BRL K17104

2025-01-15

Evaluation Guideline

for the Kiwa (technical approval-with-)product certificate for Plastics piping systems for water supply with or without pressure – Glass-reinforced thermosetting plastics (GRP) based on epoxy resin (E) with filament wound pipes

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Preface

This Evaluation Guideline (BRL) has been accepted by the Kiwa Board of Experts Watercycle (CWK), in which all relevant parties in the field of glass fibre reinforced epoxy piping systems with filament wound pipes intended for the transport of drinking water and raw water are represented. This Board of Experts also supervises the certification activities and will adjust this BRL if required. All references to Board of Experts in this evaluation guideline pertain to the above mentioned Board of Experts.

This evaluation guideline will be used by Kiwa in conjunction with the Kiwa Regulations for Certification, which include the general rules employed by Kiwa for its certification activities.

The following parts of this BRL have been modified:

- Several general and standard texts have been revised to comply with the new (Dutch and English) Kiwa BRL template.

Kiwa Nederland B.V.

Sir Winston Churchilllaan 273

Postbus 70

2280 AB RIJSWIJK

Telephone: Tel. +31 88 998 44 00
NL.Kiwa.info@Kiwa.com
www.kiwa.com

Binding declaration
This evaluation guideline has been declared binding by Kiwa effective 22 November 2024.

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Contents

1 Introduction

1.1 General

This evaluation guideline includes all relevant requirements which are employed by Kiwa when dealing with applications for the issue and maintenance of a certificate for products used for glass fibre reinforced epoxy piping systems with filament wound pipes intended for the transport of drinking water.

This evaluation guideline replaces BRL-K17104 dated 2016-09-30.
In any case, the quality declarations issued on the basis of the latest BRL will lose their validity after three months of validation of this BRL.

When carrying out certification activities, Kiwa is bound by the requirements laid down in NEN-EN ISO/IEC 17065.

1.2 Field of application / scope

The products are intended to be used for the transport of drinking water and raw water at temperatures up to 50 °C. The products with nominal size from DN 25 to DN 3000 can be used in under and above ground applications. The pipes and fittings are provided with tensile resistant and non-tensile resistant joints with or without rubber sealing elements.

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 17021-1 for certification bodies certifying management 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, processes and services.

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 recognition and acceptance of accreditation has been concluded by the Board of Accreditation. If no certificate of accreditation can be submitted, the certification institution itself will verify if the accreditation criteria have been met.

1.4 Quality declaration

The quality declaration to be issued by Kiwa is described as a Kiwa (technical approval-with-)product certificate.
A model of the (technical approval-with-)product 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 General

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

- **Board of Experts**: the Board of Experts Watercycle (CWK).

- **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.

- **Drinking water**: water intended or partly intended for drinking, cooking or food preparation or other domestic purposes, excluding hot tap water, which is made available by pipeline to consumers or other customers (source Dutch drinking water act*);*

- **Evaluation Guideline (BRL)**: the agreements made within the Board of Experts on the subject of certification.

- **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 evaluation guideline.

- **Household water:** non-potable water that may only be used within premises for flushing toilets (source Dutch Drinking Water Act).

- **IQC scheme (IQC):** a description of the quality inspections carried out by the supplier as part of his quality system.

- **Initial investigation**: The initial evaluation of the supplier and the investigation of the relevant products for the first issuance of a certificate.

- **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 be deemed, on delivery, to comply with the product specification recorded in the product certificate.

- **Product requirements**: requirements made specific by means of measures or figures, focussing on (identifiable) characteristics of products and containing a limiting value to be achieved, which can be calculated or measured in an unequivocal manner.

- **Supplier**: the party that is responsible for ensuring that the products meet and continue to meet the requirements on which the certification is based.

- **Tap water**: water intended or partly intended for drinking, cooking or food preparation or other domestic purposes;
  Remark: Tap water can be drinking water, warm tap water or household water;

2.2 Quality control

2.2.1 Audit

The systematic assessment by Kiwa of the product to be certified against the requirements and guidelines declared applicable. An audit is aimed at ascertaining whether the supplier concerned meets the requirements and guidelines imposed and makes proper use of the certificate, the certification mark and, where applicable, the accompanying logos and labels.

2.2.2 Audit test (AT)

Test performed by a test laboratory on behalf of an inspection body or certification body to confirm that the product continues to conform to the requirements given in the relevant standard and to provide information to assess the effectiveness of the quality management system.

2.2.3 Batch release test (BRT)

Test performed by or on behalf of the producer on a batch of products, which has to be satisfactorily completed before the batch can be released.

2.2.4 Process verification test (PVT)

Test performed by or on behalf of the producer on products at specific intervals to confirm that the process continues to be capable of producing products which conform to the requirements given in the relevant standard.

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

2.2.5 Product

Pipe or fitting of a clearly identified type intended to be a part of a piping system which the supplier puts on the market.

2.2.6 Product batch

Clearly identified collection of products, manufactured consecutively or continuously under the same conditions, conforming to the same specification.

Remark:
The production batch is defined and identified by the product manufacturer.

2.2.7 Sample

One or more products drawn from the same production batch or lot, selected at random and regardless of their quality.

Remark:
The number of products in the sample is the sample size.

2.2.8 Testing laboratory

Laboratory which measures, tests, calibrates or otherwise determines the characteristics of the performance of materials and products.

Remark 1:
In the context of this document, the materials and products can be subjected to type testing, batch release testing, process verification testing, audit testing, and witness testing, as applicable.

Remark 2:
A testing laboratory is preferably accredited according to NEN-EN-ISO/IEC 17025.

2.2.9 Type testing (TT)
Testing performed to prove that the material, product, joint or assembly is capable of conforming to the requirements given in the relevant standard.

Remark:
Provided that the process verification tests are done regularly, the type test results remain valid until there is a change in the material or product or assembly.

2.3 Geometrical characteristics

2.3.1 Nominal size (DN)
Alphanumerical designation of a size of a component, which is a convenient integer approximately equal to a manufacturing dimension in mm and which can apply to either the internal diameter (DN-ID) or the external diameter (DN-OD).

2.3.2 Mean diameter (d_m)
Diameter of the circle corresponding with the middle of the pipe wall cross section, which is expressed in metres (m), by either equation 2.1 or 2.2:

$d_m = d_i + e$ (2.1)

$d_m = d_e - e$ (2.2)

where

d_i is the internal diameter, in metres (m);

d_e is the external diameter, in metres (m);

e is the wall thickness of the pipe, in metres (m)

2.4 Definitions related to material or product characteristics

2.4.1 Hydrostatic design stress (HDS)
The estimated maximum tensile stress in the wall of the pipe in the hoop direction due to internal hydrostatic pressure that can be applied continuously with a high degree of certainty that failure of the pipe will not occur.

2.4.2 Initial specific ring stiffness (S_0)
Value of S obtained when tested in accordance with ISO 7685, in Newtons per square metre (N/m^2).

2.4.3 Long-term hydrostatic pressure (LTHP)
The estimated internal pressure on the piping product that, when applied will cause failure of the product after a specified number of hours.

2.4.4 Long-term hydrostatic strength (LTHS)
The estimated tensile stress in the wall of the pipe in the hoop direction due to internal hydrostatic pressure that, when applied will cause failure of the pipe after a specified number of hours.

2.4.5 Lower confidence limit of the predicted hydrostatic strength (σ_{LPL})
Value, within the dimensions of stress, which represents the 97,5% lower confidence limit of the predicted hydrostatic strength at a temperature T and time t.

2.4.6 Nominal pressure (PN)

Numerical designation used for reference purposes related to the mechanical characteristics of the component of a piping system. It corresponds to the allowable operating pressure in bar, which can be sustained with water at 20 °C on a basis of 50 years, and based on the minimum safety factor.

2.4.7 Nominal stiffness (SN)

Alphanumerical designation for stiffness classification purposes, which has the same numerical value as the minimum initial specific ring stiffness value required, when expressed in Newtons per square metre (N/m^2).

Remark:
The designation for reference or marking purposes consists of the letters SN plus a number.

2.4.8 Relative ring deflection (y/d_m)

Ratio of the change in diameter of a pipe, y, in metres, to its mean diameter, derived as a percentage (%).

2.4.9 Safety factor

Coefficient with a value equal to or larger than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower confidence limit.

2.4.10 Specific ring stiffness (S)

Physical characteristic of the pipe expressed in Newtons per square metre (N/m^2) which is a measure of the resistance to ring deflection per metre length under external load and is defined by equation 2.3:

$$S = \frac{E \times I}{{d_m}^3} \qquad (2.3)$$

Where

E is the is the apparent modulus of elasticity, which can be derived from the result of the ring stiffness test, i.e. ISO 7685, expressed in Newtons per square metre (N/m^2);
d_m is the mean diameter of the pipe, in metres (m);
I is the second moment of area in the longitudinal direction per metre length, in metres to the fourth power per metre, (m^4/m) (see equation 2.4):

$$I = \frac{e^3}{12} \qquad (2.4)$$

where:
e is the wall thickness of the pipe, in metres (m).

2.5 Definitions related to joints

2.5.1 Non-tensile resistant

Flexible joints without hydrostatic end thrust.
For example:

- Socket-and-spigot joint with an elastomeric sealing element (including double socket designs).

2.5.2 Tensile resistant

Flexible and rigid joints with hydrostatic end thrust.
For example:

- locked socket-and-spigot joint with an elastomeric sealing element (including double socket designs);
- Flanged joint, including integral and loose flanges;
- Laminate or adhesive bonded joints;
- Mechanical clamped joint e.g. bolted coupling including joints made from materials other than GRP.

3 Procedure for obtaining a quality declaration

3.1 Initial investigation

The initial investigation to be performed based on the product requirements as contained in this evaluation guideline, including the test methods, depending on the type of products to be certified:

- type testing to determine whether the products comply with the product and/or performance requirements;
- production process assessment;
- assessment of the quality system and the IQC-scheme;
- assessment on the presence and functioning of the required procedures.

3.2 Granting the certificate

After completing the initial investigation, the results are presented to the Decision maker (see §11.4). This person evaluates the results and decides whether the certificate can be granted or if additional data and/or tests are necessary before the certificate can be granted.

3.3 Investigation into the product and/or performance requirements

Kiwa will investigate the products to be certified against the certification requirements as stated in this evaluation guideline or will have them investigated on its behalf. The necessary samples will be drawn by or on behalf of Kiwa.

3.4 Production process assessment

When assessing the production process, it is investigated whether the producer is capable of continuously producing products that meet the certification requirements. The evaluation of the production process takes place during the ongoing work at the producer.
The assessment also includes at least:

- The quality of raw materials, half-finished products and end products;
- Internal transport and storage.

3.5 Contract assessment

If the supplier is not the producer of the products to be certified, Kiwa will assess the agreement between the supplier and the producer.
This written agreement, which is available to Kiwa, must at least include:
That accreditation bodies, scheme managers and Kiwa will be given the opportunity to observe the certification activities carried out by Kiwa or on behalf of Kiwa at the producer.

4 Requirements and test methods for the piping system

This chapter describes the requirements that the piping system shall meet, as well as the determination methods to establish that the requirements are being met.

4.1 Regulatory requirements

4.1.1 Requirements to avoid deterioration of the quality of drinking water

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 declaration, 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.

4.2 Classification

Pipes and fittings shall be classified according to nominal size (DN), nominal pressure (PN), and joint type.

Pipes shall include nominal stiffness in their classification.

4.2.1 Nominal size (DN)

The nominal size of pipes and fittings shall conform to table 3.

4.2.2 Nominal pressure (PN)

The nominal pressure (PN) shall conform to one of those listed in table 1.

Table 1 – Nominal pressure classes

Nominal pressure PN, expressed in bar				
1	4	6	8	10
12.5	16	20	25	32
40	50			
Components marked PN 1 are non-pressure (gravity) components				

The nominal pressure PN is based on the long-term resistance to internal pressure of the component by the formula given in equation (4.1)

$$PN = \frac{P_{LPL}}{f} \qquad (4.1)$$

where:

f is a safety factor = 2.0.

P_{LPL} is the pressure, expressed in bar, which represents the 97,5% lower confidence limit of the predicted hydrostatic pressure at a temperature of 20 °C and time of 50 years of the component.

4.2.2.1 Hydrostatic or pressure design basis

The hydrostatic or pressure design basis for the pipes and fittings shall be obtained according to ASTM D 2992 – procedure B (static).

The time for determination to determine of the long-term hydrostatic strength (LTHS) or the long-term hydrostatic pressure (LTHP) is 438000 hours (50 years).

The supplier shall declare and record the P_{LPL} value in his quality plan for the pipes and fittings that shall be listed in the certificate. The supplier may also declare and record the σ_{LPL} value, calculated from the P_{LPL} value using the following equation (for pipes only):

$$\sigma_{LPL} = \frac{P_{LPL} \times (D - t)}{20 \times t} \qquad (4.2)$$

where:

P_{LPL} is the pressure, expressed in bar, which represents the 97,5% lower confidence limit of the predicted hydrostatic pressure at a temperature of 20 °C and time of 50 years;

σ_{LPL} is the stress, expressed in MPa, which represents the 97,5% lower confidence limit of the predicted hydrostatic pressure at a temperature of 20 °C and time of 50 years;

D is the average reinforced outside diameter expressed in mm;

t is the minimum reinforced wall thickness (thickness of the structural layer) expressed in mm.

4.2.3 Nominal stiffness (SN)

The nominal stiffness (SN) of pipes shall conform to one of those listed in table 2. These values for nominal stiffness relate to the minimum initial specific ring stiffness (S_0) determined according to NEN 7037.

Table 2 – Nominal stiffness (SN)

Nominal stiffness (SN)	Minimum initial specific ring stiffness $S_{0,min}$ (N/m^2)
1250	1250
2500	2500
5000	5000
10000	10000
For other stiffnesses the value of $S_{0,min}$ shall be equal to SNv	

Where special applications require the use of pipes with a higher nominal stiffness than those listed in table 2 the pipe shall be marked SNv, where v is the number equal to the pipes nominal stiffness.

4.3 Incoming goods / raw materials

The supplier shall record all incoming goods and raw materials for the manufacturing of certified components in his internal quality control scheme. The supplier shall also

record the requirements imposed on the incoming goods including the applicable test methods.

4.4 Materials (general)

Pipes and fittings may be constructed using chopped and/or continuous glass filaments, strands or rovings, mats or fabric, synthetic veils, and epoxy resin with or without fillers and if applicable additives necessary to impart specific properties of the resin. The pipes and fittings may also incorporate aggregates e.g. sand.
The supplier shall record in his quality plan the size of particles in aggregates and fillers.
The supplier shall record in his quality plan the recipe and build-up of pipes and fittings.

4.5 Appearance of pipes and fittings

The surface of the pipes and fittings shall be inspected visually.

The supplier shall record in his quality plan which imperfections are allowable defects and repairable defects, and which defects impair the ability of the component to conform to the requirements of this BRL.

4.6 Elastomeric sealing elements

In case rubber sealing elements are present in the joints, the rubber sealing elements shall meet the requirements of Kiwa evaluation guideline K17504.

4.7 Reference conditions for testing

4.7.1 Type Testing and Audit Testing

The characteristics specified in all clauses of this evaluation guideline shall, unless otherwise specified, be determined at (23 ± 5) °C. For service temperatures over 35 °C and up to and including 50 °C type test shall, unless otherwise specified, be carried out at least the design service temperature $^{+5}/_{0}$ °C, to establish de-rating factors for all long –term properties to be used in design. For details see annex III.

4.7.2 Quality control

The supplier shall record in his quality plan the conditions under which quality control tests shall be carried out in his laboratory. All influencing parameters shall be recorded, but at least the temperature with permissible deviation.

4.8 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, installation instructions etc.
This information shall be recorded in the supplier's quality plan.

4.9 Protection of products during storage and transport

For the purpose of hygienic handling, products shall be protected against contamination. This is with respect to the surfaces of the product that come into contact with drinking water during the application.

Precautions to protect the product against contamination shall be agreed upon between the supplier and Kiwa and shall be recorded in the quality management system of the supplier.

4.10 Hygienic treatment of products in contact with drinking water

The supplier must have a procedure in place that protects the products in such way, that the hygiene is ensured during storage and transport.
In addition, the supplier shall inform the customer about the handling of products delivered under the certificate, which come into contact with drinking water and warm tap water, from arriving at the construction site through to the realization and commissioning. The primary reason for providing this the information is to contribute to the awareness of the importance of hygienic work as a ‘prevention measure’.

5 Requirements and test methods: pipes

This chapter contains the requirements that pipes have to fulfil. These requirements will form part of the technical specification of the pipes, as included in the certificate.

5.1 Dimensions and tolerances

The dimensions shall be determined according to EN-ISO 3126. Routine measurements shall be carried out at room temperature or if the manufacturer prefers at the temperature specified in clause 4.7.1.
In case of dispute, the dimensions shall be determined at the temperature given in clause 4.7.1.

Other methods may be used as these are recorded in the quality plan of the supplier and as approved by Kiwa.

5.1.1 Inside diameter

The inside diameter shall conform to the applicable values relative to the nominal size given in table 3.

Table 3 – Nominal diameter, minimum and maximum inside diameter

Nominal diameter DN	Inside diameter (d_i)	
	Minimum (mm)	Maximum (mm)
25	23	27
40	38	42
50	48	52
(65)	63	68
80	78	82
100	97	103
(125)	123	127
150	147	153
200	196	204
250	246	255
300	296	306
(350)	346	357
400	396	408
(450)	446	459
500	496	510
600	595	612
700	695	714
750	745	765
800	795	816
900	895	918
1000	995	1020
1100	1095	1120
1200	1195	1220
1400	1395	1420
1600	1595	1620
1800	1795	1820
2000	1995	2020
2200	2195	2220
2400	2395	2420
2600	2595	2620
2800	2795	2820
3000	2995	3020

5.1.2 Build-up of the pipe

The pipe shall be composed of the following layers:

- inner layer (liner);
- structural wall;
- outer layer (topcoat).

The total thickness of the wall construction is equal to the sum of the structural wall thickness and the thickness of the inner and the outer layer.
The supplier declares and record in his quality plan:

- the minimum structural wall thickness (e_{eff});
- the minimum permissible total wall thickness;
- the nominal thickness of the inner layer, of the outer layer and the structural wall and their permissible deviations.

5.1.2.1 Inner layer

The inner layer shall consist of a resin-rich layer, reinforced with one or more layers of E(CR)-glass or synthetic veil.
The thickness of the inner layer shall be 0.5 $^{+0.1}/_{-0.3}$ mm.

5.1.2.2 Structural wall

The structural wall shall be build- up of E(CR)-glass or E(CR)-type glass roving, which is impregnated with epoxy resin.

The mass of the glass in the structural wall shall be declared by the supplier and shall be determined according to ASTM D 2584.

The test may be performed on samples without inner layer when this is recorded in the quality plan of the supplier.

The roving in the structural wall shall be helically wound.

5.1.2.3 Outer layer

The outer layer is a resin-rich layer with a thickness of (0.3 ± 0.2) mm, excluding an optional extra UV protecting layer.

5.1.3 Winding angle

The supplier shall record in his quality plan the winding angle of the pipes listed on the certificate.

The winding angle (ω) is determined by measuring the angle of representative roving and is calculated as follows:

$$\omega = tan^{-1}\left(\frac{a}{b}\right)$$

where:
a is the outside circumference of the pipe;
b is the pitch of the winding.

The supplier records the nominal winding angle with the maximum permissible tolerance of the winding angle.

5.1.4 Minimum structural wall thickness of any pipe

The minimum structural wall thickness of any pipe is 1.8 mm.

5.1.5 Sockets and spigot formed at the pipe

The internal diameter of the socket, external diameter of the spigot, socket length and the conical shape, as well as the dimension and permissible tolerances of the socket and spigot shall be recorded on drawings and documented in the quality plan of the supplier.

At midway of the spigot the out-of-roundness, i.e. the difference between the largest and smallest measured outer diameter shall not exceed 0.007 x d_i.

The out-of-roundness of the socket shall be recorded on drawings.

5.2 Mechanical and physical characteristics

5.2.1 Specific ring stiffness (S_0 and STES)

Being tested according to NEN 7037 the pipe shall possess at least the S_0 value as listed in table 3.

For underground applications in the Netherlands a so-called specific tangential end stiffness (STES) of 2000 N/m^2 is required. This STES value is defined by:

$$STES = S_0 \times \alpha \times \beta \qquad (5.1)$$

Where:

S_0 is the initial specific ring stiffness determined according to NEN 7037;

α is the reduction factor associated with creep determined according to NEN 7037;

β is the reduction factor associated with aging in water determined according to NEN 7037.

The initial specific ring stiffness may also be determined according to ISO 7685. The STES shall be calculated using equation 5.1.

The product of the reducing factors shall not be lower than:

$$\alpha \times \beta > 0.6 \qquad (5.2)$$

The supplier shall declare the reducing factors and record them in his quality plan.

5.2.2 Resistance to initial ring deflection

The resistance to initial ring deflection shall be determined according to ISO 10466.

The test is performed with one test piece of 300 mm long with a permissible deviation of the length of 5%.

The test shall be conducted using mean diametrical deflections appropriate to the nominal ring stiffness (SN) of the pipe. The first level of deflection is the minimum relative ring deflection for bore cracks and the second level is the minimum relative ring deflection for structural failure.

Table 4 – Minimum initial ring deflections

Nominal stiffness (SN)	**1250**	**2500**	**5000**	**10000**
No sign of bore cracking [1)] at a relative ring deflection of:	18%	15%	12%	9%
No structural failure [2)] at a relative ring deflection of:	30%	25%	20%	15%

[1)] Inspected without magnification

[2)] the following is considered structural failure: inter laminar separation, tensile failure of the glass fibre reinforcement, buckling of the pipe wall.

When the actual initial specific ring stiffness (S_0) is much higher than the classified nominal stiffness (SN), the minimum relative deflection levels may be corrected using the following equation:

$$\left(\frac{y}{d_m}\right)_{cor} = \left(\frac{SN}{S_0}\right)^{1/3} \times \left(\frac{y}{d_m}\right)_{tab}$$

Where:

$\left(\frac{y}{d_m}\right)_{cor}$ is the corrected minimum relative ring deflection;

$\left(\frac{y}{d_m}\right)_{tab}$ is the minimum relative ring deflection listed in table 4;

SN is the nominal stiffness

S_0 is the initial specific ring stiffness determined according to ISO 7685.

The supplier shall record these corrections in his quality plan.

5.2.3 Axial tensile strength (ATS)

When tested according to ASTM D 2105 the initial longitudinal tensile strength of the pipe build up only with a structural wall and outer layer shall be not lower than the by the supplier declared values. The load bearing capacity of the outer layer shall be neglected in the calculations. The test shall be performed on two samples.

Alternatively the axial tensile strength may be determined on test strips according to ASTM D 638 (dumbbell-shaped) or NEN-EN 1393 (parallel strips). The test shall be performed with a minimum of 5 test pieces per sample.

The supplier shall record the axial tensile strength for (every type test group) in his quality plan.

Remark: See clause 8.2.2. for details about type test groups.

5.2.4 Inter laminair shear strength (ILSS)

The inter laminair shear strength is determined according to ASTM D 2344. The test shall be performed with 10 test pieces per sample. The test is performed where the surface of the test piece that corresponds to the outer surface of the pipe is supported.

The supplier shall record the inter laminair shear strength (for every type test group) in his quality plan.

5.2.5 Ultimate elastic wall stress (UEWS)

The ultimate elastic wall stress shall be determined according to chapter 13.

The supplier shall record the ultimate elastic wall stress (for each type test group) in his quality plan. The sample fulfils the requirement when the measured value is higher than the declared value.

5.2.6 Glass transition temperature

The glass transition temperature shall be determined according to NEN-EN-ISO 11357-2 with the following additional considerations:

- start temperature shall be recorded in the supplier's quality plan or shall be a default value of 30 °C;
- end temperature shall be recorded in the supplier's quality plan and depends on the resin system;
- heating rate is 20 °C per minute;
- the sample may be heated two times to determine Tg1 (first run) and Tg2 (second run). Between these runs the sample is cooled town to the required start temperature;
- Tg1 and Tg2 are midpoint temperatures (T_{mg}) as defined by the standard test method.

Remark:
The glass transition temperature is a measure of the degree of cure of the resin system and is represented by Tg1.

The supplier shall record Tg1 of every resin system in his quality plan.
The supplier may record Tg2 also of every resin system in his quality plan.

The sample fulfils the requirement when the measured glass transition temperature (Tg1) is between the declared minimum and maximum values of the supplier.

5.2.7 Resistance to internal pressure (verification test)

The pipe shall not show any defect when tested according to ASTM D 1598 and the test parameters listed in table 5.

The test shall be performed on one test piece with a free length that depend on the nominal size of the pipe. For DN up to and including 250 mm the free length of the test piece is 3 x DN + 250 (mm). For DN greater than 250 mm, the free length shall be DN + 1000 (mm).

Table 5 – Test conditions for the resistance to internal pressure of pipes

Duration of the test (hours)	Test pressure (bar)
100 ± 0.1	2.0 x PN
0.1 ± 0.01	2.5 x PN
1. The test may be performed with end sealing devices or joints for testing with or without end thrust 2. Water inside the test piece and air outside the test piece. 3. Test temperature (23 ± 5) °C.	

5.2.8 Resistance to shock or impact

For determination of the resistance to shock or impact the following equipment is needed:

- apparatus to acquire a constant hydrostatic pressure in the test sample;
- pressure gauge with an accuracy of 0.05 MPa;
- end caps, to pursue an axial load on the test sample;
- falling dart apparatus, which is able to let a dart fall down vertically without friction, from a height varying from 500 to 1000 mm;
- the support of the test piece shall be a flat stiff plate;
- falling body with a mass of 500 g;
- the falling body shall be spherical at the bottom with a 12.5 mm radius.

The length of the test sample of the pipe between end caps shall be at least 1,5 m.

Attach the end caps to the test sample. Fill the test sample with water and remove any entrapped air from the test sample. Place the test sample onto the support of the falling dart test apparatus. Execute the test by hitting the test sample four times at distances equally divided over the length of the test sample. In table 6 the mass and falling height required are listed.

Raise the hydrostatic pressure at the inside to 1,5 times the nominal pressure of the pipe. Repeat the falling dart test with the test sample under hydrostatic pressure but hit the sample at another location than during the falling dart test without hydrostatic pressure, by turning the test sample. Keep the test sample at a constant hydrostatic pressure of 1,5 times the nominal pressure of the pipe for 168 hours. After the expired testing time the sample shall be examined for any defects or leakage.

The pipe shall show neither defects nor leakage.

Table 6 – Mass of the falling body and falling height

Nominal diameter (mm)	**mass of the falling body[1)] (g)**	**falling height[1)] (mm)**
< 80	500	500
80 up and including to 200		500
200 up and including 350		500
350 up and including 750		500
750 up and including 1000		1000
1000 up and including 3000		1000

1) allowed deviation from mentioned value ($^{+5}/_{0}$)

5.2.9 Opacity

The walls from pipes intended to be used for above ground transport of drinking water shall not transit more than 0.27% of the light when being tested according to NEN-EN-ISO 7686. The thinnest wall component in the supplier's product range shall be tested.

5.3 Marking of pipes

5.3.1 General

The products shall be marked with following indelible marks and indications:

- name or logo of the manufacturer;
- material: E (Epoxy);
- T (trekvast, i.e. end load bearing) NT- niet -trekvast, i.e. not-end load bearing);
- Nominal size DN;
- Nominal Pressure (PN);
- When applicable, nominal stiffness (SN);
- data or code indicating the date of production;
- pipes intended to be used for the transport of drinking water above ground shall be marked as such;
- reference to this evaluation guideline.

5.4 Certification mark

After concluding a Kiwa certification agreement, the certified products shall, beside the marks indicated in the respective standards, be indelible marked with the:

Kiwa Water Mark "**KIWA**  "

6 Requirements and test methods: fittings

This chapter contains the requirements that products have to fulfil. These requirements will form part of the technical specification of the products, as included in the certificate.

6.1 General

Fittings shall be designed and manufactured, in accordance with relevant design practices, to have a mechanical performance equal to or greater than a straight pipe of the same pressure and stiffness rating when installed in a piping system, and, if appropriate supported by supports, anchor blocks or encasements.

Fittings are bends, tees, double socket joints (couplings), reducers, adaptors etc., with or without flanges.

Fittings made from pipes sections shall be manufactured from pipes with the same PN and SN rating.

6.2 Build-up of the fitting

The supplier of the fitting shall record the fitting design and manufacturing procedure as part of his quality plan.

6.3 Dimensions and permissible tolerances

The supplier shall record the dimensions and permissible tolerances on drawings that are part of his quality plan.

The dimensions shall be determined according to EN-ISO 3126. Routine measurements shall be carried out at room temperature or if the manufacturer prefers at the temperature specified in clause 4.7.1.

In case of dispute, the dimensions shall be determined at the temperature given in clause 4.7.1.

Other methods may be used as these are recorded in the quality plan of the supplier and as approved by Kiwa.

6.4 Resistance to internal pressure (verification test)

The fitting shall not show any defect when tested according to ASTM D 1598 at a test temperature of (23 ± 5) °C and the test conditions listed in table 7. The test shall be performed on one test piece.

Table 7 – Test conditions for the resistance to internal pressure of fittings

Duration of the test (hours)	Test pressure (bar)
100 ± 0.1	2.0 x PN
0.1 ± 0.01	2.5 x PN
1. The test may be performed with end sealing devices or joints for testing with or without end thrust 2. Water inside the test piece and air outside the test piece.	

6.5 Marking of fittings

6.5.1 General

The products shall be marked with following indelible marks and indications:

- name or logo of the manufacturer;
- material: E (Epoxy);
- T (trekvast, i.e. end load bearing) NT- niet-trekvast, i.e. not-end load bearing);
- Nominal size DN;
- Nominal Pressure (PN);
- When applicable, nominal stiffness (SN);
- data or code indicating the date of production;
- fittings intended to be used for the transport of drinking water above ground shall be marked as such;
- reference to this evaluation guideline.

6.5.2 Certification mark

After concluding a Kiwa certification agreement, the certified products shall, beside the marks indicated in the respective standards, be indelible marked with the:

Kiwa Water Mark: "**KIWA**  "

7 Requirements and test methods: joints

This chapter contains the requirements that products have to fulfil. These requirements will form part of the technical specification of the products, as included in the certificate.

7.1 General

The dimensions and design of the components for the joints shall be such, that joints shall be watertight under normal operating pressure and at least as strong as the pipes and fittings themselves.

The dimensions shall be determined according to EN-ISO 3126. Routine measurements shall be carried out at room temperature or if the manufacturer prefers at the temperature specified in clause 4.7.1.

In case of dispute, the dimensions shall be determined at the temperature given in clause 4.7.1.

Other methods may be used if these are recorded in the quality plan of the supplier and as approved by Kiwa.

All dimensions of the tested joint, which may influence the performance of the system shall be recorded by de supplier in his quality plan.

7.2 Joints with elastomeric sealing elements

7.2.1 Fixation of the elastomeric sealing element

For the judgement of the fixation of the elastomeric sealing element the end of the pipe shall be pushed into the socket. The pipe shall have a length of at least 3 m. The elastomeric sealing element is installed according to the supplier's instructions.
The test shall be carried out in a way similar to practice.

To meet the requirement concerning the fixation of the elastic sealing element, it shall be possible to slide the pipe into the socket, without the elastomeric sealing element being pushed out. This shall be checked by means of non-destructive examination.

7.2.2 Locking key

The locking key of rigid locked joints with elastomeric sealing elements shall be made of a pressure resistant and shear resistant material, e.g. polyvinylchloride, polyamide or material equivalent to it. In the latter case the equivalency shall be demonstrated either by documentation or by testing.

7.2.3 Tensile resistant (Flexible joint)

The tensile resistant socket-spigot joint shall be tested in accordance with ISO 7432 and criteria listed in table 8 at a test temperature of (23 ± 5) °C, after the connection is established as described under 7.2.1.

The joint fulfils the requirements when during the test no leakage is detected. Unless stated in ISO 7432, the bending moment test shall be applicable to joints of all nominal sizes and the length of the joined test piece may exceed the 10 m. The number of test pieces to be used is one.

Table 8 – Test criteria tensile resistant flexible joints

Test	Test and sequence	Test pressure	Duration
External pressure differential [3)]	Negative pressure	-0.4 bar (0.6 bar absolute)	1 h
Initial leakage	Initial pressure	1.5 x PN	15 min.
Misalignment with internal pressure and end thrust	Preliminary pressure Maintained pressure Positive cyclic pressure + shear force F1 [1)]	1.5 x PN 2.0 x PN 1.5 x PN	15 min. 24 h 10 cycles of 5 min each
Resistance to bending moment with end thrust	Positive cyclic pressure + bending moment F2 [2)]	1.5 x PN	10 cycles of 5 min. each
Short-term resistance to internal pressure	Maintained pressure	2 x PN 2.5 x PN	100 h 0,1 h

[1)] The shear load will have a value of: F1 = 20 x ID. Where: F1 = shear load (N) ID = inner diameter (mm).
[2)] In the joint bending test a bending moment F2 shall be applied which results in an axial stress, equal to 50% of the allowable axial stress due to bi-axial hydrostatic pressure.
[3)] For the external pressure differential test allow the pressure to stabilize for 30 minutes before sealing off. The maximum permissible pressure increase during the seal-off period shall be 0.1 bar.

7.2.4 Non-tensile resistant (flexible joint)

The Non-tensile resistant socket-spigot joint shall be tested in accordance with ISO 8639 and criteria listed in table 9 at a test temperature of (23 ± 5) °C, after the connection is established as described under 7.2.1.

The joint fulfils the requirements when during the test no leakage is detected. Unless stated in ISO 8639 the length of the joined test piece may exceed the 10 m. The number of test pieces to be used is one.

Table 9 – Test criteria non-tensile resistant flexible joints

Test	Test and sequence	Test pressure	Duration
Total draw and external pressure difference [4)]	Negative pressure	- 0.4 bar (0.6 bar absolute)	1 h
Angular deflection [1)] and draw [2)]	Initial pressure Positive static pressure	1.5 x PN 2.0 x PN	15 min 24 h
Misalignment and draw [2)]	Initial pressure Positive static pressure + shear force F1 [3)] Positive cyclic pressure + shear force F1 [3)]	1.5 x PN 2.0 x PN 1.5 x PN	15 min 24 h 10 cycles of 5 min. each
Short-term resistance to internal pressure and draw [2)]	Maintained pressure	2.0 x PN 2.5 x PN	100 h 0.1 h

[1)] The angular deflection is the maximum deflection declared by supplier.
[2)] The joint shall be capable of a draw (ΔL) of not less than 0.5% of the effective length of the longest pipe with which the joint is intended to be used: (ΔL) = 0.005* L.
[3)] The shear load will have a value of: F1 = 20 x ID Where: F1 = shear load (N), ID = inner diameter (mm)
[4)] For the external pressure differential test allow the pressure to stabilize for 30 minutes before sealing off. The maximum permissible pressure increase during the seal-off period shall be 0.1 bar.

7.3 Tensile resistant wrapped and cemented joints

The tensile resistant rigid joint shall be tested in accordance with ISO 8533 and criteria listed in table 10 at a test temperature of (23 ± 5) °C.

The joint fulfils the requirements when during the test no leakage is detected.

The bending moment test shall be applicable to joints of all nominal sizes and the length of the joined test piece may exceed the 10 m. The number of test pieces to be used is one.

Table 10 – Test criteria tensile resistant wrapped and cemented joints

Test	Test and sequence	Test pressure	Duration
External pressure [2)]	Negative pressure	- 0.4 bar (0.6 bar absolute)	1 h
Initial leakage	Initial pressure	1.5 x PN	15 min
Resistance to bending moment with end thrust	Positive cyclic pressure + bending moment F2 [1)]	1.5 x PN	10 cycles of 5 min each
Resistance to internal pressure and end thrust	maintained pressure	2.0 x PN	24 h
Short-term resistance to internal pressure	maintained pressure	2.0 x PN 2.5 x PN	100 h 0.1 h

1) In the joint bending test a bending moment F2 shall be applied which results in an axial stress, equal to 50% of the allowable axial stress due to bi-axial hydrostatic pressure.

2) For the external pressure differential test allow the pressure to stabilize for 30 minutes before sealing off. The maximum permissible pressure increase during the seal-off period shall be 0.1 bar.

7.3.1 Adhesive

The type of adhesive to be applied shall be a two component epoxy matching the epoxy type used for the pipes and fittings.

Depending on the nominal size (DN) adhesive joint may be conical – cylindrical or conical – conical. The supplier shall record the type of adhesive joint (conical – cylindrical or conical – conical) as well as the dimensions of the joint in his quality plan.

7.4 Tensile resistant bolted flanged joint

The tensile resistant rigid joint shall be tested in accordance with ISO 8483 and criteria listed in table 11 at a test temperature of (23 ± 5) °C.

The joint fulfils the requirements if during the test no leakage is detected.

Unless stated in ISO 8483, the joined test piece may exceed the 10 m. The number of test pieces to be used is one.

Table 11 – Test criteria tensile resistant flange joints

Test	Test and sequence	Test pressure	Duration
External pressure differential [2)]	Negative pressure	- 0.4 bar (0.6 bar absolute)	1 h
Initial leakage	Initial pressure	1.5 x PN	15 min
Resistance to internal pressure and end thrust	Preliminary pressure maintained pressure	1.5 x PN 2.0 x PN	15 min 24 h
Resistance to bending moment with end thrust	Preliminary pressure Positive cyclic pressure + bending moment F2 [1)]	1.5 x PN 1.5 x PN	15 min 10 cycles of 5 min. each
Short-term resistance to internal pressure	maintained pressure	2.0 x PN 2.5 x PN	100 h 0.1 h
Bolt-tightening torque [3)]	Visual inspection	Not applicable	Not applicable

1) In the joint bending test a bending moment F2 shall be applied which results in an axial stress, equal to 50% of the allowable axial stress due to bi-axial hydrostatic pressure.

2) For the external pressure differential test allow the pressure to stabilize for 30 minutes before sealing off. The maximum permissible pressure increase during the seal-off period shall be 0.1 bar.

3) Assemble one of the tested flanges to a steel flat face blind flange.

7.4.1 Drilling of flanges

The drillings shall be executed according to the specifications of the manufacturer.

7.4.2 Flanges

Type of flanges shall be ”flat face”.
The washers shall meet the requirements of the manufacturer of the flange.
The rubber sealing elements shall comply with clause 4.6.

7.4.3 Torque moments

The supplier shall record the torque moments of the jointing bolts in his quality plan.

8 Assessment of conformity

This chapter contains the requirements for the assessment of conformity that products have to fulfil.

Remark 1:
It is recommended that the quality management system conforms to or is no less stringent than the relevant requirements to NEN-EN-ISO 9001.

Remark 2:
If third-party certification is involved, it is recommended that the certification body is accredited to NEN-EN-ISO/IEC 17021, and NEN-EN-ISO/IEC 17065, as applicable.

8.1 General

The supplier shall record in his quality plan all relevant procedures relating to production control, i.e. BRT and PVT.

8.2 Type Testing (TT)

8.2.1 General

Type tests shall be conducted in accordance with the requirements and rules given in this evaluation guideline.

8.2.2 Pipe or fitting type test group

A pipe or fitting type test group consists of a range or family of products made such that the results of the long-term type tests are applicable to all products in the group.
A pipe type test group shall be made of products:

- manufactured by the same process;
- with the same material specifications;
- with the same pipe wall construction (i.e. the sequence of layers, layer compositions, material properties;
- design method for using the results of the long-term type tests in determining the pipe wall for all combinations of DN, PN and SN);
- tested with the same loading condition (i.e. uniaxial or biaxial load).

In analogy with pipes and fittings, joints can also be divided in joint type test groups. In case this is applicable, the supplier shall define his joint type test groups and record these in his quality plan.

The quality plan of the supplier shall document all process details that could influence type test performance. The quality plan shall document the complete product design method and demonstrate how the results of the type tests are used to establish product designs.

All type test groups shall fulfil the requirements given in this evaluation guideline.

8.3 Audit testing (AT)

8.3.1 General

The characteristics listed in table 15 are to be audit tested at the minimum sampling frequency as listed in the same table.
When a manufacturer fabricates fittings using pipes of the same classification for which the fittings are to be used, the audit test for the pipes covering mechanical and chemical characteristics do cover these fittings.

Where tests have been witnessed during (routine) inspections performed by Kiwa, additional tests for audit purposes will not be required.

8.4 Quality control tests

8.4.1 Batch release tests (BRT)

The supplier shall describe in his internal quality control scheme the limits used to define a batch for testing purposes. Typically, a quality control batch consists of products of a particular diameter, stiffness class and pressure class.
Samples for BRT can be obtained from a pre-manufactured batch, periodically from a continuous production or other appropriate method, depending on the manufacturing process.

A batch may be released for supply when all the relevant tests and inspections have been carried out and the requirements have been met. If one or more items fail to meet the criteria in one or more tests or inspections, then the retest procedures shall be performed.

The supplier shall record a rejecting/retesting procedure to deal with non-conformities regarding BRT in his quality plan.

8.4.2 Process verification tests (PVT)

The supplier shall detail in his quality plan a verification procedure of such a nature and of such a frequency as to ensure, with reasonable probability, that the long-term properties are maintained. The frequency of these tests shall complement the frequency of audit tests, if applicable.
The purpose of PVT tests is to assess the conformity of the long-term properties of the product. The characteristics listed in Table 15 shall be addressed.

When the results from PVT tests show non-compliance then the process shall be investigated and corrected and the retest procedures detailed in the manufacturer's quality plan shall be performed. If third party certification is involved then the certification body shall be informed.

8.5 Changes in material, design and process

The objective of this clause is to define what constitutes a change in a piping system component's material, design or process and consequently requiring a certain degree of reassessment of conformity.

What constitutes a change shall be discussed and agreed upon between the supplier and the certification body and if needed the component manufacturer, if necessary, assisted by material suppliers.

When any of the following is altered then a change has occurred (see tables 12, 13, 14).

Table 12 – Change in materials [1)]

Constituent	Change	Tests to assess the effects of change
Reinforcement	Reinforcement manufacturer	Clause 8.5.1 “Requalification”
	Sizing	
	Glass type	
	linear density (tex)	
Resin system [2)]	Resin manufacturer	Clause 8.5.1 when resin in the structural wall is changed
	Resin type	
	Hardener type (curing agent)	
Resin system inner layer [3)]	Composition	Clause 4.1 when resin in the inner layer is changed
	Inner layer thickness	
Adhesive for bounded joints	Adhesive manufacturer	Joint performance test according to clause 7.3 or Survival test according 5.2.9.
	Adhesive type	
Laminated joints	Resin manufacturer	Joint performance test according to clause 7.3 or Survival test according 5.2.9.
	Resin type	
	Hardener type (Curing agent)	
Flanged joints	Gasket manufacturer	Joint performance test according to clause 7.4 or Survival test according 6.4.
	Gasket type	
Rubber elastomeric elements	Compound manufacturer	Joint performance test according to clause 7.2.3 or Survival test according to 5.2.9.
	Rubber compound type	

1) for all changes the fitness for contact with drinking waters shall be assessed (see clause 4.1)
2) e.g. change in chemistry, change of curing temperature and time
3) Assessment shall be performed for components that cannot be manufactured without inner liner.

Table 13 – Change in design

Aspect	Change	Test to assess the effects of change
Pipe or fitting	The laminate design and construction methodology	Survival test according 5.2.9. or 6.4 and joint performance test according to clause 7.
Joints	Altered component shape and dimensions	
Locking key	Locking key manufacturer	
	Material type	

Table 14 – Change in process

Aspect	Change	Test to assess the effects of change
Modifications of process conditions	Modifications of process conditions other than routine adjustments and maintenance	Clause 8.5.1 “requalification” or Survival test according to 5.2.9 or 6.4

8.5.1 Requalification

Components shall be re-qualified in accordance with clause 8.5.1.1 “Alternative Material Qualification” or ASTM D 2992 Section 12 (Procedure B).

Remark:
The concept of requalification with ILSS, ATS and UEWS as specified in the alternative material qualification is a new concept. For future product development, this method will most likely be the preferred method. However, manufacturers with existing data per ASTM D 2992 will not have this option since no baseline data was generated at the time of qualification and since requalification may have already been done per ASTM D 2992 Section 12. Therefore, Section 12 from ASTM D2992 needs

to remain an option for requalification, even though it is a more onerous requirement than ILSS, ATS and UEWS.

8.5.1.1 Alternative material qualification

the re-qualification test may be performed on a baseline test sample. The baseline sample shall be representative for the type test group under investigation. When a baseline test sample is used the supplier shall record all relevant process conditions and relevant characteristics of the baseline test sample in his quality plan.

Samples and test pieces for testing the initial characteristics shall be conditioned for at least 2 hours at (23 ± 2) °C.

Water aged samples shall be tested within 2 hours up to 24 hours after removing from the water bath. Samples which cannot be tested in 24 hours after ageing at temperatures of 80 °C or 100 °C shall be stored in water at ambient temperatures prior to testing.

All mechanical testing shall be performed at (23 ± 2) °C.

For the re-qualification the following test shall be performed.

8.5.1.2 Axial tensile strength (ATS)

The axial tensile strength shall be determined according to clause 5.2.3.
When the ATS is determined according to ASTM D 2105 the number of test samples and the test parameters are as follows:

- 2 samples initial;
- 2 samples aged in water during 1500 hours at 80 °C.

When the ATS is determined on strips or dumbbells the number of test pieces and the test parameters are as follows:

- 5 test pieces initial;
- 5 test pieces aged in water during 250 hours at 100 °C.

A benchmark requirement for the initial axial tensile strength is the supplier's declared value.
The minimum required axial tensile strength after ageing in water is 85% of the mean initial value. When appropriate the supplier shall declare the new values.

8.5.1.3 Inter laminair shear strength (ILSS)

The inter laminar shear strength shall be determined according to clause 5.2.4. The number of test pieces is as follows:

- 10 test pieces initial;
- 10 test pieces aged in water during 250 hours at 100 °C.

A benchmark requirement for the initial inter laminar shear strength is the supplier's declared value.
The minimum required inter laminar shear strength after ageing in water at 100 °C is 75% of the mean initial value. When appropriate the supplier shall declare the new values.

8.5.1.4 Ultimate elastic wall strength (UEWS)

The ultimate elastic wall stress shall be determined according to clause 5.2.5.
The number of samples is as follows

- 1 sample initial;
- 1 sample aged in water during 1500 hours at 80 °C.

A benchmark requirement for the initial ultimate elastic wall strength is the supplier's declared value.
The minimum required ultimate elastic wall strength after ageing in water at is 80% of the mean initial value. When appropriate the supplier shall declare the new value.

9 Requirements in respect of the quality system

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

9.1 Manager of the quality system

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

9.2 Internal quality control/quality plan

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

The following shall be demonstrably recorded in this IQC scheme:

- which 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 as shown in Annex II.

9.3 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.
If and when required, the test and measuring equipment shall be calibrated at specified intervals.
The supplier shall record and evaluate the validity of the previous measuring data if at the time of calibration it is established that the equipment is not functioning properly.
The measuring equipment in question must carry an identification that allows for determining the calibration status.
The supplier shall record the results of the calibration.

9.4 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.

9.5 Other requirements

The supplier shall be able to submit the following:

- the organisation's organogram;
- qualification requirements of the personnel concerned.

10 Summary of tests and inspections

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 evaluation guideline;
- **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 evaluation guideline; 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.

10.1 Test matrix

The test matrix is given in table 15.

Table 15 – Test matrix

Description of requirement	**Clause BRL**	**Tests within the scope of:**		
		Pre-certification	**Surveillance by Kiwa after granting of certificate**	
			Inspection	**Frequency**
Piping system				
Fitness for contact with drinking water	4.1	x	x [c)]	1 / year
Classification	4.2	x	-	
Incoming goods / raw materials	4.3	x	IQC [b)]	
Materials (general)	4.4	x	-	
Appearance of pipes and fittings	4.5	x	x [b)]	
Elastomeric sealing elements	4.6	x	x [b)]	
Reference conditions for testing	4.7	x	x [b)]	
Installation instructions	4.8	x	x [b)]	
Protection of products during storage and transport	4.9	x	x [b)]	
Hygienic treatment of products in contact with drinking water	4.10	x	x [b)]	
Pipes				
Dimensions and tolerances	5.1	x	x [b)]	
Specific ring stiffness (S_0 and STES)	5.2.1	x	x [c)]	1 / 2 years
Resistance to initial ring deflection	5.2.2	x	x [b)]	
Axial tensile strength (ATS)	5.2.3	x	x [b)]	

Continuation of Table 15

Description of requirement	Clause BRL	Tests within the scope of:		
		Pre-certification	Surveillance by Kiwa after granting of certificate	
			Inspection	Frequency
Inter laminar shear strength (ILSS)	5.2.4	x	x [b)]	
Ultimate elastic wall strength (UEWS)	5.2.5	x	x [b)]	
Glass transition temperature	5.2.6	x	x [b)]	
Resistance to internal pressure (verification test)	5.2.7	x	x [b)]	
Resistance to shock or impact	5.2.8	x	-	
Opacity	5.2.9	x	-	
Marking of pipes	5.3	x	x [b)]	
Fittings				
General	6.1	x	-	
Build-up of the fitting	6.2	x	x [b)]	
Dimensions and permissible tolerances	6.3	x	x [b)]	
Resistance to internal pressure (verification test)	6.4	x	x [b)]	
Marking of fittings	6.5	x	x [b)]	
Joints				
General (dimensions)	7.1	x	x [b)]	
Joints with elastomeric sealing elements	7.2	x	-	
Tensile resistant wrapped and cemented joints	7.3	x	-	
Tensile resistant bolted flange joints	7.4	x	-	

a) In case of product or production process changes, it shall be determined again in consultation between the supplier and Kiwa, if the product complies with the performance requirements.

b) All product characteristics that can be determined within the visiting time (maximum 1 day) are determined by the inspector or by the supplier in the presence of the inspector. In case this is not possible, an agreement will be made between the certification body and the supplier about how the inspection will take place. The frequency of inspection visits is defined in clause 11.5 of this evaluation guideline.

c) Requirement that is part of the Audit Testing (AT).

10.2 Inspection of the quality system of the supplier

The quality system of the supplier 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 Certification.

11 Agreements on the implementation of certification

11.1 General

The certification body must have a procedure in place in which the general regulations used for certification are established.

11.2 Certification staff

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

- Certification assessor/Reviewer **(CAS/RV**): in charge of carrying out the design and documentation evaluations, pre-certification tests, initial investigations, and evaluation of applications and reviewing conformity assessments.
- 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 based on the inspections carried out and taking decisions on the need to take corrective actions.

11.2.1 Competence criteria certification staff

The competence criteria for the implementing certification staff are laid down in the following table. The competence of the certification staff involved must have been demonstrably recorded.

Basic competences	**Evaluation criteria**
Knowledge of company processes. Skills for conducting professional assessments on products, processes, services, installations, design, and management systems.	*Relevant work experience* **SAS, CAS/RV**: 1 year **DM**: 5 years, including 1 year related to certification Relevant technical knowledge and experience at the level of: **SAS:** High school **CAS/RV, DM**: Bachelor
Skills with regard to site assessments to be performed Adequate communication skills (e.g. writing reports, presentation skills and interviewing skills).	**SAS**: Kiwa Assessment training or equivalent and 4 site assessments including 1 supervised self-reliant assessment.
Execution of Initial Investigation	**CAS**: 2 initial assessments under supervision.
Conducting reviews	**RV**: evaluation of 3 reviews

Technical competences	**Evaluation criteria**
Education	**General:** Education in one of the following technical areas: • Engineering.

Experience – specific	**CAS** • 2 complete applications self-reliant (to be evaluated by **PM**). **SAS** • 2 inspection assessments together with a qualified **SAS**.
Skills in performing witnessing	**SAS** Internal training witness testing

Legenda:

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

11.2.2 Qualifications Certification staff

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 regarding qualifications shall be recorded in the quality assurance system of the certification body.

11.3 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 their decision on the findings included in the report.

11.4 Decision for granting the certificate

The decision for granting the certificate or the imposition of measures with regard to the certificate shall be based on the results recorded in the file.

The results of an initial investigation and a periodic assessment (in case of critical non-conformities) must be assessed by a reviewer.

Based on the performed review, the decision maker will decide if:

- The certificate can be granted,
- Sanctions are imposed,
- The certificate shall be suspended or revoked.

The reviewer and the decision maker shall not have been involved in the preparation of the results based on which the decision is being made.
The decision shall be recorded in a traceable manner.

11.5 Nature and frequency of third party audits

The certification body shall carry out surveillance assessments on site at the supplier to verify compliance with their obligations. The Board of Experts decides on the frequency of assessments.

In case the quality system of the supplier is certified on the basis of 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, the frequency of assessments is set at 2 inspection visits per year (without an ISO 9001 certification, the frequency is 3x per year).
If the supplier is the holder of a system (not a manufacturer of a pipe or a fitting), the frequency is set to 1 inspection a year (with or without ISO 9001 certificate).
For suppliers with a private label certificate, the frequency of assessments for the products covered by this certificate is established at 1 assessment per year (with or without ISO 9001 certification). The assessments are conducted at the site of private label holder and focused on the aspects inserted in the IQC scheme and the results of the control performed by the private label holder. The IQC scheme of the private label holder shall at least refer to:

- the correct way of applying markings to the certified products;
- compliance with required procedures for receiving and final inspection;
- the storage of products and goods;
- dealing with complaints about delivered products.

Inspections shall invariably include:

- The IQC-scheme of the supplier and the results of tests carried out by the supplier;
- The correct marking of the certified products;
- The compliance with the required procedures.

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

11.5.1 Serverty of nonconformities

The severity of the issued nonconformity in relation to the assessment conducted after granting the product certificate by certification body can be differentiated as follows:

- Nonconformities entitled as critical are deviations that can directly affect the quality and/or performance of product and/or process
- Other" nonconformities (noncritical nonconformities).

11.6 Report to the Board of Experts

The certification body shall report at least annually about the performed certification activities. In this report the following aspects shall be included:

- mutations in number of issued certificates (granted/withdrawn);
- number of executed assessments in relation to the established minimum;
- results of the inspections;
- measures imposed in case of nonconformities;
- complaints received from third parties about certified products.

11.7 Interpretation of requirements

The Board of Experts may record the interpretation of requirements of this evaluation guideline in one or more separate interpretation document(s). This or those interpretation documents will be available to the members of the Board of Experts, the certification bodies, and the certificate holders who are active based on this evaluation guideline. This or those interpretation documents will be published on Kiwa’s website.

12 Titles of standards

12.1 Public law rules

Dutch Government Gazette ("Staatscourant") dated 1 July 2017	Regulation on materials and chemicals drinking water and warm tap water supply ("Materialen en Chemicaliën drink- en warm tapwatervoorziening")

12.2 Standards / normative documents

Standard	Title
ASTM D638-14: 2014	Standard Test Method for Tensile Properties of Plastics
ASTM D1598-15a: 2015	Standard Test Method for Tim-to-Failure of Plastic Pipe Under Constant Internal Pressure
ASTM D2105-01: 2014	Standard Test Method for Longitudinal Tensile Properties of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Tube
ASTM D2344/D2344M-13: 2013	Standard Test Method for Short-Beam Strength of Plymer Matrix Composite Materials and their Laminates
ASTM D2584-11: 2011	Standard Test Method for Ignition Loss of Cured Reinforced Resins
ASTM D2992-12: 2012	Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings
BRL K17504	Vulcanised rubber products for cold and hot drinking water applications
EN-ISO 9001:2015	Quality management systems - Requirements
ISO 7432: 2021	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.
ISO 7685: 2019	Plastics piping systems – Glass-reinforced thermosetting plastics (GRP) pipes – Determination of initial specific ring stiffness.
ISO 8483: 2019	Glass-reinforced thermosetting plastics (GRP) pipes and fittings – Test methods to prove the design of bolted flange joints.
ISO 8533: 2019	Glass-reinforced thermosetting plastics (GRP) pipes and fittings – Test methods to prove the design of cemented or wrapped joints.
ISO 8639: 2023	Glass-reinforced thermosetting plastics (GRP) pipes and fittings – Test methods for leaktightness and proof of structural design of flexible joints
ISO 10466: 2021	Plastics piping systems - Glass-reinforced thermosetting plastics (GRP) pipes – Test method to prove the resistance to initial ring deflection.
ISO 10928: 2024	Plastics piping systems – Glass-reinforced thermosetting plastics (GRP) pipes and fittings – Methods for regression analysis and their use.
NEN 7037: 1981	Glass reinforced thermosetting plastics pipes for drain and sewer - Requirements and test methods
NEN-EN 1393: 1996	Plastics Piping Systems – Glass-reinforced thermosetting plastics (GRP) pipes – Determination of initial longitudinal tensile properties

Continuation of 12.2

Standard	Title
NEN-EN-ISO 3126: 2005	Plastics Piping Systems – Plastics components – Determination of dimensions
NEN-EN-ISO 11357-2: 2020	Plastics – Differential scanning calorimetry (DSC) – Part 2: Determination of glass transition temperature and glass transition step height

* When no date of issue has been indicated, the latest version of the document is applicable

13 Test method – Ultimate Elastic Wall Stress

13.1 Scope

This procedure specifies a method for determining the Ultimate Elastic Wall Stress (UEWS) of thermosetting resin pipes.

13.2 Definitions

13.2.1 Ultimate Elastic Wall stress (UEWS)

The maximum circumferential wall stress resulting from an internal hydrostatic pressure that produces an elastic deformation in any direction, expressed in MPa.

13.2.2 Cycle

The total of (see figure 1):

- time required to pressurise the specimen up to the Cyclic Test Pressure (CTP_i);
- one minute at CTP_i;
- quick release of the pressure;
- one minute at atmospheric pressure.

The pressure shall be increased uniformly at a pressure to time ratio between 5 MPa/min and 10 MPa/min.

13.2.3 Cycle group

The total of ten subsequent cycles at a given Cyclic Test Pressure (CTP_i) (see figure 1).

13.2.4 Cyclic Test Pressure (CTP)

The maximum hydrostatic pressure that shall be applied during a cycle group. The Cyclic Test Pressure (CTP) can be combined with an index i (CTP_i) to indicate the group number of a given cycle group.

13.3 Principle

The test method consist of loading a test piece to a prescribed Cyclic Test Pressure (CTP) in a short time interval. The cyclic Test Pressure (CTP) of a defined group of cycles is gradually increased until the UEWS is determined.

13.4 Apparatus

Pressurizing system, capable of applying the pressure to the liquid in the test pieces in such a way as to avoid entrapment of air. The system shall be capable of maintaining the maximum pressure in every CTP within ± 2 % for the duration of the test .

End sealing devices for the test piece, capable of inducing the specified state of stress, i.e. with or without hydrostatic end thrust.

Strain measuring device(s) capable of measuring the required strain to an accuracy of within ± 2%.

The specimen support shall be of such type that axial stress resulting from support spacing is avoided. The support shall not contribute to the restraint of the specimen in either circumferential or longitudinal direction.

13.5 Test pieces

13.5.1 Number

The number of test pieces shall be one.

13.5.2 Free length

The test piece shall comprise a full section of the pipe, the free length (L) of which, between the sealing devices, shall be three times the inner diameter of the pipe, but in no case less than 500 mm.

13.5.3 Cutting

The ends shall be smooth, perpendicular to the axis of the pipe.

13.5.4 Dimensions

Determine the relevant specimen dimensions such as inner diameter, reinforced wall thickness, liner and topcoat thickness, specimen length in accordance with EN-ISO 3126. The inner diameter, liner and reinforced wall thickness shall at least be determined at the location of each strain gauge used.

Other methods may be used when these are recorded in the quality plan of the supplier and approved by Kiwa.

13.6 Conditioning

The test shall be performed at a temperature of (23 ± 5) °C.

13.7 Sample preparation

13.7.1 Applying strain gauges

- Remove the topcoat from the pipe using sandpaper, in order to obtain a direct contact between the strain gauges and the reinforced wall. Destruction of the outer layer of the reinforced wall must be avoided. The sanded surface must be as flat as possible, clean and free of dust.
- Apply a thin layer of adhesive (as thin as possible; in no case thicker than 0.5 mm) to the sanded surface. The adhesive shall be suitable to minimise creep effects during the testing.
- Apply the strain gauges to the adhesive film without air entrapments between the strain gauge and the pipe surface.
- Apply a thin layer of adhesive to the surface of the strain gauges.
- Cover the strain gauges and adhesive with polyester foil. Remove entrapped air bubbles.
- Fix the polyester foil with tape tightly wrapped around the pipe so that the adhesive layer with the strain gauge is as thin as possible. The tape shall withstand the curing temperature of the adhesive.
- Cure the adhesive in accordance with the instructions of the supplier.
- Remove the polyester foil and tape after curing of the adhesive.

13.8 Procedure

13.8.1 Step 1

Determine the cyclic test pressure of the first cycle group (CTP_1) using the following equation:

$$CTP_1 = 0.1 \times P_{UEWS,exp.};$$

where:

CPT_1	is the cycle test pressure of the first cycle group expressed in MPa;
$P_{UEWS,exp.}$	is the test pressure corresponding to the expected UEWS expressed in MPa.

13.8.2 Step 2

Preferably, the strain shall be measured in both axial and hoop direction, using one pair of strain gauges in each direction. Based on available measurements it may be decided to use strain gauges in only one direction. Following rules may be used as guidance:

- Using free end-closures and winding angle ≥ 50 °: measurement in axial direction.
- Using free end-closures and winding angle < 50 °: measurement in axial and hoop direction.
- Using restrained end-closures, all winding angles: measurement in hoop direction.

13.8.3 Step 3

Attach the end-closures to the specimen and fill it completely with water, making sure that no air is entrapped.

13.8.4 Step 4

Attach the specimen to the pressuring device.

13.8.5 Step 5

Connect the strain gauges to the strain indicator. Avoid applying tension on the wires of the strain gauge.

13.8.6 Step 6

Apply the required bridge voltage. The bridge voltage shall be as low as possible in order to avoid excessive temperature increase at the strain gauge.

13.8.7 Step 7

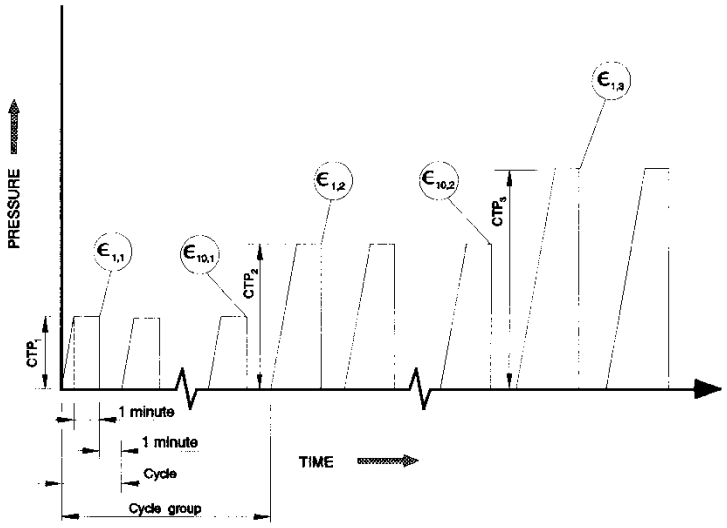
Apply a cyclic pressure of 0 to the Cyclic Test Pressure (CTP_i).
The number of cycles is 10; cycle time 1 minute at CTP_i, one minute no pressure.
Apply the First Cyclic Test Pressure (CTP_1) and perform the test by increasing the CTP after every cycle group as follows:

$$\boldsymbol{CTP_{i+1} = CTP_i + 0.1 \times P_{UEWS,exp.}}$$

where:

i	is the i^{th} cycle group
CPT_i	is the cycle test pressure of the i^{th} cycle group expressed in MPa;
$P_{UEWS,exp.}$	is the test pressure corresponding to the expected UEWS expressed in MPa.

Record the cycle test pressures (CTP_i) and the strain of the first ($\varepsilon_{1,i}$) and the tenth ($\varepsilon_{10,i}$) cycle (see figure 1).



Keys:

$\varepsilon_{1,i}$ First measured strain at the i^{th} cyclic test pressure (CPT_i)
$\varepsilon_{10.i}$ Tenth measured strain at the i^{th} cyclic test pressure (CPT_i)

Figure 1 – Definition of test cycle and Cyclic Test Pressure (CTP).

13.8.8 Step 8

The CTP shall be increased until one of the following criteria is reached:

- The difference between the maximum strain at the end of the last cycle of a given cycle group ($\varepsilon_{10,i}$) and the maximum strain at the end of the first cycle of that same cycle group ($\varepsilon_{1,i}$) exceeds 5% of the maximum strain at the end of the first cycle ($\varepsilon_{1,i}$) of that cycle group:

$$\frac{\varepsilon_{10,i}}{\epsilon_{1,i}} > 1.05$$

Where:
($\varepsilon_{1,i}$) = maximum strain at the end of the first cycle of cycle group i.
($\varepsilon_{10,i}$) = maximum strain at the end of the last cycle of cycle group i.

- The difference between the maximum strain at the end of the last cycle of a given cycle group ($\varepsilon_{10,i}$) and the predicted strain ($\varepsilon_{10,i,predicted}$) at the Cyclic Test Pressure used (CTP_i) as defined by equation (3) exceeds 5% of that predicted strain:

$$\frac{\varepsilon_{10,i}}{\epsilon_{10,i,predicted}} > 1.05$$

Where:

($\varepsilon_{10,i}$) is maximum strain at the end of the last cycle of cycle group i.
($\varepsilon_{10,i,predicted}$) is predicted strain at the Cyclic Test Pressure (CTP_i) as calculated using line A (see figure 2).

The first cycle group shall be excluded from these criterions.

13.8.9 Step 9

Proceed with at least two additional groups of ten cycles using the criteria stated in 13.8.7.

13.9 Calculation and expression of results

Plot the measured strains ($\varepsilon_{10,i}$) of the tenth cycle of the CTP_i as a function of CTP_i for all group cycles (i). An illustration of such a plot is given in figure 2.

Calculate the intercept (a) and the slope (b) of the line A and the intercept (c) and the slope (d) of the line B using linear regression analysis according to ISO 10928, method B.

Determine the intersection of the lines A and B, being the pressure P_{UEWS} (respectively the strain) representative of the UEWS.

The UEWS is calculated as following:

$$UEWS = \frac{P_{UEWS} \times (d_i + e_{eff})}{2 \times e_{eff}}$$

Where:

p_{UEWS} the intersection of the lines A and B (see figure 2) i.e. is the internal hydrostatic pressure expressed in MPa;

d_i is the inner diameter of the test piece at the location of the strain gauge, expressed in mm;

e_{eff} is the thickness of the structural wall at the location of the strain gauge, expressed in mm.

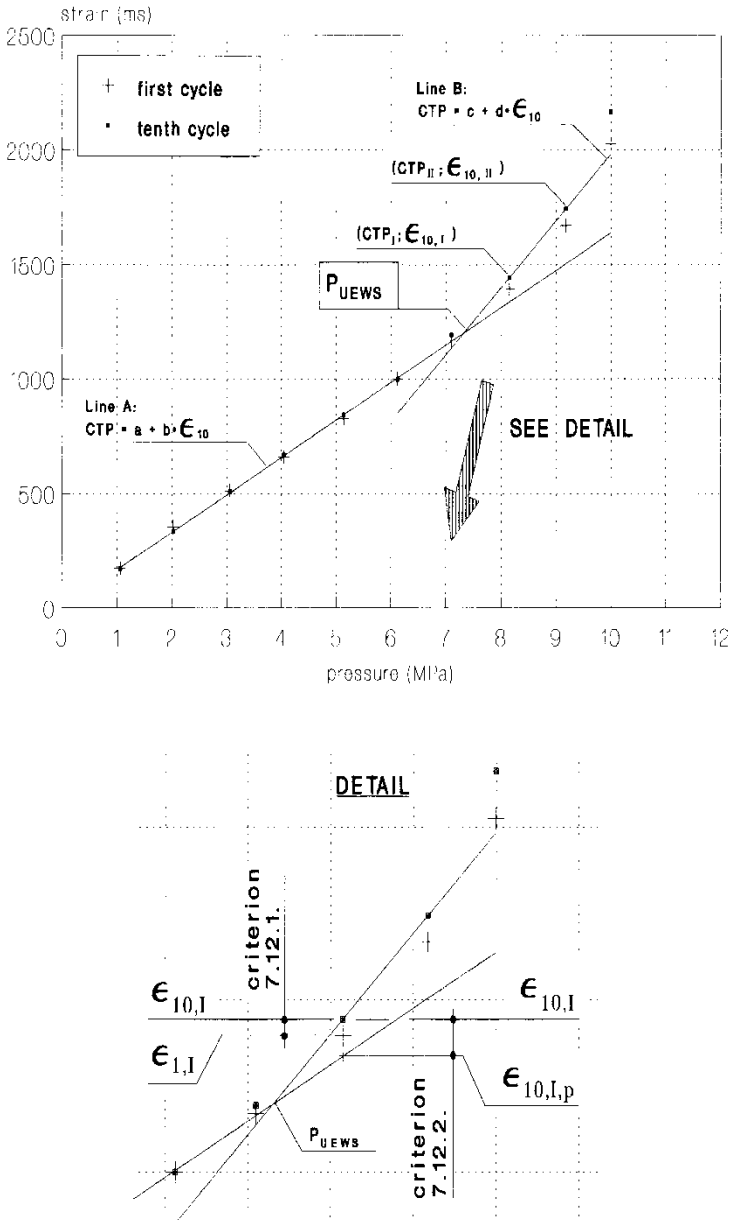


Figure 2 - Example of the expression of the results and calculation of the UEWS.

I Model certificate (example)

CERTIFICATE

Product certificate
KXXXXX/XX

Issued	*yyyy-mm-dd*
Replaces	-
Page	*1 of 1*

Pipes and fittings made of glass-reinforced epoxy for the transport of drinking water – Continuous filament winding – XXX CFW piping system

STATEMENT BY KIWA
With this process certificate, issued in accordance with the Kiwa Regulations for Certification, Kiwa declares that legitimate confidence exists that the products supplied by

Name certificate holder

as specified in this process certificate, may, on delivery, be relied upon to comply with Kiwa evaluation guideline K17104 "Plastics piping systems for water supply with or without pressure – Glass-reinforced thermosetting plastics (GRP) based on epoxy resin (E) with filament wound pipes" dated dd-mm-yyyy.

Ron Scheepers
Kiwa

This product certificate is only valid in combination with a Kiwa certified plastics piping system.
Advice: consult www.kiwa.nl in order to ensure that this certificate is still valid.

Kiwa Nederland B.V.
Sir Winston Churchilllaan 273
Postbus 70
2280 AB RIJSWIJK
The Netherlands
Tel. +31 88 998 44 00
Fax +31 88 998 44 20
info@kiwa.nl
www.kiwa.nl

Company
Name certificate holder
Address certificate holder

T: Telephone number
E: Email
I: www.

Certification process consists of initial and regular assessment of:
- quality system
- product

II Model IQC-scheme (example)

Inspection subjects	Inspection aspects	Inspection method	Inspection frequency	Inspection registration
Raw materials or materials supplied: - recipe sheets - incoming goods inspection raw materials				
Production process, production equipment, plant: - procedures - working instructions - equipment - release of product				
Finished-products				
Measuring and testing equipment - measuring equipment - calibration				
Logistics - internal transport - storage - preservation - packaging - identification				

III De-rating factors (normative)

When the epoxy piping system is to be operated at a continuous constant temperature higher than 20 °C a pressure reduction coefficient as given in table III-1 applies.

Table III-1 – Pressure reduction coefficients for epoxy piping systems

Temperature (°C) [1)]	Coefficient
20	1.00
30	1.00
40	1.00
50	1.00
1. For other temperatures between each step, interpolation is permitted.	

The allowable operation pressure (PFA) is derived from the following equation:

$$PFA = f_T \times PN$$

where:
PN is the nominal pressure
f_T is the coefficient in table IV-1