CD/K/029-5:2009
ICS 23.040.20; 23.040.45; 91.140.60; 93.025

EAST AFRICAN STANDARD

Plastics piping systems for hot and cold water installations — Polypropylene (PP) — 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.

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Introduction

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

ISO 15874-5:2003, *Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 5: Fitness for purpose of the system*

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

INTERNATIONAL STANDARD

ISO 15874-5

First edition
2003-12-01

Plastics piping systems for hot and cold water installations — Polypropylene (PP) —

Part 5: Fitness for purpose of the system

Systèmes de canalisations en plastique pour les installations d'eau chaude et froide — Polypropylène (PP) —

Partie 5: Aptitude à l'emploi du système

Reference number
ISO 15874-5:2003(E)

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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 15874-5 was prepared by the European Committee for Standardization (CEN) in collaboration with 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).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

ISO 15874 consists of the following parts, under the general title *Plastics piping systems for hot and cold water installations — Polypropylene (PP)*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

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

— *Part 7: Guidance for the assessment of conformity* [Technical Specification]

Contents

Foreword

This document (EN ISO 15874-5:2003) has been prepared by Technical Committee CEN/TC 155 “Plastics piping systems and ducting systems”, the secretariat of which is held by NEN, in collaboration with Technical Committee ISO/TC 138 "Plastics pipes, fittings and valves for the transport of fluids".

NOTE This draft was submitted for CEN enquiry as prEN 12202-5:1995.

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 June 2004, and conflicting national standards shall be withdrawn at the latest by December 2005.

This standard is part of a System Standard for plastics piping systems of a particular material for a specified application. There are a number of such System Standards.

System Standards are based on the results of the work undertaken in ISO/TC 138 “Plastics pipes, fittings and valves for the transport of fluids”, which is a Technical Committee of the International Organization for Standardization (ISO).

They are supported by separate standards on test methods to which references are made throughout the System Standard.

The System Standards are consistent with general standards on functional requirements and recommended practices for installation.

EN ISO 15874:2003 consists of the following Parts [1)], under the general title *Plastics piping systems for hot and cold water installations — Polypropylene (PP)*

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

— *Part 5: Fitness for purpose of the system* (the present standard)

— *Part 7: Guidance for the assessment of conformity* (CEN ISO/TS 15874-7).

This Part of EN ISO 15874:2003 includes a Bibliography.

At the date of publication of this standard, System Standards for piping systems of other plastics materials used for the same application are the following:

EN ISO 15875, *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE X) (ISO 15875:2003)*

EN ISO 15876, *Plastics piping systems for hot and cold water installations — Polybutylene (PB) (ISO 15876:2003)*

EN ISO 15877, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) (ISO 15877:2003)*

For pipes and fittings which have conformed to the relevant national standard before 1st November, 2003, as shown by the manufacturer or by a certification body, the national standard may continue to apply until 30th November, 2005.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

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1) This System Standard does not incorporate a Part 4 *Ancillary equipment* or a Part 6: *Guidance for installation.* For ancillary equipment separate standards can apply. Guidance on installation of plastics piping systems made from different materials intended to be used for hot and cold water installations is given by ENV 12108 [1].

Introduction

The System Standard, of which this is Part 5, specifies the requirements for a piping system and its components when made from polypropylene (PP). The piping system is intended to be used for hot and cold water installations.

In respect of potential adverse effects on the quality of water intended for human consumption, caused by the product covered by EN ISO 15874;

— This standard provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA;

— It should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

Requirements and test methods for components of the piping system are specified in Part 1, 2 and 3 of this System Standard. Part 7 (CEN ISO/TS) gives guidance for the assessment of conformity.

This Part of EN ISO 15874 specifies the characteristics of fitness for purpose of the piping systems.

1 Scope

This Part of EN ISO 15874 specifies the characteristics of the fitness for purpose of polypropylene (PP) piping systems, intended to be used for hot and cold water installations within buildings for the conveyance of water, whether or not intended for human consumption (domestic systems) and for heating systems, under design pressures and temperatures according to the class of application (see Table 1 of EN ISO 15874-1:2003).

This standard covers a range of service conditions (classes of application) and design pressure classes. For values of T_D, T_{max} and T_{mal} in excess of those in Table 1 of Part 1, this standard does not apply.

NOTE It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and any relevant national regulations and installation practices or codes.

It also specifies the test parameters for the test methods referred to in this standard.

In conjunction with the other Parts of EN ISO 15874 (see Foreword) it is applicable to PP pipes, fittings, their joints and to joints with components of other plastics and non-plastics materials intended to be used for hot and cold water installations.

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 publications are listed hereafter. 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 (including amendments).

EN 712, *Thermoplastics piping systems — End-load bearing mechanical joints between pressure pipes and fittings — Test method for resistance to pull-out under constant longitudinal force*

EN 713, *Plastics piping systems — Mechanical joints between fittings and polyolefin pressure pipes — Test method for leaktightness under internal pressure of assemblies subjected to bending*

EN 921, *Plastics piping systems — Thermoplastics pipes — Determination of resistance to internal pressure at constant temperature*

EN ISO 15874-1:2003, *Plastics piping system for hot and cold water installations — Polypropylene (PP) — Part 1: General (ISO 15874-1:2003)*

EN ISO 15874-2:2003, *Plastics piping system for hot and cold water installations — Polypropylene (PP) — Part 2: Pipes (ISO 15874-2:2003)*

EN 12293, *Plastics piping systems — Thermoplastics pipes and fittings for hot and cold water — Test method for the resistance of mounted assemblies to temperature cycling*

EN 12294, *Plastics piping systems — Systems for hot and cold water — Test method for leaktightness under vacuum*

EN 12295, *Plastics piping systems — Thermoplastics pipes and associated fittings for hot and cold water — Test method for resistance of joints to pressure cycling*

3 Terms and definitions, symbols and abbreviated terms

For the purposes of this standard the terms and definitions, symbols and abbreviated terms given in EN ISO 15874-1:2003 apply.

4 Fitness for purpose of the joints and the piping system

4.1 General

When tested in accordance with the applicable test methods as specified in Table 1, using the indicated parameters given in 4.2 to 4.7, as applicable, the joints and the piping system shall have characteristics conforming to the requirements given in the applicable clauses.

For the tests described the fittings shall be connected to the pipe with which they are intended to be used.

Table 1 specifies the tests applicable for each different type of jointing system covered by this standard.

Table 1 — Joint tests

Test	Jointing system [a]			Test parameters	Test method
	SW	EF	M		
Internal pressure test	Y	Y	Y	Shall conform to 4.2	EN 921
Bending test	N	N	Y	Shall conform to 4.3	EN 713
Pull-out test	N	N	Y	Shall conform to 4.4	EN 712
Thermal cycling test	Y	Y	Y	Shall conform to 4.5	EN 12293
Pressure cycling test	N	N	Y	Shall conform to 4.6	EN 12295
Vacuum test	N	N	Y	Shall conform to 4.7	EN 12294

[a] SW - Socket welded joint
EF - Electrofusion joint
M - Mechanical joint
Y - denotes test applicable
N - denotes test not applicable

4.2 Internal pressure test

When tested in accordance with EN 921 using the test parameters given in Table 2, 3 or 4 for the relevant classes the joint assemblies shall not leak.

The test pressure, p_J, for a given time to failure and test temperature shall be determined by the following equation:

$$p_J = p_D \times \frac{\sigma_P}{\sigma_{DP}}$$

where:

p_J is the hydrostatic test pressure, in bars [2)] , to be applied to the joint assembly during the test period;

σ_P is the hydrostatic stress value, in megapascals, for the pipe material corresponding to time to failure/test temperature points given in Table 2, 3 or 4;

σ_{DP} is the design stress value, in megapascals, for the pipe material as determined for each class and listed in Table 2 of EN ISO 15874-2:2003;

p_D is the design pressure of 4 bar or 6 bar or 8 bar or 10 bar, as applicable.

2) 1 bar = 10^5 N/m^2 = 0,1 MPa.

Table 2 — Derivation of test pressure p_J for PP-H

	Application class			
	Class 1	Class 2	Class 4	Class 5
Max. design temperature, T_{max}, in °C	80	80	70	90
Design stress of pipe material, σ_{DP}, in MPa	2,90	1,99	3,24	1,83
Test temperature [a] , T_{test}, in °C	95	95	80	95
Test duration, t , in h	1000	1000	1000	1000
Hydrostatic stress of pipe material, σ_P , in MPa	3,5	3,5	5,0	3,5
Test pressure, p_J, in bars, for a design pressure, p_D, of: 4 bar 6 bar 8 bar 10 bar	5,6 [b] 7,2 9,7 12,1	7,0 10,6 14,1 17,6	8,0 [b] 9,3 12,3 15,4	7,7 11,5 15,3 19,1
Number of test pieces	3	3	3	3

[a] Generally the highest test temperature is taken to be (T_{max} + 10) °C with an upper limit of 95 °C. However to match existing test facilities the highest test temperature for classes 1 and 2 is also set at 95 °C. The hydrostatic stresses given correspond to the given test temperatures.

[b] The 20 °C, 10 bar, 50 years, cold water requirement, being higher, determines this value (see clause 4 of EN ISO 15874-1:2003).

Table 3 — Derivation of test pressure p_J for PP-B

	Application class			
	Class 1	Class 2	Class 4	Class 5
Max. design temperature, T_{max} , in °C	80	80	70	90
Design stress of pipe material, σ_{DP}, in MPa	1,67	1,19	1,95	1,19
Test temperature [a] , T_{test}, in °C	95	95	80	95
Test duration, t , in h	1000	1000	1000	1000
Hydrostatic stress of pipe material, σ_P, in MPa	2,6	2,6	3,7	2,6
Test pressure, p_J, in bars, for a design pressure, p_D, of: 4 bar 6 bar 8 bar 10 bar	6,2 9,3 12,5 15,6	8,7 13,1 17,5 21,8	7,6 11,4 15,2 19,0	8,7 13,1 17,5 21,8
Number of test pieces	3	3	3	3

[a] Generally the highest test temperature is taken to be (T_{max} + 10) °C with an upper limit of 95 °C. However to match existing test facilities the highest test temperature for classes 1 and 2 is also set at 95 °C. The hydrostatic stresses given correspond to the given test temperatures.

Table 4 — Derivation of test pressure p_J for PP-R

	Application class			
	Class 1	Class 2	Class 4	Class 5
Max. design temperature, T_{max}, in °C	80	80	70	90
Design stress of pipe material, σ_{DP}, in MPa	3,09	2,13	3,30	1,90
Test temperature [a] , T_{test}, in °C	95	95	80	95
Test duration, t, in h	1000	1000	1000	1000
Hydrostatic stress of pipe material, σ_P, in MPa	3,5	3,5	4,6	3,5
Test pressure, p_J, in bars, for a design pressure, p_D, of: 4 bar 6 bar 8 bar 10 bar	 5,1 [b] 6,8 9,1 11,3	 6,6 9,9 13,1 16,4	 6,7 [b] 8,4 11,2 13,9	 7,4 11,1 14,7 18,4
Number of test pieces	3	3	3	3

[a] Generally the highest test temperature is taken to be (T_{max} + 10) °C with an upper limit of 95 °C. However to match existing test facilities the highest test temperature for classes 1 and 2 is also set at 95 °C. The hydrostatic stresses given correspond to the given test temperatures.

[b] The 20 °C, 10 bar, 50 years, cold water requirement, being higher, determines this value (see clause 4 of EN ISO 15874-1:2003).

In special circumstances if joint tests according to this clause cause leaks resulting from differential elongation induced deformations, a test pressure may be determined from the stress and creep data (relative to a design period of 50 years) for the different materials used.

4.3 Bending test

When tested in accordance with EN 713 to the applicable pressure for the 20 °C, 1 h condition given in Table 5, 6 or 7, as applicable, using a bending radius equal to the minimum radius of bending for the pipes as recommended by the system supplier, the joint assembly shall not leak.

This test is only applicable to pipes of nominal diameter greater than or equal to 32 mm.

Table 5 — Test parameters for bending test for PP-H

	Application class			
	Class 1	Class 2	Class 4	Class 5
Max. design temperature, T_{max}, in °C	80	80	70	90
Design stress of pipe material, σ_{DP}, in MPa	2,90	1,99	3,24	1,83
Test temperature, T_{test}, in °C	20	20	20	20
Test duration, t , in h	1	1	1	1
Hydrostatic stress of pipe material, σ_P, in MPa	21	21	21	21
Test pressure, p_J, in bars, for a design pressure, p_D, of: 4 bar 6 bar 8 bar 10 bar	33,6 [a] 43,4 57,9 72,4	42,2 63,3 84,4 105,5	33,6 [a] 38,9 51,9 64,8	45,9 68,9 91,8 114,8
Number of test pieces	3	3	3	3

[a] The 20 °C, 10 bar, 50 years, cold water requirement, being higher, determines this value (see clause 4 of EN ISO 15874-1:2003).

Table 6 — Test parameters for bending test for PP-B

	Application class			
	Class 1	Class 2	Class 4	Class 5
Max. design temperature, T_{max}, in °C	80	80	70	90
Design stress of pipe material, σ_{DP}, in MPa	1,67	1,19	1,95	1,19
Test temperature, T_{test}, in °C	20	20	20	20
Test duration, t , in h	1	1	1	1
Hydrostatic stress of pipe material, σ_P, in MPa	16	16	16	16
Test pressure, p_J, in bars, for a design pressure, p_D, of: 4 bar 6 bar 8 bar 10 bar	38,3 57,5 76,6 95,8	53,8 80,7 107,6 134,4	32,8 49,2 65,6 82,1	53,8 80,7 107,6 134,4
Number of test pieces	3	3	3	3

Table 7 — Test parameters for bending test for PP-R

	Application class			
	Class 1	Class 2	Class 4	Class 5
Max. design temperature, T_{max}, in °C	80	80	70	90
Design stress of pipe material, σ_{DP}, in MPa	3,09	2,13	3,30	1,90
Test temperature, T_{test}, in °C	20	20	20	20
Test duration, t, in h	1	1	1	1
Hydrostatic stress of pipe material, σ_P, in MPa	16	16	16	16
Test pressure, p_J, in bars, for a design pressure, p_D, of: 4 bar	23,2 [a]	30,0	23,2 [a]	33,7
6 bar	31,1	45,1	29,1	50,5
8 bar	41,4	60,1	38,8	67,4
10 bar	51,8	75,1	48,5	84,2
Number of test pieces	3	3	3	3

[a] The 20 °C, 10 bar, 50 years, cold water requirement, being higher, determines this value (see clause 4 of EN ISO 15874-1:2003).

4.4 Pull-out test

When tested in accordance with EN 712 using the parameters given in Table 8, the joint assemblies shall withstand the pull-out force, without being separated.

The force, F, shall be calculated from the following equation:

$$F = \frac{\pi}{4} d_n^{\,2} \times p_D$$

where:

F is the force, expressed in newtons (N);

d_n is the nominal outside diameter of the pipe, expressed in millimetres (mm);

p_D is the design pressure of 4, 6, 8 or 10 bar, as applicable, expressed in megapascals. In the case of the classification "All classes", the design pressure shall be 10 bar, expressed in megapascals (MPa).

Table 8 — Test parameters for pull-out test

	All application classes	Application class			
		Class 1	Class 2	Class 4	Class 5
Max design temperature, T_{max}, in °C	—	80	80	70	90
Test temperature, in °C	23	90	90	80	95
Test period, in h	1	1	1	1	1
Pull-out force, in N	$1,5 \times F$	F	F	F	F
Number of test pieces	3	3	3	3	3

4.5 Thermal cycling test

When tested in accordance with EN 12293 using the parameters given in Table 9 the pipes, fittings or joints, as applicable, shall withstand the test without leakage.

The test for flexible pipes shall only be used when the manufacturer declares that the pipe can be bent to the configuration shown. The bending radius shall not be smaller than the minimum declared bending radius. In all other cases the test for rigid pipes shall apply.

Table 9 — Test parameters for thermal cycling

	Application class			
	Class 1	Class 2	Class 4	Class 5
Max design temperature, T_{max}, in °C	80	80	70	90
Highest test temperature, in °C	90	90	80	95
Lowest test temperature, in °C	20	20	20	20
Test pressure, in bars	p_D	p_D	p_D	p_D
Number of cycles [a]	5000	5000	5000	5000
Number of test pieces	One set of fittings in accordance with the configuration shown in EN 12293.			
[a] Each cycle shall comprise $15\,^{+1}_{0}$ min at the highest test temperature and $15\,^{+1}_{0}$ min at the lowest (i.e. the duration of one cycle is $30\,^{+2}_{0}$ min).				

The tensile stress, σ_t, used to calculate the pre-stress force required in EN 12293 shall be 3,6 MPa for PP-H, 3,0 MPa for PP-B and 2,4 MPa for PP-R.

NOTE The tensile stress is calculated using the following equation:

$$\sigma_t = \alpha \times \Delta T \times E$$

where:

σ_t is the tensile stress, expressed in megapascals (MPa);

α is the coefficient of thermal expansion, expressed in reciprocal kelvins (1/K);

ΔT is the temperature difference, expressed in kelvins (K);

E is the modulus of elasticity, expressed in megapascals (MPa).

In this standard the following values apply:

$\alpha = 1{,}5 \times 10^{-4}\ K^{-1}$;

$\Delta T = 20$ K;

E = 1200 MPa (PP-H), 1 000 MPa (PP-B), 800 MPa (PP-R).

4.6 Pressure cycling test

When tested for leaktightness under pressure cycling in accordance with EN 12295 using the parameters given in Table 10, the pipes, fittings or joints, as applicable, shall not leak.

Table 10 — Test parameters for pressure cycling

Characteristics	Requirement	Test parameters			Test method
Pressure cycling	No leakage	Test temperature Number of test pieces Frequency of test cycles Number of cycles Test pressure limits for a design pressure of:	23 °C 3 (30 ± 5) cycles per min 10 000 Upper limit	Lower limit	EN 12295
		4 bar	6,0 bar	0,5 bar	
		6 bar	9,0 bar	0,5 bar	
		8 bar	12,0 bar	0,5 bar	
		10 bar	15,0 bar	0,5 bar	

4.7 Leaktightness under vacuum

When tested for leaktightness under vacuum in accordance with EN 12294 using the parameters given in Table 11, the change in vacuum pressure shall not be greater than 0,05 bar.

Table 11 — Test parameters for leaktightness under vacuum

Characteristics	Requirements	Test parameters		Test method
Leaktightness under vacuum	Change in vacuum pressure ≤ 0,05 bar	Test temperature Test duration Test pressure Number of test pieces	23 °C 1 h –0,8 bar 3	EN 12294

Bibliography

[1] ENV 12108, *Plastics piping systems — Guidance for the installation inside buildings of pressure piping systems for hot and cold water intended for human consumption*

ICS 83.140.30; 91.140.60

Price based on 9 pages