##### WORKING DRAFT EAST AFRICAN STANDARD

Plastics rainwater piping systems for above ground external use - Unplasticized Polyvinyl chloride (PVC-U) - Specification for Pipes, fittings and the system

EAST AFRICAN COMMUNITY

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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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Plastics rainwater piping systems for above ground external use - Unplasticized Polyvinyl Chloride (PVC-U) - Specification for Pipes, fittings, and the system

##### **1 Scope**

This draft East African standard specifies the requirements for pipes, fittings and the system of un-plasticized poly(vinyl chloride) (PVC-U) intended for use as above-ground external rainwater down pipes.

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

It is applicable to PVC-U rainwater systems of circular, square, rectangular or any other shape with sealed (rubber ring or solvent cement) or unsealed joints.

This standard covers a range of pipes and fittings sizes.

It also specifies requirements for brackets for anchoring the pipes.

NOTE It is the responsibility of the purchaser to specify or make the appropriate selections from the size range to take into account their particular requirements and any relevant national regulations and installation practices or codes.

**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.

EN 513, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors —Determination of the resistance to artificial weathering*

ISO 6259-2*Thermoplastics pipes — Determination of tensile properties — Part 2: Pipes made of unplasticized poly (vinyl chloride) (PVC-U), oriented unplasticized poly(vinyl chloride) (PVC-O), chlorinated poly(vinyl chloride) (PVC-C) and high-impact poly(vinyl chloride) (PVC-HI)*

ISO 23711 *Elastomeric seals — Requirements for materials for pipe joint seals used in water and drainage applications — Thermoplastic elastomers*

ISO 2507-1, *Thermoplastics pipes and fittings — Vicat softening temperature—Part 1: General test method*

ISO 2507-2, *Thermoplastics pipes and fittings — Vicat softening temperature—Part 2: Test conditions for unplasticized poly vinyl chloride (PVC-U) or chlorinated poly(vinyl chloride) (PVC-C) pipes and fittings and for high impact resistance poly(vinyl chloride) (PVC-HI) pipes*

ISO 2505, *Thermoplastics pipes — Longitudinal reversion — Test method and parameters*

ISO 3127, *Thermoplastics pipes — Determination of resistance to external blows — Round-the-clock method*

ISO 580 *Plastics piping and ducting systems — Injection-moulded thermoplastics fittings — Methods for visually assessing the effects of heating*

ISO 13229 *Thermoplastics piping systems for non-pressure applications — Unplasticized poly(vinyl chloride) (PVC-U) pipes and fittings — Determination of the viscosity number and K-value*

ISO 13254 *Thermoplastics piping systems for non-pressure applications — Test method for watertightness*

EN 1905, *Plastics piping systems — Unplasticized poly(vinyl chloride)PVC-U) pipes, fittings and material —Method for assessment of the PVC content based on total chlorine content*

EN 10204:1991, *Metallic products — Types of inspection documents*

EN 12095, *Plastics piping systems — Test method for bracket strength*

*ISO 105-A02 Textiles — Tests for colour fastness Part A02: Grey scale for assessing change in colour*

ISO 527-3, *Plastics — Determination of tensile properties Part 3: Test conditions for film and sheets*

ISO 3126, Plastics piping systems — Plastics components — Determination of dimensions

ISO 8256, *Plastics — Determination of tensile impact strength*

ISO 472, *Plastics vocabulary*

ISO 1043-1, *Plastics — Symbols and abbreviated terms Part 1: Basic polymers and their special characteristics*

ISO 1183-1 *Plastics — Methods for determining the density of non-cellular plastics*

*Part 1: Immersion method, liquid pycnometer method and titration method*

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources Part 2: Xenon-arc lamps*

ISO 4892-3, Plastics — Methods of exposure to laboratory light sources Part 3: Fluorescent UV lamps

**3 Definitions, symbols and abbreviations**

For the purposes of this standard, the following definitions, symbols and abbreviations apply.

**3.1 Definitions**

In addition to the definitions given below, the definitions given in ISO 472 and ISO 1043-1 apply.

**3.1.1**

**nominal size DN**

numerical designation of the size of a component, other than a component designated by thread size, which is approximately equal to the manufacturing dimension, in millimetres (mm).

**3.1.2**

**nominal size DN/OD**

nominal size, related to the outside diameter

**3.1.3**

**nominal outside diameter (dn)**

specified outside diameter, in millimetres, assigned to a nominal size DN/OD

**3.1.4**

**outside diameter (de)**

value of the measurement of the outside diameter through its cross-section at any point of a pipe or spigot of a fitting, rounded to the next greater 0.1 mm.

**3.1.5**

**mean outside diameter (dem)**

value of the measurement of the outer circumference of a pipe or spigot of a fitting in any cross-section, divided by π (π ≈ 3.142) , rounded to the next greater 0.1 mm.

**3.1.6**

**mean inside diameter of a pipe (dim)**

arithmetical mean of a number of measurements of the inside diameter of a pipe in the same cross-section

**3.1.7**

**mean inside diameter of a socket (dsm)**

arithmetical mean of a number of measurements of the inside diameter of a socket in the same cross-section

**3.1.8**

**wall thickness (e)**

value of the measurement of the pipe thickness at any point around the circumference rounded to the next greater 0.1 mm

**3.1.9**

**mean wall thickness (em)**

arithmetical mean of a number of measurements of the wall thickness, regularly spaced around the circumference and in the same cross-section of a component, including the measured minimum and the measured maximum values of the wall thickness in that cross-section

**3.2 Definitions for brackets**

**3.2.1**

**anchor bracket**

bracket designed to be fixed to a wall or other support and attached to a socket of a pipe or fitting to prevent the socket from moving under the effect of thermal expansion

NOTE Some anchor brackets can be adapted to act as a guide bracket. (see 3.2.2)

**3.2.2**

**guide bracket**

bracket designed to be fixed to a wall or other support and to fit a pipe sufficiently loosely to allow longitudinal thermal movement whilst preventing the pipe from bowing between anchor brackets

NOTE By fixing an guide bracket tightly below a fitting on vertical pipe work, it can be made to act as an anchor bracket. (See 3.2.1)

**3.3 Symbols**

A : length of engagement

C : depth of sealing zone

*ds* : inside diameter of a socket

*e2* : wall thickness of a socket

*e3* : wall thickness at the groove

*L1* : length of spigot

*L2* : length of socket

*I* : effective length of a pipe

*Zd* : design length of a fitting

α : nominal angle of a fitting

**3.4 Abbreviations**

TIR :true impact rate

BS: British Standard

EN: European Standard

**4 Material**

**4.1 Raw material**

The raw material shall be PVC-U to which are added those additives that are needed to facilitate the manufacture of components conforming to the requirements of this standard.

**4.2 Utilization of non-virgin material**

Utilization of non-virgin material shall conform to Annex A.

**4.3 Sealing ring retaining means**

Sealing rings may be retained using means made from polymers other than PVC-U, provided the joints conform to the requirements given in Table 12.

**4.4 Brackets not of PVC-U**

All such components shall fulfill the material and corrosion resistance requirements of WD TC 047-03: 2024

**5 General characteristics — Appearance**

When viewed without magnification, the internal and external surfaces of pipes and fittings shall be smooth, clean and free from grooving, blistering, impurities, pores or other surface irregularity likely to prevent conformity of pipes and fittings to this standard. Each end of a pipe or a fitting shall be cleanly cut, if applicable, and shall be square to its axis.

**6 Geometrical characteristics**

**6.1 General**

Dimensions shall be measured in accordance with ISO 3126.

In case of dispute the reference temperature is (23 ± 2) oC.

NOTE Figures 1 to 11 are schematic sketches only, to indicate the relevant dimensions. They do not necessarily represent manufactured components.

**6.2 Dimensions of pipes**

**6.2.1 Diameters of circular pipes**

The mean diameters of circular pipes shall conform to the requirements given in Table 1.

**Table 1 —** **Preferred pipe diameters**

Dimensions in millimetres

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Nominal size DN/OD a** | **Nominal outside diameter**  **dn** | **Mean outside diameter** | | **Mean inside diameter**  **dim, min** | **Internal cross-sectional area b**  **(mm2)** |
| dem, min | dem, max |
| 50  63  75  82  90  110  125  140  160 | 50  63  75  82  90  110  125  140  160 | 50.0  63.0  75.0  82.0  90.0  110.0  125.0  140.0  160.0 | 50.3  63.3  75.4  82.4  90.4  110.4  125.4  140.5  160.5 | 46.3  59.3  71.3  78.0  85.6  104.7  119.1  133.6  152.5 | 1 684  2 762  3 993  4 788  5 760  8 619  11 141  14 031  18 280 |
| a Nominal sizes 50 <DN/OD<160 mm other than those in the table are permitted. They should be selected from the Renard R40 series or traditional nominal sizes. In such cases the pipe outside diameter tolerance, mean inside diameter and internal cross-sectional area shall be interpolated from the nearest adjacent values above and below in the table.  b For the determination of the wall thickness of non-circular pipes and their sockets, see clause 6.2.4.2.  These sizes are based on the inside diameter series in EN 476 | | | | | |

**6.2.2 Outside dimensions and tolerances of non-circular pipes**

The pipe cross-section may be square, rectangular or any other shape. The external sizes shall be given by the manufacturer. The tolerances on the external sizes shall conform to Table 1 using the largest dimension as the nominal size and rounding down to the nearest outside diameter as given in the table. See Figure 1.

EXAMPLE For a rectangular pipe of 80 x 65 the applicable tolerances would be as DN 80.



**Figure 1 — Dimensions of non-circular pipes**

**6.2.3 Effective length of pipes**

The effective length (useful length) of a pipe, l, shall be not less than that specified by the manufacturer.



**Figure 2 — Effective length of pipe**

**6.2.4 Wall thicknesses of pipes and sockets**

**6.2.4.1 Wall thickness of circular pipes and their sockets**

The wall thickness of circular pipes and their sockets shall conform to the requirements in Table 2 when measured at the location points as shown in Figure 3.



**Figure 3 — Wall thickness location points**

**Table 2 — Wall thicknesses of pipes and pipe sockets**

Dimensions in millimetres

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Nominal size DN/OD a)** | **Nominal outside diameter**  **dn** | **Wall thickness of pipes and fittings** | | | | |
| **Sealed system** | | | **Unsealed system** | |
| **emin** | **e2,min** | **e3, min** | **emin** | **e2,min** |
| 50  63  75  82  90  110  125  140  160 | 50  63  75  82  90  110  125  140  160 | 1.5  1.5  1.5  1.6  1.8  2.2  2.5  2.7  3.2 | 1.4  1.4  1.4  1.4  1.6  2.0  2.2  2.4  2.9 | 1.0  1.0  1.0  1.0  1.0  1.2  1.4  1.5  1.8 | 1.2  1.3  1.5  1.5  1.8  2.0  -  -  - | 1.0  1.2  1.4  1.4  1.6  1.8  -  -  - |
| a) Where non-preferred sizes not listed in the table are manufactured (see footnote a in Table 1) the values of emin, e2,min, and e3,min shall be interpolated from the nearest adjacent values both above and below in this table.  These sizes are based on the inside diameter series in EN 476: | | | | | | |

**6.2.4.2 Wall thickness of non-circular pipes and their sockets**

The wall thickness of non-circular pipes and their sockets when measured at the location points as shown in Figure 3 shall be determined as follows:

a) determine the internal cross-sectional area;

b) round down to the next lower value in Table 1 and identify the corresponding circular nominal size;

c) use the wall thickness values for pipes and sockets as defined in Table 2 for that nominal size, which apply only to the middle of the faces of the non-circular pipe and socket (see Figure 1).

**6.2.5 Dimensions of sockets**

The dimensions of pipe sockets (see Figures 4 and 5) shall be the same as for fittings (see 6.4).

**6.3 Dimensions of fittings**

**6.3.1 Nominal size(s)**

The nominal size of a fitting shall correspond to and be designated by the nominal size of the pipe which it is intended to fit. Non-circular fittings are sized in the same manner in accordance with 6.2.2.

**6.3.2 Wall thicknesses of fittings**

The wall thickness of the body of fittings emin, sockets, e2,min and ring seal grooves of sealed systems, e3,min shall conform to Table 2 and Figure 3.

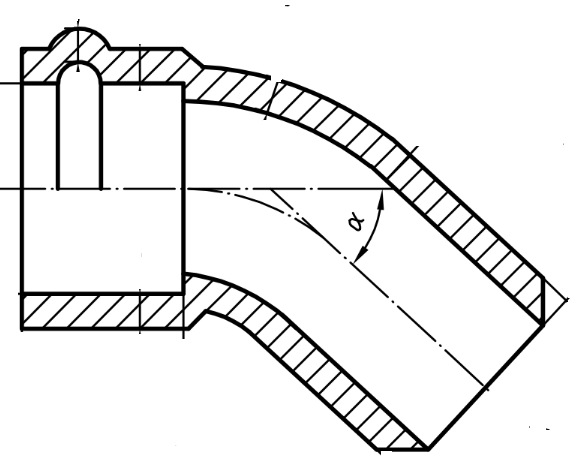
* + 1. **Angles**

For bends the nominal angles, α, shall be 87.5/90o, 75o, 67.5o, 60o and 45o.

For branches and double branches, the nominal angles α shall be 87.5/90o, 67.5o, 60o and 45o.

If other angles are required, they shall be agreed between manufacturer and purchaser and be identified accordingly.

Figure 4 provides guidance on how the nominal angle of a bend is measured



**Figure 4 — Guidance on how the nominal angle, α, of a bend is measured**

**6.3.4 Design lengths (Zd)**

The Zd-length(s) of fittings shall be given by the manufacturer.

NOTE The Zd-lengths are intended to assist in the design of moulds and are not intended to be used for quality control purposes. ISO 265-1 can be used as a guideline.

**6.4 Diameters and lengths of sockets and spigots**

**6.4.1 Ring seal sockets and spigots**

The diameters and lengths of ring seal sockets and spigots (see Figure 5) shall conform to Table 3.

Where sealing rings are firmly fixed and have multiple sealing zones, the dimensions ***A*min** and ***C*max.**

shall be measured to the effective sealing point as specified by the manufacturer.



**Figure 5 — Location of points of measurement for ring seal sockets and spigots**

**Table 3 — Diameters and lengths of ring seal sockets and related spigots**

Dimensions in millimetres

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Nominal size DN/ON a)** | **Nominal outside diameter**  ***d*n** | **Mean inside diameter b)**  ***d*sm, min.** | **Lengths of sockets and spigots** | | |
| ***A*min.** | ***C*max.** | ***L*I,min.** |
| 50  63  75  82  90  110  125  140  160 | 50  63  75  82  90  110  125  140  160 | 50.4  63.4  75.5  82.5  90.5  110.5  125.5  140.6  160.6 | 20  22  25  26  28  32  35  39  42 | 18  18  20  21  23  26  28  30  32 | 37  37  43  44  46  54  60  60  60 |
| a) Where non-preferred sizes not listed in the table are manufactured (see footnote 1 in Table 1) the values of  *d*sm,min., *A*min., *C*max. and *L*I, min. shall be interpolated from the nearest adjacent values both above and below in this table.  b) Calculated as follows *d*sm,min = (*d*sm,min + 0.1 ) mm.  These sizes are based on the inside diameter series in EN 476:1997. | | | | | |

**6.4.2 Solvent cement and unsealed sockets and spigots**

The diameters and lengths of solvent cement and unsealed sockets and spigots (see Figure 6) shall conform to Table 4.

The manufacturer shall declare whether the sockets are tapered or parallel. If parallel the *d*sm dimension shall apply at the mid mean point with a maximum taper angle of 20˚ per side.

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**Figure 6 — Location of points of measurement of solvent cement sockets, unsealed sockets and spigots**

**Table 4 — Diameters and lengths of solvent cement sockets and sockets for unsealed systems and their related spigots**

Dimensions in millimetrees

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Nominal size DN/OD a)** | **Nominal outside diameter**  *d*n | **Mean inside diameter** | | **Lengths of sockets and spigots**  *L1,min andL2, min* **c** |
| *d*sm,min | *d*sm,max  **b** |
| 50  63  75  82  90  110  125  140  160 | 50  63  75  82  90  110  125  140  160 | 50.1  63.3  75.2  82.2  90.2  110.2  125.2  140.3  160.3 | 50.4  63.5  75.6  82.6  90.6  110.6  125.7  140.8  160.8 | 30  36  40  42  46  48  51  55  58 |
| a) Where non-preferred sizes not listed in the table are manufactured (see footnote a in Table 1) the values of ,, *d*sm,min, *d*sm,max,  *L1,min andL2, min*shall be interpolated from the nearest adjacent values both above and below in this table.  b) *d*sm,min values do not apply to unsealed systems.  c) For unsealed systems the  *L1,min andL2, min*values may be reduced to 0.75L1min.  These sizes are based on the inside diameter series in EN 476:1997. | | | | |

**6.4.3 Non-circular sockets and spigots**

Non-circular sockets shall be sized as detailed in 6.2.2 using the maximum dimension of the pipe. The tolerances and dimensions given in Tables 3 or 4 shall then be applied accordingly.

**6.4.4 Spigot sleeves**

Spigot sleeves intended for jointing unsealed systems to the inside diameter of pipes shall not be subject to the requirements given in Table 1 but shall conform to the requirements given in Table 5 and as shown in Figure 7.

**Table 5 — Minimum inside diameter of spigot sleeves**

Dimensions in millimetres

|  |  |  |
| --- | --- | --- |
| **Nominal size**  **DN/OD a)** | **Nominal outside diameter**  *d*n | **Minimum inside diameter**  *d*im,min |
| 50  63  75  82  90  110 | 50  63  75  82  90  110 | 40  53  65  72  80  95 |
| a) Where non-preferred sizes not listed in the table are manufactured (see footnote 1 in Table 1) the value of *d*im,min shall be interpolated from the nearest adjacent values both above and below in this table.  These sizes are based on the inside diameter series in EN 476:1997 | | |

****

**Figure 7 — Fitting spigot sleeve fitted to internal pipe bore**

**6.5 Types of fittings**

This standard includes branches, bends, pipe couplers, pipe couplers with fixing lugs, outlet shoes and transition fittings. (See Figures 8 to 12).

Transition fittings include round to square adaptors, reducers, rainwater heads, adaptors to other material and adaptors to drainage systems including gullies.



**Figure 8 — Typical branch with outlet spigot sleeve**

**Figure 9 — Typical bend double socket**

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**Figure 10 — Typical pipe coupler with spigot sleeve**

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**Figure 11 — Typical pipe coupler with fixing lugs and outlet spigot sleeve**

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**Figure 12 — Typical outlet shoe**

**6.6 Brackets**

Brackets made from PVC-U shall conform to the requirements of 4.1, 4.2 and 7.2.

If brackets made from other materials are used with pipes and fittings conforming to this standard, they shall conform to the requirements of 4.4 and 7.2.

The nominal size of the bracket shall correspond to and be designated by the nominal size of pipe or socket which it is intended to fit. Non-circular brackets shall be sized in accordance with 6.22.

**7 Mechanical characteristics**

**7.1 Pipes**

When tested in accordance with the test methods as specified in Table 6 using the indicated parameters, the pipe shall have mechanical characteristics conforming to the requirements given in Table 6.

Non-circular sections sized as described in 6.2.2 shall be tested in accordance with the corresponding size values for circular pipe. When impact testing of non-circular pipes they shall be struck centrally on the widest flat face or flattest side. The V-block described in ISO 3127 shall also be modified to fit the non-circular pipe profile. Non-circular pipes shall be struck only once per specimen.

**Table 6 — Mechanical characteristics of pipes**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristics** | **Requirements** | **Test parameters** | | **Test method** |
| Impact resistance (round-the-clock method) | TIR≤ 10% | Type of striker for  dn < 110 mm:  dn ≥ 110 mm:  Mass of striker  Fall of striker  Conditioning medium  Condition and test temperature | d 25  d 90  Shall conform to Table 7  Shall conform to Table 7  Water  0 oC | ISO 3127 |
| Tensile impact strength a | ≥ 500 kJ/m2 | Machined specimen  Test temperature | Type 2, 3 or 5b in accordance with ISO 8256  (23 ± 2) oC | Method A of ISO 8256 |
| Tensile strength | ≥ 42 N/mm | Strain speed  Test piece | 5 mm/min  Type 5 conforming to  ISO 527-3 | ISO 6259-2 |
| Elongation at break | ≥ 100 % | Strain speed  Test piece | 5 mm/min  Type 5 conforming to  ISO 527-3 | ISO 6259-2 |
| a This type test also relates to the ageing of pipes (see Table 12).  b In case of dispute, test piece of type 5 shall be used. | | | | |

**Table 7 — Falling weight impact energy**

|  |  |  |  |
| --- | --- | --- | --- |
| **Nominal size**  **DN/OD a** | **Nominal outside diameter dn**  mm | **Mass of striker**  kg | **Fall height**  m |
| 50  63  75  82  90  110  125  140  160 | 50  63  75  82  90  110  125  140  160 | 0.5  0.8  0.8  1.25  0.8  1.6  2.0  2.5  3.2 | 1.0  1.0  1.0  1.0  2.0  2.0  2.0  2.0  2.0 |
| a Where non-preferred sizes not listed in the table are manufactured (see footnote a in Table 1) the values of the mass and fall height of the striker shall be interpolated from the nearest adjacent values both above and below in this table.  These sizes are based on the inside diameter series in EN 476 | | | |

**7.2 Mechanical characteristics of anchor brackets**

When tested in accordance with the test method as specified in Table 8 using the indicated parameters, brackets shall have mechanical characteristics conforming to the requirements given in Table 8.

**Table 8 — Mechanical characteristics of brackets**

|  |  |  |  |
| --- | --- | --- | --- |
| **Characteristic** | **Requirement** | **Test parameters** | **Test method** |
| Bracket strength | Permanent distortion ≤ 3 mm | Shall conform to Table 9 | EN 12095 |

**Table 9 — Vertical test loads on brackets**

|  |  |  |
| --- | --- | --- |
| **Nominal size**  **DN/OD a** | **Nominal outside**  **diameter dn**  mm | **Vertical test load on bracket b**  kg |
| 50  63  75  82  90  110  125  140  160 | 50  63  75  82  90  110  125  140  160 | 9.1  15.1  21.8  25.9  31.8  47.8  61.7  77.2  101.3 |
| a Where non-preferred sizes not listed in the table are manufactured (see footnote a in Table 1) the value of the test load shall be interpolated from the nearest adjacent values both above and below in this table.  b Calculation based on weight of 5.5 m column of water.  These sizes are based on the inside diameter series in EN 476 | | |

**8 Physical characteristics**

**8.1 Physical characteristics of pipes**

When tested in accordance with the test methods as specified in Table 10 using the indicated parameters, the pipe shall have physical characteristics conforming to the requirements given in Table 10.

**Table 10 — Physical characteristics of pipes**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristic** | **Requirement** | **Test parameters** | | **Test method** |
| Vicat softening temperature | ≥ 75oC | Shall conform to ISO 2507-2 | | ISO 2507-1 |
| ≤ 3 %  the pipe shall exhibit no bubbles or cracks | Test temperature Immersion time | (100 ± 2) oC  (15 ± 2) min | Method A of KS ISO 2505  :Liquid |
| Longitudinal reversion | or  a | | |
| Test-temperature  Immersion time | (100 ± 2) oC  (30 ± 2) min | Method B of KS ISO 2505  Air |
| a Method B shall be used in cases of dispute. | | | | |

**8.2 Physical characteristics of fittings**

When tested in accordance with the test method as specified in Table 11 using the indicated parameters, the fitting, except for any seal retaining means, shall have physical characteristics conforming to the requirements given in Table 11.

**Table 11 — Physical characteristics of fittings**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristic** | **Requirement** | **Test parameters** | | **Test method** |
| Effects of heating | a and b | Test temperature  Heating time | (150 ± 2) oC  (15 ± 2) min | Method A of ISO 580  Air oven |
| Vicat softening temperature | ≥ 75oC | Shall conform to ISO 2507-2 | | ISO 2507-1 |
| a) 1 Within a radius of 15 times the wall thickness around the injection point, the depth of cracks delamination or blisters shall not exceed 50 % of the wall thickness at that point.  2 Within a distance of 10 times the wall thickness from the diaphragm zone, the depth of cracks, delamination or blisters shall not exceed 50 % of the wall thickness at that point.  3 Within a distance of 10 times the wall thickness from the ring gate, the length of cracks shall not exceed 50 % of the wall thickness at that point.  4 The weld line shall not have opened more than 50 % of the wall thickness at the line.  5 In all other parts of the surface the depths of cracks and delaminations shall not exceed  30 % of the wall thickness at that point. Blisters shall not exceed a length of 10 times the wall thickness.  b) After cutting through the fitting, the cut surfaces shall show no foreign particles, when viewed without magnification. | | | | |

**9 Fitness for purpose of joint and system**

When tested in accordance with the test methods specified in Table 12, pipes, fittings and their assemblies shall conform to the requirements given in Table 12.

**Table 12 — Fitness for purpose characteristics of joint or system**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristic** | **Requirement** | **Test parameters** | | **Test method** |
| Watertightness a) | No leakage | Shall conform to ISO 13254 | | ISO 13254 |
| Artificial ageing b) (colour fastness) | The change of colour shall not exceed stage 3 of the grey scale according to ISO 105-A02 | Radiation energy Cycling and temperature regime | 2.6 GJ/m2  Method 1 of  EN 513 | Method A of ISO 4892-2  (Xenon test):artificial weathering 3) |
| or c | | |
| Exposure time  Cycle:   * irradiation * condensation | 1 600 h  (UVA 351 lamp)  6h at (50 ± 5) oC  2h at (50 ± 5) oC | ISO 4892-3  (QUV test) |
| Tensile impact strength after ageing (pipe only) | ≥ 50 % of the value before ageing | Test temperature  Test piece | (23 ± 5) oC  shall conform to Table 6 | Method A of ISO 8256 |
| a) Watertightness requirements do not apply to unsealed system.  b) This is intended as a type test for each formulation and colour and may be carried out on other profiles, e.g. those manufactured to WD TC 047-02-2024.  c) Where in case of dispute, the method of ISO 4892-2 (Xenon test) shall be used. | | | | |

**10 Sealing rings**

**10.1** The sealing ring shall have no detrimental effect on the properties of the pipe and of the fittings and shall not cause the test assembly to fail to conform to Table 12.

**10.2** Materials for sealing rings shall conform to ISO 23711.

**11 Adhesives**

The adhesive shall be solvent cement and shall be as specified by the manufacturer of pipes and/or fittings.

The adhesive shall have no detrimental effects on the properties of the pipe and of the fittings and shall not cause the test assembly to fail to conform to the requirements given in Table 12.

**12. Marking**

**12.1 General**

**12.1.1** Marking elements shall be labeled or printed or formed directly on the pipe or the fitting, in such a way that after storage, weathering and handling, and installation, legibility is maintained in accordance with one of the following levels.

One of the following three levels of legibility of the marking is specified for the individual marking aspect in the column “minimum durability of legibility of marking” given in Tables 13 and 14.

The symbols for the legibility mean the following:

a) durable in use

b) legible until the system is installed;

c) marking on the packaging, legible until the component is installed.

NOTE The manufacturer is not responsible for marking being illegible, due to actions caused during installation and use such as painting, scratching, covering of the components or use of e.g. detergents on the components unless agreed or specified by the manufacturer.

**12.1.2** Marking shall not initiate cracks or other types of defects which adversely influence the performance of the pipe or the fitting.

Marking by indentation reducing the wall thickness not more than 0,25 mm shall be deemed to conform to this clause without infringing the requirements for the wall thickness given in 6.2.4.

**12.1.3** If printing is used, the colouring of the printed information shall differ from the basic colouring of the pipe or the fitting.

**12.1.4** The size of the marking shall be such that it is legible without magnification.

**12.2 Minimum required marking of pipes**

Pipes shall be marked at least once per pipe.

The marking shall conform to the requirements given in Table 13.

**Table 13 — Minimum required marking of pipe**

|  |  |  |
| --- | --- | --- |
| **Aspects** | **Marking or symbol** | **Durability of legibility of marking** |
| Material  Manufacturer  Number of this standard  Pipe size a  Wall thickness (e)  Rainwater  Manufacturing inform  Quality Mark(if a certification scheme is set up) | PVC or PVC-U  Name or trade mark  WD TC 047 -01-2024  e.g. 80 or 65 x 65  e.g 1,6  R  2) | a  a  a  a  a  c  c  b |
| a Non-circular pipes shall be designated as 6.2.2  b For providing traceability the following details shall be given:  1 the production period, year and month, in figures or in code;  2 a name or code for the production site if the manufacturer is producing at different sites, nationally and/or internationally. | | |

**12.3 Fittings**

The marking of fittings shall be in accordance with the requirements given in Table 14.

**Table 14 — Minimum required marking of fittings**

|  |  |  |
| --- | --- | --- |
| **Aspects** | **Marking or symbol** | **Durability of legibility of marking** |
| Material  Manufacturer  Number of this standard  Nominal size a)  Nominal angle  Rainwater  Manufacturing inform  Quality Mark (if a certification scheme is set up) | PVC or PVC-U  Name or trade mark  WD TC 047 -01-202  4e.g. 80 or 65 x 65  e.g 45o  R  b) | a  a  a  a  a  c  c  b |
| a) Fittings for non-circular pipes shall be designated as 6.2.2.  b) for providing traceability the following details shall be given:  1 the production period, year , in figures or in code;  2 a name or code for the production site if the manufacturer is producing at different sites, nationally and/or internationally. | | |

**12.4 Brackets**

Brackets of PVC-U shall be marked in accordance with Table 14.

If marking details are formed directly on the brackets it shall be done in such a way that the marking does not initiate cracks or other types of failure.

Brackets made of material other than PVC-U shall not be marked directly but shall carry the following information on the packaging or on a label.

— designed for use with systems conforming to WD TC 047 -01-2024;

— nominal size;

— manufacturer’s name or trade mark;

— corrosion class as specified in WD TC 047-03-2024.

**12.5 Certified components**

Pipes and fittings conforming to this standard which are third party certified, may be marked accordingly.

**Annex A**

(normative)

**Utilization of non-virgin material**

**A.1 Material terms and definitions**

**A.1.1**

**virgin material**

materials in a form such as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no reprocess able or recyclable material has been added

**A.1.2**

**own reprocess able material**

material prepared from rejected unused pipes or fittings, including trimmings from the production of pipes or fittings, that will be reprocessed in a manufacturer’s plant after having been previously processed by the same manufacturer by a process such as moulding or extrusion, and for which the complete formulation is known

**A.1.3**

**external reprocess able material**

material comprising either one of the following forms:

a) material from rejected unused pipes of fittings or trimmings there from, that will be reprocessed and that were originally processed by another manufacturer

b) material from the production of unused PVC-U products other than pipes and fittings, regardless of where they are manufactured

**A.1.4**

**recyclable material**

material comprising either of the following forms:

a) material from used pipes or fittings which have been cleaned and crushed or ground;

b) material from used PVC-U products other than pipes or fittings which have been cleaned and crushed or ground.

**A.2 Reprocess able and recyclable material**

NOTE For the purposes of this clause the term pipes means extruded pipes, gutters and any parts of a fabricated fitting which is made from an extrusion. The term fitting means injection-moulded fittings and injection-moulded parts of a fabricated fitting.

**A.2.1 Own reprocess able material**

The use of clean own reprocess able material with agreed specification for the production of pipes and fittings is permitted without limitations.

If fitting material is used for the production of pipes it shall be considered as recyclable material.

**A.2.2 External reprocess able and recyclable materials with agreed specification**

**A.2.2.1 Material from PVC-U pipes, gutters and fittings**

External reprocess able and recyclable material with an agreed specification from PVC-U pipes, gutters and fittings that are available in relevant quantities and intervals of time is permitted to be added to virgin or own reprocess able material or a mixture of those two materials for the production of pipes and fittings provided that all of the following conditions are met:

a) a specification for each material shall be agreed between the supplier of external reprocess able or recyclable material and the pipe manufacturer. It shall at least cover the characteristics given in Table A.1. When determined in accordance with the test method given in Table A.1, the actual values for these characteristics shall conform to the agreed value, and the permitted deviations shall conform to those given in Table A.1.

NOTE The quality plan of the supplier of external reprocess able or recyclable material should conform to ISO 9002For the purposes of this sub clause, the manufacturer is responsible for claiming and ensuring that the quality plan conforms to or is no less stringent than the relevant requirements of ISO 9002.It is not essential for the manufacturer to be approved and registered for operation in accordance with ISO 9002.

**Table A.1 — Specification of characteristics to be covered by an agreement and the maximum permitted deviation for these characteristics**

|  |  |  |
| --- | --- | --- |
| **Characteristic** | **Permitted deviations** | **Test method** |
| PVC-content a | ± 4 % absolute by mass | EN 1905 |
| K-value a | ± 3 units | ISO 13229 |
| Density a | ± 20 kg/m3 | ISO 1183-1 |
| Vicat softening temperature (VST) a | ± 2oC | ISO 2507-1 |
| Particle size b | Requirements and test method shall be agreed and stated in the specification | |
| Type of stabilizer b | Requirements and test method shall be agreed and stated in the specification | |
| Impurities b | Based on the source of material and the recycling process a relevant test method and requirements shall be agreed and stated in the specification. Both the test method and the requirements shall be published | |
| a If the source of the material is pipes and fittings produced under a recognized quality mark from partner state, it is not required to test this material characteristics if the requirement covered by the quality mark conforms to the requirement given in this table.  b The relevant requirements and test method are depending on the recycling process and on the end product. | | |

b) each delivery shall be covered by a certificate according to 3.1.B of EN 10204:1991, showing conformity to the agreed specification;

c) the maximum quantity of external reprocess able and recyclable material that is intended to be added shall be specified by the pipe or fitting manufacturer;

d) the quantity of external reprocess able and recyclable material that is actually added in each production series shall be recorded by the pipe or fitting manufacturer;

e) type testing shall be carried out on the end product with the maximum specified amount of and with each form of external reprocess able or recyclable material with an agreed specification. Approved results shall be taken as proving conformity also of components containing lower levels of additions of external reprocess able or recyclable material.

**A2.2.2 Material from other PVC-U products than pipes gutters and fittings**

External reprocess able and recyclable material with an agreed specification from PVC-U bottles or window frames that are available in relevant quantities and intervals of time is permitted to be added to virgin or own reprocess able material or a mixture of those two materials for the production of pipes and fittings provided that all of the following conditions are met:

a) the material shall conform to all of the conditions given in a) to e) of A.2.2.1, inclusive, and to all of the additional characteristics and requirements given in Table A.2.

**Table A.2 — Requirements for external reprocess able and recyclable material from PVC-U products other than pipes gutters and fittings**

|  |  |  |
| --- | --- | --- |
| **Characteristic** | **Requirements** | **Test method** |
| PVC-content | ≥ 80 % by mass | EN 1905 |
| K-value | 56 ≤ K-value ≤ 70 | EN 922 |
| Density | 1 390 kg/m3 ≤ density ≤ 1 500 kg/m3 | ISO 1183-1 |
| Vicat softening temperature (VST) | ≥ 62oC | ISO2507-1 |
| Impurities | ≤ 1 500 ppm for particle size ≤ 1 000 µm  ≤ 1 500 ppm for 1 000 µm< particle size < 1400 µm | a |
| Particle size | > 1 000 µm: max 15 %  < 1 400 µm: 100% | Sieve analysis |
| Application source of the material | One source: bottles or window frames |  |
| If the source of the material is unused products for which the complete formulation is known and is such that all the requirements given in this table are fulfilled the material does not have to be tested and does not have to meet the requirements for particle size. | | |
| a Based on the source of material and the recycling process a relevant test method and requirements shall be agreed and stated in the specification.  Both the test method and the requirements shall be published. | | |

b) the material shall be clean and dry;

c) the maximum allowed amount of reprocess able and recyclable materials shall depend on the difference in K-value of the virgin material and the reprocess able and recyclable material as follows:

1) if the difference in K-value, when determined in accordance with ISO 13229, is ≤ 4 units, then up to 20 % by mass may be added:

2) if the difference K-value is > 4 units, or not determined, then up to 5 % by mass may be added:

d) the quantity of external reprocess able and recyclable materials that is actually added in each production series shall be recorded by the pipe and fitting manufacturer.

NOTE The attention is drawn to possible national regulations regarding heavy metals, e.g. cadmium.

**A.2.3 External reprocess able and recyclable material not covered by an agreed specification**

**A.2.3.1 Material from PVC-U pipes and fittings**

External reprocess able and recyclable material not covered by an agreed specification from PVC-U pipes and fittings that are available in random quantities and intervals of time is permitted to be added to virgin or own reprocess able material or a mixture of those two materials for the production of pipes provided that all of the following conditions are met:

a) when this material is used the production shall be considered as at least one batch and shall be tested according;

b) the material shall be clean and dry;

c) the maximum allowed amount of external reprocess able and recyclable materials that may be added shall depend on the difference in K-value of the virgin material and the external reprocess able and recyclable material as follows:

1) if the difference in K-value, when determined in accordance with ISO 13229, is ≤ 4 units, then up to 10 % by mass may be added;

2) if the difference in K-value is > 4 units, or not determined, then up to 5 % by mass may be added.

d) the quantity of external reprocess able and recyclable materials that is actually added in each production series shall be recorded by the pipe manufacturer.

**A.2.3.2 Material from other PVC-U products than pipes and fittings**

External reprocess able and recyclable material not covered by an agreed specification from other PVC-U products than pipes and fittings shall not be used for the production of pipes and fittings conforming to this standard.

**Bibliography**

1.BS EN 12200-1 Plastics rainwater piping systems for above ground external use — Unplasticized poly (vinyl chloride) (PVC-U) Part 1: Specifications for pipes, fittings and the system.

2 KS 2199:2009 Brackets for eaves gutters — Requirements and testing

3. ISO 265-1 Pipes and fittings of plastics materials — Fittings for domestic and industrial waste pipes — Basic dimensions: Metric series Part 1: Unplasticized poly(vinyl chloride) (PVC-U)