

Concept Evaluation Guideline

for the IGWP product certificate for
vulcanised rubber pipe joint seals
for waste water and cold drinking water
piping systems

Approved for critics by Polish BoE Plastics dated 24 -08--2009

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Preface Kiwa

This Polish Evaluation Guideline has been prepared by the Board of Experts IGWP, in which the parties interested in the field of vulcanised rubber pipe joint seals for waste water pipes and cold drinking water pipes, are represented. This Board of Experts also guides the performance of certification and adjusts this evaluation guideline where necessary. Wherever the term 'Board of Experts' is used in this evaluation guideline, the above-mentioned Board of Experts is meant.

Kiwa will use this Polish Evaluation Guideline in conjunction with the Kiwa Polish Regulations for Product Certification. These Regulations detail the methods employed by Kiwa for conducting the necessary investigations prior to issuing the product certificate and the method of external control.

Binding declaration

This evaluation guideline is declared binding by Kiwa per, 2009

Specific additional information

The requirements in this evaluation guideline cover the mechanical requirements in EN 681-1 for the applications WA and WC.

In this Guideline 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.

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Introduction

1.1 General

This Evaluation Guideline contains all relevant requirements on the basis of which Kiwa issues and maintains a IGWP Product Certificate for vulcanised rubber pipe joint seals for waste water and drinking water pipes.

During the execution 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

The products are intended to be applied in piping systems for the transport of waste water or cold drinking water. Joints are both those between pipes and those between pipes and fittings. 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 of use:

- I Cold potable water supply at temperatures up to 50 °C.
- II Cold non-potable water supply, drainage sewerage and rainwaterpipes, continuous flow up to 45 °C and intermittent flow up to 95 °C.

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 seals afterwards. Having such a certificate will reduce the tests needed to be carried out on the actual products.

1.3 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 for the IGWP Quality mark

1.4 Certificate

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

2 Terminology

2.1 Supplier

The party responsible for ensuring that the design of products continuously fulfils the requirements of this evaluation guideline.

2.2 IQC-scheme

A description of the quality inspections carried out by the supplier as part of his quality system.

3 Requirements and determination methods

3.1 General

In the next chapters the requirements and test methods are embodied to which rubber seals for waste water or cold drinking water pipe joints have to comply to.

3.1.1 Types of rubber seals

3.1.1.1 Solid rubber seals

The rubber should fulfil the requirements of this Evaluation Guideline in paragraph 3.4 and 3.5. Joints should also fulfil the requirements in paragraph 3.6.1 and 3.6.2.

3.1.1.2 O-rings

The rubber should fulfil the requirements of this Evaluation Guideline in paragraph 3.4 and 3.5. Joints should also fulfil the requirements in paragraph 3.6.1 and 3.6.2.

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.

3.1.1.3 Rubber seals combining two different rubber compounds (i.e. a hard and a soft rubber)

Both rubbers should fulfil the requirements of this Guideline. The adhesion between the two rubbers should fulfil the requirements of paragraph 3.6.

In cases where one of the rubbers is meant to be a kind of back up ring, only the rubber for the seal should fulfil all requirements. The rubber used for the back up function should fulfil the requirements with respect to the toxicological aspects (3.3.2), smell and taste (3.3.3) and the mechanical properties (3.5.3). The adhesion between the two rubbers should fulfil the requirements of paragraph 3.6.

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.

3.1.1.4 Rubbers vulcanized or attached to rigid materials

The rubber should fulfil the requirements of this Guideline in paragraph 3.4 and 3.5. 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.

3.1.1.5 Rubber seals containing other rigid non-adhered materials (eg metal springs)

The rubber should fulfil the requirements of this Guideline in paragraph 3.4 and 3.5.

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).

3.1.1.6 Product containing voids (not porosity)

The rubber should fulfil the requirements of this Guideline in paragraph 3.4 and 3.5.

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 3.5.4 measured at the place of the void.

3.2 Material

3.2.1 General

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

3.2.2 Blends of rubber polymers

Blends of rubber polymers may only be used for the manufacture of rings 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.

3.2.3 Homogeneity

All ingredients shall be mixed in the rubber homogeneously.

3.3 Functional requirements

3.3.1 General

The rubber seals 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 seal and the construction used the materials have to be tested as follows:

3.3.2 Toxicological requirements (drinking water applications only)

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 by the Polish Government.

3.3.3 Resistance to chemicals

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

3.3.4 Effect of rubber seals on the pipe and/or fitting material

The rubber seals 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.

3.4 Appearance, homogeneity, dimensions and volume

3.4.1 Appearance

The appearance of the rubber seals 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 seals.

3.4.2 Homogeneity

The rubber seals 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 seals and cut them in flat slices or parts of about 2 mm in thickness. Stretch the slices around 100% and record the findings.

3.4.3 Dimensions and volume

The nominal measurements - and in case it is relevant for the application - the nominal volume of the rubber seals 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 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 seals first in air and then in water.

3.5 Physical and mechanical properties of the rubber

3.5.1 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.

3.5.2 Hardness

3.5.2.1 General

The hardness shall be suitable for the material and the construction of the joints for which the rubber seals are intended.

Therefore the hardness shall be set in consultation between the manufacturer of the pipes and fittings and the manufacturer of the rubber seals.

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 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 inspection body: the nominal apparent hardness plus the corresponding tolerance, the method of measurement and the place(s) of measurement.

3.5.2.2 Difference in hardness

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

3.5.2.3 Class of hardness

The seals 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

3.5.2.4 Hardness after ageing

After ageing according to ISO 188 for a period of 168 hours at a temperature of 70 ± 2 °C the hardness (see 3.5.2.1) may not have changed by more than $+8/-5$ IRHD.

3.5.2.5 Mechanical properties

Tear resistance measured according to 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 ISO 37 shall, depending on the class of hardness, meet the requirements laid down in table 2B.

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 seals and moulded under conditions which are comparable with those used in production.

After ageing for 168 hours according to ISO 188 at a temperature of 70 ± 2 °C:

- 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 %.

Table 2B: Tensile strength and elongation at break.

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

3.5.3 Compression set

The compression set of the rubber determined according to ISO 815 -1 and -2 (small test pieces) using the test conditions of table 3 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 3: Compression set.

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

3.5.4 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.

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 seal, the measurement shall be carried out as far as possible in the direction of compression of the seal 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 4: Stress relaxation.

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

3.5.5 Resistance to ozone attack

This requirement does not apply to 100 % EPM/EPDM or IIR compounds.

The rubber should show no cracks when tested in accordance with 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.

3.5.6 Swelling in water

The change in volume after immersion for 168 hours at 70°C in accordance with ISO 1817 shall be within the limits -1 and +8% (v/v).

3.6 Properties for special types of products

3.6.1 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 ring.

3.6.2 Behaviour at elongation

3.6.2.1 Massive rings with a weld

Elongate each rubber seal 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.

3.6.2.2 Rings 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.

3.6.2.3 Elongation test for welded rings after ageing

After ageing for 168 hours at $70 \pm 2^\circ\text{C}$ in accordance with ISO 188 the test of 3.6.2.1 or 3.6.2.2 is repeated. When tested the weld or joint shall not crack or contract.

3.7 Sampling, test material and test pieces

3.7.1 Sampling

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

3.7.2 Test material

3.7.2.1 Test pieces from seals

If the dimensions of the rubber seals 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 seals it is allowed and can be necessary to take test pieces with other (smaller) dimensions than those prescribed in the standards. A guideline for this preparation is given in annex G.

3.7.2.2 Test piece of complete seal

In carrying out the tests according to 3.3.3, 3.3.4 and 3.4.1 up to 3.4.3 inclusive a complete rubber seal or an unmachined part of a rubber seal shall be used.

3.7.2.3 Test pieces from test plates

If the dimensions of the rubber seals 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 seals to obtain matching properties. Details with respect to the vulcanisation and the direction of milling shall be given to the inspection body.

3.7.3 Test pieces

The test pieces required shall, in accordance with ISO 23529, be made out of the seals (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 desired that some deviations from the standards are allowed. For details see 3.7.2 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.

3.8 Marks to be applied

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

- name of manufacturer or the deposited trade mark;
- Logo: (or IGWPword mark);
- the nominal dimension or dimensions;
- the nominal hardness;
- application area
- 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
- 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"). For rubber rings made from two compounds the compound with the lowest class is valid.

If the dimensions of the seals are such that the indications applied to them may impair the seal, the seals may be marked per package in consultation with the manufacturer, the buyer and the inspection body.

Seals produced by cutting or die cutting out of sheets may be marked per package.

4 Quality system requirements

4.1 General

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

4.2 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.

4.3 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.

4.4 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.

4.5 Other Quality system requirements

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

5 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.

The table below contains a summary of the tests and inspections to be carried out in the event of certification.

5.1 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
Meting Polish hygiene legislation (*)	3.3.2	X		
Marking on product	3.9	X	X	1x year
Resistance against chemicals	3.3.3	X	X ²⁾	1x year
Effect of rubber seals on the pipe and/or fitting material	3.3.4	X	X ²⁾	1x year
Appearance	3.4.1	X	X	1x year
Homogeneity	3.4.2	X	X	1x year
Dimensions	3.4.3	X	X	1x year
Volume	3.4.3	X	X	1x year
Hardness	3.5.2	X	X	1x year
Hardness after ageing	3.5.2.4	X	X	1x year
Mechanical properties	3.5.3	X	X	1x year
Compression set	3.5.4	X	X	1x year
Stress relaxation	3.5.5	X (100d)	X (7d)	1x year
Resistance against ozone	3.5.6	X	X	1x year
Swelling in water	3.5.7	X	X	1x year
Behaviour at elongation	3.6.2	X	X	1x year

*) These properties are only used for drinking water applications

- 1) 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.
- 2) This aspect is compared on the basis of IQCs inspection (indirectly by means of direct related parameters) with the aspect found for approval

5.2 Evaluation of the quality system

During each inspection visit the quality system of the supplier shall be examined and evaluated.

6 Agreements on the performance of certification

6.1 General

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

6.2 Certification staff

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

- Certification engineers: in charge of evaluating 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.

6.2.1 Qualification requirements for executive staff of CI that fulfil the requirements of EN 45011

The qualification of the executive staff of a CI must fulfil the requirements of chapter 5 of EN 45011.

The way qualification of the staff is performed must be described in the quality manual of the CI.

EN45011	Auditor (A) pre-certification tests and inspections of companies	Inspector (B) factory, field & project visits and follow-up inspections	C person deciding on granting of certificate -uitbreiding
1 Education, general	<ul style="list-style-type: none"> • Relevant tech. thinking and working level comparing to Bachelor (1,2) • Internal training in certification and Kiwa policies • Training in audit skills 	<ul style="list-style-type: none"> • Tech. thinking and working level at vocational education (intermediate level)(2) • Internal training in certification and Kiwa policies • Training in audit skills 	<ul style="list-style-type: none"> • Thinking and working at Bachelor level (2) • Internal training in certification and Kiwa policies • Training in audit skills
2 Education, specific	<ul style="list-style-type: none"> • Training geared towards C.S. (e.g. CB-1, DTA) • Specific courses and training (knowledge and skills) 	<ul style="list-style-type: none"> • Training concentrated on C.S. (e.g. CB-1, DTA) • Specific courses and training (knowledge and skills) 	<ul style="list-style-type: none"> • not applicable, unless Board of Experts has set specific requirements
3 Experience, general	<ul style="list-style-type: none"> • 1 year of relevant working experience with a minimum of 4 tests of which: 1 complete pre-certification test independently, under supervision 	<ul style="list-style-type: none"> • 1 year(3) of relevant working experience with a minimum of 4 tests, 1 of which independently, under supervision 	<ul style="list-style-type: none"> • 4 years of working experience, with a minimum of 1 year of experience with certification
4 Experience, specific	<ul style="list-style-type: none"> • Detailed knowledge of C.S. and 4 tests relating to the specific E.G. or to EGs which are related to each other. 	<ul style="list-style-type: none"> • Detailed knowledge of C.S. and 4 tests relating to the specific E.G. or to EGs which are related to each other 	<ul style="list-style-type: none"> • Basic knowledge of the specific C.S.

6.2.2 Qualification requirements for executive staff of a CI that are in addition set up by the Board of Experts for the subject of this evaluation guideline

No additional requirements are set up by the BoE.

6.2.3 Qualification

Certification staff must be demonstrably qualified by evaluation of education and experience of the above-mentioned requirements. In case qualification takes place on the basis of other criteria, then this has to be recorded in writing.

The authority for qualification rests with:

- Decision-makers: qualification of the certification experts and inspectors;
- Management of the certification body: qualification of the decision-makers.

6.3 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.

In case the quality system of the supplier is certified on the basis of ISO 9001, the frequency is fixed at 2 inspection visits per year.

7 List of mentioned documents

7.1 Standards/ normative documents:

ISO/ICC 17025	General criteria for the operation of testing laboratories
ISO/ICC 17020	General criteria for the operation of various types of bodies performing inspection
EN 45011	General requirements for bodies operating product certification systems
EN 681-1	Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanised rubber
Amendment sheet EN 681-1/A1	Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanised rubber
Amendment sheet EN 681-1/A2	Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanised rubber
Corrigendum EN 681-1/C1	Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanised rubber
EN-ISO/ IEC 17025	General requirements for the competence of testing and calibration laboratories
ISO 34-2	Determination of the tear strength of small test pieces (Delft test pieces)
ISO 37	Rubber, vulcanised or thermoplastic - Determination of tensile stress - strain properties
ISO 48	Rubber, vulcanised or thermoplastic - Determination of hardness (hardness between 30 and 85 IRHD)
ISO 188	Rubber, vulcanised – Accelerated ageing or heat-resistance tests
ISO 813	Rubber, vulcanised - Determination of adhesion to metal: one-plate method
ISO 815 1+2	Rubber, vulcanised or thermoplastic - Determination of compression set at ambient, elevated or low temperatures
ISO 1431-1	Rubber, vulcanised or thermoplastic - Resistance to ozone cracking - Part 1: Static strain test
ISO 1817	Rubber, vulcanised – Determination of the effect of liquids
ISO 2285	Rubber, vulcanised or thermoplastic - Determination of tension set at normal and high temperatures
ISO 3302	Rubber - Dimensional tolerances for use with products
ISO 3384	Rubber, vulcanised or thermoplastic – Determination of stress relaxation in compression at ambient and at elevated temperatures

ISO 3601-3	Fluid power systems - O-rings - Part 3: Quality acceptance criteria
ISO 3865	Rubber, vulcanized or thermoplastic - Methods of test for staining in contact with organic material
ISO 6914	Rubber, vulcanized; Determination of ageing characteristics by measurement of stress at a given elongation
ISO 9691	Rubber - Recommendation for the workmanship of pipe joint rings - Description and classification of imperfections
ISO 23529	Rubber - General procedures for preparing and conditioning test pieces for physical test methods

I Annex A: Summary of the material requirements for rubber seals and rubber sheets

Table 7: Summary of the requirements for rubber seals

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 seal 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 seal 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 1431/1						
Class I			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 seal test pieces.

II Annex B: Classification of O-ring sizes

Table 11: Classification 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	-

III Annex C: Explanations (informative)

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.

1.1.1 Recommendations of a general nature

1.1.1.1 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.

1.1.1.2 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.

1.1.1.3 Application

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

1.1.2 Resistance against deterioration 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.

2. Recommendations for the storage and use of rubber seals

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

The preservation of quality is aided as follows.

1.2.1 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.

1.2.2 Outdoor transport and storage

It is recommended to protect the rubber seals 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.

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 seals shall be processed directly from the - possibly temporary - package.
- c. Rubber seals 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.

4. Seals in aboveground installations

Rubber seals 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.

IV Annex D IGWP product certificate

Number	12345	Replaces
Issued		Dated

Product certificate **Rubber pipe joint seals for waste water / cold drinking water piping systems**

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

Supplier

may, on delivery, be relied upon to comply with the Kiwa evaluation guideline PO 1003 Vulcanised rubber pipe joint seals for waste water pipes and cold drinking water pipes

ing. B. Meekma
Director Certification and Inspection, Kiwa N.V.

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

Kiwa N.V.
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Company



Vulcanized rubber pipe joint seals for waste water / cold drinking water piping systems

PRODUCT SPECIFICATION

Technical specification of the product

General

Vulcanised rubber joint seals for waste water / cold drinking water pipes according to PO 1003 "Vulcanised rubber pipe joint seals for waste water or cold drinking water piping systems".

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 (only for drinking water)

Approval:

This product is approved on the basis of the requirements set in the Polish Legislation

Marking

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

Compulsory indications:
certification mark ;
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:

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

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

* If the dimensions of the seals are such that the indications applied to them may impair the seal, the seals may be marked per package in consultation with the manufacturer, the buyer and the inspection body.

Seals produced by cutting or die cutting out of sheets may be marked per package.

PROCESSING

The supplier shall provide installation instructions in the Polish 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

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

V Annex E

Model IQC-scheme

Remark: this is an example.

Subjects	Aspects	Method	Frequency	Registration
Raw materials or materials supplied: <ul style="list-style-type: none"> • recipe sheets • incoming goods inspection raw materials 	<ul style="list-style-type: none"> • Recipe according annex product agreement • Hardness • Tensile strength • Elongation at break 	Comparison supplied certificate with agreement ISO 48 ISO 37 ISO 37	Each delivery Each delivery	Entry control document
Production process, production equipment, material: <ul style="list-style-type: none"> • Procedures • Equipment • Release of product 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Soundness • Dimensions • Tensile strength • Tear strength 	Visual Measuring ISO 37 ISO 815	Continuously Every 3 hours Per day per product per machine	End control Documents
Measuring and testing equipment <ul style="list-style-type: none"> • Measuring equipment • Calibration 	<ul style="list-style-type: none"> • Proper functioning • Accuracy within range of measurement 	During usage Record of non-conformities	Continuously 1 x year	End control document Calibration document
Logistics <ul style="list-style-type: none"> • Internal transport • Storage • Preservation • Packaging • Identification 	<ul style="list-style-type: none"> • Circumstances in practice • Comparison with order 	Comparison with procedure Visual inspection	Continuously	Keep logistical procedures up to date

VI 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		
- 72 h at 23°C	X	
- 24 h at 70°C	X	X
- 72 h at -10°C	X	
- 72 h at 23°C	X	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
Ozone resistance	X	
Strength of bond or weld (if applicable)		X

1) When dimensions of products are suitable.

VII Annex G: Test pieces from seals (informative)

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 than 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 than 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 than 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.

VIII 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.