

# Enduroq: Surface technologies for large hydraulic cylinders





## Sound function throughout total lifespan

For large hydraulic cylinders there is one thing you demand above all: flawless function throughout the lifespan of your product. From civil engineering to maritime applications and even offshore use. Failure of large hydraulic cylinders results in enormous replacement costs and, above all, downtime on the entire facility. With Enduroq surface technology, you can rely on excellent wear and corrosion protection for the extended life of your large hydraulic cylinders.

Experience can be replaced by only one thing: even more experience. More than 35 years ago we pioneered the way. We were the first to apply corrosion- and wear-protective surface technologies to piston rods for large hydraulic cylinders in industrial applications. Since then, Rexroth has installed more than ten thousand large hydraulic cylinders worldwide in a wide variety of applications and in the most extreme ambient conditions.

We continuously evaluate the operating data of thousands of cylinders for you. These measurements ensure the development of even better surface technologies and processes. The result: Enduroq surface technology. Technology you can rely on for years and decades without any issues.

We link the measured data from a wide variety of applications to deep tribological expertise and a comprehensive approach. For every application and environment, we tailor a customised surface treatment solution and a perfectly matched sealing system to suit your needs.

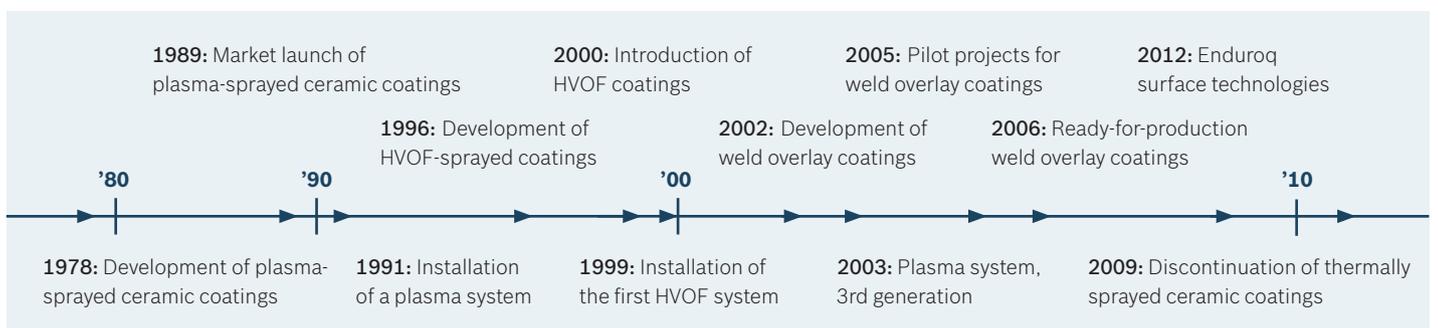
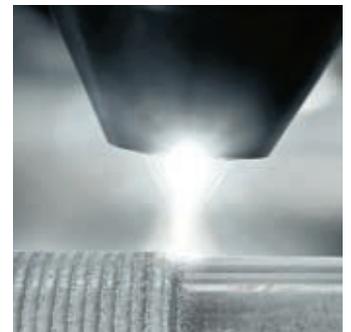
The product portfolio of Enduroq surface technology includes various coating systems with exactly defined chief applications. We carry these out ourselves on our own special systems, and we take on the responsibility. You can rely on the experience of our professionals to coat your piston rod perfectly.

Thermal spraying using HVOF technology forms the basis for the Enduroq 2000 series for large cylinders:

- ▶ **Enduroq 2000**  
Single-layer surface technology, applied with thermal spraying
- ▶ **Enduroq 2200**  
Double-layer surface technology, applied with thermal spraying

We collect Ultimet-based surface technology for large cylinders in the Enduroq 3000 series:

- ▶ **Enduroq 3000**  
Single-layer Ultimet surface technology for surfaces particularly subjected to wear
- ▶ **Enduroq 3200**  
Double-layer Ultimet surface technology for surfaces subjected to extreme wear



# Enduroq: The art of the perfect surface

Near or under water, or near the sea or under the influence of chemicals, our reliable Enduroq surface technologies satisfy the profile of properties that you require. Let us assist you in making a selection, using our experience from thousands of applications.





Temperature



Mechanical Load



(Salt) Water



Chemicals



Abrasive Materials

◀ The five most important factors influencing the piston rod of large hydraulic cylinders

**Economical protection in a mild maritime atmosphere: Enduroq 2000**

Do your large hydraulic cylinders operate in neutral to mild maritime environments? Are you looking for excellent corrosion protection with minimum seal wear? Then Enduroq 2000 is exactly the right solution for you. We apply the single-layer surface for you using the proven HVOF method. Enduroq 2000 consists of an extremely dense material.

**High quality protection under seawater conditions: Enduroq 2200**

Is your application continuously subjected to seawater? The Enduroq 2200 double-layer large hydraulic cylinders are designed specifically to meet those needs, and have been withstanding tests for decades under the most extreme conditions. It meets the toughest international standards and is allowed for use on a global scale for civil engineering and in coastal waters.

**Excellent for offshore use: Enduroq 3000**

Do you need low lifecycle costs for your offshore applications? Enduroq 3000 is particularly suited for the piston rods in highly corrosive seawater environments and under high dynamic loads. We apply the single-layer system using an innovative plasma-powder application welding technique. The particular advantage for you: in the event of mechanical damage to the Enduroq layer, the surface of an installed large hydraulic cylinder can be repaired on site. That lowers the lifecycle costs for the long term.

**Reliable under the most difficult conditions: Enduroq 3200**

Is your cylinder also exposed to aggressive environments? The Enduroq 3200 double-layer surface technology offers excellent protection against many chemical influences, and does so at a low Total Cost of Ownership. These surfaces can also be repaired on site, without having to uninstall the piston rod. That increases the availability of your facility with a significantly extended service life.

► Application areas for surface technologies

► Ambient conditions ▼ Surface technologies	Non-corrosive environment	Mild maritime environment, open area	Maritime environment, protected area	Immersed in seawater, splash-water zone
Chromium	●			
Nickel/chromium	●	●		
Enduroq 2000	●	●	●	
Enduroq 2200	●	●	●	●
Enduroq 3000	●	●	●	●
Enduroq 3200	●	●	●	●

# Data, facts and figures

Enduroq combines the physical advantages of carbon steel with exceptional corrosion protection, low friction and high wear resistance.

Enduroq	Surface technology system	Surface technology	Impact resistance	Layer thickness*	Layer hardness*	SDCT**	Roughness
<b>2000</b> <b>2200</b>	Single/ multilayer	Thermal spraying	8J	2000: 250 µm 2200: 450 µm	650 HV5	20.000 hours 40.000 hours (test ongoing)	Ra < 0.20 µm
<b>3000</b> <b>3200</b>	Single/ multilayer	Weld overlay	15J	3000: 800 µm 3200: 1.200 µm	320 HV5	40.000 hours (test ongoing)	Ra < 0.25 µm
*typical value						**Salt Droplet Corrosion Test	

## Successfully put to the test

Enduroq surface technologies have successfully passed many external and internal tests and certifications.

Here are just a few:

- ▶ ISO 6507
- ▶ ISO 4287
- ▶ ISO 4536 (58)
- ▶ ASTM G 95
- ▶ ASTM D 1141
- ▶ ASTM D 2794
- ▶ DNV - C1
- ▶ DNV - C2

We would be glad to provide you with additional results. For an extensive list, just email us:  
[enduroq@boschrexroth.com](mailto:enduroq@boschrexroth.com)

## Expertise for optimum protection

Our industry specialists provide you with comprehensive advice on which Enduroq surface technology is best for protecting your large cylinders from corrosion and wear. Here are two examples of the selection criteria, based on the internal standard TB03.400, in the civil engineering and offshore areas:

### Civil engineering:

Class	Conditions	Examples	Surface
C-2	Fresh water, outdoor application	Sluices, moving bridges, embankment gates	▶ Enduroq 2000 ▶ Enduroq 2200
C-3	Chemical compounds	Waste treatment	
C-4	Salt water	Maritime locks, RoRo bridges, flood barriers	▶ Enduroq 2200

### Offshore:

Class	Conditions	Examples	Surface
O-1	Far above the surface of the water	Drill string compensators	▶ Enduroq 2000
O-2	On deck, saltwater fog, water spray	Deck equipment, heave compensation	▶ Enduroq 2200
O-3	Under water, exposed to drilling fluids, dynamic loading	Direct riser tensioners, subsea equipment	▶ Enduroq 3000/3200

# Extended life span with our service system

If viewed over the entire life span of large hydraulic cylinders, typical maintenance costs quickly surpass the purchase costs. It doesn't have to be that way. We perfectly tailor cylinders, piston rod surface technologies, seals and fluids to your application. The result: Higher availability and lower maintenance costs.

Our database with its thousands of applications plays a crucial role. In an extensive research project together with leading seal manufacturers, we have developed a seal matrix for a wide variety of applications. Your purpose determines the configuration. Whether it's a completely closed extrusion gap at speeds up to 15 m/s, or variants that are adjustable and insensitive to dirt. Our seals have one thing in common: they combine minimum friction with excellent wear protection.

Our experience with a wide variety of fluids rounds out the system. We know firsthand how different hydraulic media react in various environments, and how they impact the chemical resistance of seals.

## Partners over the entire lifecycle

When we deliver your finished large hydraulic cylinder, we do not mark the end of a business relationship. Rather, this is often the beginning of a long time partnership. Our service organisations can always be found near you, in more than 80 countries. We ensure fast spare part service as well as preventive maintenance or repair of damaged components and surfaces.

Benefit from our experience in your applications and with our large hydraulic cylinder configuring, manufacturing and surface technology. Time to reduce your lifecycle costs with Enduroq. For more information, go to: [www.enduroq.com](http://www.enduroq.com)



- ▲ Seal testing
- ▶ Rexroth's seal matrix takes into account the seal configuration, wipers, sliding rails, and piston seal



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