

## **ECE R110 Annex 3 & ISO 11439**

**“High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles”**

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**CSA  
Group**

## Craig Webster:

- Founder of worlds' largest high pressure test facility at Powertech Labs (Vancouver) for CNG and hydrogen fuel cylinders (began in 1983)
- Convener (since 1996) of ISO TC 58/SC 3/WG 17 for the ISO 11439 standard for CNG fuel cylinders
- Test many cylinder designs to ECE R110 Annex 3, as well as ISO 11439 and other standards

## ISO 11439:

- ISO/DIS 11439 created in 1998 for industry review
- ISO/DIS 11439 used by ECE R110 as basis of Annex 3
- ISO/DIS 11439 changed by WG 17 and published as ISO 11439: 2000

There were significant technical differences between ISO/DIS 11439 and the published ISO 11439 standard = differences between ECE R110 and ISO 11439 today.

# ECE R110 Annex 3 – Industry concerns



For a global CNG vehicle market, manufacturers are concerned they must conduct multiple tests to meet both ECE R110 and ISO 11439 requirements

Manufacturers are also concerned that Annex 3 of the ECE R110 regulation and ISO 11439 are being changed independently of each other

- ISO 11439: 2103 contains large revisions to Change of Design tables

The ISO/DIS 11439 version used in Annex 3 contained technical errors

- Some errors corrected by ECE R110 publishing supplements

ECE R110 Annex 3 was also changed to allow use of welded stainless steel as cylinder liner materials

ECE R110 Annex 3 requires 26 changes/deletions to the referenced standards to update to latest versions or to adopt correct requirements

# ECE R110 vs ISO 11439 – Examples of test differences



In testing cylinder designs for CNG service, I must perform additional tests for manufacturers to accommodate ECE R110 requirements, compared to those of ISO 11439

Test	ECE R110 Annex 3	ISO 11439:2013
Bonfire	2 cylinders	1 cylinder
Environmental	Acid Test	Multiple Environment Tests
Natural Gas Cycling	300 pressure cycles	1 000 pressure cycles
PRD testing	A.24 test	Requires ISO 15500-3 compliance
Tensile Testing of Plastics	Wrong standard referenced (ISO 3628 for photography)	ISO 527-2
Boss Torque test	Apply 500 Nm	Apply 150% of manufacturers' recommended torque

# ECE R110 Annex 3 – Examples of technical concerns

## Allows use of stainless steel cylinder liners

- not allowed in ISO 11439 - no-one has ever made a stainless steel cylinder liner for CNG service – would it be safe?
- Are the heat affected zones of stainless welds resistant against sulphide stress cracking in CNG environments? (there is no weld test in ECE R110 for SSC)

## Requires only 300 cycles in the natural gas pressure cycling test

- ISO 11439 requires 1 000 natural gas pressure cycles (300 found inadequate)

## Allows use of pressure-activated PRDs

- ISO 11439 considers pressure-activated PRDs unsafe as allows leak path, and prone to premature failure (overpressure protection provided by fueling station PRV)

## Uses an inferior environmental test for automotive service conditions

- Test in A.14 of Annex 3 only has 1 chemical environment and simple test conditions, compared to ISO 11439 with 5 environments and a complex test protocol

## Coating tests cannot be performed

- Tests in A.9 of Annex 3 cannot be performed because the wrong standards are referenced for both the adhesion and the sunlight exposure tests

ECE R110 (2013) contains 149 pages

- 55 pages are in Annex 3 for CNG cylinder design
- This means over 1/3 of the ECE R110 regulation deals with the requirements for CNG cylinders!

ECE R110 already references the use of ISO standards throughout the regulation:

- 19 ISO standards referenced in Annex 3
- 10 ISO standards are referenced for hose testing in Annex 4B
- Various ISO standards referenced in Annex 4F and in Annex 5 for test methods

# Proposal for ECE R110 Annex 3



Currently the entire ISO 11439 requirements are copied into Annex 3 of ECE R110, and changes have been allowed that are not examined by a Working Group of experts

Considering that:

- ECE R110 already references ISO standards in its text
- Annex 3 (requirements for CNG cylinders) occupies over 1/3 of the ECE R110 regulation
- High pressure cylinders is a subject matter that requires expert understanding and review of issues

For public safety, it is proposed that ECE R110 Annex 3 simply reference the use of the ISO 11439 standard for CNG cylinders.