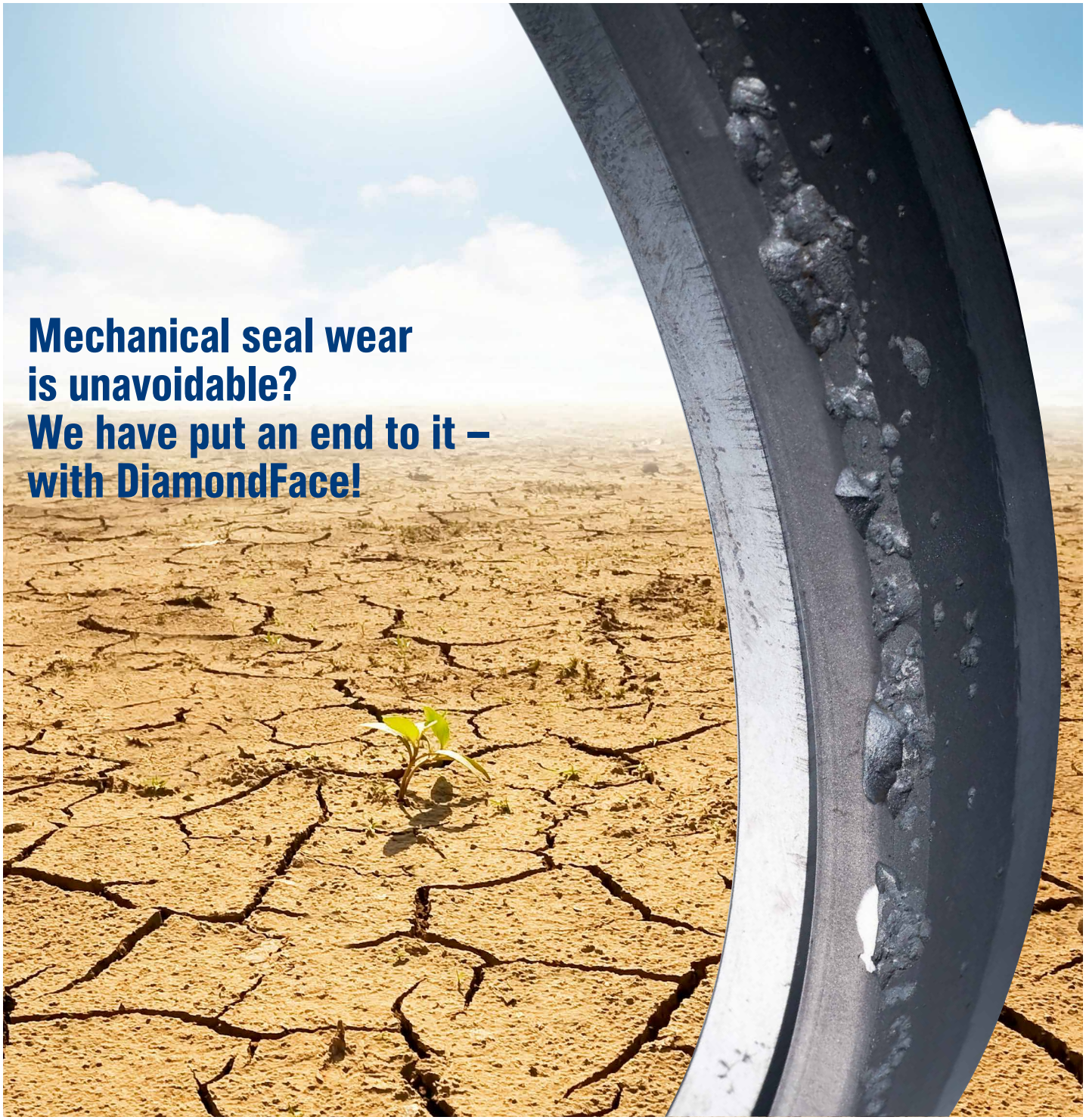
The innovation with the best operating performance
for pumps, agitators and compressors.

EagleBurgmann®
Rely on excellence

DiamondFace technology for mechanical seals

Maximum operational performance

Minimum Total Life Cycle costs



Mechanical seal wear is unavoidable? We have put an end to it – with DiamondFace!

Mechanical seals are a factor that has a decisive effect on the cost-effectiveness of your operation. Because their wear determines the productivity of the entire system, whether it is a pump, agitator or compressor. What causes damage to the seal faces? One reason is dry running which is often unavoidable due to insufficient lubrication or when gas-lubricated seal faces get in contact. The resulting temperature rise causes the seal to wear. And ultimately results in system downtimes.

EagleBurgmann has solved this problem which directly affects the success of your plant. The solution is DiamondFace.

DiamondFace is an innovative microcrystalline diamond coating for mechanical seals. It is extremely hard and offers high wear protection, excellent heat conductivity, maximum chemical resistance and low friction. The coating adhesion also exceeds all known practical requirements. This increases the service life of mechanical seals several times over, the maintenance intervals are extended accordingly and the life cycle costs are greatly reduced. DiamondFace – an innovation that pays for itself.

Hazards for mechanical seals – risks for you:

- Sharp temperature rises due to dry running or erosion of the seal faces by abrasive media.
- Compressor operating conditions in which the machine is running at speeds below the seal face lift-off threshold.
- Electrochemical corrosion in feed water pumps in power stations.

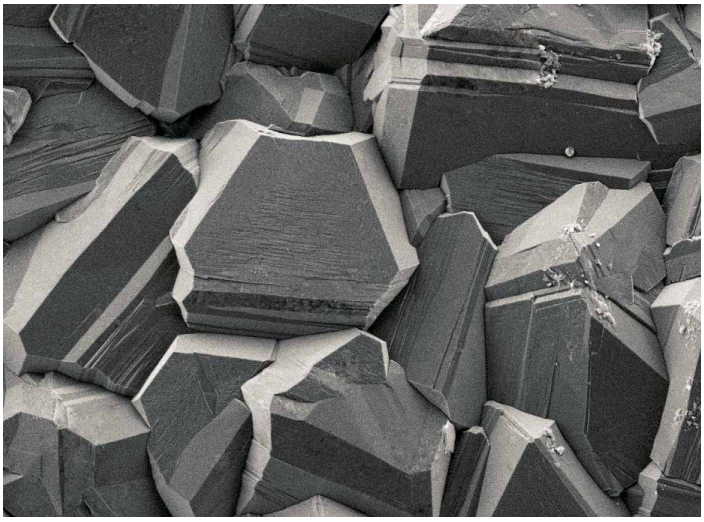
You too can benefit from our success story.

The diamond thin-layer technology was developed in 2007 by EagleBurgmann together with the Fraunhofer Institute for Surface Engineering and Thin Films (IST). EagleBurgmann has established DiamondFace for mechanical seals as a series-produced product - the very first on the market.

The technology behind it is a microcrystalline diamond layer up to 15 µm thick which is applied to the seal face under vacuum at temperatures of 2,000 °C (3,632 °F) by chemical vapor deposition (CVD). The properties of this diamond layer are where you benefit. Primarily from its extreme hardness and robustness.

Numerous applications in the fields of oil & gas, refineries, chemical industry, slurry, pharma and water supply are testament to the added value that DiamondFace can bring to the overall performance of a facility. This innovation has thousands of success stories relating to its application in a vast range of industrial sectors. Worldwide.

Unleash the massive potential of diamond.
With the DiamondFace mechanical seal for your specific applications.



DiamondFace is a synthetically-produced pure diamond with the same excellent properties as natural diamond. It is applied to silicon carbide seal faces in the form of a microcrystalline coating.

Diamonds are not only a girl's best friend. The advantages for you as an operator:

BEST OPERATIONAL PERFORMANCE

Increased service life for the mechanical seal and thus the entire system.

As there is practically no wear of the diamond layer, even when DiamondFace is running against itself, the result is an extremely long service life, even if the seal runs dry at times. The diamond coating also provides excellent protection against wear, even in media with a high solids content.

MINIMUM MAINTENANCE

Extending the maintenance intervals optimizes the entire system from the costs viewpoint.

The main cost blocks, i.e. maintenance and repair costs for the machine and seal and the stoppage and production downtime costs or prevention costs are greatly reduced.

MINIMUM TOTAL LIFE CYCLE COSTS

These factors all combine to greatly improve life cycle costs.

The total costs across the life cycle of a mechanical seal are significantly lowered by DiamondFace.

In use worldwide. Convincing worldwide.

Mechanical seals with DiamondFace cover an extremely wide spectrum of applications in many different industrial fields. The innovative thin layer technology has already become established in the following fields of application:

- **Oil, gas and multiphase applications**
- **Refining technology**
- **Pulp and paper industry**
- **Shipbuilding**
- **Mining industry / slurry applications**
- **Pharmaceutical industry**
- **Water and waste water technology**
- **Metal production and processing**
- **Chemical industry**
- **Power plant technology**
- **Food and beverage industry**
- **Special applications (ceramics, ultrapure water, etc.)**

DiamondFace in oil production

Multiphase pumps for the oil industry pump mixtures of crude oil, formation water and natural gas, in vastly differing concentrations and compositions. The pumps' sensitive components include the mechanical seals. These are generally equipped with sophisticated flushing and lubricating systems to allow them to work without interruption. They prevent overheating due to dry running or erosion of the seal faces by abrasive media. DiamondFace mechanical seals for booster pumps also make things easier, as EagleBurgmann has demonstrated with its seals that are in use successfully under extreme conditions.

DiamondFace in power plant technology

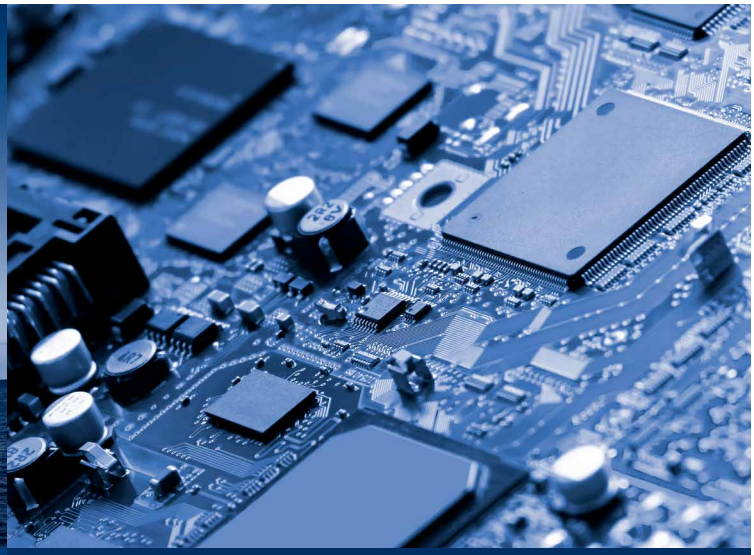
With DiamondFace coated high-performance seals there is no possibility for electrochemical corrosion in feed water pumps. The technology not only makes dosing systems superfluous, but it also impresses with outstanding operating times. DiamondFace mechanical seals are the perfect match for high performance feed water pumps and are available for both conventional and nuclear power plants.

Numerous conventional and nuclear power plant operators already rely on this innovative sealing technology with DiamondFace.

DiamondFace on the high seas

Four booster pumps on each of five cruise liners were equipped with DiamondFace mechanical seals to guarantee safe and reliable alternation between the various grades of fuel used.

The initial situation was marked by the mechanical seals frequently running dry, resulting in overloading of the seal faces and secondary seals. The result of applying DiamondFace technology is clearly improved dry running and much longer service periods of up to 10,000 hours.



DiamondFace in microelectronics components production

The production of microelectronics components is a complex and demanding cleanroom process that requires a supply of totally pure process water.

With DiamondFace coating the mechanical seals, the contamination limits were easily undershot as the facing is subject to practically no wear, thus guaranteeing fault-free operation.

DiamondFace in ceramics production

Ceramic mold casting is one of the traditional ceramic molding processes. The mixing and dispersing process causes a sharp temperature rise in the machine and at the seal faces, causing the dispersion to adhere.

The low friction coefficient of the DiamondFace coating greatly reduces the rise in temperature, preventing adhesions and guaranteeing an interruption-free process.

DiamondFace in oil sand extraction

The exploitation of oil sand fields exposes the equipment used to the harshest conditions. The pumping equipment must be able to withstand an extremely abrasive mixture of oil, sand, water and steam. As a consequence, the service life of conventional mechanical seals is shortened due to insufficient lubrication and dry running caused by the abrasive solids content.

The application of mechanical seals with DiamondFace coating optimizes the dry running capability and extends operating periods several times over.

Valuable benefits of the diamond coating:

The combination of silicon carbide (SiC) seal faces with the DiamondFace coating also allows longer dry running phases (up to several hours) while reducing heat generation.

Minimal friction
Minimized friction coefficient when dry running and when exposed to fluid friction. The measured value is 5 times lower than with a standard SiC/SiC pairing.

- No problems caused by inadequate lubrication
- Tolerant to dry running
- Low heat generation
- Less cooling capacity required
- Higher operating temperatures possible

Minimal wear
The average wear of the hard diamond layer in pure dry running mode is an outstanding 0.08 ... 0.2 µm/h.

- Unparalleled wear resistance even with solids or abrasive media
- Long operating period
- Highest chemical resistance
- Highest corrosion resistance
- No abraded particles to contaminate the product
- Excellent heat conductivity

Excellent adhesion due to the chemical bond between DiamondFace and SiC
The diamond bonds chemically with the silicon carbide and the resulting layer adhesion exceeds all known practical requirements.

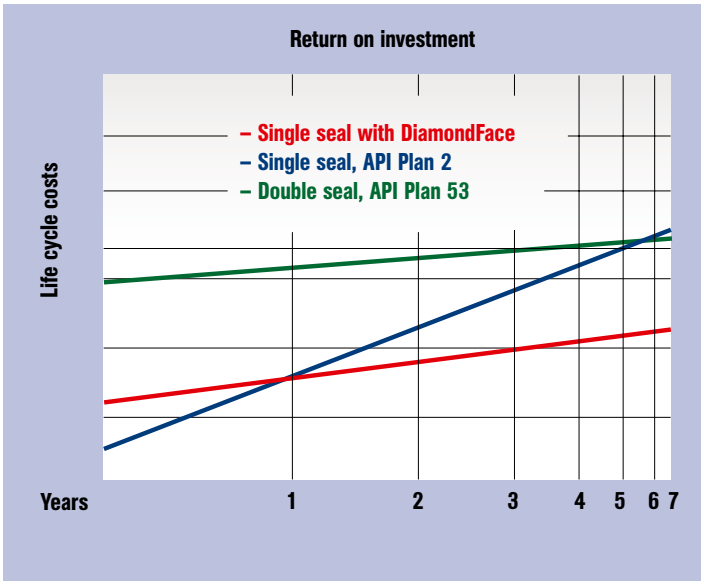
- Extremely robust and solves the problem of crack defects and flaking
- No delamination
- Long operating period

Optimal surface flatness
The surface flatness of DiamondFace seal faces lies within the tolerance range of uncoated silicon carbide seal faces.

- Full functional reliability

Video: DiamondFace

The technical benefits pay for themselves:
With the significantly extended service life of a DiamondFace mechanical seal you will achieve your ROI (return on investment) in a very short time. DiamondFace – a worthwhile investment.



Detailed ROI calculation with the FSA/ESA Life Cycle Cost Estimator software

Proven sealing competence plus DiamondFace innovation:

EagleBurgmann offers proven seal series with DiamondFace technology for pumps, agitators and compressors. Existing systems can also be converted easily and effectively - without time-consuming or expensive design changes.

eCartex

- Universal mechanical seals for centrifugal pumps
- Up to 80 % savings on power consumption.
- Operating periods can be extended by more than 100 %
- Available as single or double seals

DiamondFace for engineered pump seals

- Used successfully in pipeline and multiphase pumps in the oil and gas industry, for example
- Maximum robustness even under extreme conditions and with sharply fluctuating media content in the pumped product mixture
- High availability and minimal maintenance
- For demanding applications (e.g. bad actors)

DF-SA for feed water pumps

- Resistant to electrochemical corrosion in feed water pumps
- No conditioning of the cooling circuit required
- Operating periods of 40,000 hours and more. The seals thus have the same maintenance intervals as pump bearings or balancing elements, for example.
- Friction down by 30 %, reducing power consumption as a result

DiamondFace for compressor seals

- For critical operating conditions below the seal face lift-off threshold
- DiamondFace protects the seal faces against wear and damage
- No impairment of the lift-off capacity
- Considerable reduction of the risk of damage and failure
- Enormously increased safety

DiamondFace sliding bearings

- Axial and radial bearings for magnetic couplings and pumps under high-stress conditions
- Maximum wear protection
- Leak-free and maintenance-free pumping and mixing
- Maximum reliability, availability and operational safety

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EagleBurgmann, a joint venture of the German Freudenberg Group and the Japanese Eagle Industry Group, is one of the internationally leading companies for industrial sealing technology. Our products are used everywhere where safety and reliability are important: in the oil and gas industry, refining technology, the petrochemical, chemical and pharmaceutical industries, food processing, power, water, mining, pulp & paper, aerospace and many other spheres. Every day, more than 6,000 employees in more than 60 subsidiaries contribute their ideas, solutions and commitment towards ensuring that customers all over the world can rely on our seals. Our modular TotalSealCare service underlines our strong customer orientation and offers tailor-made services for every application.

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