



## WORKING DRAFT EAST AFRICAN STANDARD

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**Plastic piping systems for water supply — Unplasticized poly vinyl chloride (PVC-U) — Guidance for the assessment of conformity**

EAST AFRICAN COMMUNITY

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## Foreword

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

The Community has established an East African Standards Committee (EASC) mandated to develop and issue East African Standards (EAS). The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the public and private sector organizations in the community.

East African Standards are developed through Technical Committees that are representative of key stakeholders including government, academia, consumer groups, private sector and other interested parties. 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 principles and procedures for development of East African Standards.

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.

The committee responsible for this document is Technical Committee EASC/TC 047, *Plastic pipes, fittings, valves, piping systems and ducting systems*.

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# Plastic piping systems for water supply — Unplasticized poly (vinyl chloride) (PVC-U) — Guidance for the assessment of conformity

## 1 Scope

This draft East African Standard gives guidance for the assessment of conformity intended to be included in the manufacturer's quality plan as part of the quality system.

This standard includes:

- a) requirements for materials, components, joints and assemblies given in Parts 1 to 5 of ISO 1452
- b) requirements for the manufacturer's quality system;

NOTE 1 It is recommended that the quality system conforms to ISO 9001, as applicable.

- c) definitions and procedures to be applied if third party certification is involved;

NOTE 2 If third party certification is involved, it is recommended that the certification body is accredited to ISO/IEC 17065:2012.

In conjunction with Parts 1 to 5 of ISO 1452 it is applicable to unplasticized poly(vinyl chloride) (PVC-U) piping systems 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; for the supply of water under pressure at approximately 23 °C (cold water) intended for human consumption and for general purposes.

This standard is also applicable to PVC-U piping systems for the conveyance of water up to and including 45 °C. For temperatures between 25 °C and 45 °C figure A.1 in Annex A of ISO 1452-2 applies.

## 2 Normative references

This draft East African 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:

ISO 1452-1, *Plastics piping systems for water supply — Unplasticized poly(vinyl chloride)(PVC-U) — Part 1: General*

ISO 1452-2, *Plastics piping systems for water supply — Unplasticized poly(vinyl chloride)(PVC-U) — Part 2: Pipes*

ISO 1452-3, *Plastics piping systems for water supply — Unplasticized poly(vinyl chloride)(PVC-U) — Part 3: Fittings*

ISO 1452-4, *Plastics piping systems for water supply — Unplasticized poly(vinyl chloride)(PVC-U) — Part 4: Valves and ancillary equipment*

ISO 1452-5, *Plastics piping systems for water supply — Unplasticized poly(vinyl chloride)(PVC-U) — Part 5: Fitness for purpose of the system*

ISO/IEC 17065:2012 *Conformity assessment — Requirements for bodies certifying products, processes and services*

ISO 2859-1 *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3951 *Sampling procedures for inspection by variables Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

### 3 Terms and definitions

For the purposes of this standard, the definitions and abbreviations given in ISO 1452-1 apply together with the following:

#### 3.1 Definitions

##### 3.1.1

##### **certification body**

impartial body, governmental or non-governmental, possessing the necessary competence and responsibility to carry out certification of conformity according to given rules of procedure and management

##### 3.1.2

##### **inspection body**

impartial organization or company, approved by a certification body as possessing the necessary competence to verify and/or to carry out initial type testing, audit testing and inspection of the manufacturer's factory production control in accordance with the relevant European Standard

##### 3.1.3

##### **testing laboratory**

laboratory which measures, tests, calibrates or otherwise determines the characteristics of the performance of materials and products

##### 3.1.4

##### **quality system**

organisational structure, responsibilities, procedures, processes and resources for implementing quality management (see ISO 8402)

##### 3.1.5

##### **quality plan**

document setting out the specific quality practices, resources and sequence of activities relevant to a particular product or range of products

##### 3.1.6

##### **type testing (TT)**

testing performed to prove that the material, component, joint or assembly is capable of conforming to the requirements given in the relevant standard

##### 3.1.6.1

##### **preliminary type testing (PTT)**

type testing carried out by, or on behalf of, the manufacturer

##### 3.1.6.2

##### **initial type testing (ITT)**

type testing carried out by, or on behalf of, a certification body for certification purposes

##### 3.1.7

##### **batch release test (BRT)**

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test performed by the manufacturer on a batch of components, which has to be satisfactorily completed before the batch can be released

### 3.1.8

#### **process verification test (PVT)**

test performed by the manufacturer on materials, components, joints or assemblies at specific intervals to confirm that the process continues to be capable of producing components conforming to the requirements given in the relevant standard

NOTE Such tests are not required to release batches of components and are carried out as a measure of process control.

### 3.1.9

#### **audit test (AT)**

test performed by, or on behalf of, a certification body to confirm that the material, component, joint or assembly continues to conform to the requirements given in the System Standard and to provide information to assess the effectiveness of the quality system

### 3.1.10

#### **indirect test (IT)**

test performed by the manufacturer different from that specified for that particular characteristic, having verified its correlation with the specified test

### 3.1.11

#### **witness testing (WT)**

testing accepted by a certification body for initial type testing and/or audit testing, which is carried out by, or on behalf of, the manufacturer and supervised by a representative of the certification body, qualified in testing

### 3.1.12

#### **material batch or compound batch**

clearly identifiable quantity of a particular material or compound

### 3.1.13

#### **production batch**

clearly identifiable collection of units, manufactured consecutively or continuously under the same conditions, using material or compound conforming to the same specification

### 3.1.14

#### **lot**

clearly identifiable sub-division of a batch for inspection purposes

### 3.1.15

#### **sample**

one or more units of product drawn from a batch or lot, selected at random without regard to quality

NOTE The number of units of product in the sample is the sample size.

### 3.1.16

#### **acceptable quality level (AQL)**

when a continuous series of lots or batches is considered, the quality level which for the purpose of sampling inspection is the limit of a satisfactory process average (see ISO 2859-1 and ISO 3951)

NOTE The designation of an AQL does not imply that a manufacturer has the right knowingly to supply any non-conforming unit of product.

### 3.1.17

#### **inspection level**

relationship between the lot or batch size and the sample size (see ISO 2859-1)

### 3.1.18

#### **group**

collection of similar components from which samples are selected for testing purposes.

### 3.1.19

#### **single component**

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single part as a final product or a part of an assembled final product

### **3.1.20**

#### **assembled component**

assembled final product using two or more single parts

### **3.1.21**

#### **assembly**

test piece consisting of various components

### **3.1.22**

#### **sampling plan**

specific plan which indicates the number of units of components or assemblies to be inspected

## **3.2 Abbreviations**

AQL:

acceptable quality level

AT

audit test

BRT:

batch release test

IT:

indirect test

ITT:

initial type testing

MRS

Minimum required strength

PTT:

preliminary type testing

PVT:

process verification test

TT:

type test

WT:

witness testing

## **4 Requirements**

### **4.1 General**

**4.1.1** Materials, components, joints and assemblies shall conform to the requirements given in Parts 1 to 5 of ISO 1452 as applicable.

**4.1.2** Components and/or assemblies shall be produced by the manufacturer under a quality system which includes a quality plan.

### **4.2 Testing and inspection**

#### **4.2.1 Grouping**

For the purposes of this standard the following groups shall apply for TT, PTT, ITT, PVT and AT.

**4.2.1.1 Pressure group**

Three pressure groups, each comprising a group of one or more current nominal pressures, shall be designated as given in Table 1.

**Table 1 — Pressure groups**

Pressure group	Range of nominal pressures, PN
1	6; 7.5; 8
2	10; 12.5
3	16, 20, 25

**4.2.1.2 Size group**

Four size groups, each comprising a group of current nominal diameters,  $d_n$ , shall be designated as given in Table 2.

**Table 2 — Size groups**

Size group	Range of nominal diameters $d_n$
1	12, 16, 20, 25, 32, 40, 50, 63
2	75, 90, 110, 125, 140, 160, 180, 220, 225
3	250, 280, 315, 355, 400, 450, 500, 560, 630
4	710, 800, 900, 1000

**4.2.1.3 Single component group**

Six single component groups, each comprising a group of components of similar design, shall be designated as given in Table 3.

**Table 3 — Single component groups**

Single component group	Single components
1	11° to 90° bends
2	45° and 90° elbows and tees
3	Reducers, couplers, end caps
4	Unions, flange adaptors, adaptor pieces and/or their parts
5	Valves and/or their parts
6	Ancillaries and/or their parts

**4.2.1.4 Assembled component group**

Seven assembled component groups, each comprising a group of assembled component of similar functional design, shall be designated as given in Table 4.



**Table 4 — Assembled component groups**

Assembled component group	Assembled components
1	Seat valves
2	Diaphragm valves
3	Ball valves
4	Gates valves
5	Butterfly valves
6	Integral sockets, adaptor fittings, flange connections, end-load-bearing and non-end-load-bearing couplers
7	Tapping saddles

**4.2.1.5 Jointing method group**

Five jointing method groups, each comprising a group of components and assemblies having the same jointing method, shall be designated as given in Table 5.

**Table 5 — Jointing method groups**

Jointing method group	Jointing method
1	Solvent cement type (socket and spigot)
2	Sealing ring type (socket and spigot)
3	Flange type
4	Mechanical clamping type
5	Threaded type

**4.2.1.6 Sampling plan A**

A sampling plan A, as detailed in Table 6 specifies a pattern for the number of units to be taken from one dn of a particular size group for e.g. type testing (see Table 2 and Table 8).

**Table 6 — Sampling plan A**

Size group	Number of units to be taken from one dn (sample size)
1	5
2	5
3	3

4	1
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## 4.2.2 Type tests (TT)

### 4.2.2.1 General

Type tests shall demonstrate that products conform to all requirements for the characteristics given in Tables 8, 9 and 10.

In addition, relevant type tests shall be carried out, as indicated in those Tables, whenever there is a change in design, in material and/or to extension of the product range.

For the purposes of defining the change of the material/compound of this standard, the dosage level of ingredients of a compound shall not exceed the tolerance bands given in Table 7. The values of X shall be specified by the manufacturer in his quality plan (see Table 7).

If any level exceeds the dosage band or if a type is changed, this variation in formulation constitutes a change in material/compound and the relevant characteristics given in Tables 8, 9 and 10 column M shall be retested. A change in the supplier of a material or within a type of stabilizer does not necessarily constitute a change in material/compound. A change in the chemical nature of the stabilizer, e.g. from Pb to Sn, shall constitute a change in material.

**Table 7 — Material/Compound tolerance bands**

Materials/Ingredients	Type	Value X and band
PVC resin 100 parts	K-value	$X_1: \pm 2$
Stabilizers based on	1) Pb or 2) Ca-Zn or 3) Sn or 4) Others	$X_2: \pm 40 \%$
Total quantity of other additives	CaCO <sub>3</sub> , pigments, lubricants, etc.	$\sum_{i=1}^n X_i: \pm 50 \%$

For the purpose of the change in design, the following characteristics are relevant:

- dimensions;
- geometry of the component;
- jointing design.

In the quality plan of the manufacturer at least the geometry, dimensions and the applied tolerances according and in addition to the requirements of KS ISO 1452 shall be specified.

If one or more of these characteristics exceed the defined specifications, the relevant characteristics given in column D of Tables 8, 9 and 10 shall be retested.

For the extension of the production range, the relevant characteristics given in column E of Tables 8, 9 and 10 shall be retested.

**Table 8 — Characteristics of material and pipes that require type testing, TT**

Characteristics	Reference to Part, clause and Table	Initial/ changes/ extension <sup>1)</sup>				Sampling procedure
		I	D	M	E	
Effect on water quality	1-4.2	+	-	+	-	Once per pipe material as defined in the relevant test method standard
Density	2-4.2	+	-	+	-	One evaluation per material/ compound
MRS-value <sup>2)</sup>	2-4.3	+	-	+	-	One evaluation per material/ compound
Sealing ring material	2-11	+	-	+	-	One evaluation per ring material
Adhesive material	2-12	+	-	+	-	One evaluation per adhesive
Appearance		+	-	+	+	Three units per dn per pressure group; the test pieces shall be such that the whole marking is visible
Colour		+	-	+	-	
Dimensions		+	+	-	+	
Marking		+	-	-	+	
Impact strength	2-8.1, T6	+	-	+	+	One evaluation per size group per pressure group
Internal pressure for pipe	2-8.2, T7	+	+	+	+	One sample per one dn of each size group per pressure group as per sampling plan A
Internal pressure for pipe with integral socket	2-8.2, T8	+	+	+	+	One sample per one dn of each size group per pressure group per jointing method group as per sampling plan A
Vicat softening temperature	2-9, T9	+	-	+	-	One evaluation per material/compound
Longitudinal reversion	2-9, T9	+	-	-	+	One evaluation per dn per pressure group
Degree of gelation	2-9, T9	+	-	+	-	One evaluation per pressure group
VCM - content	2-10	+	-	+	-	Once per material/compound

<sup>1)</sup> I: initial type test in the case of new system.

D: change of design.

M: change of material.

E: extension of the production range.

+: test to be carried out if it is relevant.

<sup>2)</sup> Where there is available long-term experience with a material/compound between a certification body and a manufacturer and/or with the effect of a proposed change in material/compound, beyond the limits shown in Table 7, it is not necessary to re-evaluate the MRS-value.

In this case the values determined with five test pieces at 20 °C and 60 °C during 1000 h to 5000 h shall be located on or above the 97,5 % LCL long-term characteristic curve established prior to the material/compound change.

**Table 9 — Characteristics of materials and single components of fittings, valves and ancillary equipment, that require type testing, TT**

Characteristics	Reference to Part, clause and Table	Initial/ changes/ extension 1)				Sampling procedure
		I	D	M	E	
Effect on water quality	1-4.2	+	-	+	-	Once per component material as defined in the relevant test method standard
Sealing ring material	2-11	+	-	+	-	One evaluation per ring material
Adhesive material	2-12	+	-	+	-	Once per adhesive
MRS-value 2)	3-4.2, 4-4.1.2	+	-	+	-	One evaluation per material/ compound
Strength of material 2)3)	3-4.4, 4-4.1.4	+	-	+	-	One evaluation per material/ compound on five test pieces
Appearance	3-4.1, 3-5.1	+	-	+	+	For each test one unit (except for measuring of dimensions three units) per d <sub>n</sub> and PN, evenly selected from all component groups
Colour	3-5.2, 4-5.2	+	-	-	-	
Dimensions	3-6, 4-6	+	+	-	+	
Marking	3-14, 4-14	+	-	-	-	
Vicat softening temperature	3-9, T21 4-9, T13	+	-	+	-	One evaluation per material/ compound
Internal pressure 1 h test 4)	3-8.1, T20 4-8.1, T9	+	+	-	-	For each test three units of one d <sub>n</sub> per size group and PN, evenly selected from all component groups
Internal pressure 1 000 h test 4)	3-8.1, T20 4-8.1, T9	+	-	-	+	
Crushing test 5)	3-8.2, 4-8.2	+		-	+	
Effects of heating	3-9, T21 4-9, T13	+	+	+	+	

1) I: initial type test in the case of new system;  
D: change of design;  
M: change of material;  
E: extension of the production range;  
+: test to be carried out if it is relevant.

2) Where there is available long-term experience with a material/compound between a certification body and a manufacturer and/or with the effect of a proposed change in material/compound, beyond the limits shown in Table 7, it is not necessary to re-evaluate the MRS.  
In this case the values determined with five test pieces at 20 °C and 60 °C during 1000 h to 5000 h shall be located on or above the 97.5 % LCL long-term characteristic curve established prior to the material/compound change.

3) Only when the MRS-value is provided by a compound producer, different from the component manufacturer.

4) Only for components which are stressed by hydraulic pressure in the system and for which a separate hydraulic pressure test can be applied.

5) Only for components on which hydraulic pressure cannot be applied.

**Table 10 — Characteristics of function of assembled components and fitness for purpose of the system (of assemblies), that require type testing TT**

Characteristics	Reference to Part, clause and Table	Initial/ changes/ extension <sup>1)</sup>				Sampling procedure
		I	D	M	E	
Leaktightness of end-load-bearing double sockets, 20 °C	3-6.6	+	+	-	+	One evaluation per size group per PN per design
Functional properties of valves	4-8.3, T10 4-8.4.1, T11 4-8.4.2, T12					One evaluation per size group per PN per assembled component group
Short-term leaktightness of assemblies						One test piece per size group per pressure group per assembled component group and per jointing method group
Long-term leaktightness of assemblies	5-4.5, T1/T2					One test piece from two different size groups per assembled component group and per jointing method group for the highest PN
<sup>1)</sup> I: initial type test in the case of new system. D: change of design. M: change of material. E: extension of the production range. +: test to be carried out if it is relevant.						

#### 4.2.2.2 Preliminary type testing (PTT)

The manufacturer shall demonstrate that the product conforms to all requirements for the characteristics given in Tables 8, 9 and 10.

#### 4.2.2.3 Initial type testing (ITT)

If third party certification is involved, the certification body shall assess the conformity of a product to all requirements for the characteristics given in Tables 8, 9 and 10.

The assessment shall be performed by validation or testing, using the sampling procedure given in Tables 8, 9 and 10 and grouping according to 4.2.1, in an approved testing laboratory or by witness testing.

Preliminary type test data including long-term characteristics, supplied by the manufacturer and traceable to material or compound and process, validated by the certification body, shall be taken into account for initial type testing.

#### 4.2.3 Batch release tests (BRT)

Those characteristics specified in Parts 1 to 5 of EN 1452:1999 and listed in Tables 11 and 12, shall be batch release tested with the minimum sampling frequency as given in these Tables.

All tests shall be carried out for each start up of the production facility of a component. A restart after production has been suspended shall not be considered as an interruption of a continuous production, provided this period of interruption does not exceed a maximum period to be defined in the manufacturer's quality plan.

**Table 11 — Characteristics of pipes and minimum sampling frequencies for BRT and retest procedures**

Characteristics	Reference to Part, clause and Table	Minimum sampling frequency per production line	Retest procedure
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Appearance	2-5.1	Once per 8 h	Procedure A
Dimensions:		Once per 8 h	
- pipe diameter	2-6.2, 2-6.3, T1		
- wall thickness	2-6.4, T2, T3		
- pipe length	2-6.5		
- socket dimensions	2-6.6, T4/T5		
Impact strength	2-8.1, T6	Start up and once per week	
Internal pressure 1 h, 20 °C <sup>1)</sup>	2-8.2, T7	Start up only	
Longitudinal reversion	2-9, T9	Start up and once per week	
Degree of gelation <sup>2)</sup>	2-9, T9	Once per 24 h	
Marking	2-14	Once per 8 h	
<sup>1)</sup> A short-term burst pressure test may be used as indirect test.			
<sup>2)</sup> A fracture toughness test conforming to ISO/DIS 11673 with the requirements given in annex C of KS ISO 1452-2 may be used as an alternative to the gelation test, except in case of dispute.			

**Table 12 — Characteristics of single components of fittings, valves and ancillary equipment and minimum sampling frequencies for BRT and retest procedures**

Characteristics	Reference to Part, clause and Table	Minimum sampling frequency per production line	Retest procedure
Appearance and marking	3-5.1, 3-14; 4-5.1, 4-14	One sample <sup>1)</sup> per lot	Procedure B
Dimensions <sup>2)</sup>	3-6 and 4-6	One sample <sup>1)</sup> per lot	
Internal pressure 1 h test <sup>3) 4)</sup>	3-8.1, T20	One sample <sup>1)</sup> per batch at least once per week	
Crushing test <sup>5)</sup>	3-8.2 and 4-8.2	One sample <sup>1)</sup> per lot	
Effects of heating	3-9, T21; 4-9, T13	One sample <sup>1)</sup> per lot	
<div>1) The sample size shall be not less than three units.</div> <div>2) Only for jointing dimensions.</div> <div>3) Only for components which are stressed by hydraulic pressure in the system and for which a separate hydraulic pressure test can be applied.</div> <div>4) A short-term burst pressure test or pulsation test may be used as indirect test.</div> <div>5) Only for components on which hydraulic pressure cannot be applied.</div>			

The manufacturer shall specify a batch or a lot in his quality plan.

A batch or lot shall only be released for supply when all the relevant tests and inspections have been carried out at least once at the specified frequencies and the requirements have been conformed to.

If a product fails in respect of any characteristic given in Tables 11 and 12, as applicable, the batch or lot shall be rejected or the retest procedures shall be performed for the characteristic on which the product failed.

The retest procedure shall conform to Tables 11 and 12 and shall be either procedure A or procedure B as follows:

**a) Procedure A**

Find the last product which conforms to the requirements as specified in Parts 2, 3 and 4 of KS ISO 1452:1999.

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Release all products produced before that point and reject the products produced after that point.

### b) Procedure B

Use a minimum sampling level as specified in Table 12. If the retest requirements are conformed to then release the batch or lot. If they are not conformed to then reject the batch or lot.

Procedures for dealing with rejected products shall be detailed in the manufacturer's quality plan.

#### 4.2.4 Process verification tests (PVT)

Those characteristics specified in Parts 1 to 5 of KS ISO 1452:1999, and listed in Tables 13 and 14, shall be process verification tested with the minimum sampling frequency as given in these Tables.

**Table 13 — Characteristics of materials and pipes and minimum sampling frequencies for PVT**

Characteristic	Reference to Part, clause and Table	Minimum sampling frequency
Internal pressure 60 °C, 1000 h	2-8.2, T7	According to the manufacturer's quality plan, samples to be evenly selected from all pressure groups and size groups in such a way that units of each $d_n$ produced are tested regularly and continuously but at least once per three years

**Table 14 — Characteristics of single components of fittings, valves and ancillary equipment and minimum sampling frequencies for PVT**

Characteristic	Reference to Part, clause and Table	Minimum sampling frequency
Internal pressure 20 °C, 1000 h	3-8.1, T20 4-8.1, T9	According to the manufacturer's quality plan, samples to be evenly selected from all pressure groups and size groups in such a way that units of each $d_n$ of each single component group produced are tested regularly and continuously but at least once per five years

If a product does not conform to the requirements in respect of any characteristic given in Tables 13 and 14, as applicable, the retest procedure detailed in the manufacturer's quality plan shall be performed. If third party certification is involved, the certification body shall be informed.

If the retest procedure does not confirm conformity of the product to the requirements, then the process shall be investigated and corrected in accordance with the procedures given in the manufacturer's quality plan.

#### 4.2.5 Audit tests (AT)

If third party certification is involved, the relevant characteristics specified in Parts 1 to 5 of KS ISO 1452:1999 may be audited and those listed in Tables 15, 16 and 17 are intended to be audit tested with the minimum sampling frequency as given in these Tables.

**Table 15 — Characteristics of materials and pipes and minimum sampling frequencies for AT**

Characteristic	Reference to Part, clause and Table	Minimum sampling frequency
Vicat softening temperature	2-9, T9	One evaluation per material/compound per year
VCM	2-10	Once per material/compound per year
Appearance	2-5.1	One unit of at least 1 m each per size group per

Colour	2-5.2	pressure group per year; the test pieces shall be such that the whole marking is visible
Dimensions	2-6	
Marking	2-14	
Impact strength	2-8.1, T6	Once per size group per year
Internal pressure for pipe <sup>1)</sup>	2-8.2, T7	Number of units according sampling plan A, however maximum three units per size group per year
Internal pressure for pipe with integral socket	2-8.2, T8	Number of units according sampling plan A, however maximum three units per size group per year
Longitudinal reversion	2-9, T9	One evaluation per size group per year
Degree of gelation	2-9, T9	One evaluation per size group per year
<sup>1)</sup> Certification bodies may accept process verification tests as audit tests if witnessed by them or by their agencies.		
NOTE: The sizes, types and classes selected for tests should be primarily those which have not previously been selected for audit testing. Samples should be preferably taken from the largest volume of production per group.		

**Table 16 — Characteristics of materials and single components of fittings, valves and ancillary equipment and minimum sampling frequencies for AT**

Characteristic	Reference to Part, clause and Table	Minimum sampling frequency
VCM	2-10	One evaluation per material/compound per year
Strength of material	3-4.4 4-4.1.4	One evaluation on five test pieces per material compound per year
Vicat softening temperature	3-9, T21 4-9, T13	One evaluation per material compound per year
Appearance	3-5.1, 4-5.1	One unit per size group and per pressure group per



Colour	3-5.2, 4-5.2	year, evenly selected from all single component groups; each single component group shall be tested at least once per two years
Dimensions	3-6, 4-6	
Marking	3-14, 4-14	
Internal pressure 1 h test <sup>1)</sup>	3-8.1, T20 4-8.1, T9	For each test one unit per size group and per year, evenly selected from all single component groups; each single component group shall be tested at least once per five years
Internal pressure 1000 h test <sup>1)2)</sup>	3-8.1, T20 4-8.1, T9	
Crushing test <sup>3)</sup>	3-8.2, 4-8.2	
Effects of heating	3-9, T21 4-9, T13	

<sup>1)</sup> Only for single components which are stressed by hydraulic pressure in the system and for which a separate hydraulic pressure test can be applied.

<sup>2)</sup> Certification bodies may accept process verification tests as audit tests if witnessed by them or by their agencies.

<sup>3)</sup> Only for single components on which hydraulic pressure cannot be applied.

**Table 17 — Characteristics of function of assembled components and fitness for purpose of the system (of assemblies) and minimum sampling frequencies for AT**

Characteristic	Reference to Part, clause and Table	Minimum sampling frequency
Leaktightness of endload-bearing double sockets, 20 °C	3-6.6	One evaluation size group per year
Functional properties of valve	4-8.3, T10 4-8.4.1, T11 4-8.4.2, T12	One evaluation per size group per assembled component group per pressure group per year, evenly selected from all valve types; each valve type shall be tested at least once per five years
Short-term leaktightness of assemblies	5-4.3 5-4.4 5-T1	One test piece per jointing method group per year
Long-term leaktightness of assemblies	5-4.5 5-T1/T2	One test piece per jointing method group per year
NOTE: The sizes, types and classes selected for tests should be primarily those which have not previously been selected for audit testing. Samples should be preferably taken from the largest volume of production per group.		

#### 4.2.6 Indirect tests (IT)

Generally testing shall be performed according to the test methods referred to in Parts 1 to 5 of KS ISO 1452.

Indirect testing may be used for BRT and PVT characteristics as given in Tables 11, 12, 13 and 14. Indirect testing shall not be applied to TT and AT.

The indirect test method used and the correlation or safe relationship of the indirect testing to the specified testing shall be documented in the manufacturer's quality plan. The continuing validity of the indirect testing shall be checked at regular intervals.

In cases of dispute the BRT or PVT as specified in Tables 11 to 14 shall be used. If third party certification is involved, the IT shall be acceptable to the certification body.

NOTE Indirect testing can be used to reduce the frequency of the specified BRT and PVT, but it is not intended to replace these tests completely.

#### 4.2.7 Inspection records and test records

Unless otherwise specified, all records shall be maintained for a minimum of ten years.

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