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E	General		Quantum	Some tests require a min cycle pressure of 2Mpa others require 10% of service pressure. It should be 2Mpa.		
E	General		Quantum	Non metallic parts need to be defined. Should not be applicable for o-rings and valve seats in metallic valve assemblies.		
E	General		Quantum	When non metallic parts tested the spec. is for rubber and not really suitable for other non metallic parts like Teflon etc.		
E	General		Quantum	It would be very helpful to attach a list of already approved materials for high pressure hydrogen applications.		
E			RDW	Add Annex 11: Provisions regarding hydrogen identification marks for public service vehicles and new 14.11: 14.11 Identification of vehicles of categories M2 and M3 */ equipped with a hydrogen system. 14.11.1 Vehicles of categories M2 and M3 equipped with a *Hydrogen System* shall carry a plate as specified in Annex 11. 14.11.2 The plate shall be installed on the front and rear of the vehicle and one to the side of each set of doors. */ As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3), annex 7 (TRANS/WP.29/78/Rev.1/Amend.2). Volvo.	Note: Proposed changes provided by Volvo Annex 11 will be provided from an earlier revision by	

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C	General		Jan Sandström AGA AB	Sweden has earliar 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.		
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	
E	2.1.33 and Annex 1-12, 13 and Annex 7-B19	15869-1.2 5.2.1.2.6	Hiroshi Akiyama Techno-Product Center	Both of pressure-activated and thermal-activated PRD are permitted in EIHP draft. However only thermal-activated PRD is permitted in ISO/CD 15869 and in other standards on container for CNGV, e.g. ISO 11439, ANSI/NGV2.	Container shall be protected using a thermal-activated PRD.	

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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.		
E	2.1.47		Jan Sandström AGA AB	Not sufficiantly defined. It means that all pressures from zero to infinity can be working pressure	Please use the the definition of working pressure of the ISO Standard ISO 10286 Gas Cylinders – Terminology Working Pressure: Settled pressure at a uniform temperature of 288 K (15 °C) for a full gas cylinder	
E	2.1.5		Luxfer	Define batch of liners and cylinders in more detail rather than under the test conditions (e.g. A.5.1.1).	2.1.6 "Batch (of liners)": Production quantity of up to 200 finished liners successively produced (plus units required for destructive testing) of the same nominal, length, thickness and design, from the same material cast and heat treated to the same conditions of temperature and time 2.1.7 "Batch (of finished cylinders)": Production quantity of up to 200 finished cylinders successively produced (plus finished cylinders required for destructive testing), of the same nominal diameter, length, thickness and design. The batch of finished cylinders may contain different batches of liners, fibres and matrix materials	

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E	2.1.10		Luxfer	Definition of composite container needs to be consistent with A.4.2.1.	2.1.10 "Composite Container": A Container fabricated from a Liner Over-wrapped with continuous filament windings.	
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.		
C	2.3			The ISO/CD 15869-1 does not include a classification of fuel tanks according to working pressure.		
E	2.4.2		Quantum	Why is the service pressure of a H2 system defined by the vehicle manufacturer		
E	2.4.5	ISO/CD 15869-1, clause 4.8	Secretariat of ISO/TC 197	Comment: The reference should be listed as follows: ISO 14687:1999/Cor 1:2001. This standard was published in 1999 and a technical corrigendum was issued in 2001.		
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.		

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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.		
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.		
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	
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	
E	2.4.6		Quantum	Higher gas temperature than 85 C for hydrogen should be permitted if overfill controls like temperature and pressure control are in place. You already allow material temperature to be 85 C which would mean higher gas temperature during fill for a short time anyway.		

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E	2.4.7		Faber	We do not agree on the principle stated at 2.4.7, Service Conditions, Filling & Pressure Cycles, (page no.9). The concept of a pressure vessel with life determined by the number of filling to be counted by an additional (and most likely separate) device is against the principles that have been inspired all standards in the High Pressure sector. In addition to that such a way to determine the cycles of the cylinder would penalize the user who refills frequently just to top-up the cylinder. If the present prescriptions for the cycling tests for cylinders for other gases appear too stringent, then a statistical evaluation for refilling should be carried.		
E	2.4.7		Quantum	i) The design life is specified in # of cycles, calculated from the expected lifetime mileage of the vehicle. Then the standard limits the maximum lifetime in years under 2.4.1. Reference should be made only in years or # of cycles. Why is a safety factor of 3 applied, a factor of 2 is enough considering then 2 million kilometers for the vehicle in that given example ii) In the example the # of calculated cycles is 5 000 and with the applied safety factor 15 000. Various test procedures refer to 'the # of pressure calculated '. It is not clear if it refers to 5 000 or 15 000 cycles. B17, B21, B24 etc.		

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E	2.4.7		Luxfer	The wording of this clause needs to be re-written to be clear. The possibility to have cycle life less than 5000 is not clear. The number of pressure cycles in this clause is referenced a number of times in Annex 7 Part A. What number of cycles is required when conducting a test? 5000 or 15000? Also needs to be clear that a manufacturer can define a design life of less than 20 years and a cycle life of less than 5000 (15000?) cycles.	Define maximum number of filling cycles to be 5000. Require approval testing to be conducted to 10 000 pressure cycles.	
E	2.4.7		Luxfer	Delete reference to the monitoring system as this technology has yet to be proven.		
E	2.4.7		Luxfer	The design lifetime definition of 5000 cycles in 2.4.7 is very conservative. To then expect a cylinder to exhibit a cycle performance factor of 3 times this is excessive and unnecessary if the cylinder exhibits a LBB failure mechanisms.	Define maximum number of filling cycles to be 5000. Require approval testing to be conducted to 10 000 pressure cycles.	
E	6.1.4		Hiroshi Akiyama Techno-Product Center	Only uni-directional flow on all components is permitted. In case of even manual valve, shall in-let line and out-let line be established separately?	Valve should be excluded.	
E	6.1.5		Jan Sandström AGA AB	Components must be designed to the Design Pressure and not to the Working Pressure	Reintroduce Design Pressure as of Draft 8 Clause 2.1.15	
E	6.2.2		Lincoln	As in 2.2, removal of this section is recommended.		

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E	6.2.3	Not covered	Norm Newhouse Lincoln	The impact of this section should be considered in more detail as to qualification testing. One consideration is that the bonfire test must be conducted on the entire system if, for example, all containers vent through a single PRD.		
E	14.1.10	Not covered	Norm Newhouse Lincoln	With this test, I'm not sure if helium or the gas mixtures will give the same results as 100% hydrogen. Need to determine what, if any, result is needed here. One note - when first filled, our tanks do produce bubbles in the dome regions due to escape of air trapped between the liner and the composite in the dome region. After 30-60 minutes, this should subside.		
E	14.1.11	Not covered	Norm Newhouse Lincoln	It may be unclear what to include as components that can leak. I would say that any polymer material or any connection (valve, fittings, et al) could leak.		
E	14.1.15	Not covered	Norm Newhouse Lincoln	Not clear how this is applied.		
E	14.3.2	Not covered	Norm Newhouse Lincoln	We have had regulators believe that the PRD must be installed directly into the container, while the intent of the requirement is simply that there is a PRD and that it cannot be isolated from the container.	Recommend this be modified: "A Pressure Relief Device shall be directly installed into the opening of a container or assembly referred to in Paragraph 6.2.3 of this Regulation, or into an opening in a valve assembled into the container, or onto a tube that is so mounted into the container or valve, in such a manner that it shall ..." " We have had regulators believe that the PRD must be installed directly into the	

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					container, while the intent of the requirement is simply that there is a PRD and that it cannot be isolated from the container.	
E	14.3.2.1 and 14.3.2.5		TUV	Delete “line”	discussed TUV/Volvo immediately after June meeting	
E	Annex 7: A1 References		Faber	An additional standard shall be add: ISO 9809-2:2000 (Gas cylinders-Refillable seamless steel gas cylinders-Design, construction and testing - Part2: Quenched and tempered steel cylinders with tensile strength greater than or equal to 1100MPa). Comment: Prescriptions of prEN/ISO 11114-4 would be mandatory also for cylinders according to ISO 9809-2:2000.		
E	Annex 7: A2.6 iv)		Luxfer	Circular reference with A6		
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		
E	Annex 7 A2.7	ISO/CD 15869-1, clause 6	Norm Newhouse Lincoln	We should also allow etching onto the boss for some of the information. For example, we would etch the manufacturer name and a unique serial number identifier for the container so that we can supply a new label if the original is lost or damaged.		

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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.		
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.		
E	Annex 7 A2.4 Table 7A.3 B.11		Craig Webster Powertech	This test should not be applicable to all materials, only to steels that exceed the limits specified in ISO 9809 for hydrogen service. Aluminum alloys are immune to hydrogen embrittlement when exposed to hydrogen specified in ISO 14687 (see paragraph 2.4.5 Gas Composition).	Modify requirement.	
E	Annex 7-A3.1.4		Hiroshi Akiyama Techno-Product Center	It is permitted the use of tapered or straight threads in all container types.	Only straight threads shall be permitted in aluminum container and liner.	

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E	Annex 7 A 3.3		Jan Sandström AGA AB	Burst pressure ratios. As we have constantly commented upon the quoted Burst Pressure ratios in table 7A.5 are too low and must be increased. The note *2 A Burst Pressure ratio of 1.8 is not acceptable and shall be deleted		
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) Stress ratios as the stress in the fibre at the specified minimum Burst Pressure divided by the the stress in the fibre at Design Pressure Burst Pressure ratio is the actual Burst Pressure of the cylinder divided by the Design Pressure	
E	Annex 7 Table 7A.3-Material Specif. and test data		Faber	The Hydrogen Compatibility Test should be applied to the resin and the fibers of type 4 cylinders. Comment: The resin and the fibers are in contact with the hydrogen that permeates throw the plastic liner.		
E	Table 7 A.8 B.11		Craig Webster Powertech	Hydrogen Compatibility tests for change of Fibre manufacturer, fibre material, and resin material is not logical – these materials are not in direct contact with the hydrogen (also there is no evidence they are affected by contact with hydrogen).	Delete.	

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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.		
E	Annex 7 A3.2.2 A3.2.3	ISO/CD 15869-5, clauses 5.5	Norm Newhouse Lincoln	Applicability to Type 4 bosses should be reviewed. Type 4 bosses could safely be made from other steels and aluminum.		
E	Annex 7 A3.2.2		Lincoln	Reword to "Steels for containers and liners shall conform to the material requirements of ISO 9809." Type 4 bosses could safely be made from other steels.		
E	Annex 7 A3.2.3		Lincoln	Reword to "Aluminium allows for containers and liners shall conform to the material requirements of ISO 7866." Type 4 bosses could safely be made from other aluminium alloys.		

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E	Annex 7 A3.3 Note 2	ISO/CD 15869-3, clauses 6.3 ISO/CD 15869-4, clauses 6.3 ISO/CD 15869-5, clauses 6.3	Norm Newhouse Lincoln	On one hand, I agree that a 1.8 stress/burst ratio could be used for carbon fiber to give high reliability as it relates to stress ratio. On the other hand, I'm not sure that all other issues are addressed. We should conduct a FMEA before we consider addressing this in a regulation, and we should develop performance requirements for the monitoring system. One concern that needs to be addressed is "crash" performance. With the existing 2.25-2.35 requirement for carbon, in combination with the given performance tests, carbon fiber reinforced tanks have shown excellent performance in "crash" events (i.e. hitting bridges and curbs, dropping from vehicles and being run over). With a 1.8 stress/burst ratio, we don't know if this crash performance would still remain, and a monitoring system would be of little or no benefit. It may be we would need to consider a representative crash test requirement for such a system, with lowered stress/burst ratios, if it was to be implemented.		
E	Annex 7 A3.3 Note 3	ISO/CD 15869-3, clauses 6.3 ISO/CD 15869-4, clauses 6.3 ISO/CD 15869-5, clauses 6.3	Norm Newhouse Lincoln	Wording needs to be adjusted in note 3 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.		

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E	Ann.7 A4.2.1		Quantum	The recording of the winding parameters should be left to the discretion of the manufacturer.		
E	Ann.7 A4.2.1		Luxfer	It is unclear why the specification makes these requirements. The information is not required at any stage in the document. This should be left to the manufacturers quality control system.	Remove A4.2.1	
E	Annex 7 Table 7A.5		Luxfer	Need minimum burst ratios for hybrid containers. Who ensures the stress ratios are met? Where are the strain gauges placed.		
E	Annex 7 Table 7A.5		Swedish Work Env. Auth.	Low safety factors not acceptable. Sweden has voted aginst the ISO standard due to the low safty factors.		
E	Annex 7 Table 7A.5 Note 2		Swedish Work Env. Auth.	A extreme low burst pressure ratio of 1.8 can be used. This is not acceptable. I believe that this note is not accepted in the ISO standard proposal. Sweden has voted aginst the ISO standard due to the low safty factors.		
E	Annex 7 Table 7A.5 Note 2		Volvo	It is not appropriate to specify a precise BPR of 1.8 when the integrity monitoring system and degree of damage that may be sustained is not specified. Clarify or delete note.		
E	Ann.7 5.1.1		Luxfer	Definition of batch of liners and containers to be moved to 2.1 Definitions		
E	Ann.7 A5.1.1 iii)		Luxfer	No mention of plastic liner sample for material batch tests. Does the manufacturer have to provide a finished liner to conduct the plastic liner softening test?		

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E	Ann.7 A5.1.2		Quantum	Batch testing of multiple batches must be defined more clear. Is the test conducted to approve multiple batches in the future or does approve the previous batches that have already been shipped.		
E	Ann.7 A5.1.2 iii)		Luxfer	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? Section iv indicates that only one batch is rejected. Remove clause		
E	Annex 7 Table 7A.6 - Batch Tests		Faber	For Type 2 and 3 (Metallic liner) in the case of thin wall thickness (less than 3.0 mm) impact test shall not be required. Comment: Table 7B.1, ISO 9809-1:1999 and ISO 9809-2:2000 do not define any impact test value with a minimum wall thickness less than 3.0mm.		
E	Annex 7 Table 7A.6		Luxfer	Boss Torque Test and Leak Test should be included in this Table if they are required as batch test.		

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E	Annex 7 A7 Table 7A.8	ISO/CD 15869-5, clauses 8.2 Table A.1	Norm Newhouse Lincoln	This table needs to be reviewed. Some concerns I have are that, for a Type 4 container, a change to the liner material would not have an effect on LBB performance and bonfire results, and probably not any effect on impact damage test results. Similarly, changing the fiber material shouldn't change permeation, boss torque, or hydrogen cycling. Also, changing boss features such as threads, height, or others not affecting the boss/liner or boss/composite interfaces should not affect permeation, boss torque, or hydrogen cycling.		
E	Annex 7 Table 7A.8		Quantum	What is the definition of process change?		
E	Annex 7 Table 7A.8		Luxfer	What is the definition of a design change in metallic container or liner material? Is change of material supplier a design change?	Define change limits required for these tests.	
E	Annex 7 Table 7A.8		Luxfer	What is the definition of a design change in fibre material?	Define change limits required for these tests.	
E	Annex 7 Table 7A.8 Note 1		Luxfer	What is required if a working pressure change of <20% is made and the thickness change is not proportional?	Define requirements more clearly.	
E	Annex 7 B1.2.1		Luxfer	No reference to using a test coupon for this yet A5.1.1 allows use of a heat treated test sample.		
E	Annex 7 B1.2.3		Luxfer	What is the sampling rate for fibres? B1.1 does not define Proposed change: Conduct one test per batch of fibre.		

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E	Annex 7 B1.2.3		Norm Newhouse Lincoln	Doing strand tests with the fiber and resin systems and the container cure cycle is not recommended. A minor point is that the effects of a cure cycle on a strand may not be comparable to that of a container given the differences in configuration and heat transfer. More importantly, the results likely wouldn't give you valid information. When we have used glass and aramid fibers in the past, we did strand tensile tests routinely. When we started using carbon fiber, we started doing strand tensile tests, but found it was hard to get repeatable results, even with our experienced technicians. We found that the certifications provided by the fiber manufacturers, where they often run the tensile tests on dry fibers, gave much better correlation to container performance. We have come to rely on the certifications, and this has been acceptable to our defense and aerospace customers, including government agencies.		
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		
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.		
E	Annex 7 B2.2		Hiroshi Akiyama Techno-Product Center	Brinell hardness test on the parallel wall at the centre of each container and liner. However it is sufficient if the tensile test that is prescribed to Annex 7-B1 carry out.	Delete of Brinell hardness test on the parallel wall of container and liner.	

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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.		
C	Annex 7 B4			This section of the EIHP draft regulation has been removed from ISO 15869 with the incorporation of ISO 7866.		
E	Annex 7 B4		Craig Webster Powertech	This test is covered under ISO 7866 for aluminium materials and do not need to be repeated here. Also, in ISO 7866 these corrosion tests only apply to "other" aluminium alloys not listed in the standard. In B4 all aluminium alloys are being forced to perform this corrosion test.	Delete.	
E	Ann.7: B4		Luxfer	Is no corrosion test required for steel?	Reference NACE test in ISO 11439	
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.		
E	Annex 7 B5		Craig Webster Powertech	This test is covered under ISO 7866 for aluminium cylinders and do not need to be repeated here. Also, these corrosion tests only apply to "other" aluminium alloys not listed in ISO 7866. In B5 all aluminium alloys are being forced to perform SLC tests.	Delete.	

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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.		
E	Annex 7 B6.3	ISO/CD 15869-1, clause D.21	Norm Newhouse Lincoln	These revised numbers (100C softening, 130C melt) should work for us, but I still question whether the melt temperature needs to be identified. This temperature is above any operating condition identified. Before specifying a melt temperature, consideration should be given to the benefits vs. the possibility of removing a viable material from consideration. Melt temperature is somewhat arbitrary, as well. Depending on the material and grade, melt temperature might not be meaningful. For example, some liner materials are "welded" at temperatures at least 100C greater than the melt temperature, and the plastic still has a relatively high viscosity (no flow without external load).		
E	Annex 7 B8.3		Luxfer	How can a minimum shear strength be defined? Surely this is dependant on the manufacturers design.	Requirement: The test results shall be within the Manufacturers specifications.	
E	Annex 7 B9.2 iv)		Luxfer	Why conduct chemical resistance if we have the Acid Environment Test?	Delete iv)	
E	Annex 7 B11		Luxfer	Does ISO 11114-4 adequately screen steels that are susceptible to hydrogen embrittlement?	Reference ISO 9809 for high strength steels	
E	Annex 7 B11		Lincoln	I believe that ISO 11114-4 applies only to steels, therefore it would not be applicable to all materials.		

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E	Ann.7 B11		Quantum	Where can ISO 11114-4 be found, or is it not released yet?		
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.		
E	Ann.7 B12		Quantum	A LBB should not be required if the tank can prove LBB already between my minimum requirement (5 000 cycles) and my 3 times safety requirement (15 000 cycles).		
E	Annex 7 B12		Luxfer	This test is unnecessary if a design proves LBB performance in the Ambient Cycle Test.	Remove B12 or combine with B17 for a total of three cylinder tests.	
E	Ann.7 B13		Quantum	Why are two tanks required for this test? Temperature requirements should be applicable for the tank, not the fluid. Why a hold of the tank at –40 C for 48 hours?		
E	Annex 7 B13.2		Luxfer	There is no valid reason to condition at -40C for 48 hours. Unnecessary time and expense	Bring temperature of cylinder to -40C or below or adopt equivalent test in ISO 11119.	
E	Annex7 B13.2		Luxfer	The temperature monitoring must be fixed at the surface. The requirement that the liquid stay below -40C means the chamber has to be around -100C. This is unrealistic and has not basis in reflecting any possible service conditions.	Adopt criteria of equivalent test in ISO 11119	
E	Annex 7 B13.2		Luxfer	Why two cylinders for this expensive test?	Test one unit only	

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E	Annex 7 B13.2	15869-1.2 Annex D.11	Hiroshi Akiyama Techno-Product Center	Number of cycles at 85C and at –40C is 1.5 times the number of filling cycles calculated in accordance with Paragraph 2.4.7. It is not 1.5times, and is 0.5 times the number of filling cycles correct?		
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.		
E	Annex 7 B14	ISO/CD 15869-1, clause D.17	Craig Webster Powertech	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 to working pressure	
E	Annex 7 B14.2	ISO/CD 15869-1, clause D.17	Norm Newhouse Lincoln	A test pressure of 100% has been shown to be effective in the past. In addition, the time spent at 125% is a very small portion of the life of the container. The added pressure can add significant cost without benefit. As to requiring at least 5% hydrogen or 10% helium, this also adds expense without necessarily adding a benefit. We typically use a 2% helium mixture, and have demonstrated that we can locate problems easily (typically with an o-ring seal), and that we can locate such leaks at levels below the permeation requirement for the tank. This is possible by using equipment with an appropriate level of sensitivity and sophistication. It would be better to define the		

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				procedural requirements of this section as performance related, i.e. able to find leaks at the appropriate levels.		
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).		
E	Annex 7 B15.2	ISO/CD 15869-3, clauses 10 ISO/CD 15869-4, clauses 10 ISO/CD 15869-5, clauses 10	Norm Newhouse Lincoln	Permanent expansion is specified for Types 2 and 3, Elastic expansion for Type 4. I think Type 3 would also be better served by using elastic expansion. Pehaps allow the manufacturer to determine which is appropriate?		
E	Annex 7 B 15.2		Jan Sandström AGA AB	The Test Pressure is too low	Reintroduce Design Presure B 15.2 The container shall be pressurized to ≥ 1.5times the Design Pressure instead of Working Pressure (see Annex 7 clause 5.4 in Draft 8)	
E	Ann.7 B15.3		Luxfer	The pass criteria for the Proof Test is inadequate.	Adopt wording of Volumetric Expansion Test and Proof Test from ISO 11119	

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E	Annex 7 B16.2	ISO/CD 15869-1, clause D.15	Craig Webster Powertech	"If the rate exceeds ……. the Burst Pressure ratio, *or the time at pressure above the Working Pressure times the Burst Pressure ratio must exceed 5 seconds*." Equivalent or better than saying "hold at some pressure for 5 seconds"	Change	
E	Ann.7 B17		Luxfer	The definition of the number of cycles required is unclear. It can be assumed that the minimum number of cycles to be performed is 5000 but this is clear.		
E	Ann.7 B17		Luxfer	The requirement for 15000 cycles has not technical rationale. This imposes extra cost on manufacturers who are required to conduct this test as a batch test.	Minimum number of cycles to be defined at 5000 with tests to continue to 10000 cycles. Cylinders can fail by leakage between 5000 and 10000 cycles. A diagram would assist understanding. See references.	
E	Ann.7 B17.2		Luxfer	There is no acceptance of a design that is designed for less than 5000 filling cycles.	Life definition for the cylinders needs to be reviewed and redefined.	
E	Annex 7 B18	ISO/CD 15869-1, clause D.10	Craig Webster Powertech	Change title to "Environment Test", since there are more solutions than just acids.		
E	Ann.7 B18.2 iv)		Luxfer	Cycle testing is unnecessary. Surface of the fibers is already badly damaged by impact. Test is to determine effect of solutions and temperature on stress rupture not cycle life. No other test regime requires this.	Remove cycle requirement.	
E	Annex 7 B18.2	ISO/CD 15869-1, clause D.10	Craig Webster Powertech	Editorial – subsection f) should be section iv), and the other sections renumbered accordingly.		

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E	Annex 7 B18.2	15869-1.2 Annex D.10	Hiroshi Akiyama Techno-Product Center	Sulphuric acid is 30%, diameter of preconditioned exposure area is 150 mm, and lower pressure in pressure cycle is not more than 10% in EIHP draft. There are the differences with ISO 15869.	Correct as follows: Sulphuric acid: 19%, Diameter: 100 mm, Lower pressure: not more than 2 MPa.	
E	Annex 7 B19.2	ISO/CD 15869-1, clause D.3.5	Craig Webster Powertech	Allowing a container to be tested using nitrogen, when the container will be used only for hydrogen, is wrong. Nitrogen has significantly different properties, including the fact it chills as it expands. Therefore performance of the container and PRD in a bonfire will not be the same as with hydrogen.	Delete the use of nitrogen in bonfires.	
E	Annex 7 B19.2	ISO/CD 15869-1, clause D.3.5	Norm Newhouse Lincoln	Nitrogen may not give representative results in the bonfire test. Recommend using only hydrogen.		
E	Annex 7 B20.3	ISO/CD 15869-1, clause D.18	Craig Webster Powertech	Not practical to collect small pieces of materials to weigh after gunfire. Purpose of gunfire is to determine if the container will rupture.	The wording should be changed to include the following simple statement “The container shall not rupture”.	
E	Annex 7 B20.3	ISO/CD 15869-1, clause D.18	Norm Newhouse Lincoln	Other standards, including ISO 15869, are removing the wording re pieces weighing less than 45 grams, relying on the "no evidence of fragmentation failure" for pass/fail. Experience shows that there is a clear distinction between what passes and what doesn't.		

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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.		
E	Ann.7: B21		Quantum	This test is not really a flaw tolerance test. Defined flaws should be cut into the tank to simulate damage in service between the inspection cycle, where those flaws then would be detected		
E	Annex 7 B21		Luxfer	This test does not test the flaw tolerance of cylinders. Other standards apply defined flaws to prove the behavior of the cylinder when subjected to cut damage. The flaws that would be used in this test would have no effect on the performance on the cylinder unless the visual inspection rates were set unrealistically high. Proposed change: Adopt criteria in ISO 11439.		
E	Annex 7 B21.2 and B21.3	15869-1.2 Annex D.8	Hiroshi Akiyama Techno-Product Center	Flaw size shall be specialized. Acceptable criteria are no leak and rupture within the number of filling cycles in EIHP.	Two flaws: 25mm length and 1.25mm depth, 200mm length and 0.75mm depth. Container shall not leak and rupture within the first 3000 cycles, but may fail by leakage after 3000 cycles.	

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C	Annex 7 B22	ISO/CD 15869-1, clause D.4		The EIHP draft regulation uses a hold temperature of 95C. ISO 15869 uses a hold temperature of 100C.		
E	Annex 7 B22	ISO/CD 15869-1, clause D.4	Norm Newhouse Lincoln	Recommend conditions of 100C for 200 hours to harmonize with ISO 15869. No problems have been found in the field with containers that meet the ISO requirements.		
E	Annex 7 B22.2	15869-1.2 Annex D.12	Hiroshi Akiyama Techno-Product Center	Test condition: 95C, 1000 hours There is the difference regarding holding temperature and time between EIHP and ISO 15869.	Container shall be pressurized 1.25 times working pressure and held 100C for not less than 200 hours.	
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.		
E	Ann.7 B23		Quantum	The way the tests are defined now they are very similar. High temperature creep test should be removed from the standard. Creep tests, if necessary could be simulated on parts of tanks to be more cost effective.		
E	Annex 7 B23		Luxfer	Why do we need B18, B22 and B23? B22 and B23 are effectively the same and B18 is effective stress rupture test.	Remove B22	

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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
E	Annex 7 B23.2		Lincoln	The accelerated stress rupture test was based on one which successfully screened out containers that had problems in the field. Adding humidity to the test changes the mechanisms acting on the composite.		
E	Ann.7 B24		Quantum	There is no gain in value to make the drop test so severe. I would be allowed to use a separate tank for each drop anyway. So besides adding cost, no value is added. It is also not clear what the cycle requirements are after dropping the tank.		
E	Annex 7 B24		Luxfer	Why is the drop test so severe? The requirements here are for 8 extreme drops. Equivalent standards (ISO 11439, NGV2 and B51) require 3 drops.	Adopt criteria in ISO 11439,	
E	Annex 7 B24		Luxfer	It is not clear what the cycle test requirement is after the drops. However it is unrealistic to expect a cylinder to perform as a new cylinder after undergoing these severe impact tests. Any cylinder that had received this damage would be rejected from service on visual inspection. It is reasonable to expect cylinders to have a good resistance to impact but they should be allowed to fail in a safe manner in cycle testing. This would simulate the unlikely situation where a cylinder was subjected to severe damage but the damage was not noticed.	Adopt criteria in ISO 11439,	
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 15869		

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				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.		
E	Annex 7 B24.2	ISO/CD 15869-1, clause D.9	Craig Webster Powertech	Multiple drops may be excessive – the purpose of the drop test is to consider the effect of handling damage – how many times would a container be dropped before it was installed on a vehicle? The drop test requirements in ISO 15869 come from ISO 11439 and other national CNG tank standards. These drop test requirements were implemented after a failure of an EDO design due to drop damage. There have not been any incidents since.	Change drop test requirements to those in draft ISO 15869.	
E	Annex 7 B24.2	ISO/CD 15869-1, clause D.9	Norm Newhouse Lincoln	Change to a single drop from any orientation to harmonize with ISO 15869. This test is intended to address shipping damage. No indication that more than a single drop is needed to demonstrate fitness. Containers meeting the ISO requirements have a successful history, including the ability to sustain crash impacts. In addition, it is difficult to truly drop twice in the same place, particularly given the non-repeatability of secondary and tertiary impacts.		
E	Annex 7 B24.3	15869-1.2 Annex D.9	Hiroshi Akiyama Techno-Product Center	Acceptable criteria are no leak and rupture within the number of filling cycles in EIHP.	Container shall not leak and rupture within the first 3000 cycles, but may fail by leakage after 3000 cycles.	

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E	Annex 7 B25 Permeation Test		Faber	The requirement must be changed in order to keep it accordance with ISO/CD 15869 and in case reduce it to 0.25 ml of hydrogen per hour per liter water capacity of the tank, if ISO takes the same decision. We suggest to keep the value of 0.5 ml of hydrogen per hour per liter water capacity of the tank.		
E	Ann.7 B25		Luxfer	What is Ncm3?	Leak rate of 0.25 ml/l/h	
E	Ann.7 B25		Quantum	The tank should not have to remain in the chamber for the entire 500 hours if checked periodically like once a day in an enclosed chamber.		
E	Ann.7 B26		Quantum	Does the boss torque test make sense if there is no torque applied to the boss during installation of the tank?		
E	Ann.7 B27		Quantum	1 hour fill time on a smaller tank for hydrogen cycle test is realistic but not for a large volume, high pressure tank with the compressor technology available today.		
E	Annex 7 B27	ISO/CD 15869-1, clause D.14	Craig Webster Powertech	The requirement to pressure cycle to 1.25 times working pressure is an excessive requirement and difficult to perform. Cycle testing to working pressure was specified in CNG standards and draft ISO 15869. This is intended to be an accelerated test with rapid fill and venting to determine if there are any design problems in type 4 tanks not covered by other hydraulic tests. Because of the rapid filling and venting it was not considered necessary to perform 15,000 cycles under these conditions – any design flaw would become visually obvious. This is also the reason it was not necessary to go to 1.25 times working pressure – the test was already accelerated	Change to cycling to working pressure.	

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				enough.		
E	Ann.7 B27.3		Luxfer	Why is only the boss/liner interface examined?	Liner shall be visually examined for damage and design rejected if the liner exhibits visual damage	
E	Annex 8		Quantum	The excess flow limiter has to withstand 1 000 cycles. In real life it is built as a safety device that goes thru very little cycles. It should be maximum 100 cycles.		
E	Ann. 8A		Luxfer	Are only temperature triggered PRD's allowed?	Redefine requirements.	
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.		

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E	Annex 8A		Craig Webster Powertech	Delete requirements and refer to ANSI/IAS PRD-1 standard, with a note that the PRD must meet the pressure cycle requirements consist with Paragraph 2.4.7. Problems with Annex 8A are as follows: The mercurous nitrate test in para. 2.1.3 was changed in PRD-1 for an equivalent test involving ammonia exposure, since mercurous nitrate posed a significant health risk. The creep test duration in para. 2.1.1 is inadequate – it should be 500 hours to be consistent with PRD-1 and ISO 15500-13. There is no activation test.		
E	Annex 8A 2.1.3		Norm Newhouse Lincoln	Recommend using the moist ammonia test rather than Mercurous Nitrate Test in order to avoid environmental problems with mercury compounds.		
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	
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	Adapt ISO 17268 receptacle profile	
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	

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E	Annex 8G		Craig Webster Powertech	There should be a requirement that flexible hoses are electrically conducting, i.e. a maximum resistance requirement.		
E	Annex 8H		Quantum	The endurance test for fittings should not be required because of the connection test in Annex 9		
E	Annex 9 4		Craig Webster Powertech	A hydrostatic proof test of 3 times the working pressure should be a requirement.		
E	Annex 9 Clause 4		Livio Gambone Powertech	Minimum hydrostatic strength for class 0 components should at least match cylinder burst pressure ratios per Table 7A.5	Recommend 3.0 X maximum	
E	Annex 9 Clause 5.2		Livio Gambone Powertech	Soak time of 3 hours is excessive – recommend a soak time of 2 hours for components to optimize testing	Change to 2 hour soak	
E	Annex 9 Clause 7.3		Livio Gambone Powertech	Prohibit the use of air for cycle testing due to the possibility of creating an explosive mixture in the system in the event that a hydrogen leak test follows the cycle test.	Change to nitrogen or hydrogen	
E	Annex 9 Clause 7.5		Livio Gambone Powertech	Soak time of 3 hours is excessive – recommend a soak time of 2 hours for components to optimize testing	Change to 2 hour soak	
E	Annex 9 Clause 7.6		Livio Gambone Powertech	Soak time of 3 hours is excessive – recommend a soak time of 2 hours for components to optimize testing	Change to 2 hour soak	

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E	Annex 9 13		Quantum	The minimum pressure during cycle is specified as atmospheric pressure. This will lead to interpretations. A better value would be 2Mpa as you minimum pressure.		
E	Annex 9 Clause 14		Livio Gambone Powertech	Replace or add an additional vibration test more representative of vehicle vibration conditions	Replace with or add the following test: "Vibrate at 2 +/- 0.1 G and sweep frequency from 20 to 2000 Hz at a rate of 0.5 octaves per minute in each of 3 orientation axes."	
E	Annex 9 15		Quantum	The test scope needs to be defined.		
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	
I		ISO 15869-1; D14	Jan Sandström AGA AB		Introduce 1.25 times working pressure (equal to design pressure) in the second paragraph	
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)	
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)	

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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)	
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)	

LUXFER REFERENCES

Hydraulic proof pressure test from ISO 11119

Procedure:
This test requires that the hydraulic pressure in the cylinder be increased gradually and regularly until the test pressure p_h is reached. The cylinder test pressure shall be held for a sufficiently long period (at least 30 s) to ascertain that there are no leaks and no failure. If leakage occurs in the piping or fittings, the cylinders may be re-tested after repairing such leakages.

Where cylinders are subjected to autofrettage the hydraulic proof pressure test may be part or immediately follow the autofrettage process.

Criteria:
The cylinder shall be rejected if there are leaks, failure to hold pressure or visible permanent deformation after the cylinder is depressurised.

NOTE Cracking of resin is not necessarily a sign of permanent deformation

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Hydraulic volumetric expansion test from ISO 11119

Procedure:
This test requires that the hydraulic pressure in the cylinder increase gradually and regularly until the test pressure, p_h, is reached. The cylinder test pressure shall be held for a sufficiently long period (at least 30 s) to ascertain that there are no leaks and no failure. If leakage occurs in the piping or fittings, the cylinders may be re-tested after repairing such leakages.
The total volumetric expansion of each cylinder under the test pressure, p_h, and the permanent volumetric expansion of the cylinder after the pressure is released shall be recorded. The elastic expansion (i.e. total expansion less permanent expansion) under test pressure can then be established for each cylinder.
Where cylinders are subjected to autofrettage the hydraulic proof pressure test may be part or immediately follow the autofrettage process.
Criteria:
The cylinder shall be rejected if either:
a) it shows an elastic expansion at the test pressure, p_h, in excess of 110 % of the average elastic expansion for the batch at manufacture, or

b) it shows a permanent expansion at zero pressure in excess of 5 % of the total expansion.

Environmental cycle test from ISO 11119.

Procedure:

One cylinder, as wrapped and without paint or removable protective coating, shall be tested as follows.

Condition cylinder and contained pressurising medium for 48 h at atmospheric pressure, at a temperature between 60 °C and 70 °C and at a relative humidity greater than or equal to 95 %.
The hydraulic pressurising medium external to the cylinder under test shall commence the cycle testing at ambient temperature. Hydraulically apply 5 000 cycles from a pressure approximately equal to atmospheric pressure to two-thirds of the test pressure (p_h). The cylinder skin temperature shall be maintained at between 60 ºC and 70 ºC by regulating the environmental chamber and the cycling frequency. The cycling frequency shall not exceed 5 cycles per minute.
Release pressure and stabilise cylinder at 20 °C approximately.

Stabilise the cylinder and the contained pressurising medium until the temperature is between – 50 ºC and – 60 ºC.

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Release pressure and stabilise the cylinder at 20 °C approximately. Hydraulically apply 30 cycles from a pressure approximately equal to atmospheric pressure to the test pressure (p_h).
On completion of these tests the cylinder is subjected to the burst test in **8.5.4**.

Parameters to monitor and record:

— temperatures during each part;

— humidity during 1st part of test;

— test medium used;

— number of cycles, achieving upper cyclic pressure, at each stage;

— minimum and maximum cyclic pressures;

— cycle frequency ;

— burst pressure;

— description of failure.

Criteria:
The burst pressure, p_b, shall be not less than 1,4 times the test pressure, p_h, of the composite cylinder design

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Ambient Cycle Test Criteria.

	1st part	2nd part
Number of Cycles	5000	10000
Criteria	No leakage/burst = Pass	
	No leakage or burst Pass 1st part	Leakage = Pass Burst = Fail

Figure 1 — Criteria for ambient cycle test

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