Pipe fittings and joint assemblies for unplasticized polyvinyl choride (PVC-U) pressure pipes
Part 5: General quality requirements and testing

DIN 8063-5

ICS 23.040.45

Supersedes
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Rohrverbindungen und Formstücke für Druckrohrleitungen aus weichmacherfreiem Polyvinylchlorid (PVC-U) – Teil 5: Allgemeine Qualitätsanforderungen, 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 *Fittings für Druckrohre aus Thermoplasten* of the *Normenausschuss Kunststoffe* (Plastics Standards Committee).

Amendments

This standard differs from the January 1990 edition as follows:

a) requirements for resistance to hydrostatic pressure have been modified;
b) details of materials testing have been changed;
c) the standard has been editorially revised.

Previous editions

DIN 8063-5: 1970-08, 1990-01.

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 millimetres.

1 Scope

This standard specifies requirements and test methods for pipe fittings and joint assemblies for unplasticized polyvinyl chloride (PVC-U) pressure pipes, as specified in DIN 8063-1 to DIN 8063-4, and in DIN 8063-6 to DIN 8063-12.

Individual requirements specified here may be superseded by technical delivery conditions for particular applications.

NOTE: Any relevant European Standards which cover such applications shall also be observed.

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 8061	Unplasticized polyvinyl chloride (PVC-U) pipes – General quality requirements and testing
DIN 8062	Unplasticized polyvinyl chloride (PVC-U) pipes – Dimensions
DIN 8063-1	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Socket and double socket bends – Dimensions
DIN 8063-2	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Injection-moulded bends for bonding – Dimensions
DIN 8063-3	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Compression couplings – Dimensions
DIN 8063-4	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Bushings, flanges and seals – Dimensions
DIN 8063-6	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Injection-moulded elbows for bonding – Dimensions
DIN 8063-7	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Injection-moulded tees and branches for bonding – Dimensions
DIN 8063-8	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Injection-moulded sockets, caps and nipples for bonding – Dimensions
DIN 8063-9	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Injection-moulded reducers for bonding – Dimensions
DIN 8063-10	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Wall discs – Dimensions
DIN 8063-11	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Sockets with basic copper-zinc alloy element for bonding – Dimensions
DIN 8063-12	Pipe joint assemblies and fittings for unplasticized polyvinyl chloride (PVC-U) pressure pipes – Flanged and socket fittings – Dimensions
DIN 50011-12	Artificial climates in technical applications – Air temperature as a climatological quantity in controlled-atmosphere test installations
DIN EN 727	Thermoplastics pipes and fittings – Determination of Vicat softening temperature (VST)
DIN EN 10204	Inspection documents for metallic products (includes Amendment A 1 : 1995)
DIN EN ISO 12162	Thermoplastics materials for pipes and fittings for pressure applications – Classification and designation – Overall service (design) coefficient (ISO 12162 : 1995)

3 Concept

Long-term hydrostatic pressure resistance

The strength of a pipe (cf. figure 1) required to resist an induced internal hydrostatic pressure, σ, in N/mm^2, shall be calculated as follows:

$$\sigma = p \cdot \frac{d - s}{2s} \qquad (1)$$

where

p is the induced hydrostatic pressure;

d is the pipe outside diameter;

s is the pipe wall thickness.

4 Material

Fittings and joint assemblies shall be made from unplasticized PVC-U containing no fillers (see DIN 8061). The choice of the type and quantity of any vinyl chloride polymers, stabilizers, lubricants or other additives (e.g. pigments) used shall be left to the manufacturer. Material of unknown composition shall not be used.

5 Requirements

5.1 Form supplied

Fittings and joint assemblies shall be free from any cavities, blisters, burrs, irregularities or foreign matter which would impair their performance.

5.2 Surface finish

When checked as in subclause 6.2, joint assemblies and fittings shall have a smooth outer surface consistent with the manufacturing process used, and no scorched areas due to overheating.

5.3 Dimensions and tolerances

The dimensions and tolerances for fittings and joint assemblies shall be in accordance with DIN 8063-2 to DIN 8063-4 and DIN 8063-6 to 8063-12. All other dimensions shall be such that fittings are capable of resisting any stresses in service, in addition to those covered in subclause 5.4.

5.4 Long-term hydrostatic pressure resistance

5.4.1 Material

When tested as in subclause 6.4.2.1 in accordance with the specifications of table 1, test pieces shall neither fracture nor show any signs of leakage. Fittings made from pipes as in DIN 8062 and conforming to the quality requirements specified in DIN 8061 (see DIN 8063-1) shall be considered to fulfil these requirements without being tested.

Table 1: Long-term hydrostatic pressure resistance of test pieces (test conditions)

Test temperature, in °C	Exposure medium	Test period (minimum service life), in hours	Proof stress, σ_0, in N/mm²
60	Air or water	1	17
60		1 000	10

5.4.2 Fittings

When tested as in subclause 6.4.2.2 in accordance with the specifications of table 2, fittings shall neither fracture nor show any signs of leakage.

Table 2: Long-term hydrostatic pressure resistance of fittings (test conditions)

Manufacturing process	Test temperature, in °C	Exposure medium	Test period (minimum service life), in hours	Proof pressure, $p_{e,p}$, in bar
Injection-moulded [1)]	20	Air or water	1 1 000	840 : (SDR-1) 640 : (SDR-1)
From pipe sections [2)]	20		1	840 : (SDR-1)

SDR-1: Nominal value of diameter/wall thickness ratio of the fitting specified in DIN 8062 for pipe series 1.

1) For a service life of 50 years at 20 °C a basic stress, $\sigma_{v,zul}$, of 10 N/mm² shall be used. If the long-term hydrostatic test produces an MRS value equal to or greater than 25 N/mm² for the fitting material, $\sigma_{v,zul}$ may be 12,5 N/mm² for diameters of 160 mm or greater.

2) In the case of fittings made from pipe sections, $\sigma_{v,zul}$, shall be 10 N/mm² for diameters up to 90 mm and 12,5 N/mm² for diameters greater than 90 mm.

5.4.3 Joint assemblies

5.4.3.1 Bonded assemblies

When tested as in subclause 6.4.2.3.1 in accordance with the specifications of table 3, bonded assemblies shall show no signs of leakage.

Table 3: Long-term hydrostatic pressure resistance of bonded joints (test conditions)

Test temperature, in °C	Exposure medium	Test period (minimum service life), in hours	Proof pressure, $p_{e,p}$, in bar, for a basic stress, $\sigma_{v,zul}$, in N/mm², of	
			10	12,5
20	Air or water	1 000	336 : (SDR-1)	412 : (SDR-1)
60		1 000	116 : (SDR-1)	138 : (SDR-1)
SDR-1: Nominal value of diameter/wall thickness ratio of the fitting specified in DIN 8062 for pipe series 1.				

5.4.3.2 Push-in joint assemblies

When tested as in subclause 6.4.2.3.4 in accordance with the specifications of table 4, push-in joint assemblies made up of pipes as in DIN 8062, sockets as in DIN 8063-12 and commercial seals shall show no signs of leakage.

Table 4: Long-term hydrostatic pressure resistance of push-in joints (test conditions)

Test temperature, in °C	Exposure medium	Test period (minimum service life), in hours	Proof pressure, $p_{e,p}$, in bar, for a basic stress, $\sigma_{v,zul}$, in N/mm², of	
			10	12,5
20	Air or water	1 000	336 : (SDR-1)	412 : (SDR-1)
60		1 000	116 : (SDR-1)	138 : (SDR-1)
SDR-1: Nominal value of diameter/wall thickness ratio of the fitting specified in DIN 8062 for pipe series 1.				

5.4.3.3 Coupling assemblies

When tested as in subclause 6.4.2.3.2 or subclause 6.4.2.3.3 in accordance with the specifications of table 5, assemblies made up of compression couplings as DIN 8063-3 and flanges as in DIN 8063-4 shall show no signs of leakage.

Table 5: Long-term hydrostatic pressure resistance of joint assemblies (test conditions)

Test temperature, in °C	Exposure medium	Test period (minimum service life), in hours	Proof pressure, $p_{e,p}$, in bar, for a basic stress, $\sigma_{v,zul}$, in N/mm², of	
			10	12,5
20	Air or water	1 000	336 : (SDR-1)	412 : (SDR-1)
60		1 000	116 : (SDR-1)	138 : (SDR-1)
SDR-1: Nominal value of diameter/wall thickness ratio of the fitting specified in DIN 8062 for pipe series 1.				

5.5 Water absorption

When tested as in subclause 6.5, none of the joint assemblies and fittings shall absorb more than 4 mg/cm³ of water.

5.6 Heat reversion

When tested as in subclause 6.6, fittings and joint assemblies shall exhibit no cracks, blistering or delamination, except near the gate, where the depth affected shall not exceed 30 % of the wall thickness. Depending on the type of gate, the area affected may be circular, with a radius equal to 0,3 d (50 mm maximum) (where d is the inside diameter of the fitting).

Dressing is only permitted in the gate zone, and shall be carried out after testing.

5.7 Vicat softening temperature

When tested as in subclause 6.7, the Vicat softening temperature VST/B50 shall be at least 74 °C.

6 Testing

6.1 Time of testing

Testing shall be carried out not sooner than 15 hours after manufacture, and adhesive curing times shall be taken into consideration when testing bonded assemblies (see subclause 6.4.2.3).

6.2 Form supplied

The outside and, if possible, the inside surfaces of fittings shall be inspected using suitable lighting.

6.3 Dimensions and tolerances

The inside diameter of the socket shall be calculated to be the mean of two measurements taken at right angles to each other at the middle of the socket depth. Other dimensions shall be measured appropriately.

6.4 Long-term hydrostatic pressure resistance

6.4.1 Number of test pieces

Three test pieces, fittings or joint assemblies shall be used for testing as in tables 1 to 5.

6.4.2 Arrangement of test pieces

6.4.2.1 Testing of material

The following test pieces, including end-fittings, shall be tested:

extruded pipe sections: test pieces as specified in DIN 8061;

injection-moulded test pieces: as shown in figure 1.

The test piece outside diameter, d, shall be at least 50 mm, and its free length shall be at least equal to 3 d (see figure 1), with the exception of test pieces with an outside diameter of 50 mm, whose minimum free length shall be 140 mm.

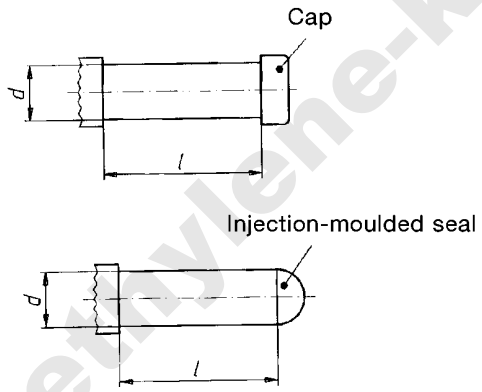

Figure 1: Form of test pieces

6.4.2.2 Testing fittings

Fittings as specified in DIN 8063-1 to DIN 8063-4 and DIN 8063-6 to DIN 8063-12 shall be tested using test assemblies as described below under item a), b) or c). Test pieces shall be arranged so that the significant parts of the fittings are loaded.

Although joints, brackets and seals are not covered by this standard, their design shall not cause the system to fail. The seal zone may be reinforced to prevent undue strain when pressures are exceeded during testing. Fittings which are part of a sealed assembly, such as screwed joints and flanged joints, shall be tested as a joint assembly (see subclause 6.4.2.3).

a) The test assembly shall be made up of fittings joined to sections of pipe as in DIN 8062 from the same series, using highly solvent adhesive or by insertion, as appropriate. The pipe section length shall be as specified in table 6.

Table 6: Length of bonded pipe sections

Pipe outside diameter	Pipe section length
Up to 50	150
From 63 to 75	200
90 or more	300

Unless otherwise specified by the adhesive manufacturer, fittings with bonded pipe sections shall be kept at ambient temperature (18 °C to 28 °C) for at least three weeks after bonding.

Fittings with bonded pipe sections shall be provided with caps so that the axial thrust resulting from the hydrostatic pressure is accommodated.

b) The test assembly shall be made up of fittings clamped, without pipe sections, in such a way that test conditions are the same as those described under item a) above.

c) The test assembly shall be made up of reducers as specified in DIN 8063-9 inserted in sockets as specified in DIN 8063-8, and bonded as specified under item a) above.

6.4.2.3 Testing joint assemblies

6.4.2.3.1 Bonded assemblies

Fittings shall be joined to sections of pipe as in DIN 8062 from the same series using a highly solvent adhesive. Unless otherwise specified by the adhesive manufacturer, fittings with bonded pipe sections shall be kept at ambient temperature (18 °C to 28 °C) for at least three weeks after bonding.

6.4.2.3.2 Screwed joints

Screwed joints as specified in DIN 8063-3 shall be joined to sections of pipe as in DIN 8062 from the same series using a highly solvent adhesive.

6.4.2.3.3 Flanged joints

Flanged joints shall be made up of fittings as specified in DIN 8063-4 joined to pipe sections using a highly solvent adhesive. The pipe section length shall be as in table 6. The ends of the pipe sections shall be provided with caps so that the the axial thrust resulting from the hydrostatic pressure is accommodated. The test assemblies shall be free to move in all directions.

6.4.2.3.4 Push-in joints

Push-in socket fittings as in DIN 8063-12 and provided with commercial seals shall be joined to sections of pipe as specified in DIN 8062, belonging to the same pipe series. The pipe section length shall be as in table 6. The ends of the pipe sections shall be provided with caps, and the assembly supported so that the axial thrust resulting from the hydrostatic pressure is accommodated.

6.4.3 Test procedure

Samples prepared as in subclauses 6.4.2.1 to 6.4.2.3 shall be filled with water at test temperature (maintained to within 5 K) through a closable opening in one of the end caps, and placed in a water bath or oven maintained at test temperature (to within 1 K) where it shall be kept for one hour to reach thermal equilibrium. If the samples are filled with water of a lower temperature, they shall be kept in the water bath or oven for 12 hours to reach thermal equilibrium.

Subsequently, the pressure in the water bath or oven shall be steadily increased to reach proof pressure, $p_{e,p}$, within about one minute. The proof pressure shall be maintained to within 2,5 % during the test period. The proof pressure for the material test shall be calculated using the following equation:

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

where

$\bar{d}$ is the test piece diameter;

s_{min} is the minimum wall thickness of the test piece;

σ_0 is the proof stress as specified in table 1.

The relevant proof pressure for testing fittings and joint assemblies shall be selected from tables 2 to 5.

6.4.4 Evaluation

It shall be established whether the samples leak or otherwise fail during testing. Results of tests on test pieces, fittings or joint assemblies in which the components fail shall be disregarded, and the test shall be repeated. The same shall apply when joint assemblies are tested and the fittings, pipe sections or clamping devices have fractured or have shown any signs of leakage.

6.5 Water absorption

Water absorption shall be determined using not less than three fittings, or test pieces cut from these where the area of the fittings is 50 cm^2 or more. These test pieces shall preferably be square, deburred and have an area of 50 cm^2 to 60 cm^2.

The area of each fitting or test piece shall be determined to an accuracy of 0,5 cm^2 and its mass to an accuracy of 1 mg. Without prior conditioning, the samples shall be immersed in boiling distilled water for 24 hours and then cooled in cold water for 15 minutes. Any excess water shall be dabbed from the surface using filter paper and the mass of each sample shall be determined within two minutes of removal from the water. The water absorbed shall be stated as a mean for the fittings or test pieces, in mg/cm^2.

6.6 Heat reversion

At least three fittings or joint assemblies shall be placed socket down on a flat surface in an oven with forced-air circulation as specified in DIN 50011-12, and conditioned as in table 7. After cooling to ambient temperature (18 °C to 28 °C), the samples shall be checked for any cracks, blisters or delamination.

Table 7: Heat reversion test

Wall thickness, s	Minimum test period, in minutes	Test temperature, in °C
Up to 3	15	150 ± 2
Over 3 up to 10	30	
Over 10 up to 20	60	
Over 20 up to 30	140	
Over 30 up to 40	220	
Over 40	240	

6.7 Vicat softening temperature

The Vicat softening temperature shall be determined as in DIN EN 727.

6.8 Certificate

By agreement, the manufacturer shall issue a DIN EN 10204 inspection document covering the results of testing.

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 standard focuses on the long-term hydrostatic testing of material and components. Materials testing at elevated temperature demonstrates the suitability of the moulding material for the manufacture of fittings. The test conditions specified for material and fittings are based on the long-term hydrostatic behaviour of the material, which correlates well with that of pipes as in DIN 8061.

NOTE: Reference curves showing the long-term hydrostatic pressure resistance of PVC-U are defined by the following equation:

$$\lg t = -164{,}461 - 29\,349{,}493 \times \log {}^{\sigma}/_{T} + 60\,126{,}534 \times {}^{1}/_{T} + 75{,}079 \times \log \sigma \qquad (3)$$

In the case of bonded assemblies using modified material, push-in joints with rubber seals, and flanged joints using fittings made of dissimilar materials, applying the test conditions for pipes to fittings would result in these being subjected to greater stress than that incurred under service conditions, resulting in leakage. The test conditions have therefore been modified accordingly and the proof pressures are given in tables 3 to 5.

It is a basic requirement for pipe assemblies that they are not to leak under normal service conditions. For assemblies conforming to this standard, a service life of 50 years at an operating temperature of 20 °C is based on a basic stress, $\sigma_{v,zul}$, of 10 N/mm^2. The *MRS* value (see DIN EN ISO 12162) for the fitting material has been shown to be 25 N/mm^2 or more, a reduced value of 12,5 N/mm^2 (assuming a safety factor of 2) may be used for $\sigma_{v,zul}$ in the case of injection-moulded fittings with a diameter of 160 mm or more. For fittings made from pipes with a diameter greater than 90 mm, the stress may also be 12,5 N/mm^2. The strain under service conditions shall be calculated for temperatures of 20 °C, 40 °C and 95 °C using the safety factors given in table 8. Subsequently, the leaktightness of the joints under this strain shall be checked. This may be done by means of a short-term test or a creep test, in which the pressure applied (with an additional safety factor) produces the same stress as the basic stress. The hydrostatic pressure, p_T, in bar, as a function of the stress, σ_T, in N/mm^2, shall be calculated using the following equation:

$$p_T = \frac{20 \cdot \sigma_T}{SDR\text{-}1} \qquad (4)$$

where SDR-1 is the nominal value of the diameter/wall thickness ratio of the fitting specified in DIN 8062 for pipe series 1.The specifications set out in tables 2 to 5 are also based on equation (4).

Table 8 presents the operating and test conditions for PVC-U pipe assemblies, and figures 2 to 5 show the stress-strain characteristics. If service temperatures are restricted to those above 20 °C, the test parameters may correspond to the temperature specified. In this case, the calculation shall follow table 8, using the relevant strain-stress diagram.

The following moulding materials, specified in DIN 7748-1, are generally used for the manufacture of fittings covered by this standard.

Moulding material DIN 7748 – PVC – U, M D, ... – .. – ...

- Polyvinyl chloride
- Unplasticized
- Injection-moulded
- Powder
- Vicat softening temperature: group 074 or higher
- Impact value: group 3
- Modulus of elasticity: group 33

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 8: Service and test conditions for PVC-U pipe assemblies

Service conditions: Temperature, in °C	20		60	
Service life in years	50		30	
Basic stress, $\sigma_{v,zul}$, at 20 °C for 50 years, in N/mm²	**10** [1]	12,5 [2]	**10** [1]	12,5 [2]
Design stress, σ [3], in N/mm²	**10**	12,5	**2,6**	3,2
Strain, ε, as a percentage	**0,42**	0,58	**0,6**	0,78
Test conditions: Safety factor for ε_{ts} [4], in percentage points	**0,21**	0,29	**0,3**	0,3
Strain, ε_{ts}, as a percentage	**0,63**	0,87	**0,9**	1,08
Test period, in hours	1 000		1 000	
Proof stress, σ_0, in N/mm²	**16,8**	20,6	**5,8**	6,9
Proof pressure, $p_{e,p}$, in bar	$\frac{\mathbf{336}}{\boldsymbol{SDR}\text{-}\mathbf{1}}$	$\frac{412}{SDR\text{-}1}$	$\frac{\mathbf{116}}{\boldsymbol{SDR}\text{-}\mathbf{1}}$	$\frac{138}{SDR\text{-}1}$

[1] Using a safety factor of 2,5.

[2] Using a safety factor of 2 (where the *MSR* value has been shown to be equal to or greater than 25 N/mm²).

[3] Based on reference curves (cf. equation (3)) and the known safety factors.

[4] 50 % of ε, but not more than 0,3 percentage points.

NOTE 1: The extrapolated curves for pipe materials assume a service life of 100 years at temperatures up to 20 °C (see DIN 8061).

NOTE 2: The strain due to tensile stress shall be converted into strain due to hoop stress, ε_t, using the following equation:

$\varepsilon_t = \varepsilon_z (1 - \mu : 2)$

where

ε_z is the tensile strain;

μ is the Poisson's ratio (here, μ = 0,4).

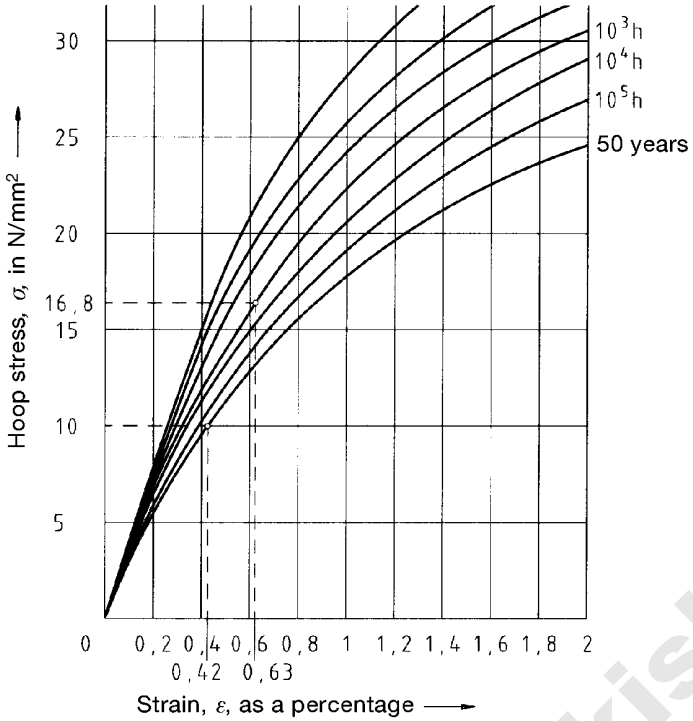

Figure 2: Stress-strain diagram for PVC-U at 20 °C
(with $\sigma_{v,zul}$ = 10 N/mm²)

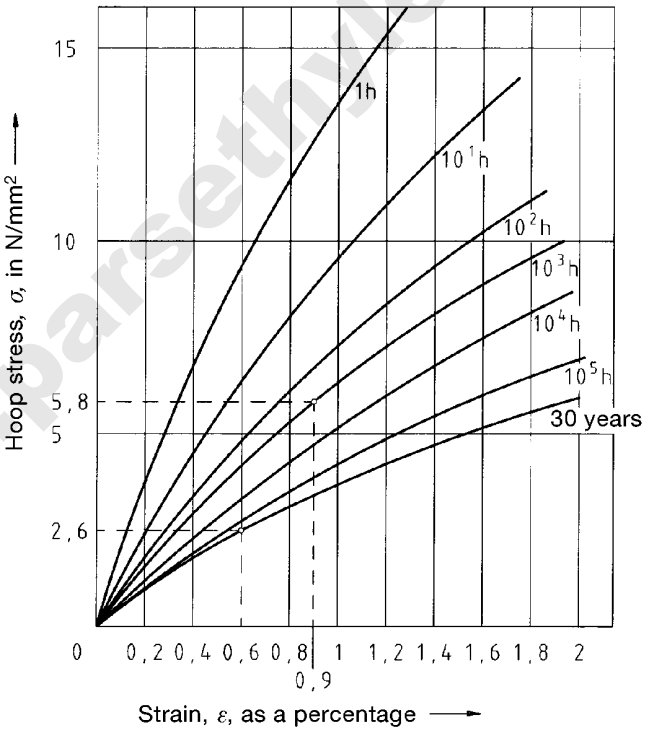

Figure 3: Stress-strain diagram for PVC-U at 60 °C
(with $\sigma_{v,zul}$ = 10 N/mm²)

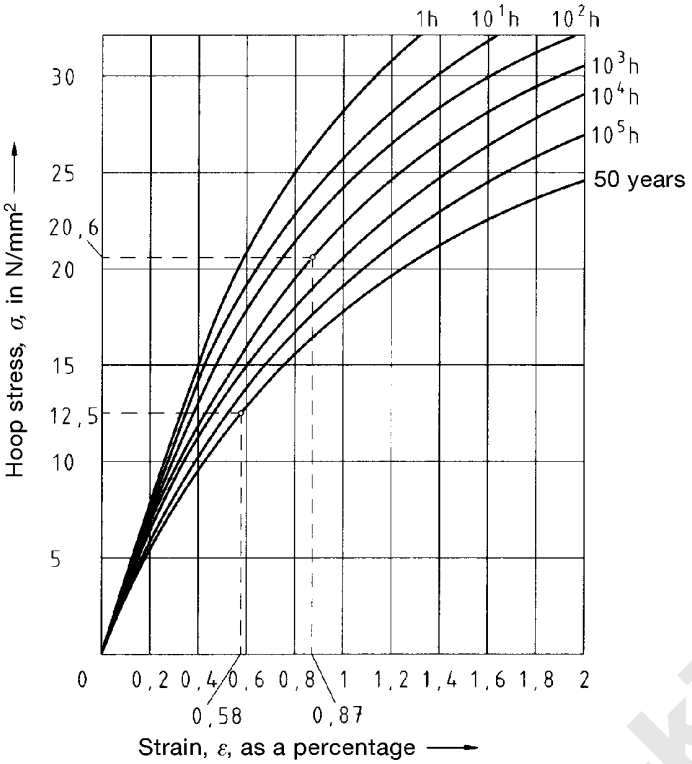

Figure 4: Stress-strain diagram for PVC-U at 20 °C
(with $\sigma_{v,zul}$ = 12,5 N/mm²)

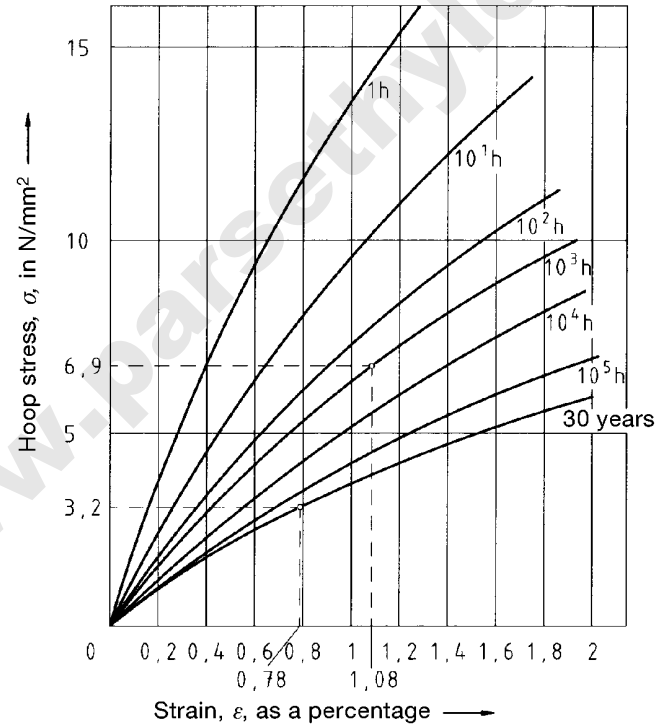

Figure 5: Stress-strain diagram for PVC-U at 60 °C
(with $\sigma_{v,zul}$ = 12,5 N/mm²)

Other relevant standards

DIN 7748-1	Unplasticized polyvinylchloride (PVC-U) moulding materials – Classification and designation
DIN 16887	Determination of the long-term hydrostatic pressure resistance of thermoplastics pipes
DIN EN 763	Injection-moulded thermoplastics pipe fittings – Test method for visually assessing the effects of heating
DIN EN 12107	Injection-moulded thermoplastics fittings, valves and ancillary equipment – Determination of the long-term hydrostatic strength of thermoplastics materials for injection moulding of piping components
DIN EN ISO 306	Thermoplastic materials – Determination of Vicat softening temperature (VST) (ISO 306 : 1994)
ISO 161-1 : 1996	Thermoplastics pipes for the conveyance of fluids – Nominal outside diameters and nominal pressures – Part 1: Metric series
ISO 4065 : 1996	Thermoplastic pipes – Universal wall thickness table
ISO/DIS 9080 : 1998	Plastics piping and ducting systems – Determination of the long-term hydrostatic strength of thermoplastics material in pipe form by extrapolation