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ASSESSMENT DIRECTIVE

FOR THE KOMO (TECHNICAL-APPROVAL-WITH-) PRODUCT CERTIFICATE FOR

PLASTIC PIPING SYSTEMS WITH METAL INNER LAYER INTENDED FOR INDOOR HEATING INSTALLATIONS: RADIATOR CONNECTIONS –

SPECIFIC REQUIREMENTS

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Preface

This KOMO® Assessment Directive (BRL) has been drawn up by the Kiwa Board of Experts Plastics Piping Systems (LSK), which counts with representatives from the interested parties on the subject matter of this BRL. This Board also supervises the certification activities based on this BRL and will make any necessary adjustments. All references to the Board of Experts in this BRL pertain to the above mentioned Board of Experts.

This BRL together with BRL 6300 “General requirements for products used in plastics piping systems” will be used by certification bodies who have a license agreement with the KOMO Foundation in connection with the established certification procedures. BRL 6300 and any additional and/or deviating requirements, as described in this BRL, specify the requirements that an applicant or holder of a KOMO certificate must meet and the manner in which the certification body assesses this. The certification procedure established by the certification body includes a description of the working method as employed by the certification body in the implementation of:

- (pre)certification tests required for granting and renewing a KOMO product certificate based on the present BRL;
- periodic assessments for the maintenance of a previously issued product certificate based on the present BRL.

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1 Introduction, general provisions, and general requirements

1.1 Introduction

Based on the regulations laid down in this KOMO Assessment Directive (BRL) in combination with BRL 6300 “General requirements for products used in plastics piping systems” a KOMO (technical-approval-with-) product certificate is issued for plastic piping systems with metal inner layer intended for indoor heating installations: radiator connections. Additions and/or deviations from BRL 6300 are documented in the relevant section of this BRL. The KOMO certificate allows the certificate holder to demonstrate to their customers that an expert, independent organization oversees the certificate holder's production process, the product quality, and the associated quality assurance. This means that the product can be assumed to possess the properties as defined in this BRL. This (technical-approval-with-) product certificate enables the certificate holder to prove their clients that an expert, independent organization supervises the certificate holder's production process, the quality of the product and its respective quality control. This means that it can be assumed that the product has the properties as set out in this BRL.

The established requirements, originating from this BRL in combination with BRL 6300, are used by the certification bodies that are accredited for this purpose by the Accreditation Council or have submitted an application for this purpose and that have a license agreement with the KOMO Foundation for this purpose, when processing an application for the issue and maintenance of a KOMO (technical-approval-with-) product certificate for Plastic piping systems with metal inner layer intended for indoor heating installations: radiator connections.

In addition to the requirements from this BRL in combination with BRL 6300, the certification bodies set additional requirements in the sense of general procedural requirements for certification, as laid down in their internal certification procedures.

1.2 Scope and field of application

1.2.1 Scope

Plastic piping systems with metal inner layer intended for indoor heating installations: radiator connections.

1.2.2 Field of application

The plastics pipes with metal inner layer and fittings according to this BRL are intended to be applied in piping systems for hot water distribution for radiator connections at a design pressure (= maximum operating pressure) of 6 or 10 bar (7 or 11 bar absolute or 6 or 10 bar overpressure), under the conditions mentioned in table 1.

Remark:

Each pressure mentioned in this Assessment Directive is defined as overpressure. (So, with "10 bar" a "10 bar overpressure" is meant).

Protection pipes must be used for medium lines with a diameter up to and including 25 mm, (see paragraph 5.3). For larger diameters, the use of protection pipes is optional.

Table 1 – Temperature profile during 50 years

	Temperature [ºC]	Lifetime	Overall service coefficient
T_{koud}	20	14 years	1,25
$T_{bedrijf}$	60 + 80	25 years + 10 years	1,5
T_{max}	90	1 year	1,3
$T_{storing}$	100	100 hours	1,0
Remark: the mentioned temperature profile is in accordance with class 5 of ISO 10508.			

Plastics piping systems with metal inner layer for radiator connections that are designed according to class 5 may also be used for class 4, underfloor heating systems. Protection pipes are not applicable in the latter case.

1.3 Validity

In addition to BRL 6300, the following applies:

Is valid for an unlimited period (maximum number of years).

The KOMO (technical approval-with-) product certificate is in principle valid for an unlimited period. Validity may be limited (terminated), among other reasons, because of:

- A modification of this Assessment Directive,
- Incompliance of the certificate holder's obligations.

1.4 Relation with Legislation and Rules and Regulations

1.4.1 European Construction Products Regulation (No. CPR, EU 305/2011)

No harmonised European standard applies to the products to which this BRL relates.

1.5 Requirements to be imposed on conformity assessing institutions

No additions and/or deviations to §1.5 of BRL 6300 are applicable.

1.6 KOMO (technical approval-with-) product certificate

Based on this BRL, the following types of certificates are issued in combination with BRL 6300:

- KOMO technical-approval-with-product certificates and
- KOMO product certificates.

Technical-approval-with-product certificates are issued for the following systems:

- Plastics piping systems as part of radiator connections in heating systems in accordance with chapters 3, 4, 5 and 6 in which the pipes and fittings have been assessed in their combination and as a unique system.

Product certificates are issued for the following types of products:

- Pipes for radiator connections according to chapter 3, paragraph 5.1 and chapter 6;
- Fittings for radiator connections according to chapter 3, paragraph 5.2 and chapter 6;
- Corrugated pipes for radiator connections according to chapter 3, paragraph 5.2 and chapter 6.

The technical-approval-with-product certificate and product certificates to be issued are to be in accordance with the product certificate template published for this version of the BRL on the KOMO® website (www.komo.nl).

1.7 Markings and indications

The following shall be applied to the products/packaging:

1.7.1 Fittings

The minimum required marking on the fittings shall be:

- KOMO or KOMO® word mark (if not possible KOMO only on the smallest packaging);
- the manufacturer’s name, trade name or logo;
- nominal outside diameter of the corresponding pipe;
- production code.

The minimum required marking on the smallest packaging unit of the fittings shall be:

- KOMO (or KOMO® word mark);
- certificate number of the accompanying technical approval-with-product certificate of the piping system, according the marking of the belonging pipe;
- the manufacturer’s name, trade name, system name or logo;
- material identification if the fitting body is made of plastics;
- nominal outside diameter and nominal wall thickness of the corresponding pipe in mm.

1.7.2 Pipes

The pipes shall be provided with the following marks, clearly legible and indelible, at intervals of no more than 2,0 meters.
The minimum required marking on the pipes shall be:

- KOMO (or KOMO® word mark) + class 5 / 6 or 10 bar;
- certificate number of accompanying technical approval-with-product certificate of the piping system;
- the manufacturer's name, trade name, system name or logo;
- material identification i.e.: stainless steel/PE-RT;
- the buildup of the pipe i.e.; stainless steel/PE-RT;
- nominal outside diameter and nominal wall thickness of the pipe in mm;
- production code.

1.7.3 Corrugated pipes

The corrugated pipes shall be provided with the following marks, clearly legible and indelible, at intervals of no more than 2,5 meters:

- KOMO (KOMO® word mark);
- certificate number of the corrugated pipe;
- factory name, tradename or logo.

The KOMO logo type to be applied:

The KOMO word mark to be applied:

KOMO®

After issuance of the KOMO® (technical-approval-with-) product certificate the KOMO® logo may also be used by the certificate holder in his external communication with regard to the certified activities as stipulated in the "Rules and Regulations for the use of the KOMO® marks" as is published on the KOMO® website. The KOMO® mark with the certificate number may also be used on the delivery documents.

2 Terminology

For an explanation of the terminology used in this Assessment Directive for certification, please go the glossary on the website of the KOMO Foundation (www.komo.nl).

2.1 General terminology and definitions

In addition to the terminology of BRL 6300 and EN-ISO 21003 parts 1, 2, 3, 5 and CEN/TS 21003 part 7, the following applies:

- **Assessment Directive (BRL):** the agreements made within the Board of Experts on the subject of certification;
- **Board of Experts:** the Board of Experts Plastics Piping Systems (LSK);
- **Installation:** configuration consisting the pipe work, fittings and appliances;
- **IQC scheme (IQCS):** a description of the quality inspections carried out by the supplier as part of his quality system;
- **Supplier:** the party that is responsible for ensuring that the products meet and continue to meet the requirements on which the certification is based**.**
- **Private label certificate:** A certificate that only pertains to products that are also included in the certificate of a supplier that has been certified by Kiwa, the only difference being that the products and product information of the private label holder bear a brand name that belongs to the private label holder;
- **Product certificate:** a document in which Kiwa declares that a product may, on delivery, be deemed to comply with the product specification recorded in the product certificate;
- **Product requirements:** requirements made specific by means of measures or figures, focusing on (identifiable) characteristics of products and containing a limiting value to be achieved, which can be calculated or measured in an unequivocal manner;
- **Initial investigation:** tests in order to ascertain that all the requirements recorded in the Assessment Directive are met;
- **Certification mark:** a protected trademark of which the authorization of the use is granted by Kiwa to the supplier whose products can be considered to comply on delivery with the applicable requirements.
  If applicable a specially for this purpose designed label on the quality information about the application of this product may be added, based on the results as stated in the report issued by Kiwa on the inspection of the prototype;
- **Follow-up investigation:** the investigation carried out after granting the certificate to determine that the certified products continue to be in compliance with the requirements laid down in the Assessment Directive;
- **Reworked material:** material from rejected unused products or trimmings that have been manufactured and retained within plants owned and operated by the same legal entity
- **Recyclate:** material resulting from the recycling of pre-consumer (unused products, excluding reworked (plastic) material) and post-consumer (from used products, that have fulfilled their intended purpose or that can no longer be used) products

2.2 Geometric terminology and definitions

The geometric terminology and definitions according EN-ISO 21003, parts 1, 2, 3, 5 and CEN/TS 21003 part 7 do apply.

2.3 Terminology and definitions in relation to application conditions

The symbols and abbreviated terms according EN-ISO 21003, parts 1, 2, 3, 5 and CEN/TS 21003 part 7 do apply.

2.4 Symbols

The symbols and abbreviated terms according EN-ISO 21003, parts 1, 2, 3, 5 and CEN/TS 21003 part 7 do apply.

2.5 Abbreviations

The symbols and abbreviated terms according EN-ISO 21003, parts 1, 2, 3, 5 and CEN/TS 21003 part 7 do apply.

3 Requirements for the design and the products and/or raw materials to be processed

This chapter includes the requirements for the design (or type), as well as the properties of the raw materials, materials, and products used in it, and the manner in which these are combined into the product whose performance in the application is certified under this BRL.

3.1 Design / type

The certificate holder shall ensure a clear description of all relevant design data, including:

- constituent raw materials, materials and products;
- recipe;
- production process / realization process.

Any proposed change in the aforementioned parameters shall be reported to the certification body. The certification body shall assess whether the change may affect the certified performance(s), which requires reassessment of the performance(s) in question.

The certification body shall determine what constitutes a significant change. Once it has been established that the products with the proposed change meet the requirements in accordance with chapters 3, 4 and 5, the change can be implemented in the production process of the certificate holder.

3.2 Raw materials and products

The raw materials and products (including semi-products) used/employed in the production process must meet the following requirements:

3.2.1 Metal materials of the inner layer

The material properties of the metal inner layer shall meet the requirements of the relevant reference EN product standards (e.g. EN 10088-1 for stainless steel and EN 1057 for copper).

3.2.1.1 Thermoplastics materials of the outer layer

The material properties of the outer layer shall meet the requirements of the relevant reference product standards as set out in table 5 or any other material according to their reference product standard covering class 5 application as described in this BRL. The relevant physical properties shall be checked in accordance with the relevant section of the relevant reference product standard.

Table 5 – Reference product standards

Material	Reference product standards
PB	EN-ISO 15876 (part 1 and 2)
PE-RT	EN-ISO 22391 (part 1 and 2)
PE-X	EN-ISO 15875 (part 1 and 2) [a]
PP	EN-ISO 15874 (part 1 and 2)
PVC-C	EN-ISO 15877 (part 1 and 2)

[a] The PE-X used shall be fully cross-linked and meet the requirements of the respective reference product standard.

3.2.2 Peak melting temperature of the adhesive

When determined according to EN-ISO 11357-3, the minimum peak melting temperature $T_{p,c}$ of the adhesive shall be > 120 °C.

3.2.3 Thermal stability of the adhesive

When determined according to EN-ISO 2578 and the methodology of annex D of EN-ISO 21003, part 2, the temperature index (thermal stability) of the adhesive shall be at > 70 °C.

3.2.4 Reworked and Recyclate materials

The use of reworked material is allowed. The use of recyclate material is not allowed.

3.2.5 Fittings and pipes

Fittings and pipes shall demonstrably comply with the requirements as specified in this KOMO Assessment Directive paragraphs 5.1 and 5.2.

If the piping system is delivered in accordance with a technical approval-with-product certificate based on this Assessment Directive, the certificate holder may assume that this requirement is being met.

3.2.6 Elastomeric sealing elements

In case rubber sealing elements are present in the joints, the rubber elements shall meet the requirements of KOMO BRL 2013 class III.

If the rubber sealing element is supplied under a product certificate based on BRL 2013 (class III), the manufacturer may assume that this requirement is met.

3.3 Processing instructions

The raw materials, materials, and semi-products employed must be applied/processed in accordance with the corresponding processing instructions and/or application conditions.

3.4 Composition / Recipe

The composition/recipe of the product (according to design, type) is described and recorded by the manufacturer. This results in a clear representation and description of, among other things, the raw materials, components, auxiliary materials and connecting materials used in such a way that the product is defined in a clear manner.

3.5 Initial and periodic investigation

The initial investigation of the plastics piping system and products to be certified shall include a full testing to determine whether the requirements of this chapter are being met. The test matrix of paragraph 5.4 (Table 10) details which tests and checks are applicable. This test matrix also details which tests and checks apply for the periodic assessments that are carried out after the attest-with-product certificate has been issued.

4 Requirements for the piping system

This chapter contains the requirements for the performance of the plastics piping system in application, which must be met, as well as the determination methods for establishing that these requirements are met.

4.1 Requirements under the Buildings and Living Environment Decree

Based on this BRL, no requirements apply in relation to the Buildings and Living Environment Decree regarding the building component/structure in which the products are used.

4.2 General

- The system shall be sufficiently oxygen-tight.
- All connections shall be leak tight and have sufficient clamping force against external influences.
- All parts of the system must be designed for a service life of 50 years with a temperature profile according to class 5 from ISO 10508 at an operating pressure of 6 or 10 bar.

The joints of the piping system must be tested for proper functioning according to table 2. This chapter includes all the connection tests required for the connection system. The combination of a rubber ring (if any), pipe, distributor (if any), support sleeve and clamp assembly in the fitting shall be tested according to the aspects listed in table 2.

4.3 Tightness and strength of joints

After testing in accordance with table 2, the piping system shall be leak tight and the pipe ends shall not show any damage.
If not indicated otherwise, the ambient temperature is (23 ± 2) °C.

Table 2 – tightness and strength of joints

Aspect	Requirement	Test parameters	Test method
Resistance to thermal cycling	no leakage	5 000 cycles T_{max} = (95 ± 2) °C T_{min} = (20 ± 2) °C t_{cyclus}= 30 min [1)] P_D (bar) Preliminary stress = ……. MPa [2)] One test piece	EN-ISO 19893
Resistance to pull-out	No separation of pipe and fitting no scratches or breakage within the distance d (= diameter of the pipe) on the pipe and fitting	t = (60 ± 1) min. Three test pieces F = 1,5 x p/4 x D_n^2 x 1 (N) – 23 °C F = 1,0 x p/4 x D_n^2 x p_D (in MPa)(N) – 95 °C d_n in mm T = 23 °C and 95 °C	EN-ISO 3501
Leaktightness under vacuum	Δp ≤ 0,05 bar	t = (60 ± 1) min. T = (23 ± 2) °C Three test pieces p = -0,8 bar	EN-ISO 13056
Leaktightness under internal pressure and bending	no leakage	t = (60 ± 1) min. T = (20± 5) °C Three test pieces Minimum bending radius [3)]	EN-ISO 3503
		Test pressure … bar [3)]	
Resistance to internal pressure	no leakage	t = 1 000 h. T = 95 °C Minimum of 3 connections	EN-ISO 1167-series
		Test pressure … bar [2)]	
Oxygen permeability [4)]	≤ 1,8 mg O_2/m².d	20 meters of pipe with 4 fittings 80 °C	ISO 17455

[1)] t_{cyclus}= t_{Tmax} + t_{Tmin} (= 15_0^{+1} + 15_0^{+1} = 30_0^{+2}) minutes. Total time = 2 500 hours)

[2)] According to the product standard of the outer layer plastics material

[3)] The minimum bending radius may be declared by the manufacturer. If no declaration is made, 15 x d will be taken as minimum bending radius

[4)] For initial type test only. Since the required value is expressed in an area measure, it is sufficient to measure the smallest diameter from the manufacturer's diameter range (as long as the same barrier thickness applies to all diameters). However, larger diameters can also be tested for verification purposes.

4.4 Installation instructions

The supplier shall provide instructions with regard to storage, transport and installation conditions of the piping system components. These instructions comprise instructions for making connections, guidance for assembling flanges and installation instructions.
This information shall be recorded in the supplier's quality plan

4.5 Requirements in relation to the performance

4.5.1 Processing requirements and application conditions

The product's performance in its application may depend in part on the method and conditions under which it is applied, as well as the properties of the (auxiliary) products and/or (auxiliary) materials (such as installation and sealing materials) used in the application.
The certificate holder prepares and provides instructions upon delivery, containing the processing or installation instructions and application conditions. These instructions inform the user and the contractor about the conditions under which the certified performance is achieved and can be maintained.
If applicable, these instructions also specify the requirements for the products and/or materials (such as installation and sealing materials) used in the application. These instructions shall be included in the installation instructions as mentioned under paragraph 4.4.

4.5.2 Initial and periodic investigation

The initial investigation of the plastics piping system and products to be certified shall include a full testing to determine whether the requirements of this chapter are being met. The test matrix of paragraph 5.4 (Table 10) details which tests and checks are applicable. This test matrix also details which tests and checks apply for the periodic assessments that are carried out after the attest-with-product certificate has been issued.

4.5.3 Technical approval-with-product certificate

The required regulations/conditions or a reference to them are included in the attest-with-product certificate.

5 Requirements for the products

This chapter includes the requirements a product must meet, converted to the product characteristics of the pipes and fittings, as well as the determination methods and the limit values to determine that these requirements are being met.

5.1 Fittings

5.1.1 Plastics fittings

The plastics fittings shall fulfil the requirements of the pertaining product standards taking into account the specifications mentioned in table 3.

Table 3 – requirements for plastics fittings

Aspect	Requirement	Test parameter	Test method
Material	According IQC [1]	According IQC [1]	According IQC [1]
Hydrostatic stress properties of material	≥ design stress (σ_D) according to the relevant product standard for class 5 [5]	Resistance to internal hydraulic pressure [2] - at 20 ºC - between 60 and 80 ºC - at 95 ºC - at 110 ºC	EN-ISO 1167-series with the help of EN-ISO 9080
Dimensions	Specification manufacturer	Dimensions	EN-ISO 3126
Rubber	BRL 2013, class III	BRL 2013, class III	BRL 2013
Degree of cross linking (PE-X fittings)	PE-Xa ≥ 70% PE-Xb ≥ 65% PE-Xc ≥ 60% PE-Xd ≥ 60%	Degree of cross linking	EN-ISO 10147
Melt flow rate (PP fittings)	≤ 30% difference with respect to granulated material	Mass 2,16 kg Temperature 230 °C	EN-ISO 1133
Melt flow rate (PB fittings)	≤ 30% difference with respect to granulated material	Mass 5 kg Temperature 190 °C	EN-ISO 1133
Resistance to internal pressure	no leakage	t = 1000 h T = 95 °C Minimum of 3 test pieces	EN-ISO 1167-series
		Test pressure …. bar [4]	
Appearance	Smooth without any flaws	Soundness	Visual inspection
Thermal stability [3], [5]	Test time > 8760 hours	Resistance to internal hydraulic pressure [2] at 110 ºC Applied stress conform the reference lines or long term strength data	EN-ISO 1167-series
Behaviour at heating	Damages around injection point ≤ 30 % of wall thickness No holes, bubbles or cracks	In consultation with manufacturer	EN-ISO 580

1) IQC: is laid down as part of the certification agreement, after approval of the certification body
2) Test pieces are injection moulded and are cylindrical shaped
3) Test shall be performed on tubular test pieces which are produced by the fitting manufacturer. Alternatively straight couplers can also be used. In this case, the most critical position (smallest wall thickness) of the base body of the coupler shall be used for the calculation of the hydrostatic hoop stress body.
4) Information from manufacturer, determined according to EN-ISO 21003-5
5) For PPSU and PVDF ISO 4076 and ISO 4070 respectively do apply

5.1.2 Metal fittings

The metal fittings shall fulfil the requirements of table 4.

Table 4 – requirements for metal fittings

Aspect	Requirement	Test parameter	Test method
Material fitting body	**Brass:** EN 1254-3 EN 1254-6 EN 1254-8 **Stainless steel:** EN 10088 EN 10283	IQC [1)]	Information manufacturer
Rubber	BRL 2013, class III	BRL 2013, class III	BRL 2013
Dimensions	EN1254-3 EN 1254-6 EN 1254-8	Minimum thickness	EN ISO 228-1 or ISO 7-1
Construction	EN1254-3 EN 1254-6 EN 1254-8	Construction drawings	EN-ISO 3126
Resistance to inner water pressure (strength fitting body)	No cracks	**Brass:** EN 1254-3 par. 5.1 EN 1254-6 Par. 5.1.4 EN 1254-8 Par.5.1.1 **Stainless steel:** 25 bar at (23 ± 2) °C during 48 hours [2)]	EN-ISO 1167-1
Brass Resistance to stress corrosion	No cracks	pH 9,5	ISO 6957
Only for DZR Brass: Resistance to dezincification [3)]	Maximum dezincification depth: ≤ 200 µm Average dezincification depth: ≤ 100 µm	EN-ISO 6509-1	EN-ISO 6509-1
Stainless steel: Resistance to intracrystalline degradation	No cracks	Method A	EN-ISO 3651-2

1) Choice of material is free. The chosen material is listed in the IQC.
2) The most critical wall thickness/ DN ratio is tested.
3) Copper alloys containing 15 % or less zinc provide a good resistance to dezincification and may be declared accordingly without testing.

5.2 Pipes

5.2.1 General

This chapter contains the requirements that the pipes shall meet, as well as the determination methods to determine that the requirements are met.

The material(s) used for each layer of the multilayer pipe shall be specified by the pipe manufacturer.

5.2.2 Surface conditions

When inspected visually, the inside and outside of the pipes shall be smooth without any flaws. The weld seam shall be regular without visible damage(s).

5.2.3 Geometrical characteristics

The dimensions of the pipes (in mm) shall be specified by the pipe manufacturer, which includes:
- Mean outside diameter: d_{em} (mm)
- Tolerance on the outside diameter (mm)
- Mean inside diameter: d_{im} (mm)
- Out-of-roundness: ovality (in mm)
- Minimum wall thickness: e_{min} (mm)
- Tolerance on the total wall thickness (mm)
- Thickness with tolerances of the different layers: e_L (mm)

The dimensions of the pipe (in mm) shall be measured in accordance with EN-ISO 3126.

Remark

In the case of dispute the measurements of dimensions shall be made not less than 24 h after manufacturing and after being conditioned for at least 4 h at (23 + 2) °C.

5.2.4 Mechanical characteristics

5.2.4.1 Long-term hydrostatic strength

The design pressure strength (p_D) is derived from the long-term pressure strength (p_{LPL}), taking in account application class 5 and the overall service design coefficient given in the relevant product standard of the outer layer material (see annex B of EN-ISO 21003-2). The long-term pressure strength (p_{LPL}) of multilayer pipes shall be measured (procedure II) as defined in ISO 17456.

The size groups are applicable as described in ISO 17456 and ISO/TS 21003-7:
- dimension group 1, all nominal dimensions less than or equal to 26 mm;
- dimension group 2, all nominal dimensions greater than 26 mm and less than or equal to 63 mm;
- dimension group 3, all nominal dimensions greater than 63 mm.

5.2.4.2 Strength of the weld seam of the metal inner layer

When tested in accordance with 5.2.8.1, the strength of the weld seam of the metal inner layer is regarded as being sufficient.

5.2.4.3 Control Points for the strength of the weld seam and the pressure strength

Table 6 – Control points for pressure testing

Resistance to internal pressure of the pipe	Testing time (hour)	T (°C)	p (bar) [1]	EN-ISO 1167
	≥ 22	95	….	
	≥ 165	95	….	
	≥ 1000	95	….	

1) Test pressures are derived in accordance with ISO 17456 clause 6.2.5 and in combination with testing according to 5.2.8.1

5.2.4.4 Resistance to delamination of the pipe layers

The pipes shall comply to the requirements for the resistance to delamination of the pipe layers (between metal and plastics layer) as specified in table 7. In deviation from the ISO 17454 standard the outer polymer layer shall be peeled off from the metal inner layer. The calibration force (F_{cal}) shall not be taken into account.

Table 7 – Delamination resistance

Requirement	Conditioning	Test pieces	Test method
$F_{pull} \geq 30$ N/cm	Before and after conditioning in accordance with EN-ISO 19893[a]	5	ISO 17454
[a] Using the test parameters of application class 5 (see EN-ISO 21003-5)			

5.2.4.5 Thermal durability of the outer layer

When tested according to Annex C of EN-ISO 21003-2 and taking the test parameters according to table 8 into account, the tested pipe shall show no visible cracks in the outer layer by the naked eye.

Table 8 – Test conditions for thermal durability of the outer layer

Test temperature °C	Test environment	Test time h	Number of test pieces
110	Air	8760	3

5.3 Corrugated pipes

5.3.1 General

Corrugated pipes are compulsory for plastics pipe diameters up to and including 25 mm. The corrugated pipes can be part of the system as desired for the larger diameters. The requirements for the corrugated pipes are included in table 9.

Table 9 – requirements for corrugated pipes

Aspect	Requirements	Test parameter	Test method
Material composition	Specification producer	IQC	Specification producer
Appearance	Regular profile. Inner and outer surface is smooth and free from holes, bubbles, contaminations or other flaws.	Flawlessnes	Visual inspection
Mass per length	Specification producer	Weight per meter	paragraph 5.3.2.3
Dimensions	Specification producer	Technical drawing	EN-ISO 3126
Resistance to compression	Compression after 5 minutes not more than 22 %. After neutralization of the load, the outside diameter must be at least 85 % of the initial value	Change in diameter	paragraph 5.3.2.1
Resistance to impact	10 test pieces => no breakage 1 breakage: repeat the test with twice the number of test pieces. Over total of 30 test pieces => not more than 2 breakages	Impact strength	paragraph 5.3.2.2
Resistance to pull force in radial direction (only with duo pipes [1)])	Pull force > 250 N No damage on the protection pipes	Pull force	paragraph 5.3.2.4
[1)] Duo pipes are protection pipes that are connected with a groove connection in the length direction of the pipe. The length of the connection is at least a (50 ± 1) mm tightly jointed connection per 0,5 m pipe.			

5.3.2 Additional test methods

5.3.2.1 Determination of the resistance to compression

Determination of the resistance to compression is prescribed in Annex I.

5.3.2.2 Determination of the resistance to impact

Apparatus

For the test an impact apparatus is required provided with a striker with a spherical shaped impact bottom with a radius of 12,5 mm and a V-shaped support block at an angle of 120º. Further, a cooler is required in which the test pieces can be conditioned at a temperature of (0 ± 1) ºC.

Test pieces

For each pipe size to be tested 10 test pieces are required with a length of 100 mm. The test pieces must be conditioned in water or air at a temperature of (0 ± 1) ºC. When refrigerating in water, the cooling time amounts 30 minutes and when cooling off in air, the cooling time amounts 60 minutes.

Procedure

Put the test pieces on the V-shaped support block and let the striker fall in the middle of the test pieces. A test piece must be tested within 10 seconds after it is taken out of the cooler. The applicable test conditions are mentioned in table 11.

Table 11 – Test conditions for corrugated pipes

Nominal outside diameter of the connecting pipe [1])	**Mass striker in g [2])**	**Fall height in mm [3])**
Up to and including 25 mm	250	1000
32 up to and including 50 mm	250	2000

1) Meant are the pipes that accompany the corrugated pipes to be tested.
2) Tolerance: - 0/+ 5 g.
3) Tolerance: - 0/+ 5 mm.

5.3.2.3 Determination of the mass per length

For the determination of the mass per length three corrugated pipes with a length of approximately 1 m are required. The real length must be determined as accurately as possible. The mass of these pipes must be determined, with the help of a balance, with an accuracy of 0,1 gram.

The arithmetic mean of the three values is qualifying.

5.3.2.4 Resistance to pull force in radial direction

Equipment

On a tensile tester two parallel metal pins will be installed. with a diameter identical to the internal diameter of the protection pipe (± 4 mm). The metal pins on the right side can be moved in parallel direction and the necessary force can be measured. During this test the metal pins shall not bend. (see figure 2). During testing the surrounding temperature and the sample temperature must be (23 ± 2) °C.

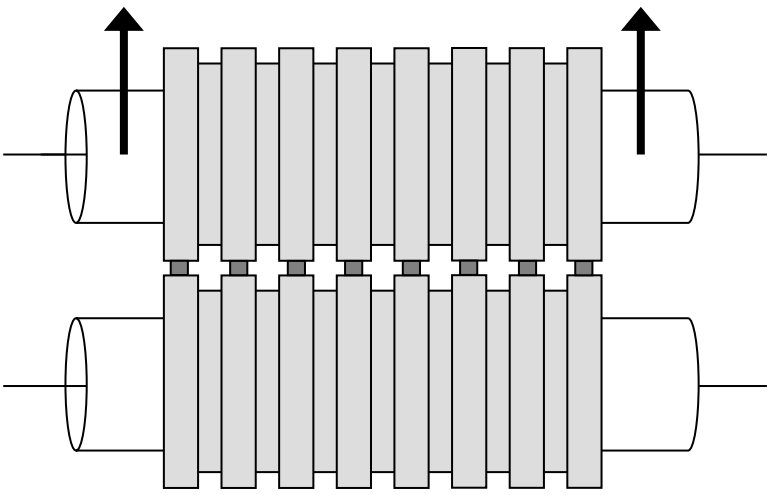

Figure 2 – test model resistance against pull force.

Test pieces

The 5 necessary test pieces must have a length of (50 ± 1) mm. There must be a connection between the 2 corrugated pipes across the entire length.

Method

The test pieces will be applied to the parallel straight metal pins where each pipe section will be placed on a different pin. (see figure 2)

When test pieces are installed the metal pins will be moved parallel in radial direction with a speed of 15 mm/min. During this movement the necessary force shall be recorded.

The test is completed only when both pipe parts are separated entirely from each other. The maximum force (pull-free force) that was necessary to complete the test shall be recorded in Newton. Of the 5 measured test pieces all values shall meet the demands for the pull-free force in radial direction.

5.3.3 Initial and periodic investigation

During the initial assessment it shall be established that the product requirements of this chapter are met by the products to be certified. This is detailed per paragraph in the test matrix of table 10. The test matrix also indicates which tests and checks are applicable during the periodic assessments after the product certificate has been issued.

5.4 Pre-certification tests and/or periodic inspection

This chapter contains an overview of the steps required for certification:

- **initial investigation**: the investigation to determine that compliance is given to all the requirements laid down in the Assessment Directive;
- **follow-up investigation:** the investigation carried out after granting the certificate to determine that the certified products continue to be in compliance with the requirements laid down in the Assessment Directive; the required frequency for the follow-up investigation by the certification body (CI) is also specified;
- **inspection of the quality system of the supplier:** monitoring compliance of the IQC scheme and procedures.

Table 10 - Test matrix

BRL 5613	EN-ISO 21003	Product characteristics	Assessment within the scope of [1, 3]:			
			initial investigation [2]	Inspection by Kiwa[2]	IQC By the manufacturer	
					During start-up	Frequency
Requirements for the design and the products and/or raw materials to be processed						
1.7		Markings and indications	X	1 x year	X	1 x 8 hours
3.1		Design/type	X		X	
3.2		Raw materials and products	X	1 x year	X	
3.3		Processing instructions	X	1 x year	X	
3.4		Composition/recipe	X	1 x year	X	1 x batch
Requirements for the piping system						
4.2		General	X			
4.3		Tightness and strength of the joints	X	1 x year[4]		
4.4		Installation instructions	X	1 x year		
Requirements for the fittings						
5.1.1		Material and mechanical requirements for plastics fittings	X	1 x year[7]	X[8]	1 x week/batch[9]
5.1.2		Material and mechanical requirements for metal fittings	X	1 x year	X[8]	1 x week or batch[8]
Requirements for the pipes						
5.2.1		General	X			
5.2.2		Surface condition	X	1 x year	X	1 x 8 hours
5.2.3		Geometrical characteristics	X	1 x year	X	1 x 8 hours
5.2.4		Mechanical characteristics	X			
5.2.4.1		Long-term hydrostatic strength	X	1 x year[5]		
5.2.4.2		Strength of the weld seam of the metal inner layer	X	1 x year[6]		1 x week/batch 22 h or 165 h
5.2.4.4		Resistance to delamination of the pipe layers	X			
5.2.4.5		Thermal durability of the outer layer	X			
Requirements for corrugated pipes						
5.3.1		General, appearance, dimensions	X	1x year	X	1 x batch
5.3.2.1		Resistance to compression	X	1x year	X	
5.3.2.2		Resistance to impact	X	1x year	X	
5.3.2.3		Mass per length	X	1x year	X	1 x batch
5.3.2.4		Resistance to pull force in radial direction (only with duo pipes)	X	1x year	X	

[1] Inspection of the quality system
The supplier's quality system will be evaluated by Kiwa based on the IQC scheme.
This inspection will at least include the aspects specified in §4 of the 'General requirements for products in contact with drinking water'. During the periodic assessment, the inspector will check the product against a selection of the above-mentioned product properties. The frequency of the periodic assessments is laid down in §6.3 Nature and frequency of periodic assessments;

[2] If, for whatever reason, it is not possible to perform a test in a laboratory specifically accredited to ISO/IEC 17025 and impartial for that activity, the test can be performed in consultation with the certification body under 'witness' in an ISO/IEC 17025 accredited laboratory;

[3] The frequency can be adjusted in consultation with the certification body , e.g.:

a. in the case of a continuous (automated) measurement;

b. if it can be demonstrated that a reduction in the frequency does not compromise the quality.

[4] Only applicable for the test “Resistance to internal pressure”

[5] This aspect is compared with the for this aspect ascertained acceptance parameters on the basis of the IQC inspection (indirect by means of direct related parameters).

[6] Only applicable for the test “Resistance to internal pressure of the pipe 1000 h”

[7] Depending on the plastic material: “Melt Flow Rate”, “Resistance to internal pressure of the fitting 1000 h” (to be combined with 1000 h system test), “Degree of crosslinking”

[8] For the aspects “appearance” and “geometrical characteristics”

[9] For the aspects “appearance” and “geometrical characteristics” and depending on the plastic material “Melt Flow Rate”, “Resistance to internal pressure of the fitting 22 h or 165 h”, “Degree of crosslinking”

6 Requirements for certificate holders and internal quality control

The requirements are in accordance with Chapter 6 of BRL 6300.

7 External conformity assessments

The requirements are in accordance with Chapter 7 of BRL 6300.

8 Requirements for the certification body

The requirements are in accordance with Chapter 8 of BRL 6300.

9 List of documents

9.1 Public law and Rules and Regulations

There are no applicable public laws and rules and regulations.

9.2 Normative documents

This Assessment Directive remits to the following normative documents:

Number	Title	version*
BRL 2013	Vulcanized rubber products for cold and hot non-drinking water applications	
BRL 6300	General requirements for products applied in plastic piping systems	
EN 1057	Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications	
EN 1254-3	Copper and copper alloys - plumbing fittings - Part 3: Fittings with compression ends for use with plastic pipes	
EN 1254-6+A1	Copper and copper alloys - Plumbing fittings - Part 6: Push-fit fittings for use with metallic tubes, plastics and multilayer pipes	
EN 1254-8+A1	Copper and copper alloys - Plumbing fittings - Part 8: Press fittings for use with plastics and multilayer pipes	
EN-ISO 10147	Pipes and fittings made of crosslinked polyethylene (PE-X) - Estimation of the degree of crosslinking by determination of the gel content	
EN-ISO 1133	Determination of the melt mass flow rate (MFR) and the melt volume (MVR) of thermoplastics	
EN-ISO 11357-3	Plastics - Differential Scanning Calorimetry (DSC) - Part 3: Determination of temperature and enthalpy of melting and crystallization	
EN-ISO 1167 series	Plastics piping systems - Thermoplastics pipes - Determination of the resistance to internal pressure at constant temperature, 1995.	
EN-ISO 13056	Plastics piping systems - Pressure systems for hot and cold water - Test method for leak tightness under vacuum	
EN-ISO 15874 series	Plastics piping systems for hot and cold water installations - Polypropylene (PP)	
EN-ISO 15875 part 1-2	Plastic piping systems for hot and cold water installations- Cross-linked polyethylene (PE-X)	
EN-ISO 15876 series	Plastics piping systems for hot and cold water installations - Polybutylene (PB)	
EN-ISO 15877 series	Plastics piping systems for hot and cold water installations - Chlorinated poly(vinyl chloride) (PVC-C)	
EN-ISO 19892	Plastics piping systems - Thermoplastics pipes and fittings for hot and cold water - Test method for the resistance of joints to pressure cycling	
EN-ISO 19893	Plastics piping systems - Thermoplastics pipes and fittings for hot and cold water - Test method for the resistance of mounted assemblies to temperature cycling	
EN-ISO 21003 series	Multilayer piping systems for hot and cold water installations - inside buildings	
EN-ISO 22391 series	Plastics piping systems for hot and cold water installations - Polyethylene of raised temperature resistance (PE-RT)	
EN-ISO 228-1	Pipe threads where pressure-tight joints are not made on the threads - Part 1: Dimensions, tolerances and designation	
EN-ISO 2578	Plastics - Determination of time-temperature limits after prolonged exposure to heat	
EN-ISO 3126	Plastics piping systems - Plastics components - Determination of dimensions	
EN-ISO 3501	Plastics piping systems - Mechanical joints between fittings and pressure pipes - Test method for resistance to pull-out under constant longitudinal force	
EN-ISO 3503	Plastics piping systems - Mechanical joints between fittings and pressure pipes - Test method for leak tightness under internal pressure of assemblies subjected to bending	

EN-ISO 3651-2	Determination of resistance to intercrystalline degradation of corrosion-resistant steel
EN-ISO 580	Plastic piping and ducting systems - Injection-moulded thermoplastic fittings - Methods for visually assessing the effects of heating
EN-ISO 6509-1	Corrosion of metals and alloys - Determination of dezincification resistance of copper alloys with zinc - Part 1: Test method
EN-ISO 9080	Plastics piping and ducting systems - Determination of long-term hydrostatic strength of thermoplastics material in pipe form by extrapolation
EN-ISO 9969	Thermoplastics pipes - Determination of ring stiffness
ISO 4070	Polyvinylidene fluoride (PVDF) - Effect of time and temperature on expected strength
ISO 4076	Polyphenylsulfone (PPSU) - Effect of time and temperature on expected strength
ISO 7-1	Pipe threads where pressure-tight joints are made on the threads - Part 1: Dimensions, tolerances and designation
ISO 10508	Plastics piping systems for hot and cold water installations - Guidance for classification and design.
ISO 17454	Plastics piping systems - Multilayer pipes - Test method for the adhesion of the different layers using a pulling rig
ISO 17455	Plastics piping systems - Multilayer pipes - Determination of the oxygen permeability of the barrier pipe
ISO 17456	Plastics piping systems - multilayer pipes - Determination of the long-term strength
ISO 6957	Copper alloys - Ammonia test for stress corrosion in resistance

*) If no date of issuance is specified in this column, the current version of the document applies.

Remark: if standards or normative documents are dated:

An annual verification will take place to verify if the normative documents are still up to date. Modifications of the applicable normative documents will be published on the services page of Kiwa's website.

I Corrugated pipes - Compression testing

I. 1 Scope

This Annex specifies the test methods for testing the resistance to compression of (flexible) corrugated protection pipes intended as protection pipe sleeves for heating installation pipes: radiator connections.

I.2 Normative references

The following referenced documents are indispensable for the application of this Annex. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.
EN-ISO 3126, *Plastics piping systems — Plastics components — Determination of dimensions*
EN-ISO 9969, *Thermoplastics pipes — Determination of ring stiffness*

I.3 Terms and definitions

For the purposes of this document, the following terms and definitions apply / the terms and definitions given in document and the following apply.

Compression
The difference between the initial diameter and the diameter of a test piece after compression at a specified load for a given time at a given temperature, the difference being referred to the initial thickness.

Compression set
The difference between the initial diameter and the final diameter of a test piece after compression for a given time at a given temperature and after a given recovery time, the difference being referred to the initial diameter.

I.4 Principle

A test piece is maintained for a specified time at a specified temperature under constant load and the effect on the outer diameter of the test piece is determined after compression and after recovery of this compression load for a specified time.

I.5 Apparatus

Compression testing machine, as specified in EN-ISO 9969, but capable of producing at least the specified diametric deflection of the test piece at the applicable speed.

Dimensional and force measuring devices, conforming to EN-ISO 9969, but capable of measuring diametric deflections up to at least the specified deflection and the corresponding compressive forces.

I.6 Test pieces

Marking and number of test pieces
The pipe of which the resistance to compression is to be determined shall be marked on its outside with a line along one generatrix over its entire length. The marked line shall be exactly on one of the axial weld lines of the pipe sample. Four test pieces, a, b, c and d, respectively, shall be taken from this marked pipe such that the ends of the test pieces are perpendicular to the pipe axis and their lengths conform to 6.2.

Length of test pieces
The length of each test piece shall be (100 ± 1) mm.

I.7 Conditioning

The test pieces shall be conditioned in air at (23 ± 2) °C for at least 24 h prior to testing.

I.8 Procedure

All tests and measurements shall be performed at a temperature of (23 ± 2) °C.
The outside diameters, d_{0a}, d_{0b}, d_{0c} and d_{0d}, of the respective test pieces, a, b, c and d (see 6.1), shall be determined at mid-length cross-section by in accordance with EN-ISO 3126 at the

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positions respectively 0°, 90°, 180° and 270° in relation to the marking line on the pipe as in clause 6.1.
Measurements on the outside diameter shall take into account at least two ribs of the corrugated profile of the pipe.

NOTE By definition: d_{0a} = 0°, d_{0b} = 90°, d_{0c} = 180° and d_{0d} = 270°.
The parallel plates of the compression testing machine shall be positioned so that contact between the plates is made over the complete area of the plates. This position of the closed plates is set as zero value (y_0 = 0).

Adjust the position of the parallel plates to be able to place the first test piece in such a way that the marking line is in contact with the upper parallel plate. In the loading device, rotate the three other test pieces, b, c and d, respectively 90°, 180° and 270° in relation to the position of the first test piece (a) when placing them in the loading device. Position the test piece with its longitudinal axis parallel to the plates and with its middle point vertically under the centre-line of the load cell.

NOTE In order to obtain the correct reading from the load cell, it is necessary to position the test piece so the expected resulting force is approximately in line with the axis of the load cell.

Adjust the parallel plates with the sample in-between at a distance from each other equal to the measured outside diameter d_{0a}, d_{0b}, d_{0c} and d_{0d}. Keep the parallel plates at this position for (60±2) s an then adjust the deflection gauge and load cell to zero.

Compress the test piece at a constant speed of (2,0 ± 0,1) mm/min, while continuously recording force and deflection measurements, until reaching a loading force, F, of (200 ± 2) N. This loading force shall be retained at (200 ± 2) N.

At the moment that the full force F is achieved, start the timer (t = 0).
Determine the position of the parallel plates from each other (d_{1a}, d_{1b}, d_{1c} and d_{1d}) at (300 ± 2) s after the application of the full load.

Release the loading force (300 ± 2) s after the full force F was achieved to 0 N. After a recovering time of (60 $^{+2}/_{-0}$) s for the test piece, determine the positional outer diameters d_{2a}, d_{2b}, d_{2c} and d_{2d} at mid-length cross-section by in accordance with EN-ISO 3126 of the respective test pieces at the same position as in clause 8.1.

I.9 Calculations

Compression after 5 min of loading

Calculate the compression after loading ($C_{200N,5min}$) as the average of the four individual compression measurements as a percentage rounded to three significant figures.

$$C_{200N,5min} = \left\{ 1 - \frac{\left(\frac{d_{1,a}}{d_{0,a}} + \frac{d_{1,b}}{d_{0,b}} + \frac{d_{1,c}}{d_{0,c}} + \frac{d_{1,d}}{d_{0,d}}\right)}{4} \right\} \text{ x } 100\%$$

Compression set after 1 min of recovery

Calculate the compression set after recovery (CS_{1min}) as the average of the four measured test pieces as a percentage rounded to three significant figures.

$$CS_{1min} = \left\{ 1 - \frac{\left(\frac{d_{2,a}}{d_{0,a}} + \frac{d_{2,b}}{d_{0,b}} + \frac{d_{2,c}}{d_{0,c}} + \frac{d_{2,d}}{d_{0,d}}\right)}{4} \right\} x\ 100\%$$

I.10 Requirements

$C_{200N,5min}$ ≤ 22,0%

CS_{1min} ≤ 15,0%