United Nations ECE/TRANS/WP.29/GRSG/2014/27

Economic and Social Council

Distr.: General
18 July 2014

Original: English

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Working Party on General Safety Provisions

107th session
Geneva, 30 September–3 October 2014
Item 9 of the provisional agenda
Regulation No. 110 (CNG/LNG vehicles)

Proposal for Supplement 3 to the 01 series of amendments to Regulation No. 110 (CNG/LNG vehicles)

Submitted by the experts from the Netherlands and the Natural Gas Vehicles Global *

The text reproduced below was prepared by the experts from the Netherlands and the International Association for Natural Gas Vehicles (IANGV/NGV Global), to introduce a new class of CNG components (Class 6) operating at a higher pressure. The modifications to the current text of Regulation No. 110 are marked in bold for new 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 3., insert a new class and amend Figure 1-1 and Figure 1-2, to read:

"3. Classification of components

Class 0 High pressure parts including tubes and fittings containing CNG at a pressure higher than 3 MPa and up to 26 MPa.

…

Class 5 Parts in contact with temperature range extending below -40 °C.

Class 6 High pressure parts including tubes and fittings containing CNG, excluding CNG containers, at a pressure higher than 26 MPa.

A component can consist of several parts, each part classified in its own class with regard to maximum working pressure and function.

…

Figure 1-1
Flow scheme for CNG and/or LNG components classification

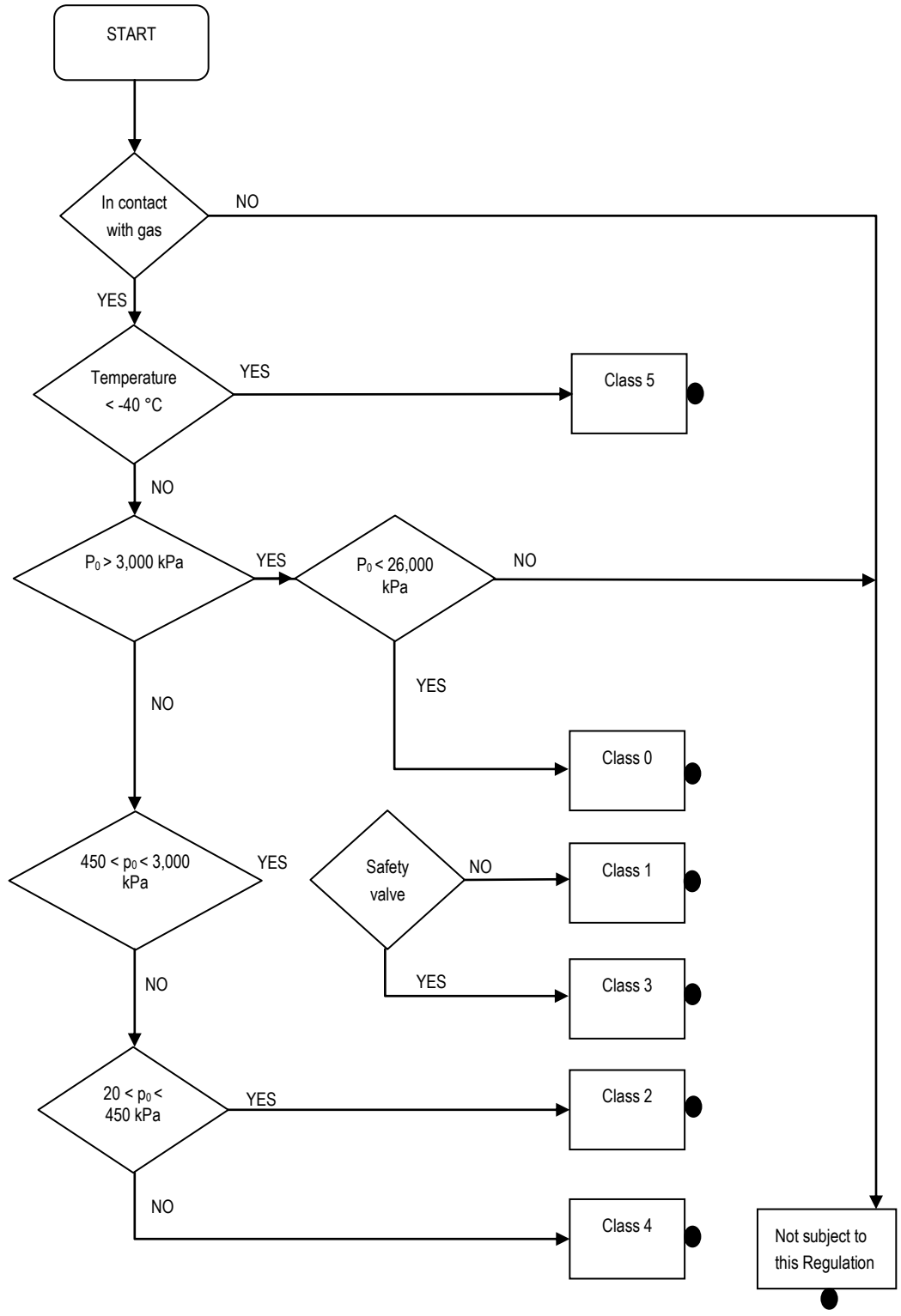

Figure 1-2
Test applicable to specific classes of components (excluding CNG cylinders and LNG tank)

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

"

Part I, paragraph 11.3., amend to read:

"11.3. Every flexible fuel line assembly that is applied in the high and medium pressure (Class 0, 1, 5 **and 6**) according to the Classification as described in paragraph 3 of this Regulation, shall be tested at the pressure twice the working pressure."

Part II, paragraph 18.7.2., amend to read:

"18.7.2. The CNG rigid fuel line may be replaced by a flexible fuel line if used in Class 0, 1, ~~or~~ 2 **or 6**."

Annex 4A,

Insert new paragraph 4.2.2., to read:

"**4.2.2. The pressure relief valve and pressure relief device in Class 6 shall be so designed as to withstand a pressure of 1.5 times the working pressure (MPa) with the outlet closed off.**"

Paragraphs 4.2.2. (former) to 4.2.5., renumber as paragraphs 4.2.3. to 4.2.6.

Insert new paragraph 4.2.7., to read:

"**4.2.7. The pressure relief valve of Class 6 shall be so designed to operate at temperatures as specified in Annex 5O.**"

Insert new paragraphs 6.2. and 6.3., to read:

"**6.3. The manual valve device in Class 6 shall be designed to withstand a pressure of 1.5 times the working pressure.**

6.4. The manual valve device in Class 6 shall be designed to operate at temperatures as specified in Annex 5O."

Paragraph 6.3. (former), renumber as paragraphs 6.5.and amend to read:

"6.~~3~~**5**. Manual valve device requirements

One specimen shall be submitted to a fatigue test at a pressure cycling rate not to exceed 4 cycles per minute as follows: held at 20 °C while pressured for 2,000 cycles between 2 MPa and 26 MPa **(for Class 0) or between 2 MPa and declared working pressure (for Class 6)**."

Paragraph 7.2.2., amend to read:

"7.2.2. The burst pressure **of the PRD (pressure triggered) of Class 0** shall be 34 MPa ± 10 per cent at ambient temperature and at the maximum operating temperature as indicated in Annex 5O."

Insert new paragraphs 7.2.3. and 7.2.4., to read:

"**7.2.3. The PRD (pressure triggered) of Class 6, shall be so designed to operate at temperatures as specified in the Annex 5O.**

7.2.4. The burst pressure of the PRD (pressure triggered) of Class 6 shall be at least 1.5 times working pressure at ambient temperature and at the maximum operating temperature as indicated in Annex 5O."

Paragraph 7.4.2.2.2., amend to read:

"7.4.2.2.2. At the completion of the test, the **Class 0** PRD (pressure triggered) burst pressure shall be 34 MPa ± 10 per cent at ambient temperature and at the maximum operating temperature as indicated in Annex 5O."

Insert new paragraph 7.4.2.2.3., to read:

"**7.4.2.2.3. At the completion of the test, the Class 6 PRD (pressure triggered) burst pressure shall be at least 1.5 times working pressure at ambient temperature and at the maximum operating temperature as indicated in Annex 5O.**"

Annex 4B,

Paragraph 0., amend to read:

"0. The purpose of this annex is to determine the provisions regarding the approval of flexible hoses for use with CNG or LNG.

…

(a) High pressure hoses (Class 0**, Class 6**);

(b) Medium pressure hoses (Class 1);

(c) Low pressure hoses (Class 2);

(d) LNG hoses (Class 5)."

Paragraph 1., amend to read:

"1. High pressure hoses, Class 0 **and Class 6** classification"

Paragraph 1.7.2.1., amend to read:

"1.7.2.1. The test has to be completed with circulating oil having a temperature of 93 °C, and a minimum pressure of 26 MPa **(Class 0) or declared working pressure (Class 6).**"

Paragraph 1.8.1.4., amend to read:

"1.8.1.4. **For Class 0,** the identification-marking "CNG Class 0"~~.~~**, for Class 6 the identification-marking "CNG Class 6"**."

Annex 4C,

Insert new paragraph 2.2.2., to read:

"**2.2.2. Class 6: The CNG filter shall be so designed to withstand a pressure of 1.5 times the working pressure (MPa).**"

Paragraphs 2.2.2. (former) to 2.2.3., renumber as paragraphs 2.2.3. to 2.2.4.

Annex 4D,

Paragraph 2.3., amend to read:

"2.3. The component shall comply with the test procedures provided for in Class 0 **or Class 6** for the parts subject to high pressure and Class 1, 2, 3 and 4 for the parts subject to medium and low pressure."

Insert new paragraphs 3.2. to 3.2.3.5., to read:

"**3.2. The part of the pressure regulator which is in contact with pressure higher than 26 MPa is regarded as Class 6.**

3.2.1. The Class 6 part of the pressure regulator shall be leak-proof (see Annex 5B) at a pressure up to 1.5 times the working pressure (MPa) with the outlet(s) of that part closed off.

3.2.2. The Class 6 part of the pressure regulator shall withstand a pressure up to 1.5 times the working pressure (MPa).

3.2.3. The part of the pressure regulator that is in contact with pressure below 26 MPa is classified as per Part I, Section 3, of this Regulation.

3.2.3.1. The Class 0 part of the pressure regulator shall be leak-proof (see Annex 5B) at a pressure up to 1.5 times the working pressure (MPa) with the outlet(s) of that part closed off.

3.2.3.2. The Class 0 part of the pressure regulator shall withstand a pressure up to 1.5 times the working pressure (MPa).

3.2.3.3. The Class 1 and Class 2 part of the CNG pressure regulator shall be leak-proof (see Annex 5B) at a pressure up to twice the working pressure.

3.2.3.4. The Class 1 and Class 2 part of the CNG pressure regulator shall withstand a pressure up to twice the working pressure.

3.2.3.5. The Class 3 part of the CNG pressure regulator shall withstand a pressure up to twice the relief pressure of the pressure relief valve, on which it is subject."

Paragraph 3.2. (former), renumber as paragraph 3.3.

Annex 4E,

Insert new paragraphs 3.1.4. to 3.1.6., to read:

"**3.1.4. The part of the CNG pressure and temperature sensors which is in contact with pressure higher than 26 MPa is regarded as Class 6.**

3.1.5. **The Class 6 part of the CNG pressure and temperature shall be leakproof at a pressure up to 1.5 times the working pressure (MPa) (see Annex 5B).**

3.1.6. **The Class 6 of the CNG pressure and temperature sensors shall withstand a pressure up to 1.5 times the working pressure (MPa).**"

Paragraphs 3.1.3. to 3.1.5. (former), renumber as paragraphs 3.1.7. to 3.1.9.

Annex 4G, insert new paragraphs 2.3.3. to 2.3.4., to read:

"**2.3.3.** **The CNG gas injector or fuel rail of Class 6 shall withstand a pressure 1.5 times the declared working pressure.**

2.3.3.1. **The CNG gas injector or fuel rail of Class 6 shall be free from leakage at a pressure 1.5 times the declared working pressure.**

2.3.4. **The CNG gas injector or fuel rail of Class 6 shall be shall be so designed to operate at temperatures as specified in Annex 5O.**"*Annex 5, Table 5.1*, 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

"

Annex 5A, Table 5.2, amend to read:

"Table 5.2

Classification of component	*Working pressure [kPa]*	*Overpressure [kPa]*
Class 0	3,000 < p < 26,000	1.5 times the working pressure
Class 1	450 < p < 3,000	1.5 times the working pressure
Class 2	20 < p < 450	2 times the working pressure
Class 3	450 < p < 3,000	2 times the relief pressure
Class 5	as specified by the manufacturer	1.5 times the working pressure
Class 6	**as specified by the manufacturer**	**1.5 times the working pressure**

"

II. Justification

1. New technologies emerging on the market perform High Pressure Direct Injection (HPDI) of natural gas in a diesel-like cycle. Experience has shown that a minimum of 30 MPa fuel pressure is needed at the injector for acceptable performance. HPDI engines have over 10 years' experience in operating natural gas engines in North America and certifying them to standards of the United States of America Environmental Protection Agency. There are environmental benefits in reduced emissions and engines that work at higher efficiencies.

2. The intent of this amendment is to introduce a new class of CNG components (Class 6) operating at pressure higher than 26 MPa to accommodate the HPDI engines. The maximum fuel storage pressure will be unchanged at 26 MPa. Class 6 components, as amended, would fulfil with all the specified testing requirements of the other Classes 0 to 5.

3. Spark-ignited (SI) natural gas engines mix fuel with air at low pressure in the intake system. Engine load is controlled by a throttle – similar to a gasoline engine. To achieve the benefits of diesel-like engines, the natural gas must be injected directly to the cylinder at high pressure to overcome the cylinder pressure and deliver the full quantity within a short duration.

4. An LNG vehicle using HPDI technology has on board LNG storage at maximum 1.6 MPa, and has a pump that raises the pressure of the natural gas to a working pressure of 31 MPa. The components downstream of the pump operate at this pressure. To put this in perspective, a truck diesel engine operates with the injection pressure in the range of 200 to 250 MPa and passenger vehicles operate under or up to approximately 200 MPa.

5. The new Class 6 components allow new technologies using HPDI being certified and introduced to the market.