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## Welded static non-pressurised thermoplastic tanks – Part 2: Calculation of vertical cylindrical tanks

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Swedish Standards corresponding to documents referred to in this Standard are listed in "Catalogue of Swedish Standards", issued by SIS. The Catalogue lists, with reference number and year of Swedish approval, International and European Standards approved as Swedish Standards as well as other Swedish Standards.

## Svetsade stationära icke trycksatta termoplasttankar – Del 2: Beräkning av vertikala cylindriska tankar

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EUROPEAN STANDARD

**EN 12573-2**

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 2000

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ICS 23.020.10

English version

## Welded static non-pressurised thermoplastic tanks - Part 2: Calculation of vertical cylindrical tanks

Cuves statiques soudées en matières thermoplastiques  
sans pression - Partie 2: Calcul des cuves cylindriques  
verticales

Geschweißte ortsfeste drucklose Behälter (Tanks) aus  
Thermoplasten - Teil 2: Berechnung von runden stehenden  
Behältern (Tanks)

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

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



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COMITÉ EUROPÉEN DE NORMALISATION  
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## 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

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 standard establishes rules for the design and calculation of welded static, vertical, non-pressurised, cylindrical, flat-bottom thermoplastic tanks. This standard applies to tanks fabricated in the following thermoplastics:

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

This standard does not take into account wind and/or snow loading. If wind or/and snow loading has to be taken into account additional calculations are necessary.

This standard is applicable to tanks in which the cylindrical shell is made of welded plates or a wound cylinder or an extruded pipe.

The calculation takes into account short-term and long-term active pressures as well as the hydrostatic loading. The following values are long-term pressures and represent the limiting values:

- Overpressure:  $0,0005 \text{ N/mm}^2$  (0,005 bar)
- Low pressure:  $0,0003 \text{ N/mm}^2$  (0,003 bar)

This standard is only applicable to tanks which are not intended to withstand internal pressure or vacuum, other than that which may occur during the transfer of fluids (including gases) in their normal operation.

## 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	is the depth of the weld seam, in millimetre
b	is the width of the nozzle compensation around the nozzle, in millimetre
$C_1$	is the load increase factor
$C_2$	is the material specific design factor
$C_3$	is the design factor for a two layered tank
C	is $C_1 \times C_2$
d	is the nominal inside diameter of the tank, in millimetre
$d_A$	is the nozzle outside diameter, in millimetre
$d_L$	is the diameter of hole in lifting lug, in millimetre
$E_{c(al.)st}$	is the allowable creep modulus at the design condition for stability (temperature, stress, time, medium, safety), in newton per square millimetre, see EN 1778
$f_l$	is the long-term welding factor
g	is the acceleration due to gravity, in metre per square second ( $9,81 \text{ m/s}^2$ )
$g_d$	is the surface related weights, in newton per square millimetre
$h_F$	is the height at the maximum filling capacity, in millimetre
$h_{F(i)}$	is the height of the liquid above the lower edge of the band (i), in millimetre
$h_Z$	is the total cylindrical height, in millimetre
$h_{ZF}$	is the height of the lower band, in millimetre
$l_m$	is the height of the equivalent middle band from stability calculations, in millimetre
$l_o$	is the height of the equivalent upper band from stability calculations, in millimetre
$l_u$	is the height of the equivalent lower band from stability calculations, in millimetre
$p_e$	is the continuously active external pressure, in newton per square millimetre
$p_i$	is the continuously active internal pressure, in newton per square millimetre
$p_{stat}$	is the overpressure at the tank base due to the contents, in newton per square millimetre
$p_{stat(i)}$	is the overpressure at lower edge of the band (i) due to the contents, in newton per square millimetre
S	is the safety factor (see part 1)
$T_A$	is the temperature of the outside air, in degree celsius
$T_D$	is the temperature of the roof, in degree celsius
$T_M$	is the contents' temperature, in degree celsius
t	is the calculated thickness of the band omitting the welding factor $f_l$ from the calculation of $\sigma_{al}$ , in millimetre
$t_B$	is the thickness of the base, in millimetre
$t_D$	is the thickness of the roof, in millimetre
$t_m$	is the thickness of the equivalent middle band from stability calculations, in millimetre
$t_o$	is the thickness of the equivalent upper band from stability calculations, in millimetre

$t_u$	is the thickness of the equivalent lower band from stability calculations, in millimetre
$t_u^*$	is the thickness of the equivalent lower band from the stress calculation, in millimetre
$t_{Z(i)}$	is the thickness of the band (i) in the case of varying skin thickness tanks, in millimetre
$t_{ZF}$	is the thickness of the lowest band of single layered tanks, in millimetre
$t_{ZN}$	is the thickness of the nozzle compensation plus the calculated element thickness, in millimetre
$t_{ZF}$	is the overall thickness of the lowest band of a multilayered tank, in millimetre
$t_{Z0'}$	is the thickness of the outer wall of a multilayered tank, in millimetre
$t_{Z1'}$	is the thickness of the inner wall of a multilayered tank, in millimetre
$V$	is the filling volume, in cubic millimetre
$V_A$	is the weakening coefficient
$\alpha$	is the angle of inclination of the roof, in degree
$\varepsilon$	is the permissible edge expansions, in percent
$\lambda$	is the buckling coefficient
$\rho$	is the density of the thermoplastic material, in gram per cubic centimetre
$\rho_F$	is the density of the contents, in gram per cubic centimetre
$\sigma_{al}$	is the allowable stress at the design condition, in newton per square millimetre, see EN 1778

The figures 1 to 4 illustrate the main dimensions of tanks.

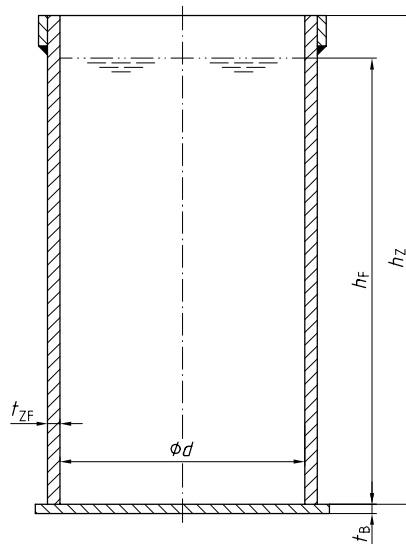


Figure 1: Open flat-base tank with constant wall thickness

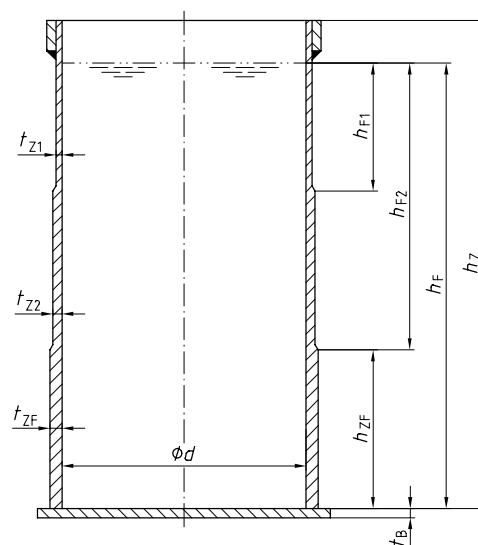


Figure 2: Open flat-base tank with varying wall thickness (three bands)

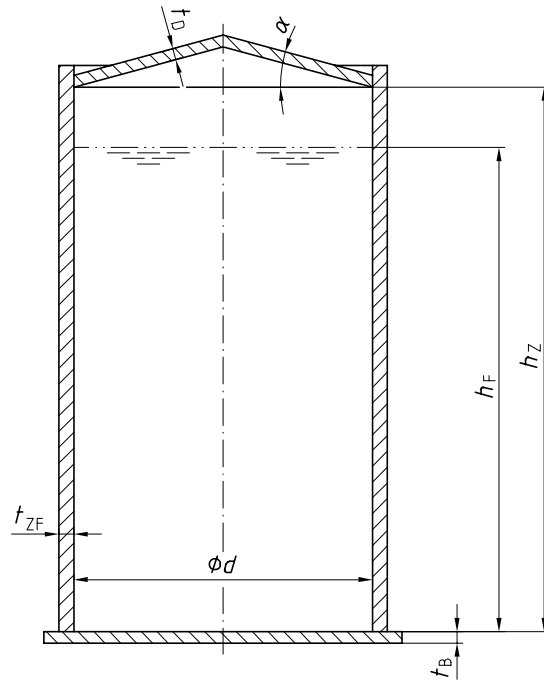


Figure 3: Flat-base tank with conical roof and constant wall thickness

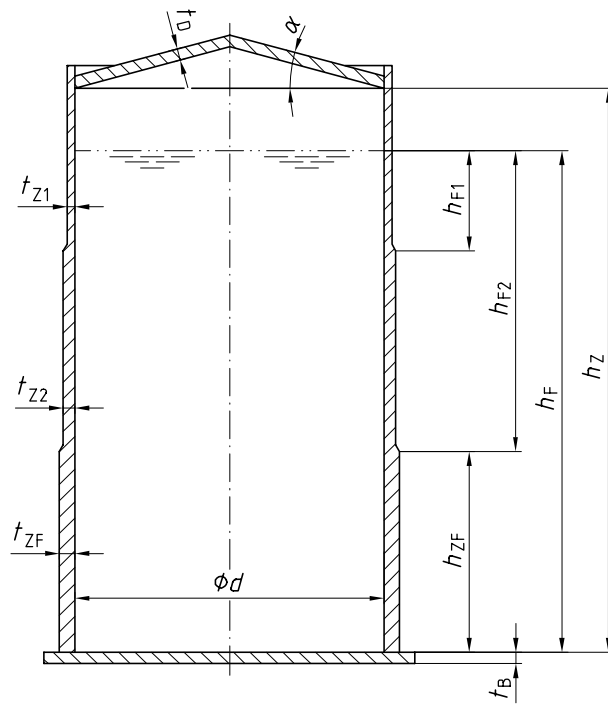


Figure 4: Flat-base tank with conical roof and varying wall thickness (three bands)