


GRPE Ad-hoc Working Group - Hydrogen Vehicle Storage Systems  
Nabern, Germany – 4 June 2002

## PROPOSALS FOR COMPRESSED GASEOUS HYDROGEN REGULATIONS

- Current status
  - Major changes between Revisions 8 & 9
  - Main regulations – key features
  - Technical annexes – Annex 7 changes
  - Input from component manufacturers
- Paul Adams  
**VOLVO**
- Per-Sigurd Heggem  
 **Raufoss**



## CURRENT STATUS

- **Rev. 9, Dated 6 May 2002**
- **Published on 14 May 2002**
- **Changes not recorded or highlighted:**
  - **Due to number and scope**
  - **To maintain clarity of the document**



## MAJOR CHANGES BETWEEN REVISIONS 8 & 9

- **Annex 7 restructured to:**
  - Remove design related requirements & restrictions
  - Improve logic
- **Take into account:**
  - Comments received on Rev.8
  - Practical experience of using ECE R110 for CNG components & vehicles
- **All pressures now based on Working Pressure in agreement with ISO**
- **Introduction of self-testing concept for less critical components (Pt.I: 3.3 & 3.4)**
- **Introduction of option for container bundles (Pt.I: 6.2.3)**
- **Improve logic in Pt.I: 6 & Pt.II: 14**
- **Removal of:**
  - Duplicated requirements
  - Unnecessary cross references
  - Unnecessary informative statements
- **Numerous editorial improvements**



## PRINCIPAL SECTIONS

<b>Part</b>	<b>Section</b>			
<b>I</b>	<b>1</b>	<b>Scope</b>	}	<b>General</b>
	<b>2</b>	<b>Definitions, Service Conditions, etc.</b>		
	<b>3 &amp; 5</b>	<b>Administrative</b>	}	<b>Components</b>
	<b>4</b>	<b>Markings</b>		
<b>6</b>	<b>Specifications for components</b>			
<b>II</b>	<b>7-11</b>	<b>Administrative</b>	}	<b>Vehicle Installation</b>
	<b>12-13</b>	<b>Administrative</b>		
	<b>14</b>	<b>Requirements for vehicle installation</b>		
	<b>15-19</b>	<b>Administrative</b>		
<b>Annexes</b>	<b>1-6</b>	<b>Component details, approval marks &amp; forms</b>	}	<b>Detailed Test Requirements</b>
	<b>7</b>	<b>Requirements &amp; approval test procedures for containers</b>		
	<b>8-9</b>	<b>Requirements &amp; approval test procedures for components other than containers</b>		
	<b>10</b>	<b>Electronic control system</b>		



## SCOPE (Sect.1)

- **Components**
- **Vehicles (Categories M & N)**
- **Specifically excludes hybrid cryogenic/ high pressure systems**
- **Specifically excludes the propulsion system or APU**



## DEFINITIONS, ETC. (Sect.2.1-3)

- Key words or phrases defined to avoid ambiguity
- Highlighted in the text to indicate that the terms are specifically defined for the purposes of the regulation
- ***Hydrogen System***, key definition defining the boundary of the systems covered by the regulation:
  - An assembly of *Hydrogen Components* and connecting parts fitted on motor vehicles using hydrogen, excluding *the Hydrogen Conversion System(s)*. The boundary between the *Hydrogen System* and the *Hydrogen Conversion System(s)* is defined as the point(s) at which the *Working Pressure* is higher than the:
    - i) Maximum operating *Pressure* of fuel cell system(s),
    - ii) The inlet *Pressure* of the gas mixer (carburettor or injector(s)) for internal combustion engines or other combustion devices.
- ***Multifunctional Component***
  - Specific Components* combined or fitted together and which may include *Hydrogen Components*.
- Container Type 5 included to provide a basis for the approval of unforeseen technologies



## SERVICE CONDITIONS (Sect. 2.4)

- **Service life**
  - Specified by vehicle manufacturer
  - Maximum of 20 years
  
- **Operating temperature range (only 1 climate zone)**  
-40°C to +85°C (ICE compartment +120°C)
  
- **Filling & pressure cycles**
  - Old concept - 1000 cycles per year of service:  
1000 x 20 years x 400 km range = 8 million km !!!!
  - New concept bases number of filling cycles on lifetime vehicle mileage, with the number of pressure cycles derived by applying a safety factor for prolonged use, etc.



## CHAPTER 6 – COMPONENTS

- **General requirements**
- **Provisions for various types of component generally refer to Annexes 7 & 8 for requirements and test procedures (Annex 8 generally refers to Annex 9 for test procedures)**
- **Requirements provided for:**
  - **Welded fittings**
  - **Rigid fuel lines**
  - **Electrical components**



## **CHAPTER 14 – VEHICLE INSTALLATION**

- **General requirements, e.g. complete system leakage**
- **Container installation, e.g. accelerations applied**
- **Container accessories, e.g. automatic shut off valves**
- **Requirements for other critical installations,  
e.g. refilling system, gas tight housing, electrical**
- **Requalification (periodic, collisions, fire)**



## MAJOR CHANGES IN ANNEX 7

- **Annex 7 restructured into a more logical build-up, and by doing so reduced a number of cross-references and double entries**
- **Removed "Design Pressure". Pressures now only relate to "Working Pressure", with factors adjusted to appropriate values in agreement with ISO**
- **Modified text to reduce design restrictions**
- **Removed design-specific requirements, leaving the container design to prove its capability by fulfilling performance-based test requirements**
- **Removed obligatory use of stress analyses and "Stress Ratios". Burst pressure ratios increased accordingly, with a possible reduction if stress ratios are verified by a stress analysis**



## **MAJOR CHANGES IN ANNEX 7 (Cont.)**

- **Approval test results are summarised in tabular forms in which both requirements and test values may be presented**
- **Several test modifications, some based on ISO-draft**
- **Removed informative appendices**
- **Numerous editorial changes**



## INDUSTRIAL ACCEPTANCE?

**Draft ECE CGH<sub>2</sub> Regulation Rev. 9 distributed to some dedicated potential manufacturers of components:**

- **Ceodeux (manufacturer of cylinder valves, PRD, fittings, etc.)**
  - **Acceptance or comments expected before 04.06**
  
- **Specma (supplier of assembled flexible hoses, representing a number of hose manufacturers)**
  - **Acceptance or comments expected before 04.06**
  
- **Swagelok (manufacturer of manual valves, purge valves, fittings, flexible hoses)**
  - **Acceptance or comments expected before 04.06**

