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C	General	General	Both documents are designed around a factor of safety of 3.0 with a proof factor of 1.3. It is unclear; however based on the comments below, if a vessel designed to the EIHP document would meet the requirements of the ISO standard and vice versa. In some instances the ISO document is more conservative and in some cases the EIHP document is more conservative. It is this reviewer's opinion that these differences must be rectified prior to either document moving forward. ISO/DIS 13985-1 also include requirements for inner tanks made of composite materials which are not covered in the EIHP draft regulations. A decision should be made as to whether there is a need for such inner tanks.		
E	2.27		Definition of "normal operating range" should be clearer	Replace example in the second half of the definition by (see diagram 1 at the end of definition)	
E	2.41		A diagram of the ranges will enhance the understanding	Add after 2.41: Diagram of ranges (example)	
C	4.3.1	ISO/DIS 13985-1, clause 7	There is no requirements for marking of the inner tank in ISO/DIS 13985-1.		
C	4.3.2	ISO/DIS 13985-1, clause 7.1	The marking requirements in the EIHP draft regulations differ from the marking requirements in ISO/DIS 13985-1.		
C	6.1.2	ISO/DIS 13985-1, clause 4.2	There is no reference to the hydrogen compatibility test in ISO/DIS 13985-1.		

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C	6.1.3	ISO/DIS 13985-1, clause 4.2	There is no reference to the toughness requirements of materials in contact with cryogenic temperature in ISO/DIS 13985-1. Comment: ISO/WI 21028-1 *Cryogenic vessels — Toughness requirements for materials at cryogenic temperature — Part 1: Temperature below -80 °C* is currently in development in ISO/TC 220.		
C	6.4.1.1	ISO/DIS 13985-1, clause 4.6.1.1.1	Ok ISO general requirements for pressure relief of the inner liner if it is metal. Only that the MPOP is established by manufacturer.		
E	6.4.1.1		Inconsistency to definitions	Replace "…≤ 110% of the design pressure…" by "…≤ 100% of the design pressure…" and "…> 110% of the design pressure…" by "…> 100% of the design pressure…"	
C	6.4.1.2	ISO/DIS 13985-1, clause 4.6.1.1.1	O.K.		
E	6.4.1.2		Inconsistency to definitions	Replace "…the maximum of the normal operating range…" by "…110% of the normal operating range.."	
C	6.4.1.3	ISO/DIS 13985-1, clause 4.6.1.1.1b	Difference. EIHP says secondary relief shall limit pressure within maximum permissible fault range which is not to exceed 90% of the yield strength of the vessel while ISO/DIS 13985-1 says no greater than 136% maximum permissible operating pressure. Depending on the materials selected and margins these could conflict.		

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C	6.4.1.5	ISO/DIS 13985-1, clause 4.6.1.1.1a	Difference. EIHP says burst disc shall have sufficient safety margin for the inner tank, which according to 6.4.1.1 should not exceed 90% of the yield strength of the vessel. ISO/DIS 13985-1 specifies between 120% and 150% of maximum permissible operating pressure. Again, depending on materials selected and margins these could conflict.		
C	14.3.1	ISO/DIS 13985-1, clause 4.4.2	O. K.		
C	14.3.1	ISO/DIS 13985-2	The EIHP documents specifically disallows the placement of the tank in the engine compartment of an internal combustion engine. There is no specific restriction in ISO/DIS 13985-2.		
C	14.3.2		No corresponding ISO statement.		
C	14.3.3	ISO/DIS 13985-2, clause 4.1	O.K. ISO/DIS 13985-2 seems to cover this.		
C	14.3.4	ISO/DIS 13985-2, clause 4.1	The accelerations to which the fuel tank will be submitted are different. The EIHP draft regulations also include different requirements based on the category of vehicles.		
C	14.3.5		No comment without documents referenced in EIHP.		
C	14.4.2	ISO/DIS 13985-2 clause 4.2	ISO/DIS 13985-2 does not specify rollover protection. ISO/DIS 13985-2 does specify relief at 120% with reset pressure defined. The Annex 7B requirement in the EIHP document which references Paragraph 6,4.2 of the EIHP document requires also a 120% setting but has no reset requirement.		

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C	14.4.1	ISO/DIS 13985-2, clause 14.5.2 and 14.5.3	ISO/DIS 13985-2 specifies only a single automatic shut-off valve between the tank and the remainder of the vehicle system while the EIHP document requires multiple normally closed valves to protect the system. The EIHP document could allow for a valve to be placed in-between the tank and the relief vent. The EIHP document does not address check valves (non-return valves).		
C	14.5	ISO/DIS 13985-2, Clause 4.4	ISO/DIS 13985-2 specifies piping strengths while the EIHP document does not. ISO/DIS 13985-2 specifies that vacuum-jacketed or insulted lines to prevent heat soak while the EIHP document tends to concern itself with structural rigidity and mounting issues.		
E	14.8.2		Hazardous zone 1 according to IEC 60079-10 will limit the possible solutions. In IEC 60079-10 it is foreseen to evaluate of the actual situation and according to the results different measures are allowed. This is common practice and should therefore be the same in an ECE regulation.	Replace in the first sentence “applicable for the hazardous zone 1” by “evaluated” and add at the end of the first sentence “if applicable”.	
C	14.9	ISO/DIS 13985-2, Clause 4.9	No differences.		
E	14.9.1.		A boil off management system should be mandatory according to the discussion in the ad hoc working group on 19.2.2002	Delete “…vent off in a safe way or shall be…”	
E	14.9.2.		A boil off management system should be mandatory according to the discussion in the ad hoc working group on 19.2.2002	Delete “If present the boil off system and..”	
E	14.9.4		A boil off management system should be mandatory according to the discussion in the ad hoc working group on 19.2.2002	Delete whole paragraph	
C	14.15	ISO/DIS 13985-2, clause 6.3	More stringent than ISO/DIS 13985-2. ISO may want to consider adoption of more specific language.		

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C	Annex 7A-1 2.2.1.1	ISO/DIS 13985-1, clause 5	**Difference**. EIHP specifies a mechanical stresses at 1.3x(Pdesign + 0.1 Mpa), control of materials, and testing per Annex 7A – 2. ISO/DIS 13985-2 clause 4.3.2 specifies a 4:1 factor of safety in design of the inner vessel (25% of UTS in any plane normal to the wall). ISO/DIS 13985-1 specifies qualification test including pressure cycling tests and burst tests. The test requirements in the ISO document are much more involved and would tend to lead to a more conservative design. In particular the ISO document addresses impact damage to the vessel which is not addressed in the EIHP document.		
E	Annex 7A-1, 2.2.2.1		If outer jacket has an additional safety device, it shall be allowed that the outer jacket is designed according to the set pressure of these additional safety device.	Delete "..but at least 0.05 MPa" at the end of the sentence.	
C	Annex 7A-1 2.2.2.2	ISO/DIS 13985-1, clause 4..4.3	**Difference**. EIHP specifies resisting an outer pressure of 0.1 MPa. ISO/DIS 13985-1 specifies a minimum collapsing pressure of 200 kPa differential pressure.		
C	Annex 7A-1 2.2.3	ISO/DIS 13985-2	There is no requirements for the outer supports in ISO/DIS 13985-2.		
C	Annex 7A-1 2.2.4	ISO/DIS 13985-2	There is no requirements for the inner supports in ISO/DIS 13985-2.		
C	Annex 7A-1 2.3		No equivalent ISO specification for EIHP "Design temperature". In addition the design temperature as specified is in conflict with the specification temperature in clause 14.1.7 of the EIHP draft regulation.		
C	Annex 7A-1 2.4.1 and 2.4.2	ISO/DIS 13985-1, clause 4.4.2	Ok. EIHP "Chemical compatibility" is similar to ISO/DIS 13985-1.		

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C	Annex 7A-1 2.4.3	ISO/DIS 13985-1, clause 4.2	There is no requirement for the compatibility of materials with atmosphere enriched with oxygen in ISO/DIS 13985-1. Comment: ISO/WI 21010 *Cryogenic vessels — Gas/material compatibility* is currently in development in ISO/TC 220.		
C	Annex 7A-1 3.1-3.3	ISO/DIS 13985-1, clause 4.4.2	Ok. EIHP "Materials" is similar to ISO/DIS 13985-1.		
C	Annex 7A-1 3.4	ISO/DIS 13985-1	There is no reference to the toughness requirements of materials in contact with cryogenic temperature in ISO/DIS 13985-1. I Comment: ISO/WI 21028-1 *Cryogenic vessels — Toughness requirements for materials at cryogenic temperature — Part 1: Temperature below -80 °C* is currently in development in ISO/TC 220.		
C	Annex 7A-1 4.	ISO/DIS 13985-1, clause 6	**Difference**. Manufacturing and mounting of the Container. EIHP specifies in 4.1 appropriate equipment, manufacturing equipment, certified personnel, a manufacturing and inspection plan, quality assurance with traceability of parts and materials. 4.7 calls out inspection and testing of containers per Annex 7-2. Annex 7-2 is design validation by calculation and manufacturing operations per prEN 1251-2 "Cryogenic vessels – Transportable vacuum insulated vessels of not more than 1000 liters volume – Part 2 Design Fabrication and Testing". While we don't have this specification to examine, we did have ISO/CD 21029-1 with the same title. The ISO document, ISO/CD 21029-1 does specify batch tests with radiographic inspection but the protocol and the criteria appear different from what ISO/DIS 13985-1 specifies. ISO/DIS 13985-1 gives specific instructions on non-destructive testing of batch lots using radiographic, ultrasonic or acoustic means. Void size specifications are given.		

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C	Annex 7A-1 5.	ISO/DIS 13985-1, Clause 4.5	The EIHP document in paragraph 5.2.3 requires a 15 minute fire resistance test while the ISO/DIS 13985-2 requires a 30 minute fire exposure test. The EIHP requires a 24 hour holding time at 20 °C for insulation while the ISO/DIS 13985-2 requires a time specified by the manufacturer (marked holding time) at 65 °C.		
C	Annex 7A-1 6.	ISO/DIS 13985-1, clause 6	Difference. EIHP "Tests and Inspection" specifies a pressure test to 1.3x(Pdesign + 0.1 Mpa) by hydraulic or other means. Verification tests include a 10% He fluid leak tests, verification of inner vessel dimensions, visual inspection, and Destructive and non-destructive tests of welding seams per 7A-2. ISO/DIS 13985-1 gives specific instructions on non-destructive testing of batch lots using radiographic, ultrasonic or acoustic means. Void size specifications are given. The comparison should be made in more detail; however, this effort has been delayed. Additional comments are to be provided as soon as possible.		
E	Annex 7A-1, 6.1		The reference to paragraphs should be corrected	For the approval samples of the container shall be subjected to the tests according to 6.3.7 to **6.3.10** of this annex and shall be witnessed by the Technical Service. A crash test according to **6.3.11** shall be....	
E	Annex 7A-1, 6.3.8		Head line should be corrected in order to be in line with annex 8A	Thermal autonomy test **under fire**	
E	Annex 7A-1, 6.3.9		Head line should be corrected in order to be in line with annex 8A	Thermal **autonomy test during normal operation**	
C	Annex 7A-1 7	ISO/DIS 13985-1	There is no equivalent requirements in ISO/DIS 13985-1.		

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C	Annex 7A-2		The comparison should be made with the applicable parts of ISO/CD 21029-1 *Cryogenic vessels — Transportable vacuum insulated vessels of no more 1000 l volume - Part 1: Design, fabrication , inspection and testing* currently in development in ISO/TC 220. However, this comparison is a fairly extensive effort. It will be performed as soon as possible. .		
C	Annex 7B	ISO/DIS 13985-1, Clause 4.6.1	The reference pressure for the two documents is different. The ISO/DIS 13985-1 document references the maximum permissible operating pressure while the EIHP document references the maximum working pressure. ISO/DIS 13985-1 allows the primary relief to be 110% of the maximum permissible operating pressure while the EIHP document requires that it not be greater than the maximum working pressure. The set pressures for the secondary relief are not specified in the EIHP document and the flow capacities are not specified.		
C	Annex 7C	ISO/DIS 13985-1 Clause 4.6.4	The EIHP document calls out specific test procedures for valves while the ISO/DIS 13985-1 document only specifies a single leakage test.		
C	Annex 7F	ISO/DIS 13985-1	We could not find a parallel requirement in the ISO/DIS 13985-1 or –2 documents.		

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C	Annex 8A 1.	ISO/DIS 13985-1, clause 5.4	Difference. EIHP "Inner tank burst test" specifies a hydraulic water test to destruction as follows: Either: 3.25x (maximum working pressure + 0.1 Mpa) or 1.5 x Rm/Rp (maximum working pressure + 0.1 Mpa) Where Rm=minimum ultimate tensile strength and Rp=minimum yield strength There is no differentiation between possible liner types. However ISO/DIS 13985-1 specifies for different liner types: • Welded metallic inner vessels: 3 x max possible permissible operating pressure • Seamless steel inner vessels: 2.25 x max possible permissible operating pressure • Glass: 3.65 x max possible permissible operating pressure • Aramid: 3.1 x max possible permissible operating pressure • Carbon: 2.35 x max possible permissible operating pressure EIHP document has no section with the text equivalent to ISO/DIS 13985-1, clause 5 that specifies pressure cycling tests as part of the approval for a new design.		
C	Annex 8A 2.	ISO/DIS 13985-1, clause 5.5	**Difference**. EIHP Thermal autonomy under fire is less stringent. EIHP: 15 minutes under fire (at least 650 C) not to exceed 1.1 x the maximum working pressure ISO/DIS 13985-1: 30 minutes under fire (at least 900 C) not to exceed 1.2 x the maximum working pressure.		
E	Annex 8A, 2.1.1.		15 minutes for the thermal autonomy under fire is too long. Remark: a conventional fuel tank is 2 minutes exposed to fire according to ECE R 34.	Replace "…be greater than 15 minutes.." by "…not less than 5 minutes…"	

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E	Annex 8A, 2.2.4.1		Inconsistency in the requirement	Replace text of the paragraph by: "The tank is filled with liquid hydrogen so that the quantity of liquid hydrogen measured by the mass measurement system shall be half of the maximum allowed quantity that may be contained in the inner vessel."	
E	Annex 8A, 2.2.4.4		15 minutes for the thermal autonomy under fire is too long. Remark: a conventional fuel tank is 2 minutes exposed to fire according to ECE R 34. The second sentence is not necessary	Replace "15 minutes" by "5 minutes". Delete second sentence.	
E	Annex 8A, 2.2.4.5		It is not necessary to measure the pressure	Delete "..and the pressure in the tank is fallen to 0,01MPa.."	
C	Annex 8A 3.	ISO/DIS 13985-1, clause 5.6	**Difference**. EIHP Thermal autonomy during normal operation is specified for 24 hours before a safety device is opened. ISO defines this as "holding time" and does not specify a time, but a procedure for measuring the time. ISO conditions are more stringent with a test temperature of 65 C as opposed to the EIHP temperature of 20 C.		
C	Annex 8A 4.	ISO/DIS 13985-1	There is no equivalent requirement in ISO/DIS 13985-1.		
E	Annex 8B, 7.1		Leakage test is not applicable for all components	Add after 3 and 4 above ".., if applicable.."	
E	Annex 8B, 10.		Wrong reference to tests	Replace "..paragraphs 5,6 and 7.." by "…paragraphs 3 and 4…"	

Acknowledgements: The comparison of the EIHP draft regulation and the ISO draft standard was performed with the help of Mr. Stephen S. Woods, Honeywell Technology Solutions Inc. at White Sands Test Facility and Mr. Harold Beeson, NASA White Sands Test Facility in cooperation with the ISO/TC 197 Secretariat. We would like to thank them for their contribution to this work.

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