

This document is a preview generated by EVS

## Gaseous hydrogen - Cylinders and tubes for stationary storage

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

<p>See Eesti standard EVS-EN 17533:2025 sisaldab Euroopa standardi EN 17533:2025 ingliskeelset teksti.</p> <p>Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.</p> <p>Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 14.05.2025.</p> <p>Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.</p>	<p>This Estonian standard EVS-EN 17533:2025 consists of the English text of the European standard EN 17533:2025.</p> <p>This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.</p> <p>Date of Availability of the European standard is 14.05.2025.</p> <p>The standard is available from the Estonian Centre for Standardisation and Accreditation.</p>
--	---

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile [standardiosakond@evs.ee](mailto:standardiosakond@evs.ee).

ICS 71.100.20

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardimis- ja Akrediteerimiskeskusele. Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardimis- ja Akrediteerimiskeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardimis- ja Akrediteerimiskeskusega: Koduleht [www.evs.ee](http://www.evs.ee); telefon 605 5050; e-post [info@evs.ee](mailto:info@evs.ee)

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation and Accreditation. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation and Accreditation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation and Accreditation: Homepage [www.evs.ee](http://www.evs.ee); phone +372 605 5050; e-mail [info@evs.ee](mailto:info@evs.ee)

EUROPEAN STANDARD

**EN 17533**

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2025

ICS 71.100.20

Supersedes EN 17533:2020

English Version

## Gaseous hydrogen - Cylinders and tubes for stationary storage

Hydrogène gazeux - Bouteilles et tubes pour stockage  
stationnaire

Gasförmiger Wasserstoff - Flaschen und Großflaschen  
zur ortsfesten Lagerung

This European Standard was approved by CEN on 7 April 2025.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

<b>Contents</b>	<b>Page</b>
European foreword .....	7
Introduction .....	8
1 Scope .....	9
2 Normative references .....	9
3 Terms, definitions and symbols .....	10
3.1 Terms and definitions .....	10
3.2 Symbols .....	15
4 Specified service conditions .....	16
4.1 Maximum allowable working pressure .....	16
4.2 Maximum allowable energy .....	16
4.3 Maximum and minimum allowable temperature .....	16
4.4 Pressure cycle life .....	16
4.5 Methods to define the acceptable number of pressure cycles or fatigue behaviour for in service performance .....	16
4.5.1 General .....	16
4.5.2 Method 1 - Pressure cycling calculation using design standards for transportable applications - Method described in Annex A .....	16
4.5.3 Method 2 - Fatigue evaluation using fracture mechanics - Method described in Annex B (Type 1 and Type 2) .....	16
4.5.4 Method 3 - Fatigue evaluation based on performance testing - Method described in Annex C .....	17
4.6 Service life .....	17
5 Additional service conditions .....	17
5.1 General .....	17
5.2 Environmental conditions .....	17
5.3 Fire conditions .....	17
6 Information to be recorded .....	17
6.1 General .....	17
6.2 Statement of service .....	17
6.3 Design, drawings and information .....	18
6.4 Material property data .....	19
6.5 Manufacturing data .....	19
6.6 Retention of records .....	19
7 Material properties .....	20
7.1 Compatibility .....	20
7.2 Steel .....	20
7.3 Stainless steels .....	20
7.4 Aluminium alloys .....	20
7.5 Fibre material .....	20
7.6 Matrix materials .....	20
7.7 Plastic liner material .....	20
8 Requirements for new design .....	21

<b>9</b>	<b>Minimum requirement for new designs.....</b>	<b>21</b>
<b>9.1</b>	<b>Stress analysis.....</b>	<b>21</b>
<b>9.1.1</b>	<b>General.....</b>	<b>21</b>
<b>9.1.2</b>	<b>Burst pressure and fibre stress ratio (not applicable if Annex B is used).....</b>	<b>22</b>
<b>9.1.3</b>	<b>Test pressure.....</b>	<b>22</b>
<b>9.1.4</b>	<b>Maximum defect size in metallic materials.....</b>	<b>23</b>
<b>9.1.5</b>	<b>Protection liner and boss against corrosion.....</b>	<b>23</b>
<b>9.1.6</b>	<b>Resistance to UV emissions.....</b>	<b>23</b>
<b>9.1.7</b>	<b>Resistance to humidity.....</b>	<b>23</b>
<b>9.1.8</b>	<b>Protective layer.....</b>	<b>23</b>
<b>9.2</b>	<b>Construction and workmanship.....</b>	<b>23</b>
<b>9.2.1</b>	<b>Materials.....</b>	<b>23</b>
<b>9.2.2</b>	<b>Openings, neck threads, neck ring, foot ring, attachment for support.....</b>	<b>24</b>
<b>9.2.3</b>	<b>Forming.....</b>	<b>24</b>
<b>9.2.4</b>	<b>Fibre winding.....</b>	<b>24</b>
<b>9.2.5</b>	<b>Curing of thermosetting resins.....</b>	<b>25</b>
<b>9.2.6</b>	<b>Autofrettage.....</b>	<b>25</b>
<b>9.2.7</b>	<b>Exterior environmental protection.....</b>	<b>25</b>
<b>9.3</b>	<b>Production and batch tests.....</b>	<b>26</b>
<b>9.3.1</b>	<b>Production tests.....</b>	<b>26</b>
<b>9.3.2</b>	<b>Batch tests.....</b>	<b>26</b>
<b>10</b>	<b>Markings.....</b>	<b>29</b>
<b>11</b>	<b>Preparation for dispatch.....</b>	<b>30</b>
<b>Annex A</b>	<b>(informative) Pressure cycling calculation using design standards for transportable applications.....</b>	<b>31</b>
<b>A.1</b>	<b>General.....</b>	<b>31</b>
<b>A.2</b>	<b>Requirements.....</b>	<b>33</b>
<b>A.2.1</b>	<b>General requirements.....</b>	<b>33</b>
<b>A.2.2</b>	<b>Specific requirements.....</b>	<b>33</b>
<b>A.3</b>	<b>Marking.....</b>	<b>35</b>
<b>A.4</b>	<b>Certificate.....</b>	<b>36</b>
<b>A.5</b>	<b>Examples of calculation for PS (MAWP).....</b>	<b>36</b>
<b>A.5.1</b>	<b>Type 1 cylinder to EN ISO 9809-1 with <math>P_w/P_h</math> of 200/300 bar in Europe.....</b>	<b>36</b>
<b>A.5.2</b>	<b>Type 3 cylinder to ISO 11119-2 with <math>P_w/P_h</math> of 200/300 bar in Europe.....</b>	<b>36</b>
<b>A.5.3</b>	<b>Type 1 cylinder to EN ISO 9809-1 with <math>P_w/P_h</math> of 700/1 050 bar in Europe.....</b>	<b>36</b>
<b>A.5.4</b>	<b>Type 3 cylinder to ISO 11119-2 with <math>P_w/P_h</math> of 1 000/1 500 bar in Europe.....</b>	<b>36</b>
<b>A.6</b>	<b>Example of cycle life calculation.....</b>	<b>37</b>
<b>Annex B</b>	<b>(normative) Design and calculation and cycle life definition by fracture mechanics (Type 1 and Type 2).....</b>	<b>38</b>
<b>B.1</b>	<b>Purpose and scope.....</b>	<b>38</b>
<b>B.2</b>	<b>Methodology.....</b>	<b>38</b>
<b>B.3</b>	<b>Exemption for low alloy steels.....</b>	<b>38</b>

<b>Annex C (normative) Design evaluation based on performance testing</b> .....	<b>39</b>
<b>C.1 Testing</b> .....	<b>39</b>
<b>C.1.1 General</b> .....	<b>39</b>
<b>C.1.2 Material tests</b> .....	<b>39</b>
<b>C.1.3 Pressure vessel tests</b> .....	<b>40</b>
<b>C.1.4 Qualification and design changes</b> .....	<b>43</b>
<b>Annex D (normative) Test methods and acceptance criteria</b> .....	<b>46</b>
<b>D.1 Hydrogen compatibility</b> .....	<b>46</b>
<b>D.2 Hydrogen sensitivity tests for metals</b> .....	<b>46</b>
<b>D.2.1 General</b> .....	<b>46</b>
<b>D.2.2 Test method 1 - Fatigue testing of tensile specimens</b> .....	<b>46</b>
<b>D.2.3 Test method 2 - Fatigue testing of disks</b> .....	<b>48</b>
<b>D.3 Tensile properties of plastics</b> .....	<b>49</b>
<b>D.4 Softening temperature of plastics</b> .....	<b>49</b>
<b>D.5 Resin properties tests</b> .....	<b>49</b>
<b>D.6 Hydrostatic burst pressure test</b> .....	<b>49</b>
<b>D.7 Ambient temperature pressure cycling for cycle life definition</b> .....	<b>50</b>
<b>D.7.1 Full amplitude pressure cycling</b> .....	<b>50</b>
<b>D.7.2 Partial amplitude pressure cycling</b> .....	<b>50</b>
<b>D.7.3 Alternative to D.7.1 and D.7.2</b> .....	<b>50</b>
<b>D.7.4 Parameters to be monitored and recorded</b> .....	<b>51</b>
<b>D.8 Leak before break (LBB) test</b> .....	<b>51</b>
<b>D.9 Bonfire test</b> .....	<b>51</b>
<b>D.10 High strain impact test</b> .....	<b>51</b>
<b>D.11 Accelerated stress rupture test</b> .....	<b>51</b>
<b>D.12 Extreme temperature pressure cycling</b> .....	<b>51</b>
<b>D.13 Permeation test</b> .....	<b>52</b>
<b>D.14 Boss torque test</b> .....	<b>52</b>
<b>D.15 Hydrogen gas cycling test (for Type 4 only)</b> .....	<b>52</b>
<b>D.16 Hardness test</b> .....	<b>53</b>
<b>D.17 Hydraulic test</b> .....	<b>53</b>
<b>D.18 Leak test</b> .....	<b>53</b>
<b>D.19 Coating tests</b> .....	<b>53</b>
<b>D.20 Coating batch tests</b> .....	<b>54</b>
<b>D.20.1 Coating thickness</b> .....	<b>54</b>
<b>D.20.2 Coating adhesion</b> .....	<b>54</b>

<b>D.21 Impact damage test (optional)</b> .....	<b>54</b>
<b>Annex E (informative) Verification of stress ratios using strain gauges</b> .....	<b>55</b>
<b>Annex F (informative) Non-destructive examination (NDE) defect size by flawed pressure vessel cycling</b> .....	<b>56</b>
<b>Annex G (informative) Manufacturer's information for handling, use and inspection of pressure vessels</b> .....	<b>57</b>
<b>G.1 General</b> .....	<b>57</b>
<b>G.2 Distribution</b> .....	<b>57</b>
<b>G.3 Reference to existing codes, standards and regulations</b> .....	<b>57</b>
<b>G.4 Pressure vessel handling</b> .....	<b>57</b>
<b>G.5 Installation</b> .....	<b>57</b>
<b>G.6 Use of pressure vessels</b> .....	<b>58</b>
<b>G.7 In-service inspection</b> .....	<b>58</b>
<b>G.7.1 General</b> .....	<b>58</b>
<b>G.7.2 Periodic re-qualification</b> .....	<b>58</b>
<b>G.7.3 Pressure vessels having experienced impact damage</b> .....	<b>58</b>
<b>G.7.4 Pressure vessels involved in fires</b> .....	<b>58</b>
<b>Annex H (informative) Optional bonfire test</b> .....	<b>59</b>
<b>H.1 General</b> .....	<b>59</b>
<b>H.2 Cylinder test</b> .....	<b>59</b>
<b>H.2.1 Cylinder set-up</b> .....	<b>59</b>
<b>H.2.2 Fire source</b> .....	<b>59</b>
<b>H.2.3 Temperature and pressure measurements</b> .....	<b>59</b>
<b>H.2.4 General test requirements</b> .....	<b>60</b>
<b>H.2.5 Test options</b> .....	<b>60</b>
<b>H.3 PRD test</b> .....	<b>60</b>
<b>H.4 Vent test</b> .....	<b>61</b>
<b>H.5 System assessment</b> .....	<b>61</b>
<b>H.5.1 Qualification limit envelope</b> .....	<b>61</b>
<b>H.5.2 Service limit envelope</b> .....	<b>61</b>
<b>H.5.3 Acceptable results</b> .....	<b>61</b>
<b>H.6 Generation of a safety envelope and actual cylinder/PRD performance</b> .....	<b>61</b>
<b>Annex I (informative) Information of factor of safety</b> .....	<b>63</b>
<b>I.1 Purpose</b> .....	<b>63</b>
<b>I.2 Background</b> .....	<b>63</b>
<b>I.3 Recommended safety factor</b> .....	<b>63</b>
<b>I.4 Discussion</b> .....	<b>63</b>

<b>I.5</b>	<b>Conclusions</b> .....	<b>65</b>
<b>I.6</b>	<b>Recommendations</b> .....	<b>65</b>
<b>I.7</b>	<b>Further reading</b> .....	<b>65</b>
	<b>Bibliography</b> .....	<b>66</b>

This document is a preview generated by EVS

## European foreword

This document (EN 17533:2025) has been prepared by Technical Committee CEN/TC 23 “Transportable gas cylinders”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2025, and conflicting national standards shall be withdrawn at the latest by November 2025.

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

This document supersedes EN 17533:2020.

EN 17533:2025 includes the following significant technical changes with respect to EN 17533:2020:

- requirements for new design have been revised;
- addition of Figure A.1 Concept of Annex A;
- Annexes B and C have been revised.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

## **Introduction**

As the use of gaseous hydrogen evolves from the chemical industry into various emerging applications, such as fuel for fuel cells, internal combustion engines and other speciality hydrogen applications, new requirements are foreseen for seamless and composite pressure vessels, including higher number of pressure cycles.

Requirements covering pressure vessels for stationary storage of compressed gaseous hydrogen are listed in this document and are mainly intended to maintain or improve the level of safety for this application.

This document is a preview generated by EVS

## 1 Scope

This document specifies the requirements for the design, manufacture and testing of cylinders, tubes and other pressure vessels of steel, stainless steel, aluminium alloys or of non-metallic construction material. These are intended for the stationary storage of gaseous hydrogen of up to a maximum water capacity of 10 000 l and a maximum allowable working pressure not exceeding 1 100 bar, of seamless metallic construction (Type 1) or of composite construction (Types 2, 3 and 4), hereafter referred to as pressure vessels.

NOTE Additional requirements with regard to assemblies (manifolded cylinders and tubes and other pressure vessels) are not covered by this document.

This document is not applicable to Type 2 and 3 vessels with welded liners.

This document is not applicable to pressure vessels used for solid, liquid hydrogen or hybrid cryogenic-high pressure hydrogen storage applications.

This document is not applicable to external piping which can be designed according to recognized standards.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN ISO 306, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST) (ISO 306)*

EN ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2)*

EN ISO 1519, *Paints and varnishes — Bend test (cylindrical mandrel) (ISO 1519)*

EN ISO 2808, *Paints and varnishes — Determination of film thickness (ISO 2808)*

EN ISO 2812-1, *Paints and varnishes — Determination of resistance to liquids — Part 1: Immersion in liquids other than water (ISO 2812-1)*

EN ISO 2409, *Paints and varnishes — Cross-cut test (ISO 2409)*

EN ISO 6272-2, *Paints and varnishes — Rapid-deformation (impact resistance) tests — Part 2: Falling-weight test, small-area indenter (ISO 6272-2)*

EN ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method (ISO 6506-1)*

EN ISO 7225, *Gas cylinders — Precautionary labels (ISO 7225)*

EN ISO 7866, *Gas cylinders — Refillable seamless aluminium alloy gas cylinders — Design, construction and testing (ISO 7866)*

EN ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests (ISO 9227)*

EN ISO 9809-1, *Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes — Part 1: Quenched and tempered steel cylinders and tubes with tensile strength less than 1 100 MPa (ISO 9809-1)*

EN ISO 9809-4, *Gas cylinders — Design, construction and testing of refillable seamless steel gas cylinders and tubes — Part 4: Stainless steel cylinders with an Rm value of less than 1 100 MPa (ISO 9809-4)*

EN ISO 11114-1, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 1: Metallic materials (ISO 11114-1)*

EN ISO 11114-2, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 2: Non-metallic materials (ISO 11114-2)*

EN ISO 11114-4, *Transportable gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 4: Test methods for selecting steels resistant to hydrogen embrittlement (ISO 11114-4)*

EN ISO 11114-5:2022, *Gas cylinders — Compatibility of cylinder and valve materials with gas contents — Part 5: Test methods for evaluating plastic liners (ISO 11114-5:2022)*

EN ISO 11120, *Gas cylinders — Refillable seamless steel tubes of water capacity between 150 l and 3000 l — Design, construction and testing (ISO 11120)*

EN ISO 11357-2, *Plastics — Differential scanning calorimetry (DSC) — Part 2: Determination of glass transition temperature and step height (ISO 11357-2)*

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

EN ISO 14130, *Fibre-reinforced plastic composites — Determination of apparent interlaminar shear strength by short-beam method (ISO 14130)*

EN ISO 16474-1, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 1: General guidance (ISO 16474-1)*

EN ISO 16474-3, *Paints and varnishes — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps (ISO 16474-3)*

ASTM D3170/D3170M-14, *Standard Test Method for Chipping Resistance of Coatings*

## **3 Terms, definitions and symbols**

### **3.1 Terms and definitions**

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

#### **3.1.1**

##### **stationary storage**

##### **<stationary pressure vessel>**

pressurized storage in a fixed location for a fixed purpose that is not transported while pressurized