Agreement

Concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations*

(Revision 3, including the amendments which entered into force on 14 September 2017)

Addendum 109 – UN Regulation No. 110

Revision 4 – Amendment 2

03 series of amendments – Date of entry into force: 16 October 2018

Uniform provisions concerning the approval of:
I. Specific components of motor vehicles using compressed natural gas (CNG) and/or liquefied natural gas (LNG) in their propulsion system
II. Vehicles with regard to the installation of specific components of an approved type for the use of compressed natural gas (CNG) and/or liquefied natural gas (LNG) in their propulsion system

This document is meant purely as documentation tool. The authentic and legal binding texts is: -ECE/TRANS/WP.29/2018/22.

UNITED NATIONS

* Former titles of the Agreement:
Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958 (original version);
Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, done at Geneva on 5 October 1995 (Revision 2).
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 J_{IC}, 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.
Acceptability of Flaws in Fusion Welded Structures; Metallic Materials

EN Standards
EN 1251-2:2000 Cryogenic vessels. Vacuum insulated vessels of not more than 1,000 litres volume
EN 895:1995 Destructive tests on welds in metallic materials. Transverse tensile test
EN 1435:1997 Non-destructive examination of welds. Radiographic examination of welded joints
EN 6892-1:2016 Metallic materials. Tensile test
EN 10045-1:1990 Charpy impact test on metallic materials. Test method (V- and U-notches)

ISO Standards
ISO 148-1983 Steel – Charpy Impact Test (v-notch)
ISO 188:2011 Rubber, vulcanized or thermoplastic – Accelerated ageing and heat resistance tests
ISO 642:1999 Steel-Hardenability Test by End Quenching (Jominy Test)
ISO 1307:2006 Rubber and plastics hoses – Hose sizes, minimum and maximum inside diameters, and tolerances on cut-to-length hoses
ISO 1402:2009 Rubber and plastics hoses and hose assemblies – Hydrostatic testing
ISO 1431:2009 Rubber, vulcanized or thermoplastic – Resistance to ozone cracking
ISO 1436:2009 Rubber hoses and hose assemblies – Wire-braid-reinforced hydraulic types for oil-based or water-based fluids – Specification
ISO 1817:2015 Rubber, vulcanized or thermoplastic – Determination of the effect of liquids

3 European Norm.
4 International Organization for Standardization.
ISO 2808:2007  Paints and Varnishes – Determination of film Thickness
ISO 4080:2009  Rubber and plastics hoses and hose assemblies – Determination of permeability to gas
ISO 4624:2016  Plastics and Varnishes – Pull-off Test for adhesion
ISO 10619:2011  Rubber and plastics hoses and tubing - Measurement of flexibility and stiffness - Part 2: Bending tests at sub-ambient temperatures
ISO 7225:2005  Precautionary Labels for Gas Cylinders
ISO 7866-2012  Refillable seamless aluminium alloy cylinders – Design, construction and testing
ISO 9001:2015  Quality Assurance in Design/Development. Production, Installation and Servicing
ISO 12991:2012  Liquefied natural gas (LNG) – transportable tanks for use on board of vehicles
ISO 14469:2017  Road Vehicles: compressed natural gas CNG refuelling connector
ISO 15500-2:2016  Road vehicles – Compressed natural gas (CNG) fuel system components Part 2: Performance and general test methods
ISO 15500-17:2012  Road vehicles - Compressed natural gas (CNG) fuel system components - Part 17: Flexible fuel line
ISO 21028-1:2016  Cryogenic vessels – Toughness requirements for materials at cryogenic temperature – Part I: Temperatures below -80 °C
ISO 21029-1:2015  Cryogenic vessels – Transportable vacuum insulated vessels of not more than 1,000 litres volume – Part I: Design, fabrication, inspection and tests
ISO/IEC 17025:2005  General requirements for the competence of testing and calibration laboratories
ISO 9809-1:2010  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
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 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 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 type-approvals of vehicles approved to the requirements of Part II of this Regulation to the 02 series of amendments, first issued after 1 September2021.

24.18. Contracting Parties applying this Regulation shall continue to accept 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 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 type-approvals of, and to grant extensions of approvals to the equipment and part to the preceding series of amendments to this Regulation which are not affected by the changes introduced by the 03 series of amendments.

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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.
24.21. Contracting Parties applying this Regulation shall continue to accept 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

Paragraph A.14., amend to read (inserting new sub-paragraphs A.14.1. to A14.6., based
mainly on the text of Annex 3A, Appendix H):

"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."