

# Dredging Equipment



# Smarter polymer and technology solutions

**The growing global population, rise of emerging economies and impact of increasingly unpredictable climate events place even greater pressure on our environment. The world we live and work in is constantly changing, and civil engineered infrastructure must be more reliable and robust than ever to keep up.**

Trelleborg Marine & Infrastructure's polymer sealing and damping solutions are built on deep expertise and decades of craftsmanship. When it comes to water management, tunneling, dredging, noise and vibration isolation, offshore renewables and high-performance special projects, the operational capability of our solutions are assured at the highest level, so our world keeps moving and working.

We have unrivaled global reach, with feet-on-the-ground local presence, cross-industry expertise and in-house end-to-end solution capabilities, combining to improve integrity, sustainability and efficiency, and accelerate performance across projects.



As well as being the global leading provider of dredging solutions to customers around the world, Trelleborg Marine & Infrastructure supplies dredging hoses to all major dredging companies in Belgium and the Netherlands, the territory widely considered to be home to the world's market leaders. With more than 100 years of industry-leading expertise, Trelleborg Marine & Infrastructure is at the forefront of the design, manufacture and installation of polymer sealing and damping solutions for civil infrastructure operations.

During this time, we have developed a unique understanding of the critical challenges involved in civil infrastructure applications, allowing us to innovate continuously to provide products and solutions driven by quality, with assured performance, improved safety and reliability, and reduced operational costs.

Our market-leading sealing and damping solutions, unique industry insight and comprehensive aftersales support make Trelleborg Marine & Infrastructure the partner of choice.



**“Trelleborg Marine & Infrastructure’s polymer sealing and damping solutions are built on deep expertise and decades of craftsmanship.”**

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## CHAPTER 1

# Smarter Approach to dredging

**Dredging hoses demand long-lasting reliability and safety to ensure efficient delivery and discharge of abrasive materials. The complex nature of dredging hoses means they must be able to perform efficiently, even in the harshest working conditions.**

High-quality raw materials and stringent testing methods are crucial to maintaining the performance, reliability and safety of dredging equipment. Without superior materials, dredging hoses risk premature wear and tear and, in some cases, failure. Likewise, robust testing ensures that dredging hoses are designed to perform efficiently in the working environment and carry materials without risking the safety of the operation.

Trelleborg has been the leading supplier of dredging equipment in various applications for several decades. Our dredging hoses are based on robust design criteria and testing to ensure flexibility, reliability and resilience, with longer-life guarantee in all applications. Our deep sector expertise, high-quality products and use of the very latest technology have enabled Trelleborg to supply its products to numerous leading dredging companies across the globe.



## CHAPTER 2

# Design criteria

**Design criteria are created using the latest technology methods to ensure safety and reliability of dredging equipment for a wide range of applications. Each dredging hose is designed according to a customer's individual specifications, so that the final product is tailor-made to the specific working conditions of their environment and suitable for the exact materials it will transport.**

Reliability is guaranteed from concept to completion and beyond, starting with the use of high-quality, raw materials. Chosen specifically for its high level of wear resistance and flexibility, rubber is the ideal material for transport lines. Quality control is guaranteed through the specific rubber compounds used, as well as the precise layering of each element of the hose.

An overdimensioning process is employed during the design stage, making each hose thicker than specified, which provides a safety margin to give the hose an additional shield against unforeseen circumstances. Each hose consists of three essential layers – an inner layer, a reinforcement layer and an outer layer – which are vital to the quality and functional capabilities of the hose.

Robust testing schemes ensure every hose is suitable to perform efficiently in the specific environment. As well as the standard dimensional and visual appearance checks, additional checks including bending tests, tensile tests, pressure tests and bursting pressure tests, guarantee a reliable, fit-for-purpose hose.

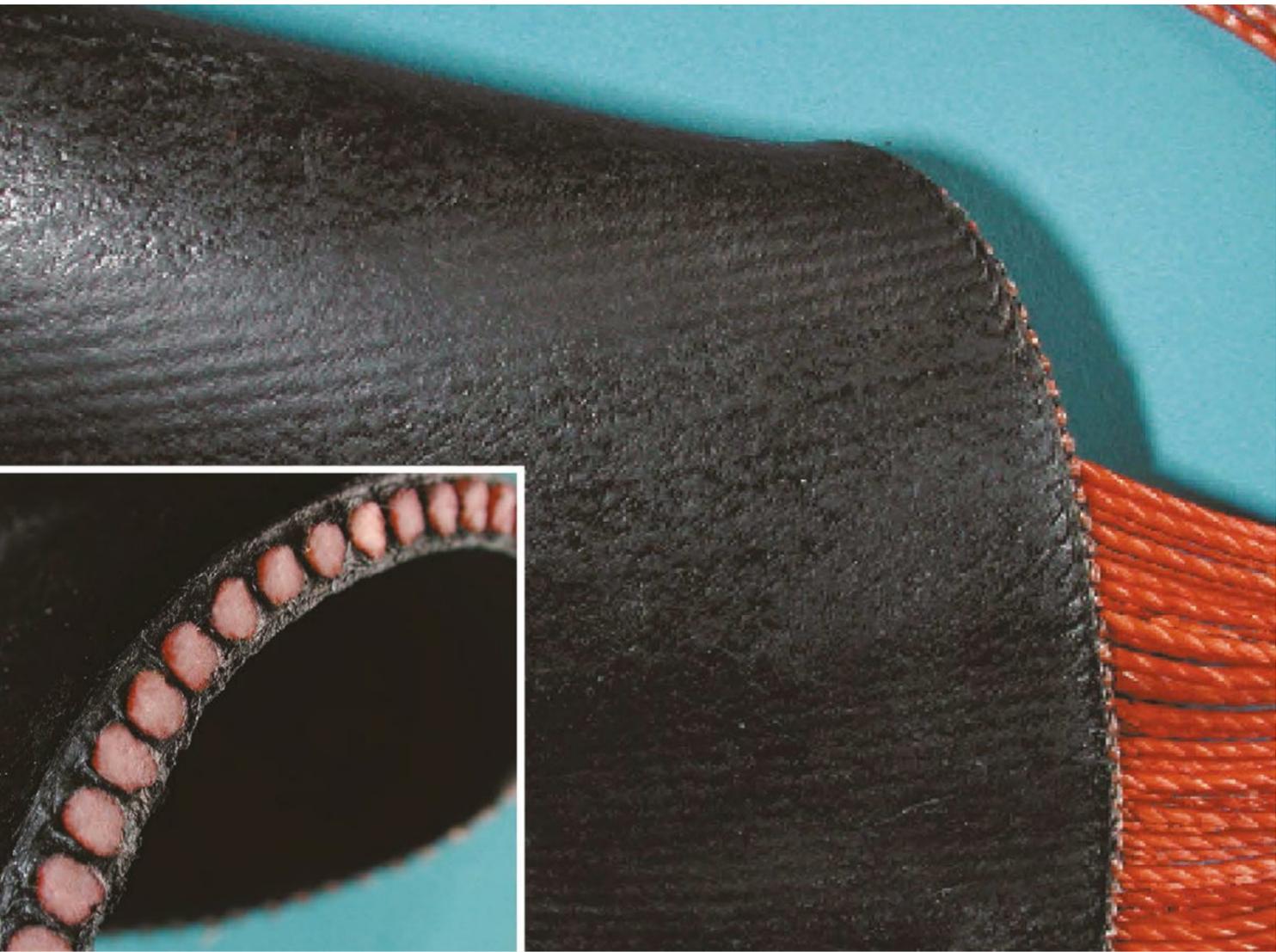
### INNER LAYER: RUBBER

The properties of the inner layer are decided by the materials it will be used to transfer – this could be solids, liquids, gases, acids and alkalis or abrasives with high velocity. Dredging slurry is mostly a combination of sand, gravel, rock and water. The polymer used could either be natural rubber, polybutadiene or styrene butadiene rubber, or a combination of these. Regardless of which polymer is chosen, the inner layer is guaranteed to be resistant to the materials to be transported.

Sufficient testing ensures the rubber compounds are analyzed for strength and elongation at break and hardness, before and after aging. Testing also measures tear strength, solvent, heat and abrasion resistance, ensuring these are adequate to perform in the specific working environment.

### REINFORCEMENT LAYER: RUBBERIZED FABRIC

The base polymer and fabric for the reinforcement layer is dependent on the operating pressure of the hose. As a result, the precise bonding between the layers is crucial for maximizing the strength of the hose in working conditions. Unidirectional tire cords are specifically chosen to avoid contacts between the threads, which may result in premature failure of the hose. Testing for fabric strength and elongation at break, as well as the bonding strength between layers ensures the hose can withstand high pressure.



### OUTER LAYER: RUBBER

The outer layer has cut and chip resistant properties and a high abrasion resistance, as well as oil, heat, ozone, chemical and oxygen resistance properties, for resilience when exposed to various environmental conditions. Ethylene propylene diene rubber (EPDM) is the primary choice of material, ensuring the hose performs efficiently in challenging environmental conditions.

Testing includes strength and elongation at break, and hardness before and after aging, as well as tear strength, ozone resistance and abrasion resistance.

## CHAPTER 3

# Production facilities

**The production and manufacturing process is vital to ensuring the lifespan of a hose in critical applications.**

We have developed production lines controlled in-house from our design center and state-of-the-art facilities both in our Qingdao and Ridderkerk factories. These facilities use a wide range of mandrels, semi-automatic winding machines and a number of different autoclaves for the technical process, which guarantees fast and efficient production of our dredging products.

Making a hose begins with the mandrel. Several rubber and cord piles are wound onto the mandrel, depending on the specification. Steel flanges or couplings are strongly bonded with each end of the rubber hose, which prevents collapse during operation. The mandrel piles are then covered with a layer of rubber to closely bond the inner and outer layers, which is essential for ensuring the strength and flexibility of the hose.

The vulcanization process strengthens the rubber polymers and adds elasticity for flexible application. For self-floating dredging hoses like the Trelleborg FloatLine® and RockFloat® this is followed by a wrapping of polyethylene (PE) foam and a heavy reinforced outer layer, before repeating the vulcanization process.

Each stage of production and manufacture is quality-assured by in-house specialists, who inspect the hose after each step, before being signed-off upon completion. Rigorous testing guarantees quality throughout the production process, ensuring customers receive a hose tailor-made to their specifications, which will perform efficiently in any operation.



# Raw material for dredging hoses



**When it comes to creating dredging hoses that will perform with the resilience and longevity required, it's vital that they are made with high-quality materials. In recent years, there has been an influx of smaller manufacturers using cheaper raw materials, as well as recycled materials, which have implications on product quality and durability.**

While recycled rubber is more environmentally friendly, its quality is not as high as in recycled plastic, paper or metal, or raw materials. Simply, the technology necessary to recycle rubber to the standard required in dredging hoses has not yet been developed.

The impact of these low-quality materials on product performance and lifespan is often ignored by new suppliers, but inferior material leads to inferior performance. While low-cost hoses are inexpensive in the short term, if they are made with low-quality material they can be prone to breaking down and failing prematurely without warning which could prove more costly in the long term.

Trelleborg Marine & Infrastructure's dredging hoses are made from high-quality rubber, which offer higher resilience and a longer-life guarantee than cheaper equivalents. This means they continue to function efficiently, reliably and safely, no matter the environmental condition or the working pressure of the materials being transported.

# Production specification

## DISCHARGE HOSE

These hoses can be equipped with all the different types of flanges Trelleborg Ridderkerk supplies. They are available in any size, and have a burst pressure, up to 150 bar. Liner thickness specified applies to the inside of the hose as well as the flanges. Tricolor wear indicators are optionally available.



Discharge hose

## SUCTION HOSE

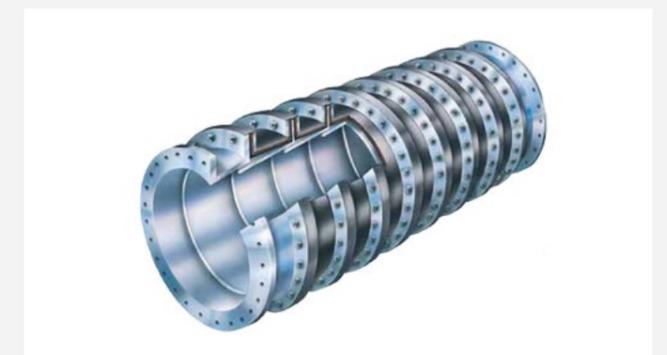
The suction hoses can be fitted with all the different types of flanges Trelleborg Ridderkerk supplies. Mostly used with these hoses are the rubber flange/steel backing flange and the Double Action flange. They can be supplied in any size and, depending on application, with 100% vacuum capability and high implosion pressures. For use with gimbals and in the ladder of cutter dredgers we can furnish you with small bending radius suction hoses. Trelleborg Ridderkerk has delivered the suction hoses for the largest trailing suction hopper ever built. In some applications, heavy spring steel spirals are used to prevent the hose from kinking. We never use ordinary (thus cheaper) galvanized wire of suction hoses. Ordinary wire cannot cope with the high dynamic loads which occur for example when your suction pipe gets obstructed. Trelleborg Ridderkerk spring steel spirals absorb these peak loads without the risk of collapsing. Heavy duty big bore suction hoses come equipped with rigid steel rings. This allows for smooth bending of the hose.



Suction hose

## BUCKET HOSE

These hoses, serving as discharge or suction hoses, are able to perform under the worst conditions imaginable. Used with very sharp materials like coral and caprock, the replaceable steel sections provide immunity to cutting while the rubber body allows for bending. Although it should be noted that these hoses require provisions to be made to prevent them from being bent beyond the minimum bending radius allowable.



Bucket hose

## ROCKTRAIL®

Driven by the application of trailing suction hopper dredgers in highly abrasive materials and the execution of jobs on sites with sharp-edged and coarse solids, Trelleborg Ridderkerk has designed the RockTrail® range of dredging hoses and flexible joints, with application of high Rockwell hardness steel rectangular wear rings. This enables us to manufacture flexible joints with a relatively large steel inner surface and at the same time with the needed flexibility and bending properties. This patented design makes application of polymer-manufactured hoses possible under circumstances and conditions where this was not possible in the past. As well as being used on the large trailers, RockTrail® suction, suction-discharge hoses and expansion joints are also used on the recently-built large rock cutter dredgers.

## CAPROCK HOSE

As a standard supplied with heavy cord layers, this hose offers considerable advantages when used for transporting sharp materials. Although rubber is a very abrasive-resistant material, it has less resistance to cutting. We vulcanize rings with a rectangular cross section into the hose, preventing the transported material from cutting through the liner.

## COMPENSATORS AND EXPANSION JOINTS

Our compensators are used in various applications, for example, to compensate for big displacements in piping systems or as flexible joints in lines inside ships or process plants. The compensators can be equipped with all the types of flanges already mentioned. The rubber used for the inner and outer layers is chosen with full regard to working conditions.



RockTrail® caprock hose



Expansion joint

## SELF-FLOATING HOSE SYSTEMS

Trelleborg Ridderkerk floating hose systems have been used on all the major reclamation projects around the world. Driven by the ever-increasing demand for longer lifetimes and the fact that floating hoses are now commonly used for cutter jobs, Trelleborg Ridderkerk has redesigned the classic rubber lined floating hose.

We incorporate the same design principle as the Rocktrail® suction/dishcharge hose to create the RockFloat® Floating discharge hose. By reducing the polymer contact surface and adding rectangular wear rings, the RockFloat® hoses show a significant improvement in lifetime.

It is now possible to use a flexible rubber floating hose as a cutter discharge line without the risk of destroying that line within a few months of operation.

The patented RockFloat® floating discharge hoses feature excellent bending characteristics with long life time, at low maintenance, for heavy duty rock cutter jobs.

These features make the following applications possible:

- Offshore rock cutter discharge applications
- Conveyance slurries containing caprock, shell and coral
- Hopper bow connection discharge applications
- Discharge of hopper rip job slurries and sharp-edged gravel

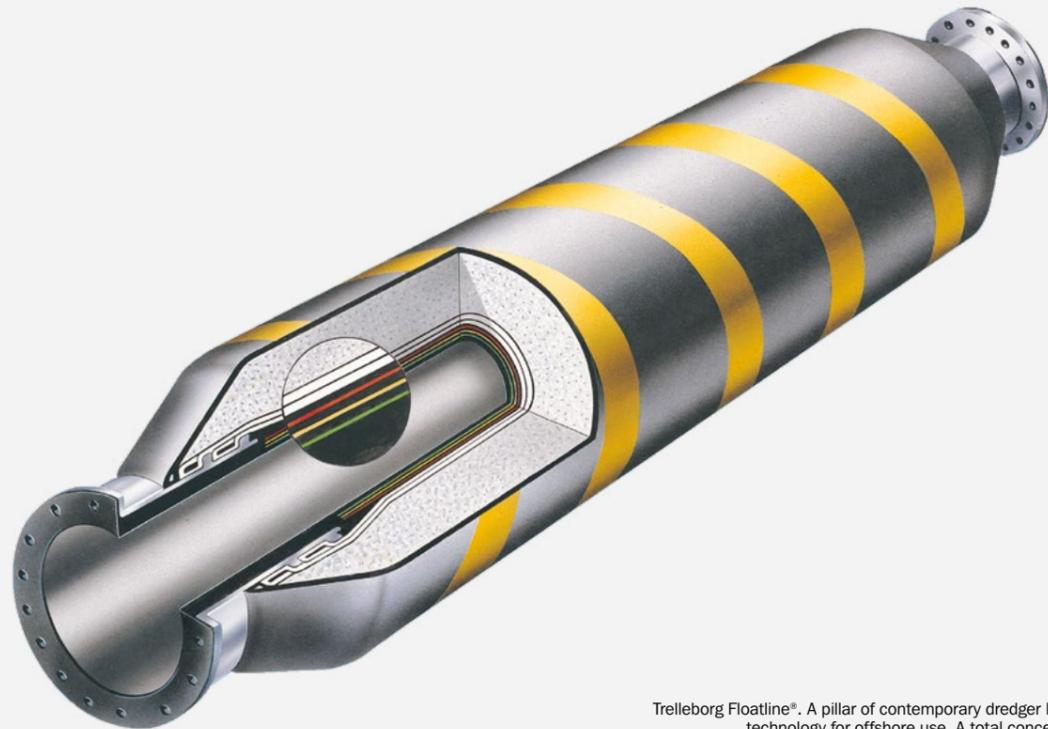


Floatline

For lighter-duty applications, Trelleborg supplies a range of standard floating hoses. The Trelleborg FloatLine® discharge hoses feature:

- Extensive use of liner compound with high natural rubber content
- High-density foams for very low, long-term water absorption
- Heavy-duty floatation outside cover reinforcement
- The strongest-fitting connection in the industry

This makes the FloatLine® hose the most economical solution for rubber-lined floating hose applications.



Trelleborg Floatline®. A pillar of contemporary dredger line technology for offshore use. A total concept.

## CHAPTER 6

# Flanges and coupling variations

### STRAIGHT ENDS

Hoses with straight ends connect in multiple ways for easy mounting, though these are only suitable for low pressure and low risk operations.



### LOW PRESSURE COLLAR

Low pressure collar hoses have widened ends to avoid obstruction of flow. These are only suitable for low pressure and low risk operations.



### RUBBER FLANGE-STEEL BACKING FLANGE

Rubber flange-steel backing flanges are used for medium pressures in suction hoses. The rubber flange means that the hose can remain relatively short, starting from a maximum angle of curvature. As the wear layer rubber extends partly into the top edge of the flange, it forms a tight seal with the flange connection.



### RUBBER FLANGE, STEEL BACKING FLANGE AND GASKET FLANGE

Designed for larger bore suction-discharge applications, this flange system operates at higher pressure and remains tightly sealed. The integrated steel insert flange at the flange face maintains a tight connection, even at higher axial loads and pressures.



## DOUBLE ACTION FLANGE® STANDARD

The Double Action Flange® has superior axial strength due to an integrated locking flange. Suitable for high bending loads, the thickness of the integrated flange and backing flange ensures it will not burst under pressure or fall apart due to rust. The thick integrated flange and backing flange allow for a large radius in the flange neck and no cutting forces on the cords.



## DOUBLE ACTION FLANGE® REINFORCED

The addition of a steel gasket lange with the Double Action Flange® provides better sealing at high pressures and offers protection to the reinforcement cords when mounted to sharp edged, raised face flanges.



## STEEL COUPLINGS

Solid steel couplings are suitable for extreme working conditions and heavy-duty applications. They can be manufactured with the smallest possible pitch circle diameters and are vulcanized into the hose. The internally-rubberized couplings are secured with our safety strap system, which is also used as a standard in our self-floating hoses for operational efficiency during extreme weather, without the risk of a defective line.



## SWIVEL FLANGE

The swivel flange is suitable for medium pressures and provides easy mounting at points where the bold holes in the mounting flanges are not precisely aligned.



FLANGE TYPE	MAIN FEATURES	PRESSURE TYPE
<b>Straight ends</b>	<ul style="list-style-type: none"> <li>Suitable for straight hoses</li> </ul>	Low
<b>Low pressure collar</b>	<ul style="list-style-type: none"> <li>Widened ends to avoid obstruction of flow</li> </ul>	Low
<b>Rubber flange-steel backing flange</b>	<ul style="list-style-type: none"> <li>Suction applications</li> <li>Hose remains relatively short</li> <li>Extended wear layer rubber to form tight connection</li> </ul>	Medium
<b>Rubber flange, steel backing flange and additional steel gasket flange</b>	<ul style="list-style-type: none"> <li>Larger bore suction-discharge applications</li> <li>Tight connection at higher axial loads and pressures</li> </ul>	High
<b>Double Action Flange® Standard</b>	<ul style="list-style-type: none"> <li>Suitable for high bending loads</li> <li>Integrated locking flange for superior axial strength</li> <li>Large radius in the flange neck</li> <li>Raised face flange edges to protect from damage</li> <li>Steel gasket flange available to provide better sealing at high pressures</li> </ul>	High
<b>Double Action Flange® Reinforced</b>	<ul style="list-style-type: none"> <li>Suitable for high bending loads</li> <li>Integrated locking flange for superior axial strength</li> <li>Large radius in the flange neck</li> <li>Better sealing at high pressures</li> <li>Protection to the reinforcement cords when mounted to sharp-edged, raised-face flanges.</li> </ul>	High
<b>Steel couplings</b>	<ul style="list-style-type: none"> <li>Extreme working conditions and heavy-duty applications</li> <li>Manufactured with smallest possible pitch circle diameters</li> <li>Vulcanized into the hose</li> <li>Secured with safety strap system for efficiency in challenging environments</li> </ul>	High
<b>Swivel flange</b>	<ul style="list-style-type: none"> <li>Easy mounting, suitable where bold holes in mounting flanges are not precisely aligned</li> </ul>	Medium

## CHAPTER 7

# Testing

**There are two vital factors which determine the functionality and efficiency of a hose. Alongside high-quality raw materials, the other key factor at play is robust testing methods.**



Industry-leading manufacturers of dredging hoses utilize production methods and materials of appropriate quality, but they also carry out stringent testing to ensure that their solutions provide the long lifespan that each project demands.

In dredging hoses, the inner and outer rubber layers need to be tested to be certain they will perform as required. As we have already alluded to, dredging hoses have to transfer a range of different materials at high velocity and the polymer used to make a hose's inner layer is determined by the material being transferred. Trelleborg performs rubber compound testing to determine strength and elongation at break and hardness, both before and after aging. We also measure tear strength, solvent and heat resistance, and abrasion resistance, to ensure these are high.

A dredging hose's outer layer is exposed to a variety of environmental elements and needs to be resistant to oil, heat, ozone, chemicals and oxygen. Also, it must have cut and chip resistance properties and high resistance to abrasions. Trelleborg tests for strength and elongation at break, and hardness before and after aging, as well as tear strength, ozone resistance and abrasion resistance.

In terms of final product inspection, typical tests in this industry include dimensional checks and visual appearance checks. However, these tests do not go far enough and fail to provide sufficient information about the performance and lifespan of a hose. This is why Trelleborg performs additional compound testing, to ensure the correct materials have been used in the production process to mitigate the aging effect of the rubber compound. Additional tests to ensure the performance of a hose may include bending tests, tensile tests, pressure tests and bursting pressure tests.

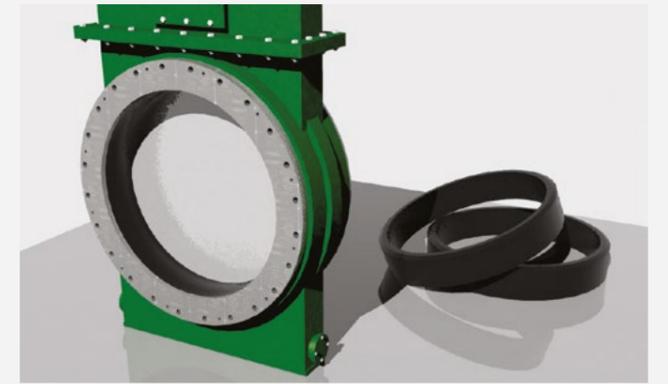
## CHAPTER 8

# Other dredging products

### SEALING RINGS FOR DREDGE GATE VALVES

The market leader in this specific field is Royal IHC in the Netherlands. Their gate valve system has widely been regarded as the best in the market for many years. The valve system provides a complete watertight sealing. These valves can be supplied for operating pressures of 8, 15 and 25 bar.

Trelleborg produces the wear-resistant rubber sealing rings for all the IHC valve systems available in diameter range 250 till 1400 mm.



### FENDERS FOR PROTECTION OF DRAGHEADS

To protect the hull of a suction hopper dredger and the very expensive draghead against impact loads during challenging conditions, special rubber fenders are mounted. All our fenders are proven to perform both durably and reliably.



### SEALS FOR BOTTOM DISCHARGE SYSTEMS

With regard to sand discharge systems, there are two main types: bottom doors and conical valves. Trelleborg produces a wide range of excellent wear-resistant rubber seals used in the associated sealing systems. Different types are available.



### NOZZLES FOR HOPPER

Tailor-made, wear resistance, damping, noise reduction.

One-piece product, no conventional nozzle cover, and no need to maintain and replace the nozzle cover as often as ordinary steel nozzles, saving on maintenance costs.





# Conclusion



## DISCLAIMER

Trelleborg AB has made every effort to ensure that the technical specifications and product descriptions in this brochure are correct.

The responsibility or liability for errors and omissions cannot be accepted for any reason whatsoever. Customers are advised to request a detailed specification and certified drawing prior to construction and manufacture. In the interests of improving the quality and performance of our products and systems, we reserve the right to make specification changes without prior notice. All dimensions, material properties and performance values quoted are subject to normal production and testing tolerances. This brochure supersedes the information provided in all previous editions. If in doubt, please check with Trelleborg Marine and Infrastructure.

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**“Trelleborg strives to design, produce and deliver rubber products which are in accordance with customers’ requests, needs and expectations. This policy is based on the Trelleborg Group policy statement ‘Code of Conduct’, which can be found at [www.trelleborg.com](http://www.trelleborg.com).”**



Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative solutions accelerate performance for customers in a sustainable way.

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