International Standard

ISO 16422-2

First edition
2024-02

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

Part 2: Pipes

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

Partie 2: Tubes

Reference number
ISO 16422-2:2024(en)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 2, *Plastics pipes and fittings for water supplies.*

This first edition of ISO 16422-2, together with ISO 16422-1 and ISO 16422-5, cancels and replaces the second edition of ISO 16422:2014, which has been technically revised.

The main changes are as follows:

— ISO 16422:2014 has been split into several parts, under the general title "*Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) for the conveyance of water under pressure*". The information previously included in ISO 16422:2014 has been divided into ISO 16422-1, ISO 16422-2 (this document) and ISO 16422-5, with the following additions to ISO 16422-2:
  - DN1200 values have been introduced;
  - the tolerances of chamfers in plain ends have been modified;
  - minimum values for orientation factors have been introduced;
  - tolerances in density have been introduced;
  - minimum length of engagement values have been introduced;
  - the long-term test at 60ºC is performed on the pipe only;
  - minimum hoop stress values for production control tests have been introduced;
  - differential scanning calorimetry (DSC) has been identified as the preferred test method for gelation in case of dispute.

A list of all parts in the ISO 16422 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Molecular orientation of thermoplastics results in the 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 primarily in circumferential direction under controlled conditions. Axial orientation can also be activated in the product.

— 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.

Improved hoop strength allows reduced wall thickness with material and energy savings. It also results in improved resistance to impact and fatigue.

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

Regarding potential adverse effects on the quality of water intended for human consumption caused by the products covered by this document, this document provides no information as to whether or not the products can be used without restriction.

The ISO 16422 series, of which this is Part 2, specifies the requirements for a piping system made from oriented unplasticized poly(vinyl chloride) (PVC-O) and its components. The piping system is intended to be used for water supply, pressurized drainage and sewerage and irrigation systems to be used underground or above ground where protected to direct sunlight.

Requirements and test methods for PVC-O components are specified in in this document, as well as in ISO 16422-1 and ISO/TS 16422-3. For other components (not manufactured from PVC-O), reference is made to the following documents: ISO 1452-3 (PVC-U) and EN 12842 (Cast Iron). Characteristics for fitness for purpose (mainly for joints) are established in ISO 16422-5.

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

Part 2: Pipes

1 Scope

This document specifies the characteristics of solid-wall pipes made of oriented unplasticized poly(vinyl chloride) (PVC-O) for piping systems intended to be used underground or above-ground (where protected from direct sunlight), for water supply, buried drainage, sewerage, treated wastewater and irrigation under pressure. It also specifies the test parameters for the test methods referred to in this document.

In conjunction with ISO 16422-1 and ISO 16422-5, this document is applicable to oriented PVC-O pipes, with or without integral socket, intended to be used for the following:

a) water mains and services lines;

b) conveyance of water for both outside and inside buildings;

c) drainage, sewerage and treated wastewater under pressure;

d) irrigation under pressure.

This document is applicable to piping systems intended for the supply of water under pressure up to and including 25 °C (cold water), intended for human consumption and for general purposes as well as for wastewater under pressure.

This document is also applicable to components for the conveyance of water and wastewater up to and including 45 °C. For temperatures between 25 °C and 45 °C, see Figure C.1.

The piping system according to this document is intended for the conveyance of cold water up to pressures of 25 bar[1)] and especially in those applications where special performance requirements are needed, such as impact loads and pressure fluctuations, up to pressure of 25 bar.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 16422-1, *Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) — Part 1: General*

ISO 16422-5, *Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) — Part 5: Fitness for purpose of the system*

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

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

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

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

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), oriented unplasticized poly(vinyl chloride) (PVC-O), 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 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 terms and definitions given in ISO 16422-1 and the following apply.

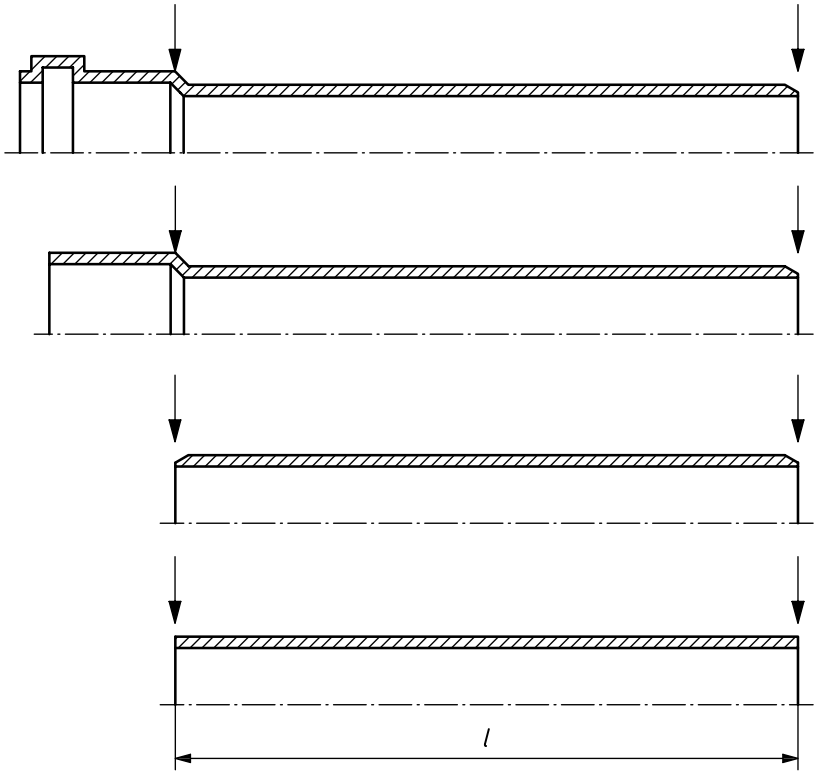
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
nominal length
minimum length which does not include the depth of the socketed portions

Note 1 to entry: See Figure 1.



Key

l nominal length of the pipe

Figure 1 — Points of measurement for nominal lengths

3.2
nominal size DN
numerical designation of the size of a component, other than a component designated by thread size, which is a convenient round number approximately equal to the manufacturing dimension in millimetres (mm)

3.3
out-of-roundness
ovality
difference between the measured maximum and the measured minimum outside diameter in the same cross-section of a pipe or spigot, or the difference between the measured maximum and the measured minimum inside diameter in the same cross-section of a socket

3.4
Poisson contraction
shortening of the length of the pipe when pressurized

3.5
temperature contraction
shortening of the length of the pipe due to drop in temperature

3.6
angular deflection
retraction of one side of the spigot due to angular deflection of the spigot within the socket

3.7
tolerance
permitted variation of the specified value of a quantity, expressed as the difference between the permitted maximum and the permitted minimum value

3.8
long-term hydrostatic strength for 50 years at 20 °C
$\sigma_{LPL20°C,50years}$
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: This 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.

3.9
working pressure
maximum pressure which a piping system can sustain in continuous use under given service conditions

4 Symbols

a	start of sealing area in the socket
b	end of cylindrical part of socket and pipe
C	overall service design coefficient
D_{em}	measured outside diameter before conditioning (orientation factor test)
D_i	measured outside diameter after conditioning (orientation factor test)
d_e	external diameter (at any point)
d_i	inside diameter of the socket
d_{im}	mean inside diameter of the socket
d_n	nominal (outside or inside) diameter
E	Young's modulus
E_c	elastic modulus in the circumferential direction (2,0 GPa)
e	wall thickness (at any point)
e_{em}	mean wall thickness before conditioning (orientation factor test)
e_i	mean wall thickness after conditioning (orientation factor test)
e_{min}	minimum wall thickness
e_n	nominal wall thickness
I	moment of inertia of a pipe = $e_n^3/12$
L	length of pipe in metres
L_o	measured length before conditioning (orientation factor test)
L_i	measured length after conditioning (orientation factor test)
l	nominal length of the pipe
l_s	length of the socket
m	depth of engagement

m_a	minimum depth of engagement due to angular deflection of the pipe
m_{calc}	minimum depth of engagement calculated
m_{min}	lower limit of the minimum depth of engagement
m_p	minimum depth of engagement due to the Poisson contraction
m_s	minimum depth of engagement due to safety allowance
m_T	minimum depth of engagement due to temperature contraction
P_{cr}	unsupported critical buckling pressure, in kilopascals
R	radius of the striker nose
S_{calc}	calculated preferred value of the nominal S series number of the pipe according to ISO 4065:2018, Table 2
S_{Ncalc}	calculated initial ring stiffness
α	coefficient of linear expansion, (7×10^{-5}) °C^{-1}
β	angle chamfer
ΔT	temperature differential
θ	maximum angle of deflection of spigot within the socket
λ_{ai}	coefficient of axial orientation
λ_{ci}	coefficient of circumferential orientation
μ	Poisson ratio (0,40)
ρ	density
σ	hydrostatic stress in the circumferential direction
$\sigma_{LPL20°C,50years}$	long-term hydrostatic strength for 50 years at 20 °C
σ_s	design stress

5 Material

5.1 General

The material from which the pipes are made shall conform to ISO 16422-1 and to the requirements given in 5.2 and 5.4.

5.2 Density

The density, ρ, at 23 °C of the pipe, when measured in accordance with ISO 1183-1, shall be within the following limits:

1 350 kg/m^3 < ρ < 1 460 kg/m^3