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Plastics piping systems for hot and cold water installations — Guidance for classification and design

Systèmes de canalisations en plastique destinés aux installations d'eau chaude et froide — Lignes directrices pour la classification et la conception

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 10508 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 2, *Plastics pipes and fittings for water supplies*.

This second edition cancels and replaces the first edition (ISO 10508:1995), which has been technically revised. In particular, Clauses 6 to 10 have been deleted, and all product testing and fitness-for-purpose requirements have been referenced to the relevant product or system standards.

Introduction

This International Standard gives guidance for the classification and design of plastics piping systems for hot and cold water installations

Performance requirements are specified in the relevant product or systems standards.

A list of current product or systems standards is given in Annex B.

Plastics piping systems for hot and cold water installations — Guidance for classification and design

1 Scope

This International Standard gives guidance for the classification and design of hot and cold water pressure systems which use plastics pipes and plastics or metal fittings.

It establishes a classification system for common service conditions for pressurized hot and cold water systems. It gives a basis for evaluation and design of thermoplastics pipes and fittings in relation to the system performance requirements.

It applies to plastics piping systems used to carry water

a) in distribution systems of hot and cold water, including potable water, and

b) in transportation systems of hot water for heating,

under design pressures up to at least 10 bar [1] at 20 °C and up to 10 bar at temperatures according to the class of application (see Table 1).

For values of T_D, T_{max} and T_{mal} in excess of those in Table 1, this International Standard is not applicable.

Acceptance of any pipe(s) and/or fitting(s) made from a specific grade of material is subject to the relevant product or systems standard and the requirements detailed there.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7686, *Plastics pipes and fittings — Determination of opacity*

ISO 9080, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

ISO 12162, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient*

ISO 13760, *Plastics pipes for the conveyance of fluids under pressure — Miner's rule — Calculation method for cumulative damage*

1) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
design temperature
T_D
temperature or a combination of temperatures of the conveyed water related to the circumstances for which the system has been designed

3.2
maximum design temperature
T_{max}
highest design temperature, T_D, occurring for short periods only

3.3
malfunction temperature
T_{mal}
highest temperature that can be reached when the control limits are exceeded

NOTE This can occur up to a total of 100 h over a period of 50 years.

3.4
cold water temperature
T_{cold}
temperature of conveyed cold water of up to approximately 25 °C

NOTE For design purposes, 20 °C is used.

3.5
design pressure
p_D
highest pressure related to the circumstances for which the system has been designed

3.6
treated water for heating installations
water intended for heating installations which contains additives which have no detrimental effect on the system

4 Classification of service conditions

The performance requirements are formulated for five different classes and are shown in Table 1. Each class relates to a field of application and for a design period of 50 years. The derivation of the temperature-time profiles is given in Annex A. These applications are given as guidance and are not requirements. In countries with extreme weather conditions other classes may be preferred.

For applications not given in Table 1, the choice of the proper classification shall be agreed by the parties concerned.

All materials coming into contact with water intended for human consumption, up to a temperature of 80 °C shall not present any health risk.

All systems of components for use and in contact with potable water shall meet the water quality and health regulations operating in the country of use.

Table 1 — Classification of service conditions

Application class	T_D		T_{max}		T_{mal}		Typical field of application
	°C	Time [a] years	°C	Time years	°C	Time h	
1 [b]	60	49	80	1	95	100	Hot water supply (60 °C)
2 [b]	70	49	80	1	95	100	Hot water supply (70 °C)
3 [c]	20 30 40	0,5 20 25	50	4,5	65	100	Low-temperature under-floor heating
4	20 40 60	2,5 20 25	70	2,5	100	100	Under-floor heating and low-temperature radiators
5	20 60 80	14 25 10	90	1	100	100	High temperature radiators

NOTE This International Standard is only applicable to sealed systems which do not have values of T_D, T_{max} and T_{mal} in excess of those stated for class 5.

[a] Where more than one design temperature appears for any class, the times should be aggregated (e.g. the design temperature profile for 50 years for class 5 is 20 °C for 14 years, followed by 60 °C for 25 years, 80 °C for 10 years, 90 °C for 1 year and 100 °C for 100 h).

[b] Depending upon international, national or local regulations.

[c] Only allowed when the malfunction temperature cannot rise above 65 °C.

All systems which satisfy the conditions specified in Table 1 for one of the five classes shall also be suitable for the transportation of cold water for a period of 50 years at a temperature of 20 °C and a design pressure of 10 bar. This shall be demonstrated by using the standard extrapolation method specified in ISO 9080, or another appropriate extrapolation method.

When the specified service life is less than 50 years, all the times given in Table 1 shall be reduced by a proportionate amount, except for the time for malfunction, which shall remain at 100 h.

All heating installations should only use water or treated water as the transfer fluid. When considering problems of material compatibility such as oxygen permeation, advice should be sought from the manufacturer.

The thermal stability of the material used for the pipes or fittings shall conform to the requirements of the relevant product standard, for the intended application.

When the pipes are stated to be opaque they shall meet the minimum recommended requirement given in ISO 7686 or the relevant product standard.

Not all plastics formulations allow for extended outside storage of pipes or fittings. The user shall contact the manufacturer of the pipe or fitting before considering long-term external storage.

Plastics pipes and plastics fittings shall only be directly connected to a heat-generating source when recommended by the pipes or fittings manufacturer.

5 Design

5.1 Classification

The appropriate class from Table 1 shall be selected for each intended application.

The maximum allowable stress to a design period of 50 years shall be calculated using the stress values taken from the reference curves in the relevant product standards and applying Miner's Rule according to ISO 13760 with the appropriate overall service (design) coefficients given in the relevant product standard.

In the absence of reference curves the maximum allowable stress shall be calculated using stress values obtained by an evaluation according to the extrapolation method according to ISO 9080 and using the same method as described above.

5.2 Dimensions

Calculate

$$\frac{\sigma}{p_D} \tag{1}$$

and

$$\frac{\sigma_1}{p_1} \tag{2}$$

where

σ is the design stress of the particular class;

p_D is the design pressure.

σ_1 is the design stress [incorporating an overall service (design) coefficient for the material used according to ISO 12162] at 20 °C relative to a design period of 50 years;

p_1 is the design pressure at 20 °C.

The lower value shall then be used to determine the minimum design wall thickness by solving the following equation:

$$\frac{\sigma}{p} = \frac{d - e}{2e} \tag{3}$$

where

$\frac{\sigma}{p}$ is taken from Equation (1) or (2);

d is the nominal outside diameter;

e is the minimum design wall thickness.

Annex A
(informative)

Derivation of temperature-time profiles

A.1 Data for profiles

For the construction of temperature-time profiles, use has been made of data from Austria, France and Germany. Using DIN 4702 [1], the radiator inlet temperatures as a semi-empirical function of the outside temperature was determined to give temperature-time profiles with many components.

As an example for Bremerhaven, Germany, according to DIN 4710 [2], the data in Table A.1 was generated.

Table A.1 — Data for Bremerhaven

Temperature T °C	**Hours per year** (30-year average)	**Percentage of total time**
80 to 90	148	1,7
70 to 80	1 158	13,2
60 to 70	1 955	22,3
50 to 60	1 517	17,3
40 to 50	1 687	19,2
30 to 40	1 283	14,6
20 to 30	646	7,4
$<$ 20	373	4,3

Less severe conditions were recorded in other cities, for example, in Essen, Frankfurt am Main, Berlin and Munich, Germany, Besse, Cherbourg and Abbeville, France, and Vienna, Austria.

To make a more practical temperature-time profile, fractions have been combined as follows:

a) Hours given for a temperature range (decade) are all taken as if obtained at the highest temperature.

b) When adding a temperature decade to a higher temperature decade (for example, the hours at 60 °C to 70 °C to the hours at 70 °C to 80 °C), the time is reduced by a factor of 2,5. When transferred to a lower decade the time is multiplied by the same factor. This follows the procedures given in ISO 9080 and DIN 16887 [3].

c) The conversion factor is taken as 2,5 but can normally range from 2,5 to 3,0. Taking the factor as 2,5 results in a more severe temperature-time profile.

d) Figures are rounded, as appropriate.

e) Malfunction time is not considered as part of the temperature-time profile but is included in the application of Miner’s rule.

A.2 Example

As an illustration, the data given for Bremerhaven in Table A.1 are used.

1,7 % at 90 °C is rounded up to 2 %.

In order to obtain a rounded figure of 20 % at 80 °C of the 22,3 % at 70°C, 15 % is divided by 2,5 (which gives 6 %) and added to 13,2 % at 80 °C, giving a total of 19,2 %, which is then rounded up to 20 %.

Of the 7,3 % remaining at 70 °C, this is multiplied by 2,5 (which gives 18 %) and added to the 17,3 % at 60 °C, giving a total of 35 %.

The 19,2 % at 50 °C is divided by 2,5 (which gives 8 %) and added to 35 % at 60 °C to give a total of 43 %, which is then rounded up to 50 %.

The resulting temperature-time profile is as follows:

90 °C: 2 %

80 °C: 20 %

60 °C: 50 %

The profile can be determined similarly for lower temperatures and/or different combinations of temperature decades.

Annex B
(informative)

Product standards for plastics piping systems for hot and cold water installations

NOTE In the future, new International Standards for hot and cold water installations currently under development could be added to the following list.

ISO 15874-1, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 1: General*

ISO 15874-2, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 2: Pipes*

ISO 15874-3, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 3: Fittings*

ISO 15874-5, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 5: Fitness for purpose of the system*

ISO 15875-1, *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X) — Part 1: General*

ISO 15875-2, *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X) — Part 2: Pipes*

ISO 15875-3, *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X) — Part 3: Fittings*

ISO 15875-5, *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X) — Part 5: Fitness for purpose of the system*

ISO 15876-1, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) — Part 1: General*

ISO 15876-2, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) — Part 2: Pipes*

ISO 15876-3, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) — Part 3: Fittings*

ISO 15876-5, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) — Part 5: Fitness for purpose of the system*

ISO 15877-1, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride (PVC-C) — Part 1: General*

ISO 15877-2, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride (PVC-C) — Part 2: Pipes*

ISO 15877-3, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride (PVC-C) — Part 3: Fittings*

ISO 15877-5, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride (PVC-C) — Part 5: Fitness for purpose of the system*

ISO 22391-1, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 1: General* [2)]

ISO 22391-2, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 2: Pipes* [2)]

ISO 22391-3, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 3: Fittings* [2)]

ISO 22391-5, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 5: Fitness for purpose of the system* [2)]

2) To be published.

Bibliography

[1] DIN 4702, *Boilers for central heating*

[2] DIN 4710, *Statistics on German meteorological data for calculating the energy requirements for heating and air conditioning equipment*

[3] DIN 16887, *Determination of the long-term hydrostatic pressure resistance of thermoplastics pipes*

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