

HPP

Cylinder Rings Design Assessment and High Performance Pistons

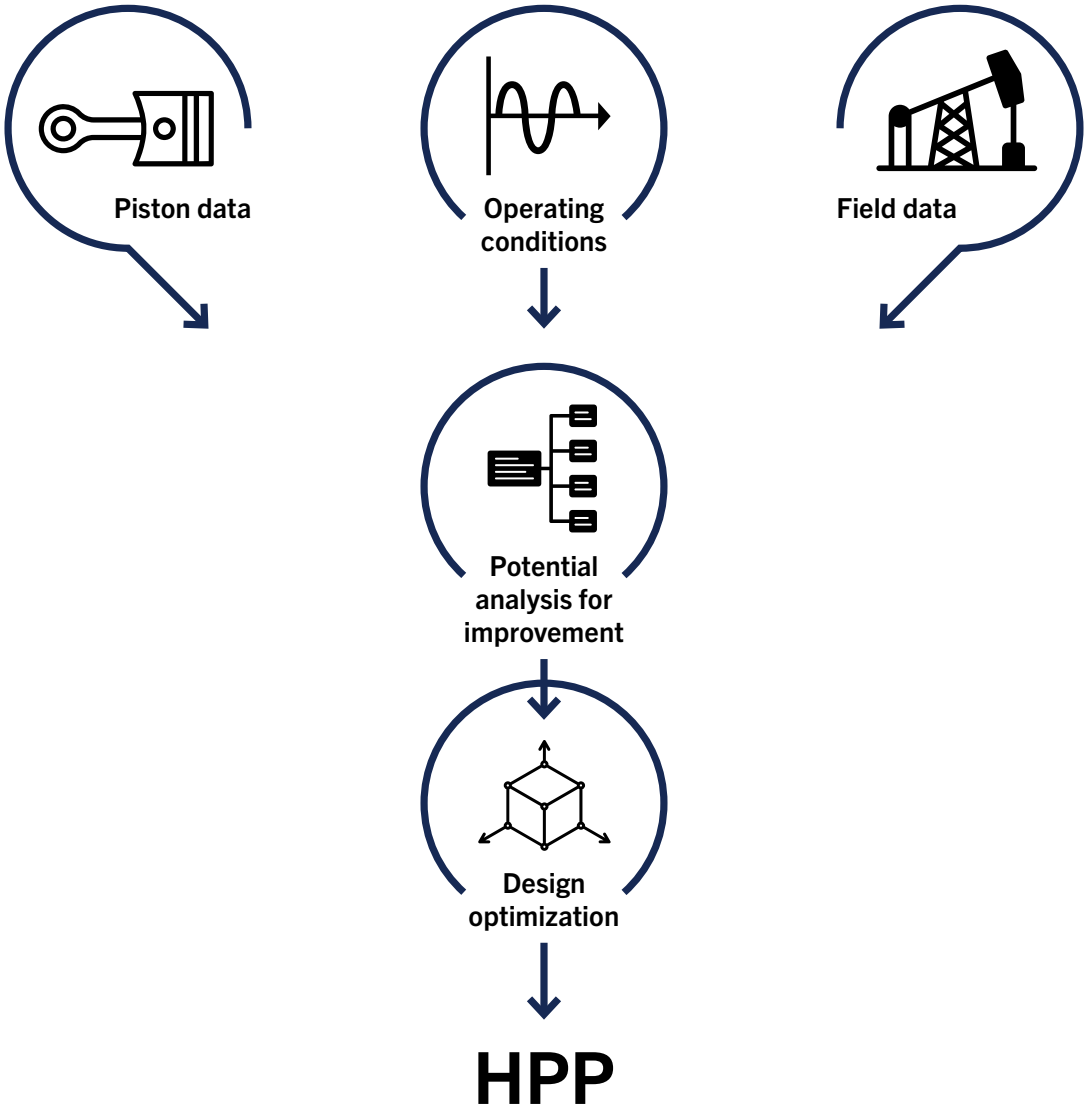
Your solution to maximize uptime and
overcome current lifetime limits

Optimization model for reciprocating compressors

Gas leaking past piston rings and rider bands is a problem for up to one in three reciprocating compressors, with a direct effect on compressor performance.

Often, the root cause is non-optimal types and arrangement of cylinder rings. Retrofit your machine with upgraded pistons to improve performance, improve reliability and increase service lifetime.

Our model for improvement consists of two parts: The Cylinder Ring Design Assessment of the existing piston and the resulting High Performance Piston.



Cylinder Rings

Design Assessment

Pistons for reciprocating compressors have traditionally been designed using rules of thumb. Unfortunately, this simple approach often does not result in reliable compressor performance as they have frequent failures on cylinder rings.

Piston rings fit into grooves of piston and create sliding seal against cylinder wall. In normal operation, outer surface of piston ring wears away through contact with cylinder liner.

To accommodate wear and allow replacement, the ring has a gap in its circumference. Over time, the radial wear of ring expands to maintain contact with cylinder wall leading to gap opens, gas leakage happens.

To improve gas leakage performance, maximize uptime and ensure longer lifetime, HOERBIGER has developed an engineering method to assess and optimize parameters such as liner to piston clearance, number of piston rings, and the design of piston rings and rider bands.

Less leakage means less unplanned downtime

Detailed compressor assessments show that 30% of reciprocating compressors have at least one cylinder showing a temperature increase above 10°C after one year of operation. Unexpected temperature rises cause serious capacity loss and often mechanical breakdown.

The main reason is gas leakage through gaps in the piston rings. Imperfect sealing increases discharge temperatures, degrades lubricating oil, weakens valve plates, and increases wear. The result is lower capacity, reduced overall compressor performance, and unplanned shutdowns.

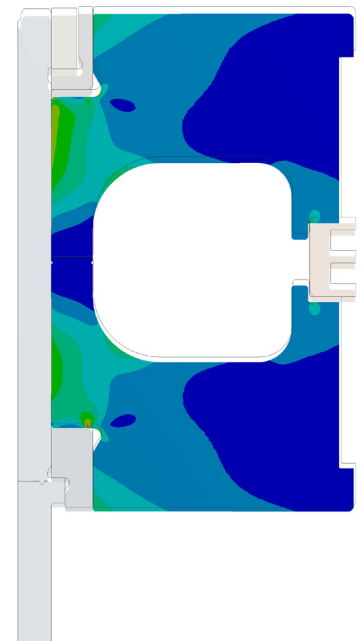
HOERBIGER's Cylinder Ring Design Assessment uses advanced modeling to design a better piston with the optimal type, number, and arrangement of cylinder rings. The result is controlled leakage, improved reliability, less unplanned downtime, and increased efficiency.

How the assessment process works

The first steps in a Cylinder Ring Design Assessment are to collect compressor, piston, and field data as well as operating conditions. It is necessary to record the existing piston design and cylinder ring arrangement, and to measure gas temperatures and blow-by.

This is followed by a finite-element analysis to model the gas leakage path in absolute detail. The modeling works for every type of piston: single-piece, two-piece, or three-piece; aluminum, cast iron, nodular iron, or steel; Supernuts® or conventional nuts.

Simulation cross-section of piston design and cylinder ring arrangements during the assessment process



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Thanks to the assessment and the resulting properly designed High Performance Piston, we have significantly improved our compressor uptime. By minimizing blow-by, we have also reduced energy losses and increased performance many times over.

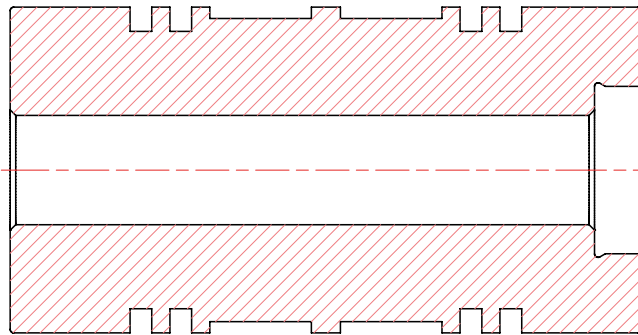
Plant Manager, Middle East

High Performance Pistons

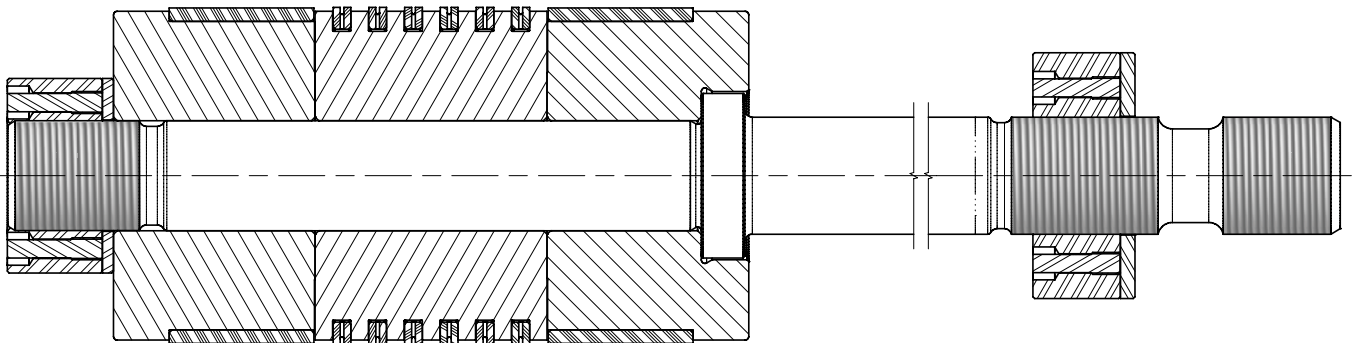
With a detailed understanding of the current situation, it is now possible to design and build a new piston with the optimal number, type and arrangement of cylinder rings and clearances to minimize blow-by and maximize ring life.

We call this a HOERBIGER High Performance Piston, and we're not exaggerating. This is a radical new approach to cylinder sealing. You can expect run times to increase typically by a factor of 2.5 before ring replacement is needed.

Examples:



Original stage



Upgraded stage: Increased number of rings, liner clearance, ring style ring arrangement

This new piston configuration method boosts capacity and dramatically improves process reliability. The result is improved product quality, energy savings, increased uptime, longer runtimes, better performance, and longer compressor life. The investment has therefore quickly paid for itself.

Easy to implement

A HOERBIGER Cylinder Ring Design Assessment is easy to incorporate into everyday engineering work, replacing traditional rule-of-thumb methods in application that are known to cause problems. The new High Performance Piston is installed in just the same way as the original piston design, so there's no loss of time. Once the new piston is in place, of course, you will quickly see the benefits in terms of improved performance and longer run times. With our solution you will maximize uptime and overcome current lifetime limits of the existing piston.



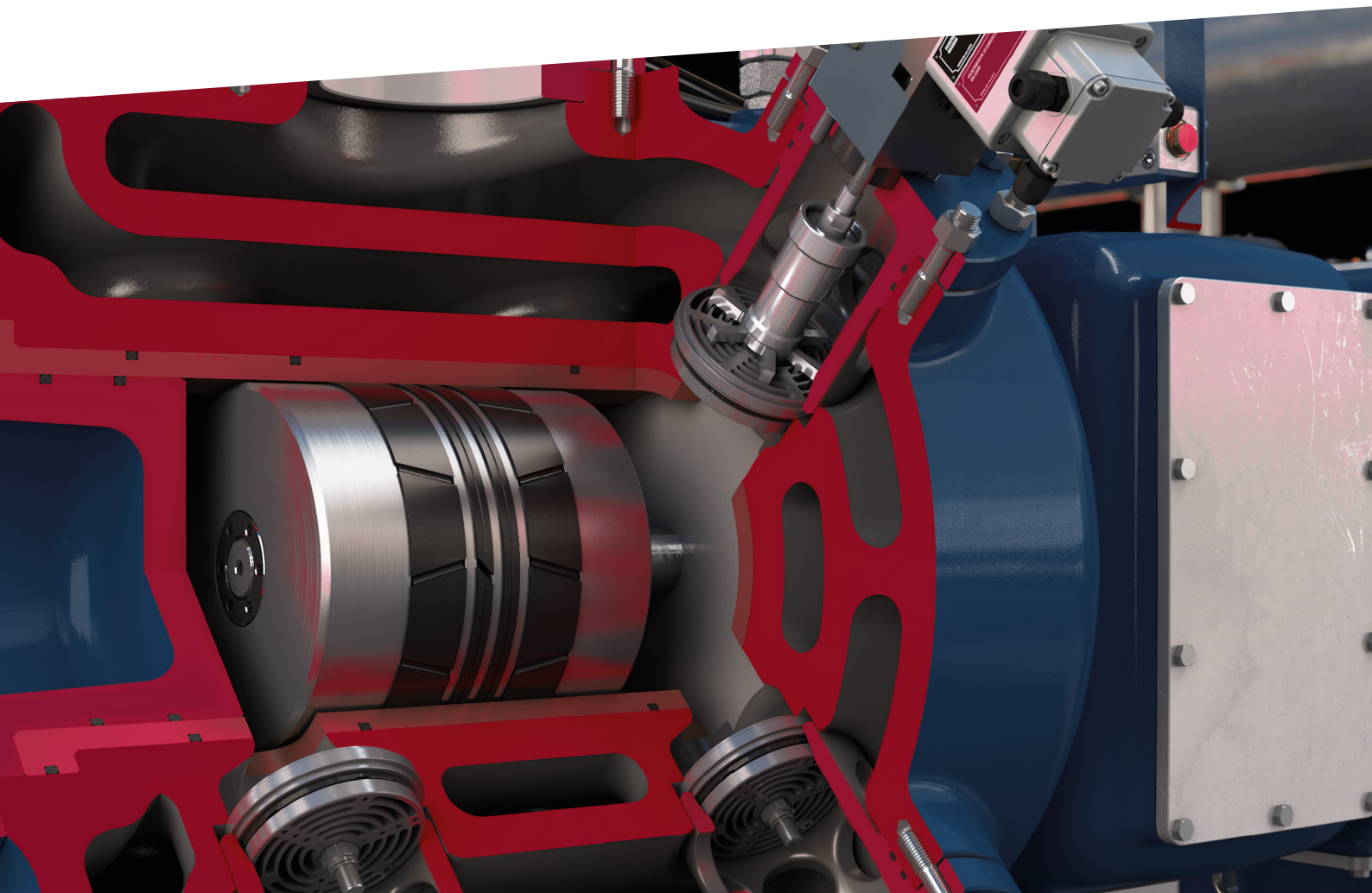
Cylinder Rings Design Assessment helped us achieve reduced power consumption and increased lifetime which saved energy and emissions costs and makes less waste.

Engineer, US



Your benefits at a glance

Features	Advantages	Benefits
Optimized piston layout	Reduced power consumption	Energy savings and lower emission costs (in combination with eHydroCOM (Electric Stepless Capacity Control System))
	Process reliability	Improved end-product quality
	Machine reliability	The runtime can be extended and is predictable
Calculation of cylinder ring arrangement and implementation	Longer MTBM/MTBF	Up to 300% lifetime increase for cylinder rings, which results in a sustainable production through the product use over the entire product life cycle and at the same time less waste
Minimized blow-by	Reduced emissions	Savings in energy and CO2 emission costs, and at the same time performance increase (+ 5%)
All cylinder rings achieve the same lifetime	Coordinated maintenance	Improved uptime and less air pollution due to long downtimes
Calculated blow-by and discharge temperatures	Lower discharge temperatures, and no increase over time	Production increase, fewer breakdowns and fewer wear parts





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Locally close to the customers – globally successful: HOERBIGER is active worldwide in 43 countries on all continents. 5,948 employees at 127 locations – including 25 production plants – deliver reliable solutions for better performance, increased safety, and fewer emissions. In 2022, they generated sales of 1.267 billion euros. For renowned customers from the energy sector, the process industry, the automotive industry, the mechanical engineering industry, safety technology, and the electronics industry, performance-determining products and services from HOERBIGER make the difference. With innovations for decarbonization and energy transition, HOERBIGER is already enabling change today for a better tomorrow. As majority shareholder, the HOERBIGER Foundation preserves the 128-year-old entrepreneurial heritage and guarantees stability, independence, and a future-oriented strategy.

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