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**Plastics piping systems for non-pressure  
drainage and sewerage — Polyester resin  
concrete (PRC) —**

**Part 1:  
Pipes and fittings with flexible joints**

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*Systèmes de canalisations en plastique pour les branchements et les  
collecteurs d'assainissement sans pression — Béton résines polyester  
(BRP)*

*Partie 1: Tubes et raccords avec assemblages flexibles*

ISO 18672-1:2009

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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 18672-1 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 6, *Reinforced plastics pipes and fittings for all applications*.

ISO 18672 consists of the following parts, under the general title *Plastics piping systems for non-pressure drainage and sewerage — Polyester resin concrete (PRC)*:

— Part 1: *Pipes and fittings with flexible joints*

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# Plastics piping systems for non-pressure drainage and sewerage — Polyester resin concrete (PRC) —

## Part 1: Pipes and fittings with flexible joints

### 1 Scope

This part of ISO 18672 specifies definitions, requirements and characteristics of pipes, fittings, joints, materials, test methods and marking for pipes and fittings made from polyester resin concrete (PRC), intended to be used within a drain or sewer system operating without pressure. It applies to products for use in buried installations to be installed by open-trench techniques or pipe jacking.

It applies to pipes, fittings and their joints of nominal sizes from DN 150 to DN 3000 for circular cross-sections, from WN/HN 300/450 to WN/HN 1400/2100 for egg-shaped cross-sections and from DN 800 to DN 1800 for kite-shaped cross-sections.

The intended use of these products is for the conveyance of sewage, rainwater and surface water at temperatures up to 50 °C, without pressure or occasionally at a head of pressure up to 0,5 bar<sup>1)</sup>, and installed in areas subjected to vehicle and/or pedestrian traffic.

The pipes are classified on the basis of the intended method of installation and cross-sectional shape.

NOTE It is the responsibility of the purchaser or specifier to make the appropriate selections, taking into account the 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.

ISO 75-2, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite*

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

ISO 7510, *Plastics piping systems — Glass-reinforced plastics (GRP) components — Determination of the amounts of constituents using the gravimetric method*

ISO 8639, *Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Test methods for leaktightness of flexible joints*

ISO 10928, *Plastics piping systems — Glass-reinforced thermosetting plastics (GRP) pipes and fittings — Methods for regression analysis and their use*

EN 681-1, *Elastomeric seals — Material requirements for pipe joint seals used in water and drainage applications — Part 1: Vulcanized rubber*

1) 1 bar = 0,1 MPa = 0,1 N/mm<sup>2</sup> = 10<sup>5</sup> N/m<sup>2</sup>

EN 13121-1, *GRP tanks and vessels for use above ground — Part 1: Raw materials — Specification conditions and acceptance conditions*

### 3 Terms, definitions, symbols and abbreviations

#### 3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

##### 3.1.1

##### **adaptor**

fitting that provides for connections to structures, pipes of other materials, or valves

##### 3.1.2

##### **angular deflection**

$\delta$

angle between the axes of two adjacent pipes

See Figures 1b) and 1c).

NOTE Angular deflection is expressed in degrees (°).

##### 3.1.3

##### **bend**

fitting that provides for a change of alignment within a pipeline

##### 3.1.4

##### **branch**

fitting comprising a pipe with one additional connecting pipe of equal or smaller nominal size, DN or WN/HN, to connect two pipelines

NOTE See 3.1.13 and 3.1.14 for DN and WN/HN.

##### 3.1.5

##### **design service temperature**

maximum sustained temperature at which the system is expected to operate

NOTE It is expressed in degrees Celsius (°C).

##### 3.1.6

##### **draw**

$D$

longitudinal movement of a joint

See Figure 1a).

NOTE Draw is expressed in millimetres (mm).

##### 3.1.7

##### **laying length of a bend**

$L$

distance from one end of the bend, excluding the spigot insertion depth,  $L_i$ , of a socket end, where applicable, projected along the axis of that end of the bend to the point of intersection with the axis of the other end of the bend

See Figure 8.

NOTE Laying length of a bend is expressed in metres (m).

**3.1.8****laying length of a pipe**

internal barrel length

 $L$ 

total length of a pipe,  $L_{\text{tot}}$ , minus, where applicable, the manufacturer's recommended spigot insertion depth,  $L_i$ , in the socket

NOTE 1 The laying length of a pipe is expressed in metres (m).

NOTE 2 See 3.1.20 for total pipe length,  $L_{\text{tot}}$ .

**3.1.9****fitting**

component comprising an adaptor, bend or branch

**3.1.10****flexible joint**

joint that allows relative movement between the components being joined

**3.1.11****minimum crushing load** $q_{\text{cr,min}}$ 

short-term load that a component is required to withstand during a crushing strength test, without failure, corresponding to its nominal size, classification and strength class

NOTE 1 The minimum crushing load is determined using Equation (1) or Equation (2), as applicable (see 5.4.1.1).

NOTE 2 For the purposes of this part of ISO 18672, it is expressed in newtons per millimetre length (N/mm).

**3.1.12****misalignment** $M$ 

amount by which the centre lines of adjacent pipes fail to coincide

See Figure 1d).

**3.1.13****nominal size****DN**

alphanumeric designation of size, for a component with a circular or kite-shaped bore

NOTE 1 It is a convenient round number for reference purposes and is related to the internal diameter when expressed in millimetres.

NOTE 2 The designation for reference or marking purposes consists of the letters DN plus a number, e.g. DN 600.

**3.1.14****nominal size****WN/HN**

alphanumeric designation of size for a component with an egg-shaped bore

NOTE 1 It is a convenient round number for reference purposes and is related to the internal width and height ( $w_i$  and  $h_i$ , see Figures 3 and 6), expressed in millimetres.

NOTE 2 The designation, for reference or marking purposes, consists of the letters WN/HN plus two numbers, e.g. WN/HN 300/450.

**3.1.15****non-pressure pipe or fitting**

pipe or fitting not subject to an internal pressure greater than 0,5 bar

### 3.1.16

#### normal service conditions

conveyance of surface water, rainwater or sewage, in the temperature range from 2 °C to 50 °C, without pressure, for 50 years

### 3.1.17

#### normalizing factor

multiplication factor that quantifies the relation between a mechanical, physical or chemical property at the service condition and the respective value at 23 °C and 50 % relative humidity

### 3.1.18

#### strength class

$S_c$

constant equal to the minimum short-term crushing load of a component,  $q_{cr,min}$ , divided by one thousandth of either its nominal size (DN) or nominal width (WN)

NOTE It is expressed in newtons per millimetre length (N/mm).

### 3.1.19

#### total draw

$D_{tot}$

sum of the draw,  $D$ , plus the additional longitudinal movement of joint components,  $J$ , due to angular deflection,  $\delta$

See Figure 1c).

NOTE It is expressed in millimetres (mm).

### 3.1.20

#### total pipe length

$L_{tot}$

distance between two planes normal to the pipe axis and passing through the extreme end points of the pipe

See Figures 2 to 7.

NOTE It is expressed in millimetres (mm).

### 3.1.21

#### type tests

tests carried out in order to assess the fitness for purpose of a product or assembly of components to fulfil its or their function(s) in accordance with the product specification

### 3.1.22

#### crushing load

crushing strength

$q_{cr}$

maximum short-term load that a component is able to withstand during a crushing strength test

NOTE It is expressed in newtons per millimetre length (N/mm).

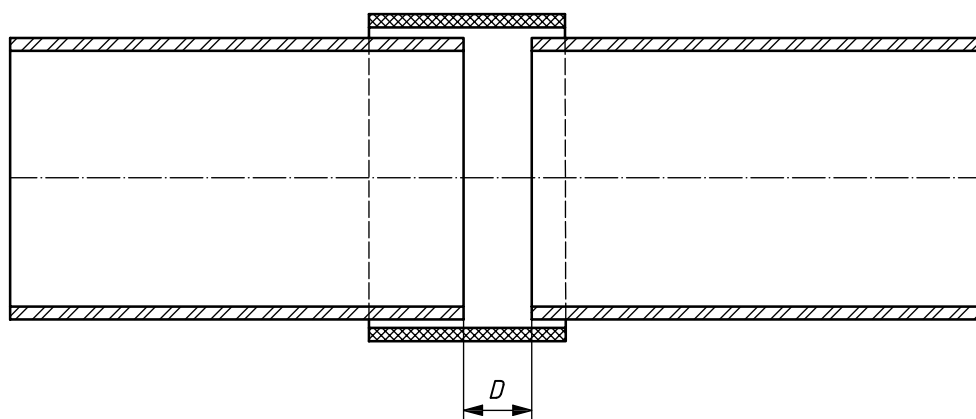
### 3.1.23

#### polyester resin concrete

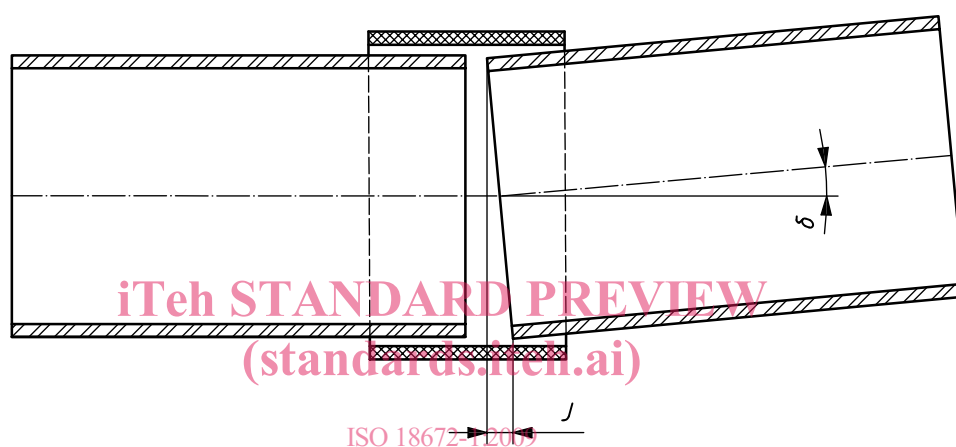
PRC

material formed from mineral aggregates and fillers which are bound together using a polyester resin



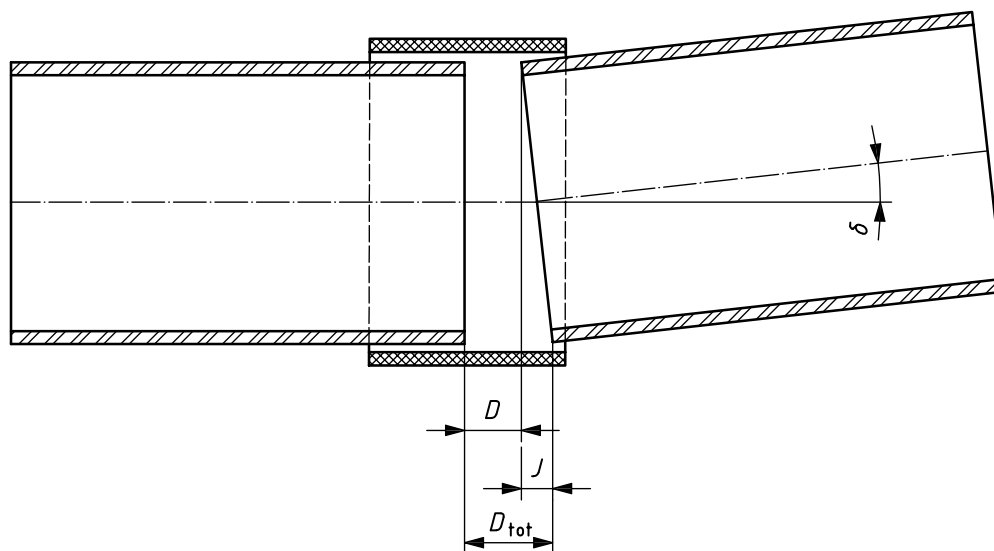


a)



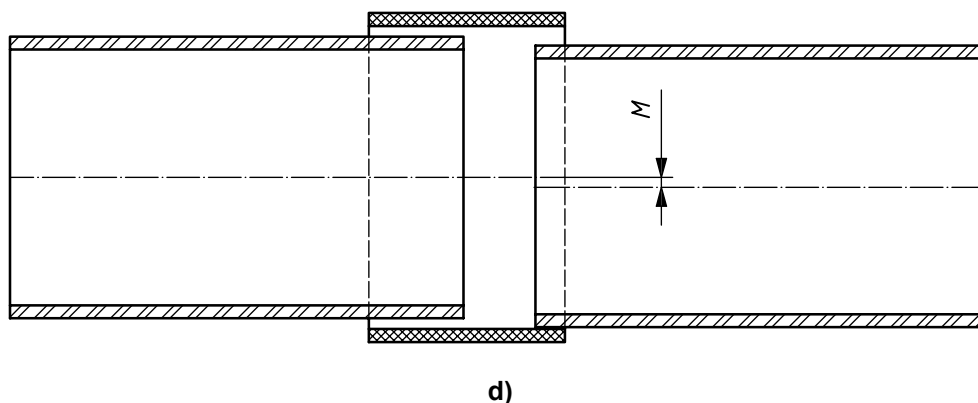
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c)

Figure 1 (continued)

**Key**

$\delta$	angular deflection
$D$	draw
$D_{\text{tot}}$	total draw
$J$	longitudinal movement of the joint due to angular deflection
$M$	misalignment

**Figure 1 — Joint movements****3.2 Symbols and abbreviations**

For the purposes of this part of ISO 18672, the symbols given in Table 1 and abbreviations given in Table 2 apply.

**Table 1 — Symbols**

Symbol	Description	Unit	Where used
$a_b$	width of a bearing strip	mm	Annexes A and B
$B$	laying length of a branch pipe	mm	6.3, Figure 9
$B_B$	nominal offset (body) length of a branch pipe	mm	6.3, Figure 9
$B_i$	spigot insertion depth of a branch pipe	mm	6.3, Figure 9
$b$	width of a sawn test piece	mm	5.4.1.2, Annexes B and E
$D$	draw	mm	3.1.6, 3.1.19, Figure 1, 7.2.2
$D_{\text{max}}$	maximum draw	mm	4.4.2.2, 7.2.2, 7.2.4
$D_{\text{tot}}$	total draw	mm	3.1.19, Figure 1, 7.2.4
$d_a$	external diameter of a pipe	mm	5.3.1, Figure 2, 5.3.3 to 5.3.6, Figures 4 to 7, 6.2.1.1, 6.3.1.1
$d_e$	external diameter of a spigot	mm	5.3.4 to 5.3.6, Figures 5 to 7
$d_i$	internal diameter of a pipe with a circular or kite-shaped cross-section	mm	5.3.1, Figure 2, 5.3.3, Figure 4, 5.3.4, Figure 5, 5.3.6, Figure 7, Annexes A, B and E
$e$	wall thickness of a pipe with a circular or kite-shaped cross-section or wall thickness of a test piece taken from a pipe	mm	4.1.3, 5.3.1, Figure 2, 5.3.3, Figure 4, 5.3.4, Figure 5, 5.3.6, Figure 7, 6.2.1.1, 6.3.1.1, Annexes A, B and E
$e_1$	wall thickness at the spring-line of a pipe with egg-shaped cross-section	mm	5.3.2, Figure 3, 5.3.5, Figure 6, Annex A

Table 1 (continued)

Symbol	Description	Unit	Where used
$e_2$	wall thickness at top of pipe of a pipe with egg-shaped cross-section.	mm	5.3.2, Figure 3, 5.3.5, Figure 6, Annexes A and B
$e_3$	pedestal height of a pipe with egg-shaped cross-section	mm	5.3.2, Figure 3
$f_{\text{corr}}$	correction factor for stress distribution	—	Annexes B and E
$f_{\text{low}}$	factor for lower load	—	Annex E
$f_{\text{up}}$	factor for upper load	—	Annex E
$h_i$	internal height of a pipe with egg-shaped cross-section	mm	3.1.14, 5.3.2, Figure 3, 5.3.5, Figure 6
$J$	longitudinal movement within a joint due to angular deflection, $\delta$ (see 3.1.2)	mm	3.1.19, Figure 1, 7.2.4
$L$	laying length of a pipe or a bend or laying length of the main pipe of a branch fitting	mm	3.1.7, 3.1.8, 4.4.2.2, 5.3.1 to 5.3.6, Figures 2 to 7, 5.3.7.1, 5.4.2.2, 5.5, Figure 8, 6.2.1.5, Figure 9, 6.3.1.4
$L_B$	nominal body length of the main pipe of a fitting	mm	6.2, Figure 8, 6.3, Figure 9
$L_i$	insertion depth of the spigot of a pipe or main pipe of a fitting	mm	3.1.7, 3.1.8, 5.3.1 to 5.3.6, Figures 2 to 7, 6.2, Figure 8, 6.3, Figure 9
$L_{\text{tot}}$	total length of a pipe	mm	3.1.8, 3.1.20, Figures 2 to 7, 5.3.1 to 5.3.6
$l_a$	lever arm length	m	Annexes C and G
$l_b$	distance between the centres of the bearers	mm	Annexes B, C and E
$l_f$	distance between the centres of the fulcrums	m	Annex G
$l_p$	length of a test piece	mm	5.4.1.2, 7.2.4.6, Annexes A, B and E
$l_s$	support span	m	Annex C
$M$	misalignment	mm	3.1.12, Figure 1
$M_{\text{BMR}}$	minimum longitudinal bending moment resistance	kNm	5.4.2, Annex C
$M_3$	calculated longitudinal bending moment resisted by the pipe when tested using three-point loading method	kNm	5.4.2.1, Annex C
$M_4$	calculated longitudinal bending moment resisted by the pipe when tested using four-point loading method	kNm	5.4.2.1, Annex C
$N_d$	specified shear load for joint misalignment test	N/mm of nominal size	7.2.4.2
$P$	test load applied by loading frame	N	Annexes A, B and E
$P_b$	total bending load applied	kN	Annex C
$P_{\text{calc}}$	calculated minimum test load	N	Annexes A and B
$P_{\text{calc,low}}$	calculated lower limit of cyclic load	N	5.4.4, Annex E
$P_{\text{calc,up}}$	calculated upper limit of cyclic load	N	5.4.4, Annex E

Table 1 (continued)

Symbol	Description	Unit	Where used
$P_{cr}$	load applied by loading frame at failure	N	Annex A
$P_{eff,CK}$	effective test load applied to a test piece with a circular or kite-shaped cross-section	N	Annex A
$P_{eff,E}$	effective test load applied to a test piece with an egg-shaped cross-section	N	Annex A
$P_{min}$	minimum load to be applied by loading frame	N	Annexes A and B
$q_{cr}$	crushing load (or crushing strength) of a pipe calculated from the load applied to the test piece at the moment of failure (collapse)	N/mm	3.1.22, Annexes A and B
$q_{cr,min}$	minimum crushing load	N/mm	3.1.11, 3.1.18, 5.4.1, Annexes A and B
$r$	radius of curvature	mm	6.2, Figure 8, 6.4
$S_c$	strength class	N/mm	3.1.11, 3.1.18, 5.2, 5.4.1.1, 5.5, 6.1.1, 6.1.5, 6.4, Annexes A and B
$t_{sq}$	tolerance on diametrical squareness	mm/m	5.3.1 to 5.3.6, Figures 2 to 7
$T_{cube}$	height, length and width of a cube sawn from a pipe wall	mm	5.4.3, Annex D
$W^*$	load due to own weight of the compression beam	N	Annexes A and B
$W_p$	load due to own weight of a test piece	N	Annex A
$W_{pipe}$	load due to own weight of a pipe	N/mm or length	Annex B
$w_i$	internal width of a pipe with an egg-shaped bore	mm	3.1.14, 5.3.2, Figure 3, 5.3.5, Figure 6, Annexes A and B
$w_p$	width of the pedestal of a pipe with an egg-shaped bore	mm	5.3.2, Figure 3
$\alpha_n$	fitting angle	degrees	6.2, Figure 8, 6.3, Figure 9, 6.4
$\delta$	angular deflection of a joint	degrees	3.1.2, Figure 1, 3.1.19, 4.4.2.1, 7.2.3
$\Delta_{str}$	deviation from straightness	mm/m	5.3.1 to 5.3.6, Figures 2 to 7
$\sigma_c$	calculated compressive strength	N/mm <sup>2</sup> <sup>a</sup>	5.4.3
$\sigma_{fat}$	calculated fatigue strength	N/mm <sup>2</sup>	Annex E
$\sigma_{low}$	lower limit of bending tensile stress	N/mm <sup>2</sup>	Annex E
$\sigma_{rb}$	calculated ring bending tensile stress or strength	N/mm <sup>2</sup>	Annexes A and B
$\sigma_{rb,min}$	minimum ring bending tensile stress	N/mm <sup>2</sup>	Annexes B and E
$\sigma_{up}$	upper limit of bending tensile stress	N/mm <sup>2</sup>	Annex E

<sup>a</sup> 1 N/mm<sup>2</sup> = 1 MPa.

Table 2 — Abbreviations

Symbol	Meaning	Where used
BMR	longitudinal bending moment resistance	5.4.2, Annex C
DN	nominal size	1, 3.1.4, 3.1.11, 3.1.13, 3.1.18, 5.2 to 5.5, 6, 7.2.4, Annexes A to C,
HN	nominal internal height of a pipe with egg-shaped cross-section	1, 3.1.4, 3.1.14, 5.2 to 5.5, 6.1, 6.4, Annex A
OC	classification for open-trench construction with circular bore	5.2 to 5.5, 6.1 and 6.4, Annexes A and B
OE	classification for open-trench construction with egg-shaped bore	5.2 to 5.5 and 6.4, Annexes A and B
OK	classification for open-trench construction with kite-shaped bore	5.2 to 5.5 and 6.4, Annexes A and B
PRC	polyester resin concrete	1, 3.1.23, 4.1.3, 4.1.6, 4.3.4, 5.2 to 5.5, 6.1 to 6.4, Annexes A to E
TC	classification for trenchless construction with circular bore	5.2 to 5.5, Annexes A and B
TE	classification for trenchless construction with egg-shaped bore	5.2 to 5.5, Annexes A and B
TK	classification for trenchless construction with kite-shaped bore	5.2 to 5.5, Annexes A and B
WN	nominal internal width of a pipe with egg-shaped cross-section	1, 3.1.4, 3.1.11, 3.1.14, 3.1.18, 5.2 to 5.5, 6.1 to 6.4, 7.2.4, Annexes A and B

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## 4 General requirements

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### 4.1 Materials

#### 4.1.1 General

The pipe or fitting shall be constructed using aggregates, polyester resin (with or without fillers) and, if applicable, additives necessary to impart specific properties to the resin.

#### 4.1.2 Resin

The resin used in the pipe or fitting shall have a temperature of deflection of at least 70 °C, when tested in accordance with Method A of ISO 75-2 with the test specimen in the edgewise position. It shall also conform to the applicable requirements of EN 13121-1.

#### 4.1.3 Aggregates and fillers

Aggregates and fillers shall not contain constituents in such quantities as may be detrimental to the curing, strength, leaktightness or durability of the polyester resin concrete (PRC) (see 3.1.23). The size of particles in aggregates and fillers shall not exceed one third of the smallest wall thickness,  $e$ , of the pipe or fitting.

#### 4.1.4 Elastomers

Each elastomeric material of the sealing component shall conform to EN 681-1. The sealing component shall be supplied by the pipe or fitting manufacturer either attached to the pipe or fitting, or separately.

#### 4.1.5 Metals

When exposed metal components are used, there shall be no evidence of corrosion of the components after the metallic item has been immersed for seven days at  $(23 \pm 2)^\circ\text{C}$  in an aqueous sodium chloride solution, 30 g/l, and then removed from the solution and visually examined for evidence of corrosion.

#### 4.1.6 Minimum resin content

When tested in accordance with ISO 7510 the content of resin in the polyester resin concrete (PRC) shall be not less than 7 % mass fraction of the sample.

### 4.2 Appearance

Both internal and external surfaces shall be free of irregularities which would impair the ability of the component to conform to the requirements of this part of ISO 18672. The edges of the pipe faces shall be free of cracks or burrs and the joint surfaces shall be free of irregularities that would preclude the formation of a leaktight seal. The ends of a component shall be square to its longitudinal axis within the tolerances specified in Clause 5, Tables 4 to 9, as applicable.

### 4.3 Reference conditions for testing

#### 4.3.1 Temperature

The mechanical, physical and chemical properties specified in this part of ISO 18672 shall be determined at  $(23 \pm 5)^\circ\text{C}$ . For service temperatures over  $35^\circ\text{C}$  and up to and including  $50^\circ\text{C}$ , type tests shall be carried out at least at the purchaser's declared design service temperature (see 3.1.5) to establish rating factors (see 3.1.17) for all long-term properties to be used in design.

#### 4.3.2 Properties of water for testing

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The water used for the tests referred to in this part of ISO 18672 shall be tap water having a pH of  $(7 \pm 2)$ .

#### 4.3.3 Loading conditions

The mechanical, physical and chemical properties specified in this part of ISO 18672 shall be determined using circumferential and/or longitudinal loading conditions, as applicable.

#### 4.3.4 Measurement of dimensions

The dimensions of the polyester resin concrete (PRC) components and the joints shall be determined at  $(23 \pm 5)^\circ\text{C}$ . Measurements shall be made either in accordance with ISO 3126 or using any method of sufficient accuracy to determine conformity or otherwise to the applicable limits. Routine measurements shall be determined at the prevailing temperature or if the manufacturer prefers, at  $(23 \pm 5)^\circ\text{C}$ .

### 4.4 Joints

#### 4.4.1 General

The manufacturer shall declare the length and the maximum external diameter or, for egg-shaped components, the maximum dimensions of the assembled joint, and the materials used, in documents at the time of the enquiry or delivery.

#### 4.4.2 Flexibility of the jointing system

##### 4.4.2.1 Maximum angular deflection

The manufacturer shall declare the maximum value of the angular deflection,  $\delta$ , for which each joint is designed, in writing at the time of enquiry or delivery.

##### 4.4.2.2 Maximum draw

The manufacturer shall declare the maximum draw,  $D_{\max}$  (see Figure 1), for which each joint is designed, in writing at the time of enquiry or delivery. For flexible joints, the maximum draw, which includes temperature effects, shall not be less than 0,2 % of the laying length,  $L$ , of the longest pipe with which it is intended to be used.

#### 4.4.3 Joint seals

Elastomeric joint seals shall be made from material conforming to EN 681-1. They shall be supplied by the pipe manufacturer and shall either be integrated into the unit or supplied separately. A sealing ring shall not have any detrimental effect on the properties of the components with which it is used and shall not cause the test assembly to fail the functional requirements of Clause 7.

#### 4.4.4 Adhesives

When the components of a joint are to be connected using adhesives, the adhesives to be used shall be specified by the manufacturer of the joint in writing at the time of enquiry or delivery. The joint manufacturer shall ensure that the adhesives do not have any detrimental effects on the components with which they are used and they shall not cause the test assembly to fail the functional requirements of Clause 7.

## 5 Pipes

ISO 18672-1:2009  
<https://standards.iteh.ai/catalog/standards/sist/b7588e29-2697-4b74-b0c4-7f14516bflfc/iso-18672-1-2009>

### 5.1 Classification

#### 5.1.1 General

Pipes shall be classified (see Tables 2 and 3) according to

- a) the intended method of installation, i.e. whether open-trench construction or trenchless construction, and
- b) the bore shape, i.e. whether circular, egg-shaped or kite-shaped.

#### 5.1.2 Method of installation

Pipes intended to be installed using open-trench techniques shall be classified as such by the use of the letter "O" in their designation.

Pipes intended to be installed using trenchless techniques, such as jacking, shall be classified as such by the use of the letter "T" in their designation.

#### 5.1.3 Bore shape

Pipes having a bore shape that is circular shall be classified by the use of the letter "C" in their designation.

Pipes having a bore shape that is egg-shaped shall be classified by the use of the letter "E" in their designation.