

REPORT

Second meeting of the GRSG Task Force on “Gas-fueled vehicle regulations”

Venue: TÜV Rheinland HQ, Cologne
Chairman: Stefan Behrning (D)
Secretariat: Helge Asmussen (D)
Dates: 27th - 28th June, 2018

1.1 Participants:

see attachment

1.2 Welcome and Introduction

The chairman welcomed the delegates to the second meeting of the group, and clarified the reason for and the targets of the Task Force.

1.3 Approval of the agenda

The agenda was adopted by the participants.

1.4 List of Documents circulated in preparation of the meeting :

Name of document	circulated by	date of circulation
GRSG/2018/xx - REVISED ITALIAN POPOSAL	Dr. Stefan Behrning	29.05.2018
Proposal for test description on None-metallic material inside the tank	Paul Dijkhof and George Nikolaou	25.06.2018 26.06.2018
2018 06 27–28 NGVGlobal DraftResponse v2	Dr. Jeffrey Seisler	22.06.2018
Paragraph 4.1 and 4.2 of the GRSG/2018/xx - REVISED ITALIAN POPOSAL	Professor Bruno Atzori	28.06.2018
in addition document GRSG-114-26 by OICA		not circulated during the meeting

For details to document GRSG-114-26 see report of the 114. GRSG session ECE/TRANS/WP.29/GRSG/93 Paragraph 29.

"The expert from OICA presented GRSG-114-26 proposing to amend the specifications for inspection of CNG-cylinders / LNG-tanks and their accessories. GRSG did not support the proposal.

[Discussions at the 27th June 18]

2. The following questions were scrutinized

2.1. None-metallic material inside the LPG tank

The following aspects were discussed resulting in the wording suggested below:

The volume of the LPG tank determines the period of time necessary to relieve the pressure from the LPG tank. Ninety seconds is deemed to be an appropriate value.

The influence of a changing temperature in the gaseous and liquid LPG phase inside the tank and of the possibility of an increasing level of the liquid phase inside the tank leading to the discharge of liquid LPG was discussed. It is not deemed to be necessary to account for these aspects in the modification suggested below. Neither was it deemed to be necessary to modify section 6.15.8.3. of the Regulation regarding flow capacity.

It is pointed out by the Task Force participants that even if there are more than one TPRD attached to a tank, each TPRD has to fulfill the stipulations of section 6.15.8.3.

By accident "Requirements" is mentioned two times with a slightly different wording at the end of the proposal. The understanding of the Task Force is that the aged as well as the new TPRD have to fulfill the stipulations of section 6.15.8.3. Anyhow it is not necessary that the values of flow capacity measured for aged and new TPRD are identical.

The Task Force agreed on the German suggestion to account for the influence of the odorization agent by adding this agent as an additive to the n-Pentane test at max. concentration as per EN 589.

The expert from Poland suggests that after a modification of UN Regulation No. 67 it shall only be possible to grant type-approvals for a multivalve assembled completely by the manufacturer applying for a new type-approval. This modification shall help to prevent errors during assembly in a work shop. The Task Force did not support this idea.

The expert from AEGPL suggests a modification of the Creep Test as described in annex 15 paragraphs 15 of the UN Regulation. The modification suggested aims at allowing a second environmental temperature less than 120 ° C for parts not exposed to high temperature due to their location in a vehicle. The Task Force did not support this idea.

The Task Force agrees on the following wording:

Proposal for test description on non-metallic material inside the tank:

Non-metallic material inside the tank shall be tested using the following procedure:

2 samples shall be tested.

Age first sample using one of the two procedures described below according to the manufacturer's instruction:

Procedure 1

Disassemble, using instructions from the manufacturer, all non-metallic materials from the component in contact with the liquid LPG, or use the complete/ entire component if the manufacturer specifies so.

Age the non-metallic materials using the test description of annex 15 paragraph 11. [The n-Pentane used shall have an odorant concentration of 50 ppm.]
Check the compliance to annex 15 paragraphs 11.2
Assemble the aged non-metallic materials back to the component using the instructions from the manufacturer.

Procedure 2

Expose the entire component to n-Pentane according to annex 15 paragraph 11.1 without the check of annex 15 Paragraph 11.2

Perform on the aged sample the vibration test annex 15 paragraph 10.5 procedure A or B.
Samples that comply shall proceed with the following test:

Place the sample in a dummy tank.

Perform the flow test according paragraph 6.15.8.3. Make sure the required pressure inside the dummy tank is maintained for at least 90 seconds.

[Requirements]: both aged and non-aged samples shall comply with the flow requirements as per paragraph 6.15.8.3. The non-metallic material of the sample shall show no cracks, deformation or any visual damage.]*

[Requirements]: both aged and non-aged samples shall have the same flow capacity. The non-metallic materials of the samples shall show no cracks, deformation or any visual damage.]*

*) "Requirement" is mentioned twice with a slightly different wording.

Possible further steps:

The Task Force asks AEGPS to use the wording suggested above when preparing a new document to be handed in for the upcoming GRSG meeting.

2.2. Modifications of test requirements for CNG Type 4

The expert from Italy introduces a revised Italian proposal (Text quoted in blue letters).

Annex 3A

1) Paragraph 6.12., in the sentence after point (c) the word "coating" shall be substituted by the word "protection". Amend to read:

"6.12. Exterior environmental protection

(c)...

Any protections applied to cylinders shall be such that the application process does not adversely affect the mechanical properties of the cylinder. The protection shall be designed to facilitate subsequent in service inspection and the manufacturer shall provide guidance on protection treatment during such inspection to ensure the continued integrity of the cylinder."

The Task Force suggests to use the wording "coatings **or protection**" as suggested by NGV Global in document "2018 06 27 – 28 NGV Global Draft Response v2.docx"

That NGV Global suggestion reads :

"The first part of (c) indicates a definition/example of 'coating' as, "e.g. organic coating, paint." Replacing 'coating' by 'protection' would not be consistent with the intent of (c) as it now stands. To be fully viable and consistent, paragraph (c) would have to read 'A protective coating (e.g. organic coating, paint) **or other protection** that shall meet the requirements of paragraph A.9. Thereafter in the paragraph where 'coatings' is used would also have to say 'coatings **or protection**'"

2) Paragraph 10.7.1., amend to read:

"10.7.1. General

Cylinder design qualification tests shall be in accordance with the requirements of paragraphs 8.6., 10.7.2., 10.7.3., ~~and~~ 10.7.4. and 10.7.5. of this annex, except that the LBB performance in paragraph 8.6.10. above is not required."

This is supported by the Task Force bringing in line the stipulations regarding CNG type 4 and CNG type 3 cylinders.

3) Add a new paragraph 10.7.5., to read:

**"10.7.5. Impact damage test
One or more finished cylinders shall be subjected to an impact damage test according to Appendix A, paragraph A.20.**

This is supported by the Task Force.

"Annex 3A, Appendix A

4) Paragraph A.20., amend to read:

"A.20. Impact damage test
One or more finished cylinders shall be drop tested at ambient temperature without internal pressurization, without **dome protections** or attached valves.
The surface ..."

In consideration of NGV Global document the expert from Italy withdrew this item 4) and presented a new version of this paragraph. The text circulated during the meeting is reproduced as Annex 1 to this report.

5) "Annex 3A

Table 6.7: Change of design

Item 11 of first column: "Dome shape" shall be amended to read "**Dome design**".

On column 8 (... Drop test A.20) for item 11 a X shall be added, specifying: "**drop test A.20 required only for all Type CNG-3 and CNG-4 designs**".

After receiving further explanation the Task Force supports this modification.

Discussion of the new subsections 4.1 and 4.2:

Subsection 4.1 describes alignments with the contents of Standard ISO 11439. This section (see Annex 1 to the report) is supported by the Task Force.

The Task Force voiced some concerns regarding subsection 4.2.

- The UN regulation does not clearly specify the flaws compared to the ISO 11439 standard in which the flaw depth and length is defined. According to Regulation No. 110 the manufacturer has to decide on the dimensions of the flaw depending on the visual inspection limits specified by the manufacturer. Furthermore the manufacturer has to decide on the area where to introduce the flaw.

- The expert from company Hexagon gives a presentation regarding the stress distribution in a type-4 cylinder. He points out that the thickness of the material cannot be the same at the dome end of the cylinder and in the cylindrical section. The adjustment of the matrix thickness is necessary to avoid a destruction of the fibers when exposed to stress. An increase of thickness in the dome end will impose the necessity to increase the thickness in the cylindrical section of the cylinder as well.

- According to the stipulations the flaw test has to be carried out on a finished cylinder. Thus, introducing flaws in the dome area at cylinders with integral dome protection would not make sense. The expert from Italy clarifies that the Italian proposal shall ensure that the dome end of the cylinder is not designed to be the weakest cylinder section. Bearing this in mind the aim is to have a robust design that does not make it necessary to have the flaw test at the dome end of a cylinder because this isn't the weakest section.

[The discussion of subsections 4.2 is continued at the 29th June 18]

The expert from Germany asked if “weakest part” should be defined in order to avoid different interpretations of this term by different authorities. According to the expert from Italy the stipulations are clearly laid down in Appendix F section F.1. This section reads:

“F.1. DETERMINATION OF FATIGUE SENSITIVE SITES The location and orientation of fatigue failure in cylinders shall be determined by appropriate stress analysis or by full scale fatigue tests on finished cylinders as required under the design qualification tests for each type of design. If finite element stress analysis is used, the fatigue sensitive site shall be identified based on the location and orientation of the highest tensile principal stress concentration in the cylinder wall or liner at the working pressure.”

It is discussed if a definition for the flaw should be taken from EN 12245 or ISO 11439. The expert from Italy points out that A.17 only stipulates “The flaw shall be greater than the visual inspection limits as specified by the manufacturer.” Furthermore section A.17 does not contain a stipulation to the effect, what area of the cylinder is to be exposed to the flaw. The expert from company Faber points out that the manufacturer has to justify the area chosen for introducing the flaw.

The Task Force participants agree, that the wall thickness influences the consequences of an identical flaw introduced to areas that are weak to an identical degree. A scratch of the same depth will have more influence on a thinner wall.

Furthermore it is pointed out that “protection” shall not be mentioned in paragraph A.17 because even as an integral part of the cylinder the protection does not make a section stronger that is identified as weakest for instance by FEA.

The Task Force agrees on the following wording:

A.17. COMPOSITE TESTS

For type CNG-2, CNG-3 and CNG-4 designs only, one finished cylinder, complete with protective coating, shall have a flaw tolerance test on the cylindrical wall as well as on the minimum composite wall thickness of the weakest part(s) of the container as identified by an appropriate stress analysis or full scale test on finished cylinders. The flaws shall be cut in the longitudinal direction into the composite. The flaws shall be greater than the visual inspection limits as specified by the manufacturer.”

Possible further steps:

The Task Force suggests the expert from Italy to use the wording above when preparing a new document to be handed in for the upcoming GRSG meeting.

2.3 Periodic requalification

The expert from NGV Global explains that there are possibilities to evaluate the section under the support straps without disassembling. Furthermore he expresses doubts if section 4.1.4. is a type-approval stipulation.

The expert from Italy suggests modifying the wording of section 18.1.6.1. as agreed by the 114. GRSG to exclude the periodical requalification from the stipulation that no tools may be used. This idea is not supported by the Task Force.

The expert from Germany points out that section 4.1.4. deals with stipulations regarding evaluation of the external cylinder surface only. It seems inconsistent that any possible damage to the internal surface of the cylinder is disregarded (i. g. due to residual sulfur or water affecting the inside of the shell); thus an internal inspection may be as necessary as an external inspection.

From a German prospective only the aspect regarding information necessary for a proper periodic requalification which shall be provided by the car manufacturer or the system integrator should be a part of the type approval Regulation No. 110.

The expert of Poland supports the idea that it is necessary to make the information regarding periodical requalification available.

The Task Force agreed on the following wording:

"4.1.4. Periodic requalification

For those countries that require periodic requalification it shall be performed in accordance with the relevant regulations of the country(ies) where the cylinders are used.

*Recommendations for periodic requalification by visual inspection or testing during the service life shall be provided by the **car manufacturer or system integrator** on the basis of use under service conditions specified herein. Each cylinder shall be visually inspected at least every 48 months after the date of its entry into service on the vehicle (vehicle registration), and at the time of any reinstallation, for external damage and deterioration. **It is suggested to visually inspect under the support straps as well.** The visual inspection shall be performed by a competent agency approved or recognized by the Regulatory Authority, **in consideration** with the manufacturer's specifications. Cylinders without label containing mandatory information or with labels containing mandatory information that are illegible in any way shall be removed from service. If the cylinder can be positively identified by manufacturer and serial number, a replacement label may be applied, allowing the cylinder to remain in service."*

Possible further steps:

The Task Force suggests the expert from OICA to use the wording above when preparing a new document to be handed in for the upcoming GRSG meeting.

3. Next meeting

No further meeting is planned at the moment.

Annex 1 to the Report of the Task Force Meeting

Paragraph 4.1 and 4.2 of Document GRSG/2018/xx - REVISED ITALIAN POPOSAL as circulated during the meeting

4.1) *Point 4. Definitions*

Paragraph 4.56, in line 3 amend to read

4.56. *“Finished cylinders”*

... including insulation **and/or protection** specified by the manufacturer **on the design drawing for the cylinder**, but free

Justification: it seems to be obvious that a protection which is “integral” could not be changed at will of the manufacturer, but shall be fully described in the “design drawing of the cylinder” as described in paragraph 5.3.1 of annex 3A. We are asking that this is clearly stated, as it is in paragraph 3.10 of ISO 11439, to avoid any misunderstandings.

Annex 3A. Appendix A

4.2) Paragraph A.17., amended to read:

“A.17. Composite flaw tolerance tests

... shall have flaws in the longitudinal direction cut in the composite **not only on the cylinder sidewall, but also on the thinnest wall of the weakest zone of the cylinder**. The flaws ...

Justification: it seems to be obvious that the most dangerous flaw is the one in the weakest point of any structure and that it will not make any sense for the reliability of the cylinder to test the “flaw tolerance” in the strongest zone of the cylinder. We are asking that this is clearly stated to avoid any misunderstandings, since it could be very dangerous for the reliability of the cylinder.