

DIN EN 13445-6:2016-12 (E)

Unfired pressure vessels - Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron

Contents		Page
Foreword.....		5
1	Scope	7
2	Normative references	7
3	Terms, definitions, units and symbols	8
3.1	Terms and definitions	8
3.2	Units	9
3.3	Symbols	9
3.4	Inter-relation of thicknesses definitions	11
4	Service conditions	11
4.1	Cyclic loading.....	11
4.2	Limitations on temperature and energy content	12
5	Requirements	12
5.1	Materials	12
5.2	Design	14
5.2.1	Technical documentation	14
5.2.2	Design methods	14
5.3	Founding.....	20
5.3.1	General.....	20
5.3.2	Welding.....	20
6	Material testing.....	20
6.1	General.....	20
6.2	Frequency and number of tests	20
6.3	Chemical analysis.....	20
6.4	Graphite structure.....	21
6.5	Inspection documents.....	21
7	Testing and final assessment.....	21
7.1	Testing	21
7.1.1	General.....	21
7.1.2	Testing requirements for $C_Q = 0,8$	21
7.1.3	Testing requirements for $C_Q = 0,9$	21
7.1.4	Surface imperfections	22
7.1.5	Cracks, laps, cold shut and non-fused chaplets	23
7.1.6	Ultrasonic testing and/or sectioning	23
7.1.7	Magnetic particle testing (only for ferritic grades).....	23
7.1.8	Penetrant testing.....	23
7.1.9	Radiographic testing	23
7.1.10	Surface roughness	24
7.1.11	Minimum wall thickness.....	24
7.1.12	Wall thickness tolerances.....	24
7.1.13	Other dimensions	24
7.1.14	Qualification of testing personnel.....	24
7.2	Final assessment	24
7.2.1	General.....	24
7.2.2	Hydraulic test pressure	24
8	Pressure vessels constructed of a combination of parts in different materials	25
9	Marking and documentation.....	25
9.1	Marking of castings	25
9.2	Name plate for the complete pressure vessel	25
9.3	Documentation	25

H.3.4 Material tests51
H.4 Allowable number of cycles51
Annex Y (informative) History of EN 13445-653
Y.1 Differences between EN 13445-6:2009 and EN 13445-6:201453
Y.2 List of corrected pages of Issue 2 (2015-07).....53
Y.3 List of corrected pages of Issue 3 (2016-07).....53
Annex ZA (informative) Relationship between this European Standard and the essential requirements
of Directive 2014/68/EU aimed to be covered54
Bibliography55

Annex A (normative) Technical data for the design calculations.....	26
A.1 Purpose.....	26
A.2 Technical data.....	26
A.2.1 Ferritic spheroidal graphite cast iron according to EN 1563:1997.....	26
A.2.2 Austenitic spheroidal graphite cast iron according to EN 13835:2002.....	27
Annex B (informative) Ductility	28
Annex C (informative) Determination of the minimum local wall thickness and minimum required burst test pressure	29
Annex D (normative) Assessment of fatigue life.....	30
D.1 Purpose.....	30
D.2 Specific definitions.....	30
D.3 Specific symbols and abbreviations	30
D.4 Limitations.....	31
D.5 General.....	31
D.6 Simplified fatigue assessment	31
D.6.1 Pseudo-elastic stress range	31
D.6.2 Correction factors.....	32
D.6.3 Fatigue design curves.....	32
D.6.4 Allowable number of cycles	38
D.6.5 Allowable stress range $\Delta\sigma$	38
D.7 Detailed fatigue assessment	38
D.7.1 Pseudo-elastic stress ranges.....	38
D.7.2 Corrections to stress range.....	39
D.7.3 Fatigue design curves.....	40
D.7.4 Allowable number of cycles	41
D.7.5 Allowable stress range.....	42
D.8 Assessment rule for total fatigue damage.....	42
D.9 Repairs of surface imperfections.....	42
Annex E (normative) Design by analysis for castings.....	43
E.1 Introduction	43
E.2 Special requirements to EN 13445-3:2014, Annex B.....	43
E.2.1 Addition to B.8.2.3: Design checks for normal operating load cases.....	43
E.2.2 Addition to B.8.2.4: Design checks for testing load cases	43
E.3 Additions to EN 13445-3:2014, Annex C.....	43
E.4 Requirements.....	44
Annex F (informative) Recommendations for in-service validation and inspection	45
F.1 Purpose.....	45
F.2 Tests during operation.....	45
F.3 Measures to be taken when the calculated allowable fatigue lifetime has been reached	46
F.3.1 General.....	46
F.3.2 Testing of vessels and pressure parts at end of life without indicated damages	46
F.3.3 Hydraulic testing of vessels and vessel parts with indicated damages	46
Annex G (normative) Specific design requirements.....	47
G.1 Scope	47
G.2 Design	47
G.2.1 General.....	47
G.2.2 Cover thickness, pressure to convex side.....	48
G.2.3 Pressure to concave side	48
G.2.4 Flange thickness.....	48
Annex H (normative) Experimental cyclic pressure testing procedure.....	49
H.1 Purpose.....	49
H.1.1 General.....	49
H.1.2 Experimental methods and other design methods	49
H.2 Validity	49
H.3 Tests requirements.....	49
H.3.1 General.....	49
H.3.2 Number of parts	49
H.3.3 Procedure	49a