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ProRox

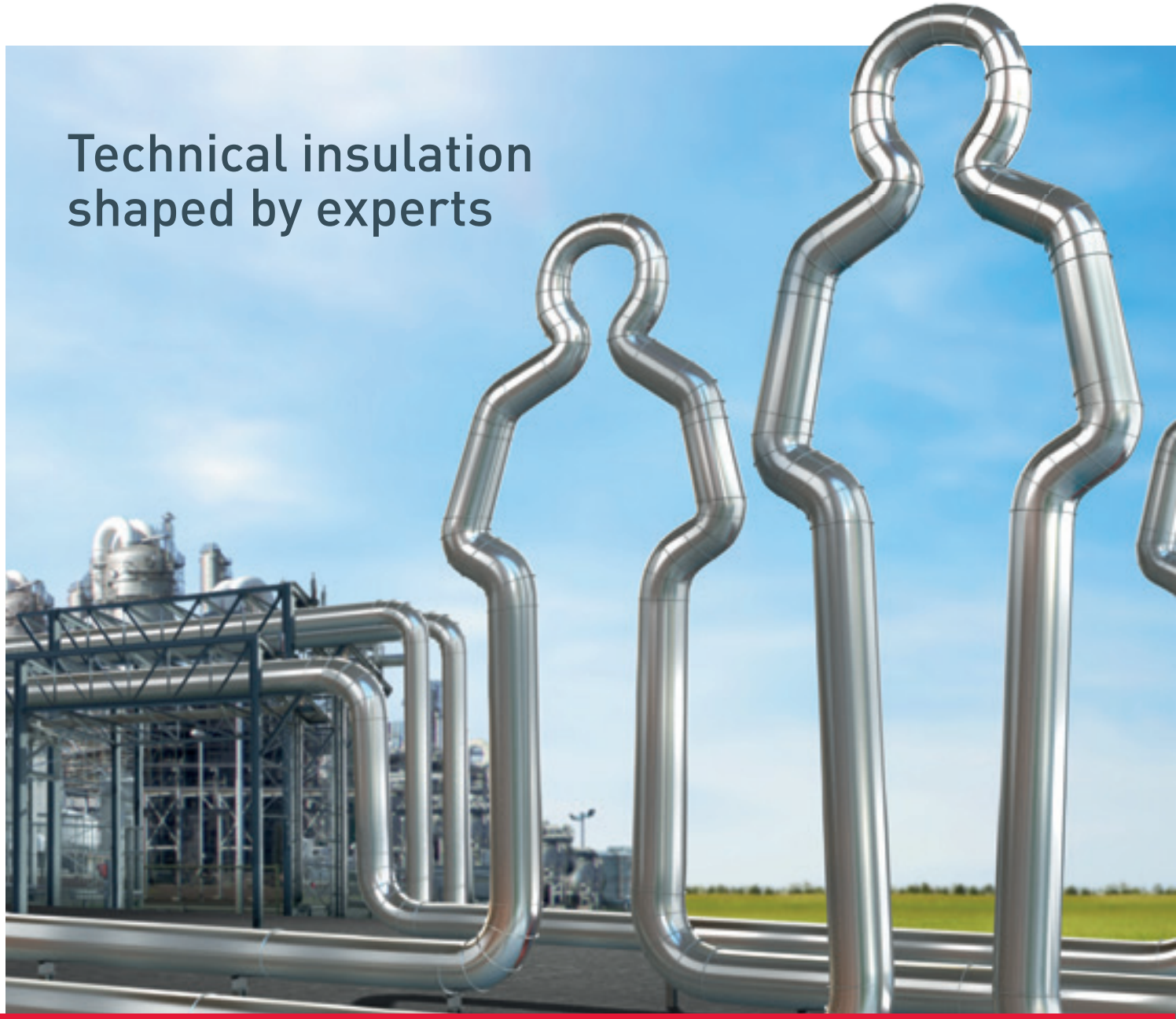
Industrial insulation

ProRox NCS 2000

How to combat Corrosion Under Insulation?

ROCKWOOL®

TECHNICAL INSULATION



Technical insulation shaped by experts

We share our knowledge to your advantage

ROCKWOOL Technical Insulation – a subsidiary of the ROCKWOOL International Group – offers innovative technical insulation solutions for the process & power generated industry and the shipbuilding & offshore market worldwide.

To that end, we have subsumed our product range into two specialist categories. SeaRox comprises the full marine and offshore range and ProRox covers all our insulation solutions for the process industry and for technical installations on board and offshore. Through our two product lines, our experts offer a full spread of products and systems guaranteeing the highest possible thermal, acoustic and fire safe insulation of all technical installations.

Our more than 75 years of experience is reflected in a complete set of high grade products and expert advice. Today, we remain fully committed to providing the very best service in the market and a total range of cutting-edge insulation solutions.

All ROCKWOOL Technical Insulation solutions meet the most stringent quality and safety standards. All ProRox and SeaRox products and constructions have been tested according to the latest regulations and approved by all major classification societies. As an innovation-driven company we demand excellence. In every segment we keep searching for new systems, methods and solutions.

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FACT: Corrosion Under Insulation reduces the service life of industrial plants

Corrosion Under Insulation (CUI) refers to the external corrosion of piping or equipment that occurs underneath externally cladded insulation due to water or moisture penetration.

Avoid costs and worse...

Corrosion is by far the most costly problem the industry faces today; both on- and offshore. Due to corrosion of piping and equipment under insulation, companies are forced to repair and/or replace major parts at considerable cost. On a global scale the cost of CUI for the industry runs into the billions of US dollars each year.

As a consequence, corrosion under insulation (CUI) considerably reduces the potential service life of industrial plants. More frequently, essential shutdowns and overhauls impact the plant's efficiency, increasing operating costs. But the alternative is worse – unattended CUI can result in disastrous accidents, chemical spillage, etc.

Between 40% and 60% of piping maintenance costs are related to CUI*

* Exxon Mobil Chemical study 2003 presented at European Federation of Corrosion, September 2003

What's the issue?

Corrosion occurs when water and oxygen are present. So, obviously, if the steelwork under insulation remains dry there is no corrosion problem. Keeping insulation dry however, can be difficult - therefore making every effort to avoid piping corrosion during storage, installation and service is essential.

Risk of water ingress

Failure to do this correctly leads to water ingress into the installation which can result in steelwork to corrode, commonly referred to as corrosion under insulation (CUI). In practice CUI especially appears in the temperature range between -4°C and 175°C* or in case of cyclic operation of the equipment. CUI will be incurred under any type of insulation, when installation issues occur or cladding material is damaged.

The main reason for water ingress is faulty installed or damaged cladding used outdoor or in wet/humid circumstances. Water ingress can also happen in cyclic temperature processes, where moisture in the air is present, or even through internal leaks.

To start the best way possible, first you need to control the basics. Tackling CUI is only effective when you take into account these three basic rules:

- Use an appropriate protective coating system
- Choose and apply a suitable insulation system
- Maintain and control the insulated system regularly

"We launch a new tool to combat CUI"

* European Federation of Corrosion

Our experts recommend a proven method: non-contact insulation

The ingress of water into the insulation system can never totally be avoided. However, you can apply a system that limits the contact time of water with the piping, called non-contact insulation. In the 'European Federation of Corrosion Publications Number 55: Corrosion under insulation (CUI) guidelines, by S. Winnik, section 8.8' it is described as an effective solution to disclose 'the hidden problem':

'A more recent insulation design which has proven successful is 'non-contact insulation'. The design has an air gap between the equipment surface and the insulation. (...) The air gap enables the equipment surface to stay relatively dry and also allows insertion of a boroscope inspection tool to check the external condition of the equipment, without removing the insulation and weather proofing.'

The use of non-contact insulation has also been tested and is recommended as a possible tool within the Norwegian oil and gas sector to prolong the lifetime of the installations. 1) + 2)

"The space between the insulation and the pipe ensures a continuous flow of air, keeping the surface dry."

1) F. A. Kvilhaug, How do different insulation solutions affect corrosion under insulation (CUI)?, Bergen, Norway, Overflate 2014

2) K. Halraldsen, Corrosion under insulation - testing of protective systems at high temperature, Texas, USA, NACE International, 2010, Paper 10022

ProRox Non-Contact System: our crowning combination

Utilizing the basic knowledge in the market and the fact that no single tool, coating system, insulation material or cladding material has proven to be the final solution to avoid corrosion under insulation, ROCKWOOL Technical Insulation experts have taken their experiences from the market to the next level launching a new combination to combat CUI.

It takes two to make it right:
ProRox NCS 2000 spacer + ProRox PS Pipe Sections

The principle of our CUI concept is simple: create an air gap between insulation and steel. When water enters, the steel can dry out and the time of wetness is reduced. This has a positive effect on the corrosion rates on unprotected steel and increases the service life of the coating and the system.

The core element of the new ROCKWOOL Technical Insulation non-contact system is the combined offering of unfaced ProRox PS Pipe Section and a new flexible spacer: ProRox NCS 2000. This spacer ring ensures a uniform, concentric air gap between the pipe and the ProRox PS Pipe Sections.

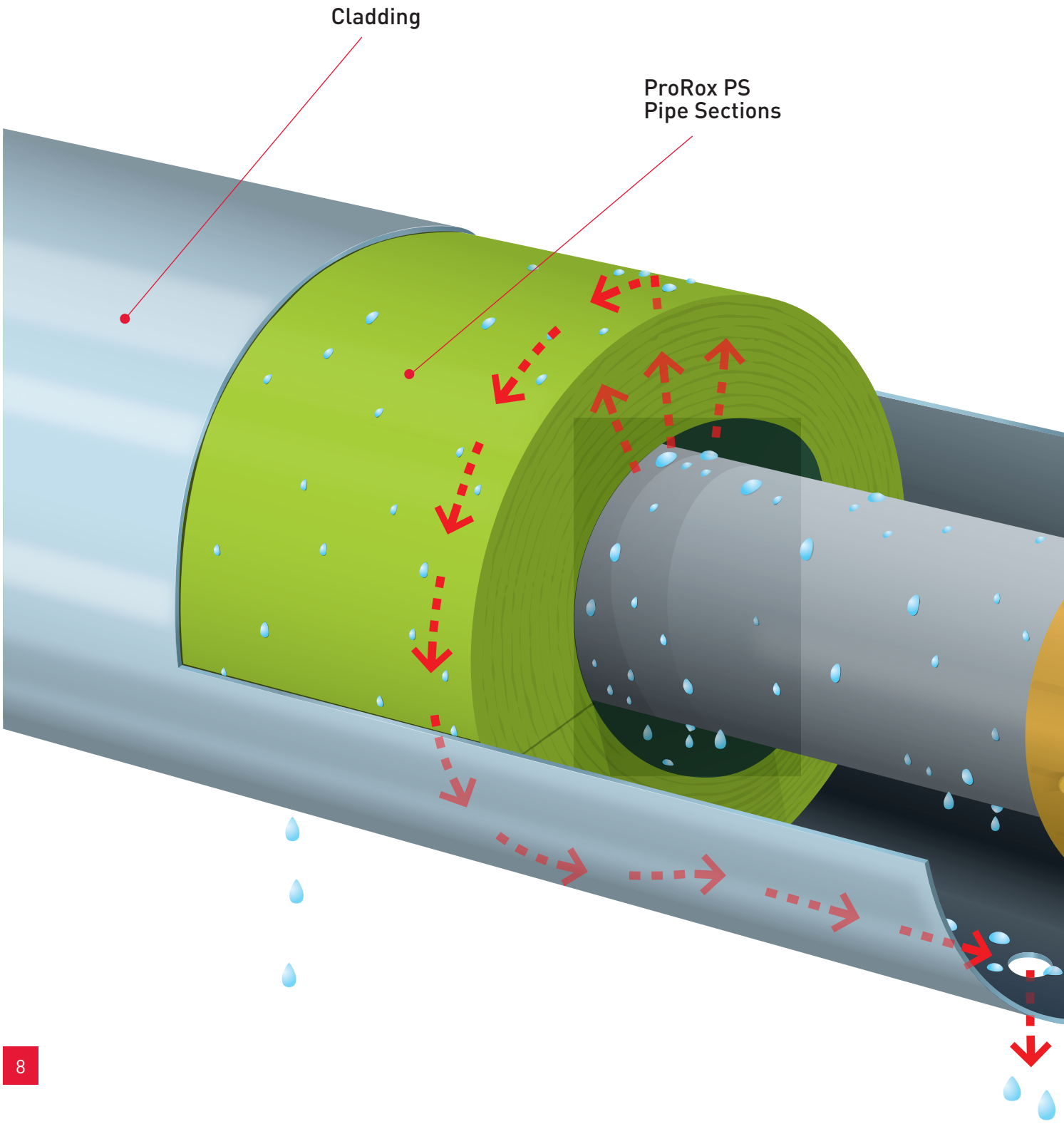
- **High temperature resistance:** ProRox NCS 2000 is made in high temperature resistant polymer (maximum lifetime service temperature of 160°C and up to 219°C on short term e.g. in relation to steamouts).
- **Unique design:** The flexible spacers are designed specifically for ProRox PS Pipe Sections without facing. Water that has penetrated the system can evaporate through the open structure of the mineral wool.
- **Uniform load transmission:** The spacer includes supports that are uniformly placed and arranged in a radial way. This arrangement ensures that the load transmission is uniform to the pipe.
- **Fast and easy installation:** The spacers are fast and easily clicked on the pipe and the tension in the product keeps the spacer on both vertical and horizontal installations.
- **Perfect fit:** One spacer size fits a range of pipe diameters. For higher pipe diameters a band is available. The spacer rings are fitted with protruding ears that will dig into the stone wool Pipe Sections and ensure that the rings stay in place during service.

The ProRox NCS 2000 is to be used for non-contact insulation systems as part of the Corrosion Under Insulation (CUI) mitigation. The product is developed as an alternative to metal systems.

- As ProRox NCS 2000 spacer rings have been designed specifically to fit the ProRox PS Pipe Sections range, the 2 products are only offered together as a system.

How does this system work?

The ProRox non-contact system with spacers creates air gaps between the steel piping and the ProRox insulation material. The constant flow of air will dry out the pipe and creates room for water to evaporate through the insulation's open structure. So when water enters the system, the water can easily dry out from the steel pipe. The water vapour in the insulation will, due to temperature gradients, move to the cladding. There it will condensate and, due to gravity, run to a lower point where it can be drained out.



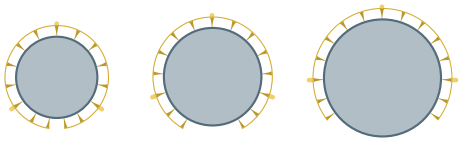
What's in it for you?

Today's market place is showing many solutions to mitigate CUI.
The ProRox non-contact system outbalances most of them.

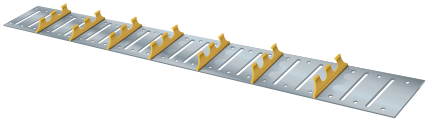
- Fast and easier installation – reduced labour cost
- No tools required for installation
- No sharp edges, therefore reducing the risk of:
  - personal accidents during installation
  - damage of the corrosion protection during installation and service
  - damage of heat tracing
- No risk of bimetallic corrosion
- Protruding ears ensure that rings stay in place during service on horizontal and vertical pipes.
- One ring fits on several pipe diameters
- Specifically designed system: all rings fit to ProRox Pipe Section ranges
- Boroscope inspection of the pipe is possible during operation

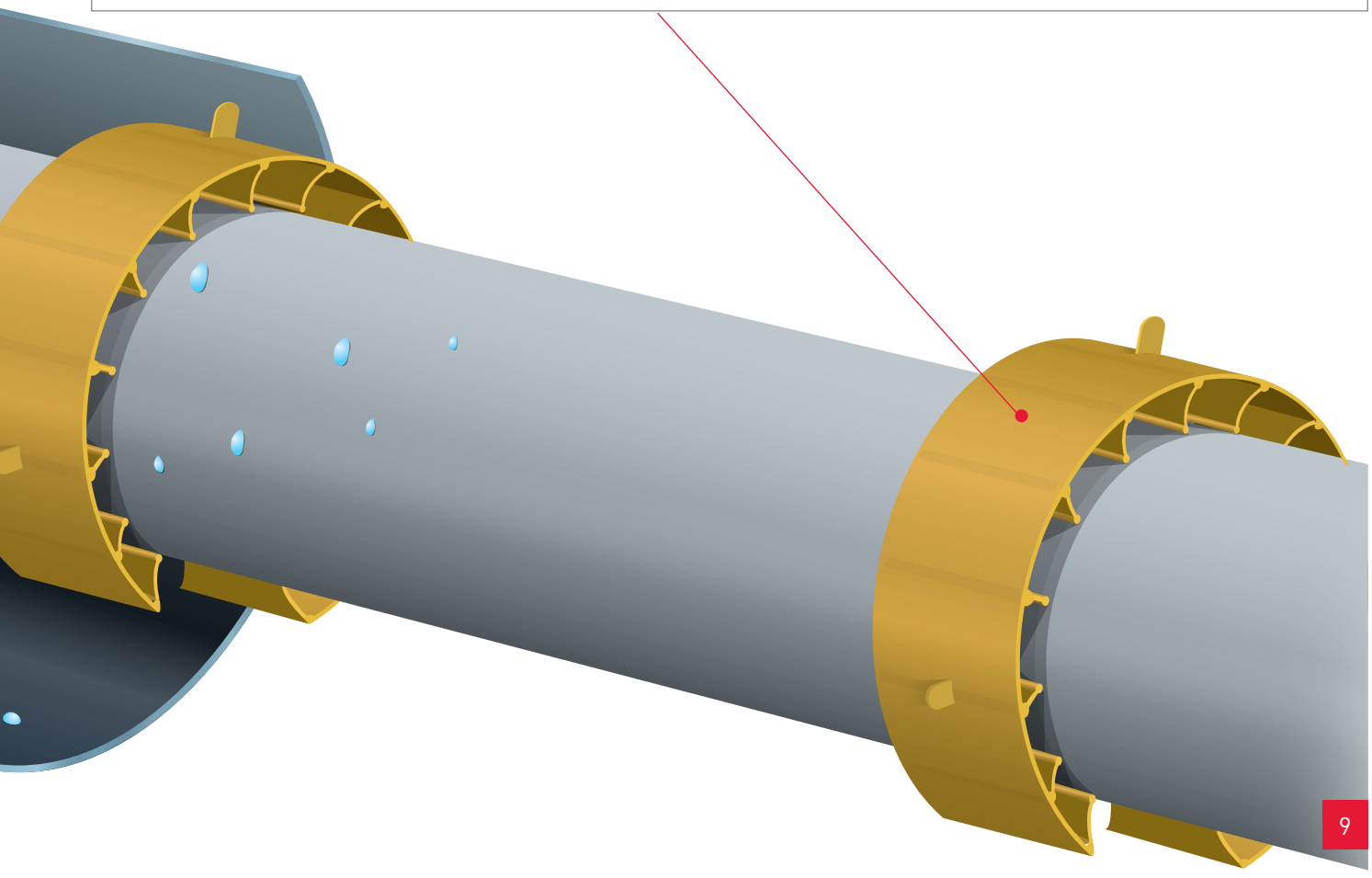
Spacer ring: ProRox NCS 2000

- Protruding ears ensure that the spacers stay in place during service.
- The height (inside legs) of the spacers are specifically designed for optimal fit of the ProRox Pipe Section range.
- For optimum mechanical integrity of the full system, it is recommended to install 4 spacers per running meter. The maximum recommended pitch between spacers is 330 mm.
- The spacers are clicked onto the pipes.
  For horizontal pipes the opening of the ring should face downwards.
- One spacer size fits a range of pipe diameters



- ProRox NCS 2000 is delivered as a ring in 8 standard dimensions covering pipes up to 324 mm. For bigger pipes and tanks a specially designed band is delivered.





Installation on pipes: technical specifications

For straight pipes with outer pipe diameters up to 324 mm the spacer rings should be used in accordance with the table below.

Spacer size	No.	18-25	28-38	42-57	60-80	83-114	121-163	169-222	230-324
Suited for outer pipe diameter	No.	18-25	28-38	42-57	60-80	83-114	121-163	169-222	230-324

The spacers are named ProRox NCS 2000 18-25 mm, ProRox NCS 2000 28-38 mm, ProRox NCS 2000 42-57 mm etc. to describe the range of outer pipe diameter in mm the specific spacer is designed for. The spacers will fit around the pipe for 75% to 100% – sufficient to create the needed air gap under the insulation and provide a mechanical base for stone wool insulation. The spacer height varies between 15 to 18 mm. The rings cover pipes up to 324 mm. For bigger pipes and tanks a specially designed band is being used.

The table below shows which ProRox Pipe Section fits the outer pipe diameter and the adequate spacer size:

Outer pipe diameter	ProRox NCS 2000	Inside diameter of ProRox PS Pipe Section
mm	(type: xx - xxx)	mm
18	18 - 25	48
22	18 - 25	54
28	28 - 38	60
35	28 – 38	70
42	42 - 57	76
48	42 - 57	83
54	42 - 57	89
60	60 - 80	102
64	60 - 80	102
70	60 - 80	108
76	60 - 80	114
83	83 - 114	121
89	83 - 114	127
102	83 - 114	140
108	83 - 114	151
114	83 - 114	159
133	121 - 163	169
140	121 - 163	178
159	121 - 163	205
169	169 - 222	205
194	169 - 222	230
219	169 - 222	260
230	230 - 324	273
245	230 - 324	280
273	230 - 324	305
305	230 - 324	341
324	230 - 324	356
>324	band	OD + 2x15mm

Acoustic properties tested according to ISO 15665

The acoustic properties of the ProRox NCS 2000 system have been tested and documented, proving the positive result of the acoustic insulation performance. Our solution: ProRox PS 960 in 85 mm thickness, spacers and 1 mm of steel cladding, meets the ISO 15665:2003 requirements:

- For pipe diameter up to 300 mm: Class A1, B1, C1
- For pipe diameter 300-650 mm: Class A2, B2, C2

ProRox NCS 2000 helps to reduce corrosion-related costs caused by plant shutdowns, plant and environmental repair and people risks.

Keep everything under control

In order to keep production reliable and efficient, we suggest a regular check-up of your insulated installations. Our proven CUI non-contact system is developed in a way boroscope inspection of the pipe is possible at all times during operation. The advantages? The shutdown times needed for plant revisions can be reduced to the max and the availability of the production plant can be increased.

ROCKWOOL Technical Insulation

ROCKWOOL© Technical Insulation, a subsidiary of the international ROCKWOOL Group, is the worldwide market leader in technical insulation. With our comprehensive product lines ProRox and SeaRox we cover the whole industrial market and marine & offshore industry, providing a full range of products and systems for the thermal and firesafe insulation of technical applications. Besides sustainable products we offer reliable expert advice, from documentation to delivery and after sales service. Throughout the whole chain from specifier, through dealer to contractor and installer we aim to add value. We don't just sell products, we supply solutions. It's this total approach that makes us the ideal choice for professionalism, innovation and trust.

All explanations correspond to our current range of knowledge and are therefore up-to-date. The examples of use outlined in this document serve only to provide a better description and do not take special circumstances of specific cases into account. ROCKWOOL Technical Insulation places great value upon continuous development of products, to the extent that we too continuously work to improve our products without prior notice. We therefore recommend that you use the most recent issue of our publications, as our wealth of experience and knowledge is always growing. Should you require related information for your specific application or have any technical queries, please contact our sales department or visit our website **www.rockwool-rti.com**.

The ROCKWOOL Group

The ROCKWOOL Group is the world's leading supplier of innovative products and systems based on stone wool. We create sustainable solutions to protect life, assets, and the environment today and tomorrow. Stone wool is a versatile material based on one of nature's most abundant resources. It forms the basis of the following ROCKWOOL Group businesses: building insulation; industrial & technical insulation for process industry, marine and offshore; acoustic ceiling systems; exterior cladding; horticultural substrate solutions; engineered fibers; noise and vibration control.

The ROCKWOOL Group was founded in 1909 and insulation production started in 1937. The Group's head office is located close to Copenhagen. In 2014, the Group generated net sales of EUR 2,180.4 million. The company is listed on the NASDAQ Copenhagen stock exchange. The Group's operations have a large presence in Europe and we also have facilities in Russia, North America, India and East Asia. Our more than 11,000 employees in more than 35 countries cater for customers in a large part of the world. For more information, please visit **www.rockwool.com**.

ROCKWOOL Technical Insulation

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ROCKWOOL Technical Insulation
is part of ROCKWOOL International A/S

The ProRox NCS 2000 system is initially launched in the United Kingdom, Denmark, Sweden, Norway and Finland.

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TECHNICAL INSULATION

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