TECHNICAL SPECIFICATION

ISO/TS 22391-7

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

Part 7: Guidance for the assessment of conformity

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

Partie 7: Guide pour l'évaluation de la conformité

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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 22391-7 was prepared by the European Committee for Standardization (CEN) Technical Committee TC 155, *Plastics piping systems and ducting systems*, in collaboration with ISO 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*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 22391 consists of the following parts, 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*

— *Part 7: Guidance for the assessment of conformity* [Technical Specification]

Introduction

At the date of publication of this part of ISO 22391, System Standards 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)*

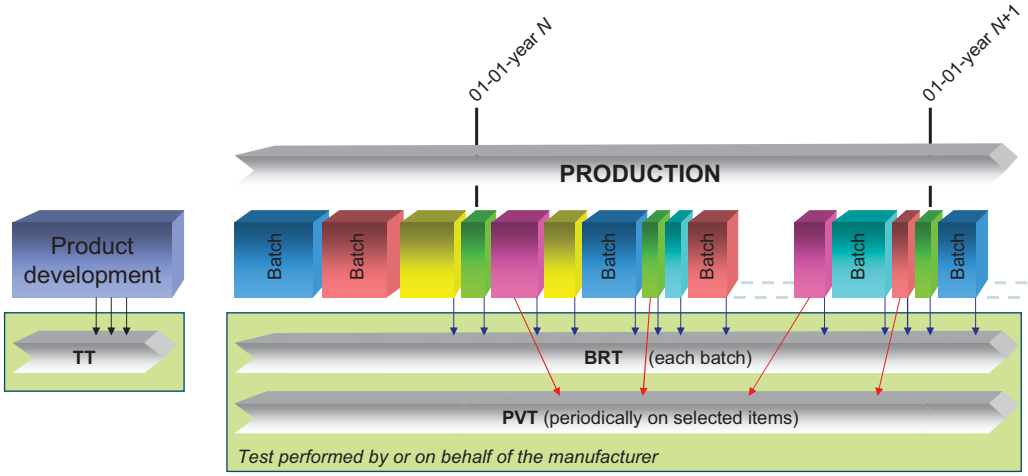
ISO 15875 (all parts), *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X)*

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)*

Figures 1 and 2 are intended to provide general information on the concept of testing and organization of those tests used for the purpose of the assessment of conformity. For each kind of test, i.e. type test (TT), batch release test (BRT), process verification test (PVT), and audit test (AT), this part of ISO 22391 details the applicable characteristics to be assessed as well as the frequency and sampling of testing.

A typical scheme for the assessment of conformity of pipes, fittings or assemblies by manufacturers is given in Figure 1.

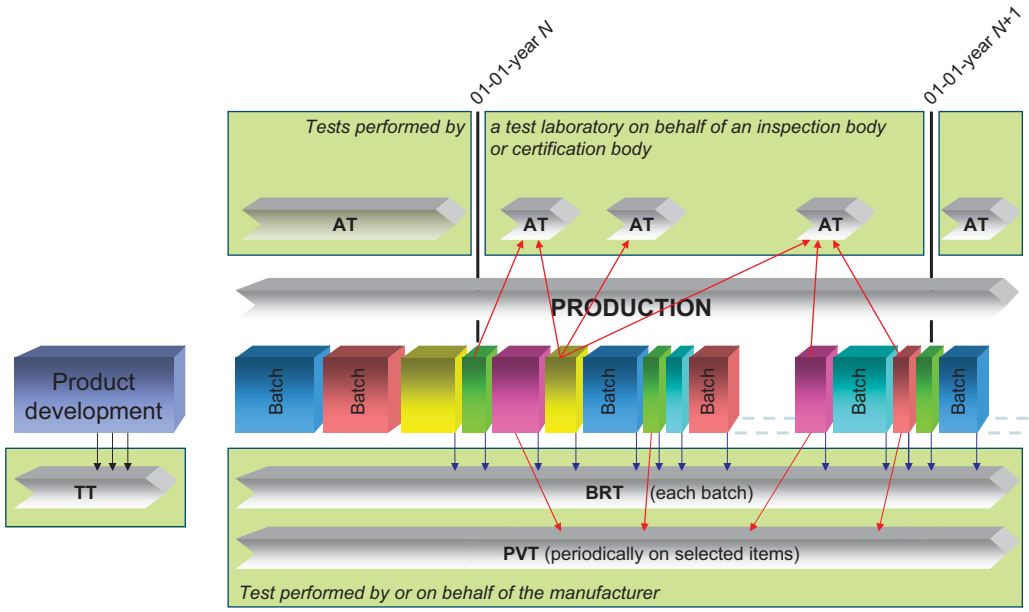


Key

BRT batch release test
PVT process verification test
TT type testing

Figure 1 — Typical scheme for the assessment of conformity by a manufacturer

A typical scheme for the assessment of conformity of pipes, fittings or assemblies by manufacturers, including certification, is given in Figure 2.



Key

AT audit test
BRT batch release test
PVT process verification test
TT type testing

Figure 2 — Typical scheme for the assessment of conformity by a manufacturer, including certification

This part of ISO 22391 specifies the requirements for a piping system when made from polyethylene (PE-RT). The piping system is intended to be used for hot and cold water installations and heating system installations.

See the foreword for a complete listing of all available parts of ISO 22391.

This part of ISO 22391 gives guidance for the assessment of conformity of materials, components, joints, and assemblies. It is intended for use by certification bodies, inspection bodies, testing laboratories, and manufacturers.

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

Part 7: Guidance for the assessment of conformity

1 Scope

This part of ISO 22391 gives guidance on the assessment of conformity of products and assemblies in accordance with other applicable part(s) of ISO 22391 intended to be included in the manufacturer's quality plan as part of the quality management system and for the establishment of certification procedures.

In conjunction with the other parts, this part of ISO 22391 is applicable to hot and cold water installations within buildings for the conveyance of water, whether or not intended for human consumption (domestic systems), under design pressures and temperatures appropriate to the class of application.

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 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3951-1, *Sampling procedures for inspection by variables — Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

ISO 3951-2, *Sampling procedures for inspection by variables — Part 2: General specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection of independent quality characteristics*

ISO 3951-3, *Sampling procedures for inspection by variables — Part 3: Double sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 3951-5, *Sampling procedures for inspection by variables — Part 5: Sequential sampling plans indexed by acceptance quality limit (AQL) for inspection by variables (known standard deviation)*

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

ISO 22391-2:2009, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 2: Pipes*

ISO 22391-3:2009, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 3: Fittings*

ISO 22391-5:2009, *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 and definitions

For the purposes of this document, the terms and definitions given in ISO 22391-1, ISO 22391-2, ISO 22391-3 and the following apply.

3.1
certification body
impartial body, governmental or non-governmental, possessing the necessary competence and responsibility to carry out certification of conformity according to given rules of procedure and management

NOTE A certification body is preferably compliant with ISO/IEC 17021[5].

3.2
inspection body
body, that performs inspection

NOTE 1 A body can be an organization, or part of an organization.

[ISO/IEC 17020:1998[4], 2.2]

NOTE 2 An inspection body is preferably compliant with ISO/IEC 17020[4].

3.3
testing laboratory
laboratory which measures, tests, calibrates or otherwise determines the characteristics of the performance of materials and products

NOTE 1 In the context of this part of ISO/TS 22391, the materials and products can be subjected to type testing, batch release testing, process verification testing, audit testing, and witness testing, as applicable.

NOTE 2 A testing laboratory is preferably compliant with ISO/IEC 17025[6].

3.4
quality management system
management system to direct and control an organization with regard to quality

[ISO 9000:2005[2], 3.2.3]

NOTE Requirements for quality management systems are given in ISO 9001[3].

3.5
quality plan
document setting out the specific quality practices, resources and sequence of activities relevant to a particular product or range of products

3.6
type testing
TT
testing performed to prove that the material, component, joint or assembly is capable of conforming to the requirements given in the relevant standard

NOTE The type test results remain valid until there is a change in the material or product or assembly provided that process verification tests are done regularly.

3.7
batch release test
BRT
test performed by or on behalf of the manufacturer on a batch of components, which has to be satisfactorily completed before the batch can be released

3.8
process verification test
PVT
test performed by or on behalf of the manufacturer on materials, components, joints or assemblies at specific intervals to confirm that the process continues to be capable of producing components which conform to the requirements given in the relevant standard

NOTE Such tests are not required to release batches of products and are carried out as a measure of process control.

3.9
audit test
AT
test performed by a test laboratory on behalf of an inspection body or certification body to confirm that the material, component, joint or assembly continues to conform to the requirements given in the relevant standard and to provide information to assess the effectiveness of the quality management system

3.10
indirect test
IT
test performed by or on behalf of the manufacturer, different from the test specified for that particular characteristic, having previously verified its correlation with the specified test

3.11
witness test
WT
testing accepted by an inspection or a certification body for type testing and/or audit testing, which is carried out by or on behalf of the manufacturer and supervised by a representative of the inspection or certification body, qualified in testing

3.12
material
generic term for compounds grouped by families, expressed by generic names, e.g. polypropylene, stainless steel, brass or EPDM

NOTE Definition from European Commission, Directorate-General for Enterprise and Industry, Sub-group on Product Testing Procedures (EC, DG ENT and IND, SG PTP).

3.13
compound
clearly defined homogeneous mixture of base polymer with additives, i.e. antioxidants, pigments, stabilizers and others, at a dosage level necessary for the processing and the intended use of the final product

3.14
material batch
clearly identified quantity of a given homogeneous compound manufactured under uniform conditions, and defined and identified by the compound manufacturer

3.15
product
pipe or fitting of a clearly identified type intended to be a part of a piping system which the manufacturer puts on the market

3.16
product batch
clearly identified collection of units, manufactured consecutively or continuously under the same conditions, using material or compound conforming to the same specification

NOTE The product batch is defined and identified by the product manufacturer.

3.17
lot
clearly identifiable sub-division of a batch for inspection purposes

3.18
sample
one or more units of product drawn from a batch or lot, selected at random without regard to their quality

NOTE The number of units of product in the sample is the sample size.

3.19
acceptable quality limit
AQL
quality level that is the worst tolerable process average when a continuing series of lots is submitted for acceptance sampling

NOTE 1 See ISO 2859-1, ISO 3951-1, ISO 3951-2, ISO 3951-3, and ISO 3951-5.

NOTE 2 The designation of an AQL does not imply that a manufacturer has the right knowingly to supply any non-conforming unit of product.

3.20
inspection level
relationship between the lot or batch size and the sample size

NOTE See ISO 2859-1.

3.21
limiting quality
〈acceptance sampling〉 quality level, when a lot is considered in isolation, which, for the purposes of acceptance sampling inspection, is limited to a low probability of acceptance

NOTE See ISO 2859-2[1].

3.22
group
collection of similar components from which samples are selected for testing purposes

3.23
single component
single part as a final product or a part of an assembled final product

3.24
assembled component
assembled final product using two or more single parts

3.25
assembly
product that can be dismantled into a set of components

EXAMPLE A test piece consisting of various products.

3.26
sampling plan
specification of the type of sampling to be used combined with the operational specification of the entities or increments to be taken, the samples to be constituted and the measurements or tests to be made

EXAMPLE A specific plan which indicates the number of units of products or assemblies to be inspected.

3.27
product type
generic description of a product

EXAMPLE A pipe or fitting or their main parts, of the same design, from a particular compound.

3.28
cavity
⟨moulding⟩ space within a mould to be filled to form the moulded product

EXAMPLE That part of an injection mould which gives the form to the injection-moulded product.

4 Abbreviated terms

To avoid misunderstanding, the abbreviations in this clause are defined as being the same in each language. For the same reason, the terms are given in three languages, English, French, and German.

EXAMPLE In the French language, the abbreviation for the French equivalent of “acceptable quality level” (AQL) is NQA; however, for the purposes of this part of ISO 22391, the abbreviation of the English term (AQL) is adopted.

	EN	FR	DE
AQL	acceptance quality limit	niveau de qualité acceptable	annehmbare Qualitätsgrenzlage
AT	audit test	essai d’audit	Überwachungsprüfung
BRT	batch release test	essai de libération de campagne de fabrication	Freigabeprüfung einer Charge
IT	indirect test	essai indirect	indirekte Prüfung
PVT	process verification test	essai de vérification du procédé de fabrication	Prozessüberprüfung
TT	type test	essai de type	Typprüfung
WT	witness testing	essai témoin	Prüfung unter Aufsicht

5 General

5.1 Materials, products and joints/assemblies shall conform to the requirements given in ISO 22391-1, ISO 22391-2, ISO 22391-3, and ISO 22391-5.

5.2 Products and assemblies shall be produced by the manufacturer under a quality management system which includes a quality plan.

It is recommended that the quality management system conform to or be no less stringent than the relevant requirements of ISO 9001[3].

5.3 For the effect on water quality, attention is drawn to the requirements of national regulations (see the introduction).

6 Testing and inspection

6.1 Grouping

6.1.1 General

For the purposes of this part of ISO 22391, the groups specified in 6.1.2 to 6.1.4 apply.

6.1.2 Pressure groups

Two pressure groups are defined, as given in Table 1.

For testing purposes, one individual operating pressure, p_o, shall be selected for each group.

Table 1 — Pressure groups

Pressure group	Operating pressure p_o bar[a]
1	4; 6
2	8; 10
a 1 bar = 0,1 MPa = 10^5 Pa = 0,1 N/mm^2.	

6.1.3 Size groups

Two size groups are defined for pipes and fittings, as given in Table 2.

For testing purposes, one individual nominal diameter, d_n, shall be selected from each group.

Table 2 — Size groups

Size group	Nominal diameter d_n mm
1	$10 \leq d_n \leq 63$
2	$63 < d_n \leq 160$

6.1.4 Fitting groups

Four groups of fittings each having a similar design are defined, as given in Table 3.

For testing purposes, one individual fitting shall be selected from each group.

Table 3 — Fitting groups

Fitting group	Type of fitting
1	Bends
2	Elbows, tees
3	Reducers, couplers, end caps
4	Unions, flange adaptors, adaptor pieces or their plastics parts and others

6.2 Type testing

Relevant TTs shall be carried out whenever there is a change in design, material or production method, other than routine in-process adjustments, and whenever there is an extension of the product range.

NOTE TTs, to be carried out when a change of the production site occurs, depend on the extent of the change. Therefore relevant TTs should be defined individually by the manufacturer.

TTs shall demonstrate that the products conform to all requirements for the characteristics given in Tables 5 to 7, as applicable.

Conditions considered as leading to a change of material are given in Table 4. The characteristics and the values of w (see Table 4) shall be specified by the manufacturer in their quality plan.

If any characteristic is changed or any level exceeds the band, this variation in formulation constitutes a change in material and the relevant characteristics given in Tables 5 and 6, as applicable, shall be retested. If certification is involved, retesting shall be agreed between the certification body and the manufacturer.

A change in the supplier of a material or stabilizer does not necessarily constitute a change in material, compound or formulation.

Table 4 — Conditions considered to lead to a change of material

Type of material change		Conditions
M1	Change of polymer	Change of supplier Change of polymerization Change of chemical properties of comonomers
M2	Change in additive package (e.g. pigments, antioxidants)[a]	Amount greater than $(w \pm 30)$ % mass fraction of any individual additive Change of chemical properties or nature of additive
[a] In order to check the effect of a change of additive package (M2) on the hydrostatic stress properties specified in ISO 22391-2, three test pieces shall be tested at two different stress levels at 95 °C. The lowest stress level shall give failure times of approximately 2 500 h. All failure points shall be on or above the relevant reference curve of ISO 22391-2:2009, Figure 1 or 2, for the relevant material.		

For the purposes of defining a change in design, the following characteristics are relevant:

a) dimensions;

b) geometry of the product;

c) jointing system.

In the manufacturer's quality plan, the geometry, the dimensions and the dimensional tolerances shall be specified at least in accordance with and in addition to the requirements given in the relevant part(s) of ISO 22391.

If one or more of these characteristics exceed the defined specifications, the relevant characteristics given in Tables 5 to 7, as applicable, shall be retested. If certification is involved, retesting shall be agreed between the certification body and the manufacturer.

Table 5 — Characteristics of pipes that require type testing

Characteristic	Reference	Conditions requiring test				Sampling procedure
		N[a]	M1[b]	M2[c]	E[d]	
Influence on water intended for human consumption	ISO 22391-1:2009, 5.2	+	+	+	—[e]	According to national regulations
Hydrostatic stress properties of material[f]	ISO 22391-2:2009, 4.2	+	+	+[g]	—[e]	One evaluation per material
Appearance	ISO 22391-2:2009, 5.1	+	+	+	+	One test piece per d_n and pressure group
Opacity	ISO 22391-2:2009, 5.2	+	+	+	+	One test with the smallest wall thickness produced
Dimensions	ISO 22391-2:2009, Tables 3 to 7	+	+	+	+	One test piece per d_n and pressure group
Resistance to internal pressure	ISO 22391-2:2009, Tables 8 and 9	+	+	+	+	Three test pieces on one d_n per size group
Longitudinal reversion	ISO 22391-2:2009, Table 10	+	+	+	+	Three test pieces on one d_n per size group
Melt mass-flow rate MFR	ISO 22391-2:2009, Table 10	+	+	+	+	One test piece on one d_n per size group
Thermal stability	ISO 22391-2:2009, Table 10	+	+	+	—[e]	One test piece per material
Marking	ISO 22391-2:2009, Clause 10	+	—[e]	—[e]	+	One test piece per d_n and pressure group

[a] New system.

[b] Change of polymer.

[c] Change in additive package.

[d] Extension of the product range (except the products already covered by the scheme of sampling procedure).

[e] Test not applicable.

[f] If the material supplier has evaluated the hydrostatic stress properties specified in ISO 22391-2, the manufacturer of pipes only has to check conformity with the reference curves for the expected hydrostatic strength given in ISO 22391-2:2009, Figure 1 or 2, by testing three test pieces at two different stress levels at 95 °C. The lowest stress level shall give failure times of approximately 2 500 h. All failure points shall be on or above the relevant reference curves of ISO 22391-2:2009, Figure 1 or 2.

[g] In order to check the effect of a change of additive package (M2) on the hydrostatic stress properties specified in ISO 22391-2, three test pieces shall be tested at two different stress levels at 95 °C. The lowest stress level shall give failure times of approximately 2 500 h. All failure points shall be on or above the relevant reference curve of ISO 22391-2:2009, Figure 1 or 2, for the appropriate material.

Table 6 — Characteristics of fittings that require type testing

Characteristic	Reference	Conditions requiring test					Sampling procedure
		N[a]	D[b]	M1[c]	M2[d]	E[e]	
Influence on water intended for human consumption	ISO 22391-1:2009, 5.2	+	—[f]	+	+	—[f]	According to national regulations
Hydrostatic stress properties of material[g]	ISO 22391-3:2009, 4.1	+	+	+	+[c, h]	—[f]	One evaluation per material
Opacity	ISO 22391-3:2009, 5.2	+	—[f]	+	+	—[f]	One test with the smallest wall thickness produced
Dimensions	ISO 22391-3:2009, Clause 6	+	+	+	+	—[f]	One test piece per d_n and fitting group
Resistance to internal pressure	ISO 22391-3:2009, Clause 7	+	+	+	+	—[f]	One test piece per size group and fitting group for the relevant design pressure and appropriate class of application
Melt mass-flow rate MFR	ISO 22391-3:2009, Clause 8	+	—[f]	+	+	—[f]	One test piece on one d_n per size group and fitting group
Marking	ISO 22391-3:2009, Clause 11	+	—[f]	—[f]	—[f]	—[f]	One test piece per d_n and fitting group

[a] New system.

[b] Change in design.

[c] Change of polymer.

[d] Change in additive package.

[e] Extension of the product range (except the products already covered by the scheme of sampling procedure).

[f] Test not applicable.

[g] If the material supplier has evaluated the hydrostatic stress properties specified in ISO 22391-2, the manufacturer of fittings only has to check conformity with the reference curves for the expected hydrostatic strength given in ISO 22391-2:2009, Figure 1 or 2, by testing three test pieces at two different stress levels at 95 °C. The lowest stress level shall give failure times of approximately 2 500 h. All failure points shall be on or above the relevant reference curves of ISO 22391-2:2009, Figure 1 or 2.

[h] In order to check the effect of a change of additive package (M2) on the hydrostatic stress properties specified in ISO 22391-2, three test pieces shall be tested at two different stress levels at 95 °C. The lowest stress level shall give failure times of approximately 2 500 h. All failure points shall be on or above the relevant reference curve of ISO 22391-2:2009, Figure 1 or 2, for the appropriate material.

Table 7 — Characteristics of fitness for purpose of the system that require type testing

Characteristic	Reference	Conditions requiring test			Sampling procedure
		N[a]	D[b]	E[c]	
Resistance to internal pressure	ISO 22391-5:2009, 4.2	+	+	+	One evaluation per size group and jointing system for the relevant design pressure and appropriate application class
Leak tightness under internal pressure and bending	ISO 22391-5:2009, 4.3	+	+	+	One evaluation per size group and jointing system for the relevant design pressure and appropriate application class
Resistance to pull-out	ISO 22391-5:2009, 4.4	+	+	+	One evaluation for the smallest and largest d_n per size group and jointing system for the relevant design pressure and appropriate application class
Resistance to thermal cycling	ISO 22391-5:2009, 4.5	+	+	+	One evaluation per d_n and jointing system for the relevant design pressure and appropriate application class
Resistance to pressure cycling	ISO 22391-5:2009, 4.6	+	+	+	One evaluation per size group and jointing system for the relevant design pressure
Leak tightness under vacuum	ISO 22391-5:2009, 4.7	+	+	+	One evaluation per size group and jointing system per pressure group

[a] New system.

[b] Change in design.

[c] Extension of the product range (except the products already covered by the scheme of sampling procedure).

6.3 Batch release tests

6.3.1 General

Those characteristics specified in ISO 22391-2 and ISO 22391-3 and listed in Tables 8 and 9 shall be subject to BRTs with the minimum sampling frequency as given in Table 8 or 9, as applicable. Alternatively, the manufacturer may use the sampling procedures detailed in either ISO 2859-1 with an inspection level S-2 or ISO 3951-1, ISO 3951-2, ISO 3951-3 or ISO 3951-5, as applicable, with an inspection level S-3, as appropriate. In any case, an AQL of not greater than 6,5 % shall be used.

The manufacturer shall specify a batch or lot in their quality plan.

A batch or lot shall only be released for supply when all the relevant tests and inspections have been carried out at least once at the specified frequencies and the requirements have been met.

If a product fails in respect of any characteristic given in Table 8 or 9, as applicable, the batch or lot shall be rejected or the retest procedures shall be performed for the characteristic on which the product failed.

The retest procedure shall be either Procedure A (6.3.2) or Procedure B (6.3.3).

6.3.2 Procedure A

Find the last product, which conforms to the requirements as specified in ISO 22391-2 and ISO 22391-3. Release all products produced before that point and reject the products produced after that point.

6.3.3 Procedure B

Use a sampling procedure in accordance with ISO 2859-1, ISO 3951-1, ISO 3951-2, ISO 3951-3 or ISO 3951-5, as applicable, based on a maximum AQL of 4 % and a minimum inspection level S-3.

If the retest requirements are met, release the batch or lot. If they are not met, reject the batch or lot.

Procedures for dealing with rejected products shall be detailed in the manufacturer's quality plan.

Table 8 — Characteristics of pipes and minimum sampling frequencies for batch release tests

Characteristic	Reference	Minimum sampling frequency	Retest procedure
Appearance	ISO 22391-2:2009, 5.1	One test piece every 8 h per machine	A or B
Outside diameter	ISO 22391-2:2009, Tables 3 to 6	One test piece every 8 h per machine	A
Wall thickness	ISO 22391-2:2009, Tables 3 to 7	One test piece every 8 h per machine	A
Resistance to internal pressure[a], one of: (95 °C, 22 h); (95 °C, 165 h)	ISO 22391-2:2009, Tables 8 and 9	One test piece every 24 h per machine	A or B
Longitudinal reversion	ISO 22391-2:2009, Table 10	One test piece per week per machine	A or B
Marking	ISO 22391-2:2009, Clause 10	One test piece every 8 h per machine	A or B

[a] In case of dispute, perform testing at 95 °C and 165 h.

Table 9 — Characteristics of fittings and minimum sampling frequencies for batch release tests

Characteristic	Reference	Minimum sampling frequency	Retest procedure
Appearance	ISO 22391-3:2009, 5.1	One test piece every 8 h per cavity	A or B
Geometrical characteristics (but only those dimensions that vary with the manufacturing process and affect the function of the joint or fitting)	ISO 22391-3:2009, Clause 6	One test piece every 8 h per cavity	A
Resistance to internal pressure (20 °C, 1 h)	ISO 22391-3:2009, Clause 7	One test piece per week per machine	A or B
Marking	ISO 22391-3:2009, Clause 11	One test piece every 8 h per cavity	A or B

6.4 Process verification tests

Those characteristics specified in ISO 22391-2 and ISO 22391-3 and listed in Tables 10 and 11 shall be subject to PVTs with the minimum sampling frequency given in Table 10 or 11, as applicable, if not type tested or audit tested in the same period.

Table 10 — Characteristics of pipes and minimum sampling frequencies for process verification tests

Characteristic	Reference	Minimum sampling frequency
Resistance to internal pressure (95 °C, 1 000 h)	ISO 22391-2:2009, Tables 8 and 9	One test piece per year per d_n and nominal wall thickness, e_n

Table 11 — Characteristics of fittings and minimum sampling frequencies for process verification tests

Characteristic	Reference	Minimum sampling frequency
Resistance to internal pressure (95 °C, 1 000 h)	ISO 22391-3:2009, Clause 7	One test piece per year per size group and per fitting group

If the product does not conform to the requirements in respect of any characteristic given in Table 10 or 11, as applicable, the retest procedure detailed in the manufacturer's quality plan shall be performed. If certification is involved, the certification body shall be informed.

If the retest procedure does not confirm conformity of the product to the requirements, then the process shall be investigated and corrected in accordance with the procedures given in the manufacturer's quality plan, as well as to verify the characteristics given in Table 10 or 11, as applicable.

A test performed as an AT does not need to be repeated as a PVT.

6.5 Audit tests

ATs are performed if certification is involved only.

Those characteristics specified in ISO 22391-2 and ISO 22391-3 and listed in Tables 12 to 14 are intended to be audit tested with the minimum sampling frequency as given in Tables 12 to 14, as applicable.

Certification bodies may accept PVTs as ATs if witnessed by them or by their agencies.

The sizes, types, and classes selected for tests should preferably be primarily those which have not previously been selected for audit testing. Samples should preferably be taken from the largest volume of production per group.

Table 12 — Characteristics of pipes and minimum sampling frequencies for ATs

Characteristic	Reference	Minimum sampling frequency
Appearance	ISO 22391-2:2009, 5.1	Three test pieces per year per size group
Dimensions	ISO 22391-2:2009, Tables 3 to 7	Three test pieces per year per size group
Resistance to internal pressure (95°C, 1 000 h)	ISO 22391-2:2009, Tables 8 and 9	Three test pieces per year per size group
Longitudinal reversion	ISO 22391-2:2009, Table 10	Three test pieces per year per size group
Marking	ISO 22391-2:2009, Clause 10	Three test pieces per year per size group

Table 13 — Characteristics of fittings and minimum sampling frequencies for ATs

Characteristic	Reference	Minimum sampling frequency
Appearance	ISO 22391-3:2009, 5.1	Three fittings per year per size group and fitting group
Dimensions	ISO 22391-3:2009, Clause 6	Three fittings per year per size group and fitting group
Resistance to internal pressure (95°C, 1 000 h)	ISO 22391-3:2009, Clause 7	Three fittings per year per size group and fitting group
Marking	ISO 22391-3:2009, Clause 11	Three fittings per year per size group and fitting group

Table 14 — Characteristics for fitness for purpose and minimum sampling frequencies for ATs

Characteristic	Reference	Minimum sampling frequency
Resistance to internal pressure	ISO 22391-5:2009, 4.2	One evaluation per size group and jointing system per year for the relevant design pressure and appropriate application class
Leak tightness under internal pressure and bending	ISO 22391-5:2009, 4.3	One evaluation per 5 years per size group and jointing system for the relevant design pressure and appropriate application class
Resistance to pull-out	ISO 22391-5:2009, 4.4	One evaluation per 5 years for the smallest and largest d_n per size group and jointing system for the relevant design pressure and appropriate application class
Resistance to thermal cycling	ISO 22391-5:2009, 4.5	One evaluation per 5 years per d_n and jointing system for the relevant design pressure and appropriate application class
Resistance to pressure cycling	ISO 22391-5:2009, 4.6	One evaluation per 5 years per size group and jointing system for the relevant design pressure
Leak tightness under vacuum	ISO 22391-5:2009, 4.7	One evaluation per 5 years per size group and jointing system per pressure group

6.6 Indirect tests

Generally, testing shall be performed using the test methods referred to in ISO 22391-1, ISO 22391-2, ISO 22391-3, and ISO 22391-5.

ITs may be used for BRT characteristics as given in Tables 8 and 9. Indirect testing shall not be used for TTs, PVTs or ATs.

The indirect test method used and the correlation or safe relationship of the indirect testing to the specified testing shall be documented in the manufacturer's quality plan. The continuing validity of the indirect testing shall be checked at regular intervals.

In cases of dispute, the BRTs as specified in Tables 8 and 9 shall be used.

If certification is involved, the IT shall be accepted by the certification body.

6.7 Test records

Unless otherwise specified, all records shall be maintained for a minimum of 10 years in accordance with the information given in the quality management system.

Bibliography

[1] ISO 2859-2, *Sampling procedures for inspection by attributes — Part 2: Sampling plans indexed by limited quality (LQ) for isolated lot inspection*

[2] ISO 9000:2005, *Quality management systems — Fundamentals and vocabulary*

[3] ISO 9001, *Quality management systems — Requirements*

[4] ISO/IEC 17020:1998, *Conformity assessment — General criteria for the operation of various types of bodies performing inspection*

[5] ISO/IEC 17021, *Conformity assessment — Requirements for bodies providing audit and certification of management systems*

[6] ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

[7] ISO/IEC Guide 65:1996, *General requirements for bodies operating product certification systems*

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