



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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**Hoop-wrapped composite cylinders with steel liner for the
on-board storage of compressed natural gas as a fuel for
automotive vehicles**

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1 Scope

This document specifies the types and parameters, technical requirements, test methods, inspection rules, marking, coating, packaging, transportation and storage requirements for hoop-wrapped composite cylinders with steel liner for the on-board storage of compressed natural gas as a fuel for automotive vehicles (hereinafter referred to as "the hoop-wrapped cylinder").

This document applies to the hoop-wrapped cylinders, of which the designed and manufactured nominal working pressure is 20MPa, 25MPa, 30MPa, the nominal volume is 30L~450L, the working temperature is -40 degrees C~65 degrees C, and the designed service life is 15 years.

The hoop-wrapped cylinders manufactured in accordance with this document are only used for the compressed natural gas storage containers for vehicles that are fixed on vehicles and filled in compliance with GB 18047 and used as a vehicle fuel. Additional loads due to external forces are not included in the conditions of use.

2 Normative references

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

GB/T 222, Permissible tolerances for chemical composition of steel products

GB/T 223 (all parts), Iron, steel and alloy - Determination

GB/T 224, Determination of the depth of decarburization of steels

GB/T 226, Test method for macrostructure and defect of steel by etching

GB/T 228.1, Metallic materials - Tensile testing - Part 1: Method of test at normal temperature

GB/T 229, Metallic materials - Charpy pendulum impact test method d) Impact of gravel;

e) Contact with acid and alkali solutions, fertilizers;

f) Corrosion of automotive fluids, including gasoline, hydraulic fluids, battery acids, glycols and oils;

g) Exposure to exhaust gases.

5.2 Materials

5.2.1 Liner materials

5.2.1.1 It shall be timeless sedated steel smelted by electric furnace or oxygen converter.

5.2.1.2 It shall use high-quality chrome-molybdenum steel (30CrMo or 34CrMo4).

5.2.1.3 It shall comply with the corresponding national standards or industry standards and have a quality certificate. The manufacturer of the hoop-wrapped cylinder shall carry out verification and analysis of various indicators according to the furnace tank number.

5.2.1.4 The chemical composition of the material is limited as shown in Table 2. The allowable deviation of its chemical composition shall be in accordance with the provisions of GB/T 222.

5.2.1.5 The low magnification structure of the billet shall not have white spots, residual shrinkage cavities, delamination, bubbles, foreign bodies and inclusions. The central porosity shall not be greater than level 2.0. The segregation shall not be greater than level 2.5.

Table 2 -- Chemical composition of steel

5.2.1.6 Seamless steel pipe

5.2.1.6.1 The straightness of the steel pipe shall not exceed 1.5mm/m. The roundness shall not be greater than 80% of the allowable deviation of the outer diameter.

5.2.1.6.2 There shall be no cracks, folds, folds, delamination and scars on the inner and outer surfaces of the steel pipes. If there are defects, they shall be completely removed.

The clearance shall be smooth. The actual wall thickness after removal shall not be less than the minimum allowable wall thickness.

5.2.1.6.3 The seamless steel pipe shall be inspected for longitudinal and transverse Element Content ultrasonic flaw detection one by one by the steel mill according to the provisions of

GB/T 5777. The requirements for acceptance level U2 shall be met.

5.2.2 Wrapping layer material

5.2.2.1 Resin

5.2.2.1.1 The impregnating material may be a thermoset or thermoplastic resin. Suitable matrix materials are: epoxy, modified epoxy, polyester and vinyl thermosetting resins and polyethylene, polyamide thermoplastic resins.

5.2.2.1.2 The performance and technical indicators of the impregnating material shall comply with the provisions of the corresponding national standards or industry standards. There shall be a quality certificate.

5.2.2.2 Fiber

5.2.2.2.1 The type of fiber material for structural reinforcement shall be glass fiber, aramid fiber or carbon fiber.

5.2.2.2.2 The fiber material shall comply with the provisions of the corresponding national standards or industry standards. It shall have a quality certificate.

5.3 Design

5.3.1 General provisions

5.3.1.1 This document does not provide design formulas. However, proper calculation, analysis and demonstration are required in the design, so as to make the hoop-wrapped cylinder can successfully pass the tests of materials, types and batches specified in this document.

5.3.1.2 The design shall ensure that the failure mode of the hoop-wrapped cylinder due to the degradation of the quality of the pressure-bearing components during normal use is "leak before explosion". If the metal liner leaks, it shall only be due to the expansion of fatigue cracks.

5.3.1.3 The maximum tensile strength of the liner material shall be limited. If the sulfur and phosphorus content is not more than 0.005% and 0.010% respectively, and the hydrogen sulfide stress corrosion test (stress ring method) is carried out according to

Annex A and GB/T4157, the actual tensile strength of the allowable material shall be

greater than 880MPa but not greater than 1000MPa. When designing, the guaranteed value of the yield strength of the liner material shall not exceed 90% of the guaranteed value of the tensile strength.

5.3.1.4 The hydrostatic test pressure P_h of the hoop-wrapped cylinder is 1.5 times the

nominal working pressure P.

5.4.1 The manufacture of the liner and the hoop-wrapped cylinder shall comply with the provisions of this document. It shall comply with the product drawings and the provisions of the relevant technical documents.

5.4.2 The liner generally adopts the following manufacturing methods:

- a) It uses billets, ingots and bars as raw materials. It is made by squeezing, stretching or spin thinning and mouth closing;
- b) It uses seamless steel pipe as raw material. It is made by closing the bottom and closing the mouth;
- c) It uses steel plate as raw material. It is made by stamping, stretching or spinning, thinning and mouth closing.

5.4.3 The chemical composition of the material shall be verified by the furnace number of the material before the liner is manufactured. The analysis method shall be performed according to GB/T 223 (all parts) or GB/T4336. The results shall meet the requirements of 5.2.1.

5.4.4 The liner shall not be welded.

5.4.5 The liner made of seamless steel pipe and made by closing the bottom shall be subjected to the bottom sealing test one by one before mouth closing.

5.4.6 Special tools are allowed to use to grind the surface defects on the liner and the hoop-wrapped cylinder.

5.4.7 Manufacturing shall be managed in batches. For the finished liners and finished hoop-wrapped cylinders, a batch shall be: no more than 200 pieces plus the number of liners or hoop-wrapped cylinders for the destructive test.

5.4.8 The heat treatment liner shall be heat treated as a whole through a continuous heating furnace. The heat treatment shall be carried out according to the qualified heat treatment process. Quenching process can use oil or water with additives as quenching medium. When adding additives in water as a quenching medium, the cooling rate of the liner in the medium shall not be greater than 80% of the cooling rate in water at 20°C. After the liner is heat-treated, non-destructive testing shall be carried out one by one.

5.4.9 Before the manufacture of the hoop-wrapped cylinder, the wrapping layer materials shall be confirmed in batches. It shall meet 5.2.2 and the following requirements:

- a) The epoxy equivalent of the grease shall be determined according to GB/T 4612;
- b) The fiber linear density (metric number) shall be determined according to GB/T 7690.1;
- c) The breaking strength of fiber shall be determined according to GB/T 7690.3 or