INTERNATIONAL STANDARD

ISO 16422

Second edition
2014-02-15

Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) for the conveyance of water under pressure — Specifications

Tubes et assemblages en poly(chlorure de vinyle) non plastifié orienté (PVC-O) pour le transport de l'eau sous pression — Spécifications

Reference number
ISO 16422:2014(E)

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Published in Switzerland

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 2, *Plastics pipes and fittings for water supplies*.

This second edition cancels and replaces the first edition (ISO 16422:2006), of which it constitutes a minor revision with the following changes:

— Table 4: Physical characteristics: Resistance to dichloromethane and alternative tests.

— Annex A: Determination of pipe material classification: Procedures for classified and non-classified feedstock material.

— Annex F: Determination of axial and tangential orientation factor.

Introduction

Molecular orientation of thermoplastics results in improvement of physical and mechanical properties. Orientation is carried out at temperatures well above the glass transition temperature.

Orientation of PVC-U pipe-material can be induced by different processes.

In general the following production process is common. A thick-wall tube is extruded (feedstock) and conditioned at the desired temperature. The orientation process is activated in circumferential and axial directions under controlled conditions.

After the orientation process, the pipe is cooled down quickly to ambient temperature.

The orientation of the molecules creates a laminar structure in the material of the pipe wall. This structure gives the ability to withstand brittle failure emanating from minor flaws in the material matrix or from scratches at the surface of the pipe wall. PVC-O can therefore be considered as highly resistant to notches and no testing is needed. Because of the morphology of oriented PVC-U pipe-material, there is no risk of long-line rapid crack propagation.

Improved hoop strength, allows reduced wall thickness with material and energy savings. Improved resistance to impact and fatigue also result.

The classification depends on material compound/formulation and stretch ratios used. Therefore, with the classification, these characteristics may be specified or determined.

Variations in stretch ratios should be within 10 % of the value determined on the pipes used for classification. The determination of the stretch ratios may be carried out as shown in Annex F.

Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) for the conveyance of water under pressure — Specifications

1 Scope

This International Standard specifies the requirements of pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O), for piping systems intended to be used underground or above-ground where not exposed to direct sunlight, for water mains and services, pressurized sewer systems and irrigation systems.

The piping system according to this International Standard is intended for the conveyance of cold water under pressure, for drinking water and for general purposes up to and including 45 °C, and especially in those applications where special performance requirements are needed, such as impact loads and pressure fluctuations, up to pressure of 25 bars[1)].

Joints constructed of other materials should meet their own relevant standards in addition to the fitness-for-purpose requirements of this International Standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3:1973, *Preferred numbers — Series of preferred numbers*

ISO 161-1, *Thermoplastics pipes for the conveyance of fluids — Nominal outside diameters and nominal pressures — Part 1: Metric series*

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

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

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

ISO 1452-2:2009, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 2: Pipes*

ISO 1452-5:2009, *Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure — Unplasticized poly(vinyl chloride) (PVC-U) — Part 5: Fitness for purpose of the system*

ISO 1628-2, *Plastics — Determination of the viscosity of polymers in dilute solution using capillary viscometers — Part 2: Poly(vinyl chloride) resins*

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

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

1) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2

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 2531, *Ductile iron pipes, fittings, accessories and their joints for water applications*

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

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

ISO 4065, *Thermoplastics pipes — Universal wall thickness table*

ISO 4633, *Rubber seals — Joint rings for water supply, drainage and sewerage pipelines — Specification for materials*

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

ISO 7686, *Plastics pipes and fittings — Determination of opacity*

ISO 9080, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

ISO 9852, *Unplasticized poly(vinyl chloride) (PVC-U) pipes — Dichloromethane resistance at specified temperature (DCMT) — Test method*

ISO 9969, *Thermoplastics pipes — Determination of ring stiffness*

ISO 11922-1:1997, *Thermoplastics pipes for the conveyance of fluids — Dimensions and tolerances — Part 1: Metric series*

ISO 12162, *Thermoplastics materials for pipes and fittings for pressure applications — Classification, designation and design coefficient*

ISO 13783, *Plastics piping systems — Unplasticized poly(vinyl chloride) (PVC-U) end-load-bearing double-socket joints — Test method for leaktightness and strength while subjected to bending and internal pressure*

ISO 13844, *Plastics piping systems — Elastomeric-sealing-ring-type socket joints for use with plastic pipes — Test method for leaktightness under negative pressure, angular deflection and deformation*

ISO 13845, *Plastics piping systems — Elastomeric-sealing-ring-type socket joints for use with thermoplastic pipes — Test method for leaktightness under internal pressure and with angular deflection*

ISO 13846, *Plastics piping systems — End-load-bearing and non-end-load-bearing assemblies and joints for thermoplastics pressure piping — Test method for long-term leaktightness under internal water pressure*

ISO 18373-1, *Rigid PVC pipes — Differential scanning calorimetry (DSC) method — Part 1: Measurement of the processing temperature*

3 Terms and definitions

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

3.1
nominal outside diameter
d_n
numerical designation of size which is common to all components in a thermoplastics piping system other than flanges and components designated by thread size

Note 1 to entry: It is a convenient round number for reference purposes.

Note 2 to entry: For pipe conforming to ISO 161-1, the nominal outside diameter, expressed in millimetres, is the minimum mean outside diameter $d_{em, min}$.

3.2
nominal wall thickness
e_n
specified wall thickness, in millimetres

Note 1 to entry: It is identical to the specified minimum wall thickness at any point $e_{y, min}$.

3.3
nominal pressure
PN
alphanumeric designation related to the mechanical characteristics of the components of a piping system and used for reference purposes

3.4
hydrostatic pressure
p
internal pressure applied to a piping system

3.5
working pressure
maximum pressure which a piping system can sustain in continuous use under given service conditions without pressure surge

Note 1 to entry: For thermoplastics piping systems, the value of the nominal pressure is equal to the working pressure at a temperature of 20 °C, expressed in bar.

3.6
hydrostatic stress
σ
stress, expressed in megapascals, induced in the wall of a pipe when it is subjected to internal water pressure

Note 1 to entry: It is calculated using the following approximate equation:

$$\sigma = p\frac{(d_n - e_n)}{20e_n}$$

where

p is the applied internal pressure, in bar;

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

e_n is the nominal wall thickness, in millimetres.

Note 2 to entry: If σ and p are given in the same units, the denominator becomes $2e_n$

3.7
long-term hydrostatic strength for 50 years at 20 °C
σ_{LTHS}
quantity with the unit of stress, i.e. MPa, which can be considered to be a property of the material under consideration

Note 1 to entry: It represents the 97,5 % lower confidence limit for the long-term hydrostatic strength and equals the predicted average strength at a temperature of 20 °C and for a time of 50 years with internal water pressure.

3.8
lower confidence limit of the predicted hydrostatic strength
σ_{LPL}
quantity with the dimension of stress, which represents the 97,5 % lower confidence limit of the predicted hydrostatic strength for a single value at a temperature T and a time t

Note 1 to entry: It is denoted as $\sigma_{LPL} = \sigma(T,t,0,975)$.

Note 2 to entry: The value of this quantity is determined by the method given in ISO 9080.

3.9
minimum required strength
MRS
required value of σ_{LPL} for a temperature T of 20 °C and a time t of 50 years

Note 1 to entry: For a particular material, its MRS is established from the value of σ_{LPL} rounded to the next lower value of the R 10 series from ISO 3:1973, when σ_{LPL} is less than 10 MPa, or to the next lower value of the R 20 series when σ_{LPL} is greater than 10 MPa.

Note 2 to entry: See also ISO 1452-2:2009, Clause 7.

3.10
design coefficient
C
coefficient with a value greater than one, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in σ_{LPL}.

3.11
pipe series
S
dimensionless number for pipe designation

Note 1 to entry: See ISO 4065

3.12
standard dimension ratio
SDR
numerical designation of a pipe series which is a convenient round number approximately equal to the dimension ratio of the nominal outside diameter, d_n, and the nominal wall thickness e_n

Note 1 to entry: According to ISO 4065, the standard dimension ratio, SDR, and the pipe series S are related, as expressed in the following equation:

$$SDR = 2S + 1$$

3.13
orientation factor
factor related to the stretch ratio used in orientation processing

4 Symbols and abbreviated terms

4.1 Symbols

C	overall service (design) coefficient
d_e	outside diameter (at any point)
d_{em}	mean outside diameter
d_i	inside diameter (at any point)
d_{im}	mean inside diameter of socket
d_n	nominal (outside or inside) diameter
e	wall thickness (at any point)
e_m	mean wall thickness
e_n	nominal wall thickness
f_A	derating (or uprating) factor for application
f_T	derating factor for temperatures
K	K-value
p	internal hydrostatic pressure
p_T	test pressure
PN	nominal pressure
δ	material density
σ	hydrostatic stress
σ_s	design stress
λ_a	axial orientation factor
λ_c	circumferential orientation factor
σ_{LPL}	Lower predicted confidence limit