

## Proposal for amendments to UN Regulation No. 110

The text reproduced below has been prepared by the experts from NGV Global to introduce certain change of design criteria in Annex 3 of R.110. For the sake of clarity and readability the modifications to the current text of the Regulation are highlighted in yellow for new additions (underlined) and deleted characters are highlighted in green with strikethrough.

### I. Proposal

Annex 3A: Table 6.7 Change of Design

Design change	Type of test												
	Burst hydrostatic A.12	Cycling ambient temp A.13	Acid environment A.14	Bonfire A.13	Penetration A.16	Flow Tolerance A.17	High temp creep A.18	Stress rupture A.19	Drop test A.20	Permeation A.21	Boss Torque A.25	Cycling A.27	PRD Performance A.24
Fibre manufacturer	X	X					<del>X</del>	X*	X*	<del>X†</del>	<del>X†</del>	<del>X†</del>	
Metallic cylinder or metal liner material	X	X	X*	X	X*	X	X*	X*	X*				
Plastic liner material		X	X				X			X†	X†	X†	
Fibre material	X	X	X	X	X	X	X	X	X	<del>X†</del>	<del>X†</del>	<del>X†</del>	
Resin material			X		X	X	X	<del>X</del>	<del>X</del>				
Diameter change ≤ 20 per cent	X	X											
Diameter change > 20 per cent	X	X		X	X*	X			<del>X</del>				
Length change ≤ 50 per cent	X			X†									
Length change > 50 per cent	X	X		X†					<del>X</del>				
Working pressure	X	X											

change ≤ 20 per cent @													
Dome shape	X	X								X†	X†	X†	
Opening size	X	X											
Coating change			X										
End boss design										X†	X†	X†	
Change in manufacturing Process	X	X											
Pressure relief device				X									X

X=required

\* test not required on metal (CNG) designs

† Test only required on all composite (CNG-4) designs

‡ Test only required when length increases

@ Only when thickness changes proportional to diameter and/or pressure change

## II. Justification

This proposal is intended to incorporate changes/additions in the Change of Design Table to better specify appropriate test requirements for CNG cylinders with composite materials and, in some cases, to harmonize with ISO 11439.

**Separation of columns:** The existing table combines A.18, A.19 and A.20 into one column; also A.21, A.25 and A.27 into a single column. This proposed amendment separates the tests into their own columns for improved clarity so that each of them can be seen individually as it relates to their appropriate Design Change row.

The rest of the proposed changes from the Design Change column are indicated below with the justification for specific changes (additions or deletions).

### For fibre manufacturer:

- There will be no change in high temperature creep performance for change in fiber manufacturer. This test is intended to test for creep for resin and liner materials and for residual manufacturing stresses in them. Harmonizes with ISO 11439. [deleted]
- There will be no change in permeation performance. Fiber has no effect on permeation. Permeation resistance is provided by the liner. Harmonizes with ISO 11439. [deleted]
- There will be no change in boss torque performance. This is more an issue with the boss material and its physical configuration. Fiber is insignificant in boss torque performance and a change in fiber manufacturer will have no effect. Harmonizes with ISO 11439. [deleted]

- There will be no change in gas cycling performance for a Type 4 due to change in fiber manufacturer. Harmonizes with ISO 11439. [deleted]

**For metallic cylinder or liner material:**

- Clarification that “metallic” applies both to cylinders and liners. [added]

**For plastic liner material:**

- Added high temperature creep test. Plastic liner materials may be affected by high temperatures and are subject to the high temperature creep test at qualification. It is logical to conduct the high temperature creep test when the plastic liner material changes. Harmonizes with ISO 11439. [added]

**For fiber material:**

- There will be no change in permeation performance. Fiber has no effect on permeation. The resin matrix microcracks and allows gas that permeates through the liner to pass through the composite easily. Harmonizes with ISO 11439. [deleted]
- There will be no change in boss torque performance. Fiber is insignificant in boss torque performance. This is more an issue with the boss material and its physical configuration. Harmonizes with ISO 11439. [deleted]
- A change in fiber material will not affect gas cycling. The ambient cycling test will address any fatigue issues. [deleted]

**For resin material:**

- Stress rupture is primarily a fiber issue. Harmonizes with ISO 11439. [deleted]
- Drop test is primarily a fiber issue. The performance should not change as long as the resin type (i.e. thermoset vs. thermoplastic) does not change. Harmonizes with ISO 11439. [deleted]

**For length change > 50 percent:**

- Change in length could have significant influence on drop test performance. Harmonize with ISO 11439. [added]

**For dome shape change:**

- Change in dome shape will not affect permeation. Permeation is a liner material issue. Harmonizes with ISO 11439. [deleted]
- Change in dome shape will not affect boss torque. Boss torque is primarily a boss material issue, secondarily dependent on the boss physical configuration (boss/liner/composite interface). Harmonizes with ISO 11439. [deleted]
- Change in dome shape will not affect gas cycling. The ambient cycling test will address any fatigue issues. Harmonizes with ISO 11439. [deleted]