SLOVENSKI STANDARD
SIST EN 12573-4:2000

01-december-2000

Welded static non-pressurised thermoplastic tanks - Part 4: Design and calculation of flanged joints

Welded static non-pressurised thermoplastic tanks - Part 4: Design and calculation of flanged joints

Geschweißte orstfeste drucklose Behälter (Tanks) aus Thermoplasten - Teil 4: Konstruktion und Berechnung von Flanschverbindungen

Cuves statiques soudées en matieres thermoplastiques sans pression - Partie 4: Conception et calculs des joints a brides

Ta slovenski standard je istoveten z: EN 12573-4:2000

ICS:

23.020.10	Nepremiļ ne posode in rezervoarji	Stationary containers and tanks
23.040.60	Prirobnice, oglavki in spojni elementi	Flanges, couplings and joints

SIST EN 12573-4:2000 en

EUROPEAN STANDARD
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ICS 23.020.10; 23.040.60

English version

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This European Standard was approved by CEN on 14 February 2000.

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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 Central Secretariat has the same status as the official versions.

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 266 "Thermoplastic static tanks", 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of an identical text or by endorsement, at the latest by September 2000, and conflicting national standards shall be withdrawn at the latest by September 2000.

prEN 12573:1999 "Welded static non-pressurised thermoplastic tanks" consists of:

Part 1: General principles
Part 2: Calculation of vertical cylindrical tanks
Part 3: Design and calculation of single skin rectangular tanks
Part 4: Design and calculation of flanged joints

The normative annex A gives the values for the calculation of loose metal backing rings

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This part of this standard specifies the design and calculation of circular flanged joints, fabricated in the following thermoplastics:

Polyethylene (PE)
Polypropylene (PP)
Poly (vinyl chloride) (PVC)
Poly (vinylidene fluoride) (PVDF)

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 12573-1:1999 Welded static non-pressurised thermoplastic tanks – Part 1: General principles

EN 1778 Characteristic values for welded thermoplastic constructions – Determination of allowable stresses and moduli for design of thermoplastic equipment

3 Symbols and abbreviations

For the purposes of this part of this Standard the following symbols and abbreviations apply:

A_1	is the reduction factor to take account of the effect of specific strength, see EN 1778
A_{2K}	is the reduction factor taking into account the effect of surrounding medium, see EN 1778
a	is the depth of the weld seam, in millimetre
b	is the effective double flange width, in millimetre
b_D	is the gasket width, in millimetre
C,	are welding process constants
c	is the corrosion allowance, in millimetre
d_D	is the gasket mean diameter, in millimetre

d_K	is the bolt shank diameter, in millimetre
d_L	is the bolt hole diameter, in millimetre
d'_L	is the reduced bolt hole diameter, in millimetre
d_a	is the outside diameter of flange, in millimetre
d_i	is the inside diameter of cylindrical components, in millimetre
d_t	is the pitch circle diameter, in millimetre
d_1	is the inside diameter of loose backing ring, in millimetre
d_2	is the mean contact diameter of a flange or stub flange, in millimetre
d_3	is the d_1 + 2 x flange edge radius, in millimetre, see figure 15
f_1	is the depth of the weld undercut, in millimetre
h_D	is the gasket thickness, in millimetre
h_F	is the required thickness of a flange plate, in millimetre
K	is the creep strength at the design temperature and lifetime, in newton per square millimetre, see EN 1778
K'	is the creep strength at a test condition (temperature and time), in newton per square millimetre
K_D	is the deformation resistance of gasket material, in newton per square millimetre
K_{Fl}	is the allowable yield stress of loose backing ring material (metal), in newton per square millimetre
K_{Schr}	is the allowable yield stress of bolt material, in newton per square millimetre
k_O	is the characteristic value of a gasket in the assembled condition, in millimetre
k_1	is the characteristic value of a gasket in the operating condition, in millimetre
L_a	is the flange neck height, in millimetre
l	is the lever arm of bolt force, in millimetre
n	is the number of bolts
P_{DV}	is the assembly force, in newton
P_{Fl}	is the surface pressure, in newton per square millimetre
P_{SB}	is the bolt force in operating condition, in newton
P'_{SB}	is the bolt force at test pressure, in newton
P_{SO}	is the bolt force in assembled condition prior to application of pressure, in newton
p	is the operating pressure above atmospheric, in bar
p'	is the test pressure, in bar
S	is the safety factor, see part 1
S_M	is the safety factor for metals in operating condition
S'_M	is the safety factor for metals in test and assembled condition
t	is the wall thickness of cylindrical component, in mm
v	is the weakening coefficient
W_1, W_2, W_3	are the moments of resistance of the flange, in cubic millimetre
y_1, y_2	is the lever arm of the forces acting on the O-ring, in millimetre
α	is the angle, in degrees

4 Design requirements

4.1 General

Various types of flanges are characterized by their shapes as shown in figure 1 to 4:

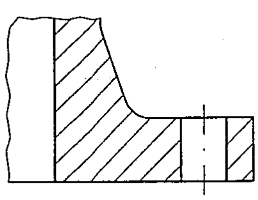

Figure 1: Fusion weld, moulded full face flange

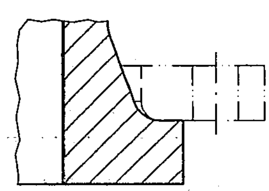

Figure 2: Fusion welded stub flange

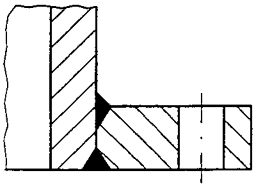

Figure 3: Welded-on full face flange

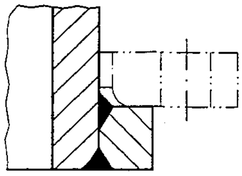

Figure 4: Welded-on stub flange

All these flange joints shall be designed with a continuous gasket or O-ring, see figures 5 to 10:

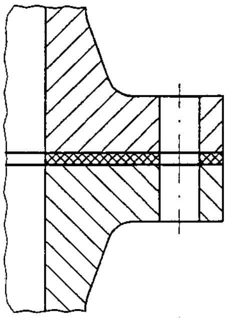

Figure 5: Full face flanges with continuous gasket

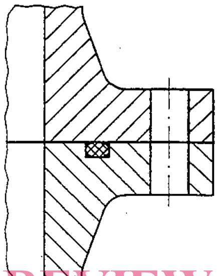

Figure 6: Full face flanges with O-ring

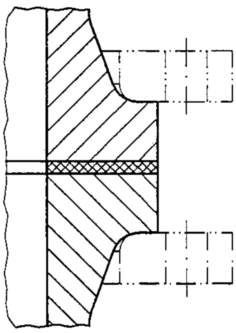

Figure 7: Stub flanges with continuous gasket

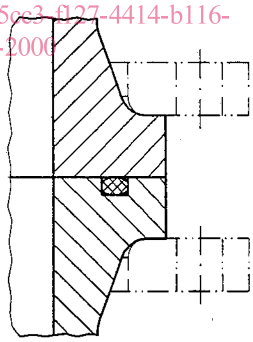

Figure 8: Stub flanges with O-ring

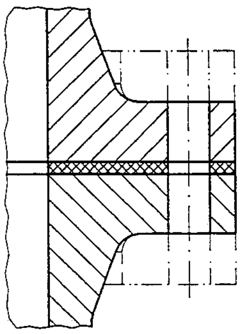

Figure 9: Full face flange and loose metal backing ring

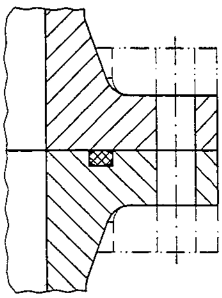

Figure 10: Full face flange and loose metal backing

4.2 Design principles

The number of bolts shall be chosen as large as possible, so that a uniform seal can be ensured. The number of bolts shall be at least four. The bolt spacing in thermoplastic flanges shall not exceed 5 d_L and shall not be greater than 80 mm.

At low pressures the calculation can produce a flange thickness which is so small that the flanges can be deformed by the bolts forces.

When positioned in the side wall of a tank below the liquid level, all flanges shall be reinforced with a loose backing ring (e. g. GRP or steel), see figure 9 and 10.

NOTE 1: For design examples see [2] of Bibliography.

NOTE 2: When selecting the gasket material, the thermal and chemical resistance should be considered carefully. Gaskets of soft material are preferred.

5 Calculation of the properties of bolts

5.1 General

The inside diameter of the thread of the steel bolt shall be the largest value calculated from equation (1) or (2):

a) for the operating condition

$$d_k = Z\sqrt{\frac{P_{SB}}{K_{Schr} \bullet n}} + c \qquad (1)$$

b) for the assembled condition

$$d_K = Z\sqrt{\frac{P_{SO}}{K_{Schr} \bullet n}} + c \qquad (2)$$

where:

Z = 1.75 for steel bolts, with known allowable yield stress, where $p' \leq 1{,}3\ p$

c = 3 mm

External forces, e. g. due to thermal expansion, are not taken into account in equations (1) and (2).

5.2 Calculation of the bolt forces in the case of continuous gaskets

5.2.1 Operating condition

The bolt force in the operating condition shall be calculated according to equation (3).

$$P_{SB} = \frac{p}{10}\left(\frac{\pi \bullet d_D^2}{4} + 3{,}8\ d_D \bullet k_l\right) \qquad (3)$$

5.2.2 Assembled condition

The bolt force in assembled condition shall be calculated according to equation (4).

$$P_{SO} = P_{DV} = \pi \bullet d_D \bullet k_O \bullet K_D \tag{4}$$

If P_{SO} becomes greater than P_{SB}, then P_{SO} shall be calculated according to equation (5).

$$P_{SO} \quad 0{,}2P_{DV} + 0{,}8\sqrt{P_{SB} \cdot P_{DV}}$$

The gasket parameters k_1 and $k_0 \cdot K_D$ shall be taken from table 1.

5.3 Calculation of the bolt forces in the case of O-ring gaskets

5.3.1 Flanges with O-ring gasket

The bolt force in the operating condition for flanges with O-ring gaskets, see figure 11, shall be calculated according to equation (6).

$$P_{SB} = \frac{p \bullet \pi \bullet d_D^2}{40} \bullet \frac{y_1}{y_2} \tag{6}$$

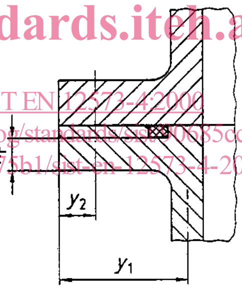

Figure 11: Flange with O-ring gasket

5.3.2 Stub flanges with O-ring gasket

The bolt force in the operating condition for stub flanges with O-ring gaskets, see figure 12, shall be calculated according to equation (7).

$$P_{SB} = \frac{p \bullet \pi \bullet d_D^2}{40} \tag{7}$$

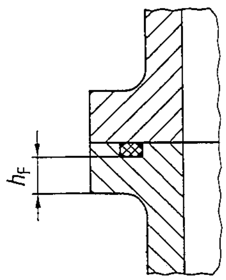

Figure 12: Stub flange with O-ring gasket