

**Economic and Social Council**Distr.: General
10 July 2015

Original: English

Economic Commission for Europe**Inland Transport Committee****World Forum for Harmonization of Vehicle Regulations****Working Party on General Safety Provisions****109th session**

Geneva, 29 September – 2 October 2015

Item 11 of the provisional agenda

Regulation No. 110 (Specific components for CNG)**Proposal for the 02 series of amendments to Regulation No. 110
(Specific components for CNG)****Submitted by the expert from Japan^{*}**

The text reproduced below was prepared by the expert from Japan proposing to remove the provisions for welded constructions of compressed natural gas (CNG) cylinders or metal liners, including high-strength steel CNG cylinders. It is based on informal documents GRSG-107-09, GRSG-107-37 and GRSG-108-11, distributed during the previous sessions of the Working Party on General Safety Provisions (GRSG) (see report ECE/TRANS/WP.29/GRSG/87, para. 43). The modifications to the current text of Regulation No. 110 are marked in bold for new characters or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2012–2016 (ECE/TRANS/224, para. 94 and ECE/TRANS/2012/12, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Paragraph 2., amend to read (deleting two references):

"2. References

.....

EN Standards⁴

~~EN 13322-2 2003 Transportable gas cylinders — Refillable welded steel gas cylinders — Design and construction — Part 2: Stainless steel~~

~~EN ISO 5817 2003 Arc welded joints in steel; guidance on quality levels for imperfections~~

N 1251-2 2000 Cryogenic vessels. Vacuum insulated vessels of not more than 1,000 litres volume

....."

Paragraph 6.3., amend to read:

"6.3. Every container shall also bear a marking plate with the following data clearly legible and indelible:

- (a) A serial number;
- (b) The capacity in litres;
- (c) The marking "CNG";
- (d) Operating pressure/test pressure/**working pressure** [MPa];
- (e) Mass [kg];
- (f) Year and month of approval (e.g. 96/01);
- (g) Approval mark according to paragraph 7.4. "

Insert a new paragraph 6.4., to read:

"**6.4. Every automatic valve and every pressure relief device fitted to the container shall also bear a marking with the following data clearly legible and indelible:**

- (a) **The marking "CNG";**
- (b) **Working pressure [MPa]."**

Paragraph 6.4. (former), renumber as paragraph 6.5.

Insert a new paragraph 6.6., to read:

"**6.6. Every one of the following components shall also bear a clearly legible and indelible marking of the data listed below (a) and (b): pressure relief valve (primary); pressure relief valve (secondary); manual fuel shut off valve; manual vapour shut off valve; LNG check valve; and LNG valves (manual or automatic) fitted to the tank.**

- (a) **The marking "LNG";**
- (b) **Working pressure [MPa]."**

Paragraph 7.2., amend to read:

- "7.2. An approval number shall be assigned to each type of component or multifunctional component approved. Its first two digits (at present ~~0204~~ corresponding to the ~~0204~~ series of amendments) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same alphanumeric code to another type of component. "

Insert new paragraph 8.2.2., to read:

- "**8.2.2. Cylinders of welded construction or metal liners of welded construction are not permitted.**"

Paragraph 18.1.8.4., amend to read:

- "18.1.8.4. A label shall be placed adjacent to the **CNG and/or** LNG fill receptacle stating the fuelling requirements **with the following data**. The fuelling requirements shall be as recommended by the manufacturer:
- (a) **The marking "CNG" and/or "LNG";**
 - (b) **Working pressure [MPa]."**

Paragraphs 24.1. and 24.2., amend to read:

- "24.1. As from the official date of entry into force of the ~~0204~~ series of amendments to this Regulation, no Contracting Party applying this Regulation shall refuse to grant or refuse to accept type approval under this Regulation as amended by the ~~0204~~ series of amendments.
- 24.2. As from ~~6042~~ months after the date of entry into force of the ~~0204~~ series of amendments to this Regulation, Contracting Parties applying this Regulation shall grant approvals only if the type of components to be approved meets the requirements of Part I of this Regulation as amended by the ~~0204~~ series of amendments to this Regulation."

Paragraph 24.3., shall be deleted:

Paragraphs 24.4. to 24.7. (*former*), renumber as paragraphs 24.3. and 24.6., and amend to read:

- "24.3. As from ~~6048~~ months after the date of entry into force of the ~~0204~~ series of amendments to this Regulation, Contracting Parties applying this Regulation shall grant approvals only if the vehicle type to be approved meets the requirements of Part II of this Regulation as amended by the ~~0204~~ series of amendments to this Regulation.
- 24.4. Until ~~6042~~ months after the date of entry into force of the ~~0204~~ series of amendments to this Regulation, Contracting Parties applying this Regulation can continue to grant type approvals for the type of components to **the 01 series of amendments** to ~~the original version of~~ this Regulation without taking into account the provisions of the ~~0204~~ series of amendments.
- 24.5. Until ~~6048~~ months after the date of entry into force of the ~~0204~~ series of amendments to this Regulation, Contracting Parties applying this Regulation can continue to grant type approvals for the vehicle type to **the 01 series of amendments** to ~~the original version of~~ this Regulation without taking into account the provisions of the ~~0204~~ series of amendments.

24.6. Notwithstanding the provisions of paragraphs ~~24.4.24.5.~~ and ~~24.5.24.6.~~, Contracting Parties applying this Regulation shall not refuse to grant extensions of type approvals for existing types of component or vehicle types which have been issued according to this Regulation without taking into account the provisions of the ~~0201~~ series of amendments to this Regulation."

Insert a new paragraph 24.7., to read:

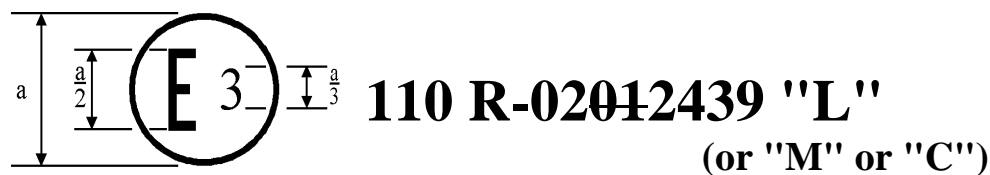
"24.7. Notwithstanding the transitional provisions above, Contracting Parties whose application of this Regulation comes into force after the date of entry into force of the most recent series of amendments are only obliged to accept type approval granted in accordance with the 01 series of amendments."

Annex 2A, amend to read:

"Annex 2A

Arrangement of the CNG/LNG component type approval mark

(See paragraph 7.2. of this Regulation)



$a \geq 8 \text{ mm}$

The above approval mark affixed to the CNG and or LNG component shows that this component has been approved in Italy (E 3), pursuant to Regulation No. 110 under approval number ~~0201~~2439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. 110 as amended by the ~~0201~~ series of amendments.

The letter "L" indicates that the product is suitable for use with LNG.

The letter "M" indicates that the product is suitable in moderate temperatures.

The letter "C" indicates that the product is suitable in cold temperatures. "

Annex 2C, amend to read:

"Annex 2C

Arrangement of approval marks

Model A

(See paragraph 17.2. of this Regulation)



$a \geq 8 \text{ mm}$

The above approval mark affixed to a vehicle shows that the vehicle has, with regard to the installation of CNG/LNG system for the use of natural gas for propulsion, been approved in Italy (E 3), pursuant to Regulation No. 110 under approval number ~~0201~~2439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. 110 as amended by the ~~0201~~ series of amendments.

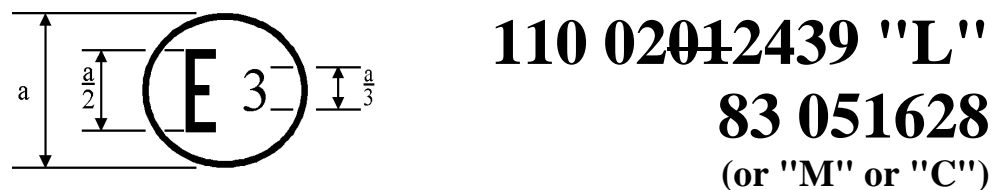
The letter "L" indicates that the product is suitable for use with LNG.

The letter "M" indicates that the product is suitable in moderate temperatures.

The letter "C" indicates that the product is suitable in cold temperatures.

Model B

(See paragraph 17.2. of this Regulation)



$a \geq 8 \text{ mm}$

The above approval mark affixed to a vehicle shows that the vehicle has, with regard to the installation of CNG/LNG system for the use of natural gas for propulsion, been approved in Italy (E 3), pursuant to Regulation No. 110 under approval number ~~0201~~2439. The first two digits of the approval number indicate that at the date the approval was granted in accordance with the requirements of Regulation No. 110 as amended by the ~~0201~~ series of amendments and that Regulation No. 83 included the 05 series of amendments.

The letter "L" indicates that the product is suitable for use with LNG.

The letter "M" indicates that the product is suitable in moderate temperatures.

The letter "C" indicates that the product is suitable in cold temperatures."

Annex 3, paragraph 1.1., amend to read:

- "1.1. Annex 3A sets out minimum requirements for light-weight refillable gas cylinders. The cylinders are intended only for the on-board storage of high pressure compressed natural gas as a fuel for automotive vehicles to which the cylinders are to be fixed. Cylinders may be of any steel, aluminium or non-metallic material, design or method of manufacture suitable for the specified service conditions. This annex also covers stainless steel metal liners of seamless ~~or welded~~ construction. "

Annex 3A

Paragraphs 6.3.2.4. and 6.3.2.5., shall be deleted.

Paragraph 6.3.2.6. (former), renumber as paragraph 6.3.2.4. and amend to read:

"6.3.2.4. Sulphide stress cracking resistance

The ultimate tensile strength of the steel from a finished cylinder shall not exceed 1,200 MPa. If the upper limit of the specified tensile strength for the steel exceeds 950 MPa, the steel from a finished cylinder shall be subjected to a sulphide stress cracking resistance test in accordance with Appendix A to this annex, paragraph A.3. and meet the requirements listed therein."

Table 6.1, amend to read:

"Table 6.1

Material design qualification test

	<i>Relevant paragraph of this annex</i>				
	<i>Steel</i>	<i>Aluminium</i>	<i>Resins</i>	<i>Fibres</i>	<i>Plastic liners</i>
Tensile properties	6.3.2.2.	6.3.3.4.		6.3.5.	6.3.6.
Impact properties	6.3.2.3.				
Bending properties	6.3.2.4.				
Weld examination	6.3.2.5.				
Sulphide stress cracking resistance	6.3.2.4. 6.3.2.6.				
Sustained load crack resistance		6.3.3.3.			
Stress corrosion cracking		6.3.3.2.			
Shear strength			6.3.4.2.		
Glass transition temperature			6.3.4.3.		
Softening/Melting temperature					6.3.6.
Fracture mechanics*	6.7.	6.7.			

* Not required if flawed cylinder test approach in paragraph A.7. of Appendix A to this annex is used ."

Annex 3A - Appendix A

Paragraphs A.1. and A.2., amend to read:

"A.1. Tensile tests, steel and aluminium

A tensile test shall be carried out on the material taken from the cylindrical part of the finished cylinder using a rectangular test piece shaped in accordance with the method described in ISO 9809 for steel and ISO 7866 for aluminium. ~~For cylinders with welded stainless steel liners, tensile tests shall be also carried out on material taken from the welds in accordance with the method described in paragraph 8.4. of EN 13322-2.~~ The two faces of the test pieces representing the inside and outside surface of the cylinder shall not be machined. The tensile test shall be carried out in accordance with ISO 6892.

NOTE - Attention is drawn to the method of measurement of elongation described in ISO 6892, particularly in cases where the tensile test piece is tapered, resulting in a point of fracture away from the middle of the gauge length.

A.2. Impact test, steel cylinders and steel liners

The impact test shall be carried out on the material taken from the cylindrical part of the finished cylinder on three test pieces in accordance with ISO 148. The impact test pieces shall be taken in the direction as required in Table 6.2 of Annex 3A from the wall of the cylinder. ~~For cylinders with welded stainless steel liners, impact tests shall be also carried out on material taken from the weld in accordance with the method described in paragraph 8.6. of EN 13322-2.~~ The notch shall be perpendicular to the face of the cylinder wall. For longitudinal tests the test piece shall be machined all over (on six faces), if the wall thickness does not permit a final test piece width of 10 mm, the width shall be as near as practicable to the nominal thickness of the cylinder wall. The test pieces taken in transverse direction shall be machined on four faces only, the inner and outer face of the cylinder wall unmachined."

Paragraph A.28., shall be deleted.

II. Justification

Ad paragraph 2. (References), paragraph 8. (Specifications on CNG and/or LNG components), paragraph 8.2.2., Annex 3, paragraph 1.1., Annex 3A, paragraphs 6.3.1., 6.3.2.4. and 6.3.2.5. and Annex 3A – Appendix A, paragraphs A.1., A.2. and A.28.:

1. The main drawback of welded metal cylinders relates to fatigue. It is very difficult to eliminate defects of welding and inspection technology or its application may not be adequate to identify infinitesimal defects in the welding. As both the production and quality control of welded metal cylinders are extremely difficult, welded metal cylinders with an operating pressure of 20 MPa should be removed from the scope of UN Regulation No. 110 to ensure that no unsafe CNG cylinder of this type enters the market as fuel storage system on vehicles, subject to enforcement of this amendment to UN Regulation No. 110.

2. According to Japanese research, there is currently no manufacturer in the world of welded metal cylinders for CNG vehicles. Thus, there is no constraint for manufacturers and their products if welded metal cylinders are removed from this Regulation.

Ad Annex 3A, paragraph 6.3.2.6.:

3. The presence of water or high humidity may cause deteriorations of strength (delayed fractures) of high-strength steel. Reports indicate that high-strength steel with a tensile strength of more than 1,200 MPa often results in a conspicuous deterioration of strength (see informal document GRSG-107-09 and GRSG-107-37). Accordingly, in highly humid regions the risk of delayed fracture increases due to the increased exposure of cylinders to moisture.

4. UN Regulation No. 110 requires sulphide stress cracking resistance test for CNG-1 and CNG-2 cylinders using high-strength steel with a tensile strength of more than 950 MPa. But there is no upper requirement for tensile strength.

5. For steel cylinders (CNG-1 cylinder) and steel liner cylinders (CNG-2 cylinder) built with high-strength steel, setting an upper limit of tensile strength should be required to ensure safety so that they could be considered suitable for the use in environments with high humidity.

Ad paragraphs 6.3., 6.4., 6.5., 6.6. and 18.1.8.4.:

6. An accident in Japan causing one fatality and one serious injury happened during the scrapping work of a CNG cylinder in September, 2012. The cylinder was displaced by the Tsunami caused by the Great East Japan Earthquake.

7. As the market for NGVs expands, the number of scraping works of CNG cylinders will increase in future. Therefore, some marking measures should be required to ease the identification of such kind of gas cylinder. So workers can take proper safety precautions to avoid accidents and injuries.

8. Furthermore, the number of compressed hydrogen gas (CHG) cylinder accessories will increase in the future. In order to prevent CNG accessories from being fitted improperly to CHG cylinders, accessories should be marked with certain data as a minimum requirement. The above-mentioned consideration should be made for LNG tank accessories as well.

9. For further reference, all cylinders/tanks, accessories fitted to the cylinder/tank and fill receptacles must be marked in Japan with the following information:

Cylinder/tank (Engraving and the following data):

- (a) The marking "CNG" and/or "LNG";
- (b) Pressure;
CNG: Working pressure [MPa]
LNG: Test pressure [MPa]
- (c) Symbol for name of inspection institute;
- (d) Name or symbol of manufacturer;
- (e) Type of cylinder/tank;
CNG: V1, V2, V3 or V4
LNG: VL
- (f) Model number and serial number;
- (g) Internal volume [L];
- (h) Date of inspection;
- (i) Date of removal from service;

- (j) (Composite cylinder) Depth of Cylinder (DC) [mm];
- (k) (Composite cylinder) Depth of Dome (DD) [mm];
- (l) Name of the person who installed;
- (m) Installed day;
- (n) Serial number of vehicle.

Accessories fitted to the cylinder/tank (Engraving and the following data):

- (a) The marking "CNG" and/or "LNG";
- (b) Pressure;
CNG: Working pressure [MPa]
LNG: Test pressure [MPa]
- (c) Date of inspection;
- (d) Symbol for name of inspection institute;
- (e) Name or symbol of manufacturer;
- (f) Model number and serial number;
- (g) Mass [kg];
- (h) Test pressure [MPa];
- (i) Type of accessories;
CNG: CNGV
LNG: LNGV

Fill receptacle:

- (a) The marking "CNG" and/or "LNG";
 - (b) Number of installed cylinder/tank;
 - (c) Date of removal from service;
 - (d) Validity period of inspection;
 - (e) Pressure;
CNG: Working pressure [MPa]
LNG: Test pressure [MPa]
 - (f) Serial number of vehicle.
-