INTERNATIONAL STANDARD

ISO 19078

Second edition
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Gas cylinders — Inspection of the cylinder installation, and requalification of high pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles

Bouteilles à gaz — Inspection de l'installation des bouteilles, et requalification des bouteilles haute pression pour le stockage du gaz naturel, utilisé comme carburant, à bord des véhicules automobiles

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 19078 was prepared by Technical Committee ISO/TC 58, *Gas cylinders*, Subcommittee SC 4, *Operational requirements for gas cylinders*.

This second edition cancels and replaces the first edition (ISO 19078:2006), with the following main technical revisions:

a) The scope clarifies the rework of some types of rejected cylinders;

b) The periodicity of inspection has been removed from this International Standard. The user is referred to the requirements of ISO 11439 for this information;

c) Damage levels and criteria are more clearly defined and better align with ISO 11439;

d) Clause 7.11 was renamed to better clarify its intent;

e) Table 2 includes acceptance and rejection conditions for gas tight housing;

f) Reference to ISO 25760 for valve removal has been added; and

g) Annex A, Inspector qualifications (informative), and Annex F, Composite matrix (informative), were removed.

Introduction

This International Standard sets out requirements regarding the periodic visual examination and inspection of natural gas fuel cylinders installed in vehicles and the condition of their installation. These cylinders are designed to store natural gas at high pressures.

Where there is any conflict between this International Standard and any applicable regulation, the regulation always takes precedence.

Gas cylinders — Inspection of the cylinder installation, and requalification of high pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles

1 Scope

This International Standard specifies the requirements for the inspection, installation and requalification of high pressure cylinders, designed and manufactured in accordance with the requirements of ISO 11439, for the on-board storage of natural gas as a fuel for automotive vehicles.

It provides criteria, in the absence of guidance from the cylinder or vehicle manufacturer, for the acceptance (including any allowed rework) or rejection (including any allowed rework or destruction) of a cylinder and its installation.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11439, *Gas cylinders — High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles*

ISO 15500-13, *Road vehicles — Compressed natural gas (CNG) fuel system components — Part 13: Pressure relief device (PRD)*

ISO 15500-15, *Road vehicles — Compressed natural gas (CNG) fuel system components — Part 15: Gas-tight housing and ventilation hose*

ISO 15501-1, *Road vehicles — Compressed natural gas (CNG) fuel systems — Part 1: Safety requirements*

ISO 15501-2, *Road vehicles — Compressed natural gas (CNG) fuel systems — Part 2: Test methods*

ISO 25760, *Gas cylinders — Operational procedures for the safe removal of valves from gas cylinders*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
abrasion
damage to an area of the cylinder or its installation equipment caused by scraping, wearing, vibration or rubbing away of the material by friction

Note 1 to entry: Abrasion can be the result of many cycles of something rubbing lightly on the surface of the cylinder or its installation equipment, or due to a few cycles, perhaps only one, of heavy rubbing.

3.2
impact
blow to the surface of the cylinder that can significantly damage and/or indent the surface (e.g. cutting, gouging)

Note 1 to entry: Impact can also induce such damage as delaminations, which are not readily apparent through visual examination.

3.3
component
parts that are used directly in conjunction with the installation of the fuel container to include the cylinder, valve, pressure relief device (PRD), vent and mounting

3.4
condemned
cylinder or piece of its installation equipment no longer fit for service and for which repair is not allowed

3.5
crazing
hairline cracking of the resin, giving it an opaque, frosty appearance

3.6
cut
damage caused by a sharp object coming into contact with the cylinder's surface

3.7
delamination
form of composite damage, in which a separation develops between layers of the composite

3.8
destroyed
cylinder or piece of its installation equipment in a state that makes it physically unusable for its purpose

3.9
dome
curved end portion of the cylinder

3.10
external coating
surface treatment applied to the cylinder for environmental protection and/or improved appearance

3.11
gas tight housing
enclosure fitted at any potential leakage points (e.g. cylinder/valve connection or PRD) to collect and vent any leaked gas to outside the vehicle

3.12
helical
winding in the longitudinal and circumferential direction on both the cylindrical and dome regions of the cylinder

Note 1 to entry: The strands of reinforcing fibres are oriented at an angle to the longitudinal axis of the cylinder.

3.13
hoop direction
hoop pattern
winding along the cylindrical portion of the cylinder

Note 1 to entry: The strands of reinforcing fibres are oriented at an angle of nearly 90 degrees to the longitudinal axis of the cylinder.

3.14
inspection body
organization that performs the visual inspection of compressed natural gas (CNG) cylinders used in natural gas vehicles (NGVs)

3.15
inspector
individual who is authorized by an inspection body to perform the visual inspection

3.16
inspection mark
stamp, label or tag placed by an inspector on the cylinder indicating acceptance of the cylinder

3.17
Level 1 damage/condition
minor damage that can occur during normal use

Note 1 to entry: Such damage normally has no adverse effects on the safety of the cylinder and its continued use. Scratched paint or nicks that have no appreciable depth in metal, or similar damage in the composite cylinder paint or resin where there are no visible frayed fibres, are considered to be of this level of damage.

Note 2 to entry: See Table 1.

3.18
Level 2 damage/condition
damage that is more severe than Level 1, but where after repair the cylinder is authorized to return to service, or based upon the recommendations of the manufacturer may be classified as Level 1 or Level 3

Note 1 to entry: See 7.4.3 and Table 1.

3.19
Level 3 damage/condition
damage that requires a cylinder be condemned

Note 1 to entry: A Level 3 condition is such that the cylinder must be rendered unfit for continued service and cannot be repaired.

Note 2 to entry: See Table 1.

3.20
liner
internal container of the cylinder, which sometimes carries pressure, that prevents leakage of gas through the composite cylinder structure

3.21
manufacturer
cylinder maker, unless otherwise stated

3.22
marking
information permanently applied to an item (e.g. stamping and permanent labelling)

3.23
mounting brackets and/or straps
devices used to secure cylinders in a vehicle

3.24
overpressurization
pressurization of the cylinder, which at 15 °C results in a settled pressure that is higher than the working pressure marked on the cylinder, or pressurization of a cylinder to a pressure that is above 26 MPa independent of temperature conditions (for a 20 MPa working pressure cylinder)

3.25
pressure relief device
PRD
device that releases the contained gas in specific emergency conditions in accordance with ISO 15500-13

3.26
reinforcing fibres
continuous fibrous strands in the composite, such as carbon, aramid, glass or combinations thereof, which withstand loads caused by pressurization

3.27
rejected cylinder or installation equipment
cylinder or its installation equipment that needs to be removed from service, i.e. disassembled from the vehicle

Note 1 to entry: For Level 2 damage, the cylinder is evaluated further before repairing or condemning. For Level 3 damage, the cylinder or equipment is subsequently condemned.

3.28
repair
action, including rework, to return a cylinder to an acceptable Level 1 condition

3.29
resin
material that is used to bind and hold the fibres in place

3.30
working pressure
settled pressure, at a uniform temperature of 15 °C

3.31
stress corrosion cracking
SCC
phenomenon resulting in a split or rift in the materials, caused by a combination of load and aggressive environment

Note 1 to entry: Such cracks in composite materials are typically sharply defined and can appear as a family of cracks or as a single crack.

3.32
valve
device installed in one of the threaded openings of the cylinder used to allow gas flow into or from the cylinder

Note 1 to entry: A manual valve is turned on or off with a handle. A solenoid valve is turned on or off automatically. Some solenoid valves can be operated manually with special tools.

3.33
vent line
high-pressure line used to conduct gas from a PRD to a location outside the vehicle, where gas can be discharged safely

4 Background information

4.1 General

NGV cylinders inspected in accordance with this International Standard are designed and qualified in accordance with ISO 11439. These cylinders have markings that identify the ISO 11439 type of construction.

An inspection body shall perform all inspection work. Trained and qualified personnel shall perform installations or other service required by this International Standard.

4.2 Cylinder types and descriptions

4.2.1 CNG-1 metal

CNG-1 cylinders are all metal and can be made of any alloy of steel or aluminium that meets the qualification requirements outlined in ISO 11439.

4.2.2 CNG-2 metal liner partially reinforced with resin-impregnated continuous filament (hoop-wrapped)

CNG-2 cylinders have a metallic liner with sufficient strength and thickness to carry the entire longitudinal load at the required burst pressure, and to withstand the working pressure without rupture. Metal liner materials are those identified under CNG-1 cylinders (see 4.2.1). These cylinders are reinforced with fibres wound only in the hoop (circumferential) direction.

4.2.3 CNG-3 metal liner totally reinforced with resin-impregnated continuous filament (fully wrapped)

CNG-3 cylinders have a metallic liner that is generally load carrying, but they do not have sufficient strength and thickness to carry the longitudinal load at the burst pressure. They are reinforced with fibres wound in both a helical and hoop pattern. Metal liner materials are those identified under CNG-1 cylinders (see 4.2.1).

4.2.4 CNG-4 non-metallic liner totally reinforced with resin-impregnated continuous filament (all composite)

CNG-4 cylinders have a non-metallic liner that does not carry load. The liner is typically a thermoplastic material. These cylinders are reinforced with fibres wound in both a helical pattern and hoop direction. Metallic bosses are used to accept accessories such as valves and PRDs. Boss materials are typically aluminium alloy or stainless steel.

4.3 Required marking information

The marking requirements of ISO 11439 shall be reviewed to verify the exact wording, lettering size and required content as follows:

a) “CNG ONLY”;

b) “DO NOT USE AFTER MM/YYYY” (providing the month and year of expiry);

c) the manufacturer’s identification;

d) the cylinder identification (a unique serial number for each cylinder);

e) the working pressure;

f) the ISO standard, along with cylinder type and certification registration number (if applicable);

g) the words “Use only a manufacturer-approved PRD”;

h) the date of manufacture (month and year);

i) any additional markings, as required by the regulations of the country (or countries) of use.

When labels are used, all cylinders shall have a unique identification number and the manufacturer’s identification stamped on an exposed metallic surface, to permit tracing in the event of the label being destroyed.

5 Inspection body and inspectors

The inspection body shall be recognized in accordance with the regulations in the country of use.

In order to ensure that the cylinders are fit for continued safe use, the inspection shall be carried out exclusively by persons competent to do so. The inspector shall have available and within easy access during the inspection the equipment described in Clause 6 and the documentation referenced in 7.3.2. The vehicle to be inspected shall be positioned in such a way that the inspector has unimpeded access to the surface of the cylinder, or else in accordance with the vehicle manufacturer’s recommendations (see

7.3.5). If the inspector finds areas, such as those described in Clause 7, that require additional inspection or testing, the cylinder shall be depressurized in accordance with the recommendations in Annex A and with the manufacturer's instructions, and then removed from the vehicle. If the inspector determines that the cylinder needs to be permanently removed from service, this shall be done in accordance with Clause 9.

6 Inspection equipment

6.1 Adequate light, sufficient to illuminate all surfaces clearly, in order to examine properly the external surfaces of cylinders, mounting brackets, valves, vent lines, etc.

CAUTION — To avoid combustion or fire, either use explosion-proof lights or ensure that the area is well ventilated.

6.2 Angled inspection mirrors, or other suitable devices, to aid in the examination of cylinder surfaces that are partially concealed by the installation.

6.3 Various hand tools, to remove covers, shields or other installed equipment, such that the external cylinder surfaces, brackets, valves, PRDs and other components can be viewed.

6.4 Torque wrench, to verify that the mounting bracket bolts are properly tightened.

6.5 Depth gauge, to determine the depth of cuts, pits and abrasions. A commercial-type pit or depth gauge should be used for this purpose; alternatively, the use of other equipment to estimate imperfection depths is acceptable.

6.6 Rule and straightedge, in combination, to evaluate indentations and bulges.

6.7 Rule or tape measure, to determine the length of noted cuts and the general area of abrasion.

6.8 Commercial-type leak test fluid, which does NOT contain ammonia, harsh corrosives or chemicals incompatible with the system materials (the fluid is usually a mild soap solution that meets these criteria). A methane gas detector may also be used to test for leakage. Additional information is provided in 7.6.4.

6.9 Ultrasonic thickness gauge, to determine the remaining wall thickness on cylinders with exposed metal regions (excluding boss).

7 Cylinder, valve and pressure relief device inspection

7.1 Inspection interval

CAUTION — Failure to perform diligent and accurate inspections on a regular basis, or promptly (in the case of a potentially damaging incident or unusual behaviour), can result in a serious accident causing severe damage or injury, or both.

NGV fuel storage systems shall be visually inspected by a recognized inspector (see Clause 5), at intervals as stated in ISO 11439. Annex B specifies typical conditions and usage that may warrant more frequent inspections, while Annex D outlines specific considerations relating to internal inspections.

7.2 Conditions requiring immediate inspection

Inspections usually are carried out as stated in 7.1 on pressurized cylinders; however, due to the high risk presented by cylinders described in this clause, it is essential to depressurize the cylinder and consider the following list prior to the normal inspection procedure in 7.4.

