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Working Party on General Safety Provisions

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Item 6 (b) of the provisional agenda
Amendments to Gas-Fuelled Vehicle Regulation:
UN Regulation No. 110 (Compressed Natural Gas and Liquified Natural Gas vehicles)

Proposal for Supplement 1 to the 05 of Amendments to UN Regulation No. 110 (Compressed Natural Gas and Liquified Natural Gas vehicles)

Submitted by the expert from International Association for Natural Gas Vehicles and the Netherlands*

The text reproduced below was prepared by the Task Force on UN Regulation No. 110. It is based on working document ECE/TRANS/WP.29/GRSG/2022/12 and on informal documents GRSG-123-28 and GRSG-123-02, distributed at the 123rd session of the Working Party on General Safety Provisions (GRSG). The modifications to the existing text are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2022 as outlined in the proposed programme budget for 2022 (A/76/6, part V, sect. 20, para. 20.76), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

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I. Proposal

Paragraph 3., Figure 1-2, add reference to Annex 5R to read:

"Figure 1-2
Test Applicable to Specific Classes of Components (Excluding CNG Cylinders and LNG Tanks)

Test	*Class 0*	*Class 1*	*Class 2*	*Class 3*	*Class 4*	*Class 5*	*Class 6*	*Annex*
Overpressure or strength	X	X	X	X	O	X	X	5A
External leakage	X	X	X	X	O	X	X	5B
Internal leakage	A	A	A	A	O	A	A	5C
Durability tests	A	A	A	A	O	A	A	5L
CNG/LNG compatibility	A	A	A	A	A	A	A	5D
Corrosion resistance	X	X	X	X	X	A	X	5E
Resistance to dry heat	A	A	A	A	A	A	A	5F
Ozone ageing	A	A	A	A	A	A	A	5G
Burst/destructive tests	X	O	O	O	O	A	X	5M
Temperature cycle	A	A	A	A	O	A	A	5H
Pressure cycle	X	O	O	O	O	A	X	5I
Vibration resistance	A	A	A	A	O	A	A	5N
Operating temperatures	X	X	X	X	X	X	X	5O
LNG low temperature	O	O	O	O	O	X	O	5P
Compatibility with heat exchange fluids of non-metallic parts	A	A	A	A	A	A	A	5Q
Test Procedure for Pressure Relief Device (temperature triggered)	**A**	**O**	**O**	**O**	**O**	**O**	**A**	**5R**
X = Applicable O = Not applicable A = As applicable								

"

Annex 3A – Appendix A, paragraph A.24, shall be deleted

Annex 3A – Appendix A, paragraphs A.25 to A.27, renumber as paragraphs A.24 to A.26

Annex 4A, paragraph 4.2.5., amend to read:

"4.2.5. The pressure relief device shall be so designed to open the fuse at a temperature of 110 °C ± 10 °C **as specified in Annex 5R**."

Annex 5, paragraph 2., Table 5.1, add reference to Annex 5R and amend to read:

"Table 5.1

Test	*Class 0*	*Class 1*	*Class 2*	*Class 3*	*Class 4*	*Class 5*	*Class 6*	*Annex*
Overpressure or strength	X	X	X	X	O	X	X	5A
External leakage	X	X	X	X	O	X	X	5B
Internal leakage	A	A	A	A	O	A	A	5C
Durability tests	A	A	A	A	O	A	A	5L
CNG/LNG compatibility	A	A	A	A	A	A	A	5D
Corrosion resistance	X	X	X	X	X	A	X	5E
Resistance to dry heat	A	A	A	A	A	A	A	5F
Ozone ageing	A	A	A	A	A	A	A	5G
Burst/destructive tests	X	O	O	O	O	A	X	5M
Temperature cycle	A	A	A	A	O	A	A	5H
Pressure cycle	X	O	O	O	O	A	X	5I
Vibration resistance	A	A	A	A	O	A	A	5N
Operating temperatures	X	X	X	X	X	X	X	5O
LNG low temperature	O	O	O	O	O	X	O	5P
Compatibility with heat exchange fluids of non-metallic part	A	A	A	A	A	A	A	5Q
Test Procedure for Pressure Relief Device (temperature triggered)	**A**	**O**	**O**	**O**	**O**	**O**	**A**	**5R**
X = Applicable O = Not applicable A = As applicable								

Remarks:

(a) Internal leakage: Applicable if the Class of the component consists of internal valve seats that are normally closed during engine "OFF" condition;

…

(g) Pressure Relief Device (temperature triggered) shall be tested.

The material used …"

Add new Annex 5R, to read:

"Annex 5R

Test Procedure for Pressure Relief Device (temperature triggered)

1. Benchtop activation - pressure relief device (PRD)(temperature triggered).

1.1. The purpose of the test is to demonstrate that a PRD (temperature triggered) will consistently activate throughout its designed life.

1.2. Test set-up

The test set-up shall consist of an oven, or chimney (test chamber) capable of maintaining a temperature of 600 °C ± 10 °C surrounding the test article. The PRD (temperature triggered) shall not be exposed to direct flame impingement.

1.3. Test samples

1.3.1. Two virgin PRDs shall be tested, and the averaged activation time shall establish a baseline activation time.

1.3.2. One sample PRD (temperature triggered) that has been subjected to and passed the following design qualification tests: Annex 5E, Annex 5H, Annex 5L, and Annex 5N.

1.4. Test Procedure

1.4.1. The test chamber temperature shall be 600 °C ± 10 °C for a minimum of two minutes prior to running the test.

1.4.2. Place sample PRD (temperature triggered) that has been pressurized to 25 per cent of service pressure in the test chamber; record time to activation.

1.5. Acceptable results

PRDs (temperature triggered) that have been tested according to the tests outlined in paragraph 3.1.2., shall activate within two minutes of the recorded activation time of the samples listed in paragraph 3.1.

1.6. Batch testing

The PRD (temperature triggered) manufacturer shall institute a production batch inspection and acceptance testing programme that ensures consistent safety performance of the product.

2. Pressure relief device (temperature triggered) requirements

The pressure relief device specified by the manufacturer shall be shown to be compatible with the service conditions listed in paragraph 4. of Annex 3A and through the following qualification tests:

(a) One specimen shall be held at a controlled temperature of not less than 95 °C and a pressure not less than test pressure (30 MPa) for 24 hours. At the end of this test there shall be no leakage or visible sign of extrusion of any fusible metal used in the design.

(b) One specimen shall be fatigue tested at a pressure cycling rate not to exceed 4 cycles per minute as follows:

(i) Held at 82 °C while pressured for 10,000 cycles between 2 MPa and 26 MPa;

(ii) Held at -40 °C while pressure for 10,000 cycles between 2 MPa and 20 MPa.

At the end of this test there shall be no leakage, or any visible sign of extrusion of any fusible metal used in the design.

(c) Exposed brass pressure retaining components of pressure relief devices shall withstand, without stress corrosion cracking, immersion in ammonia. Following the immersion, the pressure relief device shall be leak tested by applying an aerostatic pressure of 26 MPa for one minute during which time the component shall be checked for external leakage. Any leakage shall not exceed 200 cm^3/h.

(i) Subject each test sample to the physical stresses normally imposed on, or within, a part as a result of its assembly with other components. Apply these stresses to the sample prior to testing and maintain them throughout the test. Samples with thread, intended to be used for installing the product in the field, shall have the threads engaged and tightened to the torque specified in the instruction manual of the sample or specified by the manufacturer. Polytetrafluorethylene (PTFE) tape or pipe compounds shall not be used on the threads;

(ii) Degrease three samples and expose them continuously for 10 days at a set position to a moist ammonia–air mixture, maintained in a glass chamber of approximately 30 l in capacity with a glass cover. Aqueous ammonia having a specific gravity of 0.94 shall be maintained at the bottom of the glass chamber, below the samples, at a concentration of 21.2 ml/l of chamber volume. Position the samples 40 mm above the aqueous ammonia solution, supported by an inert tray. Maintain the moist ammonia–air mixture in the chamber at atmospheric pressure and at a temperature of 34 °C ± 2 °C.

(d) Exposed stainless steel pressure retaining components of pressure relief devices shall be made of an alloy type resistant to chloride induced stress corrosion cracking."

II. Justification

1. Currently there are no design qualification tests within UN Regulation No. 110 to determine that a temperature activated Pressure Relief Device (PRD) will consistently activate in a timely manner. PRDs are one of the primary safety components that can prevent a container rupture during a thermal event. Ensuring that a PRD will activate when it reaches its designed activation temperature range is of utmost importance.

2. Performing batch testing, also ensures that no minor change in process or material will be detrimental to the intended activation time.

3. The addition of these tests also will harmonize UN Regulation No. 110 with ISO 15500-13:2012, and the North American CSA/ANSI PRD 1 (2020).

4. Batch testing refers to ISO15500-13 requirements.

5. The previous Annex 3A – Appendix A paragraph. A.24 is moved into new Annex 5R, which is renamed as “Test Procedure for Pressure Relief Device (Temperature Triggered)”.