



Covenant K90719/04

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Watertight and airtight sealing systems for pipe penetrations

STATEMENT BY KIWA

With this Covenant, issued in accordance with the Kiwa Regulations for Certification, Kiwa declares that legitimate confidence exists that the products supplied by

Beele Engineering

as specified in this product certificate and marked with the Kiwa®-mark in the manner as indicated in this product certificate may, on delivery, be relied upon to comply with Kiwa Covenant manual K15013.

Ron Scheepers
Kiwa

Publication of this certificate is allowed.

Advice: consult www.kiwa.nl in order to ensure that this certificate is still valid.

Kiwa Nederland B.V.

Sir Winston Churchillaan 273
Postbus 70
2280 AB RIJSWIJK
The Netherlands
Tel. +31 88 998 44 00
Fax +31 88 998 44 20
NL.Kiwa.info@Kiwa.com
www.kiwa.nl

Supplier

Beele Engineering B.V.
Beunkdijk 11
7122 AZ Aalten
The Netherlands
Tel. +31 543 461629
Fax +31 543 461786
info@beele.com
www.beele.com

COVENANT

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Watertight and airtight sealing systems for pipe penetrations

Preface

This Kiwa Covenant has been prepared by the Technical Committee "Sealing products" of Kiwa Nederland B.V. and accepted by the Kiwa Committee of Covenant (KCC). The KCC also supervises the certification activities and where necessary requires the Kiwa Covenant to be revised.

This Kiwa Covenant will be used by Kiwa in conjunction with the Kiwa-Regulations for Certification. This regulation details the method employed by Kiwa for conducting the necessary investigations prior to issuing the product certificate and the method of external control. The inspection frequency is determined by the above mentioned Technical Committee and Kiwa Committee of Covenant.

Watertight and airtight sealing systems for pipe penetrations

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Watertight and airtight sealing systems for pipe penetrations

1. Scope of the Covenant

Sealing systems for the watertight and airtight sealing of penetrations of single pipes or of multi pipes through rigid walls, floors, bulkheads and decks.

Table 1. Certified sealing systems

Sealing system	Components
NOFIRNO sealing system	NOFIRNO filler sleeves, NOFIRNO sealant
SLIPSIL sealing system	SLIPSIL sealing plugs
SLIPSIL XL-120 sealing system	SLIPSIL XL-120 sealing plugs
DYNATITE sealing system	DYNATITE sealing plugs
NOFIRNO gaskets	NOFIRNO gaskets

Application details and technical specifications of all sealing systems are described in this Covenant.

2. NOFIRNO sealing system for pipe penetrations

2.1. Description of the NOFIRNO sealing system

The sealing system consists of a combination of rubber filler sleeves and a sealant. The aperture between penetrating pipe and penetration wall is filled with filler sleeves and on both sides the conduit opening is sealed with a sealant. The thickness of the sealant is 15 or 20 mm, depending on the specific application. For special applications the sealant layer may only be present at one side.

The filler sleeves are available in six diameter sizes and in five lengths. Dimensional product details are provided by Beele Engineering on request.

2.2. Intended use

The sealing system is intended to be used for the sealing of the penetration of a single pipe or of multi pipes through a penetration in rigid walls, floors, bulkheads and decks. The sealing system is applied in an opening in a concrete wall or floor, or a metal or glass-reinforced plastic conduit frame with maximum dimensions and minimum length in the penetration direction as specified in section 2.3 and Annex C. The conduit frame is pre-installed in the wall, floor, bulkhead or deck by means of a proper method (e.g. installed during casting a concrete wall or welded in a metal bulkhead). The sealing system can be applied for circular pipes with outer diameters 5 until 273 mm, using the necessary dimensional limits of the opening, conduit frame, sealant thickness.

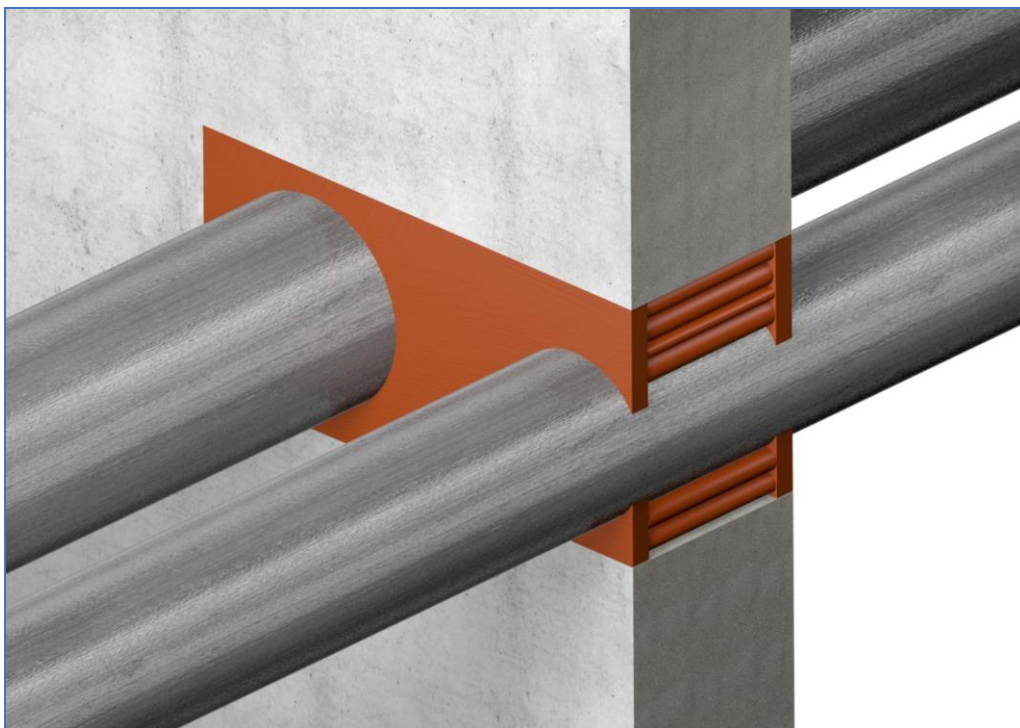


Figure 1. Principle of the NOFIRNO sealing system with pipes in a concrete wall.

Watertight and airtight sealing systems for pipe penetrations

2.3. Water- and airtightness of penetrations with NOFIRNO sealing system

2.3.1. Watertightness

The NOFIRNO sealing system is watertight and resistant to submerged conditions. Type testing at defined hydrostatic pressure on penetration seals before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the sealing system after initial installation.

The maximum allowed hydrostatic pressure depends on the dimensions of the opening in the wall, floor, bulkhead or deck, the penetration frame, the number and dimensions of the ducted pipes and the thickness of the sealant layer(s).

The relation between maximum pressure and penetration design is worked out in Kiwa assessment report 20180315HN/02. With the construction details the allowed maximum pressure can be calculated for each pipe penetration.

In Annex C an overview of the values for blind penetrations with the NOFIRNO sealing system is presented.

Penetrations with pipes allow higher values of hydrostatic pressure than blind penetrations.

Users of the NOFIRNO sealing system shall consult Beele Engineering for the pressure rating for the applicable specific applications.

2.3.2. Air tightness

The NOFIRNO sealing system is airtight. Type testing at defined static air pressure on penetration seals before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the sealing system after initial installation.

Because of the behaviour of flexible sealing products, assessment of the air/gas tightness is necessary for both low pressure as well as high pressure applications.

Table 2. Air tightness low pressure

NOFIRNO sealing system	Airtightness
All penetrations	From 0 to 0,3 mbar

In Annex D an overview of the values at high pressures for blind penetrations with the NOFIRNO sealing system is presented.

Penetrations with pipes allow higher values of static pressure than blind penetrations.

Users of the NOFIRNO sealing system shall consult Beele Engineering for the pressure rating for the applicable specific applications.

The assessments of the water- and airtightness of the NOFIRNO sealing system have been carried out according to Kiwa test protocols. The test methods comply with the principles of the test methods according to DNVGL-CP-0165 Edition February 2016 (Section 2, chapter 4).

Test method: Kiwa test protocols – Water tightness Version 2015-10-16 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - C Water tightness, Edition 2014.

Test method: Kiwa test protocols – Gas tightness Version 2015-06-22 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - D Gas tightness, Edition 2014.

3. SLIPSIL sealing system for pipe penetrations

3.1. Description of the SLIPSIL sealing system

The sealing system consists of SLIPSIL rubber sealing plugs, SLIPSIL stainless steel conduit sleeves with welded flange and NOFIRNO rubber gaskets. The rubber sealing plugs consist of two or more segments that are jointed together during installation to form one plug for the sealing of the penetration of a single pipe or of multi pipes through a SLIPSIL conduit in a rigid wall, floor, bulkhead or deck. For building applications the use of CSD HR plastic conduit sleeves, pre-installed during casting of the concrete wall or floor, is also possible. The inner side wall of the plugs has a waved surface; during installation the wave tops are in close contact with the penetrated pipe which enables the sealing between pipe and plug. The outer side wall of the plugs has lips that are being bended and compressed during installation which enables the sealing between plug and conduit wall. The lips should prevent the plugs from moving while installed. The plug consists of two or more segments for installation reasons. The flat contact surfaces of the plug segments are pressed together while installed, enabling sealing between the segments. SLIPSIL conduit sleeves with welded flange and CSD HR plastic conduit sleeves are special designed and constructed for this application. Dimensional product details are provided by Beele Engineering on request.

3.2. Intended use

The rubber sealing plugs are intended to be used for the sealing of the penetration of a single pipe or of multi pipes through rigid walls, floors, bulkheads and decks. The sealing plugs are applied in a metal or glass-reinforced plastic conduit with corresponding suitable inner diameter. The conduit is pre-installed in the wall, floor, bulkhead or deck by means of a proper method (e.g. installed during casting a concrete wall or welded in a metal bulkhead). The sealing plugs can be applied for circular pipes with diameter 5 until 273 mm.

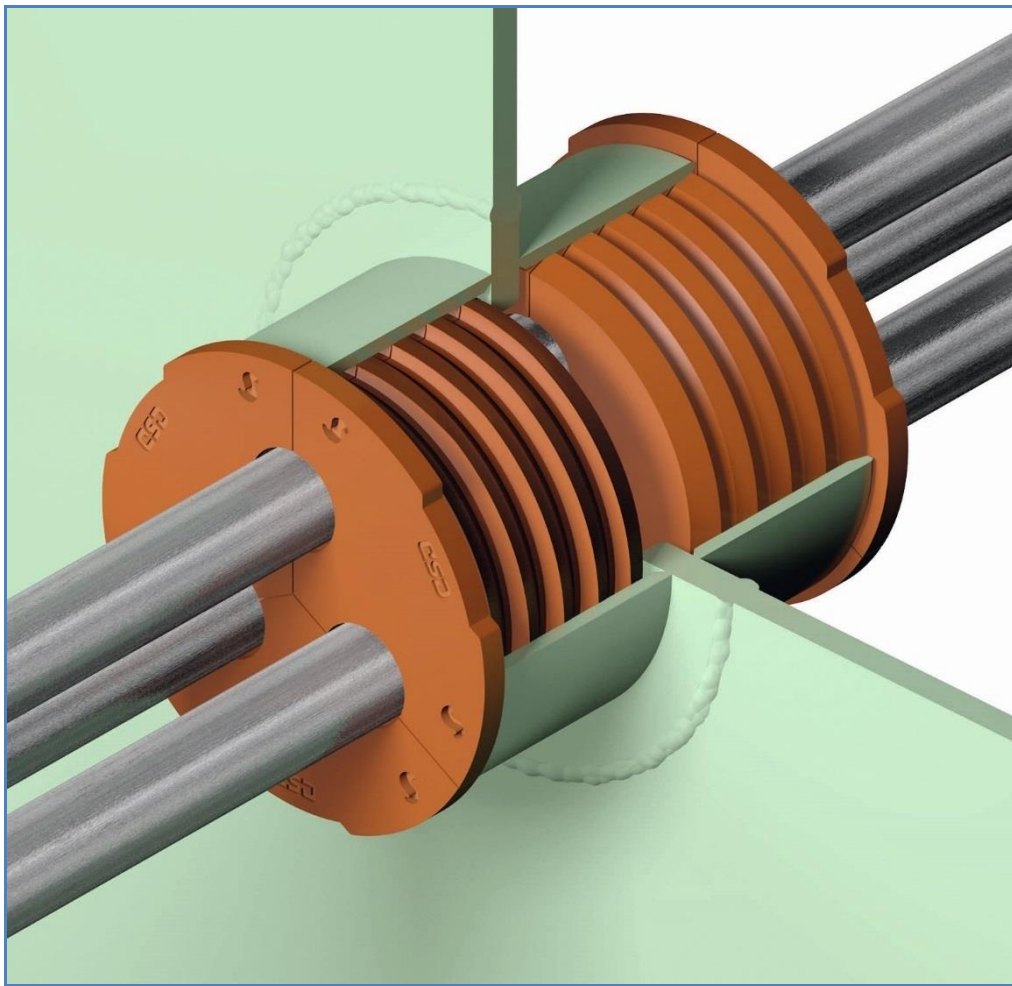


Figure 2. Principle of SLIPSIL sealing system with pipes in a bulkhead.

Watertight and airtight sealing systems for pipe penetrations

3.3. Water- and airtightness of penetrations with SLIPSIL sealing system

3.3.1. Watertightness

The SLIPSIL sealing system is watertight and resistant to submerged conditions. Type testing at defined hydrostatic pressure on penetration seals before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the sealing system after initial installation.

Table 3. Watertightness

SLIPSIL sealing system			Watertightness
SLIPSIL plugs	Conduit range Inner diameter	Pipe range Outer diameter	Pressure [bar]
SLIPSIL 25/0 until 339/0	25 – 339 mm	None (blind)	From 0 to 2,5
SLIPSIL 25/5-6 until 339/273	25 – 339 mm	5 – 273 mm	From 0 to 2,5

3.3.2. Airtightness

The SLIPSIL sealing system is airtight. Type testing at defined static air pressure on penetration seals before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the sealing system after initial installation.

Because of the behaviour of flexible sealing products, assessment of the air/gas tightness is necessary for both low pressure as well as high pressure applications.

Table 4. Airtightness low pressure

SLIPSIL sealing system	Airtightness
All configurations	From 0 to 0,3 mbar

Table 5. Airtightness high pressure

SLIPSIL sealing system			Airtightness
SLIPSIL plugs	Conduit range Inner diameter	Pipe range Outer diameter	Pressure [bar]
SLIPSIL 25/0 until 339/0	25 – 339 mm	None (blind)	From 0 to 2,5
SLIPSIL 25/5-6 until 339/273	25 – 339 mm	5 – 273 mm	From 0 to 2,5

The assessments of the water- and airtightness of the SLIPSIL sealing system have been carried out according to Kiwa test protocols. The test methods comply with the principles of the test methods according to DNVGL-CP-0165 Edition February 2016 (Section 2, chapter 4).

Test method: Kiwa test protocols – Water tightness Version 2015-10-16 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - C Water tightness, Edition 2014.

Test method: Kiwa test protocols – Gas tightness Version 2015-06-22 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - D Gas tightness, Edition 2014.

4. SLIPSIL XL-120 sealing system for pipe penetrations

4.1. Description of the SLIPSIL XL-120 sealing system

The sealing system consists of SLIPSIL XL-120 rubber sealing plugs with additional length. The rubber sealing plugs consist of two or more segments that are jointed together during installation to form one plug for the sealing of the penetration of pipes through a circular steel conduit in a bulkhead. The inner side wall of the plugs has a waved surface; during installation the wave tops are in close contact with the penetrated pipe which enables the sealing between pipe and plug. The outer side wall of the plugs has lips that are being bended and compressed during installation which enables the sealing between plug and conduit wall. The lips should prevent the plugs from moving while installed. The plug consists of two or more segments for installation reasons. The flat contact surfaces of the plug segments are pressed together while installed, enabling sealing between the segments.

For optimum sealing functionality the SLIPSIL XL-120 plugs are installed in SLIPSIL XL-120 conduit sleeves with fitting dimensions. In case welding conduit sleeves to the partition is not possible, SLIPSIL NWSL flanged conduit sleeves can be applied to install the sleeves from one side of the partition. Dimensional product details are provided by Beele Engineering on request.

4.2. Intended use

The rubber sealing plugs are intended to be used for the sealing of the penetration of a single pipe or of multi pipes through rigid walls, floors, bulkheads and decks. The sealing plugs are applied in a metal or glass-reinforced plastic conduit with corresponding suitable inner diameter. The conduit is pre-installed in the wall, floor, bulkhead or deck by means of a proper method (e.g. installed during casting a concrete wall or welded in a metal bulkhead). The sealing plugs can be applied for circular pipes with diameter 5 until 219 mm.

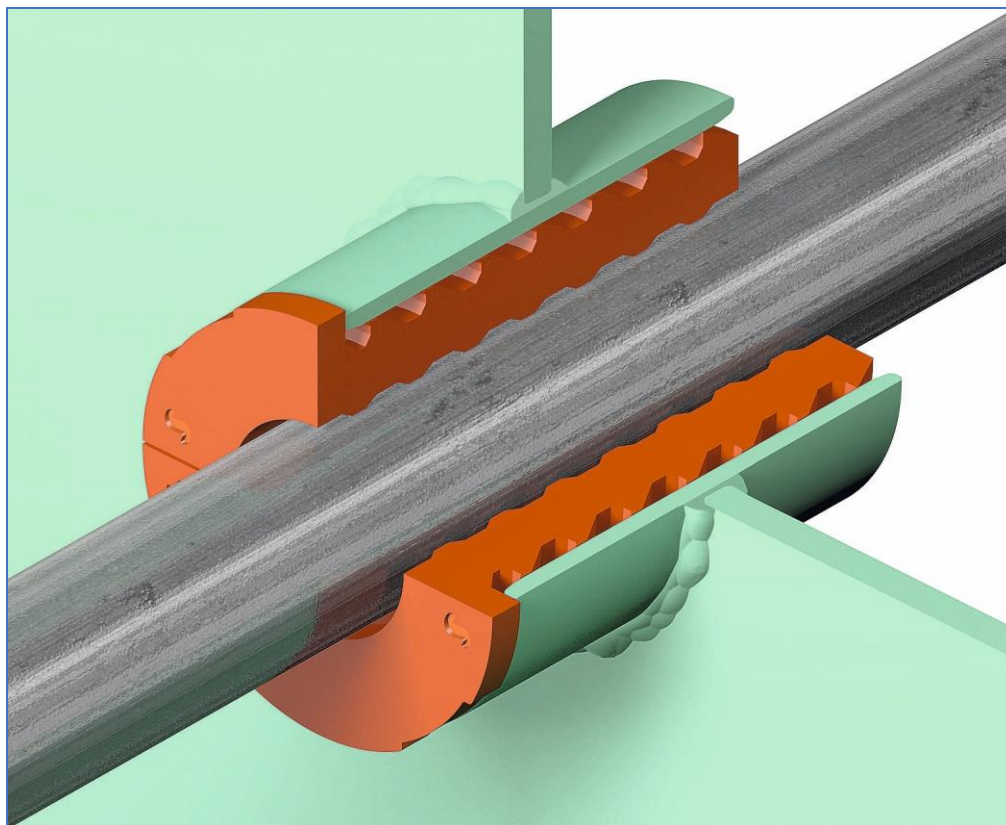


Figure 3. Principle of a pipe penetration through symmetrically welded conduit sleeve in a bulkhead with one SLIPSIL XL-120 sealing plug.

Watertight and airtight sealing systems for pipe penetrations

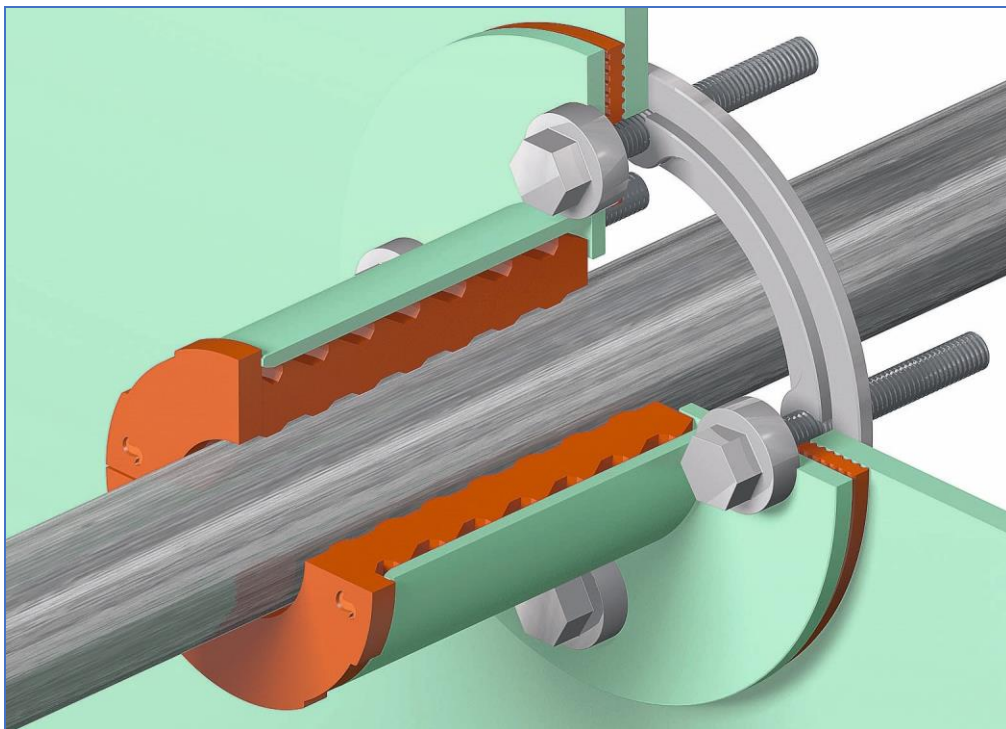


Figure 4. Principle of a pipe penetration through a SLIPSIL NWSL flanged conduit sleeve in a bulkhead with one SLIPSIL XL-120 sealing plug.

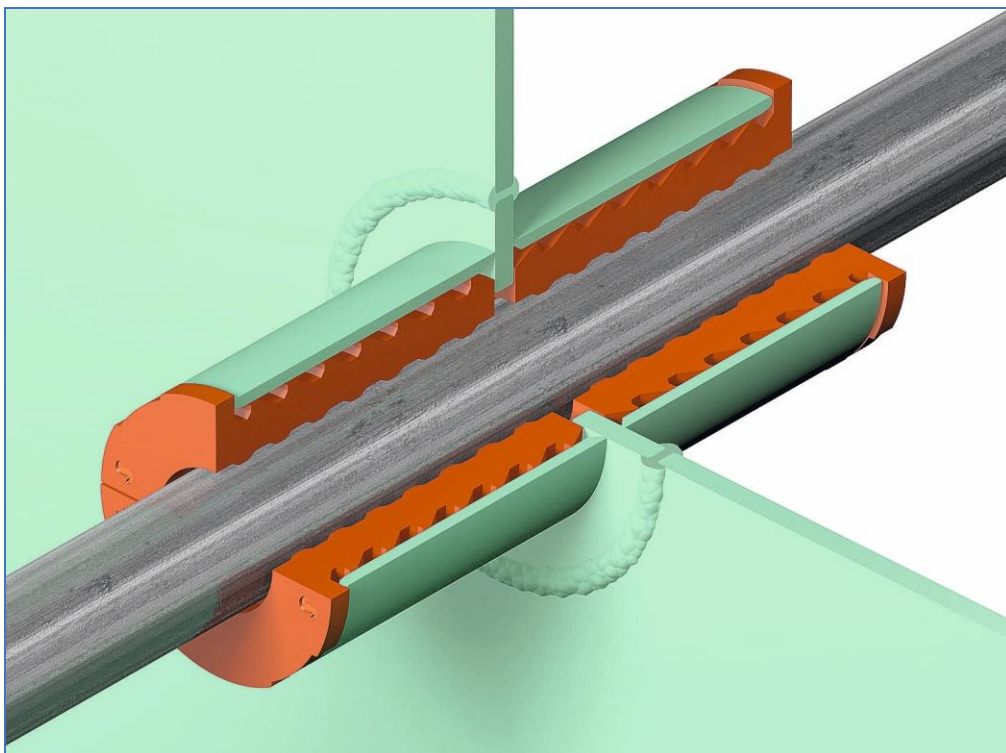


Figure 5. Principle of a pipe penetration through a symmetrically welded conduit sleeve in a bulkhead with two SLIPSIL XL-120 sealing plugs for compliance to water tightness after fire (SOLAS Regulation Chapter II-1, 13.2.3).

Watertight and airtight sealing systems for pipe penetrations

4.3. Water- and airtightness of penetrations with SLIPSIL XL-120 sealing system**4.3.1. Watertightness**

The SLIPSIL XL-120 sealing system is watertight and resistant to submerged conditions. Type testing at defined hydrostatic pressure on penetration seals before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the sealing system after initial installation.

Table 6. Watertightness

SLIPSIL XL-120 sealing system			Watertightness
SLIPSIL XL plugs	Conduit range Inner diameter	Pipe range Outer diameter	Pressure [bar]
SLIPSIL XL 41/5-6 until 260/219	41 – 260 mm	5 – 219 mm	From 0 to 2,5
SLIPSIL XL 41/0	41 mm	None (blind)	From 0 to 2,5
SLIPSIL XL 55/0 – 82/0	55 – 82 mm	None (blind)	From 0 to 2,0
SLIPSIL XL 100/0 – 150/0	100 – 150 mm	None (blind)	From 0 to 1,0
SLIPSIL XL 160/0 – 260/0	160 – 260 mm	None (blind)	From 0 to 0,5

4.3.2. Airtightness

The SLIPSIL XL-120 sealing system is airtight. Type testing at defined static air pressure on penetration seals before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the sealing system after initial installation.

Because of the behaviour of flexible sealing products, assessment of the air/gas tightness is necessary for both low pressure as well as high pressure applications.

Table 7. Airtightness low pressure

SLIPSIL XL-120 sealing system	Airtightness
All configurations	From 0 to 0,3 mbar

Table 8. Airtightness high pressure

SLIPSIL XL-120 sealing system			Airtightness
SLIPSIL XL plugs	Conduit range Inner diameter	Pipe range Outer diameter	Pressure [bar]
SLIPSIL XL 41/5-6 until 260/219	41 – 260 mm	5 – 219 mm	From 0 to 2,5
SLIPSIL XL 41/0	41 mm	None (blind)	From 0 to 2,5
SLIPSIL XL 55/0 – 82/0	55 – 82 mm	None (blind)	From 0 to 2,0
SLIPSIL XL 100/0 – 150/0	100 – 150 mm	None (blind)	From 0 to 1,0
SLIPSIL XL 160/0 – 260/0	160 – 260 mm	None (blind)	From 0 to 0,5

The assessments of the water- and airtightness of the SLIPSIL XL-120 sealing system have been carried out according to Kiwa test protocols. The test methods comply with the principles of the test methods according to DNVGL-CP-0165 Edition February 2016 (Section 2, chapter 4).

Test method: Kiwa test protocols – Water tightness Version 2015-10-16 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - C Water tightness, Edition 2014.

Test method: Kiwa test protocols – Gas tightness Version 2015-06-22 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - D Gas tightness, Edition 2014.

5. DYNATITE sealing system for pipe penetrations

5.1. Description of the DYNATITE sealing system

The sealing system consists of DYNATITE rubber sealing plugs, DYNATITE stainless steel conduit sleeves with welded flange and NOFIRNO rubber gaskets. The rubber sealing plugs consist of two or more segments that are jointed together during installation to form one plug for the sealing of the penetration of a single pipe or of multi pipes through a DYNATITE conduit in a wall, floor, bulkhead or deck. The inner side wall of the plugs has a waved surface; during installation the wave tops are in close contact with the penetrated pipe which enables the sealing between pipe and plug. The outer side wall of the plugs has lips that are being bended and compressed during installation around the pipe inside the conduit sleeve which enables the sealing of the penetration. The lips should prevent the plugs from moving while installed. The plug consists of two or more segments for installation reasons. The flat contact surfaces of the plug segments are pressed together while installed, enabling sealing between the segments. DYNATITE conduit sleeves with welded flange are special designed and constructed for this application. Dimensional product details are provided by Beele Engineering on request.

5.2. Intended use

The rubber sealing plugs are intended to be used for the sealing of the penetration of a single pipe or of multi pipes through rigid walls, floors, bulkheads and decks. The sealing plugs are applied in a DYNATITE stainless steel conduit with corresponding suitable inner diameter. The conduit is pre-installed to or in the wall, floor, bulkhead or deck by means of a proper method (e.g. mounted with the use of a NOFIRNO gasket or welded in a metal bulkhead). The DYNATITE sealing system can be applied for circular pipes with diameter 5 until 114 mm.

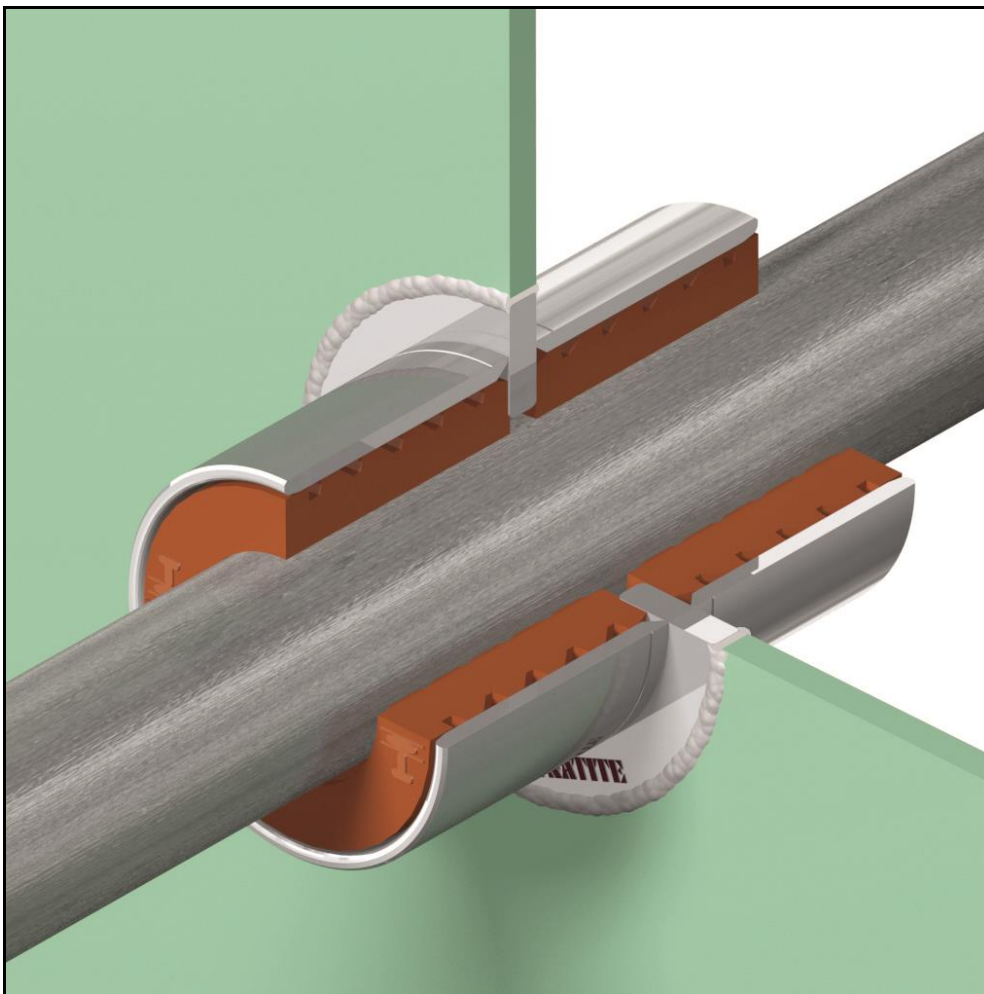


Figure 6. Principle of DYNATITE sealing system with a pipe in a bulkhead.

Watertight and airtight sealing systems for pipe penetrations

5.3. Water- and airtightness of penetrations with DYNATITE sealing system**5.3.1. Water tightness**

The DYNATITE sealing system is watertight and resistant to submerged conditions. Type testing at defined hydrostatic pressure on penetration seals before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the sealing system after initial installation.

Table 9. Watertightness

DYNATITE sealing system			Watertightness
DYNATITE plugs	Conduit range Inner diameter	Pipe range Outer diameter	Pressure [bar]
DYNATITE 25/0DT until DYNATITE 339/0DT	25 – 339 mm	None (blind)	From 0 to 2,5
DYNATITE 25/5-6DT until DYNATITE 339/105DT	25 – 339 mm	5 – 114 mm	From 0 to 2,5
DYNATITE 25/5-6DT until DYNATITE 150/105DT	25 – 150 mm	5 – 105 mm	From 0 to 8

Table 10. Watertightness

DYNATITE sealing system			Watertightness
DYNATITE plugs	Conduit range Inner diameter	Pipe range Outer diameter	Pressure [bar]
DYNATITE 41/8-9DT until DYNATITE 82/42-44DT	41 – 82 mm	8 – 44 mm	From 0 to 15

5.3.2. Airtightness

The DYNATITE sealing system is airtight. Type testing at defined static air pressure on penetration seals before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the sealing system after initial installation.

Because of the behaviour of flexible sealing products, assessment of the air/gas tightness is necessary for both low pressure as well as high pressure applications.

Table 11. Airtightness low pressure

DYNATITE sealing system	Airtightness
All configurations	From 0 to 0,3 mbar

Table 12. Airtightness high pressure

DYNATITE sealing system			Airtightness
DYNATITE plugs	Conduit range Inner diameter	Pipe range Outer diameter	Pressure [bar]
DYNATITE 25/0DT until DYNATITE 339/0DT	25 – 339 mm	None (blind)	From 0 to 2,5
DYNATITE 25/5-6DT until DYNATITE 339/273DT	25 – 339 mm	5 – 114 mm	From 0 to 2,5

The assessments of the water- and airtightness of the DYNATITE sealing system have been carried out according to Kiwa test protocols. The test methods comply with the principles of the test methods according to DNVGL-CP-0165 Edition February 2016 (Section 2, chapter 4).

Test method: Kiwa test protocols – Water tightness Version 2015-10-16 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - C Water tightness, Edition 2014.

Test method: Kiwa test protocols – Gas tightness Version 2015-06-22 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - D Gas tightness, Edition 2014.

Watertight and airtight sealing systems for pipe penetrations

6. NOFIRNO gaskets

6.1. Description of the products

The rubber gaskets are available in several types:

- Moulded flat circular discs with a circular opening in the centre; the surface on both sides of the gaskets has a pattern of small circular ribs around the centre. Figure 4.
- Moulded flat rectangular frames; the surface on both sides of the gaskets has a pattern of parallel small ribs or a rectangular pattern of small ribs. Figure 5.
- Flat gaskets with a rectangular pattern of small ribs on the surface, cut from moulded plate on custom made dimensions. Figure 6.
- Moulded flat gaskets, rectangular or circular, with a rectangular pattern of small ribs, with a split for enabling installation round a pipes. Figure 7.

During installation the small ribs are compressed, enabling the sealing of the flange and surface to which the flange is mounted.

Dimensional product details are provided by Beele Engineering on request.

6.2. Intended use

The circular rubber gaskets are intended to be used for the sealing of circular flanges and flanged penetrations of a single metal pipe or of multi metal pipes through rigid walls, floors, bulkheads and decks. The gaskets can be applied for metal circular pipes with diameter 12 until 300 mm.

The rectangular rubber gaskets are intended to be used for the sealing of rectangular flanges and flanged penetrations of a single or of multi metal pipes through rigid walls, floors, bulkheads and decks.



Figure 4. Example of circular NOFIRNO gasket with circular ribs.

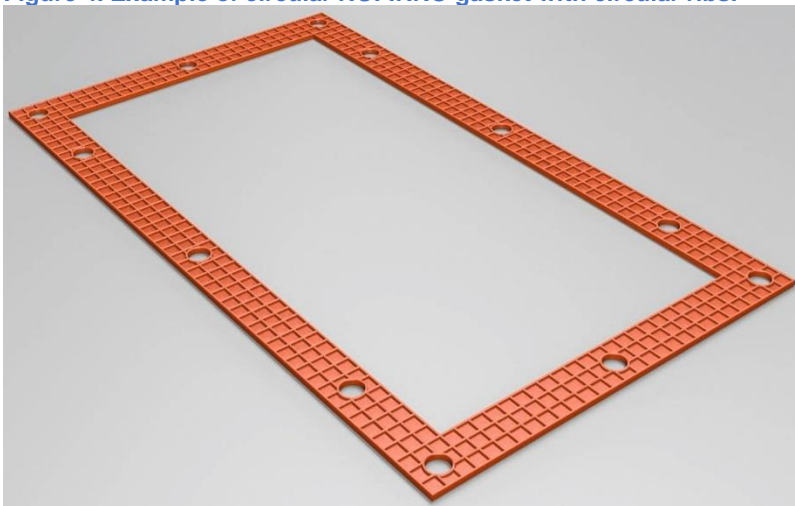


Figure 5. Example of rectangular NOFIRNO gasket with ribs in rectangular pattern.



Figure 6. Example of NOFIRNO gaskets, cut from moulded plate.

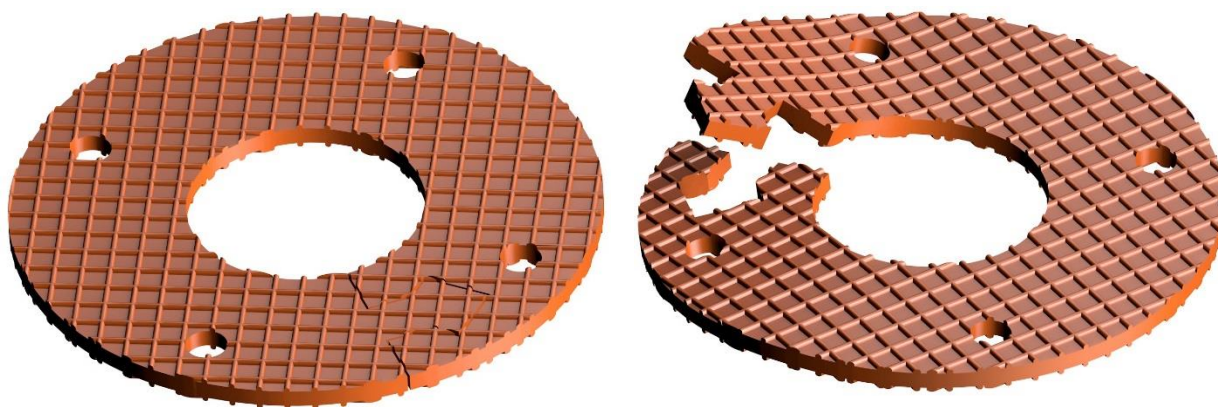


Figure 7. Example of NOFIRNO gaskets with a split for enabling installation around pipes.

Watertight and airtight sealing systems for pipe penetrations

6.3. Water- and airtightness of flanges sealed with NOFIRNO gaskets**6.3.1. Watertightness**

The NOFIRNO gaskets are watertight and resistant to submerged conditions. Type testing at defined hydrostatic pressure on constructions before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the construction after initial installation.

Table 13. Watertightness

Circular flanges with NOFIRNO gaskets			Watertightness
Gasket range Outer/Inner diameter [mm]	Gaskets Minimum difference Outer/Inner diameter	Pipe range Outer diameter	Pressure [bar]
92/12 until 400/300	80 mm	None (blind)	From 0 to 14
92/12 until 400/300	80 mm	5 – 273 mm ¹⁾	From 0 to 2,5 ¹⁾
92/12 until 217/125	80 mm	5 – 114 mm ²⁾	From 0 to 8 ²⁾
92/12 until 137/50	80 mm	None (blind)	From 0 to 15 (shock test)
92/12 until 137/50	80 mm	5 – 44 mm ²⁾	From 0 to 15 ²⁾ (shock test)

1) in combination with SLIPSIL plugs and SLIPSIL conduit sleeves

2) in combination with DYNATITE plugs and DYNATITE conduit sleeves

Table 14. Watertightness

Rectangular flanges with NOFIRNO gaskets			Watertightness
Gasket range Outer side dimensions [mm x mm]	Gaskets Minimum width [mm]		Pressure [bar]
1000 x 600	30 mm		From 0 to 2,5

6.3.2. Airtightness

The NOFIRNO gaskets are airtight. Type testing at defined static air pressure on constructions before and after minimum 1 year after installation, without any allowed manipulation (repair, replacement, re-tightening, et cetera) of the construction after initial installation.

Because of the behaviour of flexible sealing products, assessment of the air/gas tightness is necessary for both low pressure as well as high pressure applications.

Table 15. Airtightness low pressure

Flanges with NOFIRNO gaskets	Airtightness
All configurations	From 0 to 0,3 mbar

Table 16. Airtightness high pressure

Flanges with NOFIRNO gaskets	Airtightness
	Pressure [bar]
All configurations	From 0 to 2,5

The assessments of the water- and airtightness of the NOFIRNO gaskets have been carried out according to Kiwa test protocols. The test methods comply with the principles of the test methods according to DNVGL-CP-0165 Edition February 2016 (Section 2, chapter 4).

Test method: Kiwa test protocols – Water tightness Version 2015-10-16 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - C Water tightness, Edition 2014.

Test method: Kiwa test protocols – Gas tightness Version 2015-06-22 – Protocol A.

The mentioned products and penetrations also comply to Germanischer Lloyd - Rules for Classification and Construction - VI Additional Rules and Guidelines – Part 7 Guidelines for the Performance of Type Approvals – Chapter 4 Test Requirements for Sealing Systems of Bulkhead and Deck Penetrations – Section 3 Test requirements - D Gas tightness, Edition 2014.

7. Quality system requirements

7.1. General

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

7.2. Manager of the quality system

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

7.3. Internal quality control/quality plan

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

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

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

The ICQ-schedule must be detailed in such a way that it provides Kiwa sufficient confidence that requirements will be continuously fulfilled.

7.4. Procedures and work instructions

The manufacturer must be able to submit:

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

7.5. External inspection

The manufacturer's quality system shall be assessed by Kiwa with regard to at least the aspects mentioned in the Kiwa-Regulations for Product Certification.

The Kiwa Committee Covenant will determine the inspection frequency. At the time of validation of this Covenant this frequency has been fixed at 2 inspection visits per year.

7.6. Sanction policy

The sanction policy and the weighing of the non-conformities is available through the service page on the website of Kiwa.

Watertight and airtight sealing systems for pipe penetrations

7.7. Quality control of products

The following routine tests shall be carried out according to the test methods mentioned in this covenant or otherwise mentioned.

7.7.1. *NOFIRNO rubber compound*

- a. curing – rheometer
- b. hardness – ISO 48-4
- b. tensile properties – ISO 37
- c. density – ISO 2781
- d. limited oxygen index – ISO 4589-2
- e. compression set – ISO 815-1

The production control tests shall be carried out on cured test sheets.

7.7.2. *Rubber sealing products*

- a. dimensions – internal method
- b. surface imperfections, appearance and colour – internal method
- c. hardness – ISO 48-4 (only plugs)
- d. for plugs and gaskets: hydrostatic tightness test – internal method

The product control tests shall be carried out on lots of finished products.

7.7.3. *Sealants*

Non cured material:

- a. film structure – internal method
- b. viscosity – internal method
- c. curing - internal method

Cured material:

- a. appearance and colour – internal method
- b. hardness – ISO 48-4
- c. density – ISO 2781
- d. tensile properties – ISO 37
- e. limited oxygen index – ISO 4589-2

The product control tests shall be carried out on lots of finished products (filled cartridges).

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8. Marking

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

- The name of manufacturer or the deposited trade mark;
- Kiwa Covenant mark “Watertight and airtight sealing systems” and Kiwa Covenant number;
- For rubber products: the batch number;
- For sealants: the batch number and expiry date.

Note: Materials and products certified by this Covenant may be also certified by other Covenants for other fields of application. For these materials and products the marking with the Kiwa Covenant mark “Watertight and airtight sealing systems” and corresponding Kiwa Covenant number is only obliged to be used whenever supplied for the field of application as described in this Covenant.



9. Recommendations for customers

Check at the time of deliver whether:

- the supplier has delivered in accordance with the agreement;
- the mark and the marking method are correct;
- the products show no visible defects as a result of transport etc.

If you should reject a product on the basis of the above, please contact:
Beele Engineering B.V.

And, if necessary,
Kiwa Nederland B.V.

Consult the suppliers processing guidelines for the proper storage and transport methods.
Consult the suppliers installation guidelines for proper installation.

Annex A. Components and material compositions used for the sealing systems**A.1. NOFIRNO filler sleeves, NOFIRNO gaskets, SLIPSIL and DYNATITE plugs**

These components are made of NOFIRNO rubber. The colour of the compound is terracotta. The rubber compound is manufactured and converted into products by Beele Engineering.

A.2. NOFIRNO sealant

The material of the sealant is a room temperature curing sealant. For the polymer base two different types are used. The colour of the compound is terracotta. The sealant is also available in blue, black and white. Other colours are admitted on the condition that only the pigment is exchanged in the composition. The sealant compound is manufactured by Beele Engineering and packed in 310 ml plastic cartridges.

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Annex B. Material and product properties**B.1. Physical-mechanical material properties****NOFIRNO rubber filler sleeves**

Hardness (ISO 48-4)	65 – 85 Shore A
Density (ISO 2781)	1,55 – 1,65 Mg/m ³
Tensile strength (ISO 37)	min 2,0 MPa
Elongation at break (ISO 37)	min 100 %
Limited oxygen index (ISO 4589-2)	min 40 %
Volume change in water (ISO 1817) after 7 days at 70 °C	max +8 / -1 %

SLIPSIL and DYNATITE rubber sealing plugs; NOFIRNO gaskets

Hardness (ISO 48-4)	70 – 80 Shore A
Density (ISO 2781)	1,55 – 1,65 Mg/m ³
Tensile strength (ISO 37)	min 2,0 MPa
Elongation at break (ISO 37)	min 100 %
Limited oxygen index (ISO 4589-2)	min 40 %
Volume change in water (ISO 1817) after 7 days at 70 °C	max +8 / -1 %
Stress relaxation (ISO 3384) after 7 days at 23 °C	max 19 %
Stress relaxation (ISO 3384) after 100 days at 23 °C	max 28 %
Compression set (ISO 815) after 72 hours at 23 °C	max 15 %
Compression set (ISO 815) after 24 hours at 70 °C	max 20 %

NOFIRNO sealant (cured)

Hardness (ISO 48-4)	35 – 55 Shore A
Density (ISO 2781)	1,42 – 1,52 Mg/m ³
Elongation at break (ISO 37)	min 50 %
Limited oxygen index (ISO 4589-2)	min 37 %
Volume change in water (ISO 1817) after 7 days at 70 °C	max +8 / -1 %

B.2. Durability

Durability according to EOTA Technical Report 024 (July 2009) “*Characterisation, Aspects of Durability and Factory Production Control for Reactive Materials, Components and Products*”.

The use category of the sealing systems is:

Category type X : intended for use at conditions exposed to weathering.

This includes use at external and internal conditions, high temperatures in summer, frost and frost-thaw in winter, exposure to UV and exposure to rain.

B.3. Components and materials compatibility

The materials of the NOFIRNO rubber filler sleeves and gaskets, SLIPSIL and DYNATITE rubber sealing plugs and the NOFIRNO sealant are compatible with metal parts, unplasticised plastic parts and polymeric cable sheaths.

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Annex C. Watertightness NOFIRNO sealing system

Table C1. NOFIRNO sealing system – sealant layer at both sides - blind seals (no pipes)

Applicable penetrations – NOFIRNO sealing system – sealant layer at both sides				Watertightness
Circular penetration Inner diameter [mm]	Penetration length [mm]	Sealant layers [mm]	Pipe range Outer diameter [mm]	Pressure [bar]
0 – 89	≥ 90	20	Blind	From 0 to minimum 10,3*
89 – 133	≥ 90	20	Blind	From 0 to minimum 6,8*
133 – 168	≥ 90	20	Blind	From 0 to minimum 5,4*
168 – 219	≥ 90	20	Blind	From 0 to minimum 4,1*
219 – 273	≥ 90	20	Blind	From 0 to minimum 3,3*
273 – 400	≥ 90	20	Blind	From 0 to minimum 2,3*
0 - 89	≥ 90	15	Blind	From 0 to minimum 7,7*
89 - 133	≥ 90	15	Blind	From 0 to minimum 5,1*
133 - 168	≥ 90	15	Blind	From 0 to minimum 4,1*
168 - 219	≥ 90	15	Blind	From 0 to minimum 3,1*
Rectangular penetration W x H [mm]	Penetration length [mm]	Sealant layers [mm]	Pipe range Outer diameter	Pressure [bar]
120 x 240	≥ 90	15	Blind	From 0 to minimum 3,8*
120 x 60	≥ 90	15	Blind	From 0 to minimum 7,7*
120 x 240	≥ 100	20	Blind	From 0 to minimum 5,1*
120 x 60	≥ 100	20	Blind	From 0 to minimum 10,2*
170 x 200	≥ 90	15	Blind	From 0 to minimum 3,3*
170 x 200	≥ 100	20	Blind	From 0 to minimum 4,4*
200 x 273	≥ 150	20	Blind	From 0 to minimum 3,5*
300 x 600 (4 partitions)	≥ 150	20	Blind	From 0 to minimum 4,1*
600 x 600 (4 partitions)	≥ 150	20	Blind	From 0 to minimum 2,7*
600 x 1000	≥ 150	20	Blind	From 0 to minimum 0,8*

* circular penetrations: for smaller diameters than the maximum diameter of this range, the hydrostatic pressure resistance is higher.

rectangular penetrations: for smaller penetrations than mentioned here, the hydrostatic pressure resistance is higher

The maximum allowed hydrostatic pressure depends on the dimensions of the opening in the wall, floor, bulkhead or deck, the penetration frame, the number and dimensions of the ducted pipes and the thickness of the sealant layer(s).

The relation between maximum pressure and penetration design is worked out in Kiwa assessment report 20180315HN/02. With the construction details the allowed maximum pressure can be calculated for each pipe penetration.

Penetrations with pipes allow higher values of hydrostatic pressure than blind penetrations.

Consult Beele Engineering for the pressure rating for your specific applications.

Watertight and airtight sealing systems for pipe penetrations

Table C2. NOFIRNO sealing system – sealant layer at one side - blind seals (no pipes)

Applicable penetrations – NOFIRNO sealing system – sealant layer at one side				Watertightness
Circular penetration Inner diameter [mm]	Penetration length [mm]	Sealant layer [mm]	Cable range Outer diameter	Pressure [bar]
0 – 89	≥ 90	20	Blind	From 0 to minimum 9,1*
89 – 133	≥ 90	20	Blind	From 0 to minimum 6,1*
133 – 168	≥ 90	20	Blind	From 0 to minimum 4,8*
168 – 219	≥ 90	20	Blind	From 0 to minimum 3,7*
219 – 240	≥ 90	20	Blind	From 0 to minimum 3,4*
Rectangular penetration W x H [mm]	Penetration length [mm]	Sealant layer [mm]	Pipe range Outer diameter	Pressure [bar]
120 x 240	≥ 90	15	Blind	From 0 to minimum 3,2*
120 x 60	≥ 90	15	Blind	From 0 to minimum 6,5*
120 x 240	≥ 100	20	Blind	From 0 to minimum 4,3*
120 x 60	≥ 100	20	Blind	From 0 to minimum 8,6*
170 x 200	≥ 90	15	Blind	From 0 to minimum 2,8*
170 x 200	≥ 100	20	Blind	From 0 to minimum 3,7*
200 x 273	≥ 150	20	Blind	From 0 to minimum 3,0*
300 x 600 (4 partitions)	≥ 150	20	Blind	From 0 to minimum 3,4*

- * for smaller penetrations than mentioned here, the hydrostatic pressure resistance is higher
 Penetrations of cables lead to higher values of the hydrostatic pressure resistance.
 The maximum allowed hydrostatic pressure depends on the dimensions of the opening in the wall, floor, bulkhead or deck, the penetration frame, the number and dimensions of the ducted pipes and the thickness of the sealant layer(s).
 The relation between maximum pressure and penetration design is worked out in Kiwa assessment report 20180315HN/02. With the construction details the allowed maximum pressure can be calculated for each pipe penetration.
 Penetrations with pipes allow higher values of hydrostatic pressure than blind penetrations.
 Consult Beele Engineering for the pressure rating for your specific applications.

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Annex D. Airtightness high pressure NOFIRNO sealing system

Table D1. NOFIRNO sealing system – sealant layer at both sides - blind seals (no pipes)

Applicable penetrations – NOFIRNO sealing system – sealant layer at both sides				Airtightness
Circular penetration Inner diameter [mm]	Penetration length [mm]	Sealant layers [mm]	Pipe range Outer diameter [mm]	Pressure [bar]
0 – 89	≥ 90	20	Blind	From 0 to minimum 10,3*
89 – 133	≥ 90	20	Blind	From 0 to minimum 6,8*
133 – 168	≥ 90	20	Blind	From 0 to minimum 5,4*
168 – 219	≥ 90	20	Blind	From 0 to minimum 4,1*
219 – 273	≥ 90	20	Blind	From 0 to minimum 3,3*
273 – 400	≥ 90	20	Blind	From 0 to minimum 2,3*
0 - 89	≥ 90	15	Blind	From 0 to minimum 7,7*
89 - 133	≥ 90	15	Blind	From 0 to minimum 5,1*
133 - 168	≥ 90	15	Blind	From 0 to minimum 4,1*
168 - 219	≥ 90	15	Blind	From 0 to minimum 3,1*
Rectangular penetration W x H [mm]	Penetration length [mm]	Sealant layers [mm]	Pipe range Outer diameter	Pressure [bar]
120 x 240	≥ 90	15	Blind	From 0 to minimum 3,8*
120 x 60	≥ 90	15	Blind	From 0 to minimum 7,7*
120 x 240	≥ 100	20	Blind	From 0 to minimum 5,1*
120 x 60	≥ 100	20	Blind	From 0 to minimum 10,2*
170 x 200	≥ 90	15	Blind	From 0 to minimum 3,3*
170 x 200	≥ 100	20	Blind	From 0 to minimum 4,4*
200 x 273	≥ 150	20	Blind	From 0 to minimum 3,5*
300 x 600 (4 partitions)	≥ 150	20	Blind	From 0 to minimum 4,1*
600 x 600 (4 partitions)	≥ 150	20	Blind	From 0 to minimum 2,7*
600 x 1000	≥ 150	20	Blind	From 0 to minimum 0,8*

- * for smaller penetrations than mentioned here, the hydrostatic pressure resistance is higher
 Penetrations of cables lead to higher values of the hydrostatic pressure resistance.
 Users of the NOFIRNO sealing system shall consult Beele Engineering for the pressure rating for the applicable specific applications.

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Annex E.

Table D2. NOFIRNO sealing system – sealant layer at one side - blind seals (no pipes)

Applicable penetrations – NOFIRNO sealing system – sealant layer at one side				Airtightness
Circular penetration Inner diameter [mm]	Penetration length [mm]	Sealant layer [mm]	Cable range Outer diameter	Pressure [bar]
0 – 89	≥ 90	20	Blind	From 0 to minimum 9,1*
89 – 133	≥ 90	20	Blind	From 0 to minimum 6,1*
133 – 168	≥ 90	20	Blind	From 0 to minimum 4,8*
168 – 219	≥ 90	20	Blind	From 0 to minimum 3,7*
219 – 240	≥ 90	20	Blind	From 0 to minimum 3,4*
Rectangular penetration W x H [mm]	Penetration length [mm]	Sealant layer [mm]	Pipe range Outer diameter	Pressure [bar]
120 x 240	≥ 90	15	Blind	From 0 to minimum 3,2*
120 x 60	≥ 90	15	Blind	From 0 to minimum 6,5*
120 x 240	≥ 100	20	Blind	From 0 to minimum 4,3*
120 x 60	≥ 100	20	Blind	From 0 to minimum 8,6*
170 x 200	≥ 90	15	Blind	From 0 to minimum 2,8*
170 x 200	≥ 100	20	Blind	From 0 to minimum 3,7*
200 x 273	≥ 150	20	Blind	From 0 to minimum 3,0*
300 x 600 (4 partitions)	≥ 150	20	Blind	From 0 to minimum 3,4*

- * for smaller penetrations than mentioned here, the hydrostatic pressure resistance is higher
 Penetrations of cables lead to higher values of the hydrostatic pressure resistance.
 Users of the NOFIRNO sealing system shall consult Beele Engineering for the pressure rating for the applicable specific applications.