

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 N 043** 2003-02-26

Replaces: Document GRPE/ISO **N042**

**Table 1 - Text of the survey**

During the last GRPE/ISO meeting on 22 January 2002 in Munich (see GRPE/ISO N038), it was agreed that provisions should be added to ensure that the burst pressure of the tanks measured during the batch tests should be in the same range as the burst pressure ratio measured during the type approval test.

Tank manufacturers are therefore asked to suggest a possible burst pressure range that could be established in the regulations/ISO draft standard 15869 to ensure that tanks do not have a wide range of tolerances in material properties and wall thickness for a specific design.

Please forward by 6 February 2003 your recommendations to the ISO/TC 197 Secretariat with a copy to Mr. Paul Adams and Mr. Craig Webster regarding the number that should be specified in the following requirement for the batch test:

*The Container Burst Pressure shall exceed the Working Pressure times the Burst Pressure ratio specified in ....., and shall be within  $-x\%$  and  $+y\%$  of the average burst pressure recorded during type approval testing.*

*The Burst Pressure of the Liner shall exceed the minimum Burst Pressure specified for the Liner design, and shall be within  $-x\%$  and  $+y\%$  of the burst pressure recorded during type approval testing.*

We look forward to receiving your input.

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**Table 2 - Results of the survey**

Date	Member	Organisation	Comments/Proposed Modification	Decision
2003-02-05	Mark Duncan	Dynetek	<p>Dynetek Industries Ltd does not agree with the GRPE/ISO Group of Experts suggestion to amend the container burst pressure requirement by placing a tolerance on the average burst results obtained during approval testing. The minimum burst requirement, expressed as a ratio of working pressure, is well prescribed in both GRPE and ISO. The ratios are consistent with existing standards for automotive on board storage of natural gas; for example CSA B51-97, ANSI/CSA NGV2-2000, and ISO 11439. How and by how much a manufacturer exceeds the minimum requirements, and their internal performance measurements, should be outside of the GRPE/ISO mandate.</p> <p>Furthermore, Dynetek Industries Ltd does not agree with the proposed change to the burst test acceptance criteria by including "there shall be no more than 3 metallic parts". The design of the cylinder must be such that a burst is prevented, rather than prescribing that the mode of bursting is to be in a certain fashion. Furthermore, it is almost impossible to evaluate after a burst, if a metallic part originated from the original burst or if it developed for instance from the impact with the burst pit wall.</p>	
2003-02-05	Norm Newhouse	General Dynamics Lincoln Operations	<p>Attached are my comments on the Subject "Outstanding Issue". I feel very strongly that the proposal to tie burst test results to qualification test results is, while well meaning, not something we should do. It would do little, if anything, to enhance safety, and it could significantly increase costs in ways which are discussed in the comments or in ways we do not yet foresee. It would also likely be difficult if not impossible to implement meaningfully. The requirements already set forth in ISO 15869 and the EIHP draft regulations are sufficient. We have "set the bar" very high by their requirements, and a less-than-experienced manufacturer is not likely to try to qualify without having a real commitment to safety and continued operation. Let me know if you have any questions about my comments or if I can add further clarification.</p>	

**Table 2 - Results of the survey**

Date	Member	Organisation	Comments/Proposed Modification	Decision
2003-02-06	Mark Trudgeon	Luxfer Gas Cylinders	<p>You reported that at the GRPE/ISO meeting on 22 January 2002 in Munich, "it was agreed that provisions should be added to ensure that the burst pressure of the tanks measured during the batch tests should be in the same range as the burst pressure ratio measured during the type approval test".</p> <p>I was unable to attend the meeting unfortunately, but have spoken to some of the members who did attend, and they share the opinion that although there was discussion during the meeting, there was NOT a definite agreement to add this requirement. It was, however, agreed that the container manufacturers should be invited to make proposals as to what such a requirement should look like, but it was also open for the manufacturers to oppose the whole idea.</p> <p>The concept relating burst pressure ratio at approval with burst pressure ratio at batch testing had been proposed and rejected in other working groups on composite cylinder standards, such as EN 12245, EN 12257, ISO 11119 and ISO 11439. My colleagues and I know of no other cylinder standard that has this requirement.</p> <p>The suggested requirement would subject composite cylinder manufacturers to a costly and unnecessary restriction. While the burst pressure of metal cylinders demonstrates a narrow range, the variation in materials and the complexity of composite cylinder design means it is never going to be possible to specify a tight tolerance on burst pressure. Luxfer designs and manufactures a cylinder design to pass a series of extensive approval tests and to pass the minimum burst test pressure now and in the future. If the minimum burst pressure is not met the batch fails. That is all that is needed. To now put a plus/minus tolerance on this burst pressure is completely unacceptable. Luxfer strongly opposes this proposal.</p>	
2003-02-07	Dyre Rolstad	Raufoss	<p>The companies Ragasco and Raufoss fully support the views presented to us by Mr. Mark Trudgeon (Luxfer). Our opinion is that this new proposal should be stopped/aborted immediately.</p> <p>The minimum burst pressures based on the given safety margins for the various cylinder types versus working pressure (as today) should be used and nothing else. The nature of the materials of a composite structure is such that a tight tolerance is not likely to be achieved. And there is no need for this kind of tolerance as fulfilling the burst pressure requirement gives sufficient evidence that the cylinders are safe.</p>	

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Date	Member	Organisation	Comments/Proposed Modification	Decision
2003-02-09	Gerhard König	Worthington Cylinders	<p>As one of the members in this committee representing a cylinder manufacturer of hydrogen cylinders I want to comment on the outstanding as follows:</p> <ol style="list-style-type: none"> <li>1. As I was not able to attend the meeting on January 22nd in Munich I am not quite clear what the real background of this special request is. I have read the comments from Herve Barthelemy and the decisions taken on pages 29/30 of Doc.N38 concerning the proposed burst pressure requirement during batch testing, but it is difficult to propose something if you are not aware about the consequences: <ul style="list-style-type: none"> <li>- shall this proposal be applied to all types of cylinders?</li> <li>- what are the consequences if a burst value is outside the specified range?</li> <li>- has the type approval to be repeated entirely or only the pressure cycle test? etc.</li> </ul> </li> </ol> <p>All these questions have to be considered in respect to this.</p> <ol style="list-style-type: none"> <li>2. As this issue is quite complex, it is not usual within ISO to give a two weeks time period for comments and cylinder manufacturers should have at least time to discuss this within their technical organizations.</li> <li>3. I will present this issue at the next meeting of the Technical Group of the European Cylinder Makers Association (ECMA TG) which will take place on March 13th in Brussels. ECMA TG will come back to you after the meeting on March, 13th.</li> </ol>	<p>We welcome your suggestion to present this issue and the results of this survey at the next meeting of the Technical Group of the European Cylinder Makers Association (ECMA TG), which will take place on 13 March 2003 in Brussels.</p> <p>Following the 13 March 2003 meeting, please forward the ECMA TG recommendation on this topic to the attention of:</p> <p>Mr. Christoph Albus, Chairman of the GRPE ad hoc WG on Hydrogen/ Fuel cell vehicles (christoph.albus@bmvbw.bund.de)</p> <p>Ms. Sylvie Gingras, Secretary of ISO/TC 197</p>
2002-02-10	G.Luigi Cola	Faber Industrie Spa	<p>Further to the discussions we had during the meeting of 22nd January, I send to you hereunder the text I suggest.</p> <p>The Container Burst Pressure shall exceed the Working Pressure times the Burst Pressure ratio specified in ....., and shall be not less than 85% of the average burst pressure recorded during type approval testing.</p> <p>The Burst Pressure of the Liner shall exceed the minimum Burst Pressure specified for the Liner design, and shall be not less than 85% of the burst pressure recorded during type approval testing.</p>	

Table 3 – Comments on the survey results

Date	Member	Organisation	Comments/Proposed Modification	Decision
2003-02-10	Craig Webster	Convener of the joint ISO/TC 58/SC 3 and ISO/TC 197 WG 6	Regarding the burst test survey, the overwhelming response of manufacturers is no. Only Faber had a suggested change to the wording. I think the manufacturers are saying they are a credible bunch and perhaps Air Liquide should be more circumspect in choosing their suppliers. Also, only committed suppliers would be involved in the production of high performance hydrogen storage units. The bottom line is, there appears to be no need to change the wording as it stands now.	
2003-02-13	Hervé Barthélémy	Air Liquide	<p>I am some what surprised by the answers.</p> <p>As indicated in the questionnaire you sent after the Munich meeting it was agreed to add provisions to ensure that the burst ratio of the tanks measured during batch tests should be in the same range as the burst ratio measured during the type approval test.</p> <p>The manufacturers (only) were simply asked to propose values for "x" and "y". Instead of that the North American manufacturers talked together and want now to comeback on the decision taken in Munich?</p> <p>I am not a manufacturer but I hope that I am allowed to make a proposal. For the value of "y", I can accept any value (as big as the manufacturer want). This proposal remove the main argument of these manufacturers indicating that smaller tolerance range will increase the cost. What is important as indicated in Munich (and on the slides that Sylvie kindly circulated to all of you) is the value of "x". Every body insist on the fact that this standard is a performance standard. A lot of expensive tests need to be performed at time of type approval and during batch tests, only burst (and ambient cycle) tests are requested. If the cylinders produced have burst ratio lower than the ones which passed all the types tests, how somebody could know if those less reinforced cylinders are able to pass ALL the type tests? This is why it is important to have a value of "x" as low as possible. I am proposing 5%.</p> <p>G Konig is asking the question " what the consequences if the burst value is outside the specified range " (that is more than 5% lower) My proposal is that in this case you have to demonstrate that the cylinders of the corresponding batches are able to pass the type tests affected by the burst ratio (e.g. to repeat these tests which will also allow to have the cylinders approved for the future at a lower burst ratio) or to re process corresponding cylinders by adding extra wrapping.</p> <p>OTHERS COMMENTS:</p>	

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			<p>1) My friend Mark Trudgeon indicates that the concept of relating the burst pressure ratio at approval with the burst pressure ratio at batch testing had been proposed and always rejected; THIS IS NOT TRUE; Please Mark read again the 2 first standards you are mentioning!!!</p> <p>2) Some manufacturers indicated that it is sufficient and safe to pass the minimum burst ratio indicated in the standard whatever the burst ratio was during the type approval. If it is the case why to perform all the expensive type approval tests?? . Please keep in mind that my proposal is a compromise because several people commented that the minimum values indicated in the standard are not conservative enough compare to proven specifications (e.g. DOT or European Regulations for cylinders)</p>	
2003-02-24	Hans Larsson	Swedish Gas Cylinder Committé SIS TK 296	<p>Swedish comments on documents GRPE/ISO N 038 and N 041</p> <p>The Swedish Gas Cylinder Committé has read and reviewed with interest the documents GRPE/ISO N 038 and N 041. We would like to take this opportunity to once again emphasize that we over the years constantly have commented that the proposed safety factors are unacceptably low.</p> <p>A burst ratio (Burst pressure/Service pressure) of 2,35 for carbon fibre composite cylinders is really too low. For example, ADR regulations and EN standards request a burst ratio of 3,0 and DOT ask for 3,4.</p> <p>In document N 041 a number of manufacturers have indicated their opinion and we quote:</p> <p>” ..... While the burst pressure of metal cylinders demonstrates a narrow range, the variation in materials and the complexity of composite cylinder design means it is never going to be possible to specify a tight tolerance on burst pressure. ....”</p> <p style="text-align: right;">(Luxfer)</p> <p>”.....The nature of the materials of a composite structure is such that a tight tolerance is not likely to be achieved.”</p> <p style="text-align: right;">(Raufoss)</p> <p>This is the reason why a sufficiently high burst ratio is needed and we strongly suggest to keep the burst ratio equal to 3,0.</p> <p>The reference to the burst ratio in the ISO standard for CNG vehicles is in our opinion not</p>	

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			<p>correct. Also here we have over the years indicated that burst ratio of 2,35 is too low. We support the opinion expressed by Air Liquide in document N 041and we quote:</p> <p>” ..... but the number of cylinders manufactured to these standards is limited and the experience is very short (few years) and not always satisfactory (some cylinders being subject to recall)”</p> <p>We request that the draft standard and the draft GRPE document are revised and that the burst ratio will be chosen in accordance with recognized regulations.</p>	