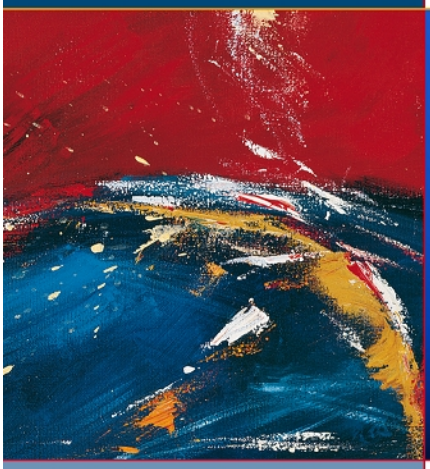
BRL K17504/02
September 3, 2009

Evaluation Guideline

for the Kiwa product certificate for vulcanised rubber products for cold and hot drinking water applications



Partner for progress

BRL K17504/02
September 3, 2009

Evaluation Guideline

for the Kiwa product certificate for vulcanised rubber products for cold and hot drinking water applications

Validation
This evaluation guideline has been validated by the Director Certification and Inspection of Kiwa on 17 November 2009

Kiwa N.V.
Certification and Inspection
Sir W. Churchill-laan 273
P.O. Box 70
2280 AB RIJSWIJK
The Netherlands

Tel. +31 70 414 44 00
Fax +31 70 414 44 20

Amendment BRL K17504/02
vulcanised rubber products for cold and hot drinking water applications

Date ammendment 22 May 2012

Validated by Kiwa Board of Experts Water Chain (CWK) dated 22 May 2012.

Validity
This amendment is related to Evaluation Guideline K17504/02 dated 3 September 2009.

Validation
This amendment has been validated by Kiwa on 22 May 2012.

Corrections:

2.1.1 Types of rubber seals
Replace all words "should" by "shall" in the complete paragraph, so in all subclauses 2.1.1.1 to 2.1.1.6.

2.5.1 General
Replace complete text by:

"Unless stated otherwise, tests shall be carried out at a temperature of 23 °C and a relative humidity of 50 % according to ISO 23529. The allowed tolerances for all mentioned test durations and test temperatures shall be according to ISO 23529.

Annex G and H describe details about the preparation of test pieces from products and testing in case the products are O-rings."

2.5.2 Hardness
Replace: "Then the hardness concerned shall be reported to the inspection body as nominal hardness with the tolerance range which has been determined by mutual consent. Usually the tolerance range for rubber is ± 5 IRHD. When the customer or the sort of construction demands such a thing the tolerance range can be ± 3 IRHD."

By: "Then the hardness concerned shall be reported to the inspection body as nominal hardness with the tolerance range ± 5 IRHD."

2.5.2.4 Hardness after ageing
Change: "70 ± 2 °C" and "125 ± 2 °C" by:"70 °C" and "125 °C".

2.5.3 Mechanical properties
Replace: "Tear resistance measured according to NEN-ISO 34-2 shall, depending on the class of hardness, meet the requirements laid down in table 2A."

By: "The tear resistance measured according to NEN-ISO 34-2 shall be at least 20N. See annex G and H."

Delete table 2A and delete the remark (*) under table 2A.

Change: "Dumbbell shaped test pieces of types 1, 2, 3 or 4 shall be used. Type 2 is the preferred type. The test report shall state the dumbbell type whenever type 2 is not used."

By: "Dumbbell shaped test pieces of type 2 shall be used preferably. In case of O-rings the test may be carried out on complete rings, depending on the product dimensions, see annex G and H. The test report shall state the test piece that is used (dumbbell type or complete ring).

Delete: "If satisfactory test pieces cannot be prepared ..... with those used in production."

Change: "70 ± 2 °C" and "125 ± 2 °C" by:"70 °C" and "125 °C".

2.5.4 Compression set
Change: "The compression set of the rubber determined according to NEN-ISO 815 (small test pieces) using the test conditions of table 3 (A or B) shall not exceed the values given in the table."

By: "The compression set of the rubber determined according to NEN-ISO 815 (small test pieces or O-rings, see annex G and H) using the test conditions of table 3 (A or B) shall not exceed the values given in the table."

Change: "The low temperature determined after 30 minutes of recovery."

By : "The low temperature value determined after 30 minutes of recovery".

2.5.6 Stress relaxation
Change: "The stress relaxation shall be determined in accordance with ISO 3384 (compression, method A, small test pieces) or ISO 6914 (tension)."

By: "The stress relaxation shall be determined in accordance with ISO 3384 (compression, method A, cylindrical test pieces or O-rings, see annex G and H) or ISO 6914 (tension, test pieces or O-rings from product group A, see annex D, G and H)."

Replace table 4C by:

Hardness class IRHD	Stress relaxation in % after			
	(ISO 3384 or ISO 6914)			(ISO 6914)
	7 days at 23 °C	100 days at 23 °C	7 days at 125 °C *	4 weeks at 140 °C *
60, 70, 80	15	22	30	55

2.5.7 Resistance to ozone attack

Replace table 5A by:

Class of resistance	Ozone concentration [pphm]	Period of exposure [h]	Temperature [°C]
I	50	120	40
II	50	48	40
III	25	48	40

Replace table 5B by:

Hardness class	Elongation in %
40 - 70	20 %
80	15 %
90	10 %

2.5.7 Resistance to ozone attack

Replace all words "should" by "shall" in this paragraph.

2.7.2.1 *Test pieces from products*
Change: "A guideline for this preparation is given in annex G."
By: "A guideline for this preparation is given in annex G or annex H."

2.8 Marks to be applied

Replace: "- Kiwa (or Kiwa word mark)"

By: "- Kiwa (or Kiwa word mark) and additionally the Kiwa watermark  ".

4.1 Test matrix

Replace by:

Description of requirement	Article BRL	Tests within the scope of		
		Initial evaluation	Surveillance by CI after issue of the certificate	
			Inspection[1)]	Frequency
Toxicological requirements	2.3.2	X	X	1x year
Smell and taste	2.3.3	X	X	1x year
Resistance to chemicals	2.3.4	X	X[3)]	1x year
Effect of rubber products on the pipe and/or fitting material	2.3.5	X	X[3)]	1x year
Appearance	2.4.1	X	X[2)]	1x year
Homogeneity	2.4.2	X	X[2)]	1x year
Dimensions and volume	2.4.3	X	X[2)]	1x year
Hardness	2.5.2	X	X	1x year
Hardness after ageing	2.5.2.4	X	X	1x year
Tear resistance	2.5.3	X		
Tensile strength	2.5.3	X	X	1x year
Tensile strength after ageing	2.5.3	X	X	1x year
Elongation at break	2.5.3	X	X	1x year
Elongation at break after ageing	2.5.3	X	X	1x year
Compression set	2.5.4	X	X	1x year
Compression set in water (class III rubbers only)	2.5.5	X		
Stress relaxation	2.5.6	X	X[4)]	1x year
Resistance to ozone attack	2.5.7	X[5)]	X[5)]	1x year
Swelling in water	2.5.8	X		
Behaviour at elongation	2.6.2	X	X	1x year
Marks to be applied	2.8	X	X[2)]	1x year

Replace remarks by:

1) In case of significant changes in the production process the product requirements shall be evaluated again (to be decided by the certification body). Properties not marked in the table for inspection shall be tested by the manufacturer at least once per 5 years, to be verified by the inspector during inspections.
2) These product properties are determined during the inspection.
3) This aspect is compared on the basis of IQC inspection (indirectly by means of direct related parameters) with the aspect found for approval.
4) Only 7 days test; at 23 °C for class I and II rubbers and at 125 °C for class III rubbers.
5) Not for EPM/EPDM or IIR.

6.1 Standards / normative documents

Change: "NEN-EN 3601-1" by:...."NEN-ISO 3601-1"

Annex A

Table 7, 8 and 9: delete footnote a)

Table 8

Replace row "stress relaxation" by:

Stress relaxation - 7 days at 23°C (b*) - 100 days at 23 °C - 7 days at 125°C	%	ISO 6914 or ISO 3384	 ≤ 15 ≤ 20 ≤ 30	 ≤ 15 ≤ 22 ≤ 30	 ≤ 15 ≤ 23 ≤ 30	 ≤ 18 ≤ 25 ≤ 30	 ≤ 18 ≤ 26 ≤ 30

Table 9

Replace row "stress relaxation" by:

Stress relaxation - 168 h at 23 °C (a*) - 100 days at 23 °C - 168 h at 125°C (e*) - 4 weeks at 140 °C (e*)	%	ISO 6914 or ISO 3384	 ≤ 15 ≤ 22 ≤ 30 ≤ 55	 ≤ 15 ≤ 22 ≤ 30 ≤ 55	 ≤ 15 ≤ 22 ≤ 30 ≤ 55

Annex B

Replace table 11 by:

Groups of products	Cross section diameter	
	Minimum [mm]	Maximum [mm]
A	-	2,75
B	2,75	6,0
C	6,0	12
D	12	25
E	> 25	-

Annex E

Row "End products":

Change: "Tear strength" by "Compression set".

Annex F

Replace content by:

In the table beneath an overview is given on what tests are applicable in case of starting the application for certification with the rubber compound and afterwards with the product manufactured from that compound.

	Raw material (vulcanised sheet)	Product 1)
Hardness	X	X
Tensile strength	X	X
Elongation at break	X	X
Compression set in air (Class I rubbers - cold)		
- 72 h at 23 °C	X	
- 24 h at 70 °C	X	X
- 72 h at -10 °C	X	
Compression set in air (Class II and III rubbers - hot)		
- 72 h at 23°C	X	
- 24 h at 125°C	X	X
Compression set in water (Class III rubbers only)		
- 3000 h at 110 °C	2)	X
- 10000 h at 110 °C	2)	X
Swelling in water		
- 168 h in water at 70 °C (Class I rubbers)	X	
- 168 h in water at 95 °C (Class II and III rubbers)	X	
- 10 weeks in water at 150 °C (Class III rubbers, only swelling seals)	X	
Stress relaxation		
- 168 h at 23 °C (Class I rubbers)	X	X
- 100 days at 23 °C	X	
- 168 h at 125 °C (Class II and III rubbers, not swelling seals)	X	X
- 672 h at 140 °C (Class III rubbers, not swelling seals)	X	
Ozone resistance (not for EPM/EPDM or IIR)	X	X
Strength of bond or weld (if applicable)		X

1) When dimensions of products are suitable.

2) Covered by test on product.

Annex H
Replace all words “should” by “shall”.

Add after aspect stress relaxation at compression:
“- Stress relaxation at tension can be measured on complete rings. This is limited to rings with cross section of max 2,75 mm and internal diameter of max 30 mm.”

Last two aspects:
Change: “Ozone can be done on ….” by: “Ozone test can be done on …”.
Change: “Swelling can be done on …”by: “Swelling test can be done on …”.

Preface

This evaluation guideline has been accepted by the Kiwa Board of Experts Water Chain (CWK), wherein all the relevant parties in the field of vulcanised rubber products for drinking water applications are represented. This Board of Experts also supervises the certification activities and where necessary require the evaluation guideline to be revised. All references to Board of Experts in this evaluation guideline pertain to the above mentioned Board of Experts.

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 inspection frequency is determined by the above mentioned Board of Experts.

Specific additional information
The requirements in this evaluation guideline cover the mechanical requirements in EN 681-1 for the applications WA, WB and WE at different temperature levels.

In this BRL additional requirements are included for some special facilities to rings, such as a hard nose or a hard base, a hard under-layer or fixation rings.

Contents

1 Introduction

1.1 General

This Evaluation Guideline contains all relevant requirements on the basis of which Kiwa issues and maintains a Kiwa Product Certificate for vulcanised rubber products for drinking water applications.

This evaluation guideline replaces Evaluation Guideline BRL K17504/01 dated 15-08-2005.

During the performance of the certification work, Kiwa is bound to the requirements as laid down in the chapter "Agreements on the implementation of certification".

1.2 Field of application / scope

The products are intended to be applied as sealing systems for drinking water. For other applications as mentioned here a more explicit testing might be necessary to assure a correct function of the products. Special types of products are described in more detail in paragraph 2.1.
In this evaluation guideline the products are classified in the following areas of use:

I Water supply at temperatures up to 50 °C (see footnote [1]).
II Water supply at temperatures intermittently up to 110 °C, or water supply up to 110 °C in serviceable piping systems.
III Hot water circulation systems based on the classification class 2 in NEN-ISO 10508.

I is equal to that used in EN 681-1.
II is based on the one mentioned in EN 681-1. The difference is a limitation with respect of the application area: discontinuously (intermittent) hot or easy serviceable.
III is for the more severe conditions applicable for these systems. Here a continuously high temperature of 70°C is assumed for the system (class 2 of NEN-ISO 10508). To set the requirements for this class III, a lifetime expectation of at least 50 years for a piping system is assumed for setting up the tests in this Evaluation Guideline. This is in line with the requirements for such systems as given in EN 806-2.

In this guideline the different classes are referred to as class I, II and III.

Certification is intended for actual products (seals). To reduce unnecessary testing it is also possible to issue a certificate on a rubber material intended to be used for the production of products afterwards. Having such a certificate will reduce the tests needed to be carried out on the actual products.

1.3 Terminology

In this Evaluation Guideline the following definitions shall apply:

- Board of Experts: the Board of Experts "Commission for the Quality Requirements for Water Supply Components (CKW)";
- Supplier: the party responsible for ensuring that the products continuously fulfil the requirements on which the certification is based;
  Note: the 'Supplier' may also be the manufacturer of the certified product(s).
- Internal quality control (IQC)-scheme: a description of the quality inspections carried out by the supplier as part of his quality system.

Furthermore, especially for the class III seals, there are two principles in use:

- sealing because of a low rate of stress relaxation which keeps the pressure between the surfaces high enough for a long period of time; for this the term 'compression sealing' is used in this guideline; most known using this principle of sealing are rubbers like EPM, EPDM, NBR, SBR.
- sealing because of swelling in combination with a material that has an outstanding resistance to aging and can deal with swelling without deterioration; for this the term 'swelling sealing' is used in this guideline; this principle is in practice only used by IIR, although also FKM might seal using this principle.

[1] In the Netherlands the maximum allowed drinking water temperature in piping systems is 25°C.

1.4 Requirements and determination methods

In this Evaluation Guideline requirements and determination methods are included, by which the following is meant:

1.4.1 Requirements

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.

1.4.2 Determination methods

Pre-certification tests: tests in order to ascertain that all the requirements recorded in the Evaluation Guideline are met. These tests are often referred to as initial type tests.
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.

The test matrix contains a summary showing what tests will be carried out by certification body in the pre-certification stage and in the event of inspections as well as showing the frequency with which the inspection tests will be carried out.

1.5 Acceptance of test reports provided by the supplier

The rules for acceptance of test reports provided by the supplier are laid down in the Kiwa Regulations for Product Certification.

1.6 Certificate

A model of the certificate to be issued on the basis of this Evaluation Guideline has been included as an Annex.

2 Product requirements and test methods

2.1 General

In the next chapters the requirements and test methods are embodied to which rubber products for drinking water pipe joints have to comply to.
In case a product is meant to be used for more then one class, for instance for class I and II or for class II and III or even for all three classes, only testing for the highest class is assumed to be sufficient for the purpose of certification as meant under this evaluation guideline.

2.1.1 Types of rubber seals

2.1.1.1 Solid rubber products

The rubber should fulfil the requirements of this Evaluation Guideline in paragraph 2.4 and 2.5.
Joints should also fulfil the requirements in paragraph 2.6.1 and 2.6.2.In case joints are present in class II or class III products such products having a joint should be used for testing.

2.1.1.2 O-rings

The rubber should fulfil the requirements of this Evaluation Guideline in paragraph 2.4 and 2.5.
Joints should also fulfil the requirements in paragraph 2.6.1 and 2.6.2.
In this Evaluation Guideline test methods for O-rings are included in annex H. In annex B a classification of O-ring sizes in groups is given. For each group the compression set at the relevant elevated temperature has to be verified before approval by a certification institute can be granted.

2.1.1.3 Rubber products combining two different rubber compounds (i.e. a hard and a soft rubber)

Both rubbers should fulfil the requirements of this BRL. The adhesion between the two rubbers should fulfil the requirements of paragraph 2.6.
In cases where one of the rubbers is meant to be a kind of back up ring, only the rubber for the product should fulfil all requirements. The rubber used for the back up function should fulfil the requirements with respect to the toxicological aspects (2.3.2), smell and taste (2.3.3) and the mechanical properties (2.5.3). The adhesion between the two rubbers should fulfil the requirements of paragraph 2.6.

The adhesion between both types of rubber should be at least 100 N/25 mm when tested according to ISO 813. In cases where the test piece is too small for a test according to ISO 813 the rubber should tear and not detach when it is tried to separate the bond.

2.1.1.4 Rubbers vulcanized or attached to rigid materials

The rubber should fulfil the requirements of this BRL in paragraph 2.4 and 2.5. The adhesion between rubber and the other material should be at least 100 N/25 mm when tested according to ISO 813. In cases where the rigid parts are too small for a test according to ISO 813 the rubber should tear and not detach when it is tried to separate the bond.

2.1.1.5 Rubber products containing other rigid non-adhered materials (eg metal springs)

The rubber should fulfil the requirements of this BRL in paragraph 2.4 and 2.5.
The non rubber material should not have a negative influence on the functioning of the rubber, for instance by having sharp edges that could cut the rubber under deformation. This should be judged by deforming the complete assembly in a way as intended during use followed by an inspection for damage to the rubber (outside and inside).

2.1.1.6 Product containing voids (not porosity)

The rubber should fulfil the requirements of this BRL in paragraph 2.4 and 2.5.
Joints should also fulfil the requirements in paragraph 2.6.1 and 2.6.2.
In cases where the part containing the void has to function in the same manner as a solid rubber the complete product should fulfil the requirements for the compression set as given in section 2.5.4 measured at the place of the void.

2.2 Material

2.2.1 General

Within the scope of this evaluation guideline all types of vulcanised rubber may be used for manufacturing products.

2.2.2 Blends of rubber polymers

Blends of rubber polymers may only be used for the manufacture of products with permission of the manufacturer of the pipes and/or fittings. Both the customer and the inspection body shall be notified of the ratio of the polymers used.

2.2.3 Homogeneity

All ingredients shall be mixed in the rubber homogeneously.

2.3 Functional requirements

2.3.1 General

The rubber products shall be suitable for the intended purpose. The design, the type(s) of rubber selected and the construction shall be such that, with regard to the type of application, a good sealing of the joints under normal circumstances is assured. Depending on the type of product and the construction used the materials have to be tested as follows:

2.3.2 Toxicological requirements

Products and materials which come into contact with drinking water may not give off substances to the drinking water in such amounts that it is harmful for consumers. In order to guarantee this, the product shall fulfil the criteria as laid down in the 'Guideline quality of materials and chemicals for drinking water supplies' (published in the Gazette dated December 13, 2002, nr. 241, and page 25). As proof thereof the application procedure Attest Toxicological Aspects (ATA) must be completed successfully.
Products and materials with an equivalent quality declaration[1][2], issued for example by a foreign accredited organization, may also be applied in The Netherlands.

2.3.3 Smell and taste

The rubber products shall not give any smell, taste or colour in concentrations which may be unpleasant for the customers of the potable water. The requirements for smell and taste are fulfilled if during a migration test, according to NEN-EN 1420-1 followed by an examination of the migration water according to NEN-EN 1622, the TFN (Threshold Flavour Number) and the TON (Threshold Odour Number) in the migration water of the third period is smaller than 150.

2.3.4 Resistance to chemicals

The rubber products have to be resistant to any chemicals drinking water can contain under usual circumstances.

2.3.5 Effect of rubber products on the pipe and/or fitting material

The rubber products may not contain substances that, under normal circumstances, can have an adverse effect on the material of the pipes and fittings.
In case of doubt a suitable method to verify this can be taken out of ISO 3865.

---

[1] To be evaluated by the Minister of Environment (Guideline quality of materials and chemicals for drinking water supplies').

[2] The assessment for the purposes of an ATA starts on the basis of the current positive lists applying to the materials. (The most current list is available on request.)

2.4 Appearance, homogeneity, dimensions and volume

2.4.1 Appearance

The appearance of the rubber products shall comply with ISO 9691. For the appearance of O-rings also reference can be made to ISO 3601-3. The appearance is judged on, at least five, random selected rubber products.

2.4.2 Homogeneity

The rubber products may not contain foreign bodies and shall be free of cracks, entrapped air, bubbles or other irregularities, i.e. ISO 9691. For testing take a random selection of at least five products and cut them in flat slices or parts of about 2 mm in thickness. Stretch the slices approximately 100% and record the findings.

2.4.3 Dimensions and volume

The nominal measurements - and in case it is relevant for the application - the nominal volume of the rubber products and the acceptable deviations shall be in accordance with the figures stated by the manufacturer and they shall be laid down in a drawing. Tolerances shall be specified from the appropriate classes of ISO 3302.
For dimensions of O-rings also reference could be made to NEN-ISO 3601-1.
Determine the dimensions by means of appropriate measuring equipment (see ISO 23529).
Determine the volume using the method as given in ISO 1817 with an accuracy of 1 mg by weighing the rubber products first in air and then in water.

2.5 Physical and mechanical properties of the rubber

2.5.1 General

Unless stated otherwise tests must be carried out at a temperature of (23 ± 2) °C and a relative humidity of (50 ± 5) % according to ISO 23529.

2.5.2 Hardness

2.5.2.1 General

The hardness shall be suitable for the material and the construction of the joints for which the rubber products are intended.
Therefore the hardness shall be set in consultation between the manufacturer of the pipes and fittings and the manufacturer of the rubber products.
Then the hardness concerned shall be reported to the inspection body as nominal hardness with the tolerance range which has been determined by mutual consent.
Usually the tolerance range for the rubber is ± 5 IRHD. When the customer or the sort of construction demands such a thing the tolerance range can be ± 3 IRHD.
The hardness shall be determined according to NEN-ISO 48.
Only in the case where the form and the dimensions of the ring do not allow measurement according to the standard mentioned previously, or in case of a check measurement (non destructive), the apparent hardness shall be determined in a way which both parties (buyer and manufacturer) have agreed upon. In that case the following issues must be laid down and submitted to the certification institute, for approval: the nominal apparent hardness plus the corresponding tolerance, the method of measurement and the place(s) of measurement.

2.5.2.2 Difference in hardness

The difference in hardness (the difference between the highest and lowest value measured) of a product shall not exceed 5 IRHD.

2.5.2.3 Class of hardness

The products shall have a nominal hardness falling within the range of values of table 1. The manufacturer shall submit the value of this nominal hardness, which shall be within the range of a class of hardness. All other tolerances only apply within the nominal hardness range of one class, as specified in table 1.

Table 1 - Class of hardness

Class of hardness in IRHD	Tolerance range of hardness class in IRHD
40	≥ 36 en ≤ 45
50	≥ 46 en ≤ 55
60	≥ 56 en ≤ 65
70	≥ 66 en ≤ 75
80	≥ 76 en ≤ 85
90	≥ 86 en ≤ 95

2.5.2.4 Hardness after ageing

After ageing according to NEN-ISO 188 for a period of 168 hours at a temperature of 70 ± 2 °C (class I) or 125 ± 2 °C (class II and III), the hardness (see 2.5.2.1) may not have changed by more than +8/-5 IRHD.

For the swelling products used for class III

- After ageing according to NEN-ISO 188 for a period of 504 hours at a temperature of 125 °C shall be within the limits -5 and +10 IRHD.
- After immersion for 10 weeks at 150°C in accordance with NEN-ISO 1817 shall be within the limits -5 and +5 IRHD.

2.5.3 Mechanical properties

Tear resistance measured according to NEN-ISO 34-2 shall, depending on the class of hardness, meet the requirements laid down in table 2A.

Table 2A: Tear resistance

Type of rubber *	Required minimum Tear resistance in N
NR and IR	55
SBR and CR	25
NBR, EPM, EPDM, IIR	20

* For other types of rubber the minimum required tear resistance must be agreed between the manufacturer and the client and approved by the certification institute.

Tensile strength and elongation at break according to NEN-ISO 37 shall, depending on the class of hardness, meet the requirements laid down in table 2B, 2C or 2D.
Dumbbell shaped test pieces of types 1, 2, 3 or 4 shall be used. Type 2 is the preferred type. The test report shall state the dumbbell type whenever type 2 is not used.

If satisfactory test pieces cannot be prepared in accordance with the instructions given for the appropriate test method they shall be taken from the slabs or sheets, of suitable dimensions, made from the same batch of the elastomer mix used to make the products and moulded under conditions which are comparable with those used in production.

After ageing for 168 hours according to NEN-ISO 188 at a temperature of 70 ± 2 °C (class I) or 125 ± 2 °C (class II):
- the tensile strength may not have decreased by more than 20%, and
- the elongation at break may not have increased by more than 10 % or decreased by more than 30% for rubbers having a hardness up till 80 IRHD. Harder rubbers are allowed decrease maximum 40 %.

For the swelling products used for class III, it goes that after ageing according to NEN-ISO 188 for a period of 504 hours at a temperature of 125 °C:
- the change in tensile strength shall be maximum 25 %;
- the change in elongation at break shall be between -40 and +10 %.

Table 2B: Tensile strength and elongation at break for class I rubbers.

Hardness class IRHD	Tensile strength MPa	Elongation at break %
40	9	400
50	9	375
60	9	300
70	9	200
80	9	125
90	9	100

Table 2C: Tensile strength and elongation at break for class II rubbers.

Hardness class IRHD	Tensile strength MPa	Elongation at break %
50	9	250
60	9	200
70	9	150
80	9	100
90	9	100

Table 2D: Tensile strength and elongation at break for class III rubbers.

Hardness class IRHD	Tensile strength MPa	Elongation at break %	
		on sheet	on products
60	9	200	175
70	9	150	130
80	9	100	100

2.5.4 Compression set

The compression set of the rubber determined according to NEN-ISO 815 (small test pieces) using the test conditions of table 3 (A or B) shall not exceed the values given in the table.
The low temperature is determined after 30 minutes of recovery.
Where the cross section is too small to obtain compression set buttons from the product, as an alternative to moulding buttons or sheets, the tension set may be determined using the method specified in ISO 2285 with a strain of 50%. For this alternative test method the same test conditions (except strain) and requirements apply as used for the determination of the compression set.

Table 3A: Compression set for class I rubbers.

Test conditions		Maximum permanent deformation in relation to the compression in % at a nominal hardness in IRHD			
Temperature °C	Duration of compression h	40 - 50	60	70	80 - 90
-10	72	40	50	50	60
23	72	12	12	15	15
70	24	20	20	20	20

Table 3B: Compression set for class II and III rubbers.

Test condition		Maximum permanent Deformation in relation to the Compression in %
Temperature °C	Duration of compression h	
23	72	15
125	24	20

2.5.5 Compression set in water (class III rubbers only)

The compression set determined using the method given in EN 681-1 annex B shall be maximal 40 % after 10000 hours in water at a temperature of 110 °C.
If the result after 3000 hours is below 20% the test can be stopped and the material is OK for this aspect. If the result after 3000 hours is above 30% the test can be stopped and the material is not OK for this aspect.

2.5.6 Stress relaxation

The stress relaxation shall be determined in accordance with ISO 3384 (compression, method A small test pieces) or ISO 6914 (tension).
Minimum measurements shall be taken after 3 hrs, 1, 3, 7 days for the 7 day test and after 3 hrs, 1, 3, 7, 30, 100 days for the 100 days test. The values obtained by regression shall not exceed the maximum values given in table 4 (A to C).

The 100 days test shall be considered as a type approval test. The requirement in respect of relaxation per logarithmic decade shall also be regarded as a type approval requirement.

The best fit straight line shall be determined by regression analysis using a logarithmic time scale. The 7 and 100 days requirements are those derived from this straight line.
If the test piece is taken from a product, the measurement shall be carried out as far as possible in the direction of compression of the product in service.
Where the cross section is too small to obtain compression buttons from the product, as an alternative to moulding buttons, the stress relaxation in tension of the product may be determined, at a temperature of 23 °C, using method A specified in ISO 6914 with the same requirements as for stress relaxation in compression.

Table 4A: Stress relaxation for class I rubbers.

Hardness class IRHD	Stress relaxation in % after (ISO 3384 or ISO 6914)		Stress relaxation in % per logarithmic decade
	7 days at 23 °C	100 days at 23 °C	
40	13	19	5,1
50	14	20	5,5
60	15	22	5,9
70	16	23	6,3
80	17	25	6,7
90	18	26	7,1

Table 4B: Stress relaxation for class II rubbers.

Hardness class IRHD	Stress relaxation in % after (ISO 3384 or ISO 6914)		
	7 days at 23 °C	100 days at 23 °C	7 days at 125 °C *
50	15	20	30
60	15	22	30
70	15	23	30
80	18	25	30
90	18	26	30

Table 4C: Stress relaxation for class III rubbers.

Hardness class IRHD	Stress relaxation in % after			
	(ISO 3384 or ISO 6914)			(ISO 6914)
	7 days at 23 °C	100 days at 23 °C	7 days at 125 °C *	3 weeks at 150 °C *
60	15	22	30	55
70	15	22	30	55
80	15	22	30	55

* These tests do not comply for swelling seals.

2.5.7 *Resistance to ozone attack*

This requirement does not need to be tested for 100 % EPM/EPDM or IIR compounds.
The rubber should show no cracks when tested in accordance with NEN-ISO 1431-1 method A under conditions as given in table 5A and table 5B.
The resistance class to be used should be established by mutual agreement between the manufacturer, the client and the inspection body depending on the intended use (see the explanatory notes under table 5).

Table 5A - Resistance to ozone attack

Class of resistance	Ozone concentration [pphm]	Period of exposure [h]	Temperature [°C]
I	50	120	40 ± 1
II	50	48	40 ± 1
III	25	48	40 ± 1

Table 5B - Elongation to be used in the ozone test

Hardness class	Elongation in %
40 - 70	20 ± 2 %
80	15 ± 2 %
90	10 ± 1 %

Explanatory notes

Class of resistance I is intended for products with a high risk of attack by ozone, for instance in case of separately supplied products without sufficient packaging or in case of connections with preinstalled rubbers.

Class of resistance II is intended for products for which a normal resistance to ozone is required.

Class of resistance III is only permissible for rubbers which are never (partly) exposed to the open air when they are in tension. Transport should always take place in sealed packages.

2.5.8 Swelling in water

The change in volume after immersion for 168 hours at 70°C (class I) or 95°C (class II and III) in accordance with NEN-ISO 1817 shall be within the limits -1 and +8% (v/v).
For swelling seals it also goes that the change in volume after immersion for 10 weeks at 150°C in accordance with NEN-ISO 1817 shall be within the limits +5 and +15% (v/v).

2.6 Properties for special types of products

2.6.1 General requirements

A ring made of rubber which has been vulcanized in advance shall not contain more than one weld, separate from eventual joints between compounds, except by agreement between the manufacturer and the client.
A ring made from two compounds shall not contain more than one weld in the direction of the outline of the products.

2.6.2 Behaviour at elongation

2.6.2.1 Massive products with a weld

Elongate each rubber product with a weld with a tensile speed of 500 mm/min to 100% elongation, unless a reduced elongation has been agreed upon by both the buyer and the manufacturer. This must be reported to the inspection body. Keep the rings in an elongated state for at least 30 seconds. When tested the weld shall not crack or contract.

2.6.2.2 Products made from two compounds

Elongate test pieces containing the joint between the two materials with a tensile speed of 500 mm/min to 100% elongation. Keep the test pieces in an elongated state for at least 30 seconds. When tested the joint shall not crack or contract.

2.6.2.3 Elongation test for welded products after ageing

After ageing for 168 hours at 70 ± 2°C in accordance with NEN-ISO 188 the test of 2.6.2.1 or 2.6.2.2 is repeated. When tested the weld or joint shall not crack or contract.

2.7 Sampling, test material and test pieces

2.7.1 Sampling

The sample shall be representative for the product to be checked and been taken out of a normal production lot.

2.7.2 Test material

2.7.2.1 Test pieces from products

If the dimensions of the rubber products are such that it is possible to take out the test pieces from them, the tests shall be carried out on such test pieces.
Depending on the dimensions of the products it is allowed and can be necessary to take test pieces with other (smaller) dimensions then those prescribed in the standards. A guideline for this preparation is given in annex G.

2.7.2.2 Test piece of complete product

In carrying out the tests according to 2.3.3, 2.3.4 and 2.4.1 up to 2.4.3 inclusive a complete rubber product or an unmachined part of a rubber product shall be used.

2.7.2.3 Test pieces from test plates

If the dimensions of the rubber products are such that the test pieces required cannot be manufactured from them, test plates produced in the manufacturer's own laboratory shall be used. Care has to be taken that the vulcanisation conditions for the sheets are similar to those for the products to obtain

matching properties. Details with respect to the vulcanisation and the direction of milling shall be given to the inspection body.

2.7.3 Test pieces

The test pieces required shall, in accordance with ISO 23529, be made out of the products (see 2.7.2.1) or out of the test sheets (see 2.7.2.3).
By preparing test pieces out of actual products it is unavoidable that some deviations from the standards are allowed. For details see 2.7.2 and Annex G. In case the products are O-rings a more product specific approach is chosen. For such products the procedure as mentioned in Annex H has to be followed.

In cases where test sheets are used, the test pieces for tensile strength and elongation at break, as well as those for tear resistance, shall be taken perpendicular to the direction of milling and compression moulding or the direction of injection moulding flow.

2.8 Marks to be applied

The rubber products must carry the following marks and indications in a clear, legible and indelible way:

- name of manufacturer or the deposited trade mark;
- Kiwa (or Kiwa word mark);
- the nominal dimension or dimensions;
- the nominal hardness;
- the year of manufacturing and preferably the quarter;
- the type of rubber applied by means of the letter codes below.

natural rubber	:	NR
isoprene rubber	:	IR
styrenebutadiene rubber	:	SBR
nitrilebutadiene rubber	:	NBR
chloroprene rubber	:	CR
ethylenepropylenecopolymer	:	EPM
ethylenepropylenedieneterpolymer	:	EPDM
isoprenebutadiene rubber (butyl)	:	IIR

- temperature class (I, II or III)
- on products from blends, the letter B ("blend") shall be placed behind de first letter code;
- the ozone resistance class (“Ozone I, II or III”). For rubber rings made from two compounds the compound with the lowest class is valid.

If the dimensions of the products are such that the indications applied to them may impair the product, the products may be marked per package in consultation with the manufacturer, the buyer and the inspection body.
Products produced by cutting or die cutting out of sheets may be marked per package.

3 Quality system requirements

3.1 General

This chapter contains the requirements that have to be fulfilled by the manufacturer's quality system.

3.2 Manager of the quality system

Within the manufacturer's organisational structure an employee must be appointed who is in charge of managing the quality system.

3.3 Internal quality control/quality plan

As part of the quality system the manufacturer must implement an internal quality control schedule (IQC-scheme).

In this IQC-scheme the following must be demonstrably recorded:

- which aspects are inspected by the manufacturer;
- according to which methods these inspections are carried out;
- how often these inspections are carried out;
- how the inspection results are registered and stored.

This IQC-schedule shall be in the format as shown in the annex. The schedule must be detailed in such a way that it provides Kiwa sufficient confidence that requirements will be continuously fulfilled.

3.4 Procedures and work instructions

The manufacturer must be able to submit:

- procedures for:
  - the handling of non-conforming products;
  - corrective actions in case non-conformities are found;
  - the handling of complaints regarding the products and / or services supplied;
- the work instructions and inspection sheets in use.
- instructions for packaging and closing off of products during storage and transport.

3.5 External inspection

The manufacturer's quality system shall be assessed by Kiwa with regard to at least the aspects mentioned in the Kiwa-Regulations for Product Certification.
The Central Board of Experts will determine the inspection frequency. At the time of validation of this evaluation guideline this frequency has been fixed at 4 inspection visits per year.

3.6 Quality control of rubber products

The following routine tests shall be carried out according to the test methods mentioned in this evaluation guideline:
a. dimensions
b. surface imperfections
c. hardness
d. tensile strength and elongation at break
e. compression set for 24 hours at 70 °C

The product control tests shall be carried out on lots of finished components using sampling procedures in accordance with either:
a) ISO 2859-l with a specified inspection level of S2 and an AQL of 2,5 % for attributes; or
b) ISO 3951 with a specified inspection level of S3 and an AQL of 2,5 % for variables.

These requirements do not preclude the use by the manufacturer of more stringent combinations of inspection levels and AQL values from ISO 2859-1 and ISO 3951.

4 Summary of tests and inspections

This chapter contains a summary of tests and inspections to be carried out during:
Initial evaluation: the investigation necessary in order to determine whether all requirements of the evaluation guideline are fulfilled,
Inspection visit: the surveillance inspections carried out after issue of the certificate in order to determine whether the certified products continuously fulfil the requirements of this evaluation guideline. The inspections are carried out according to the frequency indicated.
Inspection of the quality system: inspection with regard to the correct implementation of the IQC-schedule and procedures.

4.1 Test matrix

Description of requirement	Article BRL	Tests within the scope of		
		Initial evaluation	Surveillance by Kiwa after issue of the certificate	
			Inspection[1)]	Frequency
Toxicological requirements	2.3.2	X	X	1x year
Smell and taste	2.3.3	X	X	1x year
Resistance to chemicals	2.3.4	X	X[2)]	1x year
Effect of rubber products on the pipe and/or fitting material	2.3.5	X	X[2)]	1x year
Appearance	2.4.1	X	X	1x year
Homogeneity	2.4.2	X	X	1x year
Dimensions and volume	2.4.3	X	X	1x year
Hardness	2.5.2	X	X	1x year
Hardness after ageing	2.5.2.4	X	X	1x year
Mechanical properties	2.5.3	X	X	1x year
Compression set	2.5.4	X	X	1x year
Compression set in water (class III rubbers only)	2.5.5	X	X	1xyear
Stress relaxation	2.5.6	X (100d)	X (7d)	1x year
Resistance to ozone attack	2.5.7	X	X	1x year
Swelling in water	2.5.8	X	X	1x year
Behaviour at elongation	2.6.2	X	X	1x year
Marks to be applied	2.8	X	X	1x year

6) All product properties which can be determined within the inspection time (maximum 1 day) are determined by the inspector or by the certificate holder in presence of an inspector. When this is not possible arrangements, how inspection will take place, will be made for this aspect between the certification body and the certificate holder.
7) This aspect is compared on the basis of IKB inspection (indirectly by means of direct related parameters) with the aspect found for approval

5 Agreements on the performance of certification

5.1 General

This chapter contains the by the Board of Experts elaborated agreements on the performance of certification by Kiwa.

5.2 Certification staff

The staff involved in the certification process is sub-divided into:

- Certification engineers: in charge of carrying out the pre-certification tests and assessing the reports of the inspectors;
- Inspectors: in charge of carrying out external inspections at the supplier's works;
- Decision-makers: in charge of taking decisions in connection with the pre-certification tests performed, continuing the certification in connection with the inspections performed and taking decisions with regard to corrective actions.

5.2.1 Qualification requirements

The following qualification requirements have been set by the Board of Experts for the subject matter of this Evaluation Guideline.

Certification staff	Education	Experience
Certification expert	Higher-level professional education in one of the following disciplines: • Technical	2 year
Inspector	Intermediate-level professional education in one of the following disciplines: • Technical	1 year
Decision-maker	Higher-level professional education in one of the following disciplines: • Technical	1 year management experience

5.3 Frequency of external inspection visits

At the time of validation of this evaluation guideline the frequency has been fixed at four inspection visits per year.

6 List of mentioned documents

6.1 Standards / normative documents:

NEN-ISO 10508	Plastics piping systems for hot and cold water installations - Guidance for classification and design
NEN-EN 681-1	Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanised rubber
Amendment sheet NEN-EN 681-1/A1	Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanised rubber
Amendment sheet NEN-EN 681-1/A2	Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanised rubber
Corrigendum NEN-EN 681-1/C1	Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanised rubber
NEN-EN 806-2	Specification for installations inside buildings conveying water for human consumption – Part 2: Design
NEN EN 1420-1	Influence of organic materials on water intended for human consumption - Determination of odour and flavour assessment of water in piping systems – Part 1: Test method
NEN EN 1622	Water analysis - Determination of the threshold odour number (TON) and threshold flavour number (TFN)
NEN EN 13052-1	Influence of materials on water intended for human consumption - Organic materials - Determination of colour and turbidity of water in piping systems - Part 1: Test method
NEN EN ISO 7887	Water quality - Examination and determination of colour
NEN-ISO 34-2	Determination of the tear strength of small test pieces (Delft test pieces)
NEN-ISO 37	Rubber, vulcanised or thermoplastic - Determination of tensile stress - strain properties
NEN-ISO 48	Rubber, vulcanised or thermoplastic - Determination of hardness (hardness between 30 and 85 IRHD)
NEN-ISO 188	Rubber, vulcanised – Accelerated ageing or heat-resistance tests
NEN-ISO 813	Rubber, vulcanised - Determination of adhesion to metal: one-plate method
NEN-ISO 815	Rubber, vulcanised or thermoplastic - Determination of compression set at ambient, elevated or low temperatures
NEN-ISO 1431-1	Rubber, vulcanised or thermoplastic - Resistance to ozone cracking - Part 1: Static strain test

NEN-ISO 1817	Rubber, vulcanised – Determination of the effect of liquids
NEN-ISO 2285	Rubber, vulcanised or thermoplastic - Determination of tension set at normal and high temperatures
NEN-ISO 3302	Rubber - Dimensional tolerances for use with products
NEN-ISO 3384	Rubber, vulcanised or thermoplastic – Determination of stress relaxation in compression at ambient and at elevated temperatures
NEN-EN 3601-1	Hydrauliek en pneumatiek - O-ringen - Deel 1: Inwendige middellijnen, doorsneden , toleranties en codes voor de aanduiding
NEN-ISO 3601-3	Fluid power systems - O-rings - Part 3: Quality acceptance criteria
NEN-ISO 3865	Rubber, vulcanized or thermoplastic - Methods of test for staining in contact with organic material
NEN-ISO 4661	Rubber, vulcanised or thermoplastic – Preparation of samples and test pieces
NEN-ISO 6914	Rubber, vulcanized; Determination of ageing characteristics by measurement of stress at a given elongation
NEN-ISO 9691	Rubber – Recommendation for the workmanship of pipe joint rings – Description and classification of imperfections
NEN-ISO 23529	Rubber – General procedures for preparing and conditioning test pieces for physical test methods

7 Annex A: Summary of the material requirements for rubber products and rubber sheets

Table 7: Summary of the requirements for class I rubber products

Property	Units	Method	Requirement for hardness classes					
			40	50	60	70	80	90
Hardness (a, b)*	IRHD	ISO 48	± 5	± 5	± 5	± 5	± 5	± 5
Tear resistance minimum	N	ISO 816	20, 25 or 55	20, 25 or 55	20, 25 or 55	20, 25 or 55	20, 25 or 55	20, 25 or 55
Tensile strength on sheet test piece	MPa	ISO 37	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9
Tensile strength on product test piece b)*	MPa	ISO 37	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9
Elongation at break on sheet test piece	%	ISO 37	≥ 400	≥ 375	≥ 300	≥ 200	≥ 125	≥ 100
Elongation at break on product test piece b)*	%	ISO 37	≥ 400	≥ 375	≥ 300	≥ 200	≥ 125	≥ 100
Ageing 168 hours in air at 70°C		ISO 188						
- change hardness	IRHD	ISO 48	+8/-5	+8/-5	+8/-5	+8/-5	+8/-5	+8/-5
- change tensile strength	%	ISO 37	-20	-20	-20	-20	-20	-20
- change elongation	%	ISO 37	+10/-30	+10/-30	+10/-30	+10/-30	+10/-30	+10/-30
Compression set	%	ISO 815						
- 72 h, -10°C		EN 681	≤ 40	≤ 40	≤ 50	≤ 50	≤ 60	≤ 60
- 72 h, 23°C		Annex B	≤ 12	≤ 12	≤ 12	≤ 15	≤ 15	≤ 15
- 24 h, 70°C (b*)			≤ 20	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20
Stress relaxation	%	ISO 6914						
- 168 h at 23°C (b*)		or	≤ 13	≤ 14	≤ 15	≤ 16	≤ 17	≤ 18
- 100 days at 23°C		ISO 3384	≤ 19	≤ 20	≤ 22	≤ 23	≤ 25	≤ 26
Ozone resistance	-	ISO						
Class I		1431/1	20 %	20 %	20 %	20 %	15 %	10 %
120h, 40°C, 50 pphm			No cracks	No cracks	No cracks	No cracks	No cracks	No cracks
Class II			20 %	20 %	20 %	20 %	15 %	10 %
48 h, 40°C, 50 pphm			No cracks	No cracks	No cracks	No cracks	No cracks	No cracks
Class III			20 %	20 %	20 %	20 %	15 %	10 %
48 h, 40°C, 25 pphm			No cracks	No cracks	No cracks	No cracks	No cracks	No cracks
Swelling in water	%	ISO 1817						
- 168 h at 70°C	(v/v)			+8/-1	+8/-1	+8/-1	+8/-1	+8/-1

a) When the customer or the type of construction demands such the tolerance range can be ± 3 IRHD.
b) Properties marked with (*) will be determined for a (reduced) test on product test pieces.

Table 8: Summary of the requirements for class II rubber products

Property	Units	Method	Requirement for hardness classes				
			50	**60**	**70**	**80**	**90**
Hardness (a,b)*	IRHD	ISO 48	± 5	± 5	± 5	± 5	± 5
Tear resistance, minimum	N	ISO 816	20, 25 or 55	20, 25 or 55	20, 25 or 55	20, 25 or 55	20, 25 or 55
Tensile strength on sheet test piece	MPa	ISO 37	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9
Tensile strength on product test piece (b)*	MPa	ISO 37	≥ 9	≥ 9	≥ 9	≥ 9	≥ 9
Elongation at break on sheet test piece	%	ISO 37	≥ 250	≥ 200	≥ 150	≥ 100	≥ 100
Elongation at break on product test piece (b)*	%	ISO 37	≥ 250	≥ 200	≥ 150	≥ 100	≥ 100
Ageing 168 hours in air at 125°C		ISO 188					
- change hardness	IRHD	ISO 48	+8/-5	+8/-5	+8/-5	+8/-5	+8/-5
- change tensile strength	%	ISO 37	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20
- change elongation	%	ISO 37	+10/-30	+10/-30	+10/-30	+10/-40	+10/-40
Compression set	%	ISO 815					
- 72 h, 23°C		EN 681	≤ 15	≤ 15	≤ 15	≤ 15	≤ 15
- 24 h, 125°C (b*)		Annex B	≤ 20	≤ 20	≤ 20	≤ 20	≤ 20
Stress relaxation	%	ISO 6914					
- 7 days at 23°C (b*)		or	≤ 15	≤ 15	≤ 15	≤ 18	≤ 18
- 7 days at 125°C		ISO 3384	≤ 30	≤ 30	≤ 30	≤ 30	≤ 30
Ozone resistance	-	ISO					
Class I- 120 h, 40°C, 50 pphm		1431/1	20 % No cracks	20 % No cracks	20 % No cracks	15 % No cracks	10 % No cracks
Class II- 48 h, 40°C, 50 pphm			20 % No cracks	20 % No cracks	20 % No cracks	15 % No cracks	10 % No cracks
Class III- 48 h, 40°C, 25 pphm			20 % No cracks	20 % No cracks	20 % No cracks	15 % No cracks	10 % No cracks
Swelling in water	% (v/v)	ISO 1817					
- 168 h at 95°C			+8/-1	+8/-1	+8/-1	+8/-1	+8/-1

a) When the customer or the type of construction demands such the tolerance range can be ± 3 IRHD.
b) Properties marked with (*) will be determined for a (reduced) test on product test pieces.

Table 9: Summary of the requirements for class III rubber products

Property	Units	Method	Requirement for hardness classes		
			60	70	80
Hardness (a,d*)	IRHD	ISO 48	± 5	± 5	± 5
Tear resistance	N	ISO 816	≥ 20	≥ 20	≥ 20
Tensile strength on sheet test piece (d*)	MPa	ISO 37	≥ 9	≥ 9	≥ 9
Tensile strength on product test piece (b*)	MPa	ISO 37	≥ 9	≥ 9	≥ 9
Elongation at break on sheet test piece (d*)	%	ISO 37	≥ 200	≥ 150	≥ 100
Elongation at break on product test piece (b*)	%	ISO 37	≥ 175	≥ 130	≥ 100
Ageing 168 hours in air at 125°C (d*)		ISO 188			
-change hardness	IRHD	ISO 48	+8/-5	+8/-5	+8/-5
-change tensile strength	%	ISO 37	≤ 20	≤ 20	≤ 20
-change elongation	%	ISO 37	+10/-30	+10/-30	+10/-30
Compression set	%	ISO 815			
- 72 h, 23°C			≤ 15	≤ 15	≤ 15
- 24 h, 125°C b*)			≤ 20	≤ 20	≤ 20
Stress relaxation	%	ISO 6914			
- 168 h at 23°C (b*)		or	≤ 15	≤ 15	≤ 15
- 100 days at 23°C		ISO 3384	≤ 22	≤ 22	≤ 22
- 168 h at 125°C (e*)			≤ 30	≤ 30	≤ 30
- 3 weeks at 150°C (e*)			≤ 55	≤ 55	≤ 55
Ozone resistance	-	ISO			
Class I- 120 h, 40°C, 50 pphm		1431/1	20 % No cracks	20 % No cracks	15 % No cracks
Class II- 48 h, 40°C, 50 pphm			20 % No cracks	20 % No cracks	15 % No cracks
Class III- 48 h, 40°C, 25 pphm			20 % No cracks	20 % No cracks	15 % No cracks
Volume change	%	ISO 1817			
- 168 h, water at 95°C			+8/-1	+8/-1	+8/-1
Compression set in water		ISO 815			
- 10000 h 110 °C (b, c)*	%	EN 681	≤ 40	≤ 40	≤ 40
(- 3000 h 110 °C)	%	Annex B	(≤ 20 / 30 c)	(≤ 20 / 30 c)	(≤ 20 / 30 c))

a) When the customer or the type of construction demands such the tolerance range can be ± 3 IRHD.
b) Properties marked with (*) will be determined for a (reduced) test on product test pieces.
c) If the result after 3000 hours is below 20% the test can be stopped and the material is OK for this aspect; if the result after 3000 hours is above 30% the test can be stopped and the material is not OK for this aspect.
d) Requirements for swelling seals are given in table 10
e) This requirement and test does not comply for swelling seals.

Table 10: Requirements for swelling seals only, class III

Property	Units	Method	Requirement
Aging 3 weeks at 125 °C		ISO 188	
- change hardness	IRHD		+10/-5
- change tensile strength	%		≤ 25
- change elongation at break	%		+10/-40
Changes after storage in hot water	%	ISO 1817	+15/+5
10 weeks at 150 °C	IRHD	ISO 48	-5 / +5

8 Annex B: Categorisation of O-ring sizes

Table 11: Categorisation of O-ring sizes in groups

Groups of products	Cross section diameter	
	Minimum [mm]	Maximum [mm]
A	0,8	1,5
B	1,5	2,5
C	2,5	5
D	5	8
E	8	12
F	12	20
G	20	30
H	> 30	-

9 Annex C: Explanations (informative)

9.1 Explanations

9.1.1 Permanent seal under load

When applying seals in pipe joints it must be kept in mind that under the load and the own weight of the pipe, after a certain lapse of time the deformation of the ring may be such that the seal is no longer sufficient on the opposite side. The pipe manufacturer is recommended to take measures to prevent this.

9.1.2 Recommendations of a general nature

9.1.2.1 Percentage of compression

The extent, to which different types of rubber are compressed in the joints, varies. General rules cannot be given. The following factors affect the acceptable percentage of compression:

- the type of rubber and the way the rings are manufactured;
- the construction of the joint;
- the conditions (temperature, pressure, medium and additional assembly tensions).

Therefore, the type of rubber to be used must always be determined in consultation with the buyer, the pipe manufacturer and the rubber manufacturer.

9.1.2.2 Additional requirements

Sometimes it is necessary to have additional requirements, e.g. with regards to rigidity. Also, it may be useful to demand better resistance against ozone when long-term storage under extreme conditions is planned.

If additional requirements are judged necessary, the manufacturer of the pipes or attachments shall inform the rubber manufacturer and the inspection body of such requirements.

9.1.2.3 Application

TR 7620 can be used as a first reference of application of the various types of rubber.

9.1.3 Resistance against detoration caused by micro-organisms

Research carried out in The Netherlands and in many other countries has shown that very often in the long run natural rubber and isoprene rubber are attacked by micro-organisms and finally decomposed.

On the other hand, it is also known that in some applications no deterioration takes place, even after many years of use. It has, however, not yet been possible to determine which rubber recipes and/or conditions are responsible for this phenomenon. So far, no method is known to predict in a relatively short term whether a certain type of rubber is going to be deteriorated by micro-organisms in the long run.

Synthetic rubber (except for isoprene rubber) is not - or not known to be - attacked by micro-organisms.

Because of the reasons cited above, we recommend to use synthetic rubber wherever possible, unless the mechanical properties of natural rubber or isoprene rubber are decisive. When using natural or isoprene rubber it is important that there will be as little contact as possible between rubber and water at the joint.

We stress that the properties of natural rubber mentioned above will also appear in compounds containing these types of rubber.

9.2 Recommendations for the storage and use of rubber products

During storage and use of rubber products, appropriate measures must be taken to shield off environment influences (light, air, humidity and temperature).

The preservation of quality is aided as follows.

9.2.1 Storage in a warehouse or temporary indoor storage

a. Preferably, use a separate and closed room:
   - screened against artificial and day light;
   - ventilated with air containing as little ozone as possible (ozone is produced e.g. by generators, electric motors and arc welding);
   - with an ambient temperature between 5 and 25 °C;
   - with a relative humidity between 40% and 70%;
   - free of oil, grease and other hydrocarbons and/or vapours emanating from these.

b. Keep the storage time as short as possible.
   Apply the "first in - first out" method.
   In the case of indoor storage for a period exceeding 6 months, extra measures are required despite good conditions. These include airtight package, female ends of pipes, attachments or fittings.
   Hanging or stacking may cause extra load -pressure, elongation or tensile- and thus the formation of cracks.

9.2.2 Outdoor transport and storage

It is recommended to protect the rubber products as much as possible during transport or outdoor storage.

a. Keep exposure to influences of weather as short as possible and certainly protect against frost (temperature below -5 °C).
b. In the case of exposure to outdoor conditions for a period exceeding 2 weeks, extra measures are required such as packing, covering and screening against weather influences.
   Always prefer indoor storage or covered outdoor storage.

9.3 Processing

Some general preventive rules for processing are:

a. Keep attachments and ends free of dust, sand and dirt in order to prevent damage at assembly.
b. At assembly, loose products shall be processed directly from the - possibly temporary - package.
c. Rubber products are susceptible to mechanical damage caused by sharp objects, burrs, cutting edges and undue elongation, distortion and forcing. Check the male ends of the pipes for burrs etc. prior to assembly.
d. In the case of repeated of long term arc welding in ambient air, the rubbers shall be protected.
e. Avoid contact with oil, grease, petrol, etc. and their vapours.
f. Cleaning with chemical products varies for many applications; follow the instructions of the manufacturer.
g. Application of lubricants shall take place strictly according to the instructions of the manufacturer or supplier.
h. After processing, make sure the joint is not exposed to frost; therefore cover in time.

9.4 Products in aboveground installations

Rubber products in aboveground installations or in permanent contact with atmospheric conditions require extra attention with regard to long term resistance.
Not all rubber compounds and/or types are suitable for long term aboveground applications. The choice of a rubber compound shall therefore be well-considered.

10 Annex D: Example Kiwa Certificate

Partner for progress

Certificate

Number	12345	Replaces	Annex 1
Issued		Dated	

Product certificate

K 175034/02

Based on pre-certification tests as well as periodic inspections by Kiwa, the products referred to in this certificate and marked with the Kiwa-mark as indicated under 'marking', manufactured by

Supplier

may, on delivery, be relied upon to comply with the Kiwa evaluation guideline BRL-K17504/02 "Vulcanised rubber products for drinking water applications".

Kiwa N.V.

ing. B. Meekma
Director
Certification and Inspection

This certificate is issued in accordance with the Kiwa Regulations for Product Certification and consists of … pages.
Publication of the certificate is allowed.

Company

Kiwa N.V.
Certification and Inspection
Sir W. Churchill-laan 273
P.O. Box 70
2280 AB Rijswijk
Telephone +31 70 41 44 400
Fax +31 70 41 44 420
Internet www.kiwa.nl

Vulcanised rubber products for drinking water applications

PRODUCT SPECIFICATION

Technical specification of the product
General
Vulcanised rubber products for drinking water applications according to BRL-K17504/01 "Vulcanised rubber products for drinking water applications".
Specification
The rubber seals mentioned in the table below belong to this product certificate.

Type of rubber and compound	Hardness in IRHD	Nominal dimensions

Details of the rings have been recorded in drawing lists which are part of the IQC/schedule. Kiwa has certified this list. A copy can be claimed at the producer.

Toxicological requirements
Approval:
This product is approved on the basis of the requirements set in the "Regeling materialen en chemicaliën leidingwatervoorziening" ("Rege Materials and Chemicals for Drinking Water Supplies"; published in Staatscourant).
ATA criteria:
The ATA product certification is based on two main criteria. It shou permanently comply with:

- The product recipe approved during the assessment procedure The recipe is laid down in the for confidentiality reasons undisclosed appendix 1A to the certification agreement K...Th recipe is not to be changed without prior approval by Kiwa according to the Kiwa-ATA-approval procedure.
- Specific ATA-product requirements, laid down in appendix 1A to the certification agreement K..... For confidentiality reasons this appendix 1A is not public.

Marking
The products are marked with the Kiwa-mark.
The marking is distinctly and durable.
Location of the mark: on each rubber ring*.

Compulsory indications:
certification mark "Kiwa";
name of manufacturer or the deposited trade mark;
the nominal dimensions;
the nominal hardness;
the year of manufacturing and preferably the quarter;
the type of rubber applied by means of the letter codes below or by means of the colour mentioned between brackets, to be applied by means of coloured rubber vulcanised together with the product:

natural rubber:	NR
isoprene rubber:	IR
styrene butadiene rubber:	SBR
nitrilebutadiene rubber:	NBR
chloroprene rubber:	CR
ethenepropylenecopolymer:	EPM
ethenepropylenedienetercopolymer:	EPDM
isoprenebutadienerubber (butyl):	IIR

temperature class (I, II or III)
on seals from blends, the letter B ("blend") shall be placed behind de first letter code;
the ozone resistance class ("Ozone I, II or III* ").

* If the dimensions of the products are such that the indications applied to them may impair the product, the products may be marked per package in consultation with the manufacturer, the buyer and the inspection body.
Products produced by cutting or die cutting out of sheets may be marked per package.

PROCESSING

The supplier shall provide installation instructions in the Dutch language. A reference to these instructions shall be made at or near the packaging. The instructions must contain specific information with regard to storage, transport, processing temperature and construction of the joints.

RECOMMENDATIONS FOR CUSTOMERS

1. Check at the time of delivery whether:
   1.1 the producer has delivery in accordance with the agreement;
   1.2 the mark and the marking method are correct;
   1.3 the products show no visible defects as a result of transport etc.
2. If you should reject a product on the basis of the above, please contact:
   2.1 **Company name** and, if necessary,
   2.2 Kiwa.
3. Consult the producer's processing guidelines for the proper storage and transport methods.
4. Check whether this certificate is still valid by consulting the Kiwa internet site: www.kiwa.nl.

11 Annex E

Model IQC-scheme

Subjects	Aspects	Method	Frequency	Registration
Raw materials or materials supplied: • recipe sheets • incoming goods inspection raw materials	• Recipe according annex product agreement • Hardness • Tensile strength • Elongation at break	Comparison supplied certificate with agreement NEN-ISO 48 NEN-ISO 37 NEN-ISO 37	Each delivery Each delivery	Entry control document
Production process, production equipment, material: • Procedures • Equipment • Release of product	• Tuning parameters • Maintenance aspects • Dimensions and soundness	Adjustments of machine Maintenance schedule Measuring and visual inspection	Continuously Continuously Start up new product	Digital Work sheet Inspection document
End products	• Soundness • Dimensions • Tensile strength • Tear strength	Visual Measuring NEN-ISO 37 NEN-ISO 815	Continuously Every 3 hours Per day per product per machine	End control Documents
Measuring and testing equipment • Measuring equipment • Calibration	• Proper functioning • Accuracy within range of measurement	During usage Record of non-conformities	Continuously 1 x year	End control document Calibration document
Logistics • Internal transport • Storage • Preservation • Packaging • Identification	• Circumstances in practice • Comparison with order	Comparison with procedure Visual inspection	Continuously	Keep logistical procedures up to date

12 Annex F: Difference between requirements **on raw material and those on products (informative)**

In the table beneath an overview is given on what tests are applicable for each certificate.

	Raw material (sheet)	**Product** [1]
Hardness	**X**	**X**
Tensile strength	**X**	**X**
Elongation at break	**X**	**X**
Compression set in air (Class I rubbers - cold)		
- 72 h at 23°C	**X**	
- 24 h at 70°C	**X**	**X**
- 72 h at -10°C	**X**	
Compression set in air (Class II and III rubbers - hot)		
- 72 h at 23°C	**X**	**X**
- 24 h at 125°C	**X**	
Compression set in water (Class III rubbers only)		
- 3000 h at 110°C	[2]	**X**
- 10000 h at 110°C	[2]	**X**
Swelling in water		
168 h in water at 70°C	**X**	
Stress relaxation		
- 168 h at 23°C	**X**	**X**
- 100 days at 23°C	**X**	
- 72 h at 23°C	**X**	**X**
- 168 h at 125°C	**X**	
- 504 h at 150°C	**X**	
Ozone resistance	**X**	
Strength of bond or weld (if applicable)		**X**

1) When dimensions of products are suitable.
2) Covered by test on product.

13 Annex G: Test pieces from products

Out of end products it is often not possible to prepare test pieces having all the dimensions as prescribed in the standard. Still knowing about the properties of the actual products is useful because they have to function well in practice. Therefore it is decided for this BRL that some deviations with respect to the dimensions are to be allowed.

Most end products are rings. There using a knife the rubber part can be separated from eventually present other materials. From that point further preparation can be done using the techniques given in ISO 23529:2004. By selecting the appropriate shape and part of the product for preparing the test pieces the following things should be kept in mind:

- For hardness also small pieces can be used by taking the micro method of ISO 48
- For tensile strength and elongation, ISO 37 gives also smaller test pieces (type 3 and 4) and ring test pieces, but using type 2 is preferred. Furthermore having a constant cross section of the parallel section is the most important. Using thinner test pieces or missing a few parts of the clamping sections will hardly influence the results as long as failure stays within the parallel section. This combined with the possible smaller test pieces make that almost every end product can be tested.
- Compression set is a material property which is not very sensitive to dimensions of the test pieces. Taking rectangular test pieces lead to the same results. Combined with the possibility of stacking up to three layers almost every product can be tested. In case of too thin material available the test pieces can be scaled down to a smaller thickness. Then of course other spacers have to be applied to get a compression of about 25 %. More important then having a compression of exact 25 % is knowing the compressed height exactly. It is known that a compression between 20 and 30 % will lead to the same results.
- For the change in volume the thickness is more important then length or width. Also here it is not really necessary to have complete flat test pieces. Often parts of the full products can be used without having different results.
- For stress relaxation more or less the same applies as with compression set, although here knowing the exact deformation is of no importance at all.
- For ozone resistance it is important to have none machined surfaces. Here, for small products, taking full sections of the products is often better and giving more realistic results then trying to get the test pieces as mentioned in the standard.

For all preparations it goes that after preparation the test pieces should be conditioned at least 16 hours before testing.

14 Annex H: Testing in case the products are O-rings

How to test depends on the size of the rings.

Over 100 x 10 mm
These products are big enough to prepare proper test pieces in accordance with ISO 23529 and annex G. No special instructions are needed.

Between 15 x 2 mm and 100 x 10 mm
These rings are most of the time too small to prepare exact test pieces out of them. However in this case well defined testing is possible on complete rings or sections of complete rings.

- Hardness is measured in micro-IRHD on the rings. Care should be taken to place the device on top of the ring. Normally the highest values are the most accurate as a small misplacement of the device always will lead to a lower value for the hardness.
- Tensile tests can be done on complete rings with the devices mentioned in ISO 37. Most dimensions are best tested using the small clamps. At least 5 rings should be tested.
- Tear resistance is possible with those rings where the cross section is 7 mm or more. In those cases the test pieces can be prepared according to ISO 23529 with only small deviations from the prescribed dimensions. For smaller rings the tear strength has to be carried out on test sheets.
- Compression set can be measured on complete rings or in case the rings are too large for the clamps on sections of the rings. Method is further as given in ISO 815. A small higher value (3 to 5 %) can be the result but normally there will be enough distance of the limits.
- Stress relaxation at compression. Here goes the same as for compression set although here no higher values are found.
- Ozone can be done by either stretching the cut open parts of the rings or by stretching the complete rings by mounting them on a thorn in such a way that the required elongation is obtained.
- Swelling can be done on complete rings or on section in those cases that the complete rings are too big.