

WATER DISTRIBUTION OR DRAINAGE PIPES**Technical document****08-04 Traditional**

Heating and/or domestic distribution
and/or distribution of chilled water –
Multilayer piping systems and
associated fittings

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The English version is provided for information. In case of doubt or dispute, the French version only is valid.

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MODIFICATION HISTORY

Revision No.	Application date	Modifications
00	16/11/2018	Update to the document layout and reference Content modifications: Creation of technical document following transition of the products covered by this document to traditional status
01	01/07/2020	Tests deleted: <ul style="list-style-type: none">- Resistance to corrosion under stress- Disconnection and reuse (if applicable)- Rotation of fitting

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The requirements and provisions specified in this Technical Document will be updated in the case of new components or products.

1. STANDARDS

1.1. Product standards

NF EN ISO 21003-1: Multilayer piping systems for hot and cold water installations inside buildings - Part 1: General

NF EN ISO 21003-2: Multilayer piping systems for hot and cold water installations inside buildings - Part 2: Pipes

NF EN ISO 21003-2/A1: Multilayer piping systems for hot and cold water installations inside buildings - Part 2: Amendment 1

NF EN ISO 21003-3: Multilayer piping systems for hot and cold water installations inside buildings - Part 3: Fittings

NF EN ISO 21003-5: Multilayer piping systems for hot and cold water installations inside buildings - Part 5: Fitness for purpose of the system

XP CEN ISO/TS 21003-7: Multilayer piping systems for hot and cold water installations inside buildings - Part 7: Guidance for the assessment of conformity

NF EN 1254-3: Copper and copper alloys - Plumbing fittings - Part 3: Fittings with compression ends for use with plastics pipes

NF EN 1254-6: Copper and copper alloys - Plumbing fittings - Part 6: Fittings with push-fit ends

NF EN 1254-8: Copper and copper alloys - Plumbing fittings - Part 8: Fittings with press ends for use with plastics and multilayer pipes

1.2. Test standards

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

NF EN 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

NF EN ISO 1167-3: Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 3: Preparation of components

NF EN ISO 3126: Plastics Piping Systems - Plastics components - Determination of dimensions

NF EN ISO 6259-1: Thermoplastics pipes - Determination of tensile properties - Part 1: General test method

ISO 6259-3: Thermoplastics pipes – Determination of tensile properties – Part 3: Polyolefin pipes

NF EN ISO 10147: Pipes and fittings made of crosslinked polyethylene (PE-X) - Estimation of the degree of crosslinking by determination of the gel content

ISO 17456: Pipes and fittings made of crosslinked polyethylene (PE-X) - Estimation of the degree of crosslinking by determination of the gel content

NF EN 728: Plastics piping and ducting systems - Polyolefin pipes and fittings - Determination of oxidation induction time

NF T 54 094: Plastics piping systems made of unplasticized poly(vinyl chloride) (PVC-U) and chlorinated poly(vinyl chloride) (PVC-C) for conveyance under pressure of non gaseous fluids - Fittings - Determination of resistance to alternate pressure stress

NF EN ISO 527-1: Plastics - Determination of tensile properties - Part 1: General principles

ISO 17454: Plastics piping systems - Multilayer pipes - Test method for the adhesion of the different layers using a pulling rig

EN 712: Thermoplastics piping systems - End-load bearing mechanical joints between pressure pipes and fittings - Test method for resistance to pull-out under constant longitudinal force.

EN 713: Plastics piping systems - Mechanical joints between fittings and polyolefin pressure pipes - Test method for leaktightness under internal pressure of assemblies subjected to bending.

NF EN 12293: Plastics piping systems - Thermoplastics pipes and fittings for hot and cold water - Test method for the resistance of mounted assemblies to temperature cycling

NF EN 12294: Plastics piping systems - Systems for hot and cold water - Test method for leaktightness under vacuum

NF EN 12295: Plastics piping systems - Thermoplastics pipes and associated fittings for hot and cold water - Test method for resistance of joints to pressure cycling

ISO 6957-1988: Copper alloys. Ammonia test for stress corrosion resistance

Test method for analysis of the chemical composition of brass fittings, all types of pipe: NF EN 15079: Copper and copper alloys - Analysis by spark optical emission spectrometry (S-OES)

Test method for analysis of the chemical composition of metallic fittings (other than brass), all types of pipe: CSTB protocol based on standard NF EN 15079.

1.3. Associated implementation documents

Implementation must be carried out:

- For class 4 (heated floors): in accordance with DTU 65.14 “Implementation of heated floors with hot water”.
- For classes 2 and 5: in accordance with the “Technical Specifications (CPT) for the implementation of pipe systems based on synthetic pipes - Semi-rigid LWC pipes” (CSTB specification 2808_V2 – November 2011).

2. FIELDS OF APPLICATION

This Technical Document covers the applications indicated in the table below. These applications are drawn from the ISO 10508 standard.

Application classes 2, 4 and 5 comply with the ISO 10508 standard. According to this standard, the reader is reminded that regardless of the application class selected, the system must also comply with conveyance of cold water at 20°C for 50 years and a service pressure of 10 bar.

It also covers the “Chilled water” application class corresponding to air conditioning and cooling systems with a minimum temperature of 5°C.

Classes	Service conditions	Maximum conditions	Accidental conditions	Typical application
Class 2	70 °C 49 years	80 °C 1 year	95 °C 100 hours	Domestic hot and cold water supply
Class 4	20°C - 2.5 years and 40°C - 20 years and 60 °C - 25 years	70 °C 2.5 years	100 °C 100 hours	Low temperature radiators, underfloor heating
Class 5	20°C - 14 years and 60 °C - 25 years and 80 °C - 10 years	90 °C 1 year	100 °C 100 hours	High temperature radiators

The series and the dimensional characteristics of multilayer pipes are not standardised, and remain at the manufacturer’s discretion. The manufacturer shall provide documentation of the dimensioning of the pipes based on standards NF EN ISO 21003 and ISO 17456.

Prerequisite: The applicant must provide the regression curves in its admission application: 1 regression curve per dimension group and per temperature 20°C – 70°C - 95°C – 110°C.

The dimension groups are defined in §4.2.1.2. of standard XP CEN ISO/TS 21003-7:

Dimension group	Nominal diameter, dn
1	$14 \leq dn \leq 26$
2	$26 < dn \leq 63$
3	$63 < dn$

CSTB will ensure that the final product has not undergone any change after the regression curves have been established.

Contact with potable water

The pipes, fittings and components (particularly seals) must comply with French regulations currently in force for products designed to come into contact with potable water. In particular, they must have a currently valid ACS certification (or a self-declaration, if applicable). These documents must be presented during audits.

Additional requirements for pipes and fittings

The holder must make their installation instructions public in French, on their commercial documents, on their website or when delivering products (optional).

Specific implementation instructions

Prerequisite: crimp fittings must be associated with at least one crimper brand/crimp profile pair.

If special tools are required (crimping) to install the pipes and fittings, the holder shall indicate the specific crimper(s) used and the corresponding crimp profiles, as well as the crimping force to be applied, for which they shall have provided evidence of suitability for use in installing the fittings.

These instructions shall be defined in a manual associated to the holder's commercial documents or in the technical data sheets, as well as on their website.

These documents shall be provided to CSTB upon admission and whenever they are modified.

This requirement will be verified annually at each audit in order to ensure that the tests performed at the Mark laboratory are aligned with the holder's instructions.

In the holder's technical documents, the following points shall be precisely defined:

- Product reference for the crimper and associated crimp profiles (jaw references)
- The maintenance associated with this equipment

3. CERTIFIED CHARACTERISTICS AND TEST METHODS

3.1. Certified and optional characteristics

The characteristics listed in the table below will comply with the specifications given in paragraph 3.3.

Optional certified characteristics

The certification of the additional DURABILITY and FUNCTIONALITY characteristics “QB D”, “QB F” or “QB DF” guarantees the compliance of QB-certified products with the requirements of the CSTB Technical Guide (Specification 3597_V2). These options are based on a more detailed analysis of the durability and suitability for use of these products by means of the following tests and specifications:

“QB D” option:

- Resistance to oxidation (OIT) (durability)

“QB F” option:

- Experimental heating circuits at 110°C (functionality)

“QB DF” option:

This option is the combination of both options, “QB D” and “QB F”

3.1.1. Pipes

The characteristics listed in the table below will comply with the specifications given in paragraph 3.3.

Certified characteristics	Nature of the component or system
	Multilayer pipe
Dimensional characteristics *	X
Resistance to delamination	X
Melt mass-flow rate (MFR)	X (1)
Gel content	X (1)
Resistance to oxidation OIT (if QB D option)	X (1)
Resistance to pressure	X

3.1.2. Fittings

Certified characteristics	Nature of the component or system		
	Metal fittings	Synthetic fittings	Multi-component fittings
Dimensional characteristics*	X	X	X
Melt mass-flow rate (MFR)		X (1)	X (1)
Analysis of chemical composition	X		X

*: these characteristics are certified based on verification of the holder's registers and recorded in the audit report.

(1) if applicable

For multi-component fittings, the tests applied will be at CSTB's discretion.

3.1.3. Suitability for use

Certified characteristics	System pipe
Internal pressure	X
Bending under internal pressure	X
Pull-out	X
Thermal cycle	X
Cyclic pressure	X
Leaktightness under vacuum	X
Experimental heating circuits at 110°C (if QB F option)	X

3.3. Test methods

The conditions for verification of the characteristics certified at CSTB are listed in the tables below.

3.3.1. Pipes

Certified characteristics	Multilayer pipe
Dimensional characteristics	NF EN ISO 3126
Resistance to oxidation OIT (if QB D option)	NF EN 728 210 °C 20 min
Melt mass-flow rate (MFR)	NF EN ISO 1133-1 190°C – 5 kg
Delamination	Internal method drawn from standard EN ISO 17454 On chip
Gel content	NF EN ISO 10147
Resistance to pressure 1000 h	NF EN ISO 1167 1-2-3 – at 95 °C

3.3.2. Fittings

Certified characteristics	Metal fittings	Synthetic fittings
Dimensional characteristics	EN ISO 3126	EN ISO 3126
Melt mass-flow rate (MFR)		NF EN ISO 1133
Resistance to oxidation OIT (if QB D option)		NF EN 728
Analysis of chemical composition	NF EN 15079 and/or CSTB protocol based on NF EN 15079 standard	/

3.3.3. Suitability for use

Suitability for use	
Internal pressure	NF EN ISO 1167 1-2-3
Bending under internal pressure	NF EN ISO 3503
Pull-out	NF EN ISO 3501
Thermal cycle	NF EN 12293
Cyclic pressure	NF EN 12295
Leaktightness under vacuum	NF EN 12294
Experimental heating circuits at 110°C (if QB F option)	<p>Experimental circuits are made up of pipes and fittings of different diameters representing the range proposed by the applicant.</p> <p>For crimp fittings, the full range of proposed tools must be represented.</p> <p style="text-align: center;">Specialised Technical Guide</p> <p style="text-align: center;">Specification 3597-2</p>

3.4. Specifications

3.4.1. Pipes

Specifications					
Measurements or tests	Multilayer pipe				
Dimensional characteristics	Pipe construction: Compliant with manufacturer's declaration				
Fluidity index	Compliant with product standards of the material under consideration				
OIT (if QB D option)	Under the test conditions of the NF EN 728 standard (or NF EN ISO 11357) according to the isothermal method (for a product mass of 15 ± 2 mg and an oxygen flow rate of 50 ml/min), the oxidation induction time (OIT) must comply with the following minimum values: - on PEX pipe: OIT = 30 min at 200°C - on PB pipe: OIT = 20 min at 210°C - on PP-R pipe: OIT = 20 min at 200°C - on PE-RT pipe: OIT = 40 min at 200°C				
Delamination	≥ 15 N/cm Pipes that have undergone the thermal shock test or ≥ 25 N/cm for new pipe				
Gel content	Peroxide: > 70% Silane: > 65% Irradiation: > 60%				
Resistance to internal pressure	<table style="border: none;"> <tr> <td style="border: none;">95°C - t > 22 h -</td> <td rowspan="3" style="border: none; padding-left: 10px;">} Test pressures are to be determined based on the manufacturer's regression curve</td> </tr> <tr> <td style="border: none;">95°C - t > 165 h -</td> </tr> <tr> <td style="border: none;">95°C - t > 1000 h -</td> </tr> </table>	95°C - t > 22 h -	} Test pressures are to be determined based on the manufacturer's regression curve	95°C - t > 165 h -	95°C - t > 1000 h -
95°C - t > 22 h -	} Test pressures are to be determined based on the manufacturer's regression curve				
95°C - t > 165 h -					
95°C - t > 1000 h -					

3.4.2. Fittings

Specifications		
Measurements or tests	Metal fittings	Synthetic fittings
Dimensional characteristics	Compliant with manufacturer's diagram	Compliant with manufacturer's diagram
Melt mass-flow rate (MFR)		Compliant with product standards under consideration
Resistance to oxidation OIT (if QB D option)		Compliant with product standards under consideration
Analysis of chemical composition	Compliant with grade declared to CSTB at admission	/

3.4.3. Suitability for use

Specific suitability for use - multilayer system (pipes and all types of fittings)

PRODUCTS/TESTS	Multilayer
PRODUCT STANDARDS	NF EN ISO 21003-1-5 XP CEN ISO/TS 21003-7
Suitability for use	
Internal pressure	Part-5 §5.2
bending under internal pressure	Part-5 §5.3
Pull-out	Part-5 §5.4
Thermal cycle	Part-5 §5.5
Cyclic pressure	Part-5 §5.6
Leaktightness under vacuum	Part-5 §5.7
Experimental heating circuits at 110°C (if QB F option)	No leaks 110°C – 6 bar

4. VERIFICATION REGIME

	12 months following admission	After the 12 months following admission
Multilayer system	Half-yearly	Annual

5. MARKING

5.1. Pipes


The pipes must be indelibly marked at least every 2 metres.

This marking must include at least the following elements:

- the number of Standard EN ISO 21003,
- the name of the holder or the distributor ⁽¹⁾ (name or logo) and the commercial name of the product,
- identification of the material,
- the nominal diameter and the nominal thickness of the wall,
- the application classes (e.g. 2, 4, 5) completed by their corresponding service pressures ⁽²⁾, (e.g. “[Class 2 – 6 bar] [Class 4 – 6 bar] [Class 5 – 6 bar]”),
- the QB logo or “QB D”, “QB F” or “QB DF” if claimed, followed by the last two parts of the certificate number,
- the manufacturing references allowing traceability, including at least:
 - the production period, at least the month and year, in numbers or in code,
 - identification of the factory if there are several production sites, by name or code,
- metric marking.

Example (multilayer pipe intended for the production of hot and cold domestic water distribution and high and low temperature heating installations, “QB DF” option)

EN ISO 21003 - XXX – PEX/Al/PEX 20x12.0 / - [Class 2 – 6 bar] [Class 4 – 6 bar]

[Class 5 – 6 bar] –  aa-xyz - Manufacturing references - 100m

The packaging must include the QB logo or “QB D”, “QB F” or “QB DF” if claimed, followed by the last two parts of the certificate number.

The operating temperatures according to the usage classes that may be marked on synthetic pipes are as follows:

Classification of operating conditions (Classes)	Maximum operating temperatures (TD)	Scope of classes
2	70°C	Hot water supply
4	60°C	Underfloor heating Low temperature radiators
5	80°C	High temperature radiators

⁽¹⁾ A distributor is the beneficiary of a commercial extension.

⁽²⁾ For pipes intended only for the “Chilled Water” application class, the marking on the pipe will include the statement “Chilled Water”, the corresponding operating pressure and the minimum and maximum temperatures of the fluid conveyed.

5.2. Fittings

5.2.1. Synthetic fittings

Individual fittings must bear at least the marking described below, marked indelibly. The information must be marked on the fitting:

- the name of the holder or the distributor (1) (name or logo) and/or the commercial name of the product,
- the nominal diameter of the associated pipe,
- identification of the material (if the fitting is to be welded or glued),
- the QB logo or “QB D”, “QB F” or “QB DF” if claimed (not mandatory),
- the manufacturing references allowing traceability, including at least:
 - the production period, at least the month and year, in numbers or in code,
 - identification of the factory if there are several production sites, by name or code.

5.2.2. Metal fittings

Individual fittings must bear at least the marking described below, marked indelibly. The information must be marked on the fitting.

- the name of the holder or the distributor (1) (name or logo) and/or the commercial name of the product,
- the nominal diameter of the associated pipe,
- the QB logo or “QB D”, “QB F” or “QB DF” if claimed (not mandatory),
- the manufacturing references allowing traceability, including at least:
 - the production period, at least the month and year, in numbers or in code,
 - identification of the factory if there are several production sites, by name or code.

Example (*metal fitting for synthetic pipe “QB DF” option*)

XXX - 20 – QB **DF** – manufacturing references

⁽¹⁾ A distributor is the beneficiary of a commercial extension.

5.3. Labelling/Packaging of fittings


The following information must be marked on a label affixed to the fitting or its packaging.

- the name of the holder or the distributor (1) (name or logo) and the commercial name of the product,
- the nominal diameter of the associated pipe,
- the nominal thickness of the wall of the related pipe (except for fittings for welding or gluing),
- the application Classes (e.g. 2, 4, 5) completed by their service pressures (2), (e.g. “[Class 2 – 6 bar] [Class 4 – 6 bar] [Class 5 – 6 bar]”,

- the QB logo or “QB D”, “QB F” or “QB DF” if claimed, followed by the last two parts of the certificate number.

Example (packaging or labels for fittings referred to in §4.1.2 “QB DF” option)

XXX - 20x1,9 - [Class 2 – 6 bar] [Class 4 – 6 bar]

[Class 5 – 6 bar]  aa-xyz - Manufacturing references

*: Not mandatory if the traceability is marked on the fittings

The operating temperatures according to the usage classes which may be marked on synthetic pipes and multilayer metal core pipes are as follows:

Classification of operating conditions (Classes)	Maximum operating temperatures (TD)	Scope of classes
2	70°C	Hot water supply
4	60°C	Underfloor heating Low temperature radiators
5	80°C	High temperature radiators

⁽¹⁾ A distributor is the beneficiary of a commercial extension.

⁽²⁾ For pipes and fittings intended only for the “Chilled Water” application class, the marking on the pipe will include the statement “Chilled Water”, the corresponding operating pressure and the minimum and maximum temperatures of the fluid conveyed.

6. CHECKS PERFORMED BY THE MANUFACTURER

The checks performed by the manufacturer and the measurements of the various characteristics are carried out in accordance with the inspection plan and the operating procedures defined in the reference standards cited in paragraph 1.1 of this technical document no. 08-04 Traditional, and at least complying with the frequencies defined in the tables below:

6.1. For raw materials

Measurements or tests	Minimum sampling frequency
Supplier analysis certificate	At each delivery
OIT (NF EN 728) (1) (if QB D option)	once per week and per line
Melt flow rate (EN ISO 1133) (2)	once per week and per line

(1) On inside layer only for pipes

(2) If applicable

6.2. Pipes

Measurements or tests	Minimum sampling frequency
Dimensions, marking, appearance (EN ISO 3126)	Once every 8 hours per line
Delamination	once per week and per line
Gel content (1)	once per week and per line
Resistance to internal pressure (EN ISO 1167) 95°C - t > 22 h - or 95°C - t > 165 h - 95°C - t > 1000 h - Sigma given in §3.3.1.	1 specimen per 24 h per machine or 1 specimen per week per machine 1 specimen per year per dimension group

(1) On inside PEX layer only

6.3. Fittings

Measurements or tests	Specifications	Minimum sampling frequency	
		Metal fittings	Synthetic fittings
Dimensional characteristics	EN ISO 3126	Once every 8 hours per machine	Once every 8 hours per machine
Melt mass-flow rate (MFR)			Once a week
Resistance to oxidation OIT (if QB D option)			Once a week
Resistance to internal pressure 95°C – 1000 h	EN ISO 1167	1 specimen per year per dimension group	1 specimen per year per dimension group

7. MONITORING ARRANGEMENTS BY CSTB

7.1. Tests performed for admission and extension at CSTB

For the ranges of pipes and fittings covered under the QB 08 certification application, the applicant must provide a type test report in accordance with the EN 21003-3 standard, established by a laboratory with ISO 17025 accreditation (from an EA member accreditation body) for carrying out tests. The type tests to be performed in accordance with the EN 21003 standard are listed in the ISO TS 21003-7: 2008 standard.

7.1.1. Pipes

Measurement or test	Multilayer pipe
Dimensional characteristics	All the types submitted for admission
Resistance to oxidation OIT (1) (if QB D option)	1 test/material
Melt flow rate (3)	1 test/material
Gel content (2)	1 test/material
Delamination	1 test per dimension group
Resistance to pressure 1000 h	1 test per dimension group
Verification of the regression curve	1 DN per dimension group 4000 h at 20°, 70°, 95° and 110°C or a test report from an EN ISO 17025 accredited body

Experimental heating circuits: Experimental circuits are made up of pipes and fittings of different diameters representing the range proposed by the applicant.

(1) Based on inside layer material only

(2) On inside PEX layer only

(3) If applicable

7.1.2. Fittings

Measurement or test	Metal fittings	Synthetic fittings
Dimensional characteristics *	All the types submitted for admission	All the types submitted for admission
Melt mass-flow rate (MFR)		1 test/material
Resistance to oxidation OIT (if QB D option)		1 test/material
Analysis of chemical composition	1 test/material	

*: dimensional characteristics can be verified during the factory audit.

7.1.3. Suitability for use (pipes and fittings)

PRODUCTS/TESTS	Multilayer pipe
Internal pressure	1 test per dimension group or a test report from an EN ISO 17025 accredited body
Bending under internal pressure	1 test per DN or a test report from an EN ISO 17025 accredited body
Pull-out	1 test per dimension group or a test report from an EN ISO 17025 accredited body
Thermal cycle	1 test per DN or a test report from an EN ISO 17025 accredited body
Cyclic pressure	1 test per dimension group or a test report from an EN ISO 17025 accredited body
Leaktightness under vacuum	1 test per dimension group or a test report from an EN ISO 17025 accredited body
Experimental heating circuits 110°C 1000 h 6 bar (if QB F option)	1 assembly as defined below

7.2. Tests performed during follow-up at CSTB

Tests performed half-yearly

7.2.1. Pipes

Measurement or test	Multilayer pipe
Dimensional characteristics	1 DN (average DN and total thickness of construction)
Resistance to oxidation OIT (1) (if QB D option)	1 test/material
Melt flow rate (3)	1 test/material
Gel content (2)	1 test/material
Delamination	1 DN
Resistance to pressure 1000 h	1 DN

(1) Based on inside layer material only

(2) On inside PEX layer only

(3) If applicable

7.2.2. Fittings

Measurement or test	Metal fittings	Synthetic fittings
Dimensional characteristics *	All the types submitted for admission	All the types submitted for admission
Melt mass-flow rate (MFR)		1 test/material
Resistance to oxidation OIT (if QB D option)		1 test/material
Analysis of chemical composition	1 test/material	

*: dimensional characteristics can be verified during the factory audit.

8. SAMPLING FOR TESTS AT CSTB

8.1. Sampling for admission or extension applications to the CSTB

Collection of samples in cases of admission or extension is left to CSTB's discretion.

8.2. Sampling for follow-up at CSTB

Multilayer
Pipes
Coils 10 to 15 m of the same DN x th Straight rods 10 to 15 1m sections of the same DN x th

Synthetic fittings		Metal fittings
Fittings	Virgin material	
5 fittings of each type necessary for the performance of pressure tests	1 sachet of fitting virgin material	5 to 20 ** fittings per DN