

BRL K17201, part 2
2017-02-08

Evaluation Guideline

for the Kiwa technical approval with product certificate for renovation of drinking water piping systems – part 2 – Products for cured in place pipes (CIPP) – factory impregnated liner systems



Preface

This evaluation guideline has been prepared by the Kiwa Board of Experts Water Cycle (CWK), in which all the relevant parties in the field of “Renovation of drinking water piping systems – part 2 – Products for cured in place pipes (CIPP) – factory-impregnated liner systems” are represented. The Board of Experts also supervises the certification activities and where necessary require the evaluation guideline to be revised. All references to Board of Experts in this evaluation guideline pertain to the above mentioned Boards of Experts.

This evaluation guideline will be used by Kiwa in conjunction with the Kiwa Regulations for Product certification.

This evaluation guideline, together with part 1 “Design and installation of cured in place pipes (CIPP)” is a series of evaluation guidelines that among other things include requirements for the design, installation, semi-finished products and end products of cured in place pipes.

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Validation

This evaluation guideline has been validated by Kiwa on 8 February 2017.

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1 Introduction

1.1 General

This evaluation guideline includes all relevant requirements which are adhered to by Kiwa as the basis for the issue and maintenance of a technical approval with product certificate for the renovation of drinking water piping systems – part 2 – Products for cured in place pipes (CIPP) – factory-impregnated liner systems.

On the basis of this evaluation guideline Kiwa issues a:

- Kiwa technical approval with product certificate on the liner system (liner including fittings and joints).
- Kiwa product certificate on the liner.
- Kiwa product certificate on fittings.

For the performance of its certification work, Kiwa is bound to the requirements listed in the chapter “Agreements on the implementation of certification”.

1.2 Field of application / scope

The scope of this evaluation guideline is a renovation technique for underground and above ground piping systems using cured in place pipes (CIPP technique).

This evaluation guideline is applicable for the renovation of pipelines (pipes, fittings and their connecting joints) with sizes from DN 100 to DN 2000 intended for transportation of drinking water with a temperature up to a maximum of 35 °C.

The requirements and test methods listed in this evaluation guideline are based on a life expectancy of 50 years of the liner system.

The liners are suitable to sustain in whole or in part hydraulic and mechanical loads. In the case of a partially load, the host pipe retains in part its function.

The liners are factory-impregnated. Impregnation on the job site is not within the scope of this evaluation guideline.

The products are not intended for use under continuous varying loads of at least one cycle per minute.

The certification scope is a liner system consisting of various components as described in section 4.3. Joints (appendages) and seals of the joints are included. The certification is applicable for the renovation of circular pipes. The renovation of egg shaped pipes is not within the scope of this evaluation guideline.

When the assembled product complies to the requirements of this evaluation guideline, both the components of the liner system as well the liner system itself shall be declared suitable for this application (see section 4.4.1).

The certified liner system is the basic product for the renovation of drinking water pipelines, that shall be used by an according to BRL K17201 part 1 certified installer.

Repairs on the drinking water pipeline are outside the scope of this evaluation guideline. Repairs to the liner itself fall under the scope of this evaluation guideline.

1.3 Acceptance of test reports provided by the supplier

If the supplier provides reports from test institutions or laboratories to prove that the products meet the requirements of this evaluation guideline, the supplier shall prove that these reports have been drawn up by an institution that complies with the applicable accreditation standards, namely:

- NEN-EN-ISO/IEC 17020 for inspection bodies;
- NEN-EN-ISO/IEC 17021 for certification bodies certifying systems;
- NEN-EN-ISO/IEC 17024 for certification bodies certifying persons;
- NEN-EN-ISO/IEC 17025 for laboratories;
- NEN-EN-ISO/IEC 17065 for certification bodies certifying products.

Remark:

This requirement is considered to be fulfilled when a certificate of accreditation can be shown, issued either by the Board of Accreditation (RvA) or by one of the institutions with which an agreement of mutual acceptance has been concluded by the RvA. The accreditation shall refer to the examinations as required in this evaluation guideline. When no certificate of accreditation can be shown, Kiwa shall verify whether the accreditation standard is fulfilled.

1.4 Quality declaration

The quality declaration to be issued by Kiwa is described as a Kiwa product certificate. A model of the certificate to be issued on the basis of this evaluation guideline has been included for information as Annex I.

2 Terms and definitions

2.1 Definitions

In this evaluation guideline, the following terms and definitions apply:

- **Evaluation Guideline BRL:** The agreements made within the Board of Experts on the subject of certification.
- **Board of Experts:** The Board of Experts "CWK".
- **Supplier:** The party that is responsible for ensuring that the products meet and continue to meet the requirements on which the certification is based.
- **IQC scheme:** A description of the quality inspections carried out by the supplier as part of his quality system.
- **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 limiting value can be calculated or measured in an unequivocal manner.
- **Pre-certification tests:** Tests in order to ascertain that all the requirements recorded in the Evaluation Guideline are met.
- **Inspection tests:** Tests carried out after the certificate has been granted in order to ascertain whether the certified products continue to meet the requirements recorded in the Evaluation Guideline, thereby also indicates the frequency with which inspections are carried out by Kiwa.

Note:

The test matrix summarized which tests will be carried out by Kiwa for the Pre-certification and the inspections, and the frequency with which the inspections will be carried out.

- **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.
- **Tap water (origin NEN 1006):** Water intended for drinking, cooking, food preparation or other domestic purposes.
- **Factory-impregnated liner:** The resin is mixed with the necessary curing agents and optionally other additives at the production location. Production tools and equipment are only intended to be used for the renovation on drinking water piping systems.
- **Allowable operating pressure (PFA):** Maximum hydrostatic pressure that a component is capable of withstanding continuously in service.

Note:

In NEN-EN-ISO 11296-4 the term nominal pressure (PN) at 20 °C is used in place of PFA.

- **Allowable maximum operating pressure (PMA):** Maximum pressure occurring from time to time, including surge, that a component is capable of withstanding in service.

- **Allowable test pressure (PEA):** Maximum hydrostatic pressure that a newly installed component is capable of withstanding for a relatively short duration, in order to insure the integrity and tightness of the pipeline

[see NEN-EN 805]

Note:

This test pressure is different from the system test pressure (STP), which is related to the design pressure of the pipeline and is intended to ensure its integrity and leak tightness.

In addition the terms and definitions according to NEN-EN-ISO 11296-1, NEN-EN-ISO 11296-4 and NEN-EN 14525 apply.

2.2 Abbreviations

The in this guideline used abbreviations have the following meanings.

Abbreviation	Meaning
CIPP	Cured in place pipe
CvD-CWK	board of experts "water chain"
IQC	internal quality control
PDS	Product design specification
PS	Product specification
DR	Delivery report
SN	Nominal stiffness class
VCA	Safety Checklist Contractors

2.3 Symbols

The in this guideline used symbols have the following meanings.

Symbol	Meaning
d_{em}	Mean outside diameter
$d_{em, min}$	Minimum mean outside diameter
d_n	Nominal outside diameter
e	Wall thickness
e_m	Mean wall thickness
e_{min}	Minimum wall thickness at any point
e_n	Nominal wall thickness
E_T	Initial modulus of elasticity
E_L	Long-term modulus of elasticity
E_{FL}	Long-term flexural modulus
σ_L	Long-term flexural strength
σ_{TL}	Long-term tensile strength
E_S	Modulus of elasticity determined according to ISO 7685 (ring stiffness)
E_F	Modulus of elasticity determined acc. to NEN-EN-ISO 178 (bending test)
σ_{β}	Flexural stress at first break determined acc. to NEN-EN-ISO 178
E_0	Short-term flexural modulus
σ_{β^*}	Flexural stress at first break acc. NEN-EN-ISO 11296-4 annex B
ε_{β^*}	flexural strain at first break acc. NEN-EN-ISO 11296-4 annex B
E_{F^*}	Initial flexural modulus acc. NEN-EN-ISO 11296-4 annex B
σ_T	Initial tensile stress at first break
σ_{TL}	Long-term tensile strength
h_c	Wall thickness of the structural layer
S	Specific ring stiffness
S_0	Initial specific ring stiffness
$S_{0, min}$	Minimum initial specific ring stiffness
$S_{50, creep, wet}$	Long-term specific ring creep stiffness
$\alpha_{x, wet}$	wet creep factor

3 Procedure for granting a product certificate

3.1 Initial investigation

The initial investigation to be performed are based on the (product) requirements as included in this evaluation guideline including the test methods, and comprises the following:

- Type testing to determine whether the products comply with the product and/or functional requirements;
- Production process assessment;
- Assessment of the quality system and the IQC-scheme;
- Assessment on the presence and functioning of the remaining procedures.

3.2 Granting the product certificate

After completion of the initial investigation, the results are presented to the Decision maker (see 10.2) deciding on granting the certificate. This person evaluates the results and decides whether the certificate can be granted or if additional information and/or investigations are necessary.

4 Requirements and test methods: liners

4.1 General

This chapter describes the product requirements to which the cured in place pipes (CIPP), semi-finished products and end products of the liner system must meet.

This chapter also mentions the test methods to determine compliance with the requirements. The requirements listed in the technical specification of the product will be a part of the issued product certificates.

There is a difference between "manufactured" stage (M-stage) and "installed" stage (I-stage). The "M-stage" refers to the stage, as produced before there is any processing on the job site of the components which are required for the CIPP technique. The "I-stage" refers to the stage, as installed and is related to the final configuration at the job site of the CIPP liner in the cured condition. This evaluation guideline specifies the various properties of the components and materials in both stages.

4.2 Conditions during tests

The tests shall be carried out at a temperature of (23 ± 5) °C, unless otherwise indicated in the respective sections.

If water is used during the test then this shall be tap water with a pH (7 ± 2) .

4.3 Materials

4.3.1 Requirements to avoid deterioration in the quality of drinking water

The requirements in this chapter are public law requirements.

To prevent harmful effects on the quality of drinking water, the following government imposed provisions apply.

Products and materials which (may) come into contact with drinking water or warm tap water, shall not release substances in quantities which can be harmful to the health of the consumer, or negatively affect the quality of the drinking water. Therefore, the products or materials shall meet toxicological, microbiological and organoleptic requirements as laid down in the currently applicable "Ministerial Regulation materials and chemicals drinking water and warm tap water supply", (published in the Government Gazette). Consequently, the procedure for obtaining a recognised quality declaration, as specified in the currently effective Regulation, has to be concluded with positive results.

Products and materials with a quality declaration¹, e.g. issued by a foreign certification institute, are allowed to be used in the Netherlands, provided that the Minister has declared this quality declaration equivalent to the quality declaration as meant in the Regulation.

4.4 Liners in the M stage

The M stage refers to the stage, as manufactured before there is any processing on the job site of the components which are required for the CIPP technique.

¹ A quality declaration issued by an independent certification institute in another member state of the European Community or another state party to the agreement to the European Economic Area, is equivalent to a recognized quality declaration, to the extent that, to the judgment of the Minister of the first mentioned quality declaration, is fulfilled the at least equivalent requirements as meant in the Regulation materials and chemicals drinking water- and warm tap water supply.

4.4.1 Components of the lining tube

The lining tube shall comprise at least the following components:

- Resin system;
- Carrier material.

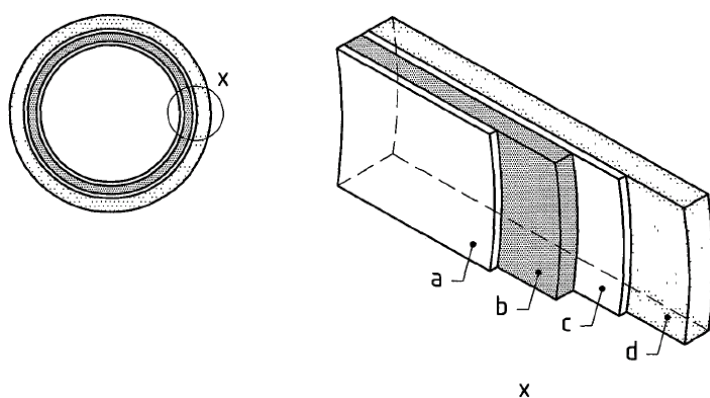
In addition, they may optionally comprise:

- Reinforcement;
- Internal membrane or temporary membrane;
- External membrane.

For the relationship between these components, see figure 4.1

Note 1. For some liner systems, the external membrane has the same function as a preliner.

Note 2. In the M-stage, no requirements are imposed on the geometry.



Key

- a internal or temporary membrane
- b composite: resin in carrier material/reinforcement
- c external membrane
- d existing pipeline

Figure 4.1 - Typical wall construction of the lining tube.

The components of the liner shall conform to the classification according to Table 4.1. Here, the materials used for each component shall be declared to Kiwa, see 4.4.1.

Table 4.1 – specification of the liner on the basis of the materials used

Components	Materials
Resin system: <ul style="list-style-type: none"> • Resin type • Filler type • Curing system 	e.g. UP, VE or EP None, inorganic or organic Heat-initiated, light initiated or ambient cure
Carrier material/reinforcement	e.g. polymeric fibres: PA, PAN, PEN, PET or PP. Glass fibres specified according to ISO 25780: clause 4.2.2. Combination of the above fibres ¹⁾
Membranes	Unrestricted ²⁾
<ol style="list-style-type: none"> 1. Where a combination of fibres is used, the proportions by mass of each fibre type shall be declared to within 5% 2. As there are no requirements for membranes, there are also no restrictions on the choice of materials used for membranes. 	

4.5 Liners in the I stage

This section contains the requirements for the liner system in the I stage, i.e. after installation and cure of the lining tube.

4.5.1 Declaration of the materials/components of the liner system

For each liner system the construction of the liner, the materials and components used, dimensions and tolerances must be specified to Kiwa, in terms of:

- Description of the structure and dimensional drawing of the liner(s);
- Description of the structure and dimensional drawing of the joints;
- If relevant, definition and composition of the seal;
- Tolerances (dimensions, properties, materials);
- Product names and product types of materials / components;
- Technical specifications (properties) of the materials / components (what material, dimensions, mechanical and physical properties);
- Whether any membranes used is an integral part of the liner.

4.5.2 Simulated installation and sampling for initial investigation (type testing)

Simulated installations are needed in order to provide test pieces for performing the type tests (initial investigation in order to obtain the certificate).

Given that the processing of CIPP, irrespective of curing system, is sensitive to heat loss to the existing pipeline and surroundings, the thermal environment of simulated installations shall be controlled in such a way that the simulated installation matches the installation conditions on the job site. The supplier of the product shall prove this to Kiwa.

Test pieces for carrying out type testing on a CIPP liner and if applicable, the combination of CIPP liner and joints (test set-up) shall be made according to the guidelines (manual) of the supplier of the liner system.

The producer of the liner system shall provide a detailed description of the simulated installation. This description shall be assessed and approved by Kiwa before the type tests are carried out for the purpose of obtaining the certificate.

Simulated installations shall be inspected by the Kiwa.

4.5.3 Conditioning of the test pieces

For the purpose of carrying out tests, test pieces shall be at least 24 hours old.

If not otherwise stated, the test pieces shall be conditioned at least 24 hours prior to testing at a temperature of (23 ± 5) °C.

4.5.4 Impregnation of the liner at factory location

Impregnation of the liner at the factory location is to be done under controlled circumstances. Impregnation on location is not allowed.

For impregnating the liner it is mandatory that a properly functioning impregnating system is present. The storage and preparation of the materials to be used are to be performed according to the instructions as provided by the producer(s) of the materials. This means for example that storage of the resin or the impregnated sockets takes place at the required temperature and for the maximum time allowed. The storage of reagents should take place in temperature controlled storage tanks.

A correct impregnation of the liner material can only take place if a vacuum is applied and taking into account a specified distance between the impregnation rolls (calibration height)..

The process parameters are to be registered.

The producer shall use equipment as specified by the supplier of the liner system (if specific equipment is required and if prescribed).

The producer shall have a procedure (manual) implemented to show that relevant registrations take place, for example in relation to:

- Condition of the resin components prior to mixing
- Procedure and method of recording considering the:
 - Mixing process;
 - Amounts of the separate components mixed;
 - Maintaining the vacuum during the mixing and impregnation of the liner;
 - Correct amount of resin per liner length.

4.6 Classification

4.6.1 General

The liners are classified on the basis of the nominal stiffness (SN), the nominal diameter (DN) of the pipe to be renovated and the nominal pressure (PN). See Tables 4.2 and 4.4.

4.6.2 Nominal stiffness

The nominal stiffness (SN) is an alphanumeric designation for stiffness classification of pipes, The nominal stiffness shall conform to one of those given in table 4.2.

In table 4.2 the common stiffness classes and their corresponding minimum initial specific ring stiffness values are listed.

Table 4.2 – Stiffness class (SN) and minimal initial specific ring stiffness

SN	S _{0,min}
630	630
1250	1250
2500	2500
5000	5000
10000	10000
The minimum initial specific ring stiffness shall be determined according to ISO 7685	

The specific ring stiffness (S) should be directly measured according to ISO 7685 and is related to the modulus of elasticity (E), the mean diameter $d_m = d_{em} - e$, and the wall thickness (e) of the pipe according to:

$$S = \frac{E}{12} \times \left(\frac{d_m}{e} \right)^{-3};$$

and alternatively, may be used to calculate the minimum specific ring stiffness on the basis of the - for a liner with a specific wall construction - declared modulus of elasticity and wall thickness for various diameters.

According to ISO 7685 the specific ring stiffness is calculated using the wall thickness, e, which is the average of the measured wall thickness of the liner sample. For classification purposes the composite thickness shall be used. For details about the definition of the composite thickness see NEN-EN-ISO 11296-4:2011 annex B.4.1.

When the initial specific ring stiffness of a liner sample is determined results shall be reported in accordance with ISO 7685:1998: clause 9 “Test report” and reporting of the composite thickness of each test piece.

See below in table 4.3 an example of a classification which can be included in the certificate to be issued.

Table 4.3 – Example of classification on the basis of the stiffness class (SN)

Liner construction and nominal thickness (mm)	Maximal diameter (mm)	Stiffness class (SN)
Liner construction type I with corresponding declared modulus of elasticity (E = MPa) and declared wall thickness (h _c) .. mm	100	e.g. 2500
	200	○ ..
	300	○ ..
	400	○ ..
	500	○ ..
	700	○ ..
Liner construction type II with corresponding declared modulus of elasticity (E = MPa) and declared wall thickness (h _c) .. mm	1000	○ ..
	100	e.g. 5000
	200	○ ..
	300	○ ..
	400	○ ..
	500	○ ..
700	○ ..	
1000	○ ..	

4.6.3 Nominal Pressure

The nominal pressure (PN) is an alphanumeric designation for the classification of pipes, with the same numeric value corresponding to the internal pressure which a fitting or pipe can withstand at continuous use.

In table 4.4 the nominal pressures and their corresponding specified minimum failure pressures are listed

Table 4.4 – Nominal pressures (PN)

PN	p _{50,s,min}
1 ¹⁾	1
2,3	2,3
4	4
6	6
10	10
12,5	12,5
16	16
20	20
25	25
32	32

1. Piping systems classified as PN 1 are used in gravity applications.

For the classification of liners to their nominal pressure shall be as follows.

Using the data obtained from the tests performed in accordance with EN 1447 and the extrapolation procedure detailed in ISO 10928, determine the extrapolated long-term failure pressure at 50 years (p_{50,min}). The specified minimum failure pressure after 50 years is (p_{50,s,min}) is given by:

$$p_{50,s,min} = \frac{p_{50,min}}{FS}$$

where:

FS is factor of safety = 2.

4.7 Imposing requirements on the liner

4.7.1 General: type test groups

The relevant type tests shall be conducted on a series or family of liners that belong to the same test group. A test group consists of a range or family of products made such that the results of the (type) testing are applicable to all products in the group.

For a test group applies that the liners in this group:

- Are produced by means of the same process;
- Have the same material specification;
- Have the same wall structure such as: sequence of layers, material properties and design method;
- Are tested under the same test conditions (e.g., uniaxial or biaxial load);
- Have dimensions of DN that comply to table 4.5.

The relevant type tests shall be conducted on a series or family of liners that belong to the same group in terms of materials and construction. Such a series or family of liners is called a type test group.

Table 4.5 – Type test groups

Group	Nominal size (DN)
1	$100 \leq DN < 600$
2	$DN \geq 600$

Conformity testing may be used to assess for example if similar components of the liner system - but delivered by different suppliers - fulfil the requirements and belong to the same type test group of liners. This prevents a frequent execution of type testing. The conformity testing shall be agreed upon between the various suppliers and Kiwa as part of the application process to be able to certify the liner system.

The certificate holder shall document and record the various type test groups that cover the product range listed on his certificate after approval of the certification body.

4.7.2 Wall thickness, wall construction and density

The thickness and relative position of each component layer of the liner, including tolerances, shall be specified as declared values. The wall structure shall be verified by means of visual assessment of the cross section of the test piece, which may be enlarged if necessary, and wherein use is made of a calliper and / or wall thickness measuring tool having an accuracy of at least 0.1 mm. Measurements shall be performed at a temperature of (23 ± 2) °C in accordance with NEN-EN-ISO 3126. See further table 4.6.

Table 4.6 – Wall thickness, wall construction and density

Property	Requirement	Test method
Construction of the wall	declared wall thickness and relative position of each layer	Manual supplier (certificate holder)
Mean wall thickness (e_m)	Not less than the design wall thickness	See section 4.7.2.1
Mean wall thickness of the structural layer- (h_c)	Not less than the design wall thickness	See section 4.7.2.2
Minimum wall thickness ¹⁾ (e_{min})	$e_{min} \geq 80\%$ of design wall thickness (e_n = nominal wall thickness = design wall thickness) $e_{min} \geq 3$ mm	See section 4.7.2.3
Density	> 90% of declared value	NEN-EN-ISO 1183-1, method A, i.e. immersion method
The requirement for minimum wall thickness does not apply to those points in which the reduction in wall thickness is caused by the irregularity of the pipe to be renovated. Irregularities which touch the structural layer are not allowed.		

4.7.2.1 Measurement of the mean wall thickness

The mean wall thickness (e_m) shall be determined according to ISO 7685 at a full ring cut from the pipe under test. The cutting edges shall be smooth and perpendicular to the longitudinal axis of the pipe. Straight lines, which shall serve as reference lines are to be drawn on the inside or the outside along the length of the test piece by 60° intervals around the circumference. The mean wall thickness (e_m) is to be calculated on the basis of the 12 results of the measurements at the ends of the reference lines.

4.7.2.2 Measurement of the thickness of the structural layer

The composite thickness should be determined according to NEN-EN-ISO 11296-4:2011, annex B.4.1.

4.7.2.3 Minimum wall thickness

The minimum wall thickness is the lowest value measured according to section 4.7.2.1.

4.7.2.4 Density

Cavities by the inclusion of air (gas) in the liner should be minimized and characterized on the basis of the density of the liner material.

The density shall be determined according to NEN-EN-ISO 1183-1. The value of the density has to be declared by the producer of the liner, in combination with the respective wall construction of the liner.

4.7.3 Degree of cure of the resin in the liner

4.7.3.1 Of simulated installations

The degree of cure of the resin shall be demonstrated. Test pieces shall be taken from simulated installations which have been subjected to the same time and heat profile as the liner undergoes during installations on the job site. For all approved resin systems the relationship between the degree of cure and the Barcol 934-1 hardness shall be demonstrated. The Barcol hardness is measured at a temperature between 10-30 °C, see table 4.7. This information shall be submitted to Kiwa. With proven correlation between the degree of cure and Barcol 934-1 hardness, the latter can be used in the field.

Table 4.7 – Demonstration of cure of the resin

Resin system type	Requirement	Test parameters		Test method
		Parameter	Value	
Epoxy	Not less than declared value	Glass transition temperature (T _{mg}) Barcol 934-1	20 °C/min	NEN-EN-ISO 11357-2 or NEN-EN-ISO 6721-2 NEN-EN 59
Polyester/ Vinyl ester	Not less than declared value	Barcol 934-1		NEN-EN 59
	< 2 % of the mass of the resin system in the liner ¹⁾	Residual styrene		NEN-ISO 4901
Styrene free resin systems ²⁾	Not less than declared value	Barcol 934-1		NEN-EN 59
	< 2 % of the mass of the resin system in the liner ¹⁾	Residual monomer		NEN-ISO 4901
1. This requirement is related to the mechanical properties. 2. In an unsaturated polyester resin systems, the styrene monomer is used for curing of the resin. In innovative styrene-free resin systems, the function of styrene monomer is taken over by other types of monomer. In that case, the residual content of this monomer shall be determined using suitable chromatographic techniques.				

For all the resin systems it shall be demonstrated that the liner conforms to all the requirements that are associated with the proper curing of the resin system before the approval of the resin system can take place. This means that at least the requirements listed in Table 4.7 "Demonstration of cure of the resin" shall be fulfilled. Additionally, liner material shall meet the requirements for the prevention of deterioration in the quality of drinking water (see clause 4.3.1).

4.7.4 Degree of cure of the liner on the construction site

The degree of cure of the resin on the construction side (see, BRL 17201, part 1) may be determined using Barcol hardness is. In that case the degree of cure of the resin shall be demonstrated by means of hardness measurements on test plates which shall be exposed to the same time-temperature profile as the liner is exposed to during the installation process on the job site. The relationship between the time-temperature profile of the test plates and an installed liner shall be demonstrated by the certificate holder.

The hardness measurements shall be carried out with a Barcol 934-1 hardness meter on a non-porous portion of the cured surface of the test plates at a temperature between 10 to 30 °C according to NEN-EN 59. This means that it shall be at least meet the hardness requirements listed in Table 4.8.

Table 4.8 – Demonstration of cure of the resin.

Resin system type	Requirement	Test parameters		Test method
		Parameter	Declared value	
Epoxy	Not less than declared value	Barcol 934-1		NEN-EN 59
Polyester/ Vinyl ester	Not less than declared value	Barcol 934-1		NEN-EN 59
Styrene free resin systems	Not less than declared value	Barcol 934-1		NEN-EN 59

Alternatively, the degree of cure of the resin may be demonstrated according to the test methods listed in table 4.7.

4.7.5 Resistance to vacuum

The resistance to vacuum shall be determined using a cured liner pipe having a length not less than either 500 mm or $3 \times d_n$. The test piece is tested with a vacuum of 0,8 bar relative to atmospheric pressure for a duration of at least 2 hours and a test temperature of $(23 \pm 2) ^\circ\text{C}$

After testing the test piece shall not show any signs of delamination or other type of failure.

4.7.6 Strength and modulus

4.7.6.1 General

The requirements and test methods for strength and modulus are based on the mechanical functioning of the liner, as well as of the following data which are necessary for making a sound design (see BRL K17201 part 1):

- E_T initial modulus of elasticity;
- E_L long-term modulus of elasticity;
- σ_L long-term flexural strength;
- σ_{TL} long-term tensile strength.

The above-mentioned properties can be measured in different types of samples: flat plates, rings, curved test pieces (ring segments) and in different directions (for example, axial and circumferential direction).

In the tables, A, B and C the requirements for the different types of test samples are listed: table A – round pipe pieces, table B - curved sample, table C- flat plate.

For obtaining the technical approval with product certificate the liner shall comply to the requirements listed in table A.

For quality control, the installed liners shall be tested according to BRL-K17201 part 1, section 5.7. To be able to make a comparison between the mechanical properties of the liner installed at the job site and the mechanical properties of the liner used during the pre-certification, the corresponding tests listed in table B and / or C shall be carried out during the pre-certification.

4.7.6.2 Measured on round pipe pieces

As described in section 4.7.6.1, the properties in accordance with table A shall always be determined.

Table A – Requirements and test methods for test pieces obtained from round liner pipe rings.

Property	Requirement	Test method
Initial specific ring stiffness (S_0)	Declared value but not less than the greater of 0,25 kPa or $(0,125/\alpha_{50,dry})$ kPa	ISO 7685
Long-term specific ring creep stiffness ($S_{50,creep,wet}$). Declaration of the wet creep factor ($\alpha_{x,wet}$)	Declared value but not less than 0,2	ISO 10468
Initial circumferential tensile strength	Declared value	ISO 8521
Long-term circumferential tensile strength	Declared value of $R_{R,p}$	Section 4.7.6.2

- **Initial specific ring stiffness (S_0)**

The initial specific ring stiffness (S_0) shall be determined according to ISO 7685 taking into account the following:

1. For the pre-certification tests two test pieces shall be tested;
2. Regular checks are performed on one sample;
3. In accordance with ISO 7685, the length of the test piece shall be 300 ± 15 mm;
4. In accordance with ISO 7685, the specific initial stiffness shall be determined on three different places per test piece.

Note:

The initial specific ring stiffness is a measure of the resistance of the ring against deflection as a result of a load.

The specific ring stiffness is determined by means of the test described in ISO 7685 and is defined as follows:

$$S = \frac{E \times I}{d_m^3}$$

Where:

E is the apparent modulus of elasticity, which can be derived from the results of the ring stiffness test, i.e. ISO 7685, expressed in Newtons per square meter;

d_m is the mean diameter of the pipe which is the mean external diameter, d_{me} , of the liner pipe minus the wall thickness, e;

I is the second moment of area in the longitudinal direction per meter length, in meters to the fourth power per meter and calculated as follows:

$$I = \frac{e^3}{12}$$

Wherein;

e is the wall thickness expressed in meters.

- **Long-term specific ring creep stiffness ($S_{50, creep, wet}$)**

The long-term specific ring creep stiffness shall be determined according to ISO 10468, taking into account the following:

1. For the pre-certification tests two test pieces shall be tested;
2. In accordance with ISO 10468, the length of the test piece shall be 300 ± 15 mm;
3. Extrapolation on the basis of a deflection of 50 years;
4. Reporting the results according to section ISO 10468, section 12.

Note:

The long-term specific ring creep stiffness is calculated according to:

$$S_{50, creep, wet} = S_0 \times \alpha_{50, creep, wet}$$

wherein;

S_0 is the initial specific ring stiffness according to ISO 7685;

$\alpha_{50, creep, wet}$ is the wet creep factor calculated on the basis of an extrapolated deflection after 50 years and determined according to ISO 10468.

- **Initial circumferential tensile strength**

Test pieces with the longitudinal axis in the circumferential direction of the pipe shall be tested in accordance with ISO 8521. For the pre-certification tests it shall be demonstrated which of the six methods mentioned in the standard is suitable for this type of product. Once a method has been found suitable and agreed, this method shall be used during regular inspections.

Method B, which is the so-called "split disk test", is preferred. The burst test (method A) is suitable for all types and sizes of liners. It is considered as the reference method.

- **Long-term circumferential tensile strength**

The long-term circumferential tensile strength is determined on the basis of the results of internal pressure measurement and a suitable extrapolation method.

The resistance to internal pressure is determined according to NEN-EN 1447 + A1 - with the following additions:

1. As a reference fluid in the test piece water shall be used;
2. As ambient medium outside of the test-piece water or air is to be applied;
3. The type of end sealing devices for the test shall be declared by the supplier: type 1 for testing with end thrust, or type 2 or 3 for testing without end thrust (see paragraph 5.2 of NEN-EN 1447 + A1:2013);
4. For the free length between the seals, the requirements of Table 14 of NEN-EN 1796:2013 apply;
5. If applicable, the measurement method for the determination of the strain shall be described;
6. The reporting of the test results shall comply with chapter 10 of NEN-EN 1447 + A1:2013.

At least 18 test pieces shall be tested. The times the test piece fail shall meet the requirements in table 4.9.

Table 4.9 - Minimum number of failed specimens in the respective time intervals.

Time interval t_u (hours)	Minimum number test pieces that failed in this time interval
$10 \leq t_u \leq 1.000$	4
$1.000 < t_u \leq 6.000$	3
$t_u > 6.000$	3 ¹⁾
1. At least one of these shall exceed 10000 hours.	

The extrapolation of the results should be carried out according to ISO 10928, method A and taking into account the following:

1. Determine the best-fit line through the data points (minimum 18 points) based on the equation: $\log(P) = B - A \times \log(t)$. The test pressure may optionally be substituted by the circumferential tension after conversion thereof by means of the formula for spherical vessels;
2. Calculate by means of the obtained equation, the values P_6 , at a time of 6 minutes (0.1 hour) and P_{50} , at a time of 438000 h (50 years).
3. Calculate the pressure regression ratio $R_{R,p}$ using the following equation:

$$R_{R,p} = \frac{P_{50}}{P_6}$$

$R_{R,p}$ shall be determined during the pre-certification and shall be declared by the manufacturer.

4.7.6.3 Measured on curved test pieces

As described in section 4.7.6.1, the choice of the shape of the test piece determines if the properties shall be determined according to table B or table C or both.

Table B – Requirements and test methods for test pieces obtained from curved samples taken from CIPP

Property	Requirement	Test method
measured on curved test pieces from the liner		
Flexural stress at first break ((σ_{fb}^*))	Declared value but not less than 25 MPa	NEN-EN-ISO 11296-4, annex B
Flexural strain at first break ((ϵ_{fb}^*))	Declared value but not less than 0,75 %	
Initial flexural modulus ((E_{F^*}))	Declared value but not less than 1500 MPa	
Long-term flexural modulus ((E_{FL}^*))	declared value	NEN-EN-ISO 11296-4, annex C

• **Flexural stress at first break (σ_{fb}^*) and initial flexural modulus (E_{F^*})**

The flexural stress at first break (σ_{fb}^*) and the initial flexural modulus (E_{F^*}) shall be determined according to NEN-EN-ISO 11296-4, annex B with the following addition:

1. The properties shall be determined in the circumferential direction;
2. Speed of the test shall be 2 mm per minute;
3. The mean values shall be calculated on the basis of five test pieces.

The initial flexural modulus (E_{F^*}) shall be at least equal to the declared value.

• **Long-term flexural modulus (E_{FL}^*)**

The long-term flexural modulus (E_{FL}^*) shall be determined according to NEN-EN-ISO 11296-4, annex C for testing under wet conditions, with the following additions:

1. The long-term flexural modulus shall be determined in the circumferential direction;
2. Two specimens shall be tested;
3. The time the test specimen shall be loaded during the test shall be 10000 hours;
4. The long-term flexural modulus (E_{FL}^*) shall be calculated in accordance with NEN-EN-ISO 899-2, section 7.1;
5. Under "wet conditions", the test pieces shall be exposed to water or to air with a relative humidity of 100%;
6. The long-term flexural modulus is determined by extrapolation of the results to an expected lifetime of 50 years, according to ISO 10928.

The long-term flexural moduli (E_{FL}^*) shall be at least equal to the declared value.

4.7.6.4 Measured on flat plates

As described in section 4.7.6.1, the choice of the shape of the test piece determines if the properties shall be determined according to table B or table C or both.

Table C – Requirements and test method for test pieces obtained from flat plates

Property	Requirement	Test method
Initial tensile stress at first break ((σ_T))	Declared value	NEN-EN-ISO 527-4
Initial modulus of elasticity ((E_T))	Declared value	
Flexural stress at first break ((σ_{fb}))	Declared value but not less than 25 MPa	NEN-EN-ISO 178
Initial flexural modulus ((E_F))	Declared value but not less than 1500 MPa	
Long-term flexural modulus ((E_{FL}))	Declared value	NEN-EN-ISO 899-2

• **Initial tensile stress at first break and initial modulus of elasticity**

The initial tensile stress at first break (σ_T) and initial modulus of elasticity (E_T) are determined using a flat plate sample with the same layer construction as the liners and shall be determined according to NEN-EN-ISO 527 part 4 with the following additions:

1. The initial tensile stress at first break and initial modulus of elasticity are determined in the axial direction of the pipe (0°) and perpendicular to the axial direction (the

- circumferential direction (90°). When relevant properties may be determined in other directions, e.g. at an angle of 45°;
2. The tests are performed with test pieces type 2 (strips) and if this does not lead to good results sample type 3 shall be used. Type 3 test pieces consist of a thickening glued on strips to prevent breakage at the clamping);
 3. The test speed shall be 2 mm / minute;
 4. Calculate the mean value and standard deviation based on five specimens;
 5. The tensile stress at first break ($\sigma_{t,x}$) is defined as the stress at which the first signs of fracture are recorded c.q. are visible ("first break");
 6. ϵ_t the elongation at break, elongation at $\sigma_{t,x}$;
 7. The modulus of elasticity (Young's modulus) shall be determined in accordance with section 10.3.2 of NEN-EN-ISO 527-1.
 8. "First break" in accordance with NEN-EN-ISO 11296-4, figure B.4.

The determined mean tensile stress at first break (σ_T), and the determined mean short-term modulus of elasticity (E_T) shall be at least equal to the declared value.

- **Initial flexural stress at break (σ_{fb}) and initial flexural modulus (E_F)**

The initial flexural stress at break (σ_{fb}) and initial flexural modulus (E_F) are determined using a flat plate sample with the same layer construction as the liners and is determined according to NEN-EN-ISO 178 with the following additions:

1. The initial tensile stress at first break and initial modulus of elasticity are determined in the axial direction of the pipe (0°) and perpendicular to the axial direction (the circumferential direction (90°)). When relevant properties may be determined in other directions, e.g. at an angle of 45°;
2. The dimensions of the test pieces shall comply with section 6.1.3 of NEN-EN-ISO 178: 2010;
3. The test speed shall be 2 mm / minute;
4. calculate the mean value and standard deviation based on five specimens;
5. The flexural stress at first break (σ_{fb}) is defined as the stress at which the first signs of fracture are visible ("first break");
6. ϵ_{fb} is the elongation at break elongation at σ_{fb} ;
7. The flexural modulus shall be determined in accordance with section 9.3 of NEN-EN-ISO 178:2010.

The determined mean flexural stress at first break (σ_{fb}), and the determined mean short-term flexural modulus (E_F) shall be at least equal to the declared value.

- **Long-term flexural modulus (E_{FL})**

The long-term flexural modulus (E_{FL}) is determined in accordance with NEN-EN-ISO 899-2 with the following additions:

1. The long-term flexural modulus in the circumferential direction of the liner shall be determined;
2. The dimensions of the test piece shall comply with section 6.1.3. of NEN-EN-ISO 178;
3. Two test pieces shall be tested;
4. The duration of the test shall be 10,000 hours;
5. Long-term flexural modulus (E_{FL}) shall be calculated in accordance with section 7.1 of NEN-EN-ISO 899-2;
6. The long-term flexural modulus is determined by extrapolation of the results to an expected lifetime of 50 years, according to ISO 10928.

The long-term flexural modulus (E_{FL}) shall be at least equal to the declared value.

4.8 Installation and user instructions

Before installing liners and / or components in accordance with this evaluation guideline, the installer shall verify if national and / or local requirements and relevant implementing rules including safety rules apply. The producer of the liner shall provide appropriate installation and operating instructions in the language of the country where the liner system is installed. In

addition, the instructions must address storage and transportation of the liners and associated components and refer to the instructions to meeting any applicable national laws and regulations. National regulations may require the installation should be performed by a certified installer in accordance with specified requirements (for example on the basis of BRL K17201, part 1). Instructions should describe the precautions to be taken, as well as the details of the installation process and the applicable requirements in case the liner is tested on the construction site. It is recommended to include recommendations in the instructions relating to the desired environmental conditions and the obtaining of optimum installation conditions.

5 Product requirements and test method for ductile iron fittings and their joints

5.1 General

In this chapter the product requirements and test methods are listed to which fittings made of ductile iron for cured in place pipe (CIPP) shall meet. The requirements shall be listed in the technical specification of the product that shall be a part of the issued product certificates.

The fittings e.g. couplings and saddles shall be used to make the following joints:

- Connections to the main pipeline including the connection between the liner and the existing pipeline;
- Branches in the main pipeline;
- Lateral connections;
- Connection with fire hydrants.

5.2 Product requirement and test methods

The product shall meet the requirements listed in NEN-EN 14525, except the requirements for the size (diameter range listed in section 4.1.1 of NEN-EN 14525). Because the liners has a smaller outside diameter than the inside diameter of the fitting, it is the responsibility of the fitting supplier that the fitting connects well with the liner. The dimensions shall be specified in technical drawings.

5.3 Performance testing of the joints

The joints shall exhibit no visible leakage when subjected to the tests. For a joint that can be used in the restrained and in the non-restrained configuration, only one set of tests in the restrained condition is required.

The test temperature shall be (23 ± 5) °C.

All flange adaptors and couplings shall be designed to be fully flexible; consequently, the allowable angular deflection declared by the manufacturer shall be not less than (for each wide tolerance end) :

- 3° for OD 40 mm to 315 mm or DN 32 to DN 300 ;
- 2° for OD 316 mm to 630 mm or DN 350 to DN 600.

In addition the supplier shall declare:

- annulus of the fitting it is designed for; i.e. allowed maximal radial and allowed maximal axial displacement (draw);
- Maximum misalignment i.e. maximum amount by which the centrelines of consecutive components fail to coincide.

Performance test for the leak tightness of joints shall be carried out according to EN 14525:2004 clause 7 and table 5.1 instead of table 4 listed in EN 14525:2004.

The number of test pieces for performance testing is 2.

Table 5.1 - Performance testing of the joints: requirements and test conditions

Test	Test requirements	Pipe section(s)	Test conditions
Positive internal pressure	Test pressure (bar): 1.5 x PN + 5 Test duration 2 h No leakages	Cured liner pipe	EN 14525:2004 clause 7.1.1 or 7.1.2 whatever applicable. shear force F = 0 N
Positive internal pressure and bending ¹⁾	Test pressure (bar): 1.5 x PN + 5 Test duration 2 h No leakages	Cured liner pipe	EN 14525:2004 clause 7.1.1. Additional force F shall be calculated according to ISO 8483, annex A
Negative internal pressure	Test pressure (bar): - 0.8 bar Test duration 2 h Max pressure change: 0.08 bar	Cured liner pipe	EN 14525:2004 clause 7.2.
Long term leak tightness	Test pressure (bar): 2.5 x PN Test duration 100 h No leakages	Cured liner pipe	EN 14525:2004 clause 7.1.1 or 7.1.2 whatever applicable. shear force F = 0 N
1. Test shall be performed depending on the design of the rehabilitated pipeline.			

5.4 Additional product requirements and test methods

In addition to 5.2, the following provisions apply.

5.4.1 Requirements to avoid deterioration in the quality of drinking water

The requirements in accordance with section 4.3.1 apply.

5.4.2 Rubber sealing elements and flange gaskets

Notwithstanding section 4.1.3.1 of NEN-EN 14525 rubber sealing elements shall meet the requirements described in BRL-K17504 comprising WA type or according to NEN-EN 681-1.

5.4.3 Flanges

In addition to section. 4.1.3.2 of NEN-EN 14525, non-standard flanges are allowed under the condition that for type testing the required appropriate pipes and covers are made available.

5.4.4 Surface protection layers

5.4.4.1 Coating system inside

The coating system shall meet the requirements of BRL K759. The application of the coating shall comply to BRL K746.

5.4.4.2 Coating system outside

If in addition to section 4.4.1 of NEN-EN 12842, the outside of the fitting is equipped with a protective layer, the protective layer shall comply to:

- BRL K753: External PUR coating on ductile iron pipes and fittings for underground installation;
- BRL K757: External PE coating on ductile iron pipes.

5.4.4.3 *Other coating systems*

In addition to 5.3.4.1 and 5.3.4.2 of this evaluation guideline, other coating systems that are suitable to be used for ductile iron fittings may be used provided they meet the functional and sustainability requirements listed in BRL-K759.

5.5 **Installation instructions and marking**


5.5.1 ***Installation instructions***

The supplier must establish assembly instructions available for the mounting of the fittings. The assembly instructions must provide information about the scope, support buses, minimum insertion depth, etc.

5.5.2 ***marking***

The following marks and designations shall be applied on a sound and clear manner on every product in accordance with section 4.5.1 of NEN-EN 14525.

The marks listed below must be moulded or stamped:

- Factory name and / or registered trademark;
- Kiwa Certification Mark **kiwa**  ;
- Production date or coding;
- Material Identification;
- DN and PN for flanges and flange parts;
- Reference to BRL-K17201.

5.5.3 ***Additional information***

On any product, information shall be included as defined in section 4.5.2 of NEN-EN 14525.

6 Requirements and test methods for non-ductile iron fittings and their joints

6.1 General

In principle all types of fittings and joints may be used under the condition that the performance of the fitting and the joint is proven sound for the purpose for the manufacturer's declared allowable operation pressure (PFA).

Examples of fittings / joint systems are flange adapters for glass reinforced thermosetting plastics (GPR), metal couplings with rubber gaskets etc.

6.2 Diameter range

The dimensions of the liner and other parts (e.g. fittings, valves) of the piping system shall be demonstrable attuned to each other.

6.3 Type of fittings / joints

6.3.1 General

Rubber gasket material shall comply with the requirements of BRL-K17504.

6.3.2 Prove of structural design of fittings

The structural design of a GRP fitting shall be demonstrated according to NEN-ISO 18851 and the following test parameters:

- Number of test samples for pre-certification tests is 2;
- Test temperature (23 ± 5) °C;
- Whether the fitting is or is not to be tested with end thrust.

After the fitting is subjected to specified internal pressure tests the test pieces shall show no signs of failure at the end of each of the tests.

The prove of structural design test on the GRP fitting may be combined with an appropriate leaktightness test.

The prove of structural design of metal fittings may be demonstrated also by internal pressure tests for a duration of e.g. 1 hour.

6.3.3 Performance testing of the joints

The joints shall exhibit no visible sign of damage to its components nor leak when subjected to the tests. For a joint that can be used in the restrained and in the non-restrained configuration, only one set of tests in the restrained condition is required.

The length of the test assembly shall be recorded in the quality system of the supplier after approval of Kiwa.

The number of test pieces to be used is 2.

The test temperature shall be (23 ± 5) °C.

The summary of test conditions is given in table 6.1, see also 6.3.3.1 and 6.3.3.2.

Table 6.1 – Summary of the test conditions for evaluation of the joints.

Property to be tested	Test to be performed	Test pressure / test duration	Additional requirement
External pressure differential	Negative pressure	-0.8 bar / 1 h	Max pressure change 0,08 bar/h
Resistance to bending ¹⁾	Maintained pressure	1.5 x PN / 15 min	
		2.0 x PN / 24 h	
Resistance to internal pressure	Maintained pressure	1.5 x PN / 15 min	
		2.5 x PN / 100 h	
1. Test shall be performed depending on the design of the rehabilitated pipeline.			

6.3.3.1 Flexible joints

Flexible joints between GRP fitting and liner, restrained or non-restrained, shall meet the performance requirements of ISO 7432, ISO 8639, respectively, see table 6.2.

Supporting sleeves (inserts) may be necessary depending on pipe material, on pipe wall thickness, on joint design and on local authorities. They shall provide adequate support over the entire compression area of the gasket. The manufacturer shall indicate when supporting sleeves are required.

Joint movements as defined in NEN-EN 1796:2013 figure 1 shall be declared by the supplier.

A technical drawing of the test set-up shall be provided by the supplier and documented in the quality system of the supplier after approval by Kiwa.

6.3.3.2 Non-flexible joints

Non-flexible joints between GRP fitting and liner, restrained or non-restrained, shall meet the performance requirements of ISO 8483 or ISO 8533 (whatever applicable), see table 6.2.

A technical drawing of the test set-up shall be provided by the supplier and documented in the quality system of the supplier after approval by Kiwa.

Table 6.2 – Test methods for joints between GRP fittings and the liner

Glass Reinforced Plastics (GRP)	Remarks
ISO 8639 - Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Test methods and proof of structural design of flexible joints.	Test performed using a test rig able to take the axial end thrust and permit free longitudinal movement.
ISO 7432 - Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Test methods to prove the design of locked socket-and-spigot joints, including double-socket joints, with elastomeric seals.	Test performed with end-sealing devices securely fixed to the pipes to transmit the end thrust loads to the pipes.
ISO 8483 - Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Test methods to prove the design of bolted flange joints	
ISO 8533 - Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Test methods to prove the design of cemented or wrapped joints	

Metal fittings / joint shall be tested for leaktightness by the relevant test method which has to be approved by Kiwa. The test methods listed in table 6.2 may be used as guidance.

7 Marking

7.1 General

The individual components of the liner system (except fittings, see chapter 5) will not be marked with the KIWA certification mark.

Each part shall be marked - on the product itself or its packaging - with the following marks:

- Name of the producer;
- Production date or coding;
- Type designation.

A certified supplier of the liner system, may use the KIWA certification mark (see below) in combination with the certificate number. For example in: quotations, brochures, website, etc.



Kiwa Certification Mark

8 Requirements in respect of the quality system

This chapter contains the requirements which have to be met by the supplier's quality system.

8.1 Manager of the quality system

Within the supplier's organizational structure an employee must have been appointed who is in charge of managing the supplier's quality system.

8.2 Internal quality control/quality plan

The supplier shall have an internal quality control scheme (IQC scheme) which is applied by him.

The following must have been demonstrably recorded in this IQC scheme:

- What aspects are checked by the producer;
- According to what methods such inspections are carried out;
- How often these inspections are carried out;
- In what way the inspection results are recorded and kept.

This IQC scheme should at least be an equivalent derivative of the model IQC scheme included in the addendum.

8.3 Control of test and measuring equipment

The supplier shall verify the availability of necessary test and measuring equipment for demonstrating product conformity with the requirements in this evaluation guideline. When required the equipment shall be kept calibrated (e.g recalibration at interval). The status of actual calibration of each equipment shall be demonstrated by traceability through an unique ID.

The supplier must keep records of the calibration results.

The supplier shall review the validity of measuring data when it is established at calibration that the equipment is not suitable anymore.

8.4 Procedures and working instructions

The supplier shall be able to submit the following:

- Procedures for:
 - Dealing with products showing deviations;
 - Corrective actions to be taken if non-conformities are found;
 - Dealing with complaints about products and/or services delivered;
- The working instructions and inspection forms used.

8.5 Other requirements imposed on the quality system

In case the quality system of the supplier is certified on the basis of ISO 9001, a combination can be made with the IQC-scheme.

9 Summary of tests and inspections

This chapter contains a summary of the following tests and inspections to be carried out in the event of certification:

- Pre-certification tests;
- Control after certification;
- Control of the supplier's the quality system.

It is also indicated at which frequency inspections are performed by Kiwa.

9.1 Test matrix

Description of requirements	Clause BRL	Tests within the scope of:		
		Pre-certification ³⁾	Control after issue of the certificate ^{1), 2)}	
			Control	Frequency
Product requirements liner				
Toxicological requirements	4.3.1	x	x	1
Components of the liner tube	4.4.1	x	x	each inspection
Declaration of materials / components	4.5.1	x	x	each inspection
Simulated installations and sampling	4.5.2	x	-	-
Conditioning of the test pieces	4.5.3	x	-	-
Classification	4.6	x	x	each inspection
Wall thickness, wall construction and density	4.7.2	x	x	each inspection (control dimensions)
Degree of cure of the resin	4.7.3	x	-	-
of simulated installations	4.7.3.1	x	-	-
of the liner on the construction site	4.7.4	x	-	-
Resistance to vacuum	4.7.5	x	-	-
Strength and modulus	4.7.6	x	-	-
Installation instructions	4.8	x	-	-
Product requirements ductile iron fittings / joints				
Product requirements and test methods	5.2	x	x	each inspection (control of dimensions and material properties)
Performance testing of the joints	5.3	x	x	-
Additional product requirements	5.4	x	x	1
Installation instructions and marking	5.5	x	x	each inspection
Product requirements not ductile iron fittings / joints				
General	6.1	x	-	-
Diameter range	6.2	x	-	-
Type of fitting / joints	6.3	x	-	-
Other				
Marking	7	x	x	each inspection
Control of IQC scheme	8	x	x	each inspection
<ol style="list-style-type: none"> 1. In case the product or production process changes significantly, the (performance) requirements shall be determined again. 2. The controls shall be carried out by the inspector or by the supplier, whether or not in attendance by the inspector. 3. Manufacturer made products shall be used for pre-certification. 				

9.2 Inspection of the quality system

The quality system will be checked by Kiwa on the basis of the IQC scheme.

The inspection contains at least those aspects mentioned in the Kiwa Regulations for Product certification

10 Agreements on the implementation of certification

10.1 General

Beside the requirements included in these evaluation guidelines, the general rules for certification as included in the Kiwa Regulations for Product Certification also apply. These rules are in particular:

- The general rules for conducting the pre-certification tests, in particular:
 - The way suppliers are to be informed about how an application is being handled;
 - How the test are conducted;
 - The decision to be taken as a result of the pre-certification tests;
- The general rules for conducting inspections and the aspects to be audited;
- The measures to be taken by Kiwa in case of Non-Conformities;
- The measures taken by Kiwa in case of improper use of Certificates, Certification Marks, Pictograms and Logos;
- Terms for termination of the certificate;
- The possibility to lodge an appeal against decisions of measures taken by Kiwa.

10.2 Certification staff

The staff involved in the certification may be sub-divided into:

- Certification assessor (**CAS**): in charge of carrying out the pre-certification tests and assessing the inspectors' reports;
- Site assessor (**SAS**): in charge of carrying out external inspections at the supplier's works;
- Decision maker (**DM**): in charge of taking decisions in connection with the pre-certification tests carried out, continuing the certification in connection with the inspections carried out and taking decisions on the need to take corrective actions.

10.2.1 Qualification requirements

The qualification requirements consist of:

- Qualification requirements for personnel of a certification body which satisfies the requirements EN ISO / IEC 17065, performing certification activities
 - Qualification requirements for personnel of a certification body performing certification activities set by the Board of Experts for the subject matter of this evaluation guideline
- Education and experience of the concerning certification personnel shall be recorded demonstrably.

Basic requirements	Evaluation criteria
Knowledge of company processes Requirements for conducting professional audits on products, processes, services, installations, design and management systems.	<i>Relevant experience: in the field</i> SAS, CAS : 1 year DM : 5 years inclusive 1 year with respect to certification Relevant technical knowledge and experience on the level of: SAS : High school CAS, DM : Bachelor
Competence for execution of site assessments. Adequate communication skills (e.g. reports, presentation skills and interviewing technique).	SAS : Kiwa Audit training or similar and 4 site assessments including 1 autonomic under review.
Execution of initial examination	CAS : 2 initial audits under review.
Conducting review	CAS : conducting 2 reviews

Technical competences	Evaluation Criteria
Education	General: Education in one of the following technical areas: <ul style="list-style-type: none"> • Civil Engineering; • Engineering.
Testing skills	General: <ul style="list-style-type: none"> • 1 week laboratory training (general and scheme specific) including measuring techniques and performing tests under supervision ; • Conducting tests (per scheme).
Experience - specific	CAS <ul style="list-style-type: none"> • 1 complete application (excluding the initial assessment of the production site) under the direction of the PM • 1 complete application self-reliant (to be evaluated by PM) • 1 initial assessments of the production site under the direction of the PM • 1 initial assessment of the production site self-reliant (witnessed by PM) SAS <ul style="list-style-type: none"> • 2 inspection visits together with a qualified SAS • 1 inspection visits conducted self-reliant (witnessed by PM)
Skills in performing witnessing	PM Internal training witness testing

Legenda:

- Certification assessor (**CAS**)
- Decision maker (**DM**)
- Product manager (**PM**)
- Site assessor (**SAS**)

10.2.2 Qualification

The qualification of the Certification staff shall be demonstrated by means of assessing the education and experience to the above mentioned requirements. In case staff is to be qualified on the basis of deflecting criteria, written records shall be kept.

The authority to qualify staff rests with the:

- **PM**: qualification of **CAS** and **SAS**;
- Management of the certification body: qualification of **DM**.

10.3 Report initial investigation

The certification body records the results of the initial investigation in a report.

This report shall comply with the following requirements:

- Completeness: the report provides a verdict about all requirements included in the evaluation guideline;
- Traceability: the findings on which the verdicts have been based shall be recorded and traceable;
- Basis for decision: the **DM** shall be able to base his decision on the findings included in the report.

10.4 Decision for granting the certificate

The decision for granting the certificate shall be made by a qualified Decision maker which has not been involved in the initial investigation. The decision shall be recorded in a traceable manner.

10.5 Layout of quality declaration

The technical approval-with-product certificate shall be in accordance with the model included in the Annex.

10.6 Nature and frequency of third party audits

The certification body shall carry out surveillance audits on site at the supplier at regular intervals to check whether the supplier complies with his obligations. The Board of Experts decides on the frequency of audits.

At the time this BRL entered into force, the frequency of audits amounts 2 audit(s) on site per year for suppliers with a quality management system in accordance with ISO 9001 for their production, which has been certified by an acknowledged body (in accordance with ISO/IEC 17021) and where the IQC scheme forms an integral part of the quality management system.

Inspections shall at least refer to:

- The suppliers IQC-scheme and the results obtained from inspections carried out by the supplier;
- The correct way of marking of certified products;
- Complying with required procedures.

The results of each audit shall be recorded by Kiwa in a traceable manner in a report.

10.7 Report to the Board of Experts

De certification body shall report annually about the performed certification activities. In this report the following aspects are included:

- Mutations in number of issued certificates (granted/withdrawn);
- Number of executed audits in relation to the required minimum;
- Results of the inspections;
- Required measures for established Non-Conformities;
- Received complaints about certified products.

10.8 Non conformities

When the certification requirements are not met, measures are taken by Kiwa in accordance with the sanctions policy, namely:

What is published on the Kiwa service portal (www.kiwa.nl) in the corresponding guideline.

10.9 Interpretation of requirements

The Board of Experts may record the interpretation of requirements of these evaluation guidelines in one separate interpretation document.

11 Titles of standards

11.1 Public law rules

"Staatscourant" (Dutch Government Gazette) from 18 July 2011, no. 11911	"Regeling Materialen en Chemicaliën drink- en warm tapwatervoorziening" (Regulation on materials and chemicals drinking water and warm tap water supply)
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11.2 Standards / normative documents

Number	Title	Version*
BRL-K746	Het appliceren van coatingssystemen ten behoeve van drinkwatertoepassingen	
BRL-K753	Uitwendige PUR bekleding op nodulair gietijzeren buizen en fittingen voor ondergrondse installatie	
BRL-K757	Uitwendige PE bekleding op nodulair gietijzeren buizen	
BRL-K759	Coatingssystemen ten behoeve van drinkwatertoepassingen	
BRL-K17201, deel 1	Kunststof leidingsystemen voor de renovatie van drinkwaterleidingen – Deel 1 – Het ontwerp en de installatie van ter plaatse uithardende buis (CIPP) – fabrieksmatig geïmpregneerde linersystemen	
BRL-K17504	Gevulkaniseerde rubber afdichtingsringen voor drinkwaterleidingen	
NEN-EN 59	Glass reinforced plastics - Determination of indentation hardness by means of a Barcol hardness tester	February 2016
NEN-EN-ISO 178	Plastics - Determination of flexural properties	October 2013
NEN-EN 681-1/ • A1:1998 • A2:2002 • C1:2002 • A3:2005	Elastomeric seals - Materials requirements for pipe joint seals used in water and drainage applications - Part 1: Vulcanized rubber	March 1996, August 1998, April 2002, October 2002, September 2005
NEN-EN 805	Water supply - Requirements for systems and components outside buildings	February 2000
NEN-EN-ISO 527-1	Plastics - Determination of tensile properties - Part 1: General principles	March 2012
NEN-EN-ISO 527-4	Plastics - Determination of tensile properties - Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites	June 1997
NEN-EN-ISO 899-2	Plastics - Determination of creep behaviour - Part 2: Flexural creep by three-point loading	July 2003
NEN 1006	Algemene voorschriften voor leidingwaterinstallaties	September 2015
NEN-EN-ISO 1183-1	Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pycnometer method and titration method	December 2012
NEN-EN 1447 + A1: 2010	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipes - Determination of long-term resistance to internal pressure	October 2010
NEN-EN 1796	Plastics piping systems for water supply with or without pressure - Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP)	February 2013
NEN-EN-ISO 3126	Plastics piping systems - Plastics components - Determination of dimensions	July 2005
NEN-ISO 4901	Reinforced plastics based on unsaturated-polyester resins - Determination of the residual styrene monomer content, as well as the content of other volatile aromatic hydrocarbons, by gas chromatography	August 2011
NEN-EN-ISO 6721-2	Plastics - Determination of dynamic mechanical properties - Part 2: Torsion-pendulum method	June 2008

ISO 7432	Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Test methods to prove the design of locked socket-and-spigot joints, including double-socket joints, with elastomeric seals	July 2002
ISO 7685	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipes - Determination of initial specific ring stiffness	July 1998
ISO 8483/ Amd 1:2012	Glass-reinforced thermosetting plastics pipes and fittings - Test methods to prove the design of bolted flange joints	December 2003 February 2012
ISO 8521	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipes - Test methods for the determination of the apparent initial circumferential tensile strength	August 2009
ISO 8533	Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Test methods to prove the design of cemented or wrapped joints	March 2012
ISO 8639	Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Test methods for leaktightness and proof of structural design of flexible joints	Februari 2016
NEN-EN-ISO 9001	Quality management systems - Requirements	October 2015
ISO 10467/ Amd 1:2012	Plastics piping systems for pressure and non-pressure drainage and sewerage - Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin	February 2004/ March 2004
ISO 10468	Glass-reinforced thermosetting plastics (GRP) pipes - Determination of the long-term specific ring creep stiffness under wet conditions and calculation of the wet creep factor	December 2003
ISO 10928/ Amd 1	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Methods for regression analysis and their use	September 2009/ July 2013
NEN-EN 12842	Ductile iron fittings for PVC-U or PE piping systems - Requirements and test methods	September 2012
NEN-EN 14525	Ductile iron wide tolerance couplings and flange adaptors for use with pipes of different materials: ductile iron, Grey iron, Steel, PVC-U PE, Fibre-cement	November 2004
NEN-EN-ISO 11296-1	Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks - Part 1: General	May 2011

NEN-EN-ISO 11296-4	Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks - Part 4: Lining with cured-in-place pipes	May 2011
NEN-EN-ISO 11357-2	Plastics - Differential scanning calorimetry (DSC) - Part 2: Determination of glass transition temperature and glass transition step height	April 2014
NEN-EN-ISO/IEC 17020	Conformity assessment - General criteria for the operation of various types of bodies performing inspection	March 2013
NEN-EN-ISO/IEC 17021	Conformity assessment - Requirements for bodies providing audit and certification of management systems	July 2015
NEN-EN-ISO/IEC 17024	Conformity assessment - General requirements for bodies operating certification of persons	July 2012
NEN-EN-ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories	July 2005
NEN-EN-ISO/IEC 17065	Conformity assessment - Requirements for bodies certifying products, processes and services	September 2009
NEN-ISO 18851	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipes and fittings - Test method to prove the structural design of fittings	April 2015
NEN-ISO 25780	Plastics piping systems for pressure and non-pressure water supply, irrigation, drainage or sewerage - Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin - Pipes with flexible joints intended to be installed using jacking techniques	May 2011
VEWIN Richtlijn Drinkwaterleidingen buiten gebouwen - Ontwerp, aanleg en beheer (gebaseerd op NEN-EN 805)		

I Model Kiwa technical approval with product certificate (infomatory)

See the next page for the model of the cover page of the Kiwa technical approval with product certificate.

Technical approval-with-product certificate
K12345

Issued YYYYY-MM-DD

Replaces

Page: 1 of 3

Certificate

Renovation of drinking water piping systems – part 2 –
Products for cured in place pipes (CIPP) – factory
impregnated liner systems

Certificate holder**DECLARATION OF KIWA**

This technical approval-with-product certificate is issued on the basis of Kiwa evaluation guideline K17201 "Renovation of drinking water piping systems – Part 2 – Products for cured in place pipes (CIPP) – factory impregnated liner systems", in accordance with the Kiwa Regulations for Product Certification.

Kiwa declares that legitimate confidence exists that the by the producer manufactured CIPP liner tubes comply with the technical specifications as laid down in this product certificate provided that they have been marked with the Kiwa mark in the manner as indicated in this technical approval-with-product certificate.

L. Leroy
Kiwa

The publication of this certificate is allowed.
Advice: consult www.kiwa.nl in order to ensure that this certificate is still valid.

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II Model IQC-scheme (informatory)

<p><u>IQC-schedule</u></p> <p><u>INTERNAL QUALITY PLAN</u></p>	<p>Manufacturer / supplier : Production location address :</p>	<p>Number of appendices:</p>
<p><u>Field(s) of application</u></p> <p><u>According Evaluation Guideline(s)</u></p>		
<p><u>Number of production shifts:</u></p>	<p><u>Quality manual, procedures and working instructions</u></p> <p>Is the Quality Management System (QMS) certified according to ISO 9001¹⁾? If yes, by which certification body: If yes, is the certification body accredited for the particular scope of certification? The following procedure for dealing with <u>complaints</u> applies:</p>	
<p><u>Quality Control</u></p> <p>Total number of employees in QC department : Number of QC-operators per shift :</p> <p>If no QC-inspections are carried out during night shifts, state the QC procedure(s)/instruction(s) to be followed: , documented in:</p>	<p>In case the QMS is <u>not</u> certified according to ISO 9001:</p> <ul style="list-style-type: none"> • Working instructions, test instructions and procedures are documented as follows: • The following procedure for <u>nonconformity review</u> applies: 	
<p><u>Inspection and test records</u></p> <p>All records shall be maintained for a minimum of years.</p>	<p>Signature of the manufacturer/supplier:</p> <p>Date :</p>	
<p><u>Specific agreements/comments/explanations</u></p>		

¹⁾ In case the QMS is ISO 9001 certified and covers the scope of the product certificate(s), reference to the applicable procedure(s) on the next pages is sufficient and the tables A till F do in principle not have to be further filled-out except for the frequency of tests/inspections (to be approved by Kiwa) in tables B, C and D.

A. Calibration of measuring and test equipment				
Applicable procedure(s) nr(s):				
Equipment to be calibrated	Calibration aspect	Calibration method	Calibration frequency	Calibration file (name and location)

B. Raw material and additives				
Applicable procedure(s) nr(s):				
B.1 Receipt				
For each delivery of raw material or additives data with respect to dates, producers, types and quantities are recorded as follows:				
B.2 Entry control				
Type of raw material	Inspection aspect	Inspection method	Inspection frequency	Registration file (name and location)

C. Batch release tests per machine (including in-process and finished product testing)				
Applicable procedure(s) nr(s):				
Production process(es):				
Type of product	Type of test	Test method	Test frequency	Registration file (name and location)

Specific agreements/comments/explanations:

D. Process verification tests Applicable procedure(s) nr(s):				
Type of product	Type of test	Test method	Test frequency	Registration file (name and location)

E. Control of nonconforming and/or rejected products Applicable procedure(s) nr(s):				
E.1 Method of registration				
E.2 Method of identification				
E.3 Method of nonconformity review and disposition				

F. Inspection with regard to packaging, storage and transportation of the finished product Applicable procedure(s) nr(s):				
Inspection aspects		Inspection method	Inspection frequency	Registration file (name and location)
F.1 Packaging/storage/ transportation etc				

Specific agreements/comments/explanations:

Raw materials list (not required to fill-out this appendix in case reference can be made to the Kiwa ATA part of the certification agreement)		Appendix I Date:
I.1	<p>The product is built-up of the following raw materials:</p> <p>a) In case of products made from ready-made raw materials: listing of name and/or unique code of the raw material(s);</p> <p>b) In case of products made from own compounded raw materials: reference to raw material/compound sheets which are (only) available at the production location and which have to be authenticated by Kiwa (e.g. by the Kiwa inspector);</p> <p>c) In case of composed products (e.g. plastics fitting body, with separate nut, clamp ring and rubber sealing ring): of each part a specification according to a) or b) (whatever applicable).</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p> <p>-</p>	

List of technical drawings			Appendix II Date:.....
Drawing title and number	Drawing date	Drawing title and number	Drawing date