INTERNATIONAL STANDARD

ISO 22391-2

Second edition
2009-12-01

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

Part 2: Pipes

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

Partie 2: Tubes

Reference number
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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 22391-2 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 22391-2:2007), 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[1)], 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 2, 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 characteristics of pipes. 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)*

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

Part 2: Pipes

1 Scope

This part of ISO 22391 specifies the characteristics of pipe 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 the design pressures and temperatures appropriate to the class of application according to ISO 22391-1.

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 test methods. 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 applicable to pipes with or without a barrier layer or layers.

It is not applicable to values of design temperature, maximum design temperature or malfunction temperature in excess of those specified in ISO 22391-1.

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 1133-1, *Plastics — Determination of the melt volume-flow rate (MVR) and the melt mass-flow rate (MFR) of thermoplastics — Part 1: Standard method*

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

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

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

ISO 13760, *Plastics pipes for the conveyance of fluids under pressure — Miner's rule — Calculation method for cumulative damage*

ISO 22391-1:2009, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 1: General*

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

For the purposes of this document, the terms, definitions, symbols and abbreviated terms given in ISO 22391-1 apply.

4 Material

4.1 Pipe material

The material from which the pipe is made shall be polyethylene of raised temperature resistance (PE-RT).

4.2 Evaluation of σ_{LPL} values

The pipe material shall be evaluated in accordance with ISO 9080 or equivalent, with internal pressure tests being carried out in accordance with ISO 1167-1 and ISO 1167-2, in order to determine the σ_{LPL} values. The σ_{LPL} value thus determined shall be at least as high as the corresponding values of the reference curves given in Figure 1 or Figure 2 (taken from ISO 24033:2009) over the complete range of times.

NOTE 1 One equivalent way of evaluation is to calculate the σ_{LPL} value for each temperature (for example 20 °C, 60 °C and 95 °C), individually.

NOTE 2 The reference curves for PE-RT Type I in Figure 1 in the temperature range of 10 °C to 95 °C are derived from Equations (1) and (2).

First branch (i.e. the left-hand portion of the lines shown in Figure 1):

$$\lg t = -190{,}481 - \frac{58\,219{,}035 \lg \sigma}{T} + \frac{78\,763{,}07}{T} + 119{,}877 \lg \sigma \qquad (1)$$

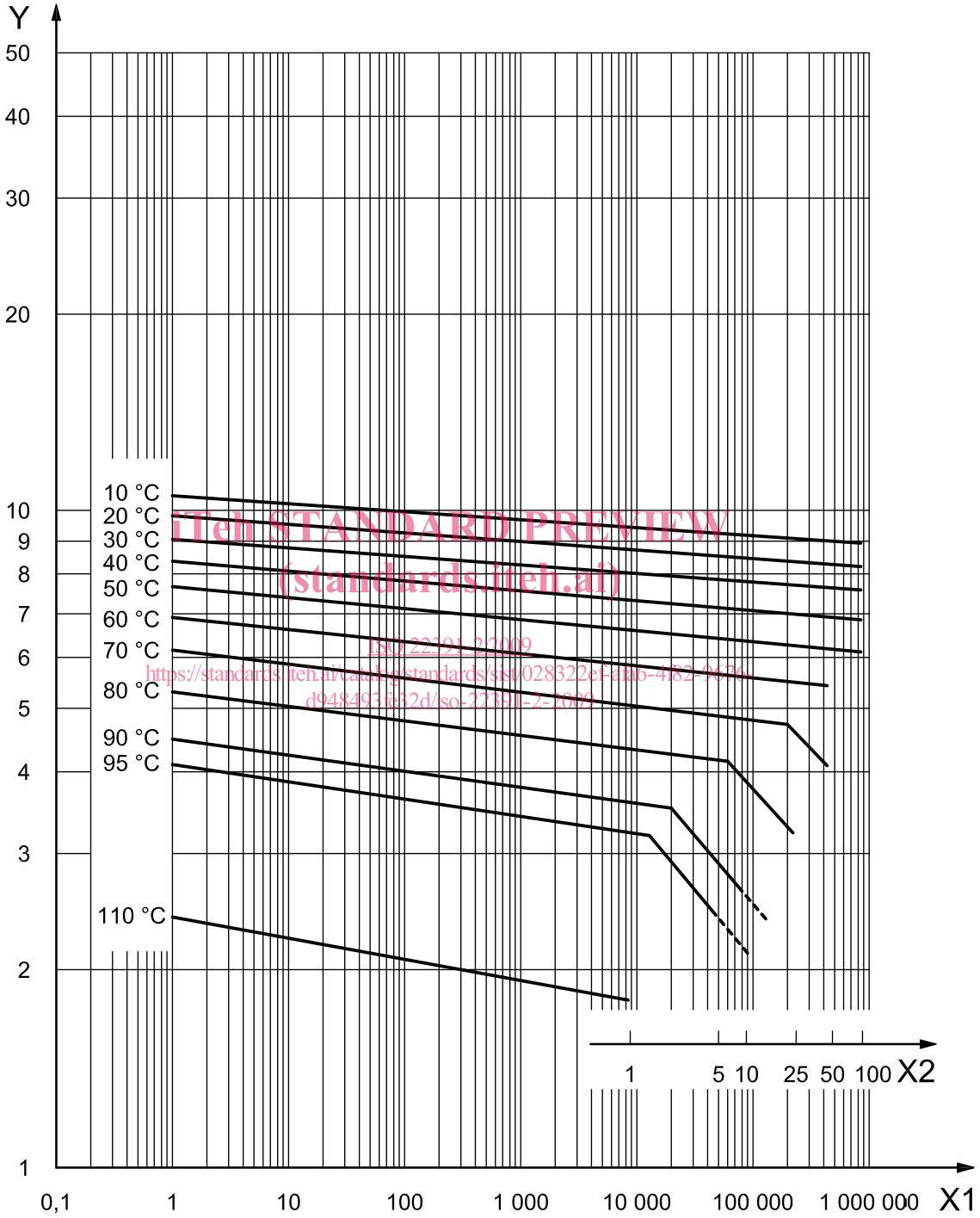
Second branch (i.e. the right-hand portion of the lines shown in Figure 1):

$$\lg t = -23{,}795\,4 - \frac{1723{,}318 \lg \sigma}{T} + \frac{11\,150{,}56}{T} \qquad (2)$$

The 110 °C values have been determined separately using water inside and air outside the test specimen and have not been derived from Equations (1) and (2).

NOTE 3 The reference curves for PE-RT Type II in Figure 2 in the temperature range of 10 °C to 110 °C are derived from Equation (3):

$$\lg t = -219 - \frac{62\,600{,}752\,\lg\sigma}{T} + \frac{90\,635{,}353}{T} + 126{,}387\,\lg\sigma \qquad (3)$$



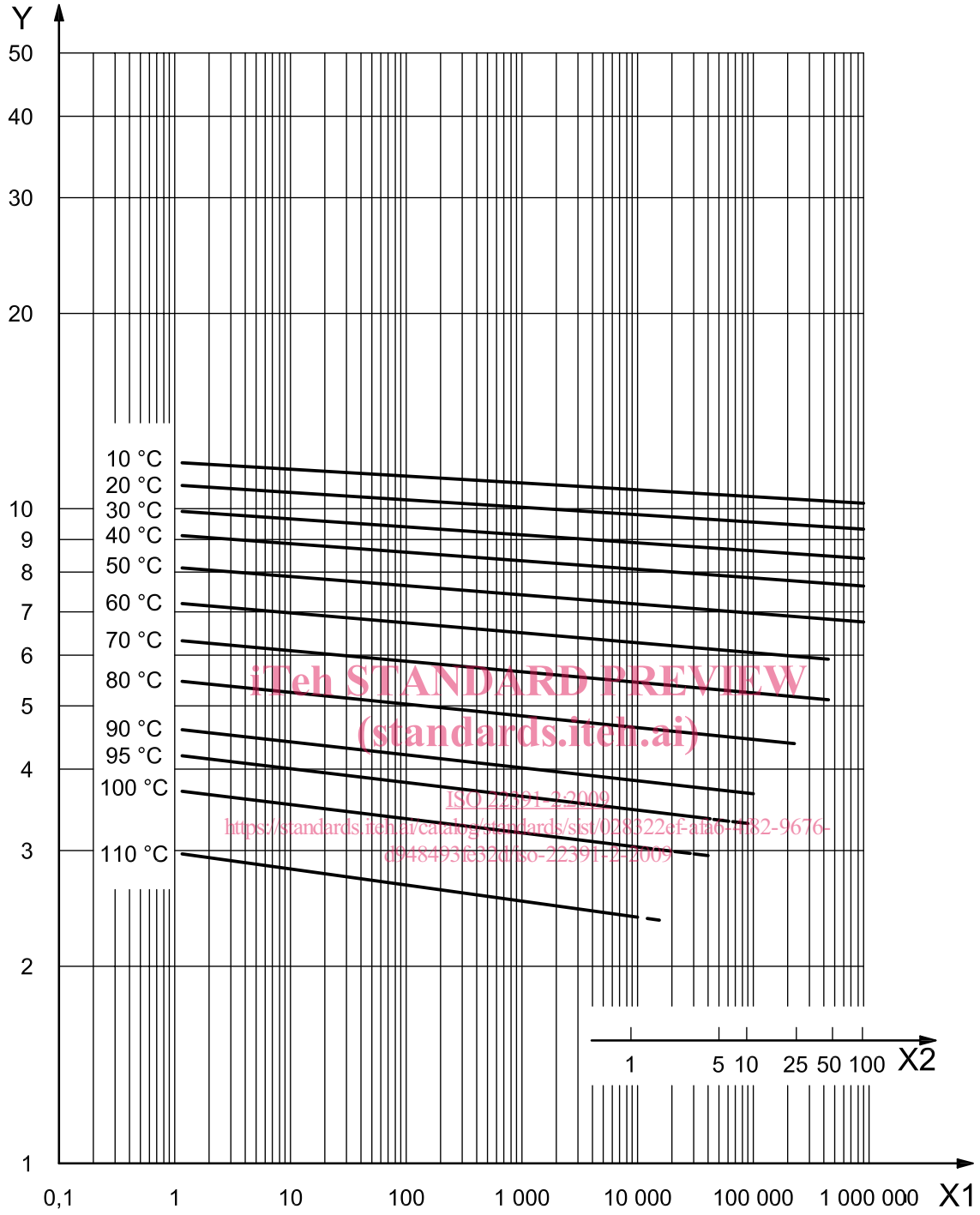
Key

X1 time, t, to fracture, expressed in hours

X2 time, t, to fracture, expressed in years

Y hoop stress, σ, expressed in megapascal

Figure 1 — Expected strength of PE-RT Type I pipes



Key

X1 time, t, to fracture, expressed in hours

X2 time, t, to fracture, expressed in years

Y hoop stress, σ, expressed in megapascal

Figure 2 — Expected strength of PE-RT Type II pipes

In order to demonstrate conformance to the reference lines, pipe samples should be tested in accordance with ISO 1167-1 and ISO 1167-2 at the following temperatures and at various hoop stresses such that, at each of the temperatures, at least three failure times fall in each of the following time intervals.

Temperatures: 20 °C; 60 °C to 70 °C; 95 °C.

Time intervals: 10 h to 100 h; 100 h to 1 000 h; 1 000 h to 8 760 h and over.

In tests lasting more than 8 760 h without failure, any test time after 8 760 h may be considered as the failure time.

Conformance to the reference lines should be demonstrated by plotting the individual experimental results on the graph. At least 97,5 % of them should lie on or above the reference line.

For PE-RT Type II these experimental results shall not give any brittle failures indicating the presence of a knee at any temperature up to 110 °C before 8 760 h.

4.3 Influence on water intended for human consumption

The material shall be in accordance with ISO 22391-1.

5 General characteristics

5.1 Appearance

When viewed without magnification, the internal and external surfaces of pipes shall be smooth, clean and free from an extent of scoring, cavities and other surface defects that would prevent conformance with this part of ISO 22391. The material shall not contain visible impurities. Slight variations in the appearance of the colour shall be permitted. The ends of the pipe shall be cut cleanly and square to the axis of the pipe.

5.2 Opacity

PE-RT pipes that are declared to be opaque shall not transmit more than 0,2 % of visible light when tested in accordance with ISO 7686.

6 Geometrical characteristics

6.1 General

6.1.1 The dimensions shall be measured in accordance with ISO 3126.

6.1.2 The maximum calculated pipe value, $S_{calc,\,max}$, for the applicable class of service condition and design pressure, p_D, shall be in accordance with Table 1 for PE-RT Type I and Table 2 for PE-RT Type II.

NOTE The derivation of $S_{calc,\,max}$ is provided by Annex A, where the method described takes account of the properties of PE-RT under the service conditions for the classes given in ISO 22391-1:2009, Table 1.

6.1.3 The values of outside diameter and/or wall thickness apply to the PE-RT pipe and, for design calculation purposes, are exclusive of any barrier layer thickness.