06.11.02 (Non GRPE/ISO Harmonization)
002	06.01.03	Comments On The GRPE Draft ECE Compressed Gaseous Hydrogen (CGH ₂) Regulation Version 10 Dated 06.11.02 (Non GRPE/ISO Harmonization)
003	08.01.03	Comments On The GRPE Draft ECE Compressed Gaseous Hydrogen (CGH ₂) Regulation Version 10 Dated 06.11.02 (Non GRPE/ISO Harmonization)
004	16.01.03	Comments On The GRPE Draft ECE Compressed Gaseous Hydrogen (CGH ₂) Regulation Version 10 Dated 06.11.02 (Non GRPE/ISO Harmonization) (Includes EIHP2 proposals to resolve the comments)
005	-	Introductory Presentation: Meeting Of The GRPE CGH ₂ Experts 23-24 January 2003 TÜV, Munich
006	24.01.03	Comments & responses on the GRPE draft ECE compressed gaseous hydrogen (CGH ₂) regulation, Version 10, Dated

GRPE No.	Date	Title
		gaseous hydrogen (CGH ₂) regulation Version 10 Dated 06.11.02 (Non GRPE/ISO harmonization) Results of the GRPE CGH ₂ Experts Meeting in Munich 23-24 January 2003
007	24.01.03	Final Proposals For Incorporating “Nominal Working Pressure” & “Maximum Allowable Working pressure”
008	24.01.03	Updated Proposals For A Removable Storage System Based On The PSA Idea
009	24.01.03	Attendance List for the GRPE CGH ₂ Experts Meeting in Munich 23-24 January 2003
010	30.01.03	Outstanding comments on the GRPE draft ECE compressed gaseous hydrogen (CGH ₂) regulation Version 10 Dated 06.11.02 (Non GRPE/ISO harmonization) after the GRPE CGH ₂ Experts Meeting in Munich 23-24 January 2003
011	30.01.03	Document Register
012	10.02.03	Outstanding comments on the GRPE draft ECE compressed gaseous hydrogen (CGH ₂) regulation Version 10 Dated 06.11.02 (Non GRPE/ISO harmonization) after the GRPE CGH ₂ Experts Meeting in Munich 23-24 January 2003
013	10.02.03	TÜV Proposal For A Burst Test For Components Other Than The Container
014	10.02.03	Modified Proposal For A Burst Test For Components Other Than The Container
015	13.02.03	Comments & responses on the GRPE draft ECE compressed gaseous hydrogen (CGH ₂) regulation Version 10 Dated 06.11.02 (Non GRPE/ISO harmonization) Results of the GRPE CGH ₂ Experts Meeting in Rüsselsheim 13 February 2003
016	13.02.03	Attendance List for the GRPE CGH ₂ Experts Meeting in Rüsselsheim 13 February 2003
017	14.03.03	JASIC presentation at the GRPE CGH ₂ Experts Meeting in Munich 23-24 January 2003
018	17.02.03	Comments on the GRPE draft ECE compressed gaseous hydrogen (CGH ₂) regulation Version 10 Dated 06.11.02 (Non GRPE/ISO harmonization) to be discussed at the Munich meeting on 5 March 2003
019	17.02.03	Document Register
020	11.03.03	Outstanding Comments On The GRPE Draft ECE Compressed Gaseous Hydrogen (CGH ₂) Regulation Version 10 Dated 06.11.02 Results of the GRPE CGH ₂ Experts Meeting in Munich 5 March

GRPE No.	Date	Title
		2003
021	11.03.03	Attendance List For the GRPE CGH ₂ Experts Meeting in Munich on 05 March 2003
022	11.03.03	Agreed Changes To Annex 8 Following The Meeting In Munich On 05 March 2003
023	04.04.03	TÜV Presentation at the GRPE CGH ₂ Experts Meeting in Munich 5 March 2003 – Component Burst /Pressure Cycling
024	04.04.03	TÜV Presentation at the GRPE CGH ₂ Experts Meeting in Munich 5 March 2003 – Component Ageing
025	04.04.03	Document Register
026	24.07.03	Comments On The GRPE Draft ECE Compressed Gaseous Hydrogen (CGH ₂) Regulation Version 12 Dated 14.05.03
027	26.08.03	Comments On The GRPE Draft ECE Compressed Gaseous Hydrogen (CGH ₂) Regulation Version 12 Dated 14.05.03
028	14.09.03	GRPE Informal Group “Hydrogen/Fuel Cell Vehicles” CGH ₂ Expert Working Group Responses To Comments On The GRPE Draft ECE Compressed Gaseous Hydrogen (CGH ₂) Regulation Version 12 Dated 14.05.03 Results Of The Göteborg Meeting On 11.09.03
029	11.09.03	Attendance List For the GRPE CGH ₂ Experts Meeting in Göteborg on 11 September 2003
030	14.09.03	Document Register

GRPE/ISO IGH CGH₂ Expert Working Group Documents

See <http://www.eihp.org/unece/docs/index.html>

GRPE/ ISO No.	Date	Title
N01	2002-07-23	Comparison between the EIHP Draft Regulations and the ISO Draft Standards on compressed gaseous hydrogen fuel tanks for land vehicles. To be discussed at the GRPE/ISO group of experts meeting on 30 July 2002 in Munich, Germany
N03	2002-07-23	Comments received with respect to EIHP2 proposals for draft ECE compressed gaseous hydrogen (CGH ₂) regulation version 9 dated 06.05.02
N04	2002-07-29	Cooperation between the UN-ECE/GRPE ad hoc WG on Hydrogen Vehicles – Onboard Storage Systems and ISO
N08	2002-07-30	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.
N09	2002-07-30	Comments received with respect to EIHP2 proposals for draft ECE compressed gaseous hydrogen (CGH ₂) regulation version 9 dated 06.05.02

GRPE/ ISO No.	Date	Title
N010	2002-07-30	Next steps agreed at the GRPE/ISO group of experts meeting on gaseous hydrogen onboard storage systems held on 30 July 2002 in Munich, Germany
N011	2002-07-30	Attendance list of the GRPE/ISO group of experts meeting on gaseous hydrogen onboard storage systems held on 30 July 2002 in Munich, Germany
N013	2002-08-05	Notice of the second meeting of GRPE/ISO group of experts on gaseous hydrogen onboard storage systems to be held on 24-25 October 2002 in Vancouver
N021	2002-10-28	Attendance list of the GRPE/ISO group of experts meeting on gaseous hydrogen onboard storage systems held on 24-25 October 2002 in Vancouver, Canada
N022	2002-10-16	New proposals for Annex 8 requirements and approval test procedures for specific components other than containers & related changes.
N023	2002-10-17	Outstanding issues to be resolved from the comparison between the EIHP Draft Regulations and the ISO Draft Standards on compressed gaseous hydrogen fuel tanks for land vehicles.
N024	2002-02-17	Comments received with respect to EIHP2 proposals for draft ECE compressed gaseous hydrogen (CGH ₂) regulation, version 9 dated 06.05.02
N025	2002-02-24	Presentation on the cooperation between the UN-ECE/GRPE ad hoc WG on Hydrogen Vehicles – Onboard Storage Systems and ISO for the meeting of the GRPE/ISO group of experts on 24-25 October 2002 in Vancouver, Canada
N026	2002-10-25	Decisions on the outstanding issues to be resolved from the 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.
N027	2002-10-25	Decisions taken on the comments received with respect to EIHP2 proposals for draft ECE compressed gaseous hydrogen (CGH ₂) regulation version 9 dated 06.05.02. Discussed at the GRPE/ISO group of experts on 24-25 October 2002 in Vancouver, Canada.
N028	2002-10-28	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 and revised at the meeting on 24-25 October 2002 in Vancouver, Canada
N029	2002-10-28	Next steps agreed at the GRPE/ISO group of experts meeting on gaseous hydrogen onboard storage systems held on 24-25 October 2002 in Vancouver, Canada

GRPE/ ISO No.	Date	Title
N031	2002-11-08	Outstanding issues – GRPE/ISO harmonization on the GRPE draft ECE compressed gaseous hydrogen (CGH ₂) regulation, Version 10 dated 06.11.02
N032	2002-12-12	Notice of the third meeting of GRPE/ISO group of experts on gaseous hydrogen onboard storage systems to be held on 22 January in Munich, Germany
N033	2002-12-23	Outstanding issues – Compilation of comments that could have an effect on the GRPE/ISO harmonization – To be reviewed at the GRPE/ISO group of experts meeting on 22 January 2003 in Munich, Germany
N034	2003-01-09	Outstanding issues – Compilation of comments that could have an effect on the GRPE/ISO harmonization – To be reviewed at the GRPE/ISO group of experts meeting on 22 January 2003 in Munich, Germany
N035	2003-01-17	Outstanding issues – Compilation of comments that could have an effect on the GRPE/ISO harmonization – To be reviewed at the GRPE/ISO group of experts meeting on 22 January 2003 in Munich, Germany
N036	2003-01-22	Attendance list of the GRPE/ISO group of experts meeting on gaseous hydrogen onboard storage systems held on 22 January 2003 in Munich, Germany
N037	2003-01-22	Presentation on the cooperation between the UN-ECE/GRPE ad hoc WG on Hydrogen Vehicles – Onboard Storage Systems and ISO for the meeting of the GRPE/ISO group of experts on 22 January 2003 in Munich, Germany
N038	2003-01-22	Outstanding issues – Compilation of comments that could have an effect on the GRPE/ISO harmonization – Discussed at the GRPE/ISO group of experts meeting on 22 January 2003 in Munich, Germany
N039	2003-01-22	EIHP comments to Craig Webster's proposals regarding ISO-references – Presented at the GRPE/ISO group of experts on 22 January 2003 in Munich, Germany
N040	2003-01-22	Gas Cylinder – Use of pressure relief devices - Presentation made by Mr. Hervé Barthélémy at the GRPE/ISO group of experts on 22 January 2003 in Munich, Germany
N041	2003-02-11	Results of the survey of the tank manufacturers regarding the burst pressure ratio for batch tests carried out as a result of the GRPE/ISO group of experts meeting on 22 January 2003 in Munich, Germany
N042	2003-02-18	Revised results of the survey of the tank manufacturers regarding the burst pressure ratio for batch tests carried out as a result of the GRPE/ISO group of experts meeting on 22 January 2003 in Munich, Germany

GRPE/ ISO No.	Date	Title
N043	2003-02-26	Revised results of the survey of the tank manufacturers regarding the burst pressure ratio for batch tests carried out as a result of the GRPE/ISO group of experts meeting on 22 January 2003 in Munich, Germany

Miscellaneous

Adams, P., *European Integrated Hydrogen Project (EIHP) – Phases 1 & 2: Vehicle Activities, Hydrogen Safety Report*, USA National Hydrogen Association, July 2002 (<http://www.hydrogensafety.info/articles/02-july-06.asp>).

GTR Action Plan, UN ECE, WP.29, GRPE Informal Doc. No. GRPE-47-24 (<http://www.unece.org/trans/doc/2004/wp29grpe/TRANS-WP29-GRPE-47-inf24e.doc>)