

DIN EN 17533:2025-07 (E)

Gaseous hydrogen - Cylinders and tubes for stationary storage

Contents	Page
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

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

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

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

I.5	Conclusions	65
I.6	Recommendations.....	65
I.7	Further reading.....	65
	Bibliography	66