SLOVENSKI STANDARD
SIST EN 12516-4:2015

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Industrijski ventili - Trdnost ohišja - 4. del: Metoda za izračun ohišij ventilov iz nejeklenih kovinskih materialov

Industrial valves - Shell design strength - Part 4: Calculation method for valve shells manufactured in metallic materials other than steel

Industriearmaturen - Gehäusefestigkeit - Teil 4: Berechnungsverfahren für drucktragende Gehäuse von Armaturen aus anderen metallischen Werkstoffen als Stahl

Robinetterie industrielle - Résistance mécanique des enveloppes - Partie 4: Méthode de calcul relative aux enveloppes d'appareils de robinetterie en matériaux métalliques autres que l'acier

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Industrial valves - Shell design strength - Part 4: Calculation method for valve shells manufactured in metallic materials other than steel

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Foreword

This document (EN 12516-4:2014) has been prepared by Technical Committee CEN/TC 69 “Industrial valves”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by April 2015 and conflicting national standards shall be withdrawn at the latest by April 2015.

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

This document supersedes EN 12516-4:2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 97/23/EC.

For relationship with EU Directive 97/23/EC, see informative Annex ZA, which is an integral part of this document.

EN 12516, *Industrial valves — Shell design strength*, consists of four parts:

— *Part 1: Tabulation method for steel valve shells*;

— *Part 2: Calculation method for steel valve shells*;

— *Part 3: Experimental method*;

— *Part 4: Calculation method for valve shells manufactured in metallic materials other than steel* (the present document).

The main changes compared to the previous edition are:

a) normative references have been updated;

b) Clause 4 has been revised;

c) additional ductile iron materials were added to Table 2;

d) Subclause 5.2.2 has been revised;

e) Safety factors in Table 17 have been corrected to be in line with other practicable standards;

f) Annex ZA has been revised.

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

1 Scope

This European Standard specifies the calculation method for valve shells manufactured in metallic materials other than steel. The loadings to be accounted for are in accordance with EN 12516-2.

Design methods are in accordance with EN 12516-2, design by formulae according to the relevant clauses.

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.

EN 485-2:2013, *Aluminium and aluminium alloys — Sheet, strip and plate — Part 2: Mechanical properties*

EN 586-2:1994, *Aluminium and aluminium alloys — Forgings — Part 2: Mechanical properties and additional property requirements*

EN 754-2:2013, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 2: Mechanical properties*

EN 755-2:2013, *Aluminium and aluminium alloys — Extruded rod/bar, tube and profiles — Part 2: Mechanical properties*

EN 1092-2, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 2: Cast iron flanges*

EN 1092-3, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 3: Copper alloy flanges*

EN 1092-4, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 4: Aluminium alloy flanges*

EN 1561:2011, *Founding — Grey cast irons*

EN 1562:2012, *Founding — Malleable cast irons*

EN 1563:2011, *Founding — Spheroidal graphite cast irons*

EN 1653:1997, *Copper and copper alloys — Plate, sheet and circles for boilers, pressure vessels and hot water storage units*

EN 1759-3, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, Class designated — Part 3: Copper alloy flanges*

EN 1982:2008, *Copper and copper alloys — Ingots and castings*

EN 12163:2011, *Copper and copper alloys — Rod for general purposes*

EN 12420:2014, *Copper and copper alloys — Forgings*

EN 12449:2012, *Copper and copper alloys — Seamless, round tubes for general purposes*

EN 12516-2:2014, *Industrial valves — Shell design strength — Part 2: Calculation method for steel valve shells*

CEN/TS 13388:2013, *Copper and copper alloys — Compendium of compositions and products*

EN 13445-8:2009, *Unfired pressure vessels — Part 8: Additional requirements for pressure vessels of aluminium and aluminium alloys*

ISO 7005-3, *Metallic flanges — Part 3: Copper alloy and composite flanges*

3 Symbols and units

Table 1 — Symbols and units

Symbol	Characteristic	Unit
f	nominal design stress	MPa
$f_{d/t}$	nominal design stress for design conditions at temperature t °C	MPa
$f_{d/20}$	nominal design stress for design conditions at 20 °C	MPa
R_m	minimum tensile strength	MPa
$R_{m/20}$	Tensile strength at 20 °C	MPa
$R_{m/t}$	tensile strength at temperature t °C	MPa
$R_{p0,1}$	minimum 0,1 %-proof strength	MPa
$R_{p0,2}$	minimum 0,2 %-proof strength	MPa
$R_{p0,2/t}$	0,2 % — proof strength at temperature t °C	MPa
$R_{p1,0/t}$	1,0 % — proof strength at temperature t °C	MPa

4 Interrelation of thickness definitions

For interrelation of thickness definitions refer to EN 12516-2:2014, Clause 4.

5 Requirements

5.1 General

The calculation method for a valve shell in materials other than steel shall be in accordance with EN 12516-2. The choice of materials and their parameters shall be taken from the following clauses of this European Standard.

5.2 Materials — Cast iron

5.2.1 Allowable grades

Materials shall be in accordance with Table 2.

Table 2 — Allowable cast iron material types and grades

Cast iron material type	EN-standard	Designation	
		Symbol	Number
Grey cast iron	EN 1561	EN-GJL-200[a] EN-GJL-250	5.1300 5.1301
Malleable cast iron	EN 1562	EN-GJMB-300-6 EN-GJMB-350-10	5.4100 5.4101
Spheroidal graphite cast iron	EN 1563	EN-GJS-350-22-LT EN-GJS-350-22-RT EN-GJS-400-18-LT EN-GJS-400-18-RT EN-GJS-400-18 EN-GJS-400-15 EN-GJS-500-7 EN-GJS-600-3 EN-GJS-700-2	5.3100 5.3101 5.3103 5.3104 5.3105 5.3106 5.3200 5.3201 5.3300

[a] Grade EN-GJL-200 shall not be used for valves with flanged connections PN 25 or above.

Material properties shall be taken from the standards listed in Table 2.

5.2.2 Strength values

Tensile strength values for grey cast iron shall be taken from EN 1561.

For the tensile strength value of malleable iron grade EN-GJMB-300-6, to be used in the calculation, 300 MPa shall be taken.

The strength values for malleable cast iron grade EN-GJMB-350-10 shall be in accordance with Table 3.

Table 3 — Malleable cast iron — Strength values

Material designation	Strength characteristics $R_{p0,2/t}$ at calculation temperature in °C						
	20	100	150	200	250	300	350
	MPa						
EN-GJMB-350-10	200	190	180	160	150	140	120

The strength values for spheroidal graphite cast iron grades shall be in accordance with Table 4, 5 or 6.

Table 4 — Spheroidal graphite cast iron — Strength values for wall thickness up to 30 mm

Material designation	Strength characteristics $R_{p0,2/t}$ at calculation temperature in °C						
	20	100	150	200	250	300	350
	MPa						
EN-GJS-350-22 LT	220	210	200	180	170	150	140
EN-GJS-350-22 RT	220	210	200	180	170	150	140
EN-GJS-400-18 LT	240	230	220	200	190	170	150
EN-GJS-400-18 RT	250	240	230	210	200	180	160
EN-GJS-400-18	250	240	230	210	200	180	160
EN-GJS-400-15	250	240	230	210	200	180	160
EN-GJS-500-7	320	300	290	270	250	230	200
EN-GJS-600-3	370	350	340	320	300	270	220
EN-GJS-700-2	420	400	390	370	350	320	280

Table 5 — Spheroidal graphite cast iron — Strength values for wall thickness > 30 mm up to 60 mm

Material designation	Strength characteristics $R_{p0,2/t}$ at calculation temperature in °C						
	20	100	150	200	250	300	350
	MPa						
EN-GJS-350-22 LT	210	200	190	170	160	145	130
EN-GJS-350-22 RT	220	210	200	180	170	150	140
EN-GJS-400-18 LT	230	220	210	190	180	165	145
EN-GJS-400-18 RT	250	240	230	210	200	180	160
EN-GJS-400-18	250	240	230	210	200	180	160
EN-GJS-400-15	250	240	230	210	200	180	160
EN-GJS-500-7	300	275	265	245	225	205	180
EN-GJS-600-3	360	325	315	300	280	255	205
EN-GJS-700-2	400	370	360	345	325	300	265

Table 6 — Spheroidal graphite cast iron — Strength values for wall thickness > 60 mm up to 200 mm

Material designation	Strength characteristics $R_{p0,2/t}$ at calculation temperature in °C						
	20	100	150	200	250	300	350
	MPa						
EN-GJS-350-22 LT	200	190	180	160	150	140	120
EN-GJS-350-22 RT	200	190	180	160	150	140	120
EN-GJS-400-18 LT	220	210	200	200	170	160	140
EN-GJS-400-18 RT	240	220	210	210	180	170	150
EN-GJS-400-18	240	220	210	210	180	170	150
EN-GJS-400-15	240	220	210	210	180	170	150
EN-GJS-500-7	290	250	240	220	200	180	160
EN-GJS-600-3	340	300	290	280	260	240	190
EN-GJS-700-2	380	340	330	320	300	280	250

5.2.3 Pressure/temperature ratings for cast iron

5.2.3.1 The pressure/temperature ratings shall comply with EN 1092-2.

5.2.3.2 The use of valves at temperatures lower than those given in the tables for pressure/temperature ratings of EN 1092-2 is permitted, provided that their shells and bonnets are manufactured in spheroidal graphite cast iron of grades EN-GJS-350-22-LT or EN-GJS-400-18-LT, see Table 7. For temperatures below the lowest temperature given in the tables of ratings, the maximum allowable pressure shall not be higher than the pressure associated to the lowest temperature in the tables. The lowest calculation temperature shall not be less than the temperature specified for Charpy impact testing in accordance with EN 1563.

Table 7 — Allowable material grades for low temperature (LT) design conditions

Symbol	Number	Temperature limits
EN-GJS-350-22-LT	5.3100	- 40 °C to 350 °C
EN-GJS-400-18-LT	5.3103	- 20 °C to 350 °C

5.2.4 Welding

Repair welding on spheroidal and malleable cast iron may be carried out at the foundry only if it is approved by the customer.

Production or repair welding shall not be carried out on parts manufactured from grey cast iron.

5.3 Materials — Wrought copper alloys

5.3.1 General

Materials shall be in accordance with Table 8.

Table 8 — Allowable material grades

Material symbol	Material number	Material composition in accordance with	Temperature limits[a]
	EN		
SF-Cu	CW024A	EN 1653	– 269 °C to 250 °C
CuZn40	CW509L	CEN/TS 13388	– 196 °C to 250 °C
CuZn39Pb0,5	CW610N	EN 1653	– 196 °C to 250 °C
CuZn20Al2	CW702R	EN 1653	– 10 °C [c] to 250 °C[b]
CuZn28Sn1	CW706R	CEN/TS 13388	– 269 °C to 250 °C[b]
CuZn32Pb2AsFeSi[c]	CW709R	EN 12163	– 10 °C to 200 °C
CuZn38Sn1	CW717R	EN 1653	– 10 °C [c] to 250 °C
CuZn38SnAl	CW715R	EN 1653	– 196 °C to 250 °C
CuNi10Fe1Mn	CW352H	EN 1653	– 269 °C to 300 °C
CuNi30Mn1Fe	CW354H	EN 1653	– 269 °C to 350 °C
CuAl10Ni5Fe4	CW307G	EN 1653	– 10 °C [c] to 250 °C
CuNi30Fe2Mn2	CW353H	CEN/TS 13388	– 269 °C to 250 °C
CuSn6[c]	CW452K	EN 12449	– 10 °C to 200 °C
CuZn36Pb2As[c]	CW602N	EN 12420	– 10 °C to 200 °C
CuZn39Pb3[c]	CW614N	EN 12420	– 10 °C to 200 °C
CuZn40Pb2[c]	CW617N	EN 12420	– 10 °C to 200 °C
CuSn5Pb5Zn5-C[c]	CC491K	EN 1982	– 10 °C to 260 °C [d]
CuSn7Pb3Zn2-C[c]	CC492K	EN 1982	– 10 °C to 260 °C
CuSn7Pb7Zn4-C[c]	CC493K	EN 1982	– 10 °C to 260 °C [d]
CuSn6Zn4Pb2-C[c]	CC498K	EN 1982	– 10 °C to 260 °C
CuAl10Fe2-C[c]	CC331G	EN 1982	– 10 °C to 260 °C
CuAl10Ni5Fe5-C[c]	CC333G	EN 1982	– 10 °C to 350 °C
CuZn33Pb2Si-C[c]	CC751S	EN 1982	– 10 °C to 200 °C
CuZn39Pb1Al-C[c]	CC754S	EN 1982	– 10 °C to 200 °C
CuAl8Fe3	CW303G	EN 12420	– 10 °C to 260 °C
CuAl10Fe3Mn2	CW306G	EN 12420	– 10 °C to 260 °C

[a] The lowest temperature limits given apply to non-welded parts. For welded parts, the lowest service temperatures are defined by the manufacturer.

[b] CuZn20Al2 F30, F33 and CuZn28Sn1 F32 only applicable up to 150 °C.

[c] Materials should be preferred.

[d] Material may be used down to – 196 °C if ductility and toughness of the material have been verified by additional Charpy impact testing.