Polyethylene (PE) pipes
General quality requirements and testing

DIN 8075

ICS 23.040.20

Supersedes May 1987 edition.

Rohre aus Polyethylen (PE) – PE 63, PE 80, PE 100, PE-HD –
Allgemeine Güteanforderungen, Prüfung

In keeping with current practice in standards published by the International Organization for Standardization (ISO), a comma has been used throughout as the decimal marker.

Contents

Foreword

This standard has been prepared by Technical Committee *Prüfverfahren für Rohre* of the *Normenausschuß Kunststoffe* (Plastics Standards Committee).

Amendments

This standard differs from the May 1987 edition as follows:

a) the material designations have been modified;

b) requirements for resistance to hydrostatic pressure have been modified;

c) service life is now assumed to be 100 years (at temperatures up to 20 °C);

d) testing for ovality has been included.

Previous editions

DIN 8075: 1960-07, 1965-01, 1987-05; DIN 8075-1: 1976-03, 1976-08; DIN 8075-2: 1980-05.

Continued on pages 2 to 11.

Translation by DIN-Sprachendienst.

In case of doubt, the German-language original should be consulted as the authoritative text.

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All dimensions are in mm.

1 Scope

This standard specifies requirements and methods of test for straight seamless pipes of circular cross section made from type PE 63, PE 80 and PE 100 polyethylene.

Pipes made from high-density polyethylene (PE-HD) (see Appendix A) are suitable for non-pressure applications and for use as conduits.

Individual requirements specified here may be superseded by technical delivery conditions for particular applications.

2 Normative references

This 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 titles of the publications are listed below. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

DIN 323-1	Preferred numbers and preferred number series – Basic, calculated and rounded values
DIN 8074	Polyethylene (PE) pipes – Dimensions
DIN 52612-1	Determination of the thermal conductivity of thermal insulating materials by the guarded hotplate apparatus – Procedure and evaluation
DIN EN 743	Plastics piping and ducting systems – Thermoplastics pipes – Determination of longitudinal reversion
DIN EN 921	Thermoplastics pipes – Determination of resistance to internal pressure at constant temperature
DIN EN 10204	Inspection documents for metallic products (includes Amendment A 1 : 1995)
DIN EN ISO 178	Determination of the flexural properties of plastics (ISO 178 : 1993)
DIN EN ISO 12162	Thermoplastics materials for pipes and fittings for pressure applications – Classification and designation – Overall service (design) coefficient (ISO 12162 : 1995)
ISO/TR 9080 : 1992	Thermoplastics pipes for the transport of fluids – Methods of extrapolation of hydrostatic stress rupture data to determine the long-term hydrostatic strength of thermoplastics pipe materials
IEC 60093	Methods of test for insulating materials for electrical purposes – Volume resistivity and surface resistivity of solid electrical insulating materials

3 Concepts

3.1 Long-term hydrostatic pressure resistance

The strength of a pipe required to resist an induced internal hydrostatic pressure, in N/mm², calculated as follows:

$$\sigma = p \, \frac{d - s}{2s} \quad (1)$$

where

p is the induced hydrostatic pressure;

d is the outside diameter;

s is the wall thickness.

3.2 Material designation

Designation of polyethylene moulding materials, based on the minimum required strength, MRS, in water at 20 °C for 50 years, as specified in DIN EN ISO 12162 (with the exception of pipes made from PE-HD).

Table 1: Material designation

Material designation	Minimum required strength*), MRS, in N/mm²
PE 63	6,3
PE 80	8,0
PE 100	10,0
PE-HD	–
*) See DIN EN ISO 12162 for definition.	

3.3 Ovality

The difference between the maximum and minimum pipe outside diameters at the same cross section.

4 Material (moulding material)

4.1 General

Pipes shall be made from polyethylene (PE), stabilized using suitable antioxidants and usually coloured throughout with carbon black or other pigments. The choice of stabilizers and other additives shall be left to the pipe manufacturer. Moulding materials of unknown composition shall not be used.

4.2 Checking long-term hydrostatic pressure resistance

In the case of pipes made from PE 63, PE 80 and PE 100, values for hydrostatic pressure resistance shall lie on or above the time-to-failure (t) curves, as shown in figures 1 to 3, and established using the following equation:

$$\lg t = A + \frac{C}{T} + D \cdot \lg \sigma \tag{2}$$

where

σ is the induced hydrostatic stress;

A, C, and D are coefficients as in table 2;

T is the temperature in K.

Table 2: Coefficients for determining the time-to-failure curves

Material	Section of curve	Coefficients		
		A	C	D
PE 63	Flat	−41,4173	22008,5722	−35,0987
	Steep	−19,8823	8619,3570	−3,0390
PE 80	Flat	−40,9578	23596,3495	−37,5758
	Steep	−19,9417	8804,4333	−3,3219
PE 100	Flat	−38,9375	24482,4670	−38,9789
	Steep	−20,3159	9342,6930	−4,5076

Analysis according to ISO/TR 9080 requires the temperature-dependent extrapolation time limits to be taken into consideration.

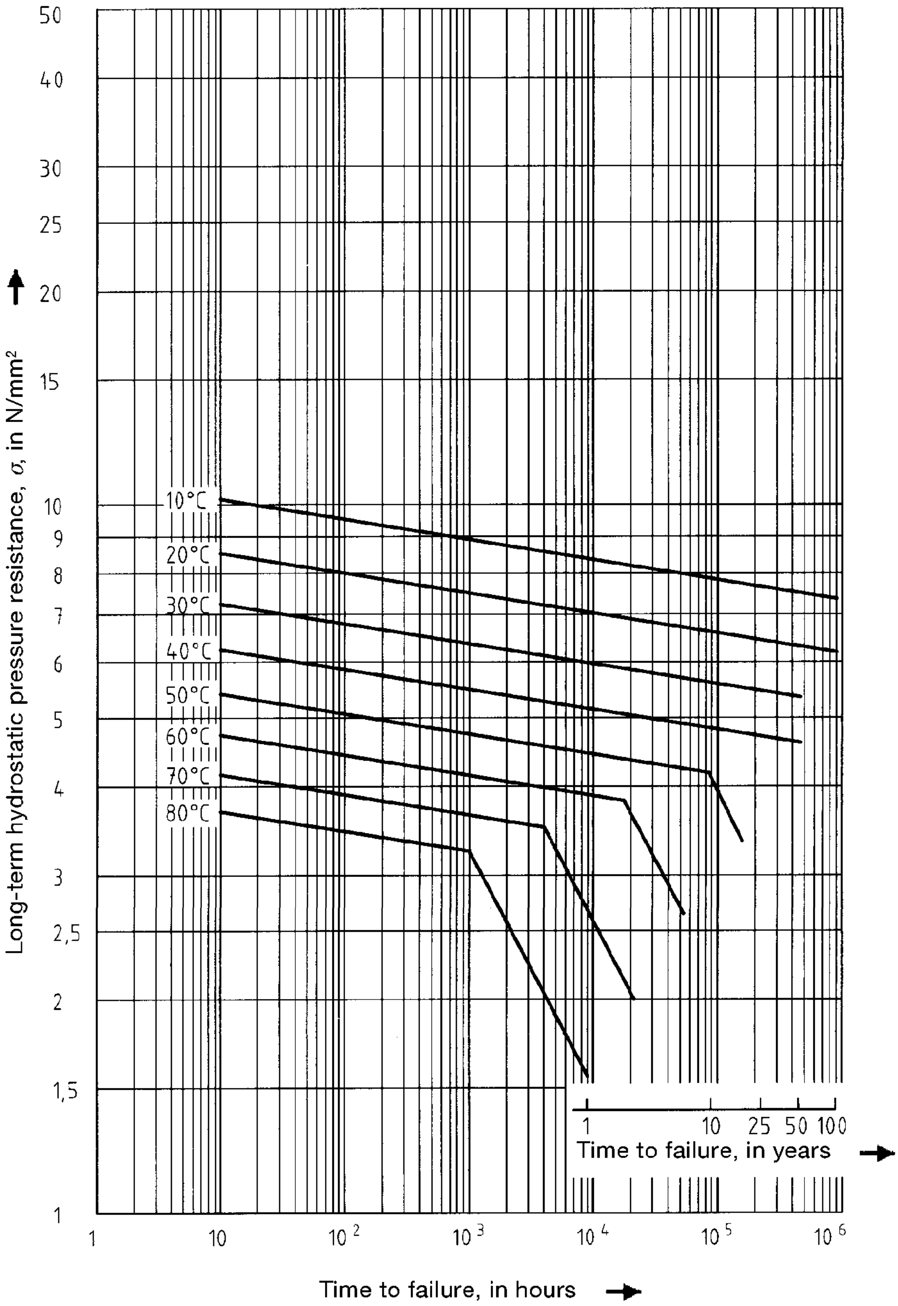

Figure 1: Long-term hydrostatic pressure resistance of pipes made from PE 63

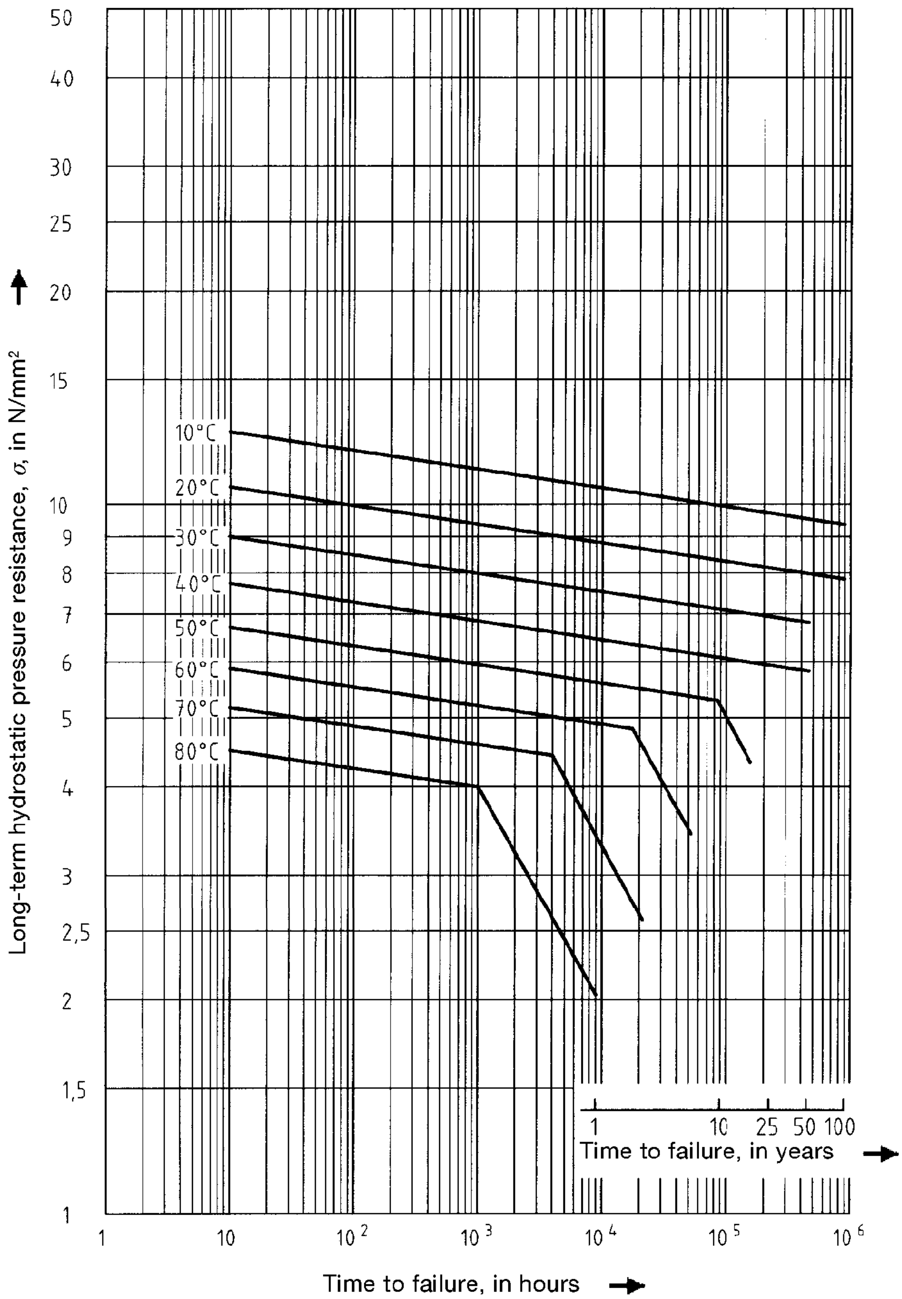

Figure 2: Long-term hydrostatic pressure resistance of pipes made from PE 80

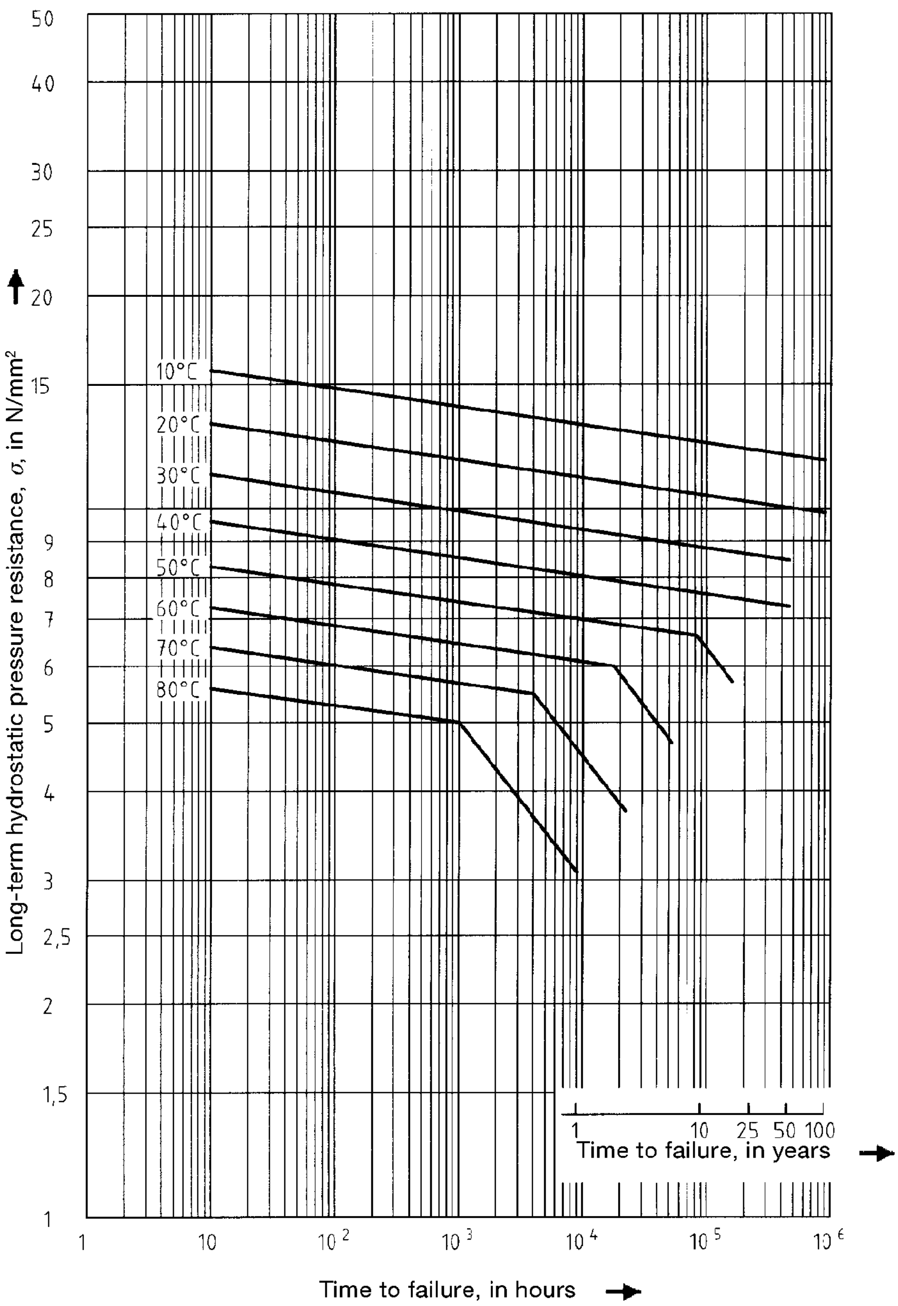

Figure 3: Long-term hydrostatic pressure resistance of pipes made from PE 100

5 Requirements

5.1 Form supplied

Pipe ends should be cut as square as possible to the pipe axis. Pipes shall be free from any blisters and irregularities (including foreign matter) which could affect their performance. Pigmentation shall be uniform throughout.

5.2 Surface finish

Pipes shall be smooth both inside and outside. Minor irregularities and shallow grooves are permissible, provided the minimum wall thickness is maintained throughout. Sharp-edged grooves are not permissible.

5.3 Dimensions and tolerances

The pipe outside diameter, wall thickness and ovality shall comply with the specifications of DIN 8074, which applies by analogy to pipes whose sizes deviate from the series of preferred numbers given in DIN 323-1 and from international specifications.

5.4 Long-term hydrostatic pressure resistance

When tested in accordance with subclause 6.4 under the conditions specified in table 3, pipes shall neither fail nor develop any signs of leakage.

Table 3: Test conditions for hydrostatic pressure testing

Material	Test temperature, in °C	Proof stress, σ_0, in N/mm²	Period of stressing (minimum time to failure), t, in hours
PE 63	20 80 80	8,0 3,5 3,2	100 165 1000
PE 80	20 80 80	10,0 4,6 4,0	100 165 1000
PE 100	20 80 80	12,4 5,5 5,0	100 165 1000

5.5 Heat reversion

When testing in accordance with subclause 6.5, the mean relative change in pipe length shall not be greater than 3 %, except where wall thicknesses are greater than 16 mm.

6 Testing

6.1 Form supplied and surface finish

The inside and outside surfaces of the pipe shall be inspected with back light, using no optical instruments.

6.2 Dimensions

The mean pipe outside diameter shall be determined to within 0,1 mm by circumferential measurement at both pipe ends, at a point at least 0,5 d from the cut edge. The wall thickness shall be determined to within 0,1 mm at both ends, at at least four points spaced evenly around the circumference of the pipe.

Measurements shall be taken at ambient temperature, or at (23 ± 2) °C in case of dispute.

6.3 Ovality

Immediately after production, ovality shall be be determined by measuring the minimum and maximum outside diameters to an accuracy of 0,1 mm.

6.4 Long-term hydrostatic pressure resistance

General information on testing is given in DIN EN 921. For each proof stress value as given in table 3, three sections of pipe (referred to below as pipes) with a length, l_1, as follows shall be taken as specimens:

where d is 250 mm or less: $l_1 \approx 3\,d + 2l_5 + 250$ mm;
where d is greater than 250 mm: $l_1 \approx 1\,000$ mm $+ 2l_5$.

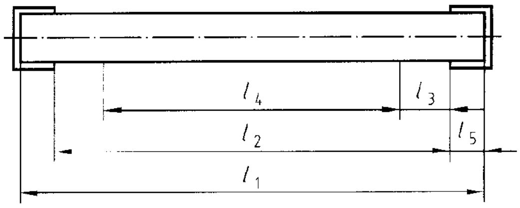

Figure 4: Specimens for hydrostatic pressure resistance test

where, in figure 4 and the preceding equations,

d is the pipe outside diameter, in mm;
l_1 is the specimen length, in mm;
l_2 is the test length, in mm;
l_3 is the length of pipe affected by the sealing devices being clamped, in mm:
for $d \leq 250$ mm: $l_3 = d$;
for $d > 250$ mm: $l_3 = 250$ mm;
l_4 is the assessment length, in mm ($l_2 - 2l_3$);
l_5 is the free length, in mm (for mounting a sealing device)

Along the assessment length, the wall thickness and the outside diameter shall be determined by circumferential measurement at eight and three points respectively, and the minimum wall thickness, s_{min}, and the mean outside diameter, $\bar{d}$, established.

Sealing devices shall be fitted to both ends of the specimen, allowing it free axial movement during the test. The specimen shall be filled with water at the test temperature specified in table 3 (±5 K) through an opening in one of the sealing devices, placed in a tank which has been heated to test temperature (maintained to within ±1 K) and left there for at least one hour to reach thermal equalization. If the pipe is filled with cooler water, it shall be left in the tank for 12 hours.

With the pipe remaining in the tank, hydrostatic pressure shall be steadily increased to proof pressure within one minute. The pressure shall be maintained to within 2,5 % throughout the period specified in table 3 (minimum time to failure).

The proof pressure, $P_{e,p}$, shall be calculated as follows:

$$P_{e,p} = \frac{2 \cdot s_{min} \cdot \sigma_0}{\bar{d} - s_{min}} \qquad (3)$$

where

$\bar{d}$ is the mean outside diameter over l_4;
s_{min} is the minimum wall thickness over l_4;
σ_0 is the proof stress as specified in table 3 (or 4).

Check whether the pipe has failed or developed signs of leakage during the specified period of stressing. If the pipe has failed within l_3 during this period, the results of the test shall not count and the test shall be repeated.

If failure with deformation occurs before 165 hours at 80 °C at test pressures 3,5, 4,6 and 5,5 N/mm², a follow-up test may be carried out at a lower test pressure and for an exposure period at least as long as that specified in table 4.

Table 4: Test conditions for follow-up testing

PE 63		PE 80		PE 100	
Proof stress, σ_0, in N/mm²	Time to failure, t, in hours	Proof stress, σ_0, in N/mm²	Time to failure, t, in hours	Proof stress, σ_0, in N/mm²	Time to failure, t, in hours
3,5	165	4,6	165	5,5	165
3,4	295	4,5	219	5,4	233
3,3	538	4,4	293	5,3	332
3,2	1 000	4,3	394	5,2	476
		4,2	533	5,1	688
		4,1	727	5,0	1 000
		4,0	1 000		

6.5 Heat reversion

Specimens shall be three pipe sections, each approximately 200 mm long or, for pipes with an outside diameter of 200 mm or more, three machine-cut pieces with a length of approximately 200 mm and an arc length of approximately 200 mm. In the latter case, the pipe section shall be divided into pieces that are 200 mm square, taken from around its circumference (e.g. a section measuring 200 x 11,4 will be divided into three pieces). The direction of the pipe axis shall be marked on the pieces. All pieces shall be subjected to testing.

Gauge marks shall be made on the outside of each specimen, approximately 50 mm from each end, along the pipe axis (for pipe sections, around the circumference). The distance between the two reference marks , l_0, shall be approximately 100 mm, measured at ambient temperature to an accuracy of 0,25 mm.

The specimens shall be laid convex side down on a glass plate dusted with talcum, so that any change in length shall not be hindered.

Subsequently, the glass plate shall be placed in an oven with forced air circulation in accordance with DIN EN 743, which has been preheated to test temperature, as specified in table 5.

Table 5: Conditions for heat reversion test

Wall thickness, s, in mm	Test temperature, in °C	Test period, t, in minutes
Up to 8	110 ± 2	60 ± 1
Over 8 up to 16		120 ± 2

After removing the specimens from the oven and allowing them to cool to ambient temperature in the same position, the minimum distance between the two gauge marks, l_{min}, shall be measured.

The relative change in length, ε, expressed as a percentage, shall be calculated as follows:

$$\varepsilon = \frac{l_0 - l_{min}}{l_0} \cdot 100 = \frac{\Delta l}{l_0}\ 100 \qquad (4)$$

where

l_0 is the distance between gauge marks before heat treatment, in mm;

l_{min} is the distance between gauge marks after heat treatment and cooling, in mm;

$\Delta l = l_0 - l_{min}$.

The arithmetical mean of the relative change in length, ε, calculated from equation (4), shall be taken as the mean relative change in length, ε, for the tested pipe.

6.6 Test certificate

By agreement, the pipe manufacturer shall issue a DIN EN 10204 inspection document.

Appendix A

Hydrostatic pressure testing for pipes made from PE-HD

For PE-HD pipes designed for non-pressure applications, the following conditions shall apply for testing.

Table A.1: Conditions for long-term hydrostatic pressure test

Material	Test temperature, in °C	Proof stress, σ_0, in N/mm²	Period of stressing (minimum time to failure), t, in hours
PE-HD	80	4	170

Appendix B

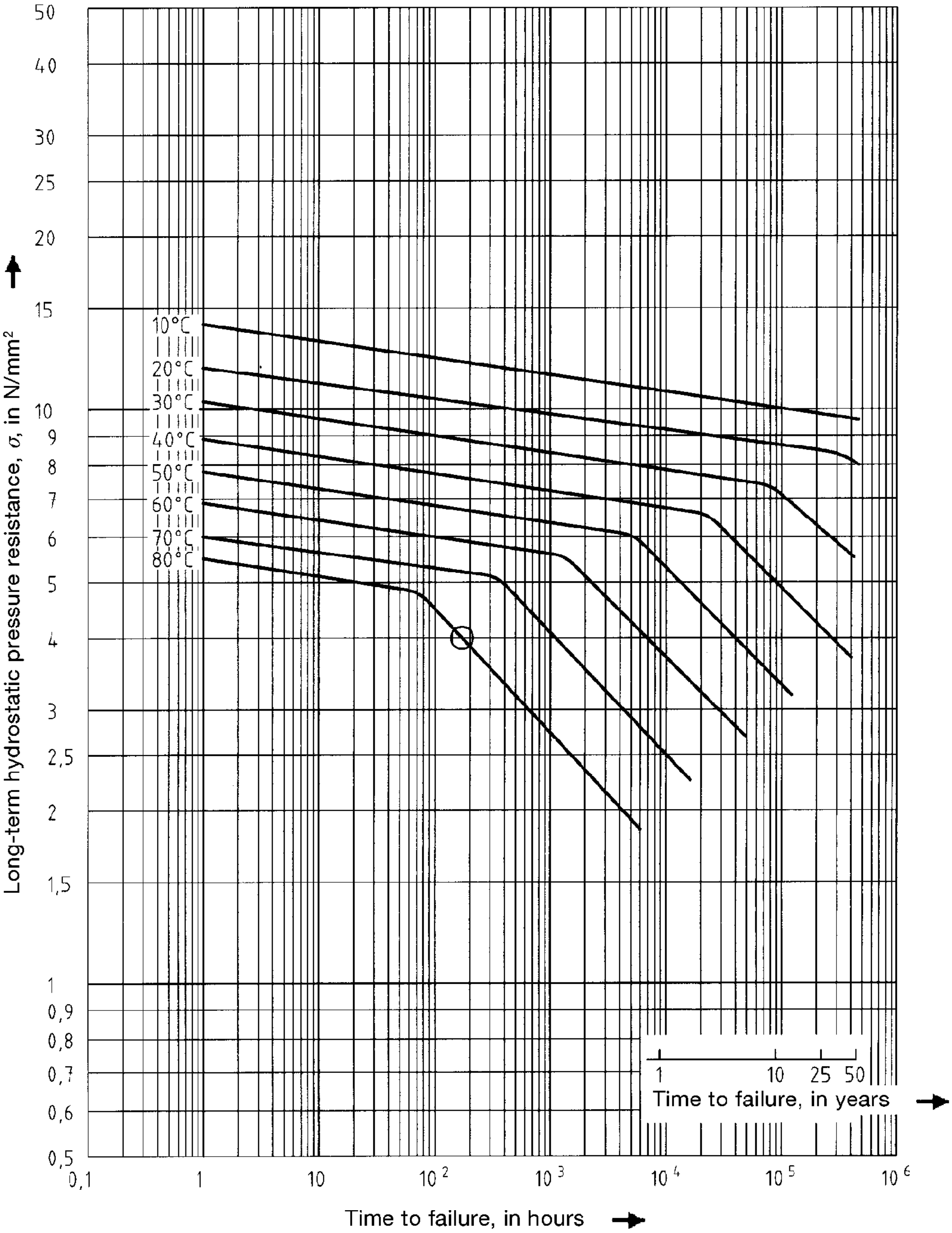

Figure B.1: Long-term hydrostatic pressure resistance of pipes made from PE-HD

Explanatory notes

This standard is a basic standard and therefore does not cover the scope of testing, inspection, or requirements relating to special applications.

The hydrostatic pressure resistance requirements specified here are based on experiments which have taken the probable service life of the pipes into consideration. Polyethylene pipes may be expected to have a service life of 100 years.

In testing for resistance to internal pressure, the quality of the pipe is defined by requirements that specify that the pipe is to resist without failure a specific proof pressure (corresponding to the specified σ value) for a minimum period of exposure at an increased temperature.

For pipes in contact with foodstuffs, the toxicological stipulations in the relevant *KTW-Empfehlungen* (KTW Recommendations) of the *Bundesgesundheitsamt* (German Federal Health Office) and any other pertinent specifications shall be observed. Pipes for medical applications shall be subject to particular agreement.

Specifications with regard to the composition of the pipe material and methods of manufacture have not been included so as not to impede technical innovation. The specification that moulding material of unknown composition should not be used is intended to prevent the use of unsuitable material, while allowing the manufacturers to derive technical and economic advantages from using reworked material.

Table C.1 gives guideline values for the properties of PE pipes specified in this standard.

Table C.1: Properties and guideline values

Property	Guideline values
Mean coefficient of linear thermal expansion at temperatures between 0 °C and 70 °C (testing as in DIN 53752)	$\approx 2 \cdot 10^{-4}\ K^{-1}$
Thermal conductivity (testing as in DIN 52612-1)	$\approx 0{,}41\ WK^{-1}m^{-1}$
Minimum modulus of elasticity (testing as in DIN EN ISO 178)	480 N/mm^2
Surface resistivity (testing as in IEC 60093)	$> 10^{12}\ \Omega$
Pipes conforming to this standard comply with the requirements for building material class B 2 as in DIN 4102-1.	

Other relevant standards

DIN 4102-11 Fire behaviour of building materials and elements – Pipe encasements, pipe sleeves, service shafts and ducts, and barriers across inspection openings – Terminology, requirements and testing

DIN 53752 Determination of coefficient of linear thermal expansion of plastics

DIN EN ISO 527-2 Determination of tensile properties of plastics – Test conditions for moulding and extrusion plastics (ISO 527-2 : 1993 + Corr 1 : 1994)