**BRL 2013**
October 12, 2016

# Evaluation Guideline

For the KOMO® product certificate of

Vulcanized rubber products for cold and hot non-drinking water applications

Adopted by the CvD LSK d.d. 11-07-2016

Accepted by the KOMO Quality- and Screening Commission d.d. 12-10-2016

# Preface Kiwa

This Evaluation Guideline has been prepared by the Kiwa Board of Experts LSK, in which the parties interested in the field of Vulcanized rubber products for non-industrial applications, 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 Evaluation Guideline in conjunction with the Kiwa 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 the external control.

**Declared in force**
This Evaluation Guideline is declared in force by Kiwa per October 12, 2016.

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2601.30530

# Amendment BRL 2013
## 10 October 2018
## Vulcanised rubber products for cold and hot non-drinking water applications

### General

This amendment is related to Evaluation guideline BRL 2013 “Vulcanised rubber products for cold and hot non-drinking water applications” dated 12 October 2016. Certification Institutes, who are accredited by the Dutch Board of Accreditation and who have a licence contract with Stichting KOMO, will use this amendment in combination with the guideline for handling of new or on-going KOMO product certificates.

This amendment is:

- Approved by the Board of Experts Plastic Piping Systems (LSK) at 16-03-2018
- Accepted by the KOMO Kwaliteits- en Toetsingscommissie at 10-04-2018

**Validity**
This amendment is valid starting 10-10-2018 and will be used in conjunction with the corresponding guideline.
Product certificates issued on the guideline keep their validity.

**Description of the change**
The change of BRL 2013 concerns:

- Adjustment of the requirements with respect to ‘swelling seals’.
- A typo in table 13.

In the BRL the following parts need to be changed:

***4.5.8 Swelling in water***
Replace par. 4.5.8 by:

The change in volume after immersion for 168 hours at 70 °C (class I) or 95 °C (class II and III) or 105 °C (class IV) in accordance with ISO 1817 shall be within the limits -1 and +8% (v/v).
For swelling seals used for class III and IV also the change in volume after immersion for 10 weeks (class III) or 15 weeks (class IV) at 150 °C in accordance with ISO 1817 shall be more than 10% (v/v). After the immersion the samples shall still be intact and it must be possible to handle them without problems for the measurements.
See the annexes F and G for more details about test pieces.

**5.6 Other requirements imposed on the quality system**
Replace ISO/TS 16949 by IATF 16949.

**7.5 Nature and frequency of external inspections**
Replace ISO/TS 16949 by IATF 16949.

Replace chapter 8 by:

# 8. List of mentioned documents

## 8.1 Statutory legislation
Constructive Products Regulation (CPR) EU 305/2011

## 8.2 Other documents
This guideline refers to following documents:

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| | |
|---|---|
| BRL K17504/03:2018 | Evaluation Guideline for the Kiwa product certificate for Vulcanized rubber products for cold and hot drinking water applications |
| BRL KQ17602: 2011 | Evaluation Guideline for the Kiwa product certificate for Vulcanized rubber seals in plastic transport and storage systems for chemical liquids and gaseous fluids for industrial applications |
| BRL 5609: 2014 | Beoordelingsrichtlijn voor het KOMO® productcertificaat voor flexibele leidingsystemen met kunststof binnenbuis voor warm-waterdistributie (see www.komo.nl) |
| EN 681-1:1996+A3:2005 | Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanized rubber |
| ISO 34-2:2015 | Rubber, vulcanized or thermoplastic - Determination of tear strength - Part 2: Small (Delft) test pieces |
| ISO 37:2017 | Rubber, Vulcanized or thermoplastic - Determination of tensile stress - strain properties |
| ISO 48:2010 | Rubber, Vulcanized or thermoplastic - Determination of hardness (hardness between 10 and 100 IRHD) |
| ISO 188:2011 | Rubber, Vulcanized – Accelerated ageing or heat-resistance tests |
| ISO 813:2016 | Rubber, vulcanized or thermoplastic - Determination of adhesion to a rigid substrate - 90° degree peel method |
| ISO 815-1:2014 | Rubber, Vulcanized or thermoplastic - Determination of compression set – Part 1:At ambient or elevated temperatures |
| ISO 815-2:2014 | Rubber, Vulcanized or thermoplastic - Determination of compression set – Part 2:At low temperatures |
| ISO 1431-1:2012 | Rubber, vulcanized or thermoplastic - Resistance to ozone cracking - Part 1: Static and dynamic strain testing |
| ISO 1629:2013 | Rubber and lattices – Nomenclature |
| ISO 1817:2015 | Rubber, vulcanized or thermoplastic - Determination of the effect of liquids |

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| | |
|---|---|
| ISO 2285:2013 | Rubber, vulcanized or thermoplastic - Determination of tension set under constant elongation, and of tension set, elongation and creep under constant tensile load |
| ISO 2859-1:1999/Amd 1: 2011 | Sampling procedures for inspection by attributes -- Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection |
| ISO 3302-1:2014 | Rubber – Tolerances for products – Part 1: Dimensional tolerances |
| ISO 3302-2:2008 | Rubber – Tolerances for products – Part 2: Geometrical tolerances |
| ISO 3384-1:2011 | Rubber, Vulcanized or thermoplastic – Determination of stress relaxation in compression - Part 1: Testing at constant temperature |
| ISO 3601-1:2012 | Fluid power systems - O-rings - Part 1: Inside diameters, cross-sections, tolerances and designation codes |
| ISO 3601-3:2005 | Fluid power systems -- O-rings -- Part 3: Quality acceptance criteria |
| ISO 3865:2005 | Rubber, vulcanized or thermoplastic -- Methods of test for staining in contact with organic material |
| ISO 3951-1:2013 | Sampling procedures for inspection by variables -- Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL |
| ISO 6914:2013 | Rubber, vulcanized or thermoplastic -- Determination of ageing characteristics by measurement of stress relaxation in tension |
| EN-ISO 9001:2015 | Quality management systems -- Requirements |
| ISO 9691:1992 | Rubber – Recommendation for the workmanship of pipe joint rings – Description and classification of imperfections |
| ISO 10508:2006 | Plastics piping systems for hot and cold water installations -- Guidance for classification and design |

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| | |
|---|---|
| IATF 16949: 2016 | Technical Specification Quality management system requirements for automotive production and relevant service parts organisations. |
| EN-ISO/IEC 17020: 2012 | Conformity assessment - General criteria for the operation of various types of bodies performing inspection |
| EN-ISO/IEC 17021-1: 2015 | Conformity assessment - Requirements for bodies providing audit and certification of management systems - Part 1: Requirements |
| EN-ISO/IEC 17024: 2012 | Conformity assessment - General requirements for bodies operating certification of persons |
| EN-ISO/IEC 17025:2005/C1:2007 | General requirements for the competence of testing and calibration laboratories |
| EN-ISO/IEC 17065: 2012 | Conformity assessment - Requirements for bodies certifying products, processes and services |
| ISO 23529:2016 | Rubber -- General procedures for preparing and conditioning test pieces for physical test methods |

Remark:
It is yearly checked if the standards are still up to date. Changes in applicable standards will be published on the service page of the website of the certification body responsible for this evaluation guideline.

***Annex B: Summary of the material requirements for rubber products and rubber sheets***

Replace table 12 by following table (inclusive note)

Table 12: 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 |
| Volume change after immersion in hot water for 10 weeks at 150 °C | % | ISO 1817 | >10* |

* After the immersion the samples shall still be intact and it must be possible to handle them without problems for the measurements.

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## Vulcanised rubber products for cold and hot non-drinking water applications

Replace table 13 by following table

Table 13: Summary of the requirements for class IV rubber products

| Property | Units | Method | Requirement for hardness classes | | |
|---|---|---|---|---|---|
| | | | 60 | 70 | 80 |
| Hardness (c*) | IRHD | ISO 48 | ± 5 | ± 5 | ± 5 |
| Tear resistance | N | ISO 34-2 | ≥ 20 | ≥ 20 | ≥ 20 |
| Tensile strength on sheet test piece (c*) | MPa | ISO 37 | ≥ 9 | ≥ 9 | ≥ 9 |
| Tensile strength on product test piece (a*) | MPa | ISO 37 | ≥ 9 | ≥ 9 | ≥ 9 |
| Elongation at break on sheet test piece (c*) | % | ISO 37 | ≥ 200 | ≥ 150 | ≥ 100 |
| Elongation at break on product test piece (a*) | % | ISO 37 | ≥ 175 | ≥ 130 | ≥ 100 |
| Ageing 336 hours in air at 125 °C (c*) | | ISO 188 | | | |
| -change hardness | IRHD | ISO 48 | +8/-5 | +8/-5 | +8/-5 |
| -change tensile strength | % | ISO 37 | ≤ 20 | ≤ 20 | ≤ 20 |
| -change elongation at break | % | ISO 37 | +10/-30 | +10/-30 | +10/-30 |
| Compression set | % | ISO 815-1 | | | |
| - 72 h, 23 °C | | | ≤ 15 | ≤ 15 | ≤ 15 |
| - 24 h, 125 °C (a*) | | | ≤ 20 | ≤ 20 | ≤ 20 |
| Stress relaxation | % | ISO 6914 | | | |
| - 168 h at 23 °C | | or | ≤ 15 | ≤ 15 | ≤ 15 |
| - 100 days at 23 °C | | ISO 3384-1 | ≤ 22 | ≤ 22 | ≤ 22 |
| - 168 h at 125 °C (a,d*) | | | ≤ 30 | ≤ 30 | ≤ 30 |
| - 8 weeks at 140 °C (d*) | | | ≤ 55 | ≤ 55 | ≤ 55 |
| Ozone resistance (a,e*) | - | ISO 1431/1 | | | |
| Class I strain: | | | 20 % | 20 % | 15 % |
| 120 h, 40°C, 50 pphm | | | f) | f) | f) |
| Class II strain: | | | 20 % | 20 % | 15 % |
| 48 h, 40°C, 50 pphm | | | f) | f) | f) |
| Class III strain: | | | 20 % | 20 % | 15 % |
| 48 h, 40°C, 25 pphm | | | f) | f) | f) |
| Volume change | % | ISO 1817 | | | |
| - 168 h, water at 105 °C | | | +8/-1 | +8/-1 | +8/-1 |
| Compression set in water | | ISO 815-1 | | | |
| - 10000 h 120 °C (a, b*) | % | EN 681 | ≤ 40 | ≤ 40 | ≤ 40 |
| (- 3000 h 120 °C) | % | Annex B | (≤ 20/30 b) | (≤ 20/30 b) | (≤ 20/30 b) |

And replace table 14 by following table (inclusive note)

Table 14: Requirements for swelling seals only, class IV

| Property | Units | Method | Requirement |
|---|---|---|---|
| Aging 5 weeks at 125 °C | | ISO 188 | |
| - change hardness | IRHD | | +10/-5 |
| - change tensile strength | % | | ≤ 25 |
| - change elongation at break | % | | +10/-40 |
| Volume change after immersion in hot water for 10 weeks at 150 °C | % | ISO 1817 | >10* |

* After the immersion the samples shall still be intact and it must be possible to handle them without problems for the measurements.

# Table of Contents

# 1 Introduction

## 1.1 General

The requirements embodied in this Evaluation Guideline (BRL), shall be employed by certification institutes that are accredited by the Dutch Accreditation Council (RvA) and have a licence agreement with the KOMO Foundation when dealing with applications for the issue or maintenance of a product certificate for Vulcanized rubber products for cold and hot non-drinking water applications.

Besides the requirements embodied in this evaluation guideline, certification institutes impose additional requirements in the sense of requirements with regard to general procedures for certification as laid down in the general certification regulations of the respective certification body.

This evaluation guideline replaces BRL 2013 dated 23 August 2012 and amendment dated 31 December 2014.
Product certificates issued on the basis of that evaluation guideline and the amendment loose their validity at most after one year after binding declaration.

During the execution of certification activities, the certification bodies have to fulfil the requirements as laid down in the chapter 'Requirements imposed on the certification body'.

## 1.2 Fields of application

The different types of products which, at least partly, have been manufactured from rubber(s) are intended for use as seals in piping systems for the transport of cold and hot water[1].
The intended systems comprehend plastics, metal and concrete piping, fittings and connectors. The systems are intended for underground as well as above ground applications. Seals for pipes, fittings and connectors made of glass reinforced plastics (GRP) are also included in the scope.
Not covered by this evaluation guideline are:

- rubber connecting elements, like flexible joints, compensators and hoses;
- rubber elements made of cellular rubber or rubber which contains an intermediate layer made of textile or any other material;
- applications in the field of food and feed;
- Vulcanized rubber products for drinking water applications; for these products the Kiwa Evaluation Guideline K17504 is applicable;
- Vulcanized rubber products for piping systems for the transport of special chemicals, or chemicals in varying concentrations, as is the case with industrial waste water.

This evaluation guideline does also refer to some special types of rubber seals. In 4.1.1. the different types of rubber seals have been recorded, such as a hard nose or a hard base seal, a seal with a hard under-layer or with fixation rings.
The products are intended to be applied as sealing elements for non-drinking water. Special types of products are described in more detail in paragraph 4.1.

| | |
|---|---|
| Class I | Non-potable water supply, drainage, sewerage and rainwater systems at temperatures continuously up to 45 °C and intermittently up to 95 °C (see footnote [1]). |
| Class II | Non-potable water supply at temperatures intermittently up to 110 °C, or water supply up to 110 °C in serviceable piping systems (see footnote [2]). |
| Class III | Non-potable hot water circulation systems based on the classification class 2 in ISO 10508. |
| Class IV | District heating, secondary systems with hot water circulation between 75 °C and 95 °C (temperature profile DH2 given in table 1). |

Class I is equal to that used in EN 681-1 for types WC and WG.
Class II is based on the one mentioned in EN 681-1 for types WD and WF. The difference is a limitation with respect to the application area: discontinuously (intermittent) hot or easy serviceable.

[1] For other applications then mentioned here more explicit testing could be necessary to assure the functioning of the seals.

Class III is for the more severe conditions applicable for these systems. Here a continuous temperature of 70 °C is assumed for the system (class 2 of 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. Rubber products that meet the requirements for class III are considered also to be suitable for applications that have temperature/time profiles according to classes 1, 3, 4 and 5 of ISO 10508. Included are non-potable hot water supply at continuously 60 °C, under-floor heating and radiators.
Class IV is for secondary systems of district heating with temperature-time profile class DH2 according to table 1. To set the requirements for this class IV, a lifetime expectation of at least 50 years for a metal piping system is assumed for setting up the tests in this Evaluation Guideline. Rubber products that meet the requirements for class IV are considered also to be suitable for plastics piping systems for district heating class DH1 according to the KOMO® evaluation guideline 5609 part A. The lifetime expectation of plastic piping systems for district heating is limited to at least 30 years.

Other non-potable hot water applications not mentioned here are not excluded. The temperature/time profile and the minimum service life to be covered shall be available in order to compare the equivalent ageing effect of the intended application at a certain constant temperature with that of Class III and IV, using the Arrhenius equation [3]. This provides the information for which class the intended application shall be classified, or that the application is not possible within the scope of this evaluation guideline.

[1] High temperature conditions between 45 °C and 70 °C are limited to max 5% of total lifetime, between 70 °C and 90 °C to max 1% of total lifetime and at 95 °C to max 100 hours
[2] High temperature conditions between 45 °C and 70 °C are limited to max 10% of total lifetime, between 70 °C and 100 °C to max 2% of total lifetime and at 110 °C to max 100 hours

[3] $k = Ae^{-\frac{E_a}{RT}}$ with k = reaction rate; A= a constant; $E_a$ = activation energy (J/mol); R = gas constant (8,314 J/(mol*K)); T = absolute temperature (K)

Table 1. Rubber classes and temperature profiles for hot water applications

| | Rubber class III | | | | | Rubber class IV | |
|---|---|---|---|---|---|---|---|
| Typical application | Hot water supply (60 °C) | Hot water supply (70 °C) | Low temperature under-floor heating (< 65 °C) | Under-floor heating, low temperature radiators | High temperature radiators | District heating, secondary system, plastic piping | District heating, secondary system, metal piping |
| | ISO 10508 class 1 | ISO 10508 class 2 | ISO 10508 class 3 | ISO 10508 class 4 | ISO 10508 class 5 | DH1 | DH2 |
| 20 °C | | | 0,5 year | 2,5 years | 14 years | | |
| 30 °C | | | 20 years | | | | |
| 40 °C | | | 25 years | 20 years | | | |
| 50 °C | | | 4,5 years | | | | |
| 60 °C | 49 years | | | 25 years | 25 years | | |
| 65 °C | | | 100 hours | | | | |
| 70 °C | | 49 years | | 2,5 years | | | |
| 75 °C | | | | | | | 38 years |
| 80 °C | 1 year | 1 year | | | 10 years | 29 years | 3 years |
| 85 °C | | | | | | | 3 years |
| 90 °C | | | | | 1 year | 1 year | 3 years |
| 95 °C | 100 hours | 100 hours | | | | | 3 years |
| 100 °C | | | | 100 hours | 100 hours | 100 hours | 100 hours |

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.
Some additional explanations with regard to these products and their use are given in annex D.

## 1.3 Relation to European Regulation Construction Products (CPR, EU 305/2011)

The harmonised European standard EN 681-1 is applicable to a number of products within the scope of this evaluation guideline. These products are those used in cold or hot water supply and those used for drainage and sewerage systems.

## 1.4 Requirements for conformity assessing bodies

If the supplier submits reports from research bodies or laboratories to show that the requirements of the evaluation guideline are met, then these reports have to be prepared by a body meeting the prevailing accreditation standard , i.e.:

- NEN-EN-ISO/IEC 17020 for inspection bodies;
- NEN-EN ISO/IEC 17021-1 or NEN-EN ISO/IEC 17021 for certification bodies certifying systems;
- NEN-EN-ISO/IEC 17024 for certification bodies certifying persons;
- NEN-EN-ISO/IEC 17025 for laboratories;
- NEN-EN-ISO/IEC 17065 for certification bodies certifying products.

**Remark:**
NEN-EN ISO/IEC 17021-1 is published at the 1st of July 2015 and will replace NEN-EN ISO/IEC 17021. For this replacement a period of 2 years is in force.

The body is deemed to meet these criteria if an accreditation certificate can be submitted which has been issued by the Dutch Accreditation Council (RvA) or an accreditation body with which the Dutch Accreditation Council has concluded a mutual acceptance agreement.
If no accreditation certificate can be submitted, the certification body shall verify whether the accreditation standard has been met.

## 1.5 Product certificate

Based on the KOMO-system applicable to this evaluation guideline, a KOMO® certificate is issued for:

- Product certificate for vulcanized rubber products for cold and hot non-drinking water applications. The claims in this product certificate are based on chapter 4 and 5 (Product requirements and determination methods and Quality system requirements) of this Evaluation Guideline.

On the website of 'Stichting KOMO' (www.komo.nl) the template for product certificates applicable for this evaluation guideline are given. The product certificate to be issued should match.

# 2 Terminology

For definitions in coherence to certification, one is referred to the website of the KOMO foundation (www.komo.nl) and the regulations of the certifying body.

## 2.1 General definitions

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

### *2.1.2 IQC-scheme (Internal Quality Control-scheme)*
A description of the quality inspections carried out by the manufacturer as part of this quality system.

### *2.1.3 Piping system*
The total of pipes, protection pipes, fittings, bends, expansion pieces, valves and other piping components.

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

### *2.2.1 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.

### *2.2.2 Determination methods*
**Initial certification tests:** tests in order to ascertain that all the requirements recorded in the Evaluation Guideline are met.
**Inspection tests:** tests carried out after the certificate has been granted in order to ascertain whether the certified products continue to meet the requirements recorded in the Evaluation Guideline.

## 2.3 Terms and definitions related to service conditions

### *2.3.1 Lifetime*
The time during which the piping system has to function with a certain operating temperature or a combination of temperatures.

### *2.3.2 Cold water temperature ($T_{cold}$)*
Temperature of the cold water with a maximum of 25 °C.

### *2.3.3 Temperature profile*
The most frequently appearing operating temperatures that during 50 years occur during a certain time.

## 2.4 Sealing mechanisms
There are two principles of sealing mechanisms in use, especially for the class III and IV seals:
- 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 and FEPM might seal using this principle.

## 2.5 Rubber compound

A material consisting of a mixture of polymer, fillers, plasticizer, vulcanisation agents and other ingredients.

## 2.6 Symbols

| | |
|---|---|
| T | temperature |
| $T_{cold}$ | cold-water temperature |
| t | time |

# 3 Procedure for obtaining a product certificate

## 3.1 Initial investigation

In order to obtain a KOMO product certificate, the certification institute will conduct an investigation. The initial investigation comprise of:

- Review of the by the supplier supplied or to be supplied documents, at which time is verified if the with the products combined piping system complies with the performance requirements as stipulated in this evaluation guideline.
- Determination of the product characteristics (of compounded products) as documented in this evaluation guideline.
- Evaluation of the installation instructions of the supplier.

## 3.2 Assesment quality system

In order to obtain a KOMO product certificate, the certification institute will conduct an investigation. The initial investigation comprise of:

- Evaluation of the production process;
- Evaluation of the quality system and the IQC-scheme;
- Assessment of the presence and functioning of other required procedures;

A determination has to be made to what extend the quality system is in accordance with the demands as stated in chapter 6 and 7 of this evaluation of this guideline.

## 3.3 Issue of the product certificate

After completion of the initial investigation, the results are presented to the decision-maker. The decision-maker evaluates the results and determines whether the product certificate can be issued or whether additional information and/or investigations are required in order to be able to issue the product certificate.

# 4 Product requirements and determination methods

## 4.1 General

In this chapter the performance requirements imposed on rubber products for non-drinking water applications are included, as well as the determination methods in order to be able to determine whether the requirements are fulfilled. At setting the requirements the uncertainties of the measurements are taken into account. This implies that drawing conclusions whether requirements are fulfilled these uncertainties do not need to be weighted anymore. In case a product is meant to be used for more then one class, for instance for class I and II or for class III and IV or even for all four classes, only testing for the highest class is assumed to be sufficient for the purpose of certification as meant under this evaluation guideline.

### *4.1.1 Types of rubber seals*

#### 4.1.1.1 *Solid rubber products*

The rubber shall fulfil the requirements of this Evaluation Guideline in paragraph 4.3 until 4.5.
Joints shall also fulfil the requirements in paragraph 4.6. In case joints are present in class II, class III or class IV products, such products having a joint shall be used for testing.

#### 4.1.1.2 *O-rings*

The rubber shall fulfil the requirements of this Evaluation Guideline in paragraph 4.3 until 4.5.
Joints shall also fulfil the requirements in paragraph 4.6.
In this Evaluation Guideline test methods for O-rings are included in annex G. In annex C also 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.

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

Both rubbers shall fulfil the requirements of this Evaluation Guideline in paragraph 4.3 until 4.5. The adhesion between the two rubbers shall fulfil the requirements of paragraph 4.6.
In cases where one of the rubbers is meant to be a kind of back up ring, only the rubber for the product shall fulfil all requirements. The rubber used for the backup function shall fulfil the requirements with respect to the mechanical properties (4.5.3). The adhesion between the two rubbers shall fulfil the requirements of paragraph 4.6.

The adhesion between both types of rubber shall 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 shall tear and not detach when it is tried to separate the bond.

#### 4.1.1.4 *Rubbers vulcanized or attached to rigid materials*

The rubber shall fulfil the requirements of this Evaluation Guideline in paragraph 4.3 until 4.5. The adhesion between rubber and the other material shall 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 shall tear and not detach when it is tried to separate the bond.

#### 4.1.1.5 *Rubber products containing other rigid non-adhered materials (e.g. metal springs)*

The rubber shall fulfil the requirements of this Evaluation Guideline in paragraph 4.3 until 4.5.
The non rubber material shall 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 shall 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).

#### 4.1.1.6 *Product containing voids (not porosity)*

The rubber shall fulfil the requirements of this Evaluation Guideline in paragraph 4.3 until 4.5.
Joints shall also fulfil the requirements in paragraph 4.6.
In cases where the part containing the void has to function in the same manner as a solid rubber the complete product shall fulfil the requirements for the compression set as given in section 4.5.4 measured at the place of the void.

## 4.2 Material

### *4.2.1 General*

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

### *4.2.2 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.

### *4.2.3 Homogeneity*

All ingredients shall be mixed in the rubber homogeneously.

## 4.3 Functional requirements

### *4.3.1 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 (non-leaking) 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:

### *4.3.2 Resistance to chemicals*

The rubber seals shall be resistant to any chemicals that waste water and heating water can contain under usual circumstances and in the usual concentrations. If necessary, the resistance to chemicals must be determined according to a procedure suitable for the purpose, see for instance ISO 1817 or the Kiwa evaluation guideline KQ17602. The requirements shall be laid down by mutual agreement of the manufacturer and the buyer.

### *4.3.3 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.

## 4.4 Appearance, homogeneity and dimensions.

### *4.4.1 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.

### *4.4.2 Homogeneity*

The rubber products may not contain foreign bodies and shall be free of cracks, entrapped air, bubbles or other irregularities as described in ISO 9691. For testing a random selection of at least five products shall be taken and they shall be cut in flat slices or parts of about 2 mm in thickness. The slices shall be stretched approximately by 100% and the findings shall be recorded.

### *4.4.3 Dimensions*

The nominal measurements 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 3302-1 or
ISO 3302-2.
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).

## 4.5 Physical and mechanical properties of the rubber

### *4.5.1 General*

Unless stated otherwise, tests shall be carried out at a temperature of 23 °C according to ISO 23529.
The allowed tolerances for all mentioned test durations and test temperatures shall be according to ISO 23529.
For tests carried out at the production location a temperature between 15 °C and 30 °C is allowed.

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

### *4.5.2 Hardness*

#### 4.5.2.1 *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 ± 5 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 certification institute, for approval: the nominal apparent hardness plus the corresponding tolerance, the method of measurement and the place(s) of measurement.

#### 4.5.2.2 *Difference in hardness*

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

#### 4.5.2.3 *Class of hardness*

The products shall have a nominal hardness falling within the range of values of table 2. 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 2.

Table 2 - Class of hardness

| Class of hardness in IRHD | Tolerance range of hardness class in IRHD | Applicable rubber class |
|---|---|---|
| 40 | $\geq$ 36 and $\leq$ 45 | I |
| 50 | $\geq$ 46 and $\leq$ 55 | I, II |
| 60 | $\geq$ 56 and $\leq$ 65 | I, II, III, IV |
| 70 | $\geq$ 66 and $\leq$ 75 | I, II, III, IV |
| 80 | $\geq$ 76 and $\leq$ 85 | I, II, III, IV |
| 90 | $\geq$ 86 and $\leq$ 95 | I, II |

#### 4.5.2.4 *Hardness after ageing*

After ageing according to ISO 188 for a period of 168 hours at a temperature of 70 °C (class I) or 125 °C (class II and III), the hardness (see 4.5.2.1) may not have changed by more than +8/-5 IRHD.

For class IV
After ageing according to ISO 188 for a period of 336 hours at a temperature of 125 °C, the hardness (see 4.5.2.1) may not have changed by more than +8/-5 IRHD.

For swelling products used for class III

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

For swelling products used for class IV

- After ageing according to ISO 188 for a period of 5 weeks at a temperature of 125 °C the change in hardness shall be within the limits -5 and +10 IRHD.
- After immersion for 15 weeks at 150 °C in water in accordance with ISO 1817 the change in hardness shall be within the limits -5 and +5 IRHD.

The products shall have a nominal hardness falling within the range of values of table 2. 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 2.

### *4.5.3 Mechanical properties*

The tear resistance measured according to ISO 34-2 shall be at least 20 N. See annex F.

The tensile strength and elongation at break according to ISO 37 shall, depending on the class of hardness, meet the requirements laid down in table 3B, 3C or 3D.
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 F and H. The test report shall state the test piece that is used (dumbbell type or complete ring).

After ageing for 168 hours according to ISO 188 at a temperature of 70 °C (class I) or 125 °C (class II and III):

- 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. For harder rubbers (> 80 IRHD) the allowed decrease is maximum 40 %.

After ageing for 336 hours according to ISO 188 at a temperature of 125 °C (class IV):

- 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. For harder rubbers (> 80 IRHD) the allowed decrease is maximum 40 %.

For swelling products used for class III and IV, it goes that after ageing according to ISO 188 for a period of 504 hours (class III) or 840 hours (class IV) 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 3B: 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 3C: 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 3D: Tensile strength and elongation at break for class III and class IV 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 |

### *4.5.4 Compression set*

The compression set of the rubber determined according to ISO 815-1 (at ambient or elevated temperatures) or ISO 815-2 (at low temperatures) (small test pieces or O-rings, see annex F and G) using the test conditions of table 4 (A or B) shall not exceed the values given in the table.
The compression set at 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 4A: 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 in 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 4B: Compression set for class II, III and IV rubbers.

| Test conditions | | Maximum permanent deformation in relation to the compression in % |
|---|---|---|
| Temperature °C | Duration of compression in h | |
| 23 | 72 | 15 |
| 125 | 24 | 20 |

### *4.5.5 Compression set in water (class III and class IV rubbers)*

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 (class III) or
120 °C (class IV).
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.

### *4.5.6 Stress relaxation*

The stress relaxation shall be determined in accordance with ISO 3384-1 (compression, method A, cylindrical test pieces or O-rings, see annex F and G) or ISO 6914 (tension, test pieces or O-rings from product group A, see annex C, F and G).
Minimum measurements shall be taken after 3 hours, 1, 3, 7 days for the 7 day test and after 3 hours, 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 5 (A to C).

The 100 days test shall be considered as a type approval test.

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 5A: Stress relaxation for class I rubbers.

| Hardness class IRHD | Stress relaxation in % after (ISO 3384-1 or ISO 6914) | |
|---|---|---|
| | 7 days at 23 °C | 100 days at 23 °C |
| 40 | 13 | 19 |
| 50 | 14 | 20 |
| 60 | 15 | 22 |
| 70 | 16 | 23 |
| 80 | 17 | 25 |
| 90 | 18 | 26 |

Table 5B: Stress relaxation for class II rubbers.

| Hardness class IRHD | Stress relaxation in % after (ISO 3384-1 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 5C: Stress relaxation for class III rubbers.

| Hardness class IRHD | Stress relaxation in % after | | | |
|---|---|---|---|---|
| | (ISO 3384-1 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 |

Table 5D: Stress relaxation for class IV rubbers.

| Hardness class IRHD | Stress relaxation in % after | | | |
|---|---|---|---|---|
| | (ISO 3384-1 or ISO 6914) | | | (ISO 6914) |
| | 7 days at 23 °C | 100 days at 23 °C | 7 days at 125 °C * | 8 weeks at 140 °C * |
| 60, 70, 80 | 15 | 22 | 30 | 55 |

* These tests do not comply to swelling seals.

### *4.5.7 Resistance to ozone attack*

This requirement does not need to be tested for 100% EPM/EPDM, VMQ, FKM, FEPM or IIR compounds.
The rubber shall show no cracks when tested in accordance with ISO 1431-1 method A under conditions as given in table 6A and table 6B. See annex F and G for details about preparing test pieces.
The resistance class to be used shall 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 6).

Table 6A - Resistance to ozone attack

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

Table 6B - Elongation to be used in the ozone test

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

**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 under strain.

**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 shall always take place in sealed packages.

### *4.5.8 Swelling in water*

The change in volume after immersion for 168 hours at 70 °C (class I) or 95 °C (class II and III) or 105 °C (class IV) in accordance with ISO 1817 shall be within the limits -1 and +8% (v/v).
For swelling seals used for class III and IV also the change in volume after immersion for 10 weeks (class III) or 15 weeks (class IV) at 150 °C in accordance with ISO 1817 shall be within the limits +5 and +15% (v/v).
See the annexes F and G for more details about test pieces.

### *4.5.9 Oil resistance*

This is an optional additional requirement, depending on the intended application. For cold water (class I) this requirement is in accordance with that in EN 681-1 for type WG.
The change in volume after immersion in oil No 1 for 72 hours at
70 °C in accordance with ISO 1817 shall be within the limits – 10 % and +10 % (v/v).
The change in volume after immersion in oil No 3 for 72 hours at 70 °C in accordance with ISO 1817 shall be within the limits -10 % and +50 % (v/v).

## 4.6 Properties for special types of products

### *4.6.1 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.

### *4.6.2 Behaviour at elongation*

4.6.2.1 *Solid 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.

4.6.2.2 *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.

4.6.2.3 *Elongation test for welded products after ageing*
After ageing for 168 hours at 70 °C in accordance with ISO 188 the test of 4.6.2.1 or 4.6.2.2 is repeated. When tested the weld or joint shall not crack or contract.

## 4.7 Sampling, test material and test pieces

### *4.7.1 Sampling*
The sample shall be representative for the product to be checked and shall be taken out of a normal production lot.

### *4.7.2 Test material*

4.7.2.1 *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 F.

4.7.2.2 *Test piece of complete product*
In carrying out the tests according to 4.4 a complete rubber product or an un-machined part of a rubber product shall be used.

4.7.2.3 *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.

### *4.7.3 Test pieces*
The test pieces required shall, in accordance with ISO 23529, be made out of the products (see 4.7.2.1). Only in case this is not possible the test pieces may be made out of test sheets (see 4.7.2.3). By preparing test pieces out of actual products it is unavoidable that some deviations from the standards occur. To what extend these are allowed see 4.7.2 and Annex F for the details. In case the products are O-rings a more product specific approach is chosen. For such products the procedure as mentioned in Annex G shall 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.

## 4.8 Certification mark

The following marks and indications must be provided on each product and product packaging in a clear, legible and indelible way:

- name of manufacturer or the deposited trade mark;
- KOMO logo (or KOMO® word mark) with certificate number;
- the nominal dimension or dimensions;
- the nominal hardness;
- the year of manufacturing and preferably the quarter;
- type of rubber applied by means of the letter codes of the nomenclature according to ISO 1629;
- temperature class (I, II, III or IV);
- 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.

# 5 Quality system requirements

## 5.1 General

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

## 5.2 Manager of the quality system

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

## 5.3 Internal quality control/quality plan

The supplier must have an implemented and operational internal quality control scheme in place (IQC-scheme).

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

- materials used in the product
- which aspects are checked 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-scheme shall be derived from the example format as shown in annex A. The scheme must be detailed in such a way that it provides CI sufficient confidence that the requirements of this evaluation guideline are continuously fulfilled.

## 5.4 Management of laboratory- and measure apparatus

The supplier must determine which laboratory- and measure apparatus are needed based on this BRL in order to demonstrate the product fulfils the requirements.

When applicable laboratory- and measure apparatus need to be calibrated at specified intervals.

The supplier needs to validate and register the previous measure results, when at the time of calibration is determined that the laboratory and measure devices are not operating correctly.

The apparatus in question need to be marked in such a way that can be determined what the calibration status is.

The supplier is required to register the calibration results.

## 5.5 Procedures and work instructions

The supplier 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;
- managing work instructions and inspection sheets in use.
- instructions for packaging and closing off of products during storage and transport.

## 5.6 Other requirements imposed on the quality system

In case the quality system of the supplier is certified on the basis of ISO 9001 or ISO/TS 16949, a combination can be made with the IQC-scheme.

## 5.7 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 after 24 hours at 70 °C (class I rubbers) or at 125 °C (class II, III and IV rubbers)

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 3951-1 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 3951-1.

# 6 Summary of tests and inspections

## 6.1 Testmatrix

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

- **Initial tests:** The test to determine if all demands are met as stated in the BRL.
- **Inspection:** the evaluation tests which is held after issuing of the certificate in order to determine if the certified products are meeting the demands continuously; thereby is also noted at what frequency inspections by the certifying institute (CI) are needed.
- **Evaluation of the quality system:** evaluation of the compliance to the IQC schedule and procedures.

| Description of requirement | Article BRL | Initial evaluation | Surveillance by CI after issue of the certificate | |
|---|---|---|---|---|
| | | | Inspection[1)] | Frequency |
| Resistance to chemicals | 4.3.2 | X | X[3)] | 1x year |
| Effect of rubber products on the pipe and/or fitting material | 4.3.3 | X | X[3)] | 1x year |
| Appearance | 4.4.1 | X | X[2)] | 1x year |
| Homogeneity | 4.4.2 | X | X[2)] | 1x year |
| Dimensions and volume | 4.4.3 | X | X[2)] | 1x year |
| Hardness | 4.5.2 | X | X | 1x year |
| Hardness after ageing | 4.5.2.4 | X | X | 1x year |
| Tear resistance | 4.5.3 | X | | |
| Tensile strength | 4.5.3 | X | X | 1x year |
| Tensile strength after ageing | 4.5.3 | X | X | 1x year |
| Elongation at break | 4.5.3 | X | X | 1x year |
| Elongation at break after ageing | 4.5.3 | X | X | 1x year |
| Compression set | 4.5.4 | X | X | 1x year |
| Compression set in water (class III and IV rubbers) | 4.5.5 | X | | |
| Stress relaxation | 4.5.6 | X | X[4)] | 1x year |
| Resistance to ozone attack | 4.5.7 | X[5)] | X[5)] | 1x year |
| Swelling in water | 4.5.8 | X | | |
| Swelling in oil No 1 and oil No 3 (if applicable) | 4.5.9 | X | | |
| Behaviour at elongation | 4.6.2 | X | X | 1x year |
| Marks to be applied | 4.8 | X | X[2)] | 1x year |

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 with "X" in the column for inspection shall be tested by the manufacturer at least once per 5 year, to be verified by the inspector during the inspections.
2) These product properties are only visually controlled during the inspections. In case of reasonable doubt samples will be taken and sent to an accredited test laboratory for determination of these properties.
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 test 7 days (at 23 °C for class I and II rubbers and at 125 °C for class III and IV rubbers).
5) Not for EPM/EPDM, VMQ, FKM, FEPM or IIR.

For the difference between certification of compounds and products see a more detailed table in annex E.

## 6.2 Evaluation of the quality system

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

# 7 Requirements imposed on the certification body

## 7.1 General

The certification body has to be accredited for the subject of this Evaluation Guideline on the basis of NEN-EN-ISO/IEC 17065 by the Dutch Accreditation Council (RvA) and have a license of KOMO.

The certification body must have the disposal of a regulation, or an equivalent document, in which the general rules for certification are laid down. In particular these are:

- The general rules for carrying out the initial tests, to be distinguished in:
  - The way suppliers are informed about the handling of the application;
  - Execution of the initial tests;
  - The decision with regard to the initial tests executed.
- The general rules with regard to the execution of inspections and the inspection aspects to be employed;
- The measures to be taken by the certification body in the event of non-conformities;
- The measures to be taken by the certification body in the event of illegitimate use of certificates, certification marks, icons and trademarks.
- The rules for termination of the certificate;
- The possibility of lodging appeal against decisions or measures made by the certification body.

## 7.2 Certification staff

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

- Certification assessor/ Reviewer: in charge of review of the by the supplier supplied or to be supplied construction drawings and documents, admissions, reviewing of applications and the review of conformity assessments;
- Site assessor: in charge of carrying out external inspections at the supplier's works;
- Decision-maker: in charge of taking decisions in connection with the initial tests performed, continuing the certification in connection with the inspections performed and making decisions on the need of corrective actions.

### *7.2.1 Competence requirements*

Distinguished are:

- Competence requirements for executive certification staff of a CI that fulfil the requirements of NEN-EN-ISO/IEC 17065;
- Competence requirements for executive certification staff of a CI that are in addition set up by the Board of Experts for the subject of this evaluation guideline.

The competencies of the relevant certification personnel must be visibly documented.

| | Certification assessor/ Reviewer | Site assessor | Decision-maker |
|---|---|---|---|
| **General competence** | | | |
| General education | • Higher vocational education | • Intermediate technical vocational education | • Higher vocational education |
| Knowledge of company processes<br>Competence for professional evaluation | • 1 year workexperience | • 2 years workexperience<br>• audittraining | • 5 years workexperience of which 1 year in certification |
| **Technical competence** | | | |
| Knowledge of the BRL | • Detailed knowledge of the specified BRLin question or the BRL's related to each other. | • Witness inspection<br>• Knowledge of the chapters of the BRL which relate to the quality system and the tests. | • n/a |
| Relevant knowledge of:<br>• The technology involved with producing the products to be inspected, the excecution of processes and the provisioning of services.<br>• The way products are used, processes are applied and services are rendered;<br>• Any deficiency that can occur during use of the product, any mistake that can be made during the use of a product and any imperfection in the rendering of services. | • Relevant technical higher vocational education work and intellectional level.<br>• At least 1 year of experience in production, testing, inspection and or in the installation trade, including:<br>- 2x inspections under supervision<br>• Or internal training course including:<br>- 2x inspections under supervision | • Intermediate technical vocational education work and intellectional level.<br>• At least 1 year of experience in production, testing, inspection and or in the installation trade, including:<br>- 3x inspections under supervision<br>- 1x independent inspection<br>• Or internal training course including:<br>- 3x inspections under supervision<br>- 1x independent inspection | • n/a |

### *7.2.2 Qualification*

Certification staff must be demonstrably qualified by evaluation of education and experience of the above-mentioned requirements.
The authority for qualification rests with the management of the certification body

## 7.3 Report initial tests

The certification body records the results of the initial tests in a report. The report must fulfil the following requirements:

- Completeness: the report judges about all requirements of the evaluation guideline;
- Traceability: the findings whereupon the judgements are based must be recorded in a traceable way;

With regard to granting the certificate, the decision-maker must be able to base his decision upon the findings recorded in the report.

## 7.4 Decision with regard to the issue of the certificate

The decision with regard to the issue of the certificate must be made by a qualified decision-maker, who was not involved at the initial tests. The decision must be traceable recorded.

## 7.5 Nature and frequency of external inspections

The certification body must enforce inspections at the supplier's site to investigate whether the obligations are met. The Board of Experts advises about the number of inspection visits required. At the time of validation of this evaluation guideline this 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 or ISO/TS 16949, the frequency is set at 2 inspection visits per year.
If the supplier is a private label owner (identical certificate derived from a product certificate) then the frequency is set at 1 inspection per 2 year.

Inspections shall invariably include:

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

The findings of the inspection visits performed shall be traceably recorded, by the certification body, in a report.

## 7.6 Report to the Board of Experts

The certification body reports at least once a year about the certification activities performed. In this reporting, the following subjects must be addressed:

- Mutations in number of certificates (new/cancelled);
- Number of inspections carried out in relation to the fixed frequency;
- Results of the inspections;
- Measures imposed in case of non-conformities;
- Complaints received from third parties concerning certified products.

## 7.7 Interpretation of requirements

The Board of Experts may lay down the interpretation of this evaluation guideline in a separate interpretation document.
The certification body is obliged to inform whether an interpretation document is available. If this is the case, then the interpretations as laid down in the interpretation document must be employed.

## 7.8 Sanction policy

The sanction policy and the weighing of shortcomings is available on the service page on the website of the certification body, which has formulated this quality assessment.

# 8 List of mentioned documents

## 8.1 Norms/ normative documents:

| | |
|---|---|
| BRL K17504/02 | Evaluation Guideline for the Kiwa product certificate for Vulcanized rubber products for cold and hot drinking water applications |
| BRL KQ17602 | Evaluation Guideline for the Kiwa product certificate for Vulcanized rubber seals in plastic transport and storage systems for chemical liquids and gaseous fluids for industrial applications |
| BRL 5609 | Beoordelingsrichtlijn voor het KOMO® productcertificaat voor flexibele leidingsystemen met kunststof binnenbuis voor warm-waterdistributie (see www.komo.nl) |
| EN 681-1:1996+A3:2005 | Elastomeric seals – Materials requirements for pipe joint seals used in water and drainage applications – Part 1: Vulcanized rubber |
| ISO 34-2:2015 | Rubber, vulcanized or thermoplastic - Determination of tear strength - Part 2: Small (Delft) test pieces |
| ISO 37:2011 | Rubber, Vulcanized or thermoplastic - Determination of tensile stress - strain properties |
| ISO 48:2010 | Rubber, Vulcanized or thermoplastic - Determination of hardness (hardness between 30 and 100 IRHD) |
| ISO 188:2011 | Rubber, Vulcanized – Accelerated ageing or heat-resistance tests |
| ISO 813:2010 | Rubber, vulcanized or thermoplastic - Determination of adhesion to a rigid substrate - 90° degree peel method |
| ISO 815-1:2014 | Rubber, Vulcanized or thermoplastic - Determination of compression set – Part 1:At ambient or elevated temperatures |
| ISO 815-2:2014 | Rubber, Vulcanized or thermoplastic - Determination of compression set – Part 2:At low temperatures |
| ISO 1431-1:2012 | Rubber, vulcanized or thermoplastic - Resistance to ozone cracking - Part 1: Static and dynamic strain testing |
| ISO 1629:2013 | Rubber and lattices – Nomenclature |
| ISO 1817:2015 | Rubber, vulcanized or thermoplastic - Determination of the effect of liquids |
| ISO 2285:2013 | Rubber, vulcanized or thermoplastic - Determination of tension set under constant elongation, and of tension set, elongation and creep under constant tensile load |

| | |
|---|---|
| ISO 2859-1:1999/Amd 1: 2011 | Sampling procedures for inspection by attributes -- Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection |
| ISO 3302-1:2014 | Rubber – Tolerances for products – Part 1: Dimensional tolerances |
| ISO 3302-2:2008 | Rubber – Tolerances for products – Part 2: Geometrical tolerances |
| ISO 3384-1:2011 | Rubber, Vulcanized or thermoplastic – Determination of stress relaxation in compression - Part 1: Testing at constant temperature |
| ISO 3601-1:2012 | Fluid power systems - O-rings - Part 1: Inside diameters, cross-sections, tolerances and designation codes |
| ISO 3601-3:2005 | Fluid power systems -- O-rings -- Part 3: Quality acceptance criteria |
| ISO 3865:2005 | Rubber, vulcanized or thermoplastic -- Methods of test for staining in contact with organic material |
| ISO 3951-1:2013 | Sampling procedures for inspection by variables -- Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL |
| ISO 6914:2013 | Rubber, vulcanized or thermoplastic -- Determination of ageing characteristics by measurement of stress relaxation in tension |
| EN-ISO 9001:2015 | Quality management systems -- Requirements |
| ISO 9691:1992 | Rubber – Recommendation for the workmanship of pipe joint rings – Description and classification of imperfections |
| ISO 10508:2006 | Plastics piping systems for hot and cold water installations -- Guidance for classification and design |
| ISO/TS 16949:2009 | Quality management systems -- Particular requirements for the application of ISO 9001:2008 for automotive production and relevant service part organizations |
| EN-ISO/IEC 17020: 2012 | Conformity assessment - General criteria for the operation of various types of bodies performing inspection |
| EN-ISO/IEC 17021-1: 2015 | Conformity assessment - Requirements for bodies providing audit and certification of management systems - Part 1: Requirements |
| EN-ISO/IEC 17024: 2012 | Conformity assessment - General requirements for bodies operating certification of persons |
| EN-ISO/IEC 17025:2005/C1:2007 | General requirements for the competence of testing and calibration laboratories |
| EN-ISO/IEC 17065: 2012 | Conformity assessment - Requirements for bodies certifying products, processes and services |
| ISO 23529:2010 | Rubber -- General procedures for preparing and conditioning test pieces for physical test methods |

# Annex A: Example IQC-scheme for product manufacturer

<table>
<tr><td><u>IQC-schedule</u><br><br><u>INTERNAL QUALITY PLAN</u></td><td colspan="2">Manufacturer / supplier :<br>Production location address :</td><td>Number of appendices:</td></tr>
<tr><td colspan="4"><u>Field(s) of application</u><br><br><u>According Evaluation Guideline(s)</u></td></tr>
<tr><td colspan="2"><u>Number of production shifts:</u></td><td colspan="2" rowspan="3"><u>Quality manual, procedures and working instructions</u><br>Is the Quality Management System (QMS) certified according to ISO 9001[1)]?<br>If yes, by which certification body:<br>If yes, is the certification body accredited for the particular scope of certification?<br><br>In case the QMS is <u>not</u> certified according to ISO 9001:<br>• Working instructions, test instructions and procedures are documented as follows:<br>• The following procedure for dealing with <u>complaints</u> applies:<br>• The following procedure for <u>nonconformity review</u> applies:</td></tr>
<tr><td colspan="2"><u>Quality Control</u><br>Total number of employees in QC department :<br>Number of QC-operators per shift :<br><br>If no QC-inspections are carried out during night shifts, state the QC procedure(s)/instruction(s) to be followed: , documented in:</td></tr>
<tr><td colspan="2"><u>Inspection and test records</u><br>All records shall be maintained for a minimum of years.</td></tr>
<tr><td colspan="2"><u>Specific agreements/comments/explanations</u></td><td colspan="2">Signature of the manufacturer/supplier:<br><br>Date :</td></tr>
</table>

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

**A. Calibration of measuring and test equipment**

Applicable procedure(s) nr(s):

| Equipment to be calibrated | Calibration aspect | Calibration method | Calibration frequency | Calibration file (name and location) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**B. Raw material and additives**

Applicable procedure(s) nr(s):

**B.1 Receipt**

For each delivery of raw material or additives data with respect to dates, producers, types and quantities are recorded as follows:

**B.2 Entry control**

| Type of raw material | Inspection aspect | Inspection method | Inspection frequency | Registration file (name and location) |
|---|---|---|---|---|
| | | | | |
| | | | | |

**C. Batch release tests per machine (including in-process and finished product testing)**

Applicable procedure(s) nr(s):

Production process(es):

| Type of product | Type of test | Test method | Test frequency | Registration file (name and location) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

Specific agreements/comments/explanations:

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

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

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

Specific agreements/comments/explanations:

| **Raw materials list**<br>**(not required to fill-out this appendix in case reference can be made to the CI ATA part of the certification agreement)** | **Appendix I**<br>Date: …… |
|---|---|

**I.1 The product is built-up of the following raw materials:**

**a) In case of products made from ready-made raw materials: listing of name and/or unique code of the raw material(s);**

**b) In case of products made from own compounded raw materials: reference to raw material/compound sheets which are (only) available at the production location and which have to be authenticated by CI (e.g. by the CI inspector);**

**c) In case of composed products (e.g. plastics fitting body, with separate nut, clamp ring and rubber sealing ring): of each part a specification according to a) or b) (whatever applicable).**

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| **List of technical drawings** | | | **Appendix II**<br>Date:…….. |
|---|---|---|---|
| Drawing title and number | Drawing date | Drawing title and number | Drawing date |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# Annex B: Summary of the material requirements for rubber products and rubber sheets

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

| Property | Units | Method | Requirement for hardness classes | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 40 | 50 | 60 | 70 | 80 | 90 |
| Hardness (a*) | IRHD | ISO 48 | ± 5 | ± 5 | ± 5 | ± 5 | ± 5 | ± 5 |
| Tear resistance | N | ISO 34-2 | ≥ 20 | ≥ 20 | ≥ 20 | ≥ 20 | ≥ 20 | ≥ 20 |
| Tensile strength on sheet test piece | MPa | ISO 37 | ≥ 9 | ≥ 9 | ≥ 9 | ≥ 9 | ≥ 9 | ≥ 9 |
| Tensile strength on product test piece (a*) | 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 (a*) | % | 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 at break | % | ISO 37 | +10/-30 | +10/-30 | +10/-30 | +10/-30 | +10/-30 | +10/-30 |
| Compression set | % | ISO 815 | | | | | | |
| - 72 h, -10°C | | | ≤ 40 | ≤ 40 | ≤ 50 | ≤ 50 | ≤ 60 | ≤ 60 |
| - 72 h, 23°C | | | ≤ 12 | ≤ 12 | ≤ 12 | ≤ 15 | ≤ 15 | ≤ 15 |
| - 24 h, 70°C (a*) | | | ≤ 20 | ≤ 20 | ≤ 20 | ≤ 20 | ≤ 20 | ≤ 20 |
| Stress relaxation | % | ISO 6914 | | | | | | |
| - 168 h at 23°C (a*) | | or | ≤ 13 | ≤ 14 | ≤ 15 | ≤ 16 | ≤ 17 | ≤ 18 |
| - 100 days at 23°C | | ISO 3384-1 | ≤ 19 | ≤ 20 | ≤ 22 | ≤ 23 | ≤ 25 | ≤ 26 |
| Ozone resistance (a,c*) | - | ISO 1431/1 | | | | | | |
| Class I strain: | | | 20 % | 20 % | 20 % | 20 % | 15 % | 10 % |
| 120 h, 40°C, 50 pphm | | | d) | d) | d) | d) | d) | d) |
| Class II strain: | | | 20 % | 20 % | 20 % | 20 % | 15 % | 10 % |
| 48 h, 40°C, 50 pphm | | | d) | d) | d) | d) | d) | d) |
| Class III strain: | | | 20 % | 20 % | 20 % | 20 % | 15 % | 10 % |
| 48 h, 40°C, 25 pphm: | | | d) | d) | d) | d) | d) | d) |
| Swelling in water | % (v/v) | ISO 1817 | | | | | | |
| - 168 h at 70°C | | | +8/-1 | +8/-1 | +8/-1 | +8/-1 | +8/-1 | +8/-1 |
| Oil resistance (b) | % (v/v) | ISO 1817 | | | | | | |
| Swelling in oil No 1, 72 h, 70 °C | | | ± 10 | ± 10 | ± 10 | ± 10 | ± 10 | ± 10 |
| Swelling in oil No 3, 72 h, 70 °C | | | -10/+50 | -10/+50 | -10/+50 | -10/+50 | -10/+50 | -10/+50 |

a) In case an initial evaluation is carried out on products using a compound that has been certified before, the requirements marked with (*) shall be determined.
b) Optional requirement for EN 681-1 type WG.
c) This requirement and test do not comply for EPM/EPDM, VMQ, FKM, FEPM or IIR.
d) Requirement: no cracks.

Table 10: Summary of the requirements for class II rubber products

| Property | Units | Method | Requirement for hardness classes | | | | |
|---|---|---|---|---|---|---|---|
| | | | 50 | 60 | 70 | 80 | 90 |
| Hardness (a*) | IRHD | ISO 48 | ± 5 | ± 5 | ± 5 | ± 5 | ± 5 |
| Tear resistance | N | ISO 34-2 | ≥ 20 | ≥ 20 | ≥ 20 | ≥ 20 | ≥ 20 |
| Tensile strength on sheet test piece | MPa | ISO 37 | ≥ 9 | ≥ 9 | ≥ 9 | ≥ 9 | ≥ 9 |
| Tensile strength on product test piece (a*) | 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 (a*) | % | 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 at break | % | ISO 37 | +10/-30 | +10/-30 | +10/-30 | +10/-40 | +10/-40 |
| Compression set | % | ISO 815 | | | | | |
| - 72 h, 23°C | | | ≤ 15 | ≤ 15 | ≤ 15 | ≤ 15 | ≤ 15 |
| - 24 h, 125°C (a*) | | | ≤ 20 | ≤ 20 | ≤ 20 | ≤ 20 | ≤ 20 |
| Stress relaxation | % | ISO 6914 | | | | | |
| - 7 days at 23°C (a*) | | or | ≤ 15 | ≤ 15 | ≤ 15 | ≤ 18 | ≤ 18 |
| - 100 days at 23°C | | ISO 3384-1 | ≤ 20 | ≤ 22 | ≤ 23 | ≤ 25 | ≤ 26 |
| - 7 days at 125°C | | | ≤ 30 | ≤ 30 | ≤ 30 | ≤ 30 | ≤ 30 |
| Ozone resistance (a,b*) | - | ISO 1431/1 | | | | | |
| Class I strain: | | | 20 % | 20 % | 20 % | 15 % | 10 % |
| 120 h, 40°C, 50 pphm | | | c) | c) | c) | c) | c) |
| Class II strain: | | | 20 % | 20 % | 20 % | 15 % | 10 % |
| 48 h, 40°C, 50 pphm | | | c) | c) | c) | c) | c) |
| Class III strain: | | | 20 % | 20 % | 20 % | 15 % | 10 % |
| 48 h, 40°C, 25 pphm: | | | c) | c) | c) | c) | c) |
| Swelling in water | % (v/v) | ISO 1817 | | | | | |
| - 168 h at 95°C | | | +8/-1 | +8/-1 | +8/-1 | +8/-1 | +8/-1 |

I.1 In case an initial evaluation is carried out on products using a compound that has been certified before, the requirements marked with (*) shall be determined.
I.2 This requirement and test do not comply for EPM/EPDM, VMQ, FKM, FEPM or IIR.
I.3 Requirement: no cracks.

Table 11: Summary of the requirements for class III rubber products

| Property | Units | Method | Requirement for hardness classes | | |
|---|---|---|---|---|---|
| | | | 60 | 70 | 80 |
| Hardness (c*) | IRHD | ISO 48 | ± 5 | ± 5 | ± 5 |
| Tear resistance | N | ISO 34-2 | ≥ 20 | ≥ 20 | ≥ 20 |
| Tensile strength on sheet test piece (c*) | MPa | ISO 37 | ≥ 9 | ≥ 9 | ≥ 9 |
| Tensile strength on product test piece (a*) | MPa | ISO 37 | ≥ 9 | ≥ 9 | ≥ 9 |
| Elongation at break on sheet test piece (c*) | % | 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 (c*) | | ISO 188 | | | |
| -change hardness | IRHD | ISO 48 | +8/-5 | +8/-5 | +8/-5 |
| -change tensile strength | % | ISO 37 | ≤ 20 | ≤ 20 | ≤ 20 |
| -change elongation at break | % | ISO 37 | +10/-30 | +10/-30 | +10/-30 |
| Compression set | % | ISO 815-1 | | | |
| - 72 h, 23 °C | | | ≤ 15 | ≤ 15 | ≤ 15 |
| - 24 h, 125 °C (a*) | | | ≤ 20 | ≤ 20 | ≤ 20 |
| Stress relaxation | % | ISO 6914 | | | |
| - 168 h at 23 °C | | or | ≤ 15 | ≤ 15 | ≤ 15 |
| - 100 days at 23 °C | | ISO 3384-1 | ≤ 22 | ≤ 22 | ≤ 22 |
| - 168 h at 125°C (a,d*) | | | ≤ 30 | ≤ 30 | ≤ 30 |
| - 4 weeks at 140 °C (d*) | | | ≤ 55 | ≤ 55 | ≤ 55 |
| Ozone resistance (a,e*) | - | ISO 1431/1 | | | |
| Class I strain: | | | 20 % | 20 % | 15 % |
| 120 h, 40°C, 50 pphm | | | f) | f) | f) |
| Class II strain: | | | 20 % | 20 % | 15 % |
| 48 h, 40°C, 50 pphm | | | f) | f) | f) |
| Class III strain: | | | 20 % | 20 % | 15 % |
| 48 h, 40°C, 25 pphm | | | f) | f) | f) |
| Volume change | % | ISO 1817 | | | |
| - 168 h, water at 95°C | | | +8/-1 | +8/-1 | +8/-1 |
| Compression set in water | | ISO 815-1 | | | |
| - 10000 h 110 °C (a, b*) | % | EN 681 | ≤ 40 | ≤ 40 | ≤ 40 |
| (- 3000 h 110 °C) | % | Annex B | (≤ 20/30 b) | (≤ 20/30 b) | (≤ 20/30 b) |

a) In case an initial evaluation is carried out on products using a compound that has been certified before, the requirements marked with (*) shall be determined.
b) 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.
c) Requirements for swelling seals are given in table 12.
d) This requirement and test do not comply for swelling seals.
e) This requirement and test do not comply for EPM/EPDM, VMQ, FKM, FEPM or IIR.
f) Requirement: no cracks.

Table 12: 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 10 weeks at 150 °C | | | |
| - volume | % | ISO 1817 | +15/+5 |
| - hardness | IRHD | ISO 48 | -5 / +5 |

Table 13: Summary of the requirements for class IV rubber products

| Property | Units | Method | Requirement for hardness classes | | |
|---|---|---|---|---|---|
| | | | 60 | 70 | 80 |
| Hardness (c*) | IRHD | ISO 48 | ± 5 | ± 5 | ± 5 |
| Tear resistance | N | ISO 34-2 | ≥ 20 | ≥ 20 | ≥ 20 |
| Tensile strength on sheet test piece (c*) | MPa | ISO 37 | ≥ 9 | ≥ 9 | ≥ 9 |
| Tensile strength on product test piece (a*) | MPa | ISO 37 | ≥ 9 | ≥ 9 | ≥ 9 |
| Elongation at break on sheet test piece (c*) | % | ISO 37 | ≥ 200 | ≥ 150 | ≥ 100 |
| Elongation at break on product test piece (a*) | % | ISO 37 | ≥ 175 | ≥ 130 | ≥ 100 |
| Ageing 336 hours in air at 125 °C (c*) | | ISO 188 | | | |
| -change hardness | IRHD | ISO 48 | +8/-5 | +8/-5 | +8/-5 |
| -change tensile strength | % | ISO 37 | ≤ 20 | ≤ 20 | ≤ 20 |
| -change elongation at break | % | ISO 37 | +10/-30 | +10/-30 | +10/-30 |
| Compression set | % | ISO 815-1 | | | |
| - 72 h, 23 °C | | | ≤ 15 | ≤ 15 | ≤ 15 |
| - 24 h, 125 °C (a*) | | | ≤ 15 | ≤ 15 | ≤ 15 |
| Stress relaxation | % | ISO 6914 | | | |
| - 168 h at 23 °C | | or | ≤ 15 | ≤ 15 | ≤ 15 |
| - 100 days at 23 °C | | ISO 3384-1 | ≤ 22 | ≤ 22 | ≤ 22 |
| - 168 h at 125 °C (a,d*) | | | ≤ 30 | ≤ 30 | ≤ 30 |
| - 8 weeks at 140 °C (d*) | | | ≤ 55 | ≤ 55 | ≤ 55 |
| Ozone resistance (a,e*) | - | ISO 1431/1 | | | |
| Class I strain: | | | 20 % | 20 % | 15 % |
| 120 h, 40°C, 50 pphm | | | f) | f) | f) |
| Class II strain: | | | 20 % | 20 % | 15 % |
| 48 h, 40°C, 50 pphm | | | f) | f) | f) |
| Class III strain: | | | 20 % | 20 % | 15 % |
| 48 h, 40°C, 25 pphm | | | f) | f) | f) |
| Volume change | % | ISO 1817 | | | |
| - 168 h, water at 105 °C | | | +8/-1 | +8/-1 | +8/-1 |
| Compression set in water | | ISO 815-1 | | | |
| - 10000 h 120 °C (a, b*) | % | EN 681 | ≤ 40 | ≤ 40 | ≤ 40 |
| (- 3000 h 120 °C) | % | Annex B | (≤ 20/30 b) | (≤ 20/30 b) | (≤ 20/30 b) |

a) In case an initial evaluation is carried out on products using a compound that has been certified before, the requirements marked with (*) shall be determined.
b) 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.
c) Requirements for swelling seals are given in table 14.
d) This requirement and test do not comply for swelling seals.
e) This requirement and test do not comply for EPM/EPDM, VMQ, FKM, FEPM or IIR.
f) Requirement: no cracks.

Table 14: Requirements for swelling seals only, class IV.

| Property | Units | Method | Requirement |
|---|---|---|---|
| Aging 5 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 15 weeks at 150 °C | | | |
| - volume | % | ISO 1817 | +15/+5 |
| - hardness | IRHD | ISO 48 | -5 / +5 |

# Annex C: Categorization of O-ring sizes

Table 15: Categorization of O-ring sizes in groups

| 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 D: Explanations (informative)

## Explanations

### *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.

### *General recommendations*

*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.

*Additional requirements*

Sometimes it is necessary to have additional requirements, e.g. with regards to rigidity of the joint. 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.

*Application*

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

### *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.

## Recommendations for the storage and use of rubber products

During storage and use of rubber products, appropriate measures must be taken to shield off environmental influences (light, air, humidity and temperature).
The preservation of quality is promoted as follows.

### *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 packaging of the different parts.
   Hanging or stacking may cause extra load -pressure, elongation or tensile- and thus the formation of cracks.

### *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.

## 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 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 end products are not exposed to frost; therefore cover in time.

## 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.

# Annex E: Difference between requirements on rubber compound (vulcanized) and those on products (informative)

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. At the initial evaluation of products that are manufactured from a compound that has not been certified before, all tests are carried out on material from products.

Table 16.

| | **Compound (Vulcanized 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, III and IV rubbers - hot) | | |
| - 72 h at 23°C | **X** | |
| - 24 h at 125°C | **X** | **X** |
| Compression set in water (Class III and IV rubbers only) | | |
| - 3000 h at 110 °C (Class III) or 120 °C (Class IV) | [2)] | **X** |
| - 10000 h at 110 °C (Class III) or 120 °C (Class IV) | [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** | |
| - 168 h in water at 105 °C (Class IV rubbers) | **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, III and IV rubbers) | **X** | **X** |
| - 672 h (Class III rubbers) or 1344 h (Class IV rubbers) at 140 °C | **X** | |
| Ozone resistance (not for EPM/EPDM, VMQ, FKM, FEPM 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 F: 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 present other materials, if applicable. From that point further preparation can be done using the techniques given in ISO 23529. By selecting the appropriate shape and part of the product for preparing the test pieces the following things shall 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 in test 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, provided that 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 to know 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 for 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 shall be conditioned at least 16 hours before testing.

# Annex G: 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.

**Less than 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 shall 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 shall 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. The method is further as given in ISO 815-1 and ISO 815-2. 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.
- Stress relaxation can be measured on complete rings. This is limited to rings with cross section of max 3,5 mm and internal diameter of max 30 mm.
- Ozone test 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 test can be done on complete rings or on sections in those cases that the complete rings are too big.