with BRL-K911/02
2003-04-10

Kiwa Productcertificate

for corrosion protection compound and tapes for tank and pipeline installations according to Evaluation Guideline BRL-K911/02 with a verification according to standard EN-12068.

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The Dutch copy of this report is binding.

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Foreword

This illustration on the Kiwa Evaluation Guideline BRL-K911 and the accompanying certified products of STOPAQ EUROPE B.V. is drawn up by Kiwa N.V. This has been done under the auspices of the producer in order to create more clarity in the physical and chemical characteristics of the following products: STOPAQ® FN 4100, STOPAQ® FN 4200 en STOPAQ® WRAPPINGBAND CZ.

Steel corrodes. From steel a great variety of products are manufactured. These products are expected to last a considerable long time. That is why these product have to protected from external influences. For ages mankind has been looking for products and developed various solutions. However, all of these solutions have different characteristics and functions.

When looking closer at these solutions, we have to conclude that the ideal solution has not been found yet. Unfortunately, most of the solutions are on a temporary base, because of their physical, chemical, mechanical and application properties. When a good protection of the substrate has to be created, the corrosion protective material has to be applied on a clean (no corrosion, no saltinated chlorides) and dry surface!

There has to be a good and lasting adherence on the substrate. The corrosion protection material is not allowed to be permeable for water and oxygen (cause of corrosion) and is not allowed to chemically or microbiologically disband (hydrolyses, oxidation). The corrosion protection material is not allowed to have a selective permeability for certain chemical substrates (osmosis). It should not be necessary to sand-, grit- or shotblast the substrate prior to the application of the corrosion protection material. The corrosion protection material should have a long-lasting excellent adhesion on the substrate and on other materials already present on the substrate (i.e. other coating materials). At application the corrosion protection material should not build up an internal stress and coefficients of expansion should be of no importance.

When studying the common used corrosion protection materials we can conclude that they do not meet these requirements completely. That is why a product was developed which could offer a solution to all the main problems and met with the requirements.

STOPAQ® products consist of chemical substances with a non polar character and an extremely low permeability for oxygen and water. The products have a low surfacetension and a long-lasting excellent adhesion on many substrates. The vitrification temperature is very low, so it is applicable in a wide temperaturerange. It is not necessary to sand-, grit- or shotblast the substrate prior to the application of the STOPAQ® products; it only has to be clean and dry.

STOPAQ® products are chemically and microbiologically inert.

The issued Productcertificate is an Approval for STOPAQ® products according to the Evaluation Guideline BRL-K911/02. STOPAQ® WRAPPINGBAND CZ is approved as a coatingmaterial of high mechanical resistance (class C-30).

Contents

1 Introduction

1.1 Field of application

STOPAQ® products are applied as a corrosion protection in over- and underground situations. This includes the treatment of components or objects as protection from environmental effects. Examples of such components include couplings, flanges, manhole covers, lifting lugs, thermite welds, flanges on detachable shafts of underground tank systems, pipelines and pipeline weld joints.

The application of the products protects the objects from getting into contact with water and oxygen; the two major ingredients of corrosion.

Because the application according to the standards is of great importance on the performance of a corrosion protection in the field, products are made out of chemical substances with a certain reological behavior. This behavior makes it easier to deform the material, compared to more solid corrosion protections, but this is simply to obviate by applying an additional external mechanical protective layer.

The major advantage of this reological behavior is that, when necessary, the materials are very easily removed or adjusted in any condition.

Because of the low surface tension of the products in combination with the reological behavior, the adhesion on many different kinds of surfaces is excellent. The corrosion protective layer is self-repairing when an inflicted external force causes any damage (i.e. rocks in the soil).

The products consist of a mixture of non-polar hydrocarbons with a vitrification temperature of at least –10º Celsius. Osmosis is not possible, in contrast with common used corrosion protective materials, because the products are not permeable thanks to use of specially selected raw materials.

In summary the essential and functional demands on the corrosion protective material in the Evaluation Guideline:

Qualitative	:	Corrosion protective for metal and lifetime
Safety	:	Safe application without fire or heating
Health	:	Non toxic or dangerous for the applicant
Utility	:	Easy to apply
Energy	:	No external energysources necessary
Environment	:	Environmental friendly and non toxic

1.2 Glossary

Adhesion	The attraction between the atoms / molecules of unlike materials in contact
Cohesion	The force that holds the atoms / molecules in a solid or liquid together
Bipolar	A molecule in which the center of positive charge does not coincide with the center of negative charge
Non polar	The opposite of bipolar; i.e. the property of a material where there is no electric bi-pole moment present
Corrosion	General term for the process which causes a material to corrode or wear
Vitrification temperature	Temperature at which a material changes from one phase (or state) to another; i.e. mechanical properties versus temperature
Hydrolysis	Decomposition of a material due to a reaction with water
Surfacetension	A property of liquids / solids caused by intermolecular forces near the surface leading to the apparent presence of a surface film and to capillarity
Osmosis	Diffusion of a solvent through a permeable (selective) membrane from a less concentrated to a more concentrated solution until it reaches a state of equal concentration at either site of the membrane
Oxidation	Chemical reaction of a material with oxygen. Theoretically: a chemical reaction whereby the atoms of an element loose electrons resulting in a higher valence of the element
Rheological behaviour	Elastic or plastic deformation of a material due to short or long lasting forces

2 Applicable product standards

2.1 General

This section describes the requirements with which the sealing material must comply. These requirements will be incorporated in the technical specifications of the product, which are incorporated in the certificate.

The table below is a summary of all requirements applicable to each line of the different products.

The manufacturers' internal quality control schedule determines the frequency of the tests 2.10 to 2.17 as a part of product testing.

Regarding the requirements of tapes standard EN-12068 was maintained as good as possible. However, it seemed to be impossible to comply to the entire standard, because of the fact that standard EN-12068 was drawn up for materials with the physical and chemical properties of a solid, instead of a liquid.

A few requirements of standard EN-12068 are skipped, as their content was not up to the mark of the higher requirements the manufacturer demands on the products. These higher requirements were applied in this Kiwa Evaluation Guideline BRL-K911.

Requirements	Sealing Compound Underground	Sealing Compound Overground	Tape Overground	Tape Underground	Kiwa BRL-K911 compared to: EN 12068: 1998	Judgement - Worse = Similar + Better
Electrical Contact Resistance	2.2	2.2	2.2	2.2	5.1, table 1, no. 3	=
Shape Retention	2.3				No requirement in EN 12068	
Water Absorption	2.4	2.4	2.4	2.4	No requirement in EN 12068	+
Vitrification Temperature	2.5	2.5	2.5	2.5	No requirement in EN 12068	+
Adhesion	2.6	2.6	2.6	2.6	5.1, table 1, no. 5 en 6	=
Effect of Cathodic Protection	2.7			2.7	5.1, table 1, no. 4	=
Restistance to Thermal Ageing	2.8	2.8	2.8	2.8	5.1, table 2, no. 2	+
Resolved Shear Stress	2.9	2.9			No requirement in EN 12068	
Shape Retention			2.10	2.10	5.1, table 1, no. 1 en 2	=
Shear Strength			2.11	2.11	5.1, table 1, no. 7	=
Saponification			2.12	2.12	5.1, table 2, no. 1	+
UV Resistance		2.13	2.13		5.1, table 2, no. 3	+
Low Temperature Unwinding Test			2.14	2.14	5.1, table 2, no. 4	=
Low Temperature Flexibility Test			2.15	2.15	5.1, table 2, no. 5	=
Drip Reststance			2.16	2.16	5.1, table 2, no. 6	=
Environmental Standards	2.17	2.17	2.17	2.17	No requirement EN 12068	+
Processing Instructions	2.18	2.18	2.18	2.18	5.2, table 7	=
Packaging, Preservation, Storage, Identification	2.19	2.19	2.19	2.19	5.2, table 3, 4, 5 en 6	=

2.2 Electrical contact resistance

The specific electrical resistance of the sealing material must be greater than 1 x 10^8 ohm.m^2 relative to the processing thickness of the material given by the manufacturer. The test is described in paragraph 3.2.

Explanation: This requirement has been included as the sealing material is used in combination with tank and piping coating. This tank and piping coating is often subjected to cathodic protection. In connection with this cathodic protection, the specific electrical resistance of the sealing material must be at least equal to the specific electrical resistance of the tank and pipe coating.

This test is carried out in accordance with NEN 6902 paragraph 5.9.

Verification to standard EN-12068: this requirement is identical to standard EN-12068 and necessary to determine the functioning of the cathodic protection and the corrosion protection properties.

2.3 Resistance to deformation

The sealing material must be resistant to deformation to be able to withstand mechanical forces exerted by the surrounding soil.
Class 'low' able to resist forces exerted 0.5 metres underground: After 24 hours the impression may not exceed 10 mm with a stamp of 100 N / dm^2 (50 kN/m^2) at 30°C.
Class 'high' able to resist forces exerted 2.5 metres underground: After 24 hours the impression may not exceed 10 mm with a stamp of 500 N / dm^2 (50 kN/m^2) at 30°C.
If the basic sealing material is insufficiently resistant to deformation, accessories such as geotextile can be used to ensure resistance to deformation provided it does not reduce the functionality o the basic material.

Explanation: The classes of resistance to deformation were opted for in view of the various applications of the material. The class 'low' applies to objects where low ground pressure is expected (manhole covers of GPL-tanks). The class 'high' applies to objects with high ground pressure such as tanks located 2.5 metres underground or irregular loads in the soil, and possible root formations.

Specifications of geo-plastics: fibres designed for use a filter, separation and/or reinforcing structure in accordance with BRL 553/01.

Material:	Polypropylene
Pore size:	> 1000 mm
Surface:	± 110 g/m^2
Permittivity:	at least 10 s^{-1}
Electrical current permeability:	no protection against electrical current ensuing from cathodic protection

This test is carried out in accordance with NEN 6910 paragraph 11.6. In deviation thereof, the pressure used in the test must be equal to 10 and 50 N / dm^2 for the classes 'low' and 'high' respectively.

Verification to standard EN-12068: this requirement does not occur in standard EN-12068 is necessary to determine the mechanical properties of the Sealing Compounds and is not applicable to the tape.

2.4 Water absorption

The sealing material must absorb hardly any water. After testing, water absorption may not exceed 0.01 grams per gram.

Principle: The principle of this method is based on the material's absorption of liquid (usually water). The material is immersed in the liquid for a certain period of time. The amount of absorbed liquid is measured.

Reagents and auxiliary substances: Distilled water.

Equipment and tools: Scale, sample dishes 50 ml ± 10%, stove with temperature settings, refrigerator, water dishes 100 ml ± 10%.

Method: Preparing the sample:
Place 500-gram ± 10% of the charge to tested in a stove at 23°C ± 2°C for at least 24 hours.

Measurement:
Weigh the sample dishes (C values).
Add a weighed quantity of the material (B values) and immerse them in water.
Place two samples in the stove at 23°C ± 2°C for 72 hours.
Place two samples in the refrigerator at 5°C ± 2°C for 72 hours.
Weigh all the sample dishes after 72 hours (value A).

C = the weight of the sample dish
B = the weight of the sample dish and the material
A = the weight of the sample dish, the material and the water.

Calculation

$$\text{Water absorption is: } \frac{A - B}{B - C} * 100$$

- The values at 23°C become averages. This produces water absorption at 23°C.
- The values at 5°C become averages. This produces water absorption at 5°C.

Accuracy
The relative standard deviation is given for each measurement and must be less than 5%.

Verification to standard EN-12068: this requirement does not occur in standard EN-12068. The Kiwa Evaluation Guideline is more stringent than standard EN-12068 in this matter.

2.5 Vitrification Temperature

No unacceptable alterations may occur in the physical behaviour of the material between -10°C and 30°C. Here the ratio between the elastic element (G') and the viscous element of the energy (G") is determinative. Tan d (G"/G' ratio) must be greater than 1. The vitrification temperature of the sealing material must be at least 5°C lower than -10°C.

Explanation: Vitrification temperature alters the elastic behaviour of the material in relationship to the reduced viscosity.

The vitrification temperature is measured by means of a (rheometer) viscosity measurement in accordance with ISO 3219.

Explanation: The oscillations in the material are studied to determine whether changes take place in the visco-elastic behaviour. Temperature fluctuations can lead to increased or reduced viscosity of the material.

The rheometer must be adjusted as follows:

Gap (space between the spindle and the gauge:	1 mm
Frequency:	1 Hz
Amplitude:	0.5
Temperature fluctuation:	+30 to -10°C

Verification to standard EN-12068: this requirement does not occur in standard EN-12068. The Kiwa Evaluation Guideline is more stringent than standard EN-12068 in this matter and necessary to determine the physical properties.

2.6 Adhesion

The sealing material must be sufficiently adhesive to adhere to the objects to be sealed. The adhesion of the material must be greater than 30 N in a test surface of 1000 mm^2. Adhesion determined by measuring the **cohesive fracture** that must be greater than 30 N in a test surface of 1000 mm^2.
The adhesive properties are determined in relation to a steel substrate. Test sections are prepared from a 3-mm steel strip. The strips are cut into square sections to determine adhesion under tensile strain.
The sealing material is conditioned at 23°C ± 2°C for 16 hours. The steel sections (blasted to Sa2½ according to ISO 8501-1) are cleaned three times with alcohol and then dried for 15 minutes. The sealing material is applied to one half of the test section, and then the other half is pressed manually onto the other half until the material is 1 mm thick. The composed test pieces are conditioned for at least 4 hours before the test is carried out. This is done to exclude the influence of changes in viscosity as a result of the processing.
The tensile-strength test is carried out under the following conditions:

Test piece dimensions:	30 x 30 mm
Number of test pieces:	6
Drawing speed:	5 mm/min
Test conditions:	23°C ± 2°C and 50°C ± 5°C, relative humidity
Thickness:	1 mm to 2 mm

Verification to standard EN-12068: this requirement is identical to standard EN-12068 and to be compared with no. 5 and 6 from table 1 in paragraph 5.1. Because of the physical properties of the material a standard adhesion test is not possible. A special test was drawn up in accordance with the requirements from standard EN-12068. During these tests the material is torn apart and material should be left behind on the test pieces. A cohesive break is indicative. The test is necessary to determine, among other things, the corrosion protection properties.

2.7 Effect of Cathodic Protection

The sealing material may not be adversely affected by the cathodic protection of the objects to be covered or sealed.

Explanation: If the physical properties of the basic material are such that it cannot be affected by cathodic protection, this will be demonstrable by means of a study of the literature.

The test is carried out in accordance with ASTM G8, method A including the supplementary guidelines below. During the test the metal-electrolyte potential and the input electrical current must be measured and recorded with intervals of a day. The metal-electrolyte potential must be adjusted daily within tolerances of +/- 50 mV of the metal-electrolyte potential set initially. The test must be carried out over a period of 90 days, after which the total equivalent circle diameter (ECD) lacking coating and/or sealing material must be measured. The ECD may not be greater than 12.7 mm.

Verification to standard EN-12068: this requirement is identical to standard EN-12068 and to be compared with no. 4 from table 1 in paragraph 5.1. Because of the chemical properties of the material the phenomenon of osmosis can not occur. The test is necessary to determine, among other things, the corrosion protection properties and the general quality of a coating.

2.8 Resistance to Thermal Ageing (lifetime)

After the ageing test, the water absorption of the sealing material may not deviate by more than 1% from the values measured initially and is the elasticity of the material not allowed to decrease, as described in Annex E (E-modules) of standard EN-12068.
The material is placed in a dish of 50 ml ± 10%. Water absorption is measured after 24 hours in accordance with paragraph 2.4. The dish is placed in a conditioned area where the temperature can be adjusted (ageing cabinet). The following test is carried out here. The ageing cabinet is set at -30°C for 4 hours and rises to +60°C (± 2°C) in ½ hour to stay on this temperature for 4 hours. One cycle entails a complete fluctuation from -30°C to +60°C and back to -30°C within a period of 9 hours.
Twenty-five of these cycles are carried out. After this, the water absorption is again measured in accordance with paragraph 2.4. The difference between the first and second measurement determines the extent of ageing.

Verification to standard EN-12068: this requirement is not identical to standard EN-12068. Kiwa Evaluation Guideline is more stringent than standard EN-12068 in this matter, as described in no. 2 table 2 of paragraph 5.1. Kiwa Evaluation Guideline does not only judge the thermal ageing at higher temperatures, but also the behavior of a material with strongly fluctuating temperatures. This test is very stringent and gives a very good indication of the lifetime expectancy of the material. The test is necessary to determine, among other things, the lifetime and the quality of the material.

2.9 Resolved Shear Stress

The resolved shear stress determines the tenacity of the material. The minimum yield point is 400 Pa at 30°C. This yield point is measured by means of (rheometer) viscosity measurement in accordance with ISO 3219. The rheometer settings are:

Shear point phase 1:	0 - 1600 Pa
Shear point phase 2:	1600 - 16000 Pa
Gap (space between the spindle and the gauge plate:	0.5 mm
Duration:	2 minutes

Explanation: In this measurement the rotation speed of the rheometer spindle is increased. Owing to the fact that the spindle turns, some force is required to set the material moving (shear point). The speed increases and so does the force, until the material starts moving and the force remains more or less the same.

Verification to standard EN-12068: this requirement does not occur in standard EN-12068 guideline and is necessary to determine the mechanical properties of the Sealing Compounds and is not applicable to the tape.

2.10 Shape Retention tape

A tape may contain a solvent to maintain the cohesion of the sealing compound during processing. The solvent must not impair the functional requirements of the tape. The tape with or without a solvent must have an adequate tensile strength to enable processing.

The resistance to a mechanical impact (at 23ºC and Tmax.) must be at least be equal to the values given in table 1 from the EN 12068 guideline. And should be established by means of the tests described in Annex A, Annex H and Annex G of standard EN-12068.

Verification to standard EN-12068: this requirement is identical to standard EN-12068 and is necessary to determine the mechanical properties and the quality of the material.

2.11 Shear Strength tape

The shear strength of a tape must be at least equal to the values given in table 1 of the EN 12068 guideline and should be established by means of the tests described in Annex D.

Verification to standard EN-12068 guideline: this requirement is identical to standard EN-12068 and is necessary to determine the mechanical properties and the quality of the material.

2.12 Microbiological resistance

The microbiological resistance of the compound or tape applied to buried objects must be such that the saponification number does not exceed 1 mg KOH/g and should be established by means of the tests described in Annex L.

Verification to standard EN-12068: this requirement is more stringent than standard EN-12068 and is necessary to determine the lifetime and the quality of the material.

2.13 UV-Resistance aboveground

The resistance to ultraviolet radiation of sealing compounds and tapes for overground use should be established by means of the tests described in Annex F of standard EN-12068, at an intensity of 17.5 GJ/m². Following this exposure, the adhesion of the overground sealing material must be tested as defined until a cohesive detachment occurs. Moreover, the material must not display any visible fractures.

Verification to standard EN-12068: this requirement is more stringent than standard EN-12068 (higher intensity) and is necessary to determine the lifetime and the quality of the material.

2.14 Low Temperature Unrolling Test tape

The properties and quality of the tapes when unwound at a low temperature should be established by means of the tests described in Annex P of standard EN-12068 and should comply to the values given in table 2.

Verification to standard EN-12068: this requirement is identical to standard EN-12068 and is necessary to determine, among other things, the quality of the material.

2.15 Low Temperature Flexibility Test tape

The flexibility and quality of the tapes when unwound at a low temperature should be established by means of the tests described in Annex N of standard EN-12068 and should comply with the values given in table 2.

Verification to standard EN-12068: this requirement is identical to standard EN-12068 and is necessary to determine, among other things, the quality of the material.

2.16 Drip Resistance tape

The drip resistance of the tapes should be established by means of the tests described in Annex Q of standard EN-12068 and should comply with the values given in table 2.

Verification to standard EN-12068: this requirement is identical to standard EN-12068 and is necessary to determine, among other things, the quality of the material.

2.17 Environmental Standards

The sealing compound or tape must not be harmful to the human health or the environment during processing or use. This must be established on the basis of the Safety Data Sheet required for chemical products according to NEN-ISO Standard 11014-1, see EU Directive 91/155/EEC.

Verification to standard EN-12068: this requirement does not occur in EN-12068 and is necessary to make sure that materials are manufactured which are not harmful to the environment. This requirement is more stringent than EN-12068.

Verification to standard EN-12068: this requirement is identical to standard EN-12068 and is necessary to determine, among other things, the quality of the material.

2.18 Processing Instructions

The manufacturer is obliged to provide processing instructions with all supplies, including at least the following:

- Necessary preparations
- How application should be carried out and under what conditions
- Minimum processing thickness
- How to use the accessories
- Processing temperatures
- Quality checks the application should be subjected to
- Chemical resistance
- Paragraph 5.2 of the EN 12068 guideline

2.19 Packaging, Preservation, Storage and Identification

The packaging must be suitable for the application. I n the event that special measures must be taken with regard to preservation, this must be clearly stated on both the processing instructions and the identification label on the packaging. Due to the preservation requirements, storage must take place in accordance with the processing instructions. The identification label must clearly state the following:

- Manufacturer's name
- Manufacturer's address and telephone number
- The description: 'Type of sealing compound / tape according to BRL K911
- Manufacturer's identification-number and/or name
- Reference to processing procedures
- The 'Kiwa' mark of approval
- The product certificate number
- The 'use by' date
- Paragraph 5.2 of the EN 12068 guideline
- Field of application
- net contents.

3 List of Documents

Number	Date[1)]	Title
ASTM G-8	1990	Standard Test Methods for Cathodic Dis bonding of Pipeline Coatings
BRL-K533/01	1995	Beoordelingsrichtlijn voor het Kiwa-produktcertificaat voor Geokunstsoffen: Weefsels bestemd voor de toepassing als filter-, scheidings- en/of wapeningsconstructie
DIN 30672		Vulstoffen
DIN 53 019	1980	Viskosimetrie: Messung von Viskositaten und Fliesskurven mit Rotationsviskosimetern mit Standardgeometrie, Teil 1, Mai 1980
ISO 3219	1993	Plastics - Polymers/resins in the liquid state or as emulsions or dispersions – Determination of viscosity using a rotational visometer with defined shear rate. Second edition
ISO 3681		Saponification
ISO 11357-1	1997	Plastics – Differential scanning calorimetry (DSC) – Part 1: General principles
NEN 6902	1985	Uitwendige bekleding met PE van ondergronds te leggen stalen buizen en hulpstukken: 1e druk
NEN 6910	1983	Uitwendige bekleding met (asfalt) bitumen van ondergronds te leggen stalen buizen en hulpstukken: 1e druk
NEN – ISO 11014-1	1994	Veiligheidsinformatieblad voor chemische produkten: Deel 1
EN 12068	1996	Cathodic protection – External organic coatings for the corrosion protection of buried or immersed steel pipelines used in conjunction with cathodic protection - Tapes and shrinkable tapes

[1] If applicable: date of previous amendment sheet.

4 References

Date[1)]	Title
2000	Onderzoek naar bekleden van laseinden, opkomers en flenzen. 28-2-2000. Nederlandse Gasunie
2000	Characterization and Evaluation of anticorrosion systems: Stopaq Wrappingband CZ, Stopaq 4100y, Stopaq 4200. March 2000. PDVSA Intevep
1998	Evaluation of compound Stopaq FN 4200 produced by Frans Nooren. 10-2-1998. Scientific research institute for Moscow construction Niimosstroi.
1998	Corrosion protective life span of Stopaq-CZ. 18-9-1998. Rijksuniversiteit Groningen.

5 Tests results

		In accordance with	FN4100	FN4200	Wrappingband CZ	Wrappingband CZ H
2.2	Electrical Contact Resistance	NEN 6902	> 10^8 ohm / m^2	> 10^8 ohm / m^2	> 10^8 ohm / m^2	> 10^8 ohm / m^2
2.3	Shape Retention	NEN 6910	< 4 mm after 24 hour at 30 °C	n.a.	n.a.	n.a.
2.4	Water absorption	BRL-K911 / 02	0.00 – 0.07 %	0.00 – 0.07 %	0.00 - 0.07 %	0.02 – 0.04 %
2.5	Glass Transition Temperature	ISO3219 rheometer ISO 11357 (DSC-scan)	tan δ > 1 (ISO 3219)	< - 70.0 ºC (ISO 11357)	- 71.2 ºC (ISO 11357)	- 64.7 ºC (ISO 11357)
2.6	Adhesion	BRL-K911 / 02	Cohesive fracture	Cohesive fracture	Cohesive fracture	Cohesive fracture
2.7	Effect of Cathodic Protection (90 days)	ASTM G8, Method A	No influence	n.a.	at 25 and 50 ºC < 12.7 mm	at 23 and 85 ºC = 0.00 mm
2.8	Resistance to Thermal Ageing	BRL-K911 / 02	-10 till 30 °C 0.00 – 0.07 %	-10 till 30 °C 0.00 – 0.07 %	-20 till 60 °C 0.00 – 0.07 %	-30 till 60 °C 0.02 - 0.04 %
2.9	Resolved Shear Stress	ISO 3219	> 400 Pa	> 250 Pa	n.a.	n.a.
2.10	Shape Retention	EN 12068, annex A	n.a.	n.a.	> 70 N at 23%	> 70 N at 23%
2.10	Shape Retention (Indentation, Class C)	EN 12068, annex G	n.a.	n.a.	CZ at 23 and 50 ºC after 1 min. no holidays recorded (15 kV).	CZ H at 23 and 85 ºC after 4 min. no holidays recorded (15 kV).
2.10	Shape Retention (Impact, Class C)	EN 12068, annex H	n.a.	n.a.	CZ impact energy of 15 J at 23 and 50 ºC after 1 min. no holidays recorded (15 kV).	CZ H impact energy of 15 J at 23 and 85 ºC after 4 min. no holidays recorded (15 kV).
2.11	Shear Strength	EN 12068, annex D	n.a.	n.a.	Cohesive fracture	Cohesive fracture
2.12	Saponification	EN 12068, annex L	n.a.	n.a.	0.55 mg KOH / g sample	0.93 mg KOH / g sample
2.13	Over ground UV-Resistance (17.5 GJ / m^2)	EN 12068, annex F	n.a.	Cohesieve fracture	Cohesive fracture	Cohesive fracture
2.14	Low Temperature Unrolling Test	EN 12068, annex P	n.a.	n.a.	at -20 °C, no separation, tears or cracks.	at –30 °C, no separation, tears or cracks.
2.15	Low Temperature Flexibility	EN 12068, annex N	n.a.	n.a.	at -20 °C, no separation, tears or cracks	at –30 °C, no separation, tears or cracks.
2.16	Drip Resistance	EN 12068, annex Q	n.a.	n.a.	no drip at 50 ºC (72 h)	no drip at 85 ºC (72 h)
2.17	Environmental Standards	NEN-ISO 11014-1	SDS d.d. 07-02-2003	SDS d.d. 07-02-2003	SDS d.d. 07-02-2003	SDS d.d. 10-12-2001
2.18	Processing Instructions	EN 12068, Paragraph 5.2	002 d.d. 02-09-2002	002 d.d. 02-09-2002	002 d.d. 02-09-2002	002 d.d. 02-09-2002 TDS d.d. 14-12-2001
2.19	Packaging, Preservation, Storage and Identification	EN 12068, Paragraph 5.2	verified	Verified	Verified	Verified

SDS = Safety Data Sheet TDS = Technical Data Sheet

The table shows the specifications of STOPAQ® Corrosion Preventive System in accordance with BRL-K911 / 02.

- STOPAQ® FN4100 is applied as a sealing compound in underground situations such as flanges, manhole covers, couplings, lifting lugs, etc.
- STOPAQ® FN4200 is applied as filler sealing compound between flangejoints in aboveground situations.
- STOPAQ® Wrappingband is used in under- and aboveground situations at pipelines. The difference between Wrappingband CZ and CZ H is the temperature range.