BRL-K17301
2017-09-15

Evaluation Guideline

for the Kiwa product certificate for piping systems of PVC for the transport of drinking water and raw water

Preface Kiwa

This evaluation guideline has been prepared by the Kiwa Board of Experts Water Cycle (CWK), wherein all the relevant parties in the field of piping systems of PVC for the transport of drinking water and raw water are represented. These Boards of Experts also supervises the certification activities and where necessary require the evaluation guideline to be revised. This Board of Experts also guides the performance of certification and updates this evaluation guideline in case necessary. Wherever the term “Board of Experts” is written in this evaluation guideline, the above- mentioned Board of Experts is meant.

This evaluation guideline will be used by Kiwa in conjunction with the Kiwa Regulations for Product certification. This regulation details the method employed by Kiwa for conducting the necessary investigations prior to issuing the product certificate and the method of external control.

The product requirements and test methods for components of PVC-U are based on NEN-EN-ISO 1452, parts 1, 2, 3, and 5. De product requirements and test methods for PVC-O pipes are based on NEN-ISO 16422. The evaluation guideline contains additional requirements and test methods set by the Board of Experts.

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Validation
This evaluation guideline has been validated by the Director Certification and Inspection of Kiwa on 2017-09-15

Contents

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 product certificate for piping systems of PVC for the transport of drinking water and raw water.

This evaluation guideline replaces BRL-K17301 dated 2014-12-12. Certificates issued on the basis of this guideline lose their validity after date 2018-03-15.

For the performance of its certification work, Kiwa is bound to the requirements as included in NEN-EN-ISO/IEC 17065 “Conformity assessment - Requirements for bodies certifying products, processes and services”.

At setting the requirements the uncertainties of the measurements are taken into account. This implies that drawing conclusions whether requirements are fulfilled these uncertainties do not need to be weighted anymore.

1.2 Field of application

The products are intended to be applied in piping systems for the transport of drinking water till a temperature of 20 °C which are not exposed to sunlight.

This guideline also applies to unplasticized polyvinylchloride (PVC-U) and oriented polyvinylchloride (PVC-O) piping systems for the transport of drinking water and raw water heated till a temperature of 45 °C. For temperatures between 25 °C and 45 °C a de-rating factor is applicable for the calculation of the maximum permissible working pressure in these piping systems (see annex III).

For the complete system of pipes and fittings applies that the working pressure is equal or lower than the nominal pressure of the component with the lowest nominal pressure. In practice the working pressure shall be less than the nominal pressure.

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 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 Kiwa product certificate. A model of the certificate to be issued on the basis of this Evaluation Guideline has been included as information in annex I.

2 Terms and definitions

In this evaluation guideline the following terms and definitions are applicable:

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

Board of Experts: The Board of Experts Water Cycle (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.

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.

Raw water: water that is used for the production of tap water (drinking water).

Special fitting: fitting with an extra function.

Gluing, solvent cementing : the process wherein the pipe and the fitting or a fitting and another fitting are connected to each other using a solvent-containing adhesive.

Spigot end fitting: fitting where the outer diameter of the spigot end is equal to the nominal outside diameter d_n of the corresponding pipe.

End-load bearing joint: joint that can resist axial loads without external mechanical support.

Non-end-load bearing joint: joint that cannot resist an axial load without external mechanical support.

2.1 Abbreviations, terms and definitions

In this evaluation guideline the terms and definitions listed in NEN-EN-ISO 1452: 1, 2, 3, 4 and 5 and listed in table 1 apply.

Table 1 – Abbreviations, terms and definitions which are applicable to this BRL.

Abbreviation	Term	Definition
λ_a	Axial orientation factor	Factor related to the stretch ratio used in the orientation processing in axial direction
λ_c	Circumferential orientation factor	Factor related to the stretch ratio used in the orientation processing in circumferential direction
d_n	Nominal diameter	Specified diameter assigned to a nominal size. Note 1: According to NEN-EN-ISO 1452, the nominal (outside) diameter of a thermoplastics pipe or a spigot, is equal to its minimum mean outside diameter, $d_{em,min.}$ Note 2: The nominal (inside) diameter of the socket of a fitting, pipe, valve or of ancillary equipment is equal to the nominal (outside) diameter of the connecting pipe for which they are designed. Note 3: The nominal diameter is expressed in millimetres.
d_e	Outside diameter at any point	Value of the measurement of the outside diameter through its cross-section at any point of a pipe, rounded up to the nearest 0,1 mm
d_{em}	Mean outside diameter	Value of the measurement of the outer circumference of a pipe or spigot end of a fitting in any cross-section, divided by π (≈ 3,142), rounded up to the nearest 0,1 mm
$d_{em,min}$	Minimum outside diameter	The minimum value of the mean outside diameter as specified in this BRL. The value is equal to the nominal outside diameter d_n and is expressed in mm
$d_{em,max}$	Maximum outside diameter	The maximum value of the mean outside diameter as specified in this BRL. The value is equal to the nominal outside diameter d_n and is expressed in mm
d_i	Inside diameter at any point	Value of the measurement of the inside diameter through its cross-section at any point of a pipe, rounded up to the nearest 0,1 mm
d_{im}	Mean inside diameter	Mean inside diameter determined according to NEN-EN-ISO 3126: clause 5.3.4
$d_{im.min}$	Minimum inside diameter	The minimum value of the mean inside diameter as specified in this BRL. The value is expressed in mm

$d_{im,max}$	Maximum inside diameter	The maximum value of the mean inside diameter as specified in this BRL. The value is expressed in mm
e	Wall thickness	Value of the wall thickness of the pipe or fitting.
e_y	Wall thickness at any point	Value of the measurement of the wall thickness at any point around the circumference of a pipe or fitting, rounded up to the nearest 0,1
e_n	Nominal wall thickness	The wall thickness according to the corresponding table in ISO 4064 and equal to the minimum allowable wall thickness at any point, $e_{y,min}$
e_m	Mean wall thickness	Arithmetical mean of at least four measurements of the wall thickness, regularly spaced around the circumference and in the same cross-section of a component, including the measured minimum and the measured maximum values of the wall thickness in that cross-section. De value is rounded up to the nearest 0,1 mm.
	Tolerance out-of-roundness	$d_{em,max} - d_{em,min}$
	Measured out-of-roundness	Difference between the measured maximum and the measured minimum outside diameter in the same cross-section of a pipe.
	Tolerance	Permitted variation of the specified value of a quantity, expressed as the difference between the permitted maximum and the permitted minimum value
SDR	Standard dimension ratio	Numerical designation of a pipe series which is a convenient round number approximately equal to the dimension ratio of the nominal outside diameter, dn, and the nominal wall thickness, en Note: According to ISO 4065, the standard dimension ratio, SDR, and the pipe series S are related as given in the following equation: SDR = 2 S + 1
S	Pipe series	Dimensionless number for pipe designation. Note: The pipe series S is related to a given pipe geometry as given in the following equation: $S = \frac{SDR - 1}{2} = \frac{d_n - e_n}{2 \times e_n}$

σ_{LPL}	Lower prediction limit	Quantity which can be considered as a material property, representing the 97,5 % lower confidence limit of the predicted long-term hydrostatic strength at 20 °C for 50 years with internal water pressure. Note: σ_{LPL} is expressed in megapascals (MPa).
MRS	Minimum required strength	Value of σ_{LPL}, rounded to the next lower value of the R10 series when σ_{LPL} is below 10 MPa, or to the next lower value of the R20 series when σ_{LPL} is 10 MPa or greater. Note: The R10 and R20 series are the basic series of preferred numbers conforming to ISO 3 and ISO 497.
C	Design coefficient	Overall coefficient with a value greater than 1,00, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower predictive limit (LPL)
σ_S	Design stress	Allowable stress for a given application at 20 °C. Note 1: It is derived from the MRS by dividing it by the coefficient, C, using the following equation: $\sigma_s = \frac{MRS}{C}$ Note 2: Design stress is expressed in megapascals (MPa).
PN	Nominal pressure	Numerical designation used for reference purposes related to the mechanical characteristics of a component of a piping system Note 1: A pressure in bar, numerically equal to PN is identical to the (maximum) allowable working pressure (PFA), when both pressures are taken at 20 ° C. Note 2: For plastics piping systems, it corresponds to the allowable operating pressure, in bar 1), conveying water at 20 °C during 50 years, as given in the following equation: $PN = \frac{20 \times MRS}{C \times (SDR - 1)}$ MRS is expressed in MPa PN is expressed in bars

PFA	(Maximum) allowable operating pressure	Maximum hydrostatic pressure which a component is capable of withstanding continuously in service (excluding surge). Note: For water temperatures up to and including 25 °C: PFA = PN For water temperatures above 25 °C: PFA: $PFA = f_T \times PN$ where f_T is the derating factor depending on water temperature; PN is the nominal pressure. In cases where a further derating factor for application is required: $PFA = f_A \times f_T \times PN$, where f_A is the factor depending on the application.

3 Procedure for granting the quality declaration

3.1 Pre-certification tests

The pre-certification tests to be performed are based on the (product) requirements as contained in this evaluation guideline, including the test methods, and comprise of, depending on the nature of the product to be certified, the following:

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

3.2 Granting the quality declaration

After finishing the pre-certification tests, the results are presented to the decision maker (see 10.4) deciding on granting of the certificate. This person evaluates the results and decides whether the certificate can be granted or if additional data and/or tests are necessary.

4 Requirements and test methods

4.1 General

This chapter contains the requirements the piping systems for the transport of drinking water and raw water have to fulfil, as well as the test methods to determine if the requirements are meet.

4.2 Requirements to avoid deterioration of the quality of drinking water

In the Netherlands the following government regulation apply to prevent degradation of the tap water quality.

Products and materials, which (may) come into contact with water, drinking water or warm tap water, are not allowed to release substances in such quantities which can jeopardise the health of the consumer or the quality of the drinking water. For that the products or materials have to meet the toxicological, microbiological and organoleptical requirements which are laid down in the valid “Ministerial Regulation materials and chemicals drinking water- and warm tap water supply” (published in the Government Gazette). This means that de procedure for obtaining a recognised quality declaration, as meant in the valid Regulation, has to be concluded with positive results.

Products and materials with a quality declaration[*], issued by e.g. 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.

4.3 Material

4.3.1 General

The pipes, fittings and valves must be manufactured from unplasticized polyvinyl chloride (PVC-U) to which only those additives may be added which are strictly required for:

- the manufacturing of the raw material;
- the production of pipes with the required characteristics and the desired colour.

None of these additives may be separately or together be present in the raw material in such amounts that risk with regard to toxicity may occur, problems of organic nature, grow of bacterium or that the ability for gluing of the pipes is negatively affected. The same applies in respect of the chemical and physical properties of the products.

The supplier is allowed to use broken, earlier processed material for the manufacturing of the pipes, provided that the material originates from own production. The supplier shall demonstrate that the characteristics of the products manufactured from reprocessed material fulfil the requirements of this evaluation guideline.
The supplier shall keep records of the reprocessed material in such a way that the pipes concerned are recognisable for the certification body.

[*] A quality declaration issued by an independent certification institute in another member state of the European Community than the Netherlands or another state party to the agreement to the European Economic Area, is equivalent to a recognised 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.

4.3.2 VCM content in material

The volume vinyl chloride monomer (VCM) in the resin used in PVC-U compound/formulation shall be less than ± 0,000 1 %. The VCM content shall be determined by means of gas-phase chromatography using the "headspace" method in accordance with NEN-EN-ISO 6401.

4.3.3 Density

The density of the material shall be determined according to NEN-EN-ISO 1183-1. The material shall have a density greater than or equal to 1350 kg/m^3 and smaller or equal to 1460 kg/m^3.

4.3.4 K value

The K value of the raw material for the production of pipes shall be at least 65,0 when determined according to NEN-EN-ISO 13229.

The K value of the raw material for the production of fittings shall be at least 55,0 when determined according to NEN-EN-ISO 13229.

4.3.5 Classification and verification of the material

4.3.5.1 Classification of compounds in pipe form

Compounds or formulations shall be designated according to NEN-EN-ISO 1452-1:2009, clause 4.4.1.

4.3.5.2 Verification of compounds in pipe form

Compounds or formulations shall be verified according to NEN-EN-ISO 1452-1:2009, clause 4.4.2.

Examples of the test parameters for the verification tests are listed in NEN-EN-ISO 1452-1:2009, table 2.

For the convenience of the reader in this evaluation guideline also a table with examples of test parameters is listed (table 2) with additional values for an exposure time of 1 and 10 hours and a temperature of 40 °C.

Table 2 – Examples of test parameters for verification tests

Duration (hours)	Temperature (°C)	Stress, σ, (MPa)
1	20	42,00
10	20	38,31
100	20	35,00
1000	20	31,87
5000	20	29,90
1	40	30,03
10	40	26,53
100	40	23,45
1000	40	20,73
5000	40	19,01
1	60	17,01
10	60	14,25
100	60	11,95
1000	60	10,00
5000	60	8,85

4.3.5.3 Pipe material

The pipe material shall have a minimum required strength (MRS) of at least 25 MPa. For testing pieces of pipe shall be used.

4.3.5.4 Material of fittings

The fitting material shall have a minimum required strength (MRS) as defined in NEN-EN-ISO 1452-1:2009, clause 4.4.1.

The supplier shall confirm the MRS value by testing as described in NEN-EN-ISO 1452-1:2009, clause 4.4.1, clause 4.4.2 or clause 4.4.3, respectively.

The material of the fittings shall be designated as PVC-U or PVC-UH.

Note: for testing, NEN-EN 12107 can be used for guidance.

4.4 Rubber

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

4.5 Glues

In case glued joints are applied, the glue shall meet the requirements of Kiwa BRL-K525.

4.6 General characteristics of the products

Characteristics of the products

4.6.1 Appearance

When viewed without magnification, the internal and external surfaces shall be smooth, clean and free from scoring, cavities and other surface defects. The ends shall be smooth and perpendicular in relation to the pipe axis.

4.6.2 Colour

The colour of the products shall be grey, blue cream or white with blue strips. The cream colour is not allowed for pipes intended for aboveground application.

4.6.3 Opacity

Products intended for aboveground application must be coloured in such a way that the walls do not let through more than 0,2 % light when tested in accordance with NEN-EN-ISO 7686.

4.7 Changes

After significant change to the product or the production process it is necessary to determine if the products still meet the requirements.
All intended changes by the supplier shall be notified in writing to the certification body. The certification body shall determine what constitutes a significant change Once it is determined that the products with the proposed change meet the requirements of this BRL, the change may be implemented in the production process of the suppliers.

CEN/TS 1452-7 shall be used as guidance document for changes of the product.

4.8 Requirements for joints

4.8.1 Fittings with elastomeric sealing rings

4.8.1.1 Leaktightness under internal pressure and with angular deflection

The leaktightness under internal pressure and with an angular deflection shall be determined according to NEN-EN-ISO 13845 taking into account the following additions / modifications:

- Number of test pieces is 3.
- Double sockets or the fittings shall meet the requirements of clause 6.2
- Pipes shall meet the requirements of clause 5.2 or clause 5.3.

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

4.8.1.2 Leaktightness under negative pressure

The leaktightness under negative pressure shall be determined according to NEN-EN-ISO 13844 taking into account the following additions / modifications:

- Number of test pieces is 3.
- Double sockets or the fittings shall meet the requirements of clause 6.2
- Pipes shall meet the requirements of clause 5.2 or clause 5.3.

Note: Pressure: 1 bar is 0,1 MPa. In this document with test pressure an over pressure is meant.

The joint fulfils the requirements when during the prescribed test duration, the pressure change at the set pressure of -0,1 bar and the set pressure of -0,8 bar is less than 0,05 bar.

4.8.2 Long-term leaktightness under internal pressure of PVC-U solvent cemented joints

The long-term leaktightness under internal pressure shall be determined according to NEN-EN-ISO 13846 taking into account the following additions / modifications:

- Number of test pieces is 3.
- Pipes shall meet the requirements of clause 5.2 or clause 5.3.
- Fitting shall meet the requirements of clause 6.3.
- The free length of the pipe section is 3 x d_n with a minimum of 250 mm.
- The test is carried out at a temperature of 40 $^{+3}/_{-1}$ °C.
- Test duration is 1000 hours.
- Test pressure is 1,3 x PN.

The solvent cementing takes place in accordance with the instructions of the supplier. The drying time amounts at least 30 days at a temperature of (23 ± 2) °C. In consultation with the supplier another drying time can be agreed upon. Socket-spigot fittings (reducing rings) must be solvent cemented in the same manner.

The joint fulfils the requirements when no leakage nor cracking in the assembly are detected during the test.

4.8.3 Saddles of PVC-U

Test pieces are required which are prepared in accordance with the instructions of the supplier. For the preparation PVC pipes are required which comply with clause 5.2 or clause 5.3. The saddles must comply with clause 7.2.
The pipes shall have the same pressure class as the saddles. The test pieces must be conditioned at least 1 hour before testing at a temperature of 23 ± 2 °C.

4.8.3.1 Leaktigthness under internal pressure

The (long-term) leaktightness under internal pressure shall be determined according to NEN-EN-ISO 13846 taking into account the following additions / modifications:

- Number of test pieces is 3.
- The test shall be performed at a temperature of (23 ± 2) °C.
- Test duration is 10 minutes;
- Test pressure is 1,5 x PN.

The joint fulfils the requirements when no leakage nor cracking in the assembly are detected during the test.

4.8.3.2 Leaktigthness under negative pressure

The leaktightness under vacuum shall be determined according to NEN-EN 12294 taking into account the following additions / modifications:

- Number of test pieces is 3.
- The test shall be carried out at a test temperature of (23 ± 2) °C.
- Internal pressure regime according to figure 2.

The joint fulfils the requirements when during the prescribed test duration, the pressure change at the set pressure of -0,1 bar and the set pressure of -0,8 bar is less than 0,05 bar.

4.8.3.3 Leaktigthness under negative pressure and compression of the pipe

The leaktightness under vacuum and compression of the pipe shall be determined according to NEN-EN 12294 taking into account the following additions / modifications:

- Number of test pieces is 1.
- The test shall be carried out at a test temperature of (23 ± 2) °C.
- The test shall be carried out with a negative pressure of -0,5 bar.
- Duration of the test is 10 minutes.
- During the test, the pipe shall be compressed between two flat plates up till 10 % of the nominal diameter of the pipe (see figure 1).

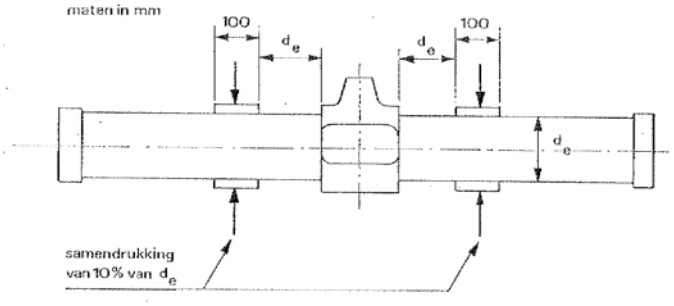


Figure 1 - Test for leaktightness of the pipe under negative pressure and compression of the pipe

The joint fulfils the requirements when during the prescribed test duration, the pressure change at the set pressure of -0,5 bar is less than 0,05 bar.

4.9 Protection products during storage and transport

For the purpose of hygienic work, products shall be protected against contamination. It concerns the surfaces of the product that in the application come into contact with drinking water. More information is given in see annex V.

5 Product requirements and test methods for PVC pipes

5.1 General

This chapter contains the requirements to which PVC-U and PVC-O pipes for the transport of drinking water have to comply with.

5.2 PVC-U

5.2.1 Material

5.2.1.1 Pipe material
See 4.3.1.

5.2.1.2 VCM content in material
See 4.3.2.

5.2.1.3 Density
See 4.3.3.

5.2.1.4 K value
See 4.3.4.

5.2.1.5 MRS value
See 4.3.5.

5.2.2 General characteristics

5.2.2.1 Appearance
See 4.6.1.

5.2.2.2 Colour
See 4.6.2.

5.2.2.3 Opacity
See 4.6.3.

5.2.3 Geometrical characteristics

5.2.3.1 Determination of the dimensions
Dimensions shall be determined according to NEN-EN-SO 3126.

5.2.3.2 Nominal diameter of the pipe
The nominal (outside) diameter, d_n, of the pipe shall conform to NEN-EN-ISO 1452-2:2009 table 1.

5.2.3.3 Mean (outside) diameter and tolerances
The mean outside diameter d_{em} of the pipe shall conform to the applicable nominal outside diameter, d_n, within the tolerance given in NEN-EN-ISO 1452-2:2009, table 1.

The tolerances for out-of-roundness shall conform to NEN-EN-ISO 1452-2:2009, table 2.

5.2.3.4 Wall thickness and its tolerances

The nominal wall thickness, e_n, is classified with the pipe series S. De nominal wall thickness corresponds to the minimum allowable wall thickness.

The nominal wall thickness shall conform to NEN-EN-ISO 1452-2:2008, table 2, as appropriate to the pipe series.

The tolerances for wall thickness, e, shall conform to NEN-EN-ISO 1452-2, table 3.

Table 4 – Nominal (minimum) wall thickness [2] (dimensions in mm)

Nominal (outside) diameter	Nominal (minimum) wall thickness							
	Pipe series S							
	S 20 (SDR 41)	(S 16,7) (SDR 34,4)	S 16 (SDR 33)	S 12,5 (SDR26)	S 10 (SDR 21)	S 8 (SDR 17)	S 6,3 (SDR 13,6)	S 5 (SDR 11)
	Nominal pressure PN based on design coefficient C = 2,5							
d_n		**PN 6**	**PN 6**	**PN 8**	**PN 10**	**PN 12,5**	**PN 16**	**PN 20**
12		--	--	--	--	--	--	1,5
16		--	--	--	--	--	--	1,5
20		--	--	--	--	--	1,5	1,9
25		--	--	--	--	1,5	1,9	2,3
32		--	--	1,5	1,6	1,9	2,4	2,9
40		--	1,5	1,6	1,9	2,4	3,0	3,7
50		--	1,6	2,0	2,4	3,0	3,7	4,6
63		--	2,0	2,5	3,0	3,8	4,7	5,8
75		--	2,3	2,9	3,6	4,5	5,6	6,8
90		--	2,8	3,5	4,3	5,4	6,7	8,2
	Nominal pressure PN based on design coefficient C = 2,0 [1), 4)]							
	PN 6,3	**PN 7,5 [4)]**	**PN 8**	**PN 10**	**PN 12,5**	**PN 16**	**PN 20**	**PN 25**
63	2,0	2,0	--	2,4	3,0	3,8	--	--
75	2,0	2,2	--	2,9	3,6	4,5	--	--
90	2,2	2,7	--	3,5	4,3	5,4	--	--
	Nominal pressure PN based on design coefficient C = 2,0 [1]							
	PN 6	**PN 7,5 [4)]**	**PN 8**	**PN 10**	**PN 12,5**	**PN 16**	**PN 20**	**PN 25**
110	2,7	3,2	3,4	4,2	5,3	6,6	8,1	10,0
125	3,1	3,7	3,9	4,8	6,0	7,4	9,2	11,4
140	3,5	4,1	4,3	5,4	6,7	8,3	10,3	12,7
160	4,0	4,7	4,9	6,2	7,7	9,5	11,8	14,6
180	4,4	5,3	5,5	6,9	8,6	10,7	13,3	16,4
200	4,9	5,9	6,2	7,7	9,6	11,9	14,7	18,2
225	5,5	6,6	6,9	8,6	10,8	13,4	16,6	--
250	6,2	7,3	7,7	9,6	11,9	14,8	18,4	--
280	6,9	8,2	8,6	10,7	13,4	16,6	20,6	--
315	7,7	9,2	9,7	12,1	15,0	18,7	23,2	--
355	8,7	10,4	10,9	13,6	16,9	21,1	26,1	--
400	9,8	11,7	12,3	15,3	19,1	23,7	29,4	--
450	11,0	13,2	13,8	17,2	21,5	26,7	33,1	--
500	12,3	14,6	15,3	19,1	23,9	29,7	36,8	--
560	13,7	16,4	17,2	21,4	26,7	--	--	--
630	15,4	18,4	19,3	24,1	30,0	--	--	--
710	17,4	20,7	21,8	27,2	--	--	--	--
800	19,6	23,3	24,5	30,6	--	--	--	--
900	22	26,3	27,6	--	--	--	--	--
1000	24,5	29,2	30,6	--	--	--	--	--

1. To apply a design coefficient of 2,5 (instead of 2,0) for pipes with nominal diameters above 90 mm, the next higher pressure rating, PN, shall be chosen.
2. The nominal wall thicknesses conform to ISO 4065:1996.
3. The PN 6 values for S 20 and S 16 are calculated with the preferred number 6,3.
4. PN 7,5 and a design coefficient C = 2,0 shall be no longer certified, two years after this evaluation guideline has been validated by Kiwa.

5.2.3.5 Length of pipe

The nominal pipe length, *l*, shall be a minimum length which does not include the depth of the socketed portions.

5.2.3.6 Dimensions of pipes with integral sockets for solvent cementing joints

The dimensions of sockets for solvent cementing shall preferably comply with the requirements specified in NEN-EN-ISO 1452-2:2009 clause 6.6.1 and shall be recorded in the Internal quality control scheme of the supplier.

Note: Values listed in NEN-EN-ISO 1452-2:2009, clause 6.6.1, are mean values. Values laid down in the IKB scheme of the supplier, could be minimum values.

5.2.3.7 Dimensions of pipes with integral sockets with rubber sealing rings type joints

The dimensions of sockets for elastomeric ring seal joint shall comply with NEN-EN-ISO 1452-2:2009, clause 6.6.2.

5.2.3.8 Dimensions of pipe ends

Pipes with plain ends intended to be used with elastomeric ring seal sockets shall be chamfered as shown in Figure 2. The tapered portion should be smooth and without damage. The pipe ends shall comply with the requirements listed in table 5.

Table 5 – Dimensions of the tapered end (expressed in mm)

Nominal outside diameter d_n		**e1**	**l**	**alpha**	
greater than	**up and including**	**min**	**min**	**min**	**max**
-	90	0,50 x e_{min}	4	5°	15°
90	110		6		
110	125		7		
125	400		8		
400	-		10		

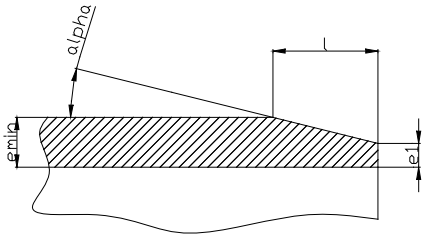


Figure 2 – Chamfer

Pipes with plain ends intended to be used for solvent cement joints shall have all sharp edged removed.

5.2.4 Classification of the pipe

Pipes shall be classified according to their nominal pressure (PN) pipe series (S) and the design stress (σ_s) according to NEN-EN-ISO 1452-2:2009, chapter 7. See annex IV for further details.

5.2.5 Mechanical characteristics

5.2.5.1 Resistance to impact

The resistance to impact of pipes shall comply with the requirements specified in NEN-EN-ISO 1452-2:2009 clause 8.1. The resistance to impact shall be determined according to ISO 3127. The drop tests shall be carried out with a test temperature of (0 ± 2) °C. The drop height and the mass of the striker depends on the nominal diameter of the pipe and is listed in table 6.

Table 6 – Test parameters for the determination of the resistance to impact

Nominal diameter (mm)	Test level M	
	Mass of the striker (kg)	Drop height (m)
20	0,500	0,400
25	0,500	0,500
32	0,500	0,600
40	0,500	0,800
50	0,500	1,000
63	0,800	1,000
75	0,800	1,000
90	0,800	1,200
110	1,000	1,600
125	1,250	2,000
140	1,600	1,800
160	1,600	2,000
180	2,000	1,800
200	2,000	2,000
225	2,500	1,800
250	2,500	2,000
280	3,200	1,800
≥315	3,200	2,000

5.2.5.2 Resistance to internal pressure

The resistance to internal pressure of pipes shall be determined according to NEN-EN-ISO 1167, all parts. For each combination of temperature and test duration one test pieces is tested (see table 7). The test pressure shall be calculated in accordance with NEN-EN-ISO 1167-1:2006, clause 7.2. This means, on the basis of the measured dimensions of the pipe.

For this test, end caps type A or B in accordance with NEN-EN-ISO 1167-1 may be used. In case of dispute, end caps type A shall be used.

Note: Type of end caps used during the test has an effect on the test results.

Table 7 – Test parameters for the determination of the resistance to internal pressure

Temperature (°C)	Test duration (hours)	Circumferential stress in pipe wall (MPa)
20	1	42,0
20	100	35,0
60	1000	12,5 [a)]

Test: water-in-water

a) If tested with the circumferential stress of 12,5 MPa, due to statistical spread of the test results, test times less than 1 000 h can be achieved. In this case, a retest procedure with a circumferential stress of 12,5 MPa or 10,0 MPa shall be performed with pipes of the same production batch and double sampling. If the retest results are positive, the requirement of the minimum reference curve for PVC-U 250, given in ISO 1452-1:2009, 4.4.2, is deemed to be verified.

The test piece meets the requirements as during the test the test piece does not fail.

The resistance to internal pressure of integral sockets on pipes shall comply to NEN-EN-ISO 1452-2:2009, table 8.

5.2.6 Physical characteristics

When not mentioned otherwise, for the pre-certification tests the number of test pieces is 3.
The number of test pieces required for the for factory production control and process control shall be listed in the supplier's IQC scheme.

5.2.6.1 Vicat softening temperature

The Vicat softening temperature shall be ≥ 80 °C when determined according to NEN-EN 727. The test piece shall be cut from the wall of a pipe.

5.2.6.2 Longitudal reversion

The longitudinal reversion after heating and cooling shall be less than 5 % when determined according to NEN-EN-ISO 2505 taking into account the following additions / modifications:

- Method: air oven or liquid bath with e.g. glycerine.
- Test temperature (150 ± 2) °C.
- Conditioning time depends on the wall thickness and shall comply to NEN-EN-ISO 1452-2:2009, clause 9.

5.2.6.3 Resistance to dichloromethane

The resistance of the pipe material to dichloromethane shall be determined according to NEN-EN 580 13846 taking into account the following additions / modifications:

- Number of test pieces is 1.
- Temperature of the bath is (15 ± 1) °C.
- Immersion time 30 minutes.
- Minimum wall thickness of the test piece is 1,5 mm.

After the test is terminated, there shall be no visible damage as a result of the contact with dichloromethane.

5.2.7 Marking of PVC-U drinking water pipes

The pipes are provided with at least the following markings:

- KIWA or  which is allowed for small diameters after consultation with Kiwa;
- supplier's name, trade name;
- material identification: PVC-U;
- nominal pressure: PN;
- nominal outside diameter and nominal wall thickness in mm;
- production code "year" and "week" 1);
- extruder number 1).

Location of the markings: on each pipe at a spacing of less than 2 m.
The markings shall be clear, legible and indelible affixed on the pipe.

1) May be displayed if desired in code.

5.3 PVC-O (biaxial oriented PVC-U)

5.3.1 General

Note 1: Because of the orientation the material has a fibrous layered structure. Processing on site of the biaxial oriented PVC-U pipes like gluing, sawing and boring can be done in the same way as with non-oriented PVC-pipes, however the processed cutting edge can have another appearance.

The supplier shall implement work instructions in his quality system for the processing of PVC-O pipes.

Note 2: Treatments on site whereby the pipe is heated may cause unwanted deformations.

Note 3: Fittings for non-oriented PVC-U pipes are also suitable for biaxial oriented pipes, dependant of the pressure class.

5.3.2 Material

5.3.2.1 Pipe material

See 4.3.1.

5.3.2.2 VCM content

See 4.3.2.

5.3.2.3 Density

See 4.3.3.

5.3.2.4 K value

See 4.3.4.

5.3.2.5 Classification and verification of material

Oriented pipes shall be made of PVC-U with a well-defined orientation level in circumferential and axial direction. The classification and verification of the MRS value shall comply to the requirements listed in NEN-ISO 16422. Among other things this means that the pipe material shall be subjected to tests with internal pressure according to NEN-EN-ISO 1167 series and the test results shall be evaluated according to NEN-EN-ISO 9080. For this test, end caps type A or B in accordance with NEN-EN-ISO 1167-1 may be used.

Note: Type of end cap used during the test has an effect on the test results.

The MRS value shall be classified according to NEN-ISO 16422:2014, clause 7 and table 8 of this evaluation guideline and specifying the type of end cap (A or B) used for the classification.

Note: Table 8 is taken from NEN-ISO 16422:2014.

Table 8 – Material classification of PVC-O pipes

Pipe Material classification number	**315**		**355**		**400**		**450**			**500**		
MRS (MPa)	31,5		35,5		40		45			50		
C	1,6	2	1,6	2	1,6	2	1,4	1,6	2	1,4	1,6	2
σ_s	20	16	22	18	25	20	32	28	23	36	32	25

See further clause 5.3.6 for the control of the relationship between orientation factor and the MRS.

5.3.3 General characteristics

5.3.3.1 Appearance
See clause 4.6.1.

5.3.3.2 Colour
See clause 4.6.2.

5.3.3.3 Opacity
See clause 4.6.3.

5.3.4 Geometrical characteristics

5.3.4.1 Determination of the dimensions
Dimensions shall be determined according to NEN-EN-ISO 3126.

5.3.4.2 Nominal diameter of the pipe
See clause 5.2.3.2.

5.3.4.3 Mean (outside) diameter and tolerances
See clause 5.2.3.3.

5.3.4.4 Wall thickness and tolerances
The nominal wall thickness e_n is classified with the pipe series S. The nominal wall thickness corresponds to the minimum allowable wall thickness.

The nominal wall thickness shall meet the requirements specified in NEN-ISO 16422:2014, table 2 for the given pipe series S: S: 20,0, 18,0, 16,0, 12,5, 10,0 and for nominal diameters DN: 90, 110, 125, 160, 200, 250, 315, 355, 400, 450, 500 and 630.

The tolerances for wall thickness shall meet the requirements specified in NEN-EN-ISO 1452-2:2009, table 3.

5.3.4.5 Length of pipe
See clause 5.2.3.5.

5.3.4.6 Dimensions of pipes with integral sockets with elastomeric sealing rings
The minimum depth of engagement of the integral sockets with elastomeric sealing ring type joints shall meet the requirements specified in NEN-ISO 16422:2014, clause 10,3.

5.3.4.7 Dimensions of pipe ends
See clause 5.2.3.8.

5.3.5 Classification of biaxial oriented pipe
PVC-O Pipes shall be classified according to their nominal pressure (PN) pipe series (S) and the design stress (σ_s) according to NEN-ISO 16422:2014, clause 8. See annex IV for further details.

5.3.6 Verification relation between orientation level and MRS
The producer shall demonstrate that the bi-axially oriented pipes (PVC-O) comply with the requirements listed in table 8. This means, among other things, that the relationship between the MRS-value and the orientation factor in the axial and the circumferential direction for the PVC-O pipes must be demonstrated by the producer.

The MRS value shall be determined in accordance with clause 5.3.2.5.

The orientation levels shall be determined according to clause 5.3.7.

If applicable, it shall be demonstrated that the pipe at (design) temperatures above 20 °C meet the requirements (see Annex III for reduction factors at higher temperatures).

5.3.7 Orientation level

Note: When determining the orientation level in the axial and circumferential direction of the pipe, use is made of the fact that a biaxial oriented pipe in the rubber phase (above the glass/rubber transition temperature) will shrink to its initial dimensions before the extrusion process.

The coefficients of axial and circumferential orientation may be determined using one test piece.

Measure the pipe outside diameter, wall thickness and the distance between de marks, L_0, with an accuracy and precision of 0,25 mm.

The orientation factors shall be declared and recorded in the quality system of the supplier.

5.3.7.1 Axial
The coefficient of axial orientation, λ_a, shall be determined according to NEN-ISO 16422:2014 annex F which in turn refers to NEN-EN-ISO 2505.
The coefficient of axial orientation, λ_a, is calculated as:

$$\lambda_a = \frac{L_0}{L_i}$$

where:
L_0 distance between the marks before heat treatment
L_i distance between the marks after heat treatment

λ_a shall be ≥ 1.

5.3.7.2 Circumferential

The coefficient of circumferential orientation, λ_c, shall be calculated as:

$$\lambda_c = \frac{D_{em} - e_{em}}{D_i - e_i}$$

where:

D_{em} the measured outside diameter (see table 1) before heat treatment.
D_i the measured outside diameter after heat treatment.
e_{em} mean wall thickness before heat treatment.
e_i mean wall thickness after heat treatment.

The length of the test piece and heat treatment, i.e. test temperature and duration of the exposure shall comply to NEN-EN-ISO 2505.

5.3.8 Mechanical characteristics

5.3.8.1 Resistance to impact

The resistance to impact of PVC-O pipes shall be determined according to NEN-ISO 16422. The pipe meets the requirement as the TIR (true impact rate) is below 10 %.

This means that the resistance impact is determined according to ISO 3127 with a falling body with a spherical target surface with a radius of 12,5 mm.
The drop height is 2 meters. The test temperature is (0 ± 2) ° C.
The mass of the striker is dependent on the nominal diameter of the pipe and is listed in Table 9.

Table 9 – Mass of the striker for various nominal diameters

Nominal diameter	Mass striker body (kg)
63	4
75	5
90	5
110	6,3
125	6,3
140	8
160	8
180	10
200	10
≥ 225	12,5

5.3.8.2 Resistance to internal pressure

The pipes shall withstand the prescribed circumferential stress in the pipe wall without cracking. . Further no leakage is allowed during the test period. The test shall be carried out in accordance with NEN-EN-ISO 1167, all parts, taking into account the additions / modifications listed in Table 10. The test shall be carried out with the same type of end caps that are used for the classification of the pipe material (see clause 5.3.5).

Table 10 – Test parameters for the determination of the resistance to internal pressure

Temperature (°C)	Duration (hours)	Circumferential stress in pipe wall (MPa) [1)]
20	100	
60	1000	
Test: water-in-water 1) The minimum circumferential stress in the material of the pipe wall shall be calculated on the basis of the results of the pre-certification tests which included the determination of the regression lines in accordance with NEN-EN-ISO 9080 and the MRS value. For this control test, the circumferential stress shall be calculated using the regression line of the pipe material (97.5% CLC-line). The test pressure shall be calculated in accordance with NEN-EN-ISO 1167-1:2006, clause 7.2. This means, on the basis of the measured dimensions of the pipe.		

The resistance to internal pressure of integral sockets on pipes shall comply to ISO 16422:2014, clause 11.1.

5.3.9 Physical characteristics

5.3.9.1 Resistance to dichloromethane

The test is carried out on non-oriented pipe. Test method according to clause 5.2.6.3

5.3.9.2 Vicat softening temperature

The Vicat softening temperature of the pipe material shall be ≥ 80 °C when determined according to NEN-EN 727. The test piece shall be cut from the wall before the pipe is orientated.

5.3.10 Marking of PVC-O drinking water pipes

The pipes are provided with at least the following markings:

- KIWA or which is allowed for small diameters after consultation with Kiwa;
- supplier's name, trade name;
- material identification: PVC-O biax 315 or PVC-O biax 400 or PVC-O biax 450 PVC-O biax 500;
- nominal pressure: PN;
- design coefficient C = 1,4 or C = 1,6 or C = 2,0;
- nominal outside diameter and nominal wall thickness in mm or SDR;
- production code "year" and "week" [1)];
- extruder number [1)].

Location of the markings: on each pipe at a spacing of less than 2 m.
The markings shall be clear, legible and indelible affixed on the pipe.

1) May be displayed if desired in code.

6 Product requirements and test methods for PVC fittings

6.1 General

This chapter contains the requirements that:

- fittings with elastomeric sealing rings, DN 50 up to and including DN 630;
- fittings for solvent cementing, DN 12 up to and including DN 160;
- bends made of PVC-U pipe, DN 50 up to and including DN 630;

for the transport of drinking water shall meet.

6.2 Fittings with elastomeric sealing rings

6.2.1 Rubber

Elastomeric sealing ring shall meet the requirements of BRL-K17504.
See clause 4.4.

6.2.2 Material

6.2.2.1 General

See clause 4.3.1.

6.2.2.2 VCM content

See clause 4.3.2.

6.2.2.3 Density

See clause 4.3.3.

6.2.2.4 K value

See clause 4.3.4.

6.2.2.5 Classification and verification of the material

See clause 4.3.5.

6.2.3 General characteristics

6.2.3.1 Appearance

See clause 4.6.1.

6.2.3.2 Colour

See clause 4.6.2.

6.2.3.3 Opacity

See clause 4.6.3.

6.2.4 Geometrical characteristics

6.2.4.1 Determination of dimensions

Dimensions of the fittings shall be determined according to NEN-EN-ISO 3126.

6.2.4.2 Nominal diameter of fittings

The nominal inside diameter(s), d_n, of the fitting shall correspond to, and be designated by, the nominal outside diameter(s) of the pipe, d_n, for which the fitting is designed.

6.2.4.3 Dimensions of fittings with elastomeric sealing rings

The dimensions and tolerances of fittings with a elastomeric sealing ring shall comply with the requirements specified in NEN-EN-ISO 1452-3:2010, clause 6.7.

6.2.5 Mechanical characteristics

6.2.5.1 Resistance to impact of fitting

The impact strength of the fitting shall be determined according to NEN-EN 12061 taking into account the following additions / modifications:

- The impact strength of the fitting is tested by dropping it on a rigid surface. After the fall, the fitting is inspected with the naked eye without magnification. In case the fitting consists of separate components, these components shall be inspected also on damage that may have an effect on the leaktightness.
- Test temperature (0 ± 2) ° C.
- Conditioning period > 30 min at 0 ° C.
- Drop height: 500 mm for DN ≤ 110, 1000 mm for DN > 125.
- Point of impact: at random.

The fitting meets the requirements when the result can be expressed as "no damage" according to clause 7 of NEN-EN 12061:1999. The for impact resistance tested test pieces shall be used for testing the leaktightness.

6.2.5.2 Resistance to internal pressure of injection moulded fittings

The fittings shall withstand the prescribed internal pressure without cracking. Further no leakage is allowed during the test period. The test shall be carried out in accordance with NEN-EN-ISO 1167, all parts, taking into account the additions / modifications listed in Table 11. For this test, end caps type A or B in accordance with NEN-EN-ISO 1167-1 may be used. In case of dispute, end caps type A shall be used.

For the purpose of testing the fittings shall be assembled on PVC pipes of the same pressure class as the fitting, or fittings shall be sealed with end caps.

Note Type of end cap used during the test has an effect on the test results.

Table 11 – Test parameters for the determination of the resistance to internal pressure of injection moulded fittings of PVC

Nominal diameter / C	Test temperature (°C)	Test duration (hours)	Test pressure [1)] (bars)
d_n < 160 / C = 2,5	20	1	4,2 x PN
d_n ≥ 160 / C = 2,0	20	1	3,36 x PN
d_n < 160 / C = 2,5	20	100	3,5 x PN
d_n ≥ 160 / C = 2,0	20	100	2,8 x PN
d_n < 160 / C = 2,5	40	1000	2,1 x PN
d_n ≥ 160 / C = 2,0	40	1000	1,68 x PN

1) The test pressure, expressed in bar, shall be determined using the following equation:

$p = C \times \frac{\sigma_{T,t}}{MRS} \times PN$;

Where:
PN is the nominal pressure expressed in bars;
C is the design coefficient (C= 2,5 or C = 2,0);
$\sigma_{T,t}$ corresponding value listed in table 2;
MRS is minimum required strength (i.e. 25 MPa).

2. Test: water-in-water.
3. Number of test pieces: 3 for each test condition.

6.2.5.3 Resistance to internal pressure of couplers made of pipe or made by machining

The fittings shall withstand the prescribed internal pressure without cracking. Further no leakage is allowed during the test period. The test shall be carried out in accordance with NEN-EN-ISO 1167, all parts, taking into account the additions / modifications listed in Table 12. For this test, end caps type A or B in accordance with NEN-EN-ISO 1167-1 may be used. In case of dispute, end caps type A shall be used.

For the purpose of testing the fittings shall be assembled on PVC pipes of the same pressure class as the fitting, or fittings shall be sealed with end caps.

Note Type of end cap used during the test has an effect on the test results.

Determine the test pressure, p, using:

$p = C \times \frac{\sigma_{T,t}}{MRS} \times PN$

Table 12 – Test parameters for the determination of the resistance to internal pressure

Temperature (°C)	Test duration (hours)	Test pressure (bar)
20	1	$C \times \frac{42{,}00}{MRS} \times PN$
20	100	$C \times \frac{35{,}00}{MRS} \times PN$
60	1000	$C \times \frac{10{,}00}{MRS} \times PN$
$\sigma_{T,t}$ is corresponding value from table 2 C is the applicable design coefficient; C = 2,0 or C = 2,5, depending of the nominal size of the fitting. PN is pressure class of the fitting tested.		

6.2.6 Physical characteristics

6.2.6.1 Vicat softening temperature

The Vicat softening temperature shall be determined according to NEN-EN 727.
Injection moulded fitting meet the requirement when the Vicat softening temperature is ≥ 74 °C.
For fittings made from pipe the Vicat softening temperature shall be ≥ 80 °C.
The test piece shall be cut from the wall of fitting.

6.2.6.2 Assessment of the effect of heating

Three complete mouldings shall be tested in accordance with NEN-EN-ISO 580 taking into account the following additions / modifications:

- Method A (forced-air oven).
- Heating temperature (150 ± 2) ° C.
- Heating time (see table 12a).

Table 12a – heating time for fittings with various mean wall thicknesses

Mean wall thickness (e_m) expressed in mm	**heating period expressed in minutes**
$e_m \leq 3$	15
$3 < e_m \leq 10$	30
$10 < e_m \leq 10$	60
$20 < e_m \leq 10$	140
$30 < e_m \leq 10$	220
$40 < e_m$	240

The surfaces of the moulding are examined before and after heating, and any cracks, blisters, delamination, or weld opening are measured and expressed as a percentage of the wall thickness.

The maximum dimensions of cracks, delamination, blisters, and flow joint openings, expressed as a percentage of the wall thickness should be less than 30 %.

6.2.7 Marking of elastimeric ring seal fittings

The fitting is provided with at least the following markings:

- KIWA or on smaller products or KK [1)] or KK [1)].
- supplier's name, trade name or logo;
- material identification PVC-U;
- nominal pressure PN;
- nominal size of the socket ends in mm;
- indication of the field of application;
- production period [2)]

The markings shall be clear, legible and indelible affixed on the fitting.

1) For small fittings marking with kk only is allowed.
2) May be displayed if desired in code.

The smallest packaging unit of the fittings shall be marked with at least the following information:

- KIWA;
- supplier's name, trade name, system name, logo or certificate number of the corresponding product (system) certificate, in accordance with the marking on the connecting pipe;
- nominal outside diameter and nominal wall thickness in mm of the connecting pipe;
- material identification, if the fitting body is made of plastic;

The markings shall be clear, legible and indelible affixed on each package.

6.3 Fittings for solvent cemented joint

6.3.1 Glue instruction

The supplier of the fittings shall deliver the products with an instruction for gluing.

6.3.2 Material

6.3.2.1 General

See clause 4.3.1.

6.3.2.2 VCM content

See clause 4.3.2.

6.3.2.3 Density

See clause 4.3.3.

6.3.2.4 K value

See clause 4.3.4.

6.3.2.5 Classification and verification of the material

See clause 4.3.5.

6.3.3 General characteristics

6.3.3.1 Appearance

See clause 4.6.1.

6.3.3.2 Colour

See clause 4.6.2.

6.3.3.3 Opacity

See clause 4.6.3.

6.3.4 Geometrical characteristics

6.3.4.1 Determination of dimensions

Dimensions of the fittings shall be determined according to NEN-EN-ISO 3126.

6.3.4.2 Nominal diameter of fittings

The nominal inside diameter(s), d_n, of the fitting shall correspond to, and be designated by, the nominal outside diameter(s) of the pipe, d_n, for which the fitting is designed.

6.3.4.3 Dimensions of fitting for solvent cementing

The dimensions and tolerances of fittings for solvent cementing shall comply with the relevant requirements specified in EN-EN-ISO 1452-3:2010, clause 6.3 and the following additions listed in the tables 13 and 14.

Table 13 – Minimum wall thickness [1)] of injection moulded PVC-U solvent cement fittings (in mm)

Nominal diameter	Material designation PVC-U 200 fittings for nominal pressures of:			Material designation PVC-U 250 fittings for nominal pressures of:		
	PN 10	PN 12,5	PN 16	PN 10	PN 12,5	PN 16
12	2,0	2,0	2,0	2,0	2,0	2,0
16	2,0	2,0	2,0	2,0	2,0	2,0
20	2,0	2,0	2,0	2,0	2,0	2,0
25	2,0	2,0	2,4	2,0	2,0	2,0
32	2,0	2,4	3,0	2,0	2,0	2,4
40	2,4	3,0	3,8	2,0	2,4	3,0
50	3,0	3,8	4,7	2,4	3,0	3,7
63	3,8	4,8	5,9	3,0	3,8	4,7
75	4,5	5,7	6,9	3,6	4,5	5,6
90	5,4	6,8	8,3	4,3	5,4	6,7

1. In any cross-section the wall thickness of the fittings shall be no less than the values listed in this table.

Table 14 – Inside diameters of the sockets (in mm)

Nominal size of the fitting	Mean inside diameter of the socket		Out-of-roundness [1)]
	min.	max.	
12	12,0	12,3	0,2
16	16,0	16,3	0,2
20	20,0	20,3	0,2
25	25,0	25,3	0,2
32	32,0	32,3	0,3
40	40,0	40,3	0,3
50	50,0	50,3	0,4
63	63,0	63,3	0,5
75	75,0	75,3	0,6
90	90,0	90,3	0,7
110	110,1	110,4	0,8
125	125,1	125,4	0,9
160	160,2	160,5	1,0

1) Tolerance: 0,007 x d_e in (d_e = the nominal outside diameter of the connecting pipe).

6.3.5 Mechanical characteristics

6.3.5.1 Resistance to impact of fitting

The impact strength of the fitting shall be determined according to EN 12061 taking into account the following additions / modifications:

- The impact strength of the fitting is tested by dropping it on a rigid surface. After the fall, the fitting is inspected with the naked eye without magnification. In case the fitting consists of separate components, these components shall be inspected also on damage that may have an effect on the leaktightness.
- Test temperature (0 ± 2) ° C.
- Conditioning period > 30 min at 0 ° C.
- Drop height: 500 mm for $d_n \leq 110$, 1000 mm for $d_n > 125$.
- Point of impact: at random.

The fitting meets the requirements when the result can be expressed as "no damage" according to clause 7 of EN 12061:1999. The for impact resistance tested test pieces shall be used for testing the leaktightness.

6.3.5.2 Resistance to internal pressure of injection moulded fittings for solvent cemented joints

The fittings shall withstand the prescribed internal pressure without cracking. Further no leakage is allowed during the test period. The test shall be carried out in accordance with NEN-EN-ISO 1167, all parts, taking into account the additions / modifications listed in Table 15. For this test, end caps type A or B in accordance with NEN-EN-ISO 1167-1 may be used. In case of dispute, end caps type A shall be used.

For the purpose of testing the fittings shall be assembled on PVC pipes of the same pressure class as the fitting, or fittings shall be sealed with end caps.

Note Type of end cap used during the test has an effect on the test results

Table 15 – Test parameters for the determination of the resistance to internal pressure

Test temperature (°C)	Test duration (hours)	Test pressure [1] (bars)
20	1	$C \times \frac{42{,}00}{MRS} \times PN$
	100	$C \times \frac{35{,}00}{MRS} \times PN$
	1000	$C \times \frac{31{,}87}{MRS} \times PN$

1) The test pressure, expressed in bar, shall be determined using the following equation:

$p = C \times \frac{\sigma_{T,t}}{MRS} \times PN$;

Where:
PN is the nominal pressure expressed in bars;
C is the design coefficient (C= 2,5 or C = 2,0);
$\sigma_{T,t}$ corresponding value listed in table 2;
PVC-U MRS is minimum required strength (i.e. 25 MPa).

2) Test: water-in-water.
3) Number of test pieces: 3 for each test condition.

6.3.6 Physical characteristics

6.3.6.1 Vicat softening temperature

The Vicat softening temperature shall be determined according to NEN-EN 727.
Injection moulded fitting meet the requirement when the Vicat softening temperature is ≥ 74 °C.
For fittings made from pipe the Vicat softening temperature shall be ≥ 80 °C.
The test piece shall be cut from the wall of a fitting.

6.3.6.2 Assessment of the effect of heating

Three complete mouldings shall be tested in accordance with NEN-EN-ISO 580 taking into account the following additions / modifications:

- Method A (forced-air oven).
- Heating temperature (150 ± 2) ° C.
- Heating time (see table 12a).

The surfaces of the moulding are examined before and after heating, and any cracks, blisters, delamination, or weld opening are measured and expressed as a percentage of the wall thickness.

The maximum dimensions of cracks, delamination, blisters, and flow joint openings, expressed as a percentage of the wall thickness should be less than 30 %.

6.3.7 Marking of PVC-U and PVC-UH fittings voor solvent cementing joints

The fitting is provided with at least the following markings:

- KIWA or on smaller products or KK [1)] or KK [1)].
- supplier's name, trade name or logo;
- material identification PVC-U;
- nominal pressure PN;
- nominal size of the socket ends in mm;
- indication of the field of application;
- production period [2)]

The markings shall be clear, legible and indelible affixed on the fitting.

1) For small fittings marking with kk only is allowed.
2) May be displayed if desired in code.

The smallest packaging unit of the fittings shall be marked with at least the following information:

- KIWA ;
- supplier's name, trade name, system name, logo or certificate number of the corresponding product (system) certificate, in accordance with the marking on the connecting pipe;
- nominal outside diameter and nominal wall thickness in mm of the connecting pipe;
- material identification, if the fitting body is made of plastic;

The markings shall be clear, legible and indelible affixed on each package.

6.4 Bends made from pipe

In this BRL the requirements are laid down for bends which are made from PVC-U pipe and are bend after a heating. Bends are produced with the following nominal angles: 11°, 22°, 30°, 45°, 60° and 90°.

6.4.1 General

Under normal operational conditions, the life span of the bends shall be at least equal to the life span of the connecting pipes. The production process shall be such that the mechanical characteristics of the PVC material are not adversely affected.

The bends shall be made from PVC-U pipes that comply with the clauses 5.2.1 and 5.2.2.

6.4.2 Geometrical characteristics

6.4.2.1 Determination of dimensions

Dimensions of the fittings shall be determined according to NEN-EN-ISO 3126.

6.4.2.2 Nominal diameter of bend

The nominal inside diameter(s), d_n, of the bend shall correspond to, and be designated by, the nominal outside diameter(s) of the pipe, d_n, for which the fitting is designed.

The nominal outside diameters may have only those values as specified in clause 5.2.3.2.

6.4.2.3 Permitted dimensional variation of the outside diameters and wall thicknesses at the ends

For the outside diameters and the minimum wall thickness at the ends of the bend, the values with the associated tolerances in accordance with clause 5.2.3.3 apply.

6.4.2.4 Permitted dimensional variation of the outside diameters and wall thicknesses at the location of the portion of the curve

For the outside diameters and the minimum wall thickness at the location of the portion of the curve the values listed in table 16 apply.

Table 16 – Permissible tolerances at the location of the portion of the curve

Size	**Permitted dimensional variation**
Mean outside diameter (d_{em})	$\pm$ 0,025 x d_n
Out-of-roundness ($d_{e,max} - d_{e,min}$)	$\leq$ 0,05 x d_n
Wall thickness of the bend ($e_{min,bocht}$)	$\geq$ 0,93 x $e_{min,buis}$
d_n = nominal diameter d_{em} = mean outside diameter e = wall thickness $e_{min,bocht}$ = minimum permissible wall thickness of the bend $e_{min,buis}$ = minimum permissible wall thickness of the connecting pipe $d_{e\ min}$ = smallest outside diameter at any point $d_{e\ max}$ = greatest outside diameter iat any point	

6.4.2.5 Angles

The nominal angles are 11°, 22°, 30°, 45°, 60° and 90°. The permissible deviation on the nominal angle is ± 2°.

6.4.2.6 Radius of curvature of bends

The radius of curvature of the centre line of the bend should be not less than 3.5 x the diameter.

6.4.2.7 Installation dimensions (Z lengths)

The Z-dimensions shall be in accordance with the values specified by the supplier. This requires that the supplier provides drawings to the certification body.

6.4.3 Bend ends

The chamfer at the ends of bends shall coly to clause 5.2.3.8.

6.4.4 Bends with sockets for solvent cementing

The dimensions of integral sockets for solvent cementing shall meet the requirements specified in clause 5.2.3.6.

6.4.5 Mechanical characteristics

In order to verify whether the heating and cooling during the production of the bend caused any impermissible decline of the mechanical characteristics, the following type tests shall be carried out.

Subject straight pipe pieces to the heating treatment and cooling down process as it is usual for the manufacturing of the bends concerned. The instructions of the heat treatment and the cooling process should be made available by the supplier to the certification body. Then carry out the following tests.

6.4.5.1 Resistance to impact

See clause 5.2.5.1.

6.4.5.2 Resistance to internal pressure

The pipes shall withstand the prescribed internal pressure without cracking. Further no leakage is allowed during the test period. The test shall be carried out in accordance with NEN-EN-ISO 1167, all parts, taking into account the additions / modifications listed in Table 17. For this test, end caps type A or B in accordance with NEN-EN-ISO 1167-1 may be used. In case of dispute, end caps type A shall be used.

For the purpose of testing the fittings shall be assembled on PVC pipes of the same pressure class as the fitting, or fittings shall be sealed with end caps.

Note Type of end cap used during the test has an effect on the test results.

Table 17 – Test parameters for the determination of the resistance to internal pressure

Temperature (°C)	Duration of the test (hours)	Circumferential stress in the pipe wall (MPa)
20	100	35,0
60	1000	12,5 [1)]
Test: water-in-water		
1. If tested with the circumferential stress of 12,5 MPa, due to statistical spread of the test results, test times less than 1 000 h can be achieved. In this case, a retest procedure with a circumferential stress of 12,5 MPa or 10,0 MPa shall be performed with pipes of the same production batch and double sampling. If the retest results are positive, the requirement of the minimum reference curve for PVC-U 250, given in ISO 1452-1:2009, 4.4.2, is deemed to be verified.		

6.4.6 Markings bends made from PVC-U drinking water pipes

The bends are provided with at least the following markings:

- KIWA or  which is allowed for small diameters after consultation with Kiwa;
- supplier's name, trade name;
- material identification: PVC-U;
- PN class;
- nominal outside diameter in mm;
- production code [1)];
- extruder number [1)].

The markings shall be clear, legible and indelible affixed on the bend.

1) May be displayed if desired in code.

7 Product requirements and test methods for special fittings

7.1 General

In this chapter the requirements are embodied to which:

- saddles of PVC-U (DN 40 up till and including 630 mm);
- end-load-bearing double-sockets of PVC;
- injection moulded PVC fittings with flange connections;
- double sockets and end-load-bearing double-sockets of PVC-U with a ventilation construction;

for the transport of drinking water have to comply with.

7.2 Saddles of PVC-U

7.2.1 General

These requirements apply to saddles of PVC-U with internal, conical screw threads: Gk ½", Gk ¾" or Gk 1", intended for usage in combination with metal service taps. The saddles are intended for assembly with PVC-U drinking water pipes according to paragraph 5.2.

7.2.2 Material

See clause 4.3

7.2.3 Elastomeric rings

The elastomeric rings shall comply the requirements specified in BRL-K17504 (see also clause 4.4).

7.2.4 General characteristics

7.2.4.1 Appearance

See clause 4.6.1.

7.2.4.2 Colour

See clause 4.6.2.

7.2.4.3 Opacity

See clause 4.6.3.

7.2.5 Construction and design

The construction of the saddle parts must be such that the parts only can be assembled together in one position.
The direction of how the clamps must be tarnished, must be indicated on each clamp by means of an arrow.
On the inside and outside surface of the saddles no sharp transitions may occur in order to avoid notch effect.
The slope of the spigot ways on the saddles and in the clamps may not be more than 7 °. The spigot ways must be rounded to a radius of at least 1,5 mm. The aberration of the straightness of the spigot ways may not be more than 0,08 x l_s (l_s = length of spigot way).

The seal between saddle and pipe must be a profiled rubber ring. The rubber sealing ring must be centred in the saddle chamber in such a way that the ring cannot be moved or come out the chamber when assembled.

7.2.6 Geometrical characteristics

7.2.6.1 Determination of dimensions

Dimensions of the fittings shall be determined according to NEN-EN-ISO 3126.

7.2.6.2 Inside diameters of the saddles

The inside diameters of the saddles must be adapted to the outside diameter of the PVC pipes for which they are intended. Hereby the for the pipes applicable tolerances for the outside diameters of the pipes must be taken into account.

7.2.6.3 Wall thickness of the saddles

In any cross-section the wall thickness shall not be smaller than the values as indicated in table 18.

Table 18 – Wall thickness of the saddles (in mm)

Corresponding pipe size	Wall thickness of saddle, minimum (mm)	Corresponding pipe size	Wall thickness of saddle, minimum (mm)
40	5,0	160	7,0
50	5,0	200	8,0
63	5,0	250	9,5
75	5,0	315	11,0
90	5,5	400	13,0
110	6,0	500	15,5
125	6,0	630	19,0

The wall thickness at the connection end, measured outside the screw thread, must be at least 8 mm.

7.2.6.4 Lengt of the saddles

The length of the saddles (measured in the direction of the pipe) depends on the outside diameter of the corresponding PVC pipes and shall be smaller than the values as indicated in table 19.

Table 19 – Minimum permissible length of the saddles (in mm)

Saddles intended for pipes with outside diameters of:	Minimum permissible length of the saddle
40, 50	60
63, 75, 90	65
110, 125	75
160, 200	80
225	95
≥ 250	100

7.2.7 Screw-thread in the saddles

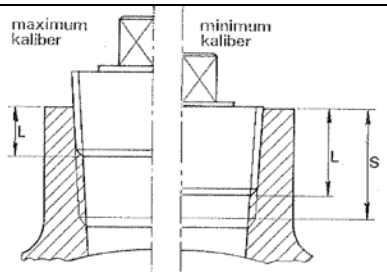
The following requirements apply for the screw threads:

- The design of the screw thread shall meet the requirements for taper internal threads according to NEN-EN 10226-2;
- the dimensions of the screw thread shall meet the requirements specified in table 21;
- the screw thread shall be smooth and sound, free of burrs or other irregularities.

The minimum and maximum tolerances of the dimensions of the screw thread in the saddle is assessed with the aid of two gauges (maximum and minimum) or a jig which is provided with a flat plane with which the minimum and maximum sizes are indicated. The determination shall be carried out with gauges that comply to the applicable ANSI / ASME standards.

The dimensions of the screw threads shall meet the requirements specified in table 20.

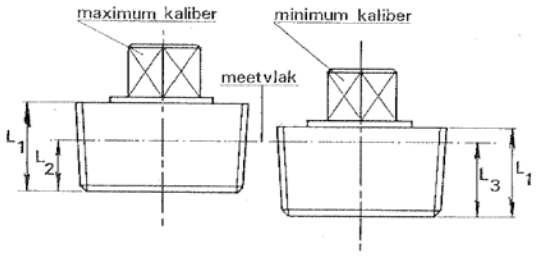
Table 20 – Dimensions of the screw threads in the saddles (in mm)



Screw thread	When fitted with a max. gauge the screw length (L) shall be at least:	When fitted with a max. gauge the screw length (L) shall be at least	Effective length of the screw thread (S) shall be at least:
Gk ½"	9,7 (5,5 threads)	15,4 (8,5 threads)	19
Gk ¾"	10,7 (6 threads)	16,4 (9 threads)	20
Gk 1"	10,0 (4,5 threads)	17,4 (7,5 threads)	22

The dimensions of the gauges shall comply to the requirements listed in table 21.

Table 21 – Dimensions of the gauges



Screw thread size	Max. gauge		Min. gauge	
	L_1	L_2	L_1	L_3
Gk ½"	16,3	6	16,3	9
Gk ¾"	17,3	10	17,3	13
Gk 1"	18,5	10	18,5	14

7.2.8 Mechanical characteristics

7.2.8.1 Resistance to impact

The determination of the resistance to impact is based ISO 3127.
The main frame of the test set-up tower and the striker shall comply with the respective requirements of ISO 3127. Figure 5 is a drawing is given of a bearing and the seat test piece. The sides of the test specimen should be supported as shown in Figure 3 by means of adjustable side supports.

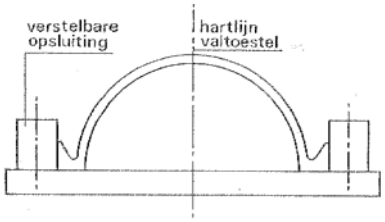


Figure 3 - Support of the saddle for the impact test

For testing the saddles shall be conditioned during at least 30 minutes at a temperature of (0 ± 2) ° C, e.g. using an ice / water mixture. The mass of the striker and the drop height dependent on the nominal diameter and are shown in Table 6.

Initially, there should be ten full saddles to be tested. (Upper and lower saddle) If an upper saddle or under saddle fails, the test shall be extended by a further 20 complete saddles (upper and lower saddle). Not more than 3 parts of the saddle 30 shall fail to satisfy the requirement (<10%).

7.2.8.2 Resistance to internal pressure

A test piece comprising a length of PVC-U pipe and a saddle of the same PN must be able to withstand the required internal pressure without cracking. Further no leakage is allowed during the test period. Five test pieces shall be tested.

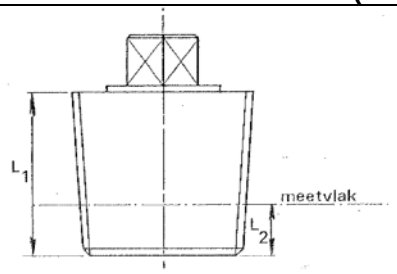
The installation of the saddle shall be carried out according to the instructions of the supplier. The PVC pipe used in the experiment shall comply with 5.2.

The test shall be performed according to clause 4.8.3.1.

7.2.8.3 Strength of the screw thread

For the determination of the strength of a the screw thread of the saddle for the connection with the service crane a special tool is required with the dimensions as shown in Table 22.

Table 22 – Dimensions of the special tool for the determination of the strength of the screw thread in the saddle (in mm).



Screw thread size	L_1 min	L_2
Gk ½”	28	6
Gk ¾”	29	10
Gk 1”	33	10

For testing, the test assembly is conditioned at a temperature of (0 ± 2) ° C for at least 30 minutes. Then, the special tool is turned into the screw thread of the saddle knob until the friction is equal to a moment of 1 N / m. From this position the tool is turned for four extra revolutions. The saddle with the screwed-in tool is maintained for 100 hours at a temperature of (0 ± 2).

The saddle meet to the requirement as no breakage or cracking occurs during this period.

7.2.8.4 Resistance to compression

For the determination of the resistance to compression of the saddle, equipment according to NEN-ISO 5893 is needed in which a seat with a speed of 35 mm / min can be compressed diametrically in a test set-up shown in Figure 6.

Place the saddle between two parallel plates positioned relative to each other which are provided with suitable support for the test piece as shown in Figure 4.
The compression is performed up to the distance a up to 50% of its original value has been reduced.

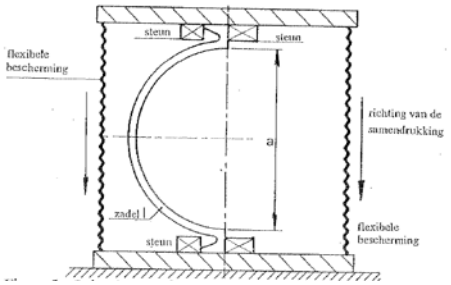


Figure 4 - Supports of the saddle during the compression test

Five test piece shall be tested. The saddle meet the requirement when no fracture or cracking occurred.

7.2.9 Physical characteristics

7.2.9.1 Vicat softening temperature

The Vicat softening temperature shall be determined according to NEN-EN 727.
Injection moulded fitting meet the requirement when the Vicat softening temperature is ≥ 74 °C.
For fittings made from pipe the Vicat softening temperature shall be ≥ 80 °C.
The test piece shall be cut from the wall of a fitting.

7.2.9.2 Assessment of the effect of heating

Three complete mouldings shall be tested in accordance with NEN-EN-ISO 580 taking into account the following additions / modifications:

- Method A (forced-air oven).
- Heating temperature (150 ± 2) ° C.
- Heating time (see table 12a).

The surfaces of the moulding are examined before and after heating, and any cracks, blisters, delamination, or weld opening are measured and expressed as a percentage of the wall thickness.

The maximum dimensions of cracks, delamination, blisters, and flow joint openings, expressed as a percentage of the wall thickness should be less than 30 %.

7.2.10 Markings of saddles for PVC-U drinking water pipes

The saddles are provided with at least the following markings:

- KIWA or on smaller products or KK [1)] or KK [1)].
- supplier's name, trade name;
- material identification: PVC-U;
- PN class;
- nominal outside diameter of the connecting pipe in mm;
- production code [2)];

The markings shall be clear, legible and indelible affixed on each saddle.

1 For small fittings marking with kk only is allowed.
2 May be displayed if desired in code.

7.3 End-load-bearing double-sockets of PE and PVC

These section applies on end-load-bearing double-sockets with an angular deflection of not more than 3 °.

7.3.1 General

The end-load-bearing double sockets shall have a strength and life that is at least equal to that of the PVC pipe of the same nominal pressure ratings.
The end-load-bearing double sockets shall be manufactured according to a controlled production process.
The end-load-bearing double sockets shall have a shape that the full flow profile of the tube is maintained.
The end-load-bearing double sockets may contain no welded PVC-U parts.
During mounting the fitting to the pipe, it is not allowed to apply notches, groves or other modifications that can have a negative effect on the life span of the piping system.
The end-load-bearing double sockets shall be installed according to the supplier's instructions.

7.3.2 Material

7.3.2.1 Pipe material of PVC-U

Double sockets and sleeves which are made from PVC-U pipes shall, apart from size, comply to clause 5.2.

7.3.2.2 Polyethylene material

The polyethylene material of end-load-bearing fittings of polyethylene (PE) shall meet the requirements listed in EN 12201-1:2011, tables 1 and 2.

7.3.3 Elastomeric sealing rings

The rubber sealing rings of the end-load-bearing fittings shall comply with BRL-K17504. (see section 4.4).

7.3.4 Adhesives and cleaning products

Adhesives and cleaning products may have no harmful effect on the PVC material.
PVC adhesives shall comply with BRL-K525.

7.3.5 Locking device and its components

The locking device shall comply to the specifications of the supplier with regard to material, dimensions and permissible deviations. The supplier must provide this specification to the certification body.

7.3.6 General characteristics

7.3.6.1 Appearance

See clause 4.6.1.

7.3.6.2 Colour

End-lead-bearing fittings of PE shall be preferably black or blue
End-lead-bearing fittings of PVC-U shall be dark grey, blue or cream. For aboveground application the colour cream is not allowed.

7.3.6.3 Opacity

See clause 4.6.3.

7.3.7 Geometrical characteristics

7.3.7.1 Determination of dimensions

Dimensions of the fittings shall be determined according to NEN-EN-ISO 3126.

7.3.7.2 Nominal diameter of the end-load-bearing couplers with elastomeric sealing rings

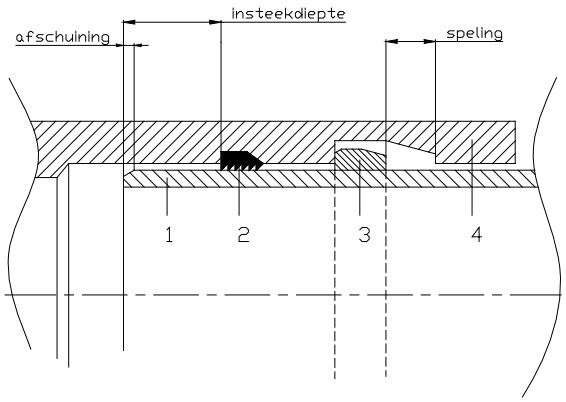
The nominal inside diameter(s), d_n, of the fitting shall correspond to, and be designated by, the nominal outside diameter(s) of the pipe, d_n, for which the fitting is designed.

7.3.7.3 Dimensions of end-load-bearing fittings with elastimeric sealing elements

For those parts of the end-load-bearing fitting that are exposed to internal pressure applies that the minimum wall thickness of the sockets and spigots,, except the sealing ring groove, shall be not less than the minimum wall thickness of the connecting pipe as specified in NEN-EN-ISO 1452-2.

Polyethylene end-load-bearing fittings shall comply to NEN-EN 12201-3. The nominal pressure of the fitting shall be at least the nominal pressure of the piping system.

The depth of engagement behind the elastomeric sealing element shall be at least two times tolerance and the distance of the chamfered portion (see figure 5).



1. pipe
2. elastomeric sealing element
3. clamp element
4. part of end-load-bearing fitting.

Figure 5 – Depth of engagement of the end-load-bearing fitting.

The dimensions and permissible tolerances of the end-load-bearing fitting and all other parts shall be provided by the supplier to the certification body.

7.3.7.4 Dimensions of solvent cemented joint between PVC sleeve and pipe

The design of the connection shall comply to NEN-EN-ISO 1452-3:2010, figure 25.

The length for solvent cementing of the sleeve may not be smaller than 0,5 x the nominal diameter of the pipe, d_n.

Sleeves shall have an inside diameter (d_s) of:

$$d_s = d_{n\,-0,2}^{\,+0,003\times d_e};$$

with a maximum permissible tolerance of d_s - d_n = 0,8 mm.

7.3.8 Mechanical characteristics

7.3.8.1 Resistance to impact

The cylindrical part of the end-load-bearing fitting shall comply with clause 5.2.5.1.

7.3.9 Physical characteristics

7.3.9.1 Vicat softening temperature

The Vicat softening temperature shall be determined according to NEN-EN 727 and for PVC-U fitting only.
Injection moulded end-load-bearing fittings meet the requirement when the Vicat softening temperature is ≥ 74 °C.
The test piece shall be cut from the wall of a fitting.

7.3.9.2 Oxidation induction time

The oxidation induction time (OIT) shall be determined according to NEN-EN-ISO 11357-6, at a test temperature of 200 °C and for polyethylene material only.
The sample meet the requirements as the oxidative induction time is greater than 20 minutes.

7.3.9.3 Assessment of the effect of heating

Three complete mouldings shall be tested in accordance with NEN-EN-ISO 580 taking into account the following additions / modifications:

- Method A (forced-air oven).
- Heating temperature (150 ± 2) ° C.
- Heating time (see table 12a).

The surfaces of the end-load-bearing fitting are examined before and after heating, and any cracks, blisters, delamination, or weld opening are measured and expressed as a percentage of the wall thickness.

The maximum dimensions of cracks, delamination, blisters, and flow joint openings, expressed as a percentage of the wall thickness should be less than 30 %.

7.3.10 Joint requirements end-load-bearing double socket coulpers

7.3.10.1 Leaktightness and strength while subjected to bending and internal pressure

The leaktightness and strength of the joint shall be determined according to NEN-EN-ISO 13783. The number of test pieces is 3.

The joint fulfils the requirements when no leakage, deformations nor cracking in the assembly are detected during the test.

7.3.10.2 Long-term leaktightness under internal pressure

The long-term leaktightness under internal pressure shall be determined according to NEN-EN-SIO 13846 taking into account the following additions / modifications:

- Number of test pieces is 3.
- The test is carried out at a temperature of 40 $^{+3}/_{-1}$ °C.
- Test duration is 1000 hours.
- Test pressure is 1,3 x PN.

The joint fulfils the requirements when no leakage nor cracking in the assembly are detected during the test.

7.3.11 Marking end-load-bearing fittings of PE and PVC-U for drinking water pipes

The end-load-bearing fittings are provided with at least the following markings:

- KIWA  or on smaller products  or KK [1)] or KK [1)].
- supplier's name, trade name;
- material identification, e.g: PVC-U, PE80 or PE100;
- PN class;
- nominal outside diameter of the connecting pipe in mm;
- production code [2)];

The markings shall be clear, legible and indelible affixed on each saddle.

1 For small fittings marking with kk only is allowed.
2 May be displayed if desired in code.

7.4 Injection moulded PVC fittings with flange connections

In this clause the requirements and test methods are listed for injection moulded fittings of PVC-U that are provided with flange connections and socket ends with rubber sealing elements (see figure 6).

The flange of the fitting is intended for the making of a connection with a metal fitting or an accessory with a flange in PVC drinking water piping systems.

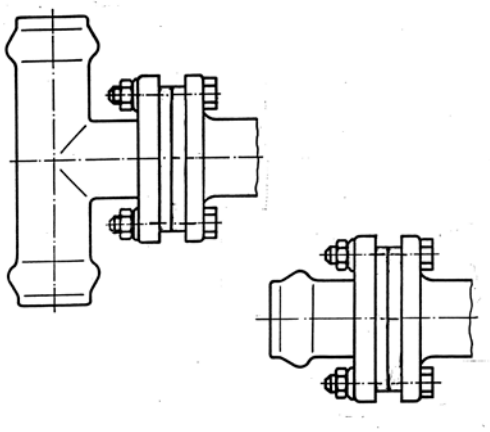


Figure 6 – Implementation of joints

7.4.1 General

The pipes to be connected with the fittings must comply with paragraph 5.2.
The joint shall be assembled according to the supplier's instructions.

7.4.2 Material

See clause 4.3.

7.4.3 Rubber

See clause 4.4.

7.4.4 General characteristics

7.4.4.1 Appearance

See clause 4.6.1.

7.4.4.2 Colour

The fittings shall be dark grey and shall comply with clause 4.6.2.

7.4.4.3 Opacity

See clause 4.6.3.

7.4.5 Geometrical characteristics

7.4.5.1 Determination of dimensions

Dimensions of the fittings shall be determined according to NEN-EN-ISO 3126.

7.4.5.2 Nominal diameter of the fittings

The nominal inside diameter(s), d_n, of the fitting shall correspond to, and be designated by, the nominal outside diameter(s) of the pipe, d_n, for which the fitting is designed.

7.4.5.3 Dimensions of the fitings

The dimensions of the flanges and flange connections shall meet the requirements as specified in NEN-EN-ISO 1452-3:2010, tables 11, 12, 19, 20, the one that is applicable.

7.4.5.4 Dimensions of the flange connection

The sizes of the flange borings shall comply with the applicable normalized values. The other values of the dimensions of the fittings shall be provided by the supplier in drawings to the certification body.

7.4.6 Mechanical characteristics

7.4.6.1 Impact resistance of fitting

The impact strength of the fitting shall be determined according to EN 12061 taking into account the following additions / modifications:

- The impact strength of the fitting is tested by dropping it on a rigid surface. After the fall, the fitting is inspected with the naked eye without magnification. In case the fitting consists of separate components, these components shall be inspected also on damage that may have an effect on the leaktightness.
- Test temperature (0 ± 2) ° C.
- Conditioning period > 30 min at 0 ° C.
- Drop height: 500 mm for DN ≤ 110, 1000 mm for DN> 125.
- Point of impact: at random.

The fitting meets the requirements when the result can be expressed as "no damage" according to clause 7 of EN 12061:1999. The for impact resistance tested test pieces shall be used for testing the leaktightness.

7.4.6.2 Resistance to internal pressure

The assembly shall withstand the prescribed internal pressure without cracking. Further no leakage is allowed during the test period. The test shall be carried out in accordance with NEN-EN-ISO 1167, all parts, taking into account the additions / modifications:

- number of test pieces is 3;
- test temperature is 40 °C;
- test duration is 1000 hours;
- test type is "water-in-water";

For the purpose of testing the fittings shall be assembled on PVC pipes of the same pressure class as the fitting, or fittings shall be sealed with end caps. The rubber sealing elements may be secured in order to prevent that the rubber sealing element is pushed out of its groove.

7.4.7 Joint requirements

7.4.7.1 Strength and leaktightness of the flange connection

For the determination of the strength of the flange connection the fittings must be subjected, freely supported, to the bending tests I and II, or III as indicated in figure 11. During the test, the fittings must be subjected to an internal water pressure and a bending force K as listed in table 23. The duration of the test is 1000 hours and the

test temperature is (23 ± 2) °C. During the test the test piece shall not fail, which means no fractures , no leakage.

Table 23 – Test parameters for the determination of the strengt hand leaktightness of the flange connection

Nominal size in mm	Internal pressure	bending force K in N
63	3,5 x PN	400
75	3,5 x PN	600
90	3,5 x PN	650
110	3,5 x PN	800
160	3,5 x PN	1500

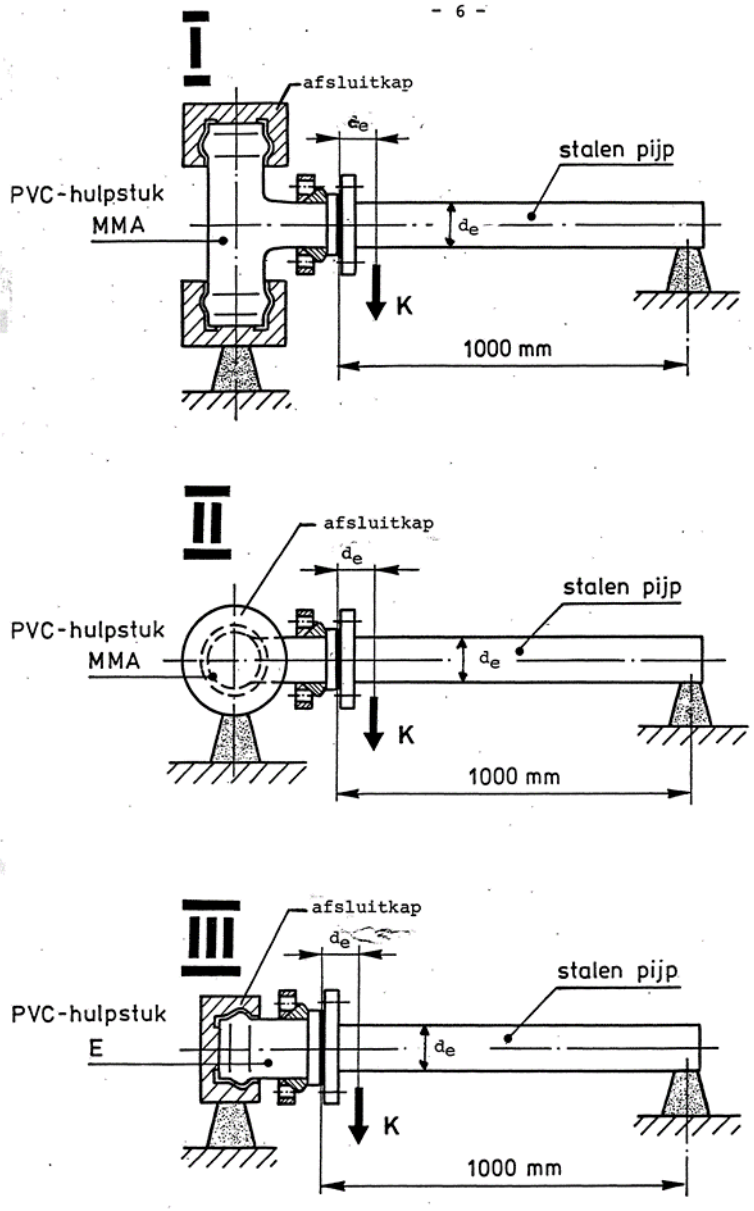


Figure 7 - Test set-up for the performance of the bending tests

7.4.8 Markings of injection moulded PVC-U fittings with flange connections voor drinking water pipes

The fittings are provided with at least the following markings:

- KIWA or on smaller products or KK [1)] or KK [1)].
- supplier's name, trade name;
- material identification: PVC-U;
- PN class;
- nominal outside diameter of the connecting pipe in mm;
- production code [1)];

The markings shall be clear, legible and indelible affixed on each saddle.

1 For small fittings marking with kk only is allowed.
2 May be displayed if desired in code.

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 as shown in Annex II.

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.

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.

9.1 Test matrix voor PVC-U pipes

Description of requirement	Clause BRL	Tests within the scope of:	
		Pre-certification	Control after issue of the certificate [1), 2)]
Toxicological requirements	4.2	x	x [3)]
Rubber	4.4	x	x
Glues	4.5	x	x
Pipe material	5.2.1.1	x	x
VCM content in material	5.2.1.2	x	x
Density	5.2.1.3	x	x
K value	5.2.1.4	x	x
MRS value	5.2.1.5	x	x
Appearance	5.2.2.1	x	x [3)]
Colour	5.2.2.2	x	x
Opacity	5.2.2.3	x	x
Nominal diameter of the pipe	5.2.3.2	x	x
Mean (outside) diameter and tolerances	5.2.3.3	x	x [3)]
Wall thickness and its tolerances	5.2.3.4	x	x [3)]
Length of the pipe	5.2.3.5	x	x
Dimensions of pipes with integral sockets for solvent cementing	5.2.3.6	x	x [3)]
Dimensions of pipes with integral sockets with rubber sealing ring type joints	5.2.3.7	x	x [3)]
Dimensions of pipe ends	5.2.3.8	x	x
Classification of the pipe	5.2.4	x	x
Resistance to impact	5.2.5.1	x	x
Resistance to internal pressure	5.2.5.2	x	x [3)]
Vicat softening temperature	5.2.6.1	x	x [3)]
Longitudinal reversion	5.2.6.2	x	x
Resistance to dichloromethane	5.2.6.3	x	x
Marking of PVC-U drinking water pipes	5.2.7	x	x [3)]

1. In case the product or production process changes significantly, the performance requirements shall be determined again.
2. During the inspection visit, the inspector shall check the product on the basis of a selection of the above listed requirements. The frequency of the inspection visits is recorded in clause 10.6 "Nature and frequency of external inspections".
3. Material is samples for an Audit Test by the inspector annually (test parameters: 1000 hours 60 °C).

9.2 Test matrix for PVC-O pipes

Description of requirement	Clause BRL	Tests within the scope of:	
		Pre-certifi-cation	Control after issue of the certificate [1), 2)]
Toxicological requirements	4.2	x	x [3)]
Rubber	4.4	x	x
Glues	4.5	x	x
General	5.3.1	x	x
Pipe material	5.3.2.1	x	x
VCM content in material	5.3.2.2	x	x
Density	5.3.2.3	x	x
K value	5.3.2.4	x	x
Classification and verification of material MRS value	5.3.2.5	x	x
Appearance	5.3.3.1	x	x
Colour	5.3.3.2	x	x
Opacity	5.3.3.3	x	x
Nominal diameter of the pipe	5.3.4.2	x	x
Mean (outside) diameter and tolerances	5.3.4.3	x	x [3)]
Wall thickness and its tolerances	5.3.4.4	x	x [3)]
Length of the pipe	5.3.4.5	x	x
Dimensions of pipes with integral sockets	5.3.4.6	x	x [3)]
Dimensions of pipe ends	5.3.4.7	x	x
Classification of biaxial oriented pipe	5.3.5	x	x
Verification relation between orientation level and MRS	5.3.6	x	x
Orientation level	5.3.7	x	x
Resistance to impact	5.3.8.1	x	x
Resistance to internal pressure	5.3.8.2	x	x [3)]
Resistance to dichloromethane	5.3.9.1	x	x
Vicat softening temperature	5.3.9.2	x	x
Marking of PVC-U drinking water pipes	5.3.10	x	x [3)]

1. In case the product or production process changes significantly, the performance requirements shall be determined again.
2. During the inspection visit, the inspector shall check the product on the basis of a selection of the above listed requirements. The frequency of the inspection visits is recorded in clause 10.6 “Nature and frequency of external inspections”.
3. Material is samples for an Audit Test by the inspector annually.

9.3 Test matrix for fittings with elastomeric sealing rings

Description of requirement	Clause BRL	Tests within the scope of:	
		Pre-certifi-cation	Control after issue of the certificate [1), 2)]
Requirements fittings			
Toxicological requirements	4.2	x	x [3)]
Rubber	6.2.1	x	x
Material - general	6.2.2.1	x	x
VCM content in material	6.2.2.2	x	x
Density	6.2.2.3	x	x
K value	6.2.2.4	x	x
Classification and verification of material	6.2.2.5	x	x
Appearance	6.2.3.1	x	x [3)]
Colour	6.2.3.2	x	x
Opacity	6.2.3.3	x	x
Nominal diameter	6.2.4.2	x	x
Dimensions of fittings with elastomeric sealing rings	6.2.4.3	x	x [3)]
Resistance to impact of fittings	6.2.5.1	x	x
Resistance to internal pressure of injection moulded fittings	6.2.5.2	x	x [3)]
Resistance to internal pressure of couplers made from pipe or made by machining	6.2.5.3	x	x [3)]
Vicat softening temperature	6.2.6.1	x	x [3)]
Assessment of the effect of heating	6.2.6.2	x	x
Marking of elastomeric ring seal fittings	6.2.7	x	x [3)]
Joint requirements			
Leaktightness under internal pressure and with angular deflection	4.8.1.1	x	-
Leaktightness under negative pressure	4.8.1.2	x	-

1. In case the product or production process changes significantly, the performance requirements shall be determined again.
2. During the inspection visit, the inspector shall check the product on the basis of a selection of the above listed requirements. The frequency of the inspection visits is recorded in clause 10.6 “Nature and frequency of external inspections”.
3. Material is samples for an Audit Test by the inspector annually.

9.4 Test matrix of fittings for solvent cementing

Description of requirement	Clause BRL	Tests within the scope of:	
		Pre-certifi-cation	Control after issue of the certificate [1), 2)]
Requirements fittings			
Toxicological requirements	4.2	x	x [3)]
Glues	4.5	x	x
Glue instructions	6.3.1	x	x
Material - general	6.3.2.1	x	x
VCM content in material	6.3.2.2	x	x
Density	6.3.2.3	x	x
K value	6.3.2.4	x	x
Classification and verification of material	6.3.2.5	x	x
Appearance	6.3.3.1	x	x [3)]
Colour	6.3.3.2	x	x
Opacity	6.3.3.3	x	x
Nominal diameter of fittings	6.3.4.2	x	x
Dimensions of fittings for solvent cementing	6.3.4.3	x	x [3)]
Resistance to impact of fittings	6.3.5.1	x	x
Resistance to internal pressure of injection moulded fittings	6.3.5.2	x	x [3)]
Vicat softening temperature	6.3.6.1	x	x [3)]
Assessment of the effect of heating	6.3.6.2	x	x
Marking of elastomeric ring seal fittings	6.3.7	x	x [3)]
Joint requirements			
Long-term leaktightness under internal pressure	4.8.1.3	x	-

1. In case the product or production process changes significantly, the performance requirements shall be determined again.
2. During the inspection visit, the inspector shall check the product on the basis of a selection of the above listed requirements. The frequency of the inspection visits is recorded in clause 10.6 “Nature and frequency of external inspections”.
3. Material is samples for an Audit Test by the inspector annually .

9.5 Test matrix bends made from pipe

Description of requirement	Clause BRL	Tests within the scope of:	
		Pre-certifi-cation	Control after issue of the certificate [1), 2)]
Toxicological requirements	4.2	x	x [3)]
Rubber	4.4	x	x
Glues	4.5	x	x
General	6.4.1	x	x
Nominal diameter of bend	6.4.2.2	x	x
Permitted dimensional variation of the outside diameters and wall thicknesses at the ends	6.4.2.3	x	x [3)]
Permitted dimensional variation of the outside diameters and wall at the location of the portion of the curve	6.4.2.4	x	x [3)]
Angles	6.4.2.5	x	x [3)]
Radius of curvature of bends	6.4.2.6	x	x [3)]
Installation dimensions (Z lengths)	6.4.2.7	x	x [3)]
Bend ends	6.4.3	x	x
Bends with sockets for solvent cementing	6.4.4	x	x
Resistance to impact	6.4.5.1	x	x
Resistance to internal pressure of injection moulded fittings	6.4.5.2	x	x [3)]
Markings bends made from PVC-U drinking water pipes	6.4.6	x	x [3)]

1. In case the product or production process changes significantly, the performance requirements shall be determined again.
2. During the inspection visit, the inspector shall check the product on the basis of a selection of the above listed requirements. The frequency of the inspection visits is recorded in clause 10.6 “Nature and frequency of external inspections”.
3. Material is samples for an Audit Test by the inspector annually.

9.6 Test matrix saddles of PVC-U

Description of requirement	Clause BRL	Tests within the scope of:	
		Pre-certifi-cation	Control after issue of the certificate [1), 2)]
Requirements fittings			
Toxicological requirements	4.2	x	x [3)]
Material	7.2.2	x	x
Elastomeric rings	7.2.3	x	x
Appearance	7.2.4.1	x	x [3)]
Colour	7.2.4.2	x	x
Opacity	7.2.4.3	x	x
Construction and design	7.2.5	x	x
Inside diameter of the saddle	7.2.6.2	x	x [3)]
Wall thickness of the saddle	7.2.6.3	x	x [3)]
Length of the saddle	7.2.6.4	x	x
Screw-thread in the saddle	7.2.7	x	x
Resistance to impact	7.2.8.1	x	x [3)]
Resistance to internal pressure	7.2.8.2	x	x [3)]
Strength of the screw thread	7.2.8.3	x	x
Resistance to compression	7.2.8.4	x	x
Vicat softening temperature	7.2.9.1	x	x [3)]
Assessment of the effect of heating	7.2.9.2	x	x
Markings bends made from PVC-U drinking water pipes	7.2.10	x	x [3)]
Joint requirements			
Leaktightness under internal pressure	4.8.2.1	x	-
Leaktightness under negative pressure	4.8.2.2	x	-
leaktightness under negative pressure and compression of the pipe	4.8.2.3	x	-

1. In case the product or production process changes significantly, the performance requirements shall be determined again.
2. During the inspection visit, the inspector shall check the product on the basis of a selection of the above listed requirements. The frequency of the inspection visits is recorded in clause 10.6 “Nature and frequency of external inspections”.
3. Material is samples for an Audit Test by the inspector annually.

9.7 Test matrix end-load-bearing double sockets of PE and PVC

Description of requirement	Clause BRL	Tests within the scope of:	
		Pre-certifi-cation	Control after issue of the certificate [1), 2)]
Requirements fittings			
Toxicological requirements	4.2	x	x [3)]
General	7.3.1	x	x
Pipe material of PVC-U	7.3.2.1	x	x
Polyethylene material	7.3.2.2	x	x
Elastomeric sealing rings	7.3.3	x	x
Adhesive and cleaning products	7.3.4	x	x
Locking device	7.3.5	x	x
Metal parts	7.3.6	x	x
Appearance	7.3.6.1	x	x [3)]
Colour	7.3.6.2	x	x
Opacity	7.3.6.3	x	x
Nominal diameter of the end-load-bearing couplers with elastomeric sealing rings	7.3.7.2	x	x
Dimensions of end-load-bearing fittings with elastomeric sealing elements	7.3.7.3	x	x
Dimensions of solvent cemented joints between PVC sleeve and pipe	7.3.7.4	x	x
Resistance to impact	7.3.8.1	x	x
Vicat softening temperature	7.3.9.1	x	x [3)]
Oxidation induction time	7.3.9.2	x	x [3)]
Assessment of the effect of heating	7.3.9.3	x	x
Markings end-load-bearing double sockets of PE and PVC	7.3.11	x	x [3)]
Joint requirements			
Leaktightness and strength while subjected to bending and internal pressure	7.3.10.1	x	-
Long-term leaktightness under internal pressure	7.3.10.2	x	-

1. In case the product or production process changes significantly, the performance requirements shall be determined again.
2. During the inspection visit, the inspector shall check the product on the basis of a selection of the above listed requirements. The frequency of the inspection visits is recorded in clause 10.6 “Nature and frequency of external inspections”.
3. Material is samples for an Audit Test by the inspector annually.

9.8 Test matrix for injection moulded PVC fittings with flange connections

Description of requirement	Clause BRL	Tests within the scope of:	
		Pre-certifi-cation	Control after issue of the certificate 1), 2)
Requirements fittings			
Toxicological requirements	4.2	x	x 3)
General	7.4.1	x	x
Material	7.4.2	x	x
Rubber	7.4.3	x	x
Appearance	7.4.4.1	x	x c)
Colour	7.4.4.2	x	x
Opacity	7.4.4.3	x	x
Nominal diameter of the fitting	7.4.5.2	x	x
Dimensions of the fittings	7.3.5.3	x	x
Dimensions of the flange connection	7.4.5.4	x	x
Impact resistance of fitting	7.4.6.1	x	x
Resistance to internal pressure	7.4.6.2	x	x
Markings end-load-bearing double sockets of PE and PVC	7.4.8	x	x c)
Joint requirements			
Strength and leaktightness of the flange connection	7.4.7.1	x	-

1. In case the product or production process changes significantly, the performance requirements shall be determined again.
2. During the inspection visit, the inspector shall check the product on the basis of a selection of the above listed requirements. The frequency of the inspection visits is recorded in clause 10.6 “Nature and frequency of external inspections”.
3. Material is samples for an Audit Test by the inspector annually.

9.9 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, also the general rules for certification as included in the Kiwa Regulations for Product Certification apply.

In particular, these are:

- The general rules for conducting the pre-certification tests, to be distinguished in:
    - the way suppliers are to be informed about 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 directions for conducting inspections and the aspects to be audited,
- The measurements to be taken by Kiwa in case of Non Conformities,
- Measurements 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 measurements taken by Kiwa.

10.2 Certification staff

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

I Certification assessor (**CAS**): in charge of carrying out the pre-certification tests and assessing the inspectors' reports;

II Site assessor (**SAS**): in charge of carrying out external inspections at the supplier's works;

III 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 following qualification requirements have been set by the Board of Experts for the subject matter of this evaluation guideline (see Table 11):

Table 11 – Qualification requirements of certification staff.

Basis requirements	**Evaluation criteria**
Knowledge of company processes Requirements for conducting professional audits on products, processes, services, installations, design and management systems.	*Relevant experience: in the field* **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 (MBO) **CAS, DM** : Bachelor (HBO)
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**: 3 initial audits under review.
Conducting review	**CAS**: conducting 3 reviews

	Certification assessor	**Site assessor**	**Decision maker**
Education - specific	• BRL-relevant technical education • specific studies and training (know-how and skills)	• BRL-relevant technical education • specific studies and training (know-how and skills)	• not applicable.
Experience - specific	• Detailed knowledge of the BRL and 4 certification tests carried out on the basis of the BRL or similar	• Detailed knowledge of the BRL and 4 inspections carried out on the basis of the BRL or one similar.	• general knowledge of the BRL

The level of education and experience of the certification staff involved should be demonstrably recorded.

Legend:

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

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:

IV Decision maker: qualification of Certification and Site assessors;

V Management of the certification body: qualification of Decision makers.

10.3 Report Pre-certification tests

The certification body records the results of the pre-certification tests in a report. This report shall comply with the following requirements:

VI completeness: the report provides a verdict about all requirements included in the evaluation guideline;

VII traceability: the findings on which the verdicts have been based shall be recorded and traceable;

VIII basis for decision: the Decision maker 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 pre-certification tests. The decision shall be recorded in a traceable manner.

10.5 Layout of quality declaration

The product certificate shall be in accordance with the model included in Annex I.

10.6 Nature and frequency of third party audits

The certification body shall carry out 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 two audits 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 17021-1) and where the IQC scheme forms an integral part of the quality management system.
In case the production of the supplier is not certified against ISO 9001, the frequency of the audits on site may be increased to three per year.

The audit program on site shall cover at least:

- the product requirements;
- the production process at the place of manufacturing;
- the suppliers IQC scheme and the results obtained from inspections carried out by the supplier;
- the correct way of marking certified products;
- compliance with required procedures;
- handling complaints.

For suppliers with a private label certificate the frequency of audits amounts to two audit per two years. These audits are conducted at the site of the private label certificate holder. The audits are focussed on the aspects inserted in the IQC scheme and the results of the control performed by the private label holder with respect to at least

- the correct way of marking certified products;
- compliance with required procedures for receiving and final inspection;
- the storage of products and goods;
- handling complaints.

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.

10.8 Non conformities

When the certification requirements are not met, measures are taken by Kiwa in accordance with the sanctions policy what is published on the Kiwa service portal (www.kiwa.nl) in the corresponding BRL.

10.9 Interpretation of requirements

The Board of Experts may record the interpretation of requirements of this evaluation guideline in one separate interpretation document.

11 Titles of standards

11.1 Public regulation

Standard	Title
Staatscourant van 21 april 2017 nr. 20932	Regeling Materialen en Chemicaliën drink- en warm tapwatervoorziening

11.2 Standards / normative documents

Number [1)]	Title
ISO 3	Preferred numbers - Series of preferred numbers
ISO 497	Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers
ISO 3127	Thermoplastics pipes - Determination of resistance to external blows - Round-the-clock method
ISO 4065	Thermoplastics pipes - Universal wall thickness table
NEN-EN 727	Plastics piping and ducting systems - Thermoplastics pipes and fittings - Determination of Vicat softening temperature (VST)
NEN 1006	General requirements for water supply installations
NEN-EN 10226-2	Pipe threads where pressure tight joints are made on the threads - Part 2: Taper external threads and taper internal threads - Dimensions, tolerances and designation
NEN-EN 12061	Plastics piping systems - Thermoplastics fittings - Test method for impact resistance
NEN-EN 12107	Plastics piping systems - Injection-moulded thermoplastics fittings, valves and ancillary equipment - Determination of the long-term hydrostatic strength of thermoplastics materials for injection moulding of piping components
NEN-EN 12201-1	Plastics piping systems for water supply, and for drainage and sewerage under pressure - Polyethylene (PE) - Part 1: Genera
NEN-EN 12201-3	Plastics piping systems for water supply, and for drainage and sewerage under pressure - Polyethylene (PE) - Part 3: Fittings
NEN-EN 12294	Plastics piping systems - Systems for hot and cold water - Test method for leaktightness under vacuum
NEN-EN 45011	General requirements for bodies operating product certification systems
NEN-EN-ISO 580	Plastics piping and ducting systems - Injection-moulded thermoplastics fittings - Methods for visually assessing the effects of heating
NEN-EN-ISO 1167-1	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 1: General method
NEN-EN-ISO 1167-2	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 2: Preparation of pipe test pieces
NEN-EN-ISO 1167-3	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 3: Preparation of components
NEN-EN-ISO 1167-4	Thermoplastics pipes, fittings and assemblies for the conveyance of fluids - Determination of the resistance to internal pressure - Part 4: Preparation of assemblies

NEN-EN-ISO 1183-1	Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pyknometer method and titration method
NEN-EN-ISO 1452-1	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 1: Genera
NEN-EN-ISO 1452-2	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 2: Pipes
NEN-EN-ISO 1452-3	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 3: Fittings (corrected and reprinted)
NEN-ENISO 1452-5	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 5: Fitness for purpose of the system
NEN-EN-ISO 2505	Thermoplastics pipes - Longitudinal reversion - Test method and parameters
NEN-EN-ISO 3126	Plastics piping systems - Plastics components - Determination of dimensions
NEN-EN-ISO 6401	Plastics - Poly(vinyl chloride) - Determination of residual vinyl chloride monomer - Gas-chromatographic method
NEN-EN-ISO 7686	Plastics pipes and fittings - Determination of opacity
NEN-EN-ISO 9001	Quality management systems - Requirements
NEN-EN-ISO 9080	Plastics piping and ducting systems - Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation
NEN-EN-ISO 11357-6	Plastics - Differential scanning calorimetry (DSC) - Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)
NEN-EN-ISO 12162	Thermoplastics materials for pipes and fittings for pressure applications - Classification, design coefficient and designation
NEN-EN-ISO 13229	Thermoplastics piping systems for non-pressure applications - Unplasticized poly(vinyl chloride) (PVC-U) pipes and fittings - Determination of the viscosity number and K-value
NEN-EN-ISO 13783	Plastics piping systems - Unplasticized poly(vinyl chloride) (PVC-U) end-load-bearing double socket joints - Test method for leaktightness and strength while subjected to bending and internal pressure
NEN-EN-ISO 13844	Plastics piping systems - Elastomeric-sealing-ring-type socket joints of unplasticized poly(vinyl chloride) (PVC-U) for use with PVC-U pipes - Test method for leaktightness under negative pressure
NEN-EN-ISO 13845	Plastics piping systems - Elastomeric-sealing-ring-type socket joints for use with unplasticized poly(vinyl chloride) (PVC-U) pipes - Test method for leaktightness under internal pressure and with angular deflection
NEN-EN-ISO 13846	Plastics piping systems - End-load-bearing and non-end-load-bearing assemblies and joints for thermoplastics pressure piping - Test method for long-term leaktightness under internal water pressure
NEN-ISO 5893	Rubber and plastics test equipment - Tensile, flexural and compression types (constant rate of traverse) - Specification
NEN-ISO 16422	Pipes and joints made of oriented unplasticized poly(vinyl chloride) (PVC-O) for the conveyance of water under pressure - Specifications

NEN-EN-ISO/IEC 17020	Conformity assessment - General criteria for the operation of various types of bodies performing inspection
NEN-EN-ISO/IEC 17021-1:2015	Conformity assessment - Requirements for bodies providing audit and certification of management system – Part 1: requirements
NEN-EN-ISO/IEC 17024	Conformity assessment - General requirements for bodies operating certification of persons
NEN-EN-ISO/IEC 17025	General requirements for the competence of testing and calibration laboratories
NVN-ENV 1452-7	Plastics piping systems for water supply - Unplasticized poly(vinyl chloride) (PVC-U) - Part 7: Guidance for the assessment of conformity

1. The documents in this table, in whole or in part, are normatively referenced in this document. For dated references, only the edition cited applies. For undated references, the latest edition of the reference document (including any amendments) applies.

Note: Within the text, references to specific clauses, tables and figures of another document shall always be dated.

I Model certificate (informative)

CERTIFICATE

Product certificate
Kxxxxx

kiwa

Issued 2017-01-01

Replaces

Page 1 of 2

Name product

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

Name Supplier

as specified in this product certificate and marked with the Kiwa®-mark in the manner as indicated in this product certificate may, on delivery, be relied upon to comply with Kiwa evaluation guideline BRL-K<number> "<title>" dated [dd-mm-yyyy]

Luc Leroy
Kiwa

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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xx

Tel.

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

II Model IQC scheme (informative)

Subjects	Aspects	Method	Frequency	Registration
Raw materials or materials supplied: Recipe sheets Incoming inspection raw materials	 - Recipe according annex product certification agreement - K-value - Vicat	 Comparison supplier's certificate with agreement - -	 Each delivery Each delivery	 Incoming inspection document
Production process, production equipment, material: - procedures - work instructions - equipment - release of product	- start up parameters - maintenance aspects - dimensions - soundness	- the focus of the production equipment - maintenance scheme - measuring - visual evaluation	- continuously - continuously - start up new product	- "digital" - record - inspection document
Finished-products	- soundness - dimensions - resistance to internal pressure - resistance MCL	- visual - measuring - - visual	- continuously - every 3 hours - per day per product per machine	Final inspection documents
Measuring and testing equipment - measuring equipment - calibration	- good functioning - accuracy within the field of activity	-during use - recording of nonconformities	- continuously - once per year	- final inspection document - calibration document
Logistics - internal transport - storage - preservation - packaging - identification or marking of semi-finished and finished products	- Practical circumstances - comparison with assignment	- Comparison with procedure - visual inspection	- continuously	- update of logistical procedures

III Maximum allowable operating pressure (PFA) and de-rating factors

(normative)
On the basis of situations that can be expected in practice, it must be taken into account that for PVC-U pipes a difference must be made between the nominal pressure as indicated on the pipes and the maximum allowable working pressure in the piping system. Limiting factors which determine the permissible working pressure, occur in situations where pipes are exposed to external loads, or chemical or thermal influences. For external loads and chemical influences no uniform derating factors can be given. These must be determined for each case on the basis of practical experiences. In situations where thermal influence exists, it is advised to follow table III,1 For a more accurate approach, NEN-EN-ISO 1452-2:2009, figure A.1 can be taken into account.

For water temperatures up to 25 ° C: PFA = PN
For water temperatures above 25 ° C: PFA = f_T x PN

in which:
f_T is the derating factor, which depends on the water temperature
PN is nominal pressure.
In cases where a derating factor is required for the application: PFA = f_A x f_T x PN, where f_A is the derating factor for the application.

Table III.1 – Derating factors for the calculation of the maximum allowable working pressure in PVC-U pipes at higher services temperature.

Temperature of the pipe wall °C		**Derating factor (f_T)**
Higher than	up to and including	
10	25	1,00
25	35	0,80
35	45	0,63

The scope of PVC-U pipes is limited to a temperature of 45 ° C.

IV Design coefficient

(normative)
The design coefficient C is a factor that is needed for the calculation of the design stress σ_s for pipes which are intended to be used with internal pressure by:

$$\sigma_S = \frac{MRS}{C};$$

where MRS is the minimum required strength.

From the calculated value of σ_s and the S value of the pipe, the nominal pressure PN can be calculated:

$$PN = \frac{\sigma_S}{S} = \frac{20 \times MRS}{C \times (SDR-1)};$$

where:
PN is the nominal pressure is expressed in bar;
MRS is the minimum required strength expressed in MPa;
C is design coefficient;
SDR is the standard dimension ratio = d_n / e_n and;
S is the S-value of the pipe.

$$S = \frac{SDR-1}{2} = \frac{d_n - e_n}{2 \times e_n};$$

where:
d_n is the nominal diameter;
e_n is nominal wall thickness.

In recent years, the production of PVC-U pipes significantly improved, which resulted in an improved impact resistance and reduced susceptibility to brittle fracture. Therefore, the design coefficient for PVC-U pipes reduced from 2.5 to 2.0.

Bi-axially oriented pipes PVC-O have a better resistance to crack initiation in applications under internal pressure than PVC-U pipes. The molecular process that underlies brittle fracture growth is suppressed by orientation. At an orientation of 1,6, this is even completely suppressed thereby lowering the design coefficient to C = 1,6 is permitted.

Note 1: The selected design coefficient C value of 1,6 is the recommended minimum in accordance with NEN-EN-ISO 12162.

Note 2: In case of plastics, it is common practice to evaluate the material at 20 °C. On the basis of this temperature, the design coefficient C set. The current operating temperature of pipes in the ground for the transport of drinking water in the Netherlands is assumed to be 10 °C. Consequently, the expected lifetime are significantly longer.

V Guidance for prevention of contamination during transport and storage of new products

(informative)

Importance of a hygienic operation
Hygiene and hygienic work is since decades an important issue with respect to the transport and distribution of drinking water in the Netherlands.
The impact of pollution can have big consequences for the water distribution[1)] and need substantial efforts to clean the system, especially because in the Netherlands chlorine is not used. Already in the 1983 published “guideline for installation of PVC-U piping systems, paragraph 4.2 "Storage", mentions this topic as follows: *For the prevention and risk of difficulties disinfecting of the pipe line afterwards, it is recommended to use plugs in pipe ends for storage of the pipes.*
The importance of hygiene also reflected in recent documents e.g. Dutch Hygiene code: "Hygiënecode Drinkwater; Opslag, transport en distributie’ with the accompanying work instructions ("werkboekje") for mechanics. As result of the Hygiene code a wide range of courses for parties involved (installers, personnel of water companies, etc.) can be followed. Last but not least the Hygiene code is also mentioned in the drinking water law of July 1, 2011 and is therefore part of the Dutch law.

Protection of the products during storage and transport
In the "Hygiënecode Drinkwater: Opslag, transport en distributie” with the accompanying work instructions for mechanics the aspect how to work hygienically is extensively described. It involves dealing with parts for piping systems (pipes, fittings, values and hydrants) starting with the arrival of the parts at the construction site to the realization and commissioning of the pipeline. The primary approach to hygienic work is ''prevention''. Secondly, there are measures described in order to make pipelines suitable for the delivery of clear drinking water. The hygiene aspects in the process from the manufacture of the product in the factory, assembly hall or other production location are briefly described in the "Hygiënecode Drinkwater". Also in this process is the primary approach prevention: For each product applies the sooner the product is protected against contamination [2)], the better the hygiene of the product can be guaranteed. To close the hygiene chain completely and to be eligible for certification, producers of part for piping systems for drinking water shall have a procedure in which measures are described for storage and the route to the water companies (delivery address), as will be defined in general terms or laid down in relevant Kiwa evaluation guidelines. The producer shall have a procedure for the protection of the products during transport and storages, to be able to guarantee that hygiene requirements are meet.

Note:
1) Mostly this is a microbiological contamination coming from the surrounding area on macro- and micro scale like dust, but also faeces and dead beasts.
2) In this context he word "protection" is used as a combination of packing (e.g. providing the product with a casing) and, when applicable, providing end caps (e.g. for pipes and fittings).

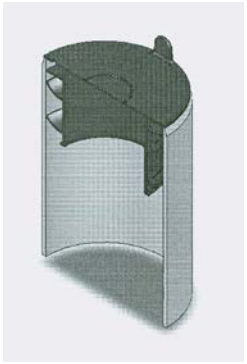
Requirements for the protection
For all preventive (protective) actions taken to protect the products against pollution, it is important that the protection is sufficient during the complete process starting after

production of the product (followed by e.g. storage, transport and again storage) and ending with the installation of the products.

Capabilities to protect the product:
The used packaging depends on the product itself (shape, dimensions, etc.)
Some packaging solutions (not binding and not exhaustive) are mentioned below:

- For small fittings (couplings, rings, rubber seals) a plastic bag eventually in a box;
- "Bubble wrap" foil in combination with adhesive tape for all openings for big(ger) fittings;
- The combination of bags made of fiber reinforced material or heat shrink foil and the use of a box for smaller part;
- End-caps / plugs or stern plastics bags for the pipe ends (where the complete pipe package is wrapped in foil).

In 2007 representatives of the manufacturers and the water companies organized in the commission ‘OnderhandelingsCommissie Kunststoffen’ (OCK) started a project to improve the quality of packaging.
The project resulted in the following construction of end-capes for pipes.
The end cap is unmovable fixed in the pipe by using flaps in a labyrinth structure to let in air but prevent pollution.
The end cap is developed for a 110 mm PVC pipe but can also be developed for other diameters (50, 63, 75 , 90, 160, 200 and 250 mm), and for all used pipe materials.
For closing pipe ends with a diameter of 315, 400, 500 and 630 mm a fiber reinforced cover in combination with adhesive tape or lashing straps can be used (see the pictures below).


Left: end cap with flaps. Right: fiber reinforced cover in combination with adhesive tape.

Mess bags cannot be sealed against dust and dirt, and for this reason are not recommended as the only packaging for small parts.