CD/K/027-5:2009
ICS 23.040.20; 23.040.45; 91.140.60; 93.025

EAST AFRICAN STANDARD

Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 5: Fitness for purpose of the system

EAST AFRICAN COMMUNITY

First Edition 2010

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

East African Community

P O Box 1096

Arusha

Tanzania

Tel: 255 27 2504253/8

Fax: 255-27-2504481/2504255

E-Mail: eac@eachq.org

Web: www.each.int

Introduction

In the preparation of this East African Standard, the following source was consulted extensively:

ISO 1452-5:2009, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 5: Fitness for purpose of the system*

Assistance derived from this source and others inadvertently not mentioned is hereby acknowledged.

INTERNATIONAL STANDARD

ISO 1452-5

First edition
2009-12-01

Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) —

Part 5: Fitness for purpose of the system

Systèmes de canalisations en plastique pour l'alimentation en eau, pour branchements et collecteurs d'assainissement enterrés et aériens avec pression — Poly(chlorure de vinyle) non plastifié (PVC-U) —

Partie 5: Aptitude à l'emploi du système

Reference number
ISO 1452-5:2009(E)

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Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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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 1452-5 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 155, *Plastics piping systems and ducting systems*, in collaboration with ISO 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*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces ISO 4422-5:1997, which has been technically revised.

ISO 1452 consists of the following parts, under the general title *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U)*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

— *Part 4: Valves*

— *Part 5: Fitness for purpose of the system*

Guidance for the assessment of conformity is to form the subject of a part 7.

Introduction

The System Standard, of which this is Part 5, specifies the requirements for a piping system and its components made from unplasticized poly(vinyl chloride) (PVC-U). The piping system is intended to be used for water supply and for buried and above-ground drainage and sewerage under pressure.

In respect of potential adverse effects on the quality of water intended for human consumption, caused by the products covered by this part of ISO 1452, the following are relevant.

a) This part of ISO 1452 provides no information as to whether the products may be used without restriction;

b) Existing national regulations concerning the use and/or the characteristics of these products remain in force.

Requirements and test methods for components requirements and test methods are specified in ISO 1452-2, ISO 1452-3 and ISO 1452-4.

This part of ISO 1452 establishes the characteristics of fitness for purpose of the plastics piping system composed of pipes, fittings, valves, ancillaries and their joints.

Guidance for installation is given in ISO/TR 4191[1].

Guidance for assessment of conformity is provided in ENV 1452-7[2].

Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) —

Part 5: Fitness for purpose of the system

1 Scope

This part of ISO 1452 specifies the characteristics for the fitness for purpose of unplasticized poly(vinyl chloride) (PVC-U) piping systems intended for water supply and for buried and above-ground drainage and sewerage under pressure.

It also specifies the test parameters for the test methods referred to in this part of ISO 1452.

In conjunction with ISO 1452-1, ISO 1452-2, ISO 1452-3 and ISO 1452-4, it is applicable to joints and assemblies with components of PVC-U, other plastics and non-plastics materials intended to be used for the following:

a) water mains and services buried in ground;

b) conveyance of water above ground for both outside and inside buildings;

c) buried and above-ground drainage and sewerage under pressure;

It is applicable to piping systems intended for the supply of water under pressure up to and including 25 °C (cold water) intended for human consumption and for general purposes as well as for waste water under pressure.

This part of ISO 1452 is also applicable to components for the conveyance of water and waste water up to and including 45 °C. For temperatures between 25 °C and 45 °C, Figure A.1 of ISO 1452-2:2009 applies.

NOTE The producer and the end-user can come to agreement on the possibilities of use for temperatures above 45 °C on a case-by-case basis.

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 1452-1, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 1: General*

ISO 1452-2:2009, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 2: Pipes*

ISO 1452-3:2009, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC U) — Part 3: Fittings*

ISO 1452-4, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC U) — Part 4: Valves*

ISO 13783, *Plastics piping systems — Unplasticized poly(vinyl chloride) (PVC-U) end-load-bearing double-socket joints — Test method for leaktightness and strength while subjected to bending and internal pressure*

ISO 13844, *Plastics piping systems — Elastomeric-sealing-ring-type socket joints of unplasticized poly(vinyl chloride) (PVC-U) for use with PVC-U pipes — Test method for leaktightness under negative pressure*

ISO 13845, *Plastics piping systems — Elastomeric-sealing-ring-type socket joints for use with unplasticized poly(vinyl chloride) (PVC-U) pipes — Test method for leaktightness under internal pressure and with angular deflection*

ISO 13846, *Plastics piping systems — End-load-bearing and non-end-load-bearing assemblies and joints for thermoplastics pressure piping — Test method for long-term leaktightness under internal water pressure*

3 Terms and definitions, symbols and abbreviations

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in ISO 1452-1 apply.

4 Fitness for purpose of joints and the system

4.1 Assemblies with non-end-load-bearing joints

The following types of assemblies with non-end-load-bearing joints shall fulfil the fitness for purpose requirements given in 4.3 to 4.5 and Tables 1 and 2, as applicable:

a) integrally socketed PVC-U pipe to pipe assemblies with elastomeric ring seal joints conforming to ISO 1452-2;

b) PVC-U fitting and pipe assemblies with elastomeric ring seal joints conforming to ISO 1452-3 and ISO 1452-2, respectively;

c) PVC-U valve and pipe assemblies with elastomeric ring seal joints conforming to ISO 1452-4 and ISO 1452-2, respectively;

d) metal fitting and PVC-U pipe assemblies with elastomeric ring seal joints;

e) metal valve and PVC-U pipe assemblies with elastomeric ring seal joints;

f) PVC-U, GRP or metal adaptor assemblies with elastomeric ring seal joints for PVC-U pipes and with flanged, threaded or other connections to pipes of different materials or to ancillary equipment, such as tapping saddles;

g) mechanical joint assemblies with PVC-U pipes.

The components of the assemblies of types b) to g) shall be assembled with PVC-U pipes of the corresponding nominal pressure, PN, or pipe series S conforming to ISO 1452-2. The assembly instructions of the component manufacturer shall be followed.

4.2 Assemblies with end-load-bearing joints

The following types of assemblies with end-load-bearing joints shall fulfil the fitness for purpose requirements given in 4.3 to 4.5 and Table 1 and Table 2, as applicable:

a) integral socketed PVC-U pipe to pipe assemblies with solvent cement joints conforming to ISO 1452-2;

b) PVC-U fitting and pipe assemblies with solvent cement joints conforming to ISO 1452-3 and ISO 1452-2, respectively;

c) flange assemblies with PVC-U pipes, using PVC-U flange adaptors and flanges conforming to ISO 1452-3 or using GRP or metal flanges;

d) PVC-U valve and pipe assemblies with solvent cement joints conforming to ISO 1452-4 and ISO 1452-2, respectively;

e) PVC-U or metal valve and PVC-U pipe assemblies with flanged joints conforming to ISO 1452-4 and ISO 1452-2, respectively;

f) PVC-U or metal tapping saddles and PVC-U pipe assemblies with solvent cement or mechanical joints conforming to ISO 1452-3 and ISO 1452-2, respectively;

g) PVC-U, GRP or metal adaptor assemblies with solvent cement joints for PVC-U pipes and with threaded or other connections to pipes of different materials conforming to ISO 1452-3;

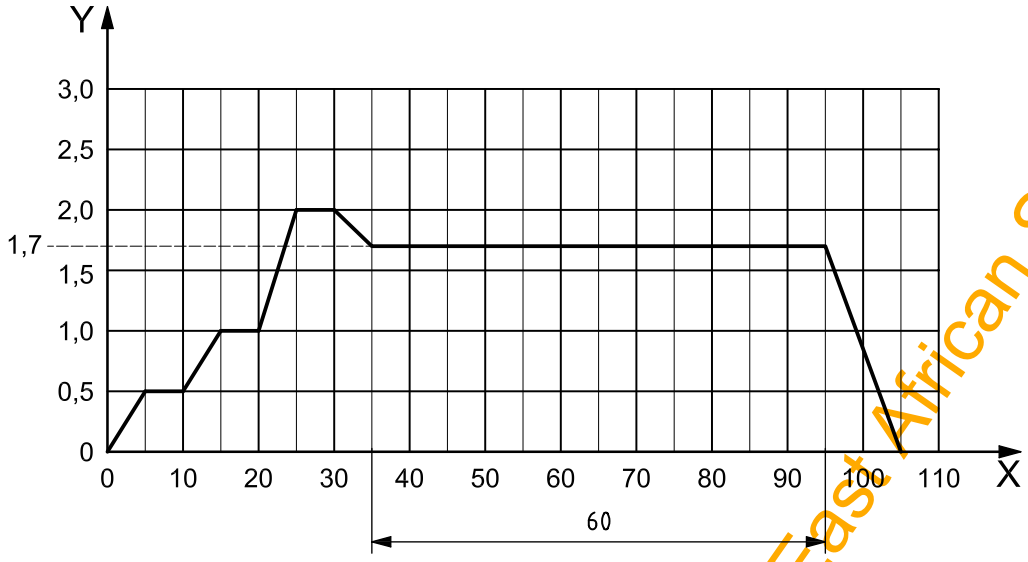
h) PVC-U or metal union and special coupling assemblies;

i) end-load-bearing double socket and PVC-U pipe assemblies with elastomeric ring seal joints (see ISO 1452-3:2009, Figure 25).

The components of the assemblies of types b) to i) shall be assembled with PVC-U pipes of the corresponding nominal pressure, PN, or pipe series S conforming to ISO 1452-2. The assembly instructions of the component manufacturer shall be followed.

4.3 Short-term pressure test for leaktightness of assemblies

When assemblies with elastomeric ring seal type joints are tested with hydrostatic pressure and angular deflection in accordance with ISO 13845, using the test parameters given in Table 1 and a hydrostatic pressure test regime in accordance with Figure 1, where the test pressure, p_T, is given by the nominal pressure, PN, multiplied by the factor f, ($p_T = f \times$ PN), they shall conform to the applicable requirements given in Table 1.



Key

X time, in minutes

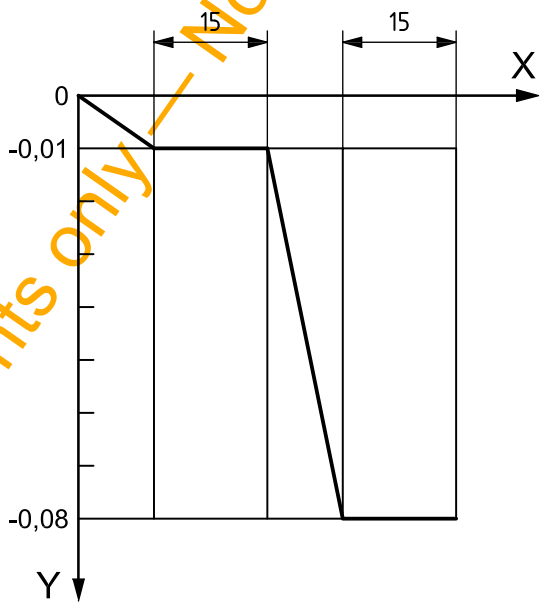
Y multiplication factor, f, used for the calculation of the test pressure

NOTE The pressure changes need not be at a linear rate.

Figure 1 — Hydrostatic pressure test regime

4.4 Short-term negative pressure test for leaktightness of assemblies

When assemblies with elastomeric sealing ring seal type joints are tested with negative pressure and angular deflection plus deformation in accordance with ISO 13844, using the test parameters given in Table 1 and a negative pressure test regime in accordance with Figure 2, they shall conform to the applicable requirements given in Table 1.



Key

X time, in minutes

Y negative pressure, in megapascals

NOTE The negative pressure changes need not be at a linear rate.

Figure 2 — Negative pressure test regime

4.5 Long-term pressure test for leaktightness of assemblies

When assemblies with solvent cement type joints, with elastomeric sealing ring type joints and with other end-load-bearing and non-end-load-bearing joints are tested in accordance with ISO 13846 using pipe sections with a free length equal to d_n, however not less than 150 mm, and the test parameters given in Table 1 and Table 2, as applicable, they shall conform to the applicable requirement given in these tables.

For long-term tests, the test parameters shall be related to the creep resulting from the permissible operating pressures and temperatures after 50 years for PVC-U as determined according to the method described in Annex B.

NOTE Hydrostatic pressures applied during short- and long-term testing on single components in accordance with ISO 1452-2, ISO 1452-3 and ISO 1452-4 are higher than the permissible operating pressure of the piping system and cannot be used for assembly testing as they would produce inadmissible stresses in joint areas and eight times more creep in the sockets that can actually occur after 50 years under working conditions.

Table 1 — Requirements for assemblies with non-end-load-bearing joints

Characteristic	Requirement	Test parameters				Test method
		Parameter	Value			
Leaktightness at short-term hydrostatic internal pressure	No leakage at any point of the jointing areas during the test period	Test pressure[a] Ambient temp. Variation in temp. Deflection Test period Number of test samples[b]	Shall conform to Figure 1 15 °C to 25 °C ± 5 K 2° 100 min 1			ISO 13845
Leaktightness at short-term negative air pressure	Negative pressure change shall be ⩽ 0,05 bar for the first and for the second 15 min	Test pressure Ambient temperature Variation in temp. Deflection Deformation[c] Test period Number of test samples[b]	Shall conform to Figure 2 15 °C to 25 °C ± 2 K 2° 5 % Shall conform to Figure 2 1			ISO 13844
Leaktightness at long-term hydrostatic internal pressure	No leakage at any point of the jointing areas during the test period		Pipe diameter			ISO 13846
			for $d_n \leqslant 90$ mm:		for $d_n > 90$ mm:	
		Water temperature	20 °C	40 °C	20 °C	40 °C
		Test pressure[a]	1,7PN	1,3PN	1,65PN	1,3PN
		Test period Number of test samples[b]	1 000 h 1		1 000 h 1	

[a] The PN value is that of the nominal pressure rating of the fitting, or if an integral socket joint is used, the nominal pressure rating of the pipe.

[b] The number of test pieces given indicates the number required to establish a value for the characteristic described in this table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan.

[c] Required only for pipe series S 16 and above (i.e. thinner walls).

Table 2 — Requirements for assemblies with end-load joints

Characteristic	Requirement	Test parameters					Test method
		Parameter	Value				
Leaktightness at long-term hydrostatic internal pressure[a]	No leakage at any point of the jointing areas during the test period		Pipe diameter				ISO 13846
			for $d_n \leqslant 90$ mm		for $d_n > 90$ mm		
		Water temperature	20 °C	40 °C	20 °C	40 °C	
		Test pressure[b]	1,7PN	1,3PN	1,65PN	1,3PN	
		Number of test samples[c]	1	1	1	1	
		Test period	1 000 h		1 000 h		
Leaktightness at short-term hydrostatic pressure and at negative air pressure[d]	No leakage at any point of the jointing areas and negative pressure change shall be $\leqslant$ 0,05 bar	Hydrostatic pressure cycles and negative air pressure period	Shall conform to ISO 13783				ISO 13783
		Number of test samples[c]	1				

[a] For assemblies a) to i), as designated in 4.2.

[b] The PN value is that of the nominal pressure rate of the fitting, or if an integral socket joint is used, the nominal pressure rate of the pipe.

[c] The number of test pieces given indicates the number required to establish a value for the characteristic described in this table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan.

[d] For assemblies as designated in 4.2 i).

Annex A
(normative)

Assemblies of imperial (inch)-sized pipes, fittings, valves and ancillaries

A.1 General

All clauses of this part of ISO 1452 shall apply, together with the following clauses. The specifications given in this annex are for the requirements which differ from those given in Clauses 1 to 4.

A.2 Test requirements for assemblies with non-end-load bearing joints

Table A.1 shall replace Table 1.

Table A.1 — Requirements for assemblies with non-end-load bearing joints

Characteristic	Requirement	Test parameters			Test method
		Parameter	Value		
Leaktightness at short-term hydrostatic internal pressure	No leakage at any point of the jointing areas during the test period	Hydrostatic pressure[a] Ambient temperature Variation in temp. Deflection Test period Number of test samples[b]	Shall conform to Figure 1 15 °C to 25 °C ± 5 K 2° 100 min 1		ISO 13845
Leaktightness at short-term negative air pressure	Negative pressure change shall be ⩽ 0,05 bar for the first and for the second 15 min	Negative air pressure Ambient temperature Variation in temp. Deflection Deformation Test period Number of test samples[b]	Shall conform to Figure 2 15 °C to 25 °C ± 2 K 2° 5 % Shall conform to Figure 2 1		ISO 13844
Leaktightness at long-term hydrostatic internal pressure	No leakage at any point of the jointing areas during the test period	Water temperature Hydrostatic pressure[a] Test period Number of test samples[b]	20 °C 1,65 × PN 1 000 h 1	40 °C 1,3 × PN 1 000 h 1	ISO 13846

[a] The PN value is that of the nominal pressure rating of the fitting, or if an integral joint is used, the nominal pressure rating of the pipe.

[b] The number of test pieces given indicates the number required to establish a value for the characteristic described in this table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan.

A.3 Test requirements for assemblies with end-load bearing joints

Table A.2 shall replace Table 2.

Table A.2 — Requirements for assemblies with end-load bearing joints

Characteristic	Requirement	Test parameters			Test method
		Parameter	Value		
Leaktightness at long-term hydrostatic internal pressure	No leakage at any point of the jointing areas during the test period	Water temp. Test pressure[a]	20 °C 1,65 × PN	40 °C 1,3 × PN	ISO 13846
		Test period	1 000 h	1 000 h	
		Number of test samples[b]	1	1	

[a] The PN value is that of the nominal pressure rating of the fitting, or if an integral joint is used, the nominal pressure rating of the pipe.

[b] The number of test pieces given indicates the number required to establish a value for the characteristic described in this table. The number of test pieces required for factory production control and process control should be listed in the manufacturer's quality plan.

Annex B
(informative)

Determination of the long-term test pressure by creep consideration

B.1 Principle

The long-term leaktightness test conforming to ISO 13846 for solvent cement, elastomeric ring seal type and mechanical joints and assemblies is based on the test method described in EN 714[3] for non-end-load-bearing and EN 715[4] for end-load-bearing joints and on the principle that the joint has to remain watertight during the service life of the assembly, i.e. 50 years. It is essential that any deformation occurring in the joint area due to creep does not produce leakage.

The test is therefore carried out under such conditions that the expected creep deformation after 50 years at nominal operating conditions is reached in 1 000 h. The strain in the piping component, according to the design stress of the system for 50 years, can be determined from isochronous stress/strain diagrams for the relevant service temperature (e.g. for PVC-U at 20 °C, see Figure B.1 and at 40 °C, see Figure B.2).

Instead of a safety factor for the test, an additional test strain not greater than 0,5 times the calculated strain is added, the maximum value of this additional test strain being decided for each individual material and/or system.

The test stress for the 1 000 h test period is again determined from the isochronous stress/strain diagram in function of the resulting test strain. This test stress is then transformed into the required test pressure using Equation (B.1):

$$p_T = \frac{\sigma_T}{\sigma_s} \times PN \qquad \text{(B.1)}$$

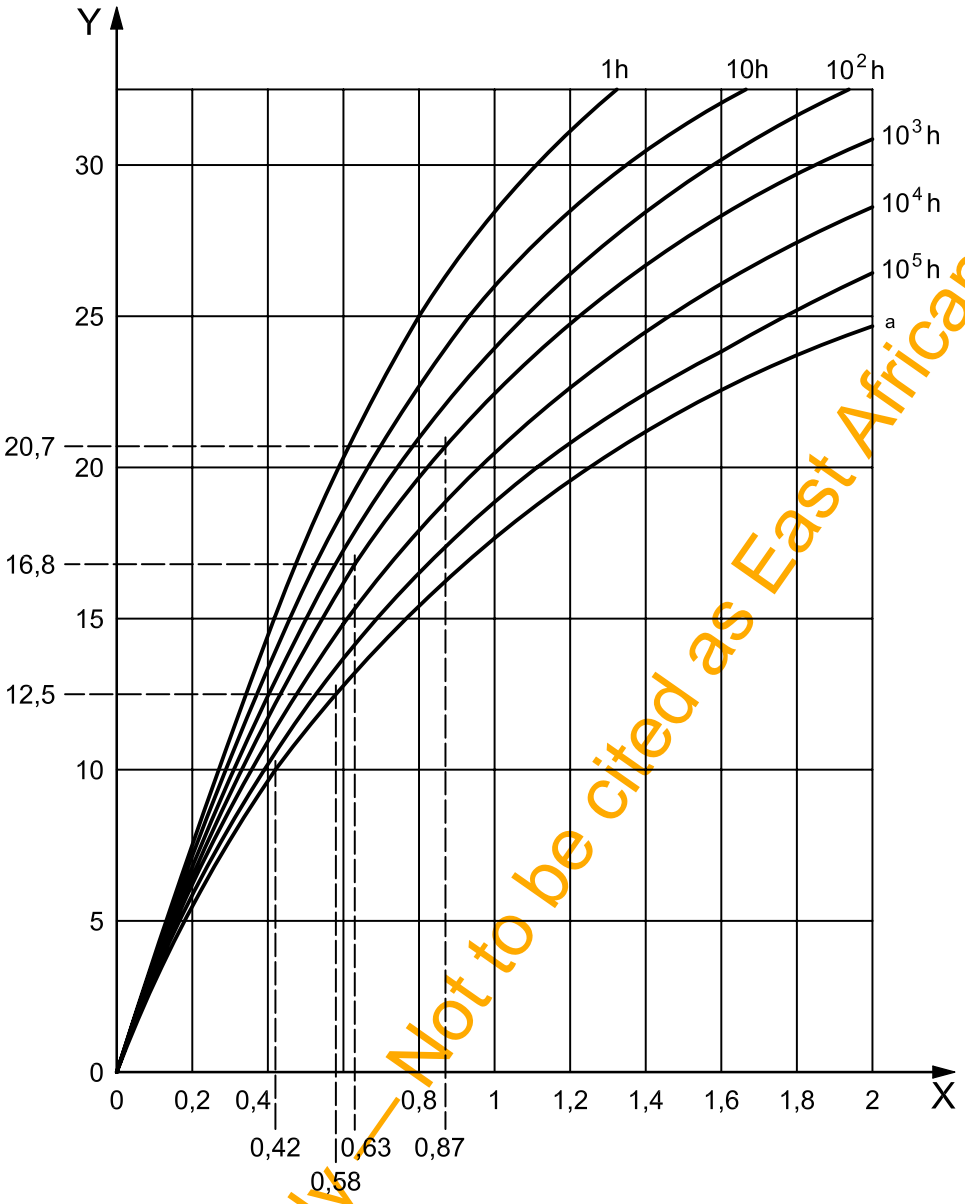
where

p_T is the test pressure, in the same unit as the nominal pressure;

σ_T is the test stress;

σ_s is the design stress;

PN represents the value of the nominal pressure.



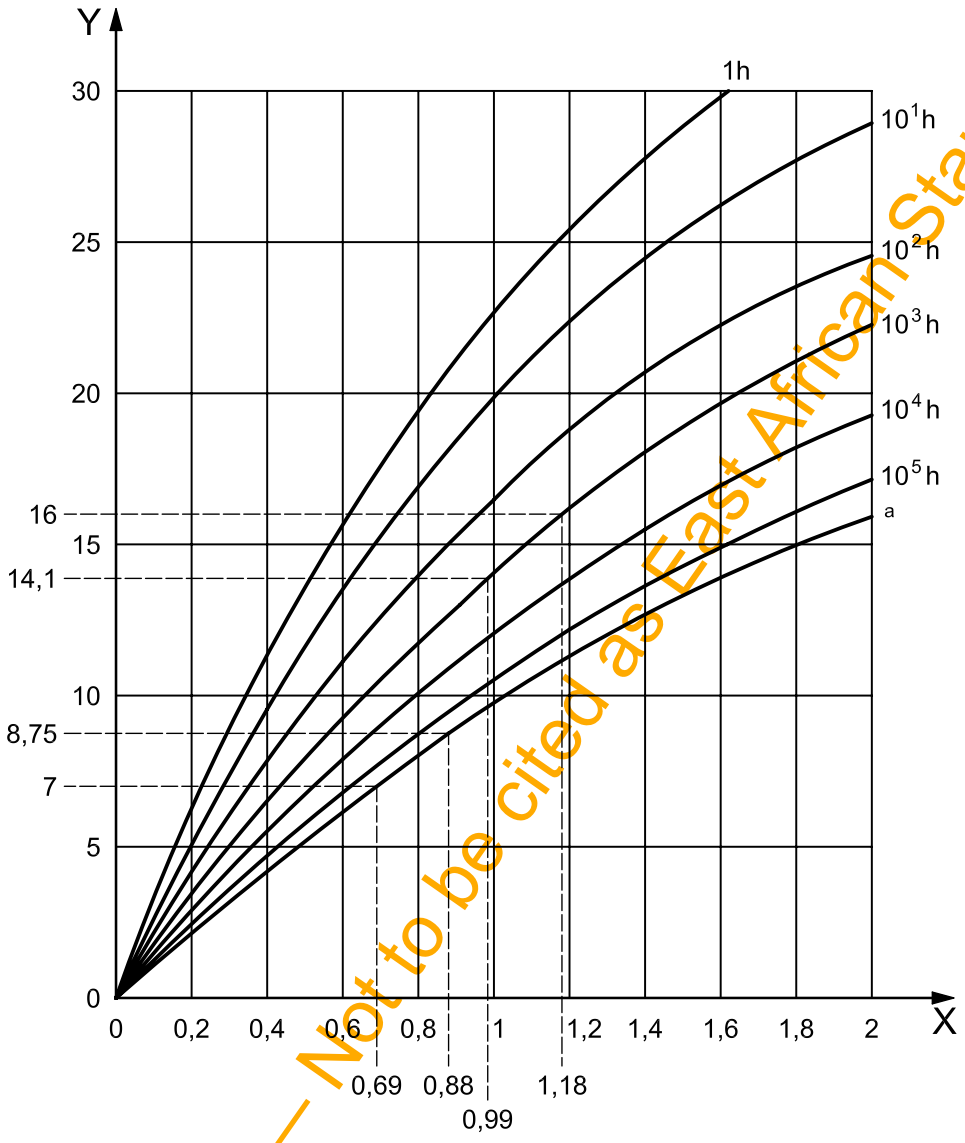
Key

X strain, ε, as a percentage

Y induced stress in pipe wall, in megapascals

a 50-year curve.

Figure B.1 — Isochronous stress/strain diagram for PVC-U at 20 °C



Key

X strain, ε, as a percentage

Y induced stress in pipe wall, in megapascals

a 50-year curve.

Figure B.2 — Isochronous stress/strain diagram for PVC-U at 40 °C

B.2 Calculation of the test pressure

For PVC-U, the strain, ε, is determined according to the stress at nominal operating conditions for the applied overall service (design) coefficient, respectively for the material type of the piping component. The induced stress is considered equal to the design stress, σ_s, corrected by the derating factor, f_T, for water temperature. An additional test strain not greater than 0,5 times the calculated strain is then added, which for PVC-U materials should not be greater than 0,3 %.

NOTE The maximum allowable temperature for PVC-U water supply in ISO 1452 is 45 °C, however a temperature of 40 °C has been established for the elevated temperature test, conforming to the recommended standard test temperatures.

The appropriate operating pressures at elevated temperatures are calculated using the derating factor graph given in ISO 1452-2:2009, Figure A.1.

The calculation steps of the test pressures for PVC-U material and for test temperatures 20 °C and 40 °C are given in Table B.1.

Table B.1 — Calculation of the test pressures for long-term leaktightness test of PVC-U assemblies

Design stress of pipe[a]	For $d_n \leqslant 90$ mm		For $d_n > 90$ and inch sizes	
Temperature	20 °C	40 °C	20 °C	40 °C
Temperature derating factor, f_T	1	0,7	1	0,7
Design stress, σ_s, related to temperature and 50 years, $f_T \times \sigma_s$	10 MPa	7 MPa	12,5 MPa	8,75 MPa
Strain (ε)[b] at an induced stress equal to $f_T \times \sigma_s$ at 50 years, (see Figure B.1 and Figure B.2)	0,42 %	0,69 %	0,58 %	0,88 %
Additional strain for test, ε_A	0,21 %	0,22 %	0,29 %	0,3 %
Strain for test, ε_T $\varepsilon_T = \varepsilon + \varepsilon_A$	0,63 %	0,91 %	0,87 %	1,18 %
Test stress (σ_T at 1 000 h) related to ε_T, (see Figure B.1 and Figure B.2)	16,8 MPa	13,0 MPa	20,7 MPa	16,0 MPa
Test pressure (p_T for 1 000 h), $p_T = \frac{\sigma_T}{\sigma_s} \times \text{PN}$ [cd]	$\frac{16,8}{10} \times$ PN bar 1,7 × PN bar	$\frac{13,0}{10} \times$ PN bar 1,3 × PN bar	$\frac{20,7}{12,5} \times$ PN bar 1,65 × PN bar	$\frac{16,0}{12,5} \times$ PN bar 1,3 × PN bar

a σ_s is the design stress for 50 years at 20 °C.

b These values have been rounded to the next higher 0,01.

c Factor to PN rounded to the next higher 0,05 bar.

d The PN-rating of the component or of the pipe if an integral pipe joint is tested.

Bibliography

[1] ISO/TR 4191, *Unplasticized polyvinyl chloride (PVC-U) pipes for water supply — Recommended practices for laying*

[2] ENV 1452-7, *Plastics piping systems for water supply — Unplasticized poly(vinyl chloride) (PVC-U) — Part 7: Guidance for the assessment of conformity*

[3] EN 714, *Thermoplastics piping systems — Non-end-load-bearing elastomeric sealing ring type joints between pressure pipes and moulded fittings — Test method for leaktightness under internal hydrostatic pressure without end thrust*

[4] EN 715, *Thermoplastics piping systems — End-load bearing joints between small diameter pressure pipes and fittings — Test method for leaktightness under internal water pressure, including end thrust*

ICS 23.040.20; 23.040.45; 91.140.60; 93.025

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