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AMENDMENT 1

Gas cylinders — High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles

AMENDMENT 1

Bouteilles à gaz — Bouteilles haute pression pour le stockage de gaz naturel utilisé comme carburant à bord des véhicules automobiles
AMENDEMENT 1

PROOF/ÉPREUVE

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 3, *Cylinder design,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 23, *Transportable gas cylinders,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Gas cylinders — High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles

AMENDMENT 1

Clause 2

Remove the dates from the following normative references in Clause 2 and where they are cited in the document text:

ASTM D1308, *Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes*

ASTM D2794, *Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)*

ASTM D3170, *Standard Test Method for Chipping Resistance of Coatings*

ASTM G154, *Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials*

NACE/TM 0177, *Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking and Stress Corrosion Cracking in H2S Environments*

7.5.2.2 c)

Add a sentence to the end of the paragraph in item c) as follows:

The actual tensile strength of the steel according to A.1 shall not exceed the value obtained by more than 5 % on the samples tested for sulfide stress cracking resistance.

7.6.2.1

Delete list item 4) and renumber list item 5) as 4).

8.2.3.1

Replace the second paragraph with the following:

The glass transition temperature of the resin material shall be determined in accordance with ASTM D3418, and shall not be less than 102 °C.

8.5.2.2 c)

Add a sentence to the end of the paragraph in item c) as follows:

The actual tensile strength of the steel according to A.1 shall not exceed the value obtained by more than 5 % on the samples tested for sulfide stress cracking resistance.

8.5.2.11

Replace the paragraph with the following:

In designs where glass or aramid fibre has a load sharing application, one cylinder shall be tested in accordance with A.18.

8.6.2.1

Delete list item b) 4).

9.2.3.1

Replace the final sentence with the following:

The glass transition temperature of the resin material shall be determined in accordance with ASTM D3418, and shall not be less than 102 °C.

9.4.5

In the first paragraph, correct the name of the test from "acid environment" to "environmental", as follows:

The exterior of cylinders shall meet the requirements of the environmental test described in A.14.

9.5.2.2 c)

Add a sentence to the end of the paragraph in item c) as follows:

The actual tensile strength of the steel according to A.1 shall not exceed the value obtained by more than 5 % on the samples tested for sulfide stress cracking resistance.

9.5.2.11

Replace the paragraph with the following:

In designs where glass or aramid fibre has a load sharing application, one cylinder shall be tested in accordance with A.18.

9.6.2

Delete list item d).

10.2.2

Replace the second paragraph with the following:

The glass transition temperature of the resin material shall be determined in accordance with ASTM D3418, and shall not be less than 102 °C.

10.5.2.10

Replace the paragraph with the following:

In designs where glass or aramid fibre has a load sharing application, one cylinder shall be tested in accordance with A.18.

A.6

Replace the first paragraph with the following:

Three finished cylinders shall be pressure cycled between less than or equal to 20 bar and greater than or equal to 1,5 × working pressure, at a rate not exceeding 10 cycles per minute in accordance with A.13.

A.7

Replace list items a), b) and d) with the following:

a) Condition for more than 48 h at zero pressure, 65 °C or higher, and 95 % or greater relative humidity. The intent of this relative humidity requirement shall be deemed met by spraying with a fine spray or mist of water in a chamber held at a minimum 65 °C.

b) Hydrostatically pressurize for 500 cycles multiplied by the specified service life in years between less than or equal to 20 bar and greater than or equal to 260 bar at 65 °C or higher, and 95 % or greater relative humidity.

d) Pressurize from less than or equal to 20 bar to greater than or equal to 200 bar for 500 cycles multiplied by the specified service life in years at −40 °C or lower. Adequate recording instrumentation shall be provided to ensure the minimum temperature of the fluid is maintained during the low temperature cycling. At no time during the pressure cycling shall the fluid be warmer than −40 °C.

Add a sentence at the end of the second paragraph:

All temperature, pressure and relative humidity values shall be recorded at least every 6 s. Cycles that fall outside the limits of the pressure, humidity and temperature values shall be discounted from the total requirement.

A.9

Add a paragraph at the beginning of A.9 as follows:

These tests are intended to validate a coating system that can be used for the same coating on other designs. An optional corrosion test is provided in Annex H.

A.10

Replace the first paragraph with the following:

This test is for the design qualification and production testing of cylinders only. It is not for the purpose of in-service inspection. Type 4 designs shall be leak tested by:

Replace list item b) with the following:

b) pressurizing the cylinders to working pressure with compressed natural gas, or nitrogen containing a detectable gas such as helium.

A.13

Replace list item b) with the following:

b) cycling the pressure in the cylinder from less than or equal to 20 bar and greater than or equal to 1,3 times working pressure at a rate not exceeding 10 cycles per minute.

A.14.5

Replace the paragraph with the following:

The cylinder shall be hydraulically pressure cycled between less than or equal to 20 bar and greater than or equal to 260 bar for a total of 3 000 cycles. The maximum pressurization rate shall be 27,5 bar per second. After pressure cycling, the cylinder shall be pressurized to 260 (+10) bar and held at that pressure a minimum of 24 h and until the elapsed exposure time (pressure cycling and pressure hold) to the environmental fluids equals 48 h.

A.17

Replace the third sentence in the first paragraph with the following:

As a minimum, one flaw shall be a minimum 25 mm long as measured in the base of the cut and a minimum 1,25 mm in depth, and another flaw shall be a minimum 200 mm long as measured in the base of the cut and a minimum 0,75 mm in depth, cut in the longitudinal direction into the cylinder sidewall.

Replace the second paragraph with the following:

The flawed cylinder shall be pressure cycled between less than or equal to 20 bar and greater than or equal to 260 bar at ambient temperature for the design lifetime in years × 1 000 cycles.

A.18

Replace the paragraph with the following:

This test shall be conducted only on cylinders where glass or aramid fibre has a load sharing application. One finished cylinder shall be pressurized to not less than 260 bar and held at a temperature of not less than 100 °C for not less than 200 h. The cylinder shall then meet the requirements of the volumetric expansion test (A.11), the leak test (A.10) and the hydrostatic pressure burst test (A.12).

A.19

Replace the paragraph with the following:

For type 2, 3 and 4 designs only, one cylinder shall be hydrostatically pressurized to 260 (+10) bar at 65 (+10) °C. The temperature shall be measured on the surface of the cylinder. Pressure and temperature shall be recorded at 1 h intervals, or less. The cylinder shall be held at this pressure and temperature for 1 000 h. The cylinder shall then be pressured to burst in accordance with the procedure described in A.12, except that the burst pressure shall exceed 85 % of the minimum design burst pressure.

A.21

Replace the second sentence with the following:

One finished cylinder shall be filled with compressed natural gas to working pressure, placed in an enclosed sealed chamber at ambient temperature, and monitored for leakage for 500 h.

A.26

Replace the first sentence with the following:

Resin materials shall be tested on a sample coupon representative of the composite overwrap in accordance with ISO 14130.

A.27

Replace the second paragraph with the following:

One finished type 4 cylinder shall be pressure cycled using compressed natural gas between equal to or less than 20 bar and equal to or greater than working pressure for 1 000 cycles. The filling time shall not cause the cylinder gas temperature to exceed the defined service conditions.

Add a paragraph at the end of the clause as follows:

The natural gas cycling test is a test of the end boss/plastic liner interface. Once an end boss design has passed the test, the same end boss design can be used in other cylinder designs without the need to repeat the natural gas cycling test.

Annex G

Add a new annex at the end of Annex G as follows:

Annex H
(informative)

Corrosion resistance

H.1 Accelerated cyclic corrosion

All CNG fuel cylinders that are expected to operate in a vehicle underbody or outside the weatherstrip, or whose in-vehicle locations are unknown, shall be exposed to 100 cycles of an accelerated cyclic corrosion test. All CNG fuel cylinders that are expected to operate in service conditions other than these shall be exposed to 20 cycles of an accelerated cyclic corrosion test.

Three samples of the CNG fuel cylinder that are in the final condition intended for service (e.g. coated utilizing the production processing) shall be exposed to an accelerated laboratory corrosion test, under a combination of cyclic conditions (salt solution, various temperatures, humidity and ambient environment). Each sample test piece shall consist of either an entire cylinder or a cylinder section. Cylinder sections, if used, shall be taken from one end of the cylinder, have a parallel length of at least 300 mm, and include a dome and neck section. Each sample shall have all cut edges sealed and protected in an appropriate manner (e.g. Type 2 samples protected by the same resin used in the manufacture). The protective coating on the cylinder samples shall be scribed before the test.

The test method involves 1 % (approximate) complex salt mist applications coupled with high temperature, high humidity and high temperature dry off. One test cycle is equal to 24 h, as illustrated in Figure H.1.

The apparatus used for this test shall consist of a fog/environmental chamber, suitable water supply conforming to ASTM D1193 Type IV, provisions for heating the chamber, and the necessary means of controlling temperature between 22 °C and 62 °C. The apparatus shall include provisions for a supply of suitably conditioned compressed air and one or more nozzles for fog generation. The nozzle or nozzles used for the generation of the fog shall be directed or baffled to minimize any direct impingement on the test samples.

The apparatus shall consist of the chamber design as defined in ISO 6270-2. During “wet-bottom” generated humidity cycles, the testing agency shall verify that visible water droplets are found on the samples to verify proper wetness.

Steam-generated humidity may be used provided the source of water used in generating the steam is free of corrosion inhibitors. During steam-generated humidity cycles, the testing agency shall confirm that visible water droplets are found on the samples to verify proper wetness.

The apparatus for the dry-off stage shall have the ability to obtain and maintain the following environmental conditions: a temperature of 60 °C ± 2 °C (140 °F ± 3,6 °F) and humidity of ≤ 30 % RH. The apparatus shall also have sufficient air circulation to prevent temperature stratification and allow thorough drying of the test samples. The force/impingement from this salt application shall not remove corrosion or damage coatings/paints system of test samples.

