TÖÖSTUSLIKUD VENTIILID. KORPUSE TUGEVUS. OSA 1: TERASEST VENTIILIKORPUSTE TABULEERIMISMEETOD

Industrial valves - Shell design strength - Part 1: Tabulation method for steel valve shells

EESTI STANDARDIKESKUS
ESTONIAN CENTRE FOR STANDARDISATION

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 12516-1:2014 sisaldab Euroopa standardi EN 12516-1:2014 ingliskeelset teksti.	This Estonian standard EVS-EN 12516-1:2014 consists of the English text of the European standard EN 12516-1:2014.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 29.10.2014.	Date of Availability of the European standard is 29.10.2014.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

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

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Industrial valves - Shell design strength - Part 1: Tabulation method for steel valve shells

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Industriearmaturen - Gehäusefestigkeit - Teil 1: Tabellenverfahren für drucktragende Gehäuse von Armaturen aus Stahl

This European Standard was approved by CEN on 9 August 2014.

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Foreword

This document (EN 12516-1:2014) 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of an identical text or by endorsement, at the latest by April 2015 and conflicting national standards shall be withdrawn at the latest by April 2015.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 12516-1:2005.

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 (Pressure Equipment Directive).

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

EN 12516 consists of four parts:

— EN 12516-1, *Industrial valves — Shell design strength — Part 1: Tabulation method for steel valve shells* (the present document);

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

— EN 12516-3, *Valves — Shell design strength — Part 3: Experimental method*;

— EN 12516-4, *Industrial valves — Shell design strength — Part 4: Calculation method for valve shells manufactured from metallic material other than steel*.

The main changes with respect to the previous edition are listed below:

a) addition of new PN values PN 160, PN 250, PN 320, PN 400;

b) B designation rating have been replaced by the PN designation;

c) B20 rating values have been replaced by Class 150 and use of the calculation method given in ASME B16.34;

d) new PN values have been added to Table 7 for the valve body minimum wall thickness values;

e) material tables have been updated to be in line with EN 1092-1 for the EN materials;

f) materials 1.0345 and 1.4458 have been deleted;

g) Annex B material groups has been updated and made normative;

h) special Class in EN material have been moved to an informative Annex C;

i) EN materials properties for pressure temperature calculation have been modified (R_m/3,5) to be consistent with the new ASME rules, and using $R_{p1\,\%}$ for stainless steel consistent with EN 12516-2;

j) ASTM material properties used for rating calculation have been updated to the new ASME B16.34 rules;

k) in the pressure-temperature calculation formula the stress factor S has been changed to 120,7 MPa in order to get a Ps of 775,7 bar which is the ceiling pressure when calculating the Special Class 4 500;

l) pressure/temperature ratings have been recalculated. For PN values they are now limited to the PN number; this has been done by increasing the Pc value in the pressure rating calculation method consequently the wall thickness for the PN designation has been increased;

m) Annexes D, E, F, G for NDE have been updated to the new EN standards and made informative;

n) Annex H limited Class has been made informative;

o) ASTM/ASME materials have been moved to an informative Annex I;

p) an informative Annex J on the relationship between DN, NPS, pipe inside diameter and outside diameter has been added;

q) Annex ZA has been updated.

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.

Introduction

EN 12516, *Industrial valves — Shell design strength*, is in four parts. EN 12516-1 and EN 12516-2 specify methods for determining the thickness of steel valve shells by tabulation or calculation methods respectively. EN 12516-3 establishes an experimental method for assessing the strength of valve shells in steel, cast iron and copper alloy as a type test by applying an elevated hydrostatic pressure at ambient temperature. EN 12516-4 specifies method for calculating the thickness for valve shells in metallic material other than steel.

The tabulation method, EN 12516-1, is similar in approach to ASME B16.34 in that the designer can look up the required minimum wall thickness dimension of the valve body from a table. The internal diameter of the inlet bore of the valve, gives the reference dimension from which the tabulated wall thickness of the body are calculated. It applies only to valve bodies, bonnets and covers with essentially circular cross-section. For valve shells with oval or rectangular shapes and for additional loads, EN 12516-2 should be used (see 8.6).

The calculation method, EN 12516-2 is similar in approach to the former DIN 3840 where the designer is required to calculate the wall thickness for each point on the pressure temperature curve using the allowable stress at that temperature for the material he has chosen. The allowable stress is calculated from the material properties using the safety factors that are defined in EN 12516-2. The formulae in EN 12516-2 consider the valve as a pressure vessel and ensure that there will be no excessive deformation or plastic instability.

EN 12516-1 specifies Standard and Special pressure/temperature ratings for valve shells with bodies having the tabulated thickness.

The tabulation method gives one thickness for the body for each PN (see 3.1) or Class designation depending only on the inside diameter, D_i, of the body at the point where the thickness is to be determined.

The thicknesses are calculated using the thin cylinder formula that is also used in EN 12516-2. The allowable stress used in the formula is equal to 120,7 MPa and the calculation pressure Pc varies according PN and Class designation.

For the Class designations, the rules for determining the pressure/temperature ratings are the same for both valve shells and flanges.

For PN designations rules for determining the pressure /temperature ratings are different for flanges and for valves, but this revision of the standard has adjusted the rules to get at room temperature the same pressure. The change of pressure in temperature needs to be taken into account by the piping/assembler.

The main reasons for the differences are due to the treatment of ceiling values. In PN flanges, a constant ceiling stress of 140 MPa at room temperature is applied. In PN and Class designations, the EN 12516-1 ceiling criteria apply, which are temperature dependent.

The reason for the down rating of Standard rating values relative to Special rating is that the Standard rating body is not subject to the specified non-destructive examination procedures and acceptance levels.

The thicknesses for all designations are approximately proportional to the Class 4 500 thickness in the ratio of the pressures.

This standard tabulates the commonly used ratings. It is possible to design shells to suit particular applications or markets using intermediate ratings. This data can be obtained using linear interpolation of the tabulated data in EN 12516-1.

A merit of the tabulation method, which has a fixed set of shell dimensions irrespective of the material of the shell, is that it is possible to have common patterns and forging dies. The allowable pressure/temperature rating for each material group varies proportional to the selected stresses of the material group to which the material belong.

A merit of the calculation method is that it allows the most efficient design for a specific application using the allowable stresses for the actual material selected for the application.

The two methods are based on different assumptions, and as a consequence the detail analysis is different. Both methods offer a safe and proven method of designing pressure-bearing components of valve shells.

1 Scope

This European Standard specifies the tabulation method for determining the wall thickness of valve bodies, bonnets and covers with essentially circular cross-section made in forged, cast or fabricated steel.

For valve shells with oval, rectangular or non-circular shapes, see 8.6.

The range of PN or Class designations for which thicknesses are tabulated is:

PN 2,5, PN 6, PN 10, PN 16, PN 25, PN 40, PN 63, PN 100, PN 160, PN 250, PN 320, PN 400, Class 150, Class 300,Class 600, Class 900, Class 1 500, Class 2 500, Class 4 500.

Pressure/temperature ratings are specified for each material group for the above PN Standard Class and Special Class designations.

The non-destructive examination procedures and acceptance levels that need to be applied to the valve shell components in order for the valve to be used at Special Class pressure/temperature ratings are defined.

Details are also given for the alternative rules for small bore valves of DN 65 and smaller designated as Limited Class.

This standard does not apply to threaded end valves:

— DN 80 or larger;

— or which have pressure ratings greater than Class 2 500;

— or which operate at temperatures greater than 540 °C.

Socket welding end valves DN 80 or larger are outside the scope of this standard.

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 19:2002, *Industrial valves — Marking of metallic valves*

EN 736-1, *Valves — Terminology — Part 1: Definition of types of valves*

EN 736-2, *Valves — Terminology — Part 2: Definition of components of valves*

EN 736-3, *Valves — Terminology — Part 3: Definition of terms*

EN 1092-1:2007+A1:2013, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1759-1:2004, *Flanges and their joint — Circular flanges for pipes, valves, fittings and accessories, Class designated — Part 1:Steel flanges, NPS ½ to 24*

EN 10028-2:2009, *Flat products made of steels for pressure purposes — Part 2: Non-alloy and alloy steels with specified elevated temperature properties*

EN 10028-3:2009, *Flat products made of steels for pressure purposes — Part 3: Weldable fine grain steels, normalized*

EN 10028-4:2009, *Flat products made of steels for pressure purposes — Part 4: Nickel alloy steels with specified low temperature properties*

EN 10028-7:2007, *Flat products made of steels for pressure purposes — Part 7: Stainless steels*

EN 10213:2007, *Steel castings for pressure purposes*

EN 10222-2:1999, *Steel forgings for pressure purposes — Part 2: Ferritic and martensitic steels with specified elevated temperature properties*

EN 10222-3:1998, *Steel forgings for pressure purposes — Part 3: Nickel steels with specified low temperature properties*

EN 10222-4:1998, *Steel forgings for pressure purposes — Part 4: Weldable fine grain steels with high proof strength*

EN 10222-5:1999, *Steel forgings for pressure purposes — Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels*

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

EN 12627:1999, *Industrial valves — Butt welding ends for steel valves*

EN ISO 9692-1:2013, *Welding and allied processes — Types of joint preparation — Part 1: Manual metal arc welding, gas-shielded metal arc welding, gas welding, TIG welding and beam welding of steels (ISO 9692-1:2013)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 736-1, EN 736-2 and EN 736-3 and the following apply.

3.1
PN (body)
alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system

Note 1 to entry: It comprises the letter PN followed by a dimensionless number.

Note 2 to entry: See EN 736-3.

3.2
Class
alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system

Note 1 to entry: It comprises the word Class followed by a dimensionless whole number.

Note 2 to entry: See EN 736-3.

3.3
Special
designation associated Special Class threaded end or welding end valves which indicates that the shell components have been subjected to the specified levels of non-destructive examination (NDE) and that the valve can be used for a higher pressure/temperature rating