Proposal for the 03 series of amendments to UN Regulation No. 110 (CNG and LNG vehicles)

Submitted by the Working Party on General Safety Provisions*

The text reproduced below was adopted by the Working Party on General Safety Provisions (GRSG) at its 113th session (ECE/TRANS/WP.29/GRSG/92, para. 38). It is based on official document ECE/TRANS/WP.29/GRSG/2017/31 as reproduced in Annex IV to the report. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee AC.1 for consideration at their March 2018 sessions.

* In accordance with the programme of work of the Inland Transport Committee for 2016–2017 (ECE/TRANS/254, para. 159 and ECE/TRANS/2016/28/Add.1, cluster 3.1), 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.
03 series of amendments to UN Regulation No. 110 (CNG and LNG vehicles)

Table of contents, Annexe 3A, remove the entry for Appendix H.

Paragraph 2. (References), amend to read:

"2. References

The following standards contain provisions that, through reference in this text, constitute provisions of this Regulation.

ASTM Standards¹
ASTM B117-90 Test method of Salt Spray (Fog) Testing
ASTM B154-92 Mercurous Nitrate Test for Copper and Copper Alloys
ASTM D522-92 Mandrel Bend Test of attached Organic Coatings
ASTM D1308-87 Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D2344-84 Test Method for Apparent interlaminar Shear Strength of Parallel Fibre Composites by Short Beam Method
ASTM D3170-87 Chipping Resistance of Coatings
ASTM D3418-83 Test Method for Transition Temperatures Polymers by Thermal Analysis
ASTM E647-93 Standard Test, Method for Measurement of Fatigue Crack Growth Rates
ASTM E813-89 Test Method for JᵢC, a Measure of Fracture Toughness
ASTM G154-16 Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

BSI Standards²
BS 5045 Part 1 (1982) Transportable Gas Containers – Specification for Seamless Steel Gas Containers Above 0.5 litre Water Capacity

¹ American Society for Testing and Materials.
² British Standards Institution.
Guidance an Methods for Assessing the Acceptability of Flaws in Fusion Welded Structures; Metallic Materials

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<th><strong>EN Standards</strong></th>
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<td>Cryogenic vessels. Vacuum insulated vessels of not more than 1,000 litres volume</td>
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<td>Destructive tests on welds in metallic materials. Transverse tensile test</td>
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<td>Non-destructive examination of welds. Radiographic examination of welded joints</td>
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<td>Metallic materials. Tensile test</td>
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<td>EN 10045-1:1990</td>
<td>Charpy impact test on metallic materials. Test method (V- and U-notches)</td>
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<td>ISO 37:2011</td>
<td>Rubber, vulcanized or thermoplastic – Determination of tensile stress-strain properties</td>
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<td>Rubber and plastics hoses and hose assemblies – Hydrostatic testing</td>
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<td>ISO 1436:2009</td>
<td>Rubber hoses and hose assemblies – Wire-braid-reinforced hydraulic types for oil-based or water-based fluids – Specification</td>
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<td>ISO 1817:2015</td>
<td>Rubber, vulcanized or thermoplastic – Determination of the effect of liquids</td>
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3 European Norm.
4 International Organization for Standardization.
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<td>2808:2007</td>
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<td>6892:2016</td>
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<td>7225:2005</td>
<td>Precautionary Labels for Gas Cylinders</td>
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<td>Refillable seamless aluminium alloy cylinders – Design, construction and testing</td>
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<td>Road vehicles – Compressed natural gas (CNG) fuel system components Part 2: Performance and general test methods</td>
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<td>Road vehicles - Compressed natural gas (CNG) fuel system components - Part 17: Flexible fuel line</td>
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<td>21028-1:2016</td>
<td>Cryogenic vessels – Toughness requirements for materials at cryogenic temperature – Part I: Temperatures below -80 °C</td>
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<td>21029-1:2015</td>
<td>Cryogenic vessels – Transportable vacuum insulated vessels of not more than 1,000 litres volume – Part I: Design, fabrication, inspection and tests</td>
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<td>17025:2005</td>
<td>General requirements for the competence of testing and calibration laboratories</td>
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<td>9809-1:2010</td>
<td>Gas cylinders — Refillable seamless steel gas cylinders — Design, construction and testing — Part 1: Quenched and tempered steel cylinders with tensile strength less than 1,100 MPa</td>
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ISO 11439:2013  Gas cylinders — High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles

NACE Standard5  Laboratory Testing of Metals for Resistance to Sulphide Stress Cracking in H2S Environments

UN Regulations6  Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility

USA Federal Regulations7  Liquid fuel tanks (as amended in 78 FR 58484 on 24 September 2013)

SAE Standards8  Recommended Practice for LNG Medium and Heavy-Duty Powered Vehicles"

*Insert new paragraphs 24.15. to 24.21., to read:

24.15. As from the official date of entry into force of the 03 series of amendments, no Contracting Party applying this Regulation shall refuse to grant or refuse to accept UN type-approvals under this Regulation as amended by the 03 series of amendments.

24.16. As from 1 September 2019, Contracting Parties applying this Regulation shall not be obliged to accept UN type-approvals of components approved to the requirements of Part I of this Regulation to the 02 series of amendments, first issued after 1 September 2019.

24.17. As from 1 September 2021, Contracting Parties applying this Regulation shall not be obliged to accept UN type-approvals of vehicles approved to the requirements of Part II of this Regulation to the 02 series of amendments, first issued after 1 September 2021.

24.18. Contracting Parties applying this Regulation shall continue to accept UN type-approvals issued according to the 02 series of amendments to this Regulation first issued before 1 September 2019 in the case of components approved to the requirements of Part I of this Regulation, and before 1 September 2021 in the case of vehicles approved to the requirements of Part II of this Regulation.

24.19. Contracting Parties applying this Regulation shall not refuse to grant UN type-approvals according to any preceding series of amendments to this Regulation or extensions thereof.

24.20. Contracting Parties applying this Regulation shall continue to accept UN type-approvals of, and to grant extensions of approvals to the equipment and

5 National Association of Corrosion Engineers.
6 United Nations Economic Commission for Europe; Regulations.
7 United States of America Federal Regulations.
8 Society of Automotive Engineers.
part to the preceding series of amendments to this Regulation which are not affected by the changes introduced by the 03 series of amendments.

24.21. Contracting Parties applying this Regulation shall continue to accept UN type-approvals to the 02 series of amendments to this Regulation, first issued before 1 September 2021."

Annex 3A

Table 6.4, replace the entry "Acid environment test" by "Environmental test".

Paragraph 6.3.6., amend to read:

"6.3.6. Plastic liners
The tensile yield strength and ultimate elongation shall be determined in accordance with paragraph A.22. (Appendix A to this annex). Tests shall demonstrate the ductile properties of the plastic liner material at temperatures of -50 °C or lower by meeting the values specified by the manufacturer; the polymeric material shall be compatible with the service conditions specified in paragraph 4. of this annex. In accordance with the method described in paragraph A.23. (Appendix A to this annex), the softening temperature shall be at least 100 °C."

Paragraph 6.12., amend to read:

"6.12. Exterior environmental protection
The exterior of cylinders shall meet the requirements of the environmental test conditions of paragraph A.14. (Appendix A to this annex). Exterior protection shall be provided by using any of the following:
(a) A surface finish giving adequate protection (e.g. metal sprayed on aluminium, anodizing); or
(b) The use of a suitable fibre and matrix material (e.g. carbon fibre in resin); or
(c) A protective coating (e.g. organic coating, paint) that shall meet the requirements of paragraph A.9. (Appendix A to this annex).
Any coatings applied to cylinders shall be such that the application process does not adversely affect the mechanical properties of the cylinder. The coating shall be designed to facilitate subsequent in service inspection and the manufacturer shall provide guidance on coating treatment during such inspection to ensure the continued integrity of the cylinder."

Paragraph 8.6.4., amend to read:

"8.6.4. Environment test
One cylinder shall be tested in accordance with paragraph A.14. (Appendix A to this annex) and meet the requirements therein."

Annex 3A, Appendix A


"A.14. Environmental test
A.14.1. Scope
This test is applicable to type CNG-2, CNG-3 and CNG-4 designs only.
A.14.2. Cylinder set-up and preparation

The upper section of the cylinder will be divided into 5 distinct areas and marked for preconditioning and fluid exposure (see Figure A.1). The areas will be nominally 100 mm in diameter. The areas shall not overlap on the cylinder surface. While convenient for testing, the areas need not be oriented along a single line, but shall not overlap the immersed section of the cylinder.

Although preconditioning and fluid exposure is performed on the cylindrical section of the cylinder, all of the cylinder, including the domed sections, should be as resistant to the exposure environments as are the exposed areas.

Figure A.1
Cylinder orientation and layout of exposure areas

A.14.3. Pendulum impact preconditioning

The impact body shall be of steel and have the shape of a pyramid with equilateral triangle faces and a square base, the summit and the edges being rounded to a radius of 3 mm. The centre of percussion of the pendulum shall coincide with the centre of gravity of the pyramid; its distance from the axis of rotation of the pendulum shall be 1 m. The total mass of the pendulum referred to its centre of percussion shall be 15 kg. The energy of the pendulum at the moment of impact shall be not less than 30 Nm and as close to that value as possible.

During pendulum impact, the cylinder shall be held in position by the end bosses or by the intended mounting brackets. The cylinder shall be unpressurized during preconditioning.

A.14.4. Environmental fluids for exposure

Each marked area is to be exposed to one of five solutions for 30 minutes. The same environment shall be used for each location throughout the test. The solutions are:

- Sulphuric acid: 19 per cent solution by volume in water;
- Sodium hydroxide: 25 per cent solution by weight in water;
- 5% Methanol/95% gasoline: gasoline concentration of M5 fuel meeting the requirements of ASTM D4814;
- Ammonium nitrate: 28 per cent by weight in water;
- Windshield washer fluid: 50 per cent by volume solution of methyl alcohol and water.

When exposed, the test sample will be oriented with the exposure area uppermost. A pad of glass wool (approximately 0.5 mm thick and between 90 and 100 mm in diameter) shall be placed on the exposure area. Apply an amount of the test fluid to the glass wool sufficient to ensure that the pad is wetted evenly across its surface and through its thickness for the duration of
the test, and that the concentration of the fluid is not changed significantly during the duration of the test.

A.14.5. Pressure cycle and hold

The cylinder shall be hydraulically pressure cycled between not more than 2 MPa and not less than 26 MPa for a total of 3,000 cycles. The maximum pressurization rate shall be 2.75 MPa per second. After pressure cycling, the cylinder shall be pressurized to 26 MPa and held at that pressure a minimum of 24 hours and until the elapsed exposure time (pressure cycling and pressure hold) to the environmental fluids equals 48 hours.

A.14.6. Acceptable results

The cylinder shall be hydraulically tested to destruction in accordance with the procedure in paragraph A.12. The burst pressure of the cylinder shall be not less than 85 per cent of the minimum design burst pressure.”

Through the whole text of the Regulation, replace the references to “acid environmental test” by “environment test” and delete the references to Annex 3A, Appendix H.

Paragraph A.16., amend to read:

”A.16. Penetration tests

A cylinder pressurised to 20 MPa ± 1 MPa with compressed gas shall be penetrated by an armour piercing bullet with a diameter of 7.62 mm or greater. The bullet shall completely penetrate at least one side wall of the cylinder. For type CNG-1 designs, the projectile shall impact the side wall at 90°. For type CNG-2, CNG-3 and CNG-4 designs, the projectile shall impact the side wall at an approximate angle of 45°. The cylinder shall reveal no evidence of fragmentation failure. Loss of small pieces of material, each not weighing more than 45 grams, shall not constitute failure of the test. The approximate size of entrance and exit openings and their locations shall be recorded.”

Paragraph A.22., amend to read:

”A.22. Tensile properties of plastics

The tensile yield strength and ultimate elongation of plastic liner material shall be determined at -50 °C using ISO 527-2, and meet the requirements of paragraph 6.3.6. of Annex 3A.”

Paragraph A.23., amend to read:

”A.23. Softening temperature of plastics

Polymeric materials from finished liners shall be tested in accordance with the method described in ISO 306. The softening temperature shall be at least 100 °C.”

Annex 3A, Appendix F, paragraph F.2.1., subparagraph (c), amend to read:

”(c) Fracture toughness of the finished cylinder or the liner from a finished cylinder, as determined at room temperature for aluminium and at -40 °C for steel, shall be established using a standardized testing technique (either ASTM 813-89 or BS 7448) in accordance with Sections 8.4 and 8.5 of BS PD6493”

Annex 3A, Appendix H, shall be deleted.

Annex 4F, paragraph 2.2., amend to read:
"2.2. CNG filling units designed in accordance with ISO 14469 and meeting all the requirements therein are deemed to fulfill the requirements of paragraphs 3. and 4. of this annex."

Annex 4J, paragraph 3.1.5., amend to read:

"3.1.5. The LNG filling receptacle shall be made out of non-sparking material and should comply with the no igniting evaluation tests described in ISO 14469."