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EAST AFRICAN STANDARD

Multilayer piping systems for hot and cold water installations inside buildings — 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 21003-5:2008, *Multilayer piping systems for hot and cold water installations inside buildings — Part 5: Fitness for purpose of the system*

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

INTERNATIONAL STANDARD

ISO 21003-5

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Multilayer piping systems for hot and cold water installations inside buildings —

Part 5: Fitness for purpose of the system

Systèmes de canalisations multicouches pour installations d'eau chaude et froide à l'intérieur des bâtiments —

Partie 5: Aptitude à l'emploi du système

Reference number
ISO 21003-5:2008(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 21003-5 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 2, *Plastics pipes and fittings for water supplies*.

ISO 21003 consists of the following parts, under the general title *Multilayer piping systems for hot and cold water installations inside buildings*:

— *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]

NOTE ISO 21003 does not include a Part 4: *Ancillary equipment*, or a Part 6: *Guidance for installation*.

Introduction

The system standard of which this is Part 5 specifies the requirements for a multilayer piping system.

The multilayer piping system is intended to be used for hot and cold water installations inside buildings.

In respect of potential adverse effects on the quality of water intended for human consumption caused by the products covered by ISO 21003:

— no information is provided as to whether the products 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 these products remain in force.

Requirements and test methods for components of the piping system are specified in ISO 21003-1, ISO 21003-2 and ISO 21003-3. ISO/TS 21003-7 gives guidance on the assessment of conformity.

This part of ISO 21003 specifies the characteristics for fitness for purpose.

For ancillary equipment, separate standards can apply.

Guidance on installation of plastics piping systems made from various materials intended to be used for hot and cold water installations is given in ENV 12108.

Other system standards which, at the date of publication of this part of ISO 21003, had been published for plastics piping systems used for the same application are listed in Annex A.

Multilayer piping systems for hot and cold water installations inside buildings —

Part 5:
Fitness for purpose of the system

1 Scope

This part of ISO 21003 specifies the characteristics for the fitness for purpose of multilayer piping systems intended to be used for hot and cold water installations inside buildings for the conveyance of water — whether or not the water is intended for human consumption (domestic systems) or for heating systems — under specified design pressures and temperatures appropriate to the class of application (see Table 1 of ISO 21003:2008).

It also specifies the test parameters for the test methods referred to in this part of ISO 21003.

ISO 21003 is a reference product standard. It is applicable to multilayer pipes, fittings, their joints, and also to joints with components made of other plastics and non-plastics materials intended to be used for hot and cold water installations. This part of ISO 21003 is intended for use only in conjunction with all the other parts of ISO 21003.

ISO 21003 covers a range of service conditions (application classes) and design pressures. It is not applicable for values of design temperature, T_D, maximum design temperature, T_{max}, and malfunction temperature, T_{mal}, in excess of those in Table 1 of ISO 21003-1:2008.

NOTE 1 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.

The polymeric materials used for the stress-designed layers are the following: polybutylene (PB), polyethylene of raised temperature resistance (PE-RT), crosslinked polyethylene (PE-X), polypropylene (PP) and chlorinated poly(vinyl chloride) (PVC-C).

The PE-X used shall be fully crosslinked and shall comply with the requirements of the relevant reference product standard (ISO 15875).

NOTE 2 For the purposes of this ISO 21003, crosslinked polyethylene (PE-X) as well as adhesives are considered as thermoplastic materials.

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 1167-1, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method*

ISO 1167-2, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 2: Preparation of pipe test pieces*

ISO 1167-3, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 3: Preparation of components*

ISO 1167-4, *Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 4: Preparation of assemblies*

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

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

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

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

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

ISO 17456, *Plastics piping systems — Multilayer pipes — Determination of long-term strength*

ISO 21003-1:2008, *Multilayer piping systems for hot and cold water installations inside buildings — Part 1: General*

ISO 21003-2:2008, *Multilayer piping systems for hot and cold water installations inside buildings — Part 2: Pipes*

ISO 21003-3, *Multilayer piping systems for hot and cold water installations inside buildings — Part 3: Fittings*

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

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 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 methods for resistance of joints to pressure cycling*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21003-1 apply.

4 Symbols and abbreviated terms

For the purposes of this part of ISO 21003, the symbols and abbreviated terms given in ISO 21003-1 apply.

5 Fitness for purpose of the joints and the piping system

5.1 General

When tested in accordance with the applicable methods as specified in Table 1, using the parameters given in 5.2 to 5.7, the joints and the piping system shall have characteristics conforming to the requirements given in the applicable subclauses.

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 part of ISO 21003.

Table 1 — Joint tests

Test	Jointing system [a]			Test parameters	Test method
	Solvent-cemented	Fusion socket Electrofusion	Mechanical		
Internal pressure test	Y	Y	Y	Shall conform to 5.2	Relevant parts of ISO 1167
Bending test	Y	Y	Y	Shall conform to 5.3	EN 713
Pull-out test	Y	Y	Y	Shall conform to 5.4	EN 712
Thermal cycling test	Y	Y	Y	Shall conform to 5.5	EN 12293
Pressure cycling test	Y	Y	Y	Shall conform to 5.6	EN 12295
Vacuum test	Y	Y	Y	Shall conform to 5.7	EN 12294

[a] Y denotes test applicable.

5.2 Internal pressure test

When tested in accordance with the relevant parts of ISO 1167, using the test parameters given in Table 2 for the relevant classes, the joint assembly shall not leak.

The test pressure shall be calculated using the following equation:

$$p_F = p_D \times \frac{p_C}{p_{CD}} \quad (1)$$

where

p_F is the hydrostatic test pressure, in bars, to be applied to the assembly during the test period;

p_C is the value of the pressure, in bars, of the pipe construction corresponding to the time to failure/test temperature specified in ISO 21003-2;

p_{CD} is the design pressure value, in bars, of the pipe construction, calculated in accordance with Annex E of ISO 21003-2:2008;

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

Table 2 — Derivation of test pressure, p_F

	Application class			
	Class 1	**Class 2**	**Class 4**	**Class 5**
Maximum design temperature, T_{max} (°C)	80	80	70	90
Design pressure of the pipe construction, p_{CD} (MPa)	b	b	b	b
Test temperature, T_{test} (°C) [a]	95	95	80	95
Test duration, t (h)	1 000	1 000	1 000	1 000
Hydrostatic pressure of the pipe construction, p_C (MPa)	b	b	b	b
Test pressure, p_F (bar)				
for a design pressure, p_D, of: 4 bar	b	b	b	b
6 bar	b	b	b	b
8 bar	b	b	b	b
10 bar	b	b	b	b
Number of test pieces	3	3	3	3

NOTE 1 bar = 0,1 MPa.

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

[b] The values of p_{CD}, p_C and p_F result from the long-term strength data for the individual construction.

If joint tests carried out in accordance with this subclause cause leaks resulting from deformation induced by differential elongation, 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.

5.3 Bending test

When tested in accordance with EN 713 to the pressure applicable to the 20 °C/1 h condition given in Table 3, using a bending radius equal to the minimum bend radius recommended for the pipes by the system supplier, the joint shall not leak.

The test pressure shall be calculated using the following equation:

$$p_F = p_D \times \frac{p_C}{p_{CD}} \quad (2)$$

where

p_F is the hydrostatic test pressure, in bars, to be applied to the assembly during the test period;

p_C is the value of the pressure, in bars, of the pipe construction corresponding to the time to failure/test temperature specified in ISO 21003-2;

p_{CD} is the design pressure value, in bars, of the pipe construction, calculated in accordance with Annex E of ISO 21003-2:2008;

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

Table 3 — Test parameters for bending test

	Application class			
	Class 1	Class 2	Class 4	Class 5
Maximum design temperature, T_{max} (°C)	80	80	70	90
Design pressure of the pipe construction, p_{CD} (MPa)	a	a	a	a
Test temperature, T_{test} (°C)	20	20	20	20
Test duration, t (h)	1	1	1	1
Hydrostatic pressure of the pipe construction, p_C (MPa)	a	a	a	a
Test pressure, p_F (bar)				
for a design pressure, p_D, of: 4 bar	a	a	a	a
6 bar	a	a	a	a
8 bar	a	a	a	a
10 bar	a	a	a	a
Number of test pieces	3	3	3	3
NOTE 1 bar = 0,1 MPa.				
a The values of p_{CD}, p_C and p_F result from the long-term strength data for the individual construction.				

5.4 Pull-out test

When tested in accordance with EN 712, using the test parameters given in Table 4, the joint assemblies shall withstand the pull-out force without being separated.

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

$$F = \frac{\pi}{4} \times {d_n}^2 \times p_D \qquad (3)$$

where

F is the force, in N;

d_n is the nominal outside diameter of the pipe, in mm;

p_D is the design pressure of 4 bar, 6 bar, 8 bar or 10 bar, as applicable, expressed in MPa. In the case of the classification “all classes”, the design pressure shall be 10 bar, expressed in MPa.

Table 4 — Test parameters for pull-out force

	All application classes	Application class			
		Class 1	Class 2	Class 4	Class 5
Maximum design temperature, T_{max} (°C)	—	80	80	70	90
Test temperature, T_{test} (°C)	23	95	95	80	95
Test duration, t (h)	1	1	1	1	1
Pull-out force, F (N)	$1{,}5 \times F$	F	F	F	F
Number of test pieces	3	3	3	3	3
The pull-out test shall be performed at 23 °C and at T_{max} for the relevant application class.					

5.5 Thermal cycling test

When tested in accordance with EN 12293, using the test parameters given in Table 5, 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 bend radius shall not be smaller than the minimum declared bend radius. In all other cases, the test for rigid pipes shall be used.

For M-pipe systems, to pre-stress branch A the reference product standard and the dimensions of the inner layer shall be used.

Table 5 — Test parameters for thermal cycling

	Application class			
	Class 1	**Class 2**	**Class 4**	**Class 5**
Maximum design temperature, T_{max} (°C)	80	80	70	90
Highest test temperature (°C)	90	90	80	95
Lowest test temperature (°C)	20	20	20	20
Test pressure (bar) [a]	p_D	p_D	p_D	p_D
Number of cycles for $D \leqslant 63$ mm [b]	5 000	5 000	5 000	5 000
Number of cycles for $D > 63$ mm [c]	2 500	2 500	2 500	2 500
Number of test pieces	One set of fittings with the configuration shown in EN 12293			
NOTE 1 bar = 0,1 MPa.				

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

[b] Each cycle shall comprise 15 min at the highest test temperature and 15 min at the lowest (i.e. the duration of one cycle is 30 min).

[c] Each cycle shall comprise 30 min at the highest test temperature and 30 min at the lowest (i.e. the duration of one cycle is 60 min).

5.6 Pressure cycling test

When tested for leaktightness under the action of pressure cycling in accordance with EN 12295, using the test parameters given in Table 6, the pipes, fittings or joints, as applicable, shall not leak.

Table 6 — Test parameters for pressure cycling

Test temperature	23 °C	
Number of test pieces	3	
Frequency of pressure cycling	(30 ± 5) cycles per minute	
Number of cycles	10 000	
Test pressure limits for a design pressure of:	Upper limit	Lower limit
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
NOTE 1 bar = 0,1 MPa.		

5.7 Leaktightness under vacuum

When tested for leaktightness under vacuum in accordance with EN 12294, using the test parameters given in Table 7, the change in vacuum pressure shall not be greater than 0,05 bar.

Table 7 — Test parameters for leaktightness under vacuum

Test temperature	23 °C
Number of test pieces	3
Test pressure	− 0,8 bar
Test duration	1 h
NOTE 1 bar = 0,1 MPa.	

Annex A
(normative)

List of reference product standards

Table A.1 — List of reference product standards

Material	Reference product standard
PB	ISO 15876-1, ISO 15876-2, ISO 15876-3, ISO 15876-5
PE-RT	ISO 22391-1, ISO 22391-2, ISO 22391-3, ISO 22391-5
PE-X	ISO 15875-1, ISO 15875-2, ISO 15875-3, ISO 15875-5
PP	ISO 15874-1, ISO 15874-2, ISO 15874-3, ISO 15874-5
PVC-C	ISO 15877-1, ISO 15877-2, ISO 15877-3, ISO 15877-5

Bibliography

[1] ISO/TS 21003-7, *Multilayer piping systems for hot and cold water installations inside buildings — Part 7: Guidance for the assessment of conformity*

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

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