

---

---

**Plastics piping systems for hot and cold  
water installations — Polyethylene of  
raised temperature resistance (PE-RT) —**

**Part 1:  
General**

*Systèmes de canalisations en plastique pour les installations d'eau  
chaude et froide — Polyéthylène de meilleure résistance à la  
température (PE-RT) —*

*Partie 1: Généralités*

STANDARDSISO.COM : Click to view details PDF of ISO 22391-1:2009



**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

STANDARDSISO.COM : Click to view the full PDF of ISO 22391-1:2009



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2009

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

**Contents**

Page

Foreword .....	iv
Introduction.....	v
<b>1</b> <b>Scope</b> .....	<b>1</b>
<b>2</b> <b>Normative references</b> .....	<b>1</b>
<b>3</b> <b>Terms, definitions, symbols and abbreviated terms</b> .....	<b>2</b>
<b>3.1</b> <b>Terms and definitions</b> .....	<b>2</b>
<b>3.2</b> <b>Symbols</b> .....	<b>5</b>
<b>3.3</b> <b>Abbreviated terms</b> .....	<b>6</b>
<b>4</b> <b>Classification of service conditions</b> .....	<b>7</b>
<b>5</b> <b>Material</b> .....	<b>8</b>
<b>5.1</b> <b>General</b> .....	<b>8</b>
<b>5.2</b> <b>Influence on water intended for human consumption</b> .....	<b>8</b>
<b>5.3</b> <b>Reprocessible material</b> .....	<b>8</b>
<b>6</b> <b>System performance requirement</b> .....	<b>8</b>
Bibliography .....	<b>9</b>

STANDARDSISO.COM : Click to view the full PDF of ISO 22391-1:2009

## 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 22391-1 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 second edition cancels and replaces the first edition (ISO 22391-1:2007), which is extended from only dealing with PE-RT material (referred to as Type I) to cover PE-RT materials Type I and Type II.

ISO 22391 consists of the following parts<sup>1)</sup>, under the general title *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT)*:

- Part 1: General
- Part 2: Pipes
- Part 3: Fittings
- Part 5: Fitness for purpose of the system

---

1) This System Standard does not incorporate a Part 4: Ancillary equipment or a Part 6: Guidance for installation. For ancillary equipment, separate standards can apply. Guidance for installation of plastics piping systems made from different materials, intended to be used for hot and cold water installations, is covered by ENV 12108.

## Introduction

The System Standard, of which this is Part 1, specifies the requirements for a piping system and its components when made from polyethylene of raised temperature resistance (PE-RT). The piping system is intended to be used for hot and cold water installations.

In respect of potential adverse effects on the quality of water intended for human consumption caused by the products covered by ISO 22391, the following are relevant.

- a) This part of ISO 22391 provides no information as to whether the products can be used without restriction.
- b) Existing national regulations concerning the use and/or characteristics of the products remain in force.

This part of ISO 22391 specifies the general aspects of the plastics piping system. At the date of publication of this part of ISO 22391, System Standards Series for piping systems of other plastics materials used for the same application are the following:

ISO 15874 (all parts), *Plastics piping systems for hot and cold water installations — Polypropylene (PP)*

ISO 15875 (all parts), *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X)*

ISO 15876 (all parts), *Plastics piping systems for hot and cold water installations — Polybutylene (PB)*

ISO 15877 (all parts), *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C)*

[STANDARDSISO.COM](http://STANDARDSISO.COM) : Click to view the full PDF of ISO 22391-1:2009

# Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) —

## Part 1: General

### 1 Scope

This part of ISO 22391 specifies the general characteristics of piping systems made of

- polyethylene of raised temperature resistance (PE-RT), Type I, and
- polyethylene of raised temperature resistance (PE-RT), Type II,

intended to be used for hot and cold water installations within buildings for the conveyance of water, whether or not the water is intended for human consumption (domestic systems) and for heating systems, under specified design pressures and temperatures appropriate to the class of application.

This part of ISO 22391 covers a range of service conditions (classes of application), design pressures and pipe dimension classes, and also specifies test parameters and defines terms. In conjunction with the other parts of ISO 22391, it is applicable to PE-RT pipes, fittings, their joints and to joints having components of PE-RT, as well as of other plastics and non-plastics materials, respectively, used for hot and cold water installations.

It is not applicable to values of design temperature, maximum design temperature or malfunction temperature in excess of those it specifies.

NOTE It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking 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.

ISO 472, *Plastics — Vocabulary*

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

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

ISO 22391-2, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 2: Pipes*

ISO 22391-3, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 3: Fittings*

ISO 22391-5, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 5: Fitness for purpose of the system*

### 3 Terms, definitions, symbols and abbreviated terms

#### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and ISO 1043-1 and the following apply.

##### 3.1.1 Geometrical terms and definitions

###### 3.1.1.1

###### nominal size

**DN**  
numerical designation of the size of a component, which is a convenient round number, approximately equal to the manufacturing dimensions in millimetres (mm)

###### 3.1.1.2

###### nominal size

###### DN/OD

nominal size, related to outside diameter

###### 3.1.1.3

###### nominal outside diameter

$d_n$

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

###### 3.1.1.4

###### outside diameter (at any point)

$d_e$

measured outside diameter through the cross-section at any point of a pipe or spigot end of a fitting, rounded up to the nearest 0,1 mm

###### 3.1.1.5

###### mean outside diameter

$d_{em}$

measured length of the outer circumference of a pipe or spigot end of a fitting in any cross-section, divided by  $\pi$  (= 3,142) rounded up to the nearest 0,1 mm

###### 3.1.1.6

###### minimum mean outside diameter

$d_{em, min}$

minimum value of the mean outside diameter as specified for a given nominal size

###### 3.1.1.7

###### maximum mean outside diameter

$d_{em, max}$

maximum value of the mean outside diameter as specified for a given nominal size

###### 3.1.1.8

###### mean inside diameter of socket

$d_{sm}$

arithmetical mean of two measured inside diameters perpendicular to each other at the mid-point of the socket length

**3.1.1.9****out-of-roundness****ovality**

difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-sectional plane of a pipe or spigot end of a fitting, or the difference between the measured maximum inside diameter and the measured minimum inside diameter in the same cross-sectional plane of a socket

**3.1.1.10****nominal wall thickness** $e_n$ 

numerical designation of the wall thickness of a component, approximately equal to the manufacturing dimension in millimetres (mm)

**3.1.1.11****wall thickness** $e$ 

measured wall thickness at any point around the circumference of a component, rounded up to the nearest 0,1 mm

**3.1.1.12****minimum wall thickness** $e_{\min}$ 

minimum wall thickness at any point around the circumference of a component, as specified

**3.1.1.13****maximum wall thickness** $e_{\max}$ 

maximum wall thickness at any point around the circumference of a component, as specified

**3.1.1.14****tolerance**

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

**3.1.1.15****pipe series****S**

dimensionless number for pipe designation conforming to ISO 4065

NOTE According to ISO 22391, the pipe series, S, is used as a means for selecting pipe sizes for practical purposes (see ISO 22391-2).

**3.1.1.16****calculated pipe value** $S_{\text{calc}}$ 

value for a specific pipe calculated using Equation (1), rounded up to the nearest 0,1 mm,

$$S_{\text{calc}} = \frac{d_n - e_n}{2e_n} \quad (1)$$

where

$d_n$  is the nominal outside diameter, in millimetres;

$e_n$  is the nominal wall thickness, expressed in millimetres.

### 3.1.2 Terms and definitions related to service conditions

#### 3.1.2.1 design pressure

$p_D$   
highest pressure related to the circumstances for which the system has been designed and is intended to be used

NOTE The design pressure is equivalent to the maximum design pressure, MDP, as specified in EN 806-1.

#### 3.1.2.2 hydrostatic stress

$\sigma$   
stress induced in the wall of a pipe when a pressure is applied using water as a medium, and calculated using the approximate Equation (2):

$$\sigma = p \times \frac{(d_{em} - e_{min})}{2e_{min}} \quad (2)$$

where

$p$  is the applied pressure, in megapascal;

$d_{em}$  is the mean outside diameter of the pipe, in millimetres;

$e_{min}$  is the minimum wall thickness, in millimetres.

NOTE It is expressed in megapascal.

#### 3.1.2.3 design temperature

$T_D$   
temperature or combination of temperatures and times of the conveyed water, dependent on the service conditions for which the system has been designed

#### 3.1.2.4 maximum design temperature

$T_{max}$   
highest design temperature occurring for short periods only

#### 3.1.2.5 malfunction temperature

$T_{mal}$   
highest temperature that can be reached when the control limits are exceeded

#### 3.1.2.6 cold water temperature

$T_{cold}$   
temperature of conveyed cold water of up to approximately 25 °C

NOTE For design purposes, 20 °C is used.

#### 3.1.2.7 treated water

water, intended for heating installations, which contains additives which have no detrimental effect on the system

### 3.1.3 Terms and definitions related to material characteristics

#### 3.1.3.1

##### lower confidence limit of the predicted hydrostatic strength

$\sigma_{LPL}$

quantity with the dimensions of stress, representing the 97,5 % lower confidence limit of the predicted hydrostatic strength at a temperature,  $T$  and time,  $t$

NOTE 1 It is given by  $\sigma_{LPL} = \sigma_{(T, t, 0,975)}$ .

NOTE 2 It is expressed in megapascal.

#### 3.1.3.2

##### design stress

$\sigma_D$

allowable stress in the pipe material,  $\sigma_{DP}$ , or in the plastics fitting material,  $\sigma_{DF}$ , for a given application or set of service conditions, respectively

See ISO 22391-2:2009, Annex A.

NOTE It is expressed in megapascal.

#### 3.1.3.3

##### overall service (design) coefficient

$C$

overall 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 the lower confidence limit, LPL

#### 3.1.3.4

##### own reprocessable material

material prepared from rejected unused pipes and fittings, including trimmings from the production of pipes and 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 or material specification is known

NOTE If material containing a barrier layer is to be reprocessed, the barrier layers are removed beforehand and discarded.

#### 3.1.3.5

##### pipes with barrier layer

plastics pipes provided with a thin outside barrier layer, e.g. to prevent or greatly diminish the diffusion of gases and the transmission of light through the pipe wall and where the design stress requirements are totally met by the base polymer (PE-RT)

## 3.2 Symbols

$C$	overall service (design) coefficient
$d_e$	outside diameter (at any point)
$d_{em}$	mean outside diameter
$d_{em, max}$	maximum mean outside diameter
$d_{em, min}$	minimum mean outside diameter
$d_n$	nominal outside diameter
$d_{sm}$	mean inside diameter of socket

## ISO 22391-1:2009(E)

$e$	wall thickness (at any point)
$e_{\max}$	maximum wall thickness (at any point)
$e_{\min}$	minimum wall thickness (at any point)
$e_n$	nominal wall thickness
$p$	internal hydrostatic pressure
$p_D$	design pressure
$S_{\text{calc}}$	calculated pipe value
$S_{\text{calc, max}}$	maximum calculated pipe value
$T$	temperature
$T_{\text{cold}}$	cold water temperature
$T_D$	design temperature
$T_{\text{mal}}$	malfunction temperature
$T_{\text{max}}$	maximum design temperature
$T_{\text{test}}$	test temperature
$t$	time
$\sigma$	hydrostatic stress
$\sigma_{\text{cold}}$	design stress at 20 °C
$\sigma_D$	design stress
$\sigma_{DF}$	design stress of plastics fitting material
$\sigma_{DP}$	design stress of plastics pipe material
$\sigma_F$	hydrostatic stress values of plastics fitting material
$\sigma_{LPL}$	lower confidence limit of the predicted hydrostatic strength
$\sigma_P$	hydrostatic stress values of plastics pipe material

### 3.3 Abbreviated terms

DN	nominal size
DN/OD	nominal size, outside diameter related
LCL	lower confidence limit
MDP	maximum design pressure
PE-RT	polyethylene of raised temperature resistance
S	pipe series