

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.