# Enabling change.
# For a better tomorrow.

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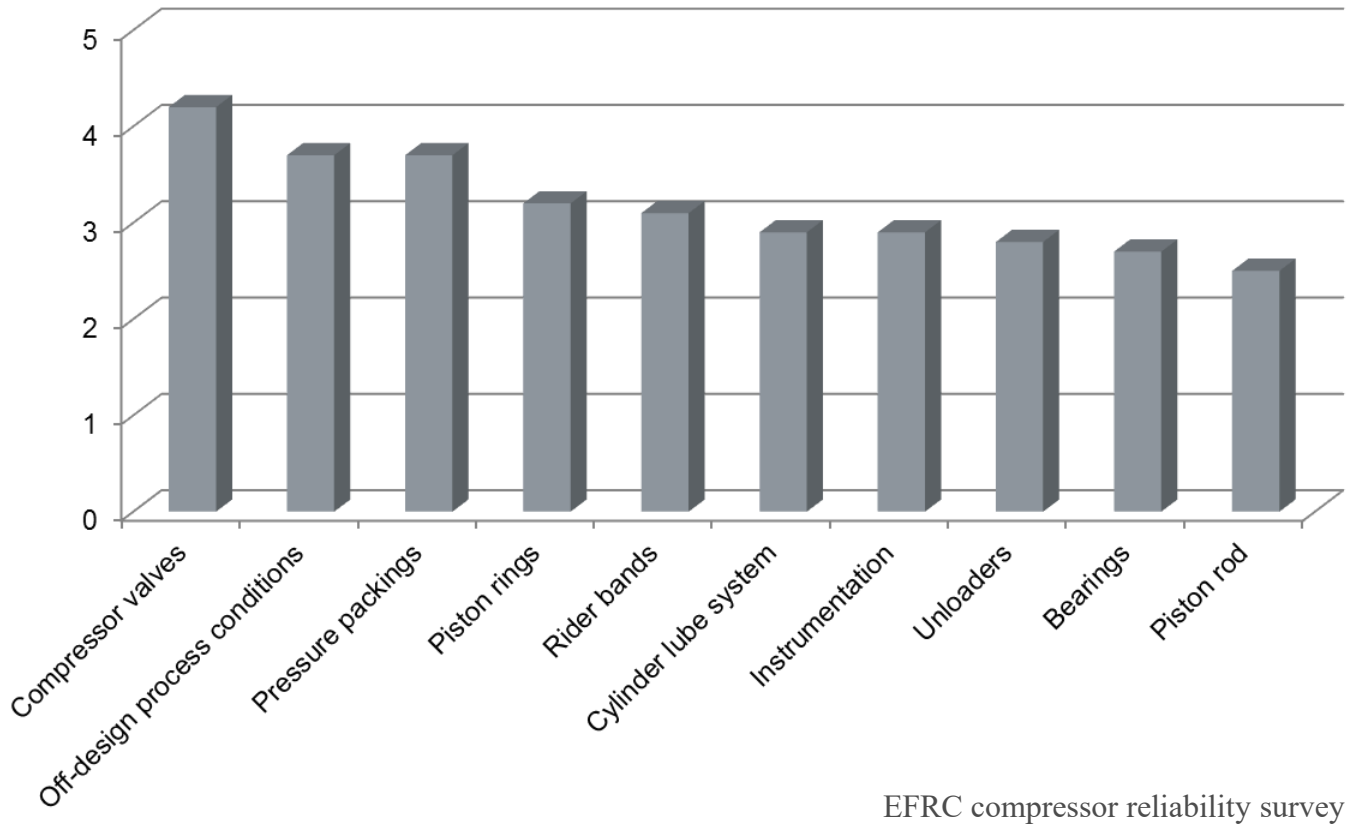
# HOERBIGER
# Division Compression Technology

## “New Generation Technology”

# ❖ Criticality of components with respect to unscheduled shutdown

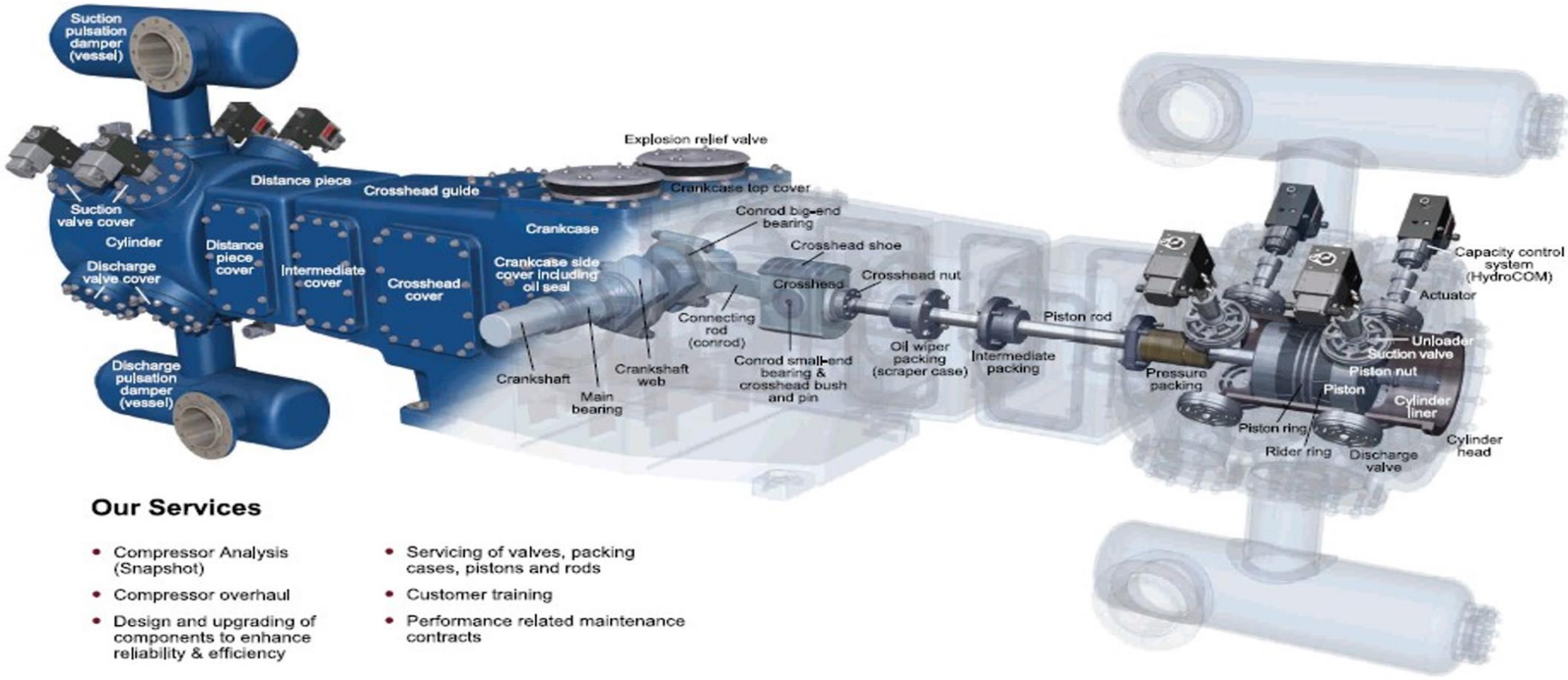
Although efforts in reliability improvement had been realized in the past decade and MTBF of reciprocating compressors increased, valves & RnP are  still the most critical components!




Criticality of components with respect to unscheduled shut down
(1-not critical, 5-very critical)

EFRC compressor reliability survey
by André Eijk & Leonard van Lier, TNO Industrie, Delft

# Complete Solutions for Reciprocating Compressors




## Our Services

- Compressor Analysis (Snapshot)
- Compressor overhaul
- Design and upgrading of components to enhance reliability & efficiency
- Servicing of valves, packing cases, pistons and rods
- Customer training
- Performance related maintenance contracts

## Our Products

www.hoerbiger.com

VIDEO

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HydroCOM


Snapshot Analyzer


Mobile Care System


Lubrication Systems


Oil-Wiper & Intermediate Packings


Pressure Packings


Piston- & Rider Rings


Piston- & Piston Rods


Explosion Relief Valves


Valves

# HOERBIGER Compressor Components and Systems

Current products

Enabling Zero Emissions

Fugitive emissions

Energy-related emissions

Vented emissions

Since 1995: Minimize energy consumption; Minimize unplanned shutdowns

2010: Minimize ring leakage; Minimize unplanned shutdowns

2014: Reduce energy consumption; Minimize unplanned shutdowns

2017: Minimize energy consumption

2019: Minimize unplanned shutdowns

2021: Eliminate uncontrolled emissions

2023: Minimize energy consumption

2024: Eliminate emissions at standstill

End 2024: Recover emissions during runtime

HydroCOM

BCD ring

Profiled plate valves

eHydroCOM XD

CR design assessment / HPP

ECP – Emission Control Panel

eHydroCOM HD

EmissionShield

Emission Recovery System

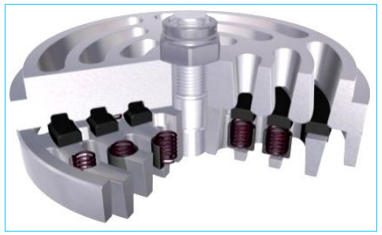
# ❖ Valve types for Reciprocating Application

## Closing Elements

Plates - rings - stripes - reeds - poppets - cones - balls ....

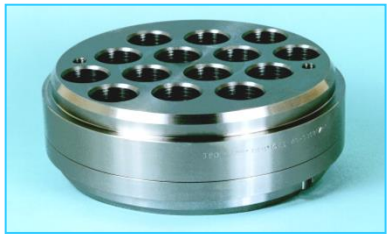
traditionally made of steel, today increasingly of fibre-reinforced plastics.

steel plates

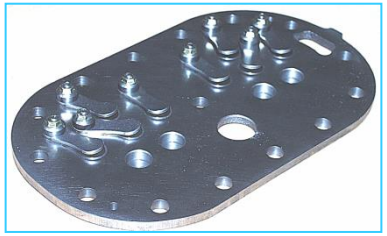


profiled plastic rings

plastic plates



poppets



reeds

flapper plates

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# ❖ Valve Series

## Different Valve Series

*Different type Sealing Element*

**Plate**

Metallic
- R
- C
- EFG
- HDS
- HJK
- U

Non-metallic
- CS
- CT
- CU
- HPV

**Ring**

Non-metallic
- CE
- CX

**Profiled Plate**

Non-metallic
- CP
- CPs
- XP
- XPL

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# CP & XP Valves - New Generation Valve Technology

For Refinery and High-pressure Natural Gas applications

# ❖ The solution for Natural Gas: the CP valve

– The HOERBIGER CP valve combines the best of plate and ring valves.

- Increased reliability: up to **3x longer service life**
- Up to **40% reduced valve losses**
- **Minimized number of valves** in high-capacity cylinders

VALVE ANIMATION

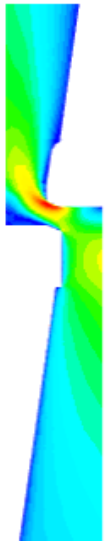
HOERBIGER

# ❖ Profiled Plate Concept

- Field proven concept
  - Profiled plate technology successfully in the field since 2007
- “Hybrid” design combines features of ring and plate valves
  - Contoured seat lands, contoured plate profile
- Optimized flow through seat-plate-guard
  - Extreme efficiency
- Strengthful material
  - High strength, high impact resistance,
  - High temperature resistance
- Better reliability
  - Extend intervals between service operations
  - Higher availability of compressor

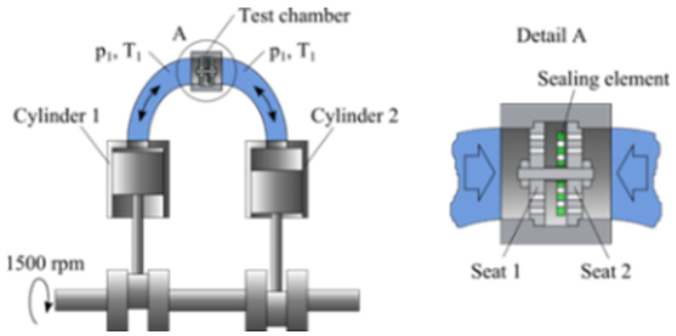
Benefits for the OEM
- Reduced number of valves, reduced clearance
- Overall reduced cylinder production costs


Combines many well proven CE-design features with profiled plate technology



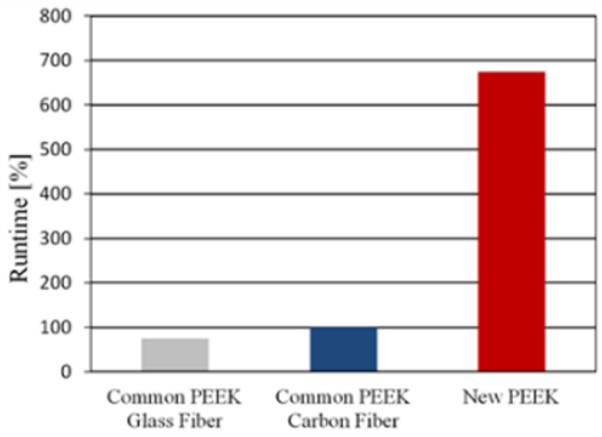
# ❖ Next Generation Polymer Technology - PowerPEEK

## Material research










**Sealing element lifetime tester**

- closely resembles compressor conditions
- allows for accelerated life time testing

**Material investigation**

- base polymers
- additives
- fiber types
- filler amounts

➔ New carbon-fiber reinforced PEEK-based sealing element material

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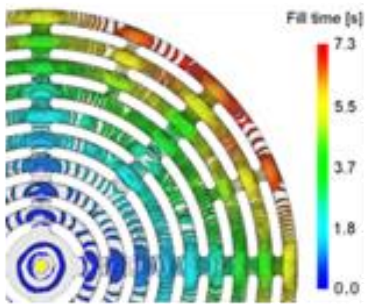
# Next Generation Polymer Technology - PowerPEEK

## Manufacturing technology

➔ **Advanced injection-molding technology**

- high fiber orientation in the ring segments in direction of the max. stresses
- high fiber orientation in the webs to control the thermal expansion
- actively influencing the formation of weld lines

Melt-flow simulation




Injection mold

Finished valve plate

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*New valve technology meets current and future challenges*

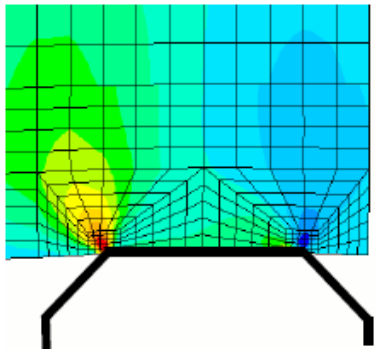
# The HOERBIGER CP valve – what is new?

## Material

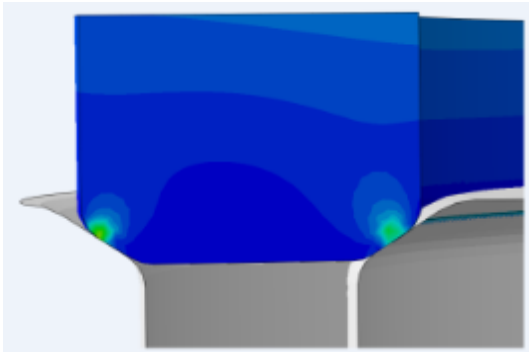
- PowerPEEK™ material
- Exceptional strength
- Exceptional impact resistance

## Design

- Profiled valve plate
- Dynamic load resistant coil springs
- Spring savers for increased service life
- Optimized impact situation on seat, guard and valve plate



conventional



profiled



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# ❖ Valve Lift Area and Equivalent Area

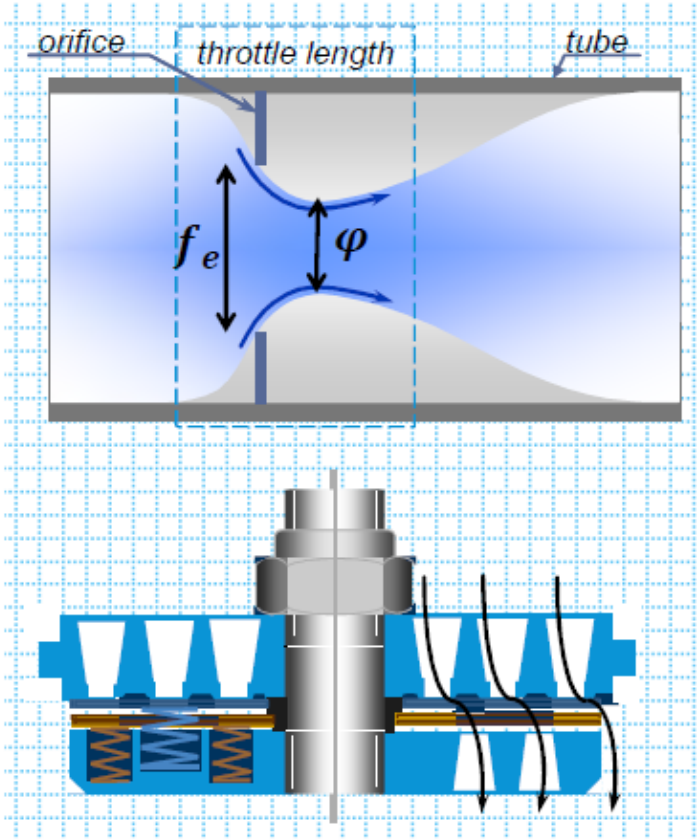
The lift area, $f_e$ tells us how much area the gas flows through

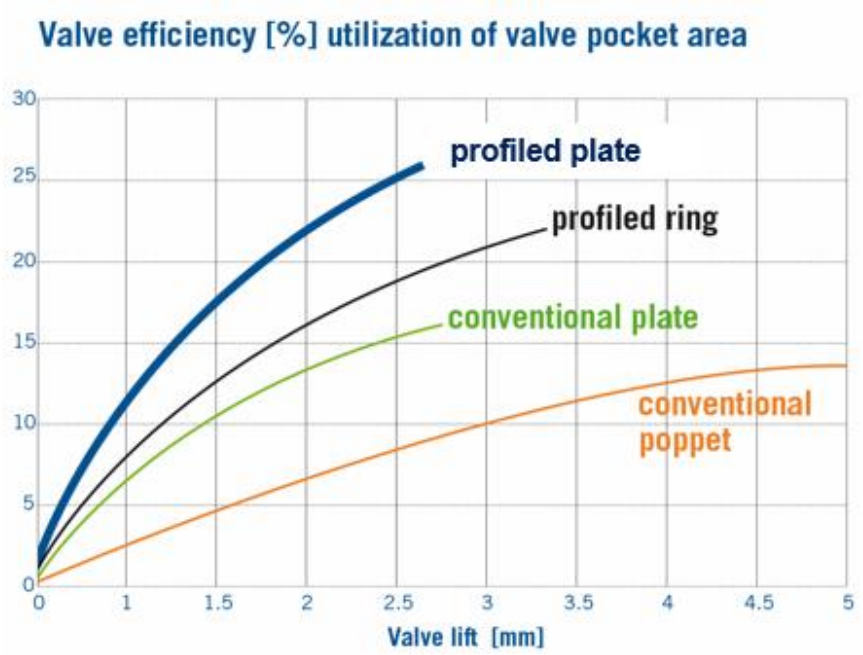
But, it's a little more complex than that

As gas moves through a practical restriction, it cannot change direction instantaneously and the flow continues to narrow after passing through

Valve designers call this area the Equivalent Area and denote it by φ

The Equivalent Area is used in most valve calculations, not the lift area

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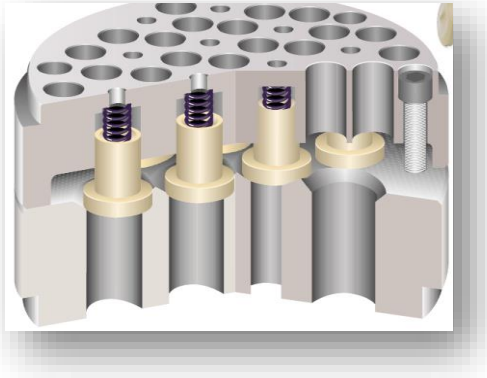
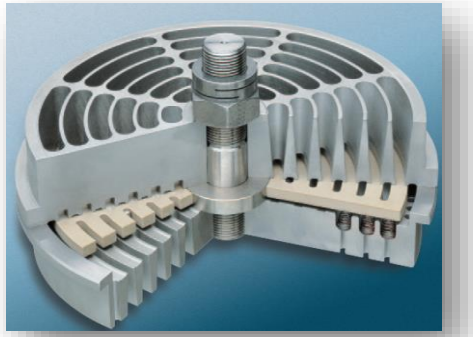
# ❖ Valve Lift Area and Equivalent Area Comparison

## Poppet Valve

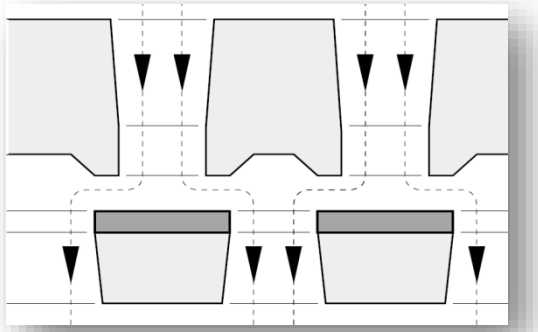


165P12 Poppet Design has
fe = 10.78cm2 (For 1mm Lift)
ϕ = 10.67cm2 (For 1mm Lift)

## Plate Valve

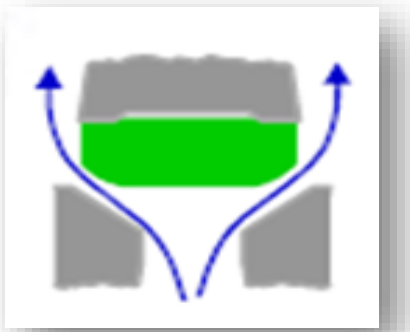


Hoerbiger 161CHS Design has
fe = 30.55cm2 (For 1mm Lift)
ϕ = 19.60cm2 (For 1mm Lift)



## New generation Valve

Hoerbiger 165CP  Design has
fe = 44.75cm2 (For 1mm Lift)
ϕ = 29.66cm2 (For 1mm Lift)



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# ❖ The profiled plate type valve family

High speed
Natural Gas

up-/ mid / downstream
Natural Gas

low / moderate speed
API style units
Process Gas
Natural Gas

NG

PG

54 90 CPs

88 212 CP

86 261 XP

272-365 XPL

PowerPEEK™

HP

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# ❖ Specification of CP valve: Against existing valve benchmark

| | |
|---|---|
| Higher Reliability | + 100% (MTBF) |
| Service interval | 2 times longer |
| Increased impact strength | + 50% |
| Efficiency improvement | + 50% |
| Seat strength increase | + 30% |

- Fully standardized, full CAM, automated design and application engineering, faster production, faster spare parts delivery

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# CaseStudy

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because performance counts

## Reliablity and Efficiency Improvement

**New Generation CP valve, Diaphrgm Actuator for compressor availability and efficiency improvement.**

| Compressor manufacturer: Ingersoll-Rand | | | |
|---|---|---|---|
| Type | 2RDS2 | Gas | Natural Gas |
| Power | 340 kW | Suction pressure | 2.9 bar (a) |
| Speed | 990 rpm | Discharge pressure | 52.1 bar (a) |
| Lubrication | Full Lube | Reference | 100333 |

### Facts in brief

M/s ONGC operates several wells on field at South Santhal region in Gujrat. From these wells Crude Oil is extracted with the help of pressurised Natural Gas. Pressurised Natural gas is recirculated in field wells by reciprocating compressors. Crude oil extraction depends on the performance of these compressors.

### Customer requirements

- At site M/s ONGC have 6 numbers of Ingersolll Rand make compressor.
- These compressors are equipped with Channel and Spring type valves.
- Suction valve is equipped with Piston type actuator.

### Solution applied

- Compressor main requirement was for High Reliable and efficient compressor components.
- New generation CP valve with non-metallic profiled valve plate were custom designed as per compressor and gas operating parameters.
- Suction valves designed with Pneumatic Diaphrgm Type actuator.

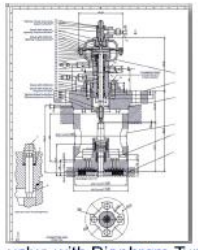
### Results

- CP Suction valve with Diaphrgm Actuator and Discharge valves were installed in February-2018. Valves and Actuators are performing satisfactorily from last 2 years.
- With CP valves comrpessor availability is increased. Substantial power saving of 2 amp was observed.
- Compact, easy to install and maintenance free, Diaphrgm type actuators appriciated by customer.

ओएनजीसी ONGC

Compressed Natural Gas used for Crude oil extraction from wells on site.

Appriciation letter from Customer for satisfactory performance of Hoerbiger Components



CP Suction valve with Diaphrgm Type Actuator

**From:** Zambare Ajay Ravindra ( अजय रवि ंद्र जांबरे ) <Ajay.Zambare@hpcl.in>
**Sent:** Monday, October 30, 2023 01:46 PM
**To:** Sudhakar N <sudhakar.n@hoerbiger.com>
**Cc:** Tandan Akarsh ( टंडन आकर्ष ) <atandan@hpcl.in>; Mahadik Mandar Prakash ( महाडिक मंदार प्रकाश ) <mmprakash@hpcl.in>; Tandan Akarsh ( टंडन आकर्ष ) <atandan@hpcl.in>
**Subject:** [EXT] RE: K4101--CP valves performance

**CAUTION:** This email originated from outside of HOERBIGER. Do not follow instructions, click on links, or open attachments unless you know the sender and know the content is safe. Report any suspicious emails to security@hoerbiger.com

Dear Sir,

M/s Hoerbiger India Pvt. Ltd. has supplied complete set of CP type Valves (16 nos.) against PO 17000372-OP-48002/ST, dated: 26.07.2017 to improve reliability on following compressor:

Compressor tag number: K4101 E/W
Make & Model: Dresser Rand 14 & 8X9 @2HSE-2
Gas / Application: Propane Gas
Plant: PDA
Driver rating: 160 KW

We have installed new generation Hoerbiger valves in
K4101 W – on 06-01-2020
K4101 E – on 15-11-2017

Till date we haven't face any performance related issue for the same.
The performance of the valves is satisfactory .

*Thanks and Regards,*

*Ajay Zambare*
*Manager,*
*Mumbai Refinery, HPCL*

हिन्दुस्तान पेट्रोलियम HP

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# CaseStudy

HOERBIGER
because performance counts

## New Generation Valve Technology for Natural Gas Application

| Compressor manufacturer: BHARAT PUMPS & COMPRESSORS LTD. | | | |
|---|---|---|---|
| Type | 2HM/2 | Gas | Natural Gas |
| Power | 285 kW | Suction pressure | 2.5 bar (a) |
| Speed | 807 rpm | Discharge pressure | 26 bar (a) |
| Lubrication | Full-lube | Reference | 302639 |

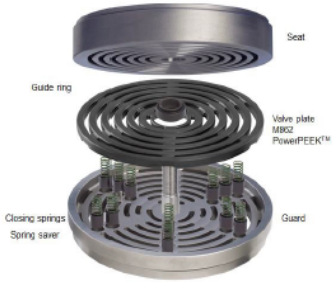
ऑयल इंडिया लिमिटेड
Oil India Limited

### Facts in brief

M/s Oil India Ltd. is mainly in the exploration and production of crude oil and gas. Exploration and Production is achieved with several low and high pressure compressors operating on fields. These compressors are running under demanding operating conditions.

### Customer requirements

- Existing valve reliablity is not good.
- Customer is getting life upto max. 6000 hrs.
- Customer wants increased reliablity for valves, this intum will increase the compressor availability.

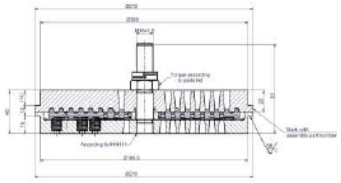


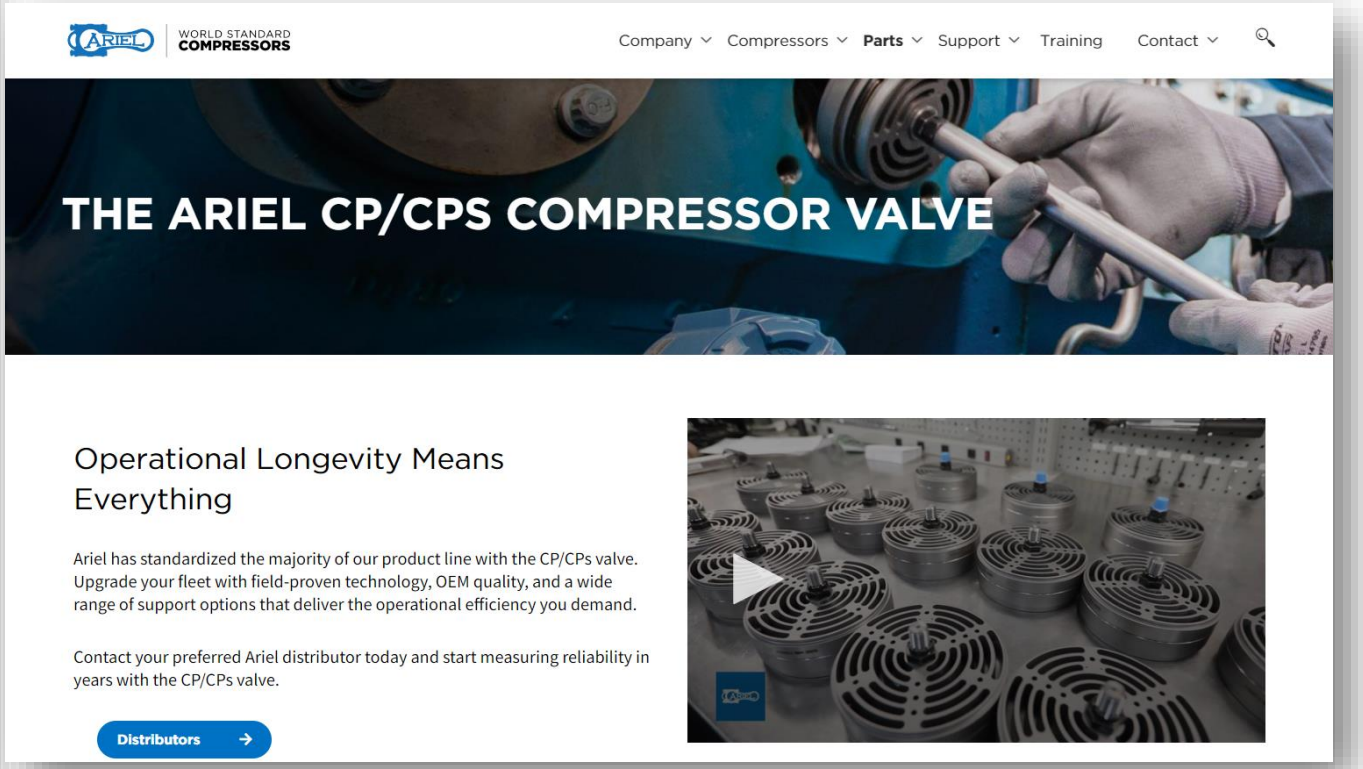

### Solution applied

- Upgrade to CP profiled plate valves for increased reliability
- 1st stage: 184CP
- 2nd stage: 155CP

### Results

- CP- valves had been installed in 2016
- Customer is satisfied with CP valve performance.
- Repeat order received for another 4 compressors.






Hoerbiger America to Arial, USA -
More than 80,000 qty of valves are supplied every year !!!

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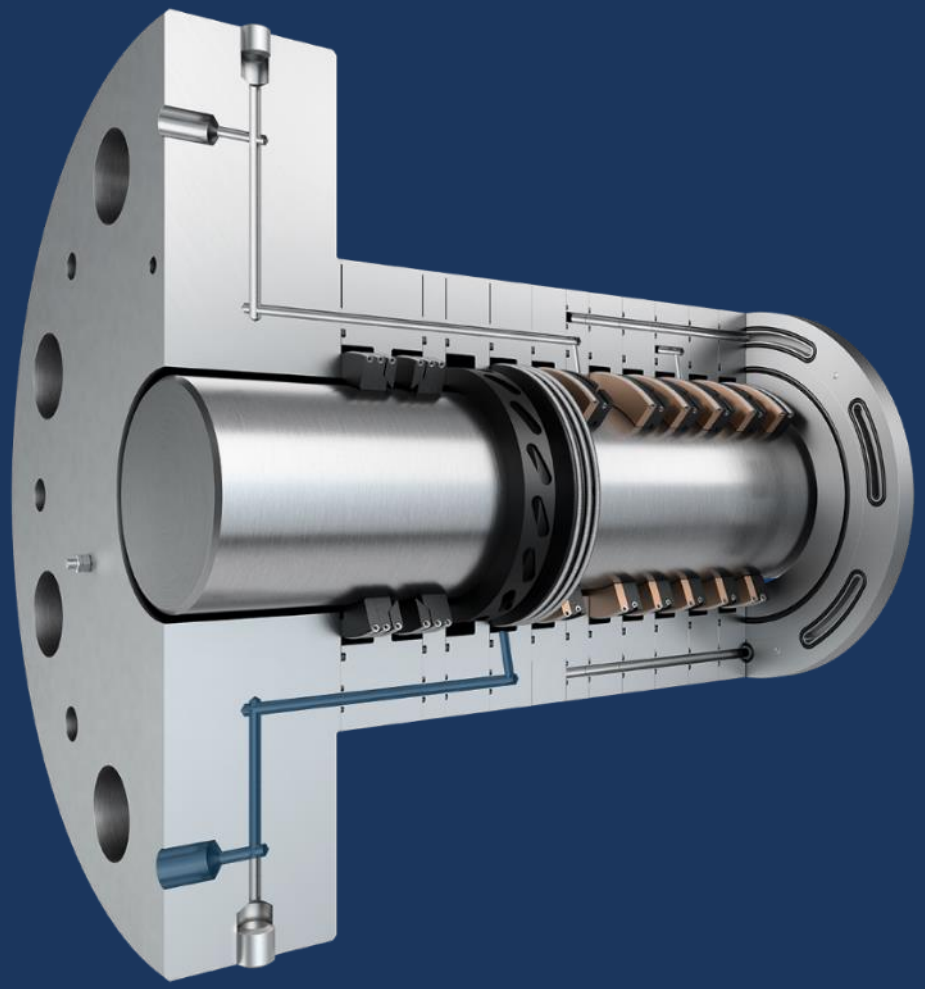
# **EmissionShield**
## Static Rod Sealing System

Eliminate emissions during standby



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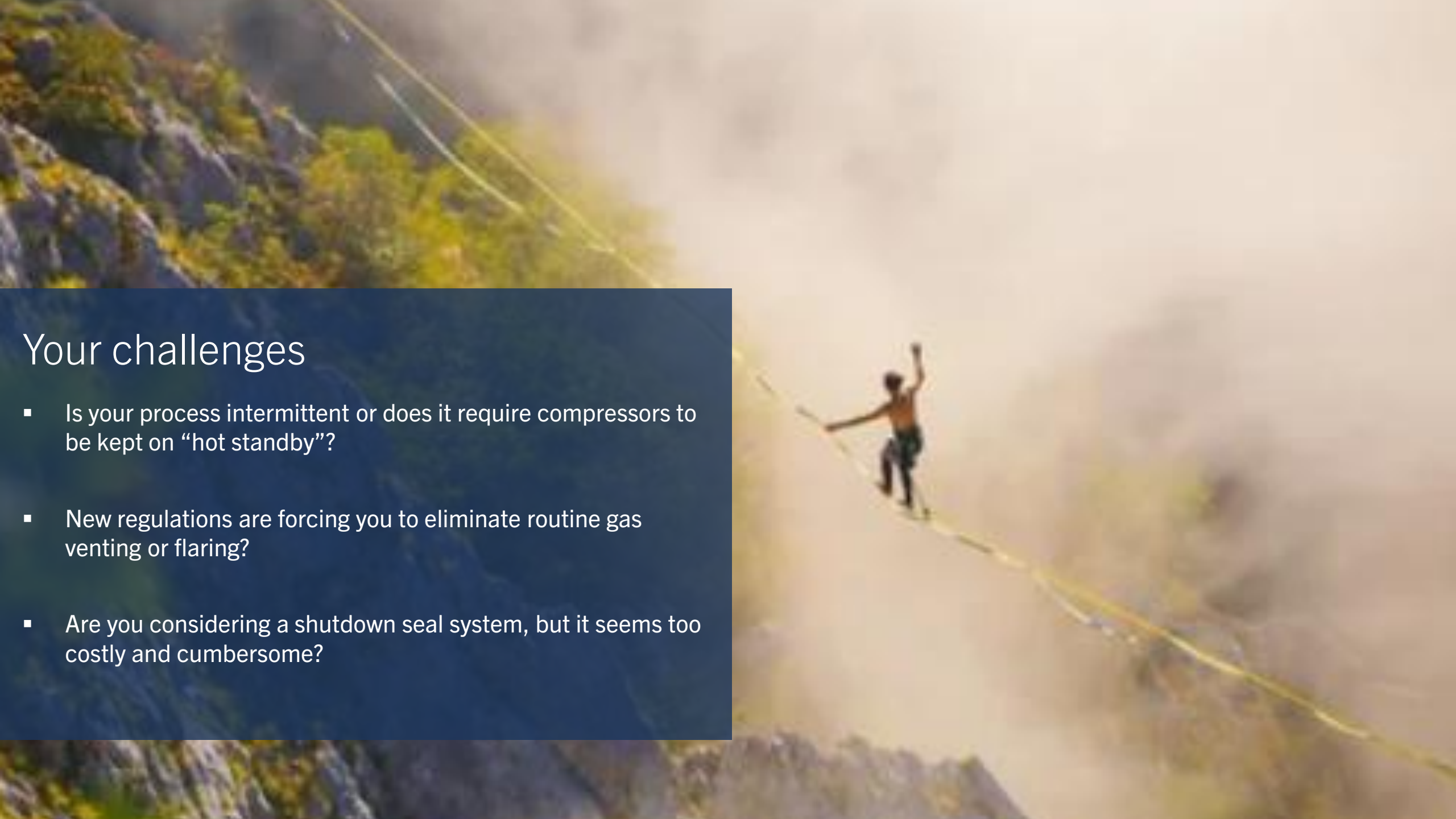
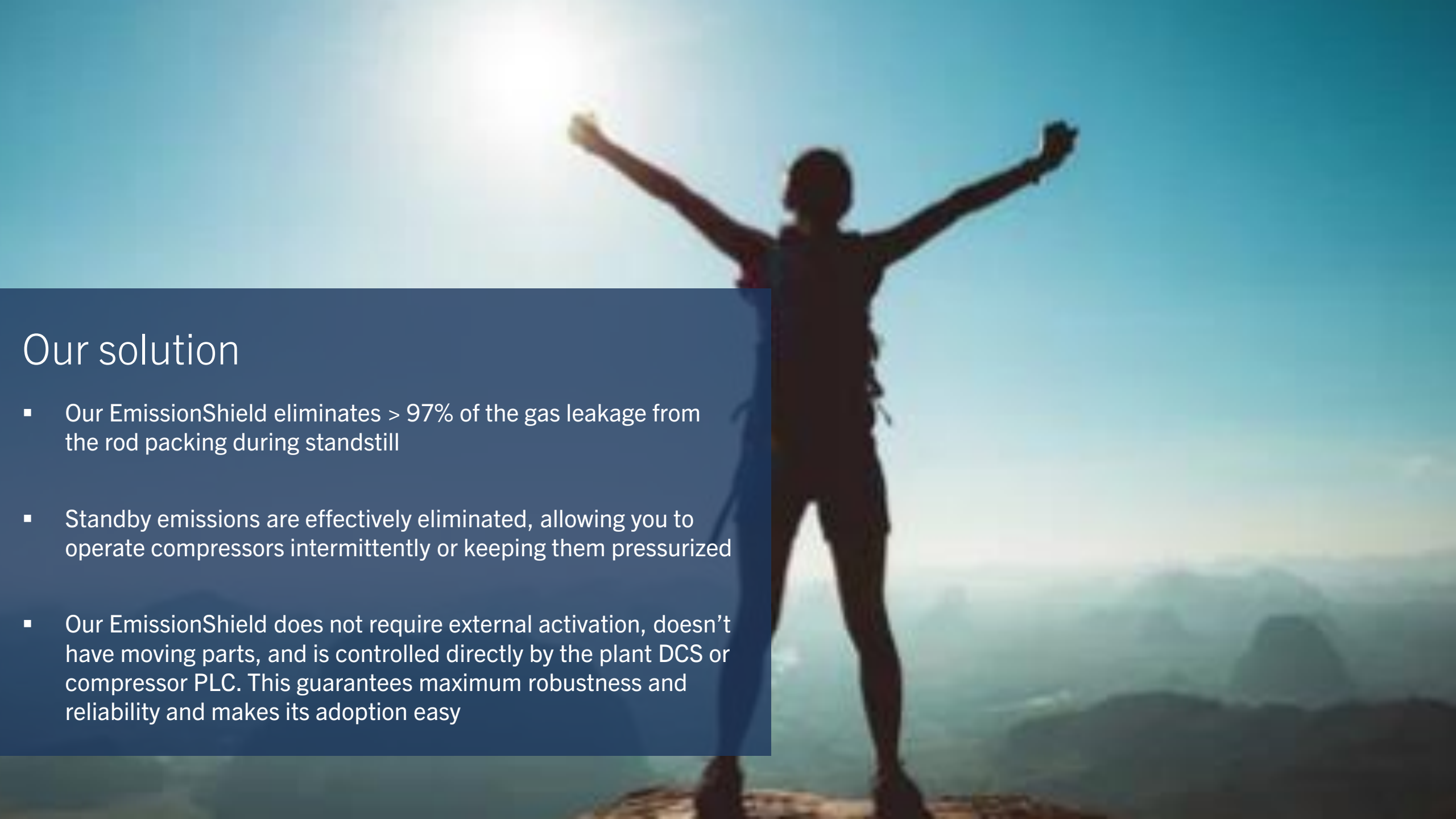


# Your challenges

- Is your process intermittent or does it require compressors to be kept on “hot standby”?
- New regulations are forcing you to eliminate routine gas venting or flaring?
- Are you considering a shutdown seal system, but it seems too costly and cumbersome?



# Our solution

- Our EmissionShield eliminates > 97% of the gas leakage from the rod packing during standstill
- Standby emissions are effectively eliminated, allowing you to operate compressors intermittently or keeping them pressurized
- Our EmissionShield does not require external activation, doesn’t have moving parts, and is controlled directly by the plant DCS or compressor PLC. This guarantees maximum robustness and reliability and makes its adoption easy

# How is the compressor kept on standby?

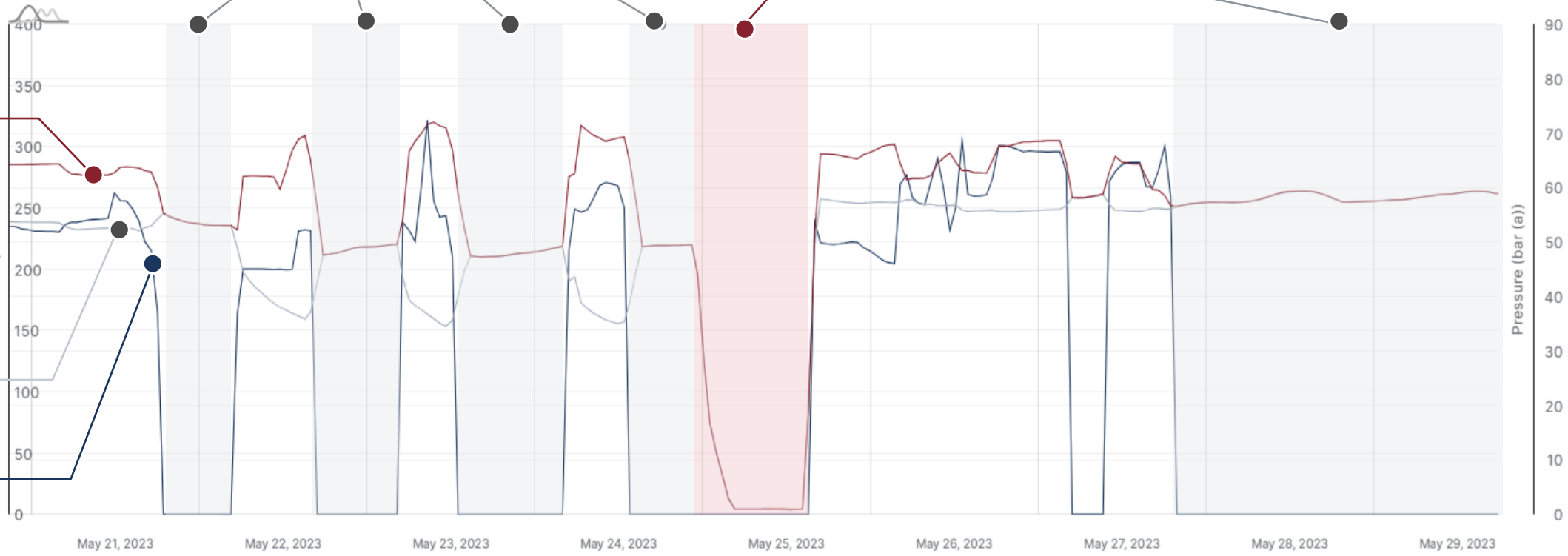
Unpressurized stand-by.
Compressor is isolated, system pressure gradually drops through packing leakage

Pressurised stand-by. Compressor not isolated, pressure is maintained artificially. Constant leakage through rod packings

Discharge pressure

Suction pressure

RPM




Example of DCS trends on a recip compressor (actual measurements)



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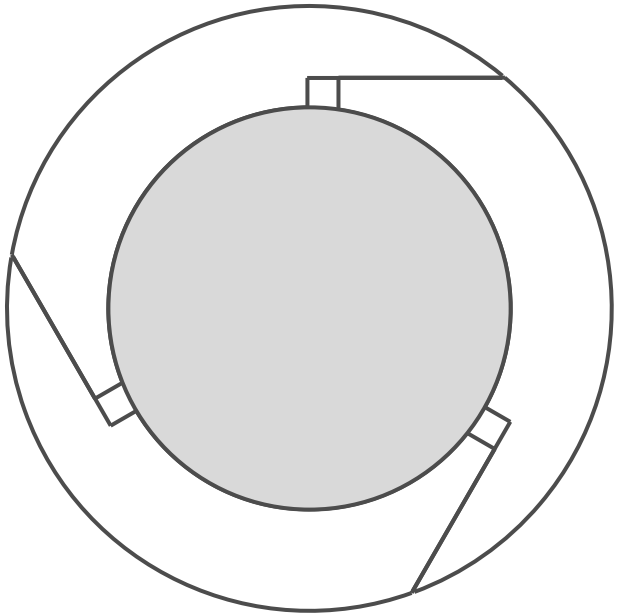
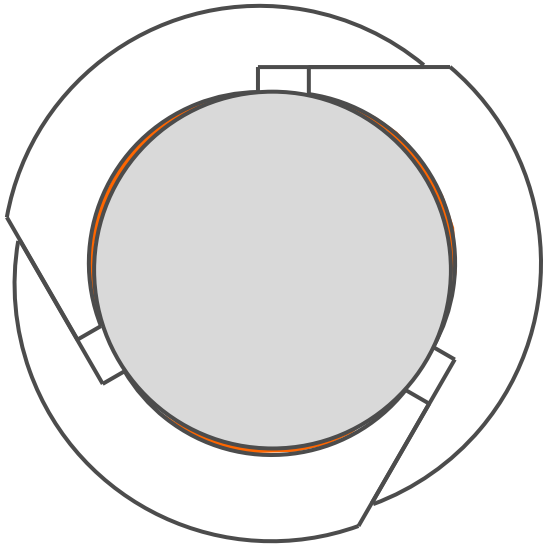
# Why (all) packing rings leak at standby



**At operating temperature**

- Conformance between rod & ring geometry
- All gaps are sealed perfectly



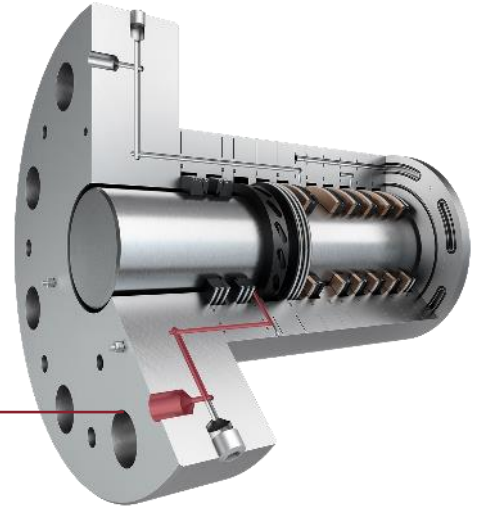
**At cooldown temperature**

- Different thermal expansion coefficients between rod (metal) and ring (polymer)
- Ring ID < Rod OD
- Gaps will open between rod and ring

# **Meet our EmissionShield**

The EmissionShield is not just a new ring
it’s a sealing system

# EmissionShield – Description



**Side-loaded rings**
Conventional design

Compressor control system (DCS or PLC)

**Packing vent line**

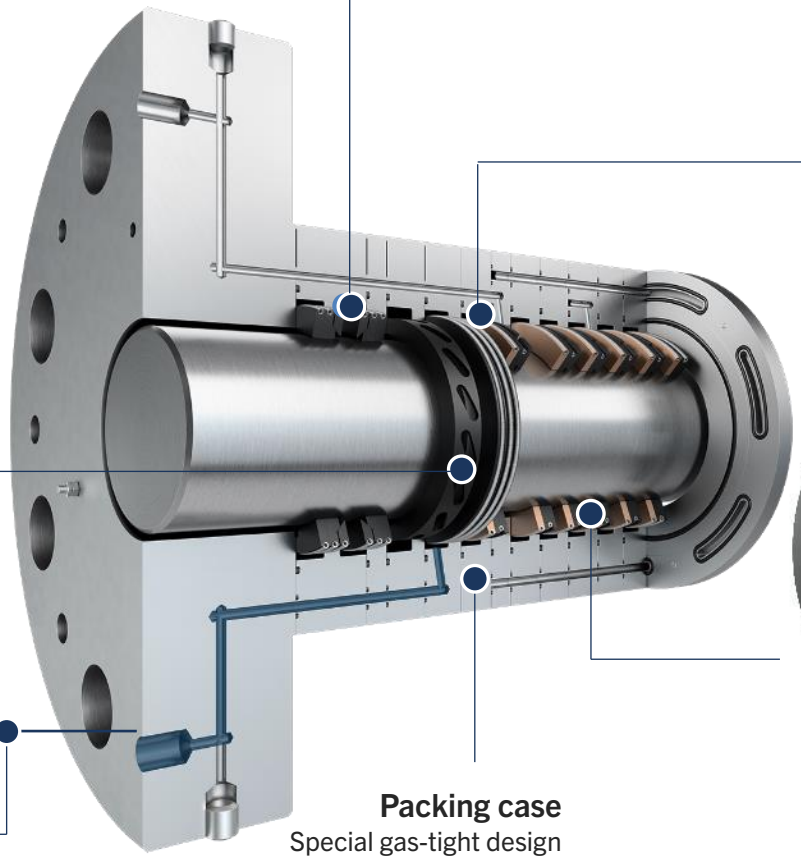
To vent

To vent

**Activation line**

**Activation Valve**
Motorized valve with spring return
Electrically actuated (24 VDC / 110-240 VAC)
Class1 Div2 / ATEX Zone2 certified

**Dual-acting ring pair**
Conventional design



**SBS – Static Seal Emissions Elimination Packing Ring**
Thermally activated

**Back-up rings**
Conventional design

**BCD - Emissions Elimination Packing Rings**
Low-emissions packing rings

**EmissionShield line**

**Packing case**
Special gas-tight design

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# Tried and tested

* Proven with field tests in real-world applications
** Proven with accelerated lab tests on a real compressor

**> 97%**

Reduction of gas losses during standby vs. conventional packings*

**~ 10min**

Average self-activation time of the SBS – Static Seal Emissions Elimination Packing Ring*

**500+**

Start/stop cycles that the SBS – Static Seal Emissions Elimination Packing Ring can withstand**



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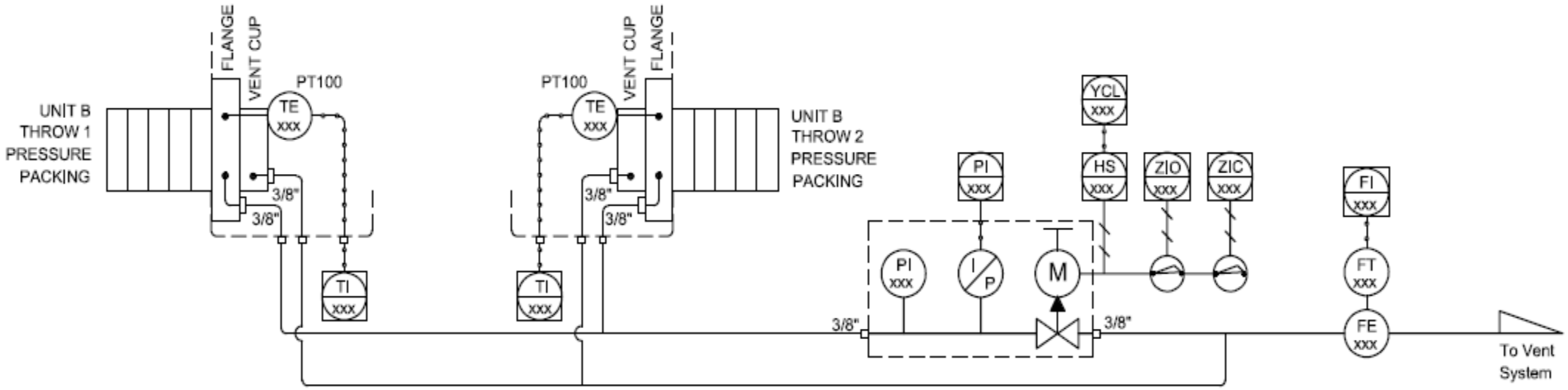
# Your benefits at a glance

| Thermally activated static seal ring | Gas-tight packing case design | Packing case with Vent and EmissionShield line outlets | Motorized activation valve with spring-loading mechanism and feedback signal |
|---|---|---|---|
| No moving parts and no external activation needed | Eliminates cup-to-cup leakage, allowing the cylinders to remain pressurized indefinitely | Provides a dual path to vent the gas out of the packing | Available for 24 VDC or 110-240 VAC supply; Class 1 + 2 and ATEX Zone certified |
| **Improves reliability as the SBS does not get stuck in case of dirt and does not wear out while compressor is running** | **Reduces emissions, as the compressor can be utilized intermittently or kept on hot standby when needed, with virtually zero gas loss** | **Improves reliability as the packing vent safely even in the unlikely case of failure of the SBS or malfunction of the activation valve** | **Increases safety as the fail-safe valve design will safely vent the compressor in case of loss of electric supply** |




NOTES:

1. Activation Unit comes pre-assembled w/ $\frac{3}{8}$" tubing connections
2. PLC control logic to close activation valves after a suitable delay to ensure the compressor has come to a stop. Open valves immediately prior to compressor start.
3. Activation valves are normally open with spring return
4. Interconnecting tubing and wiring supplied by customer

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HOERBIGER CORPORATION OF AMERICA, INC.
3350 GATEWAY DRIVE
POMPANO BEACH, FL 33069

Description:

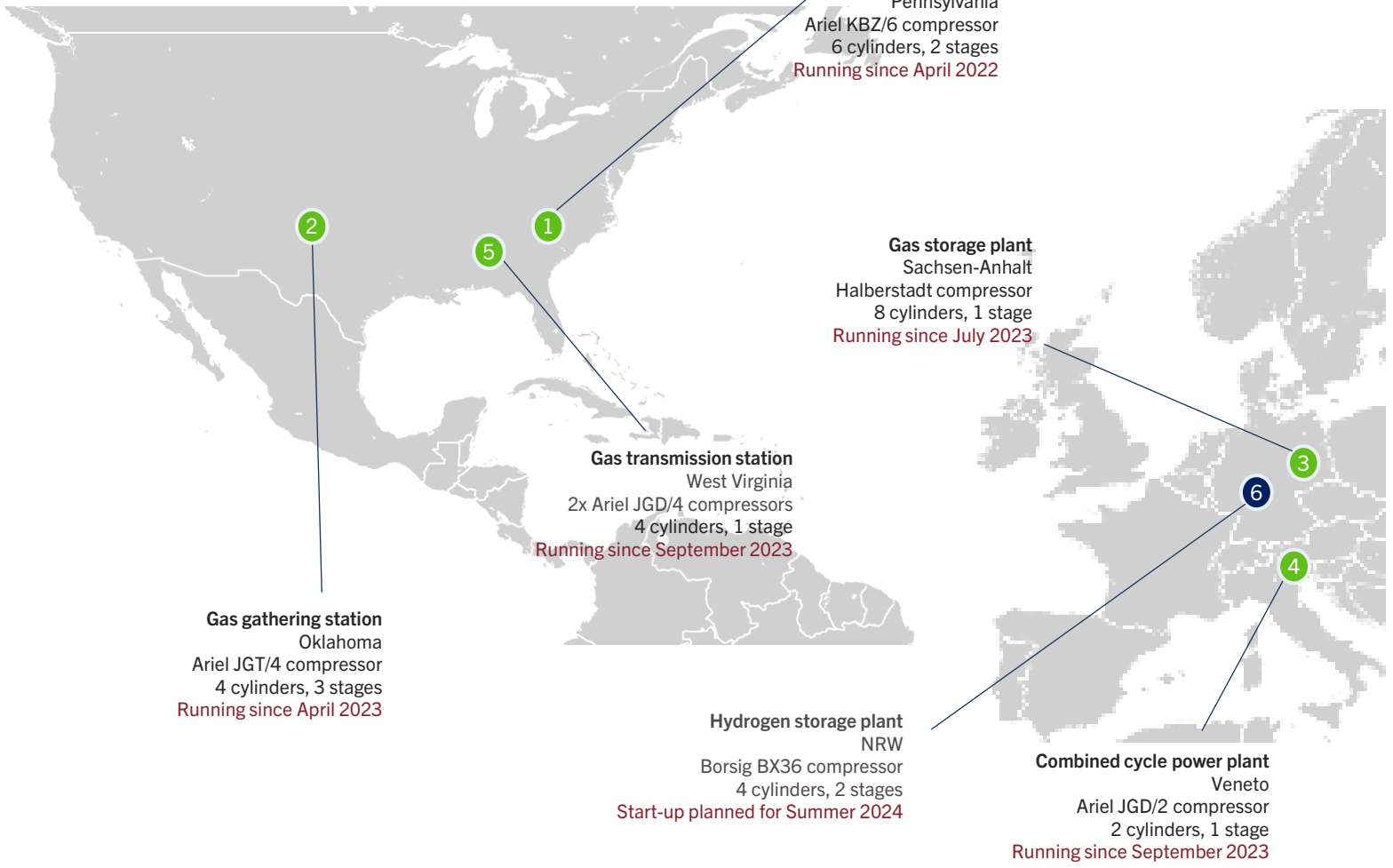
# 2–THROW STBY SEAL P&ID

| | | | |
|---|---|---|---|
| Drawn By: PT | Date: 10/11/22 | PAGE: 1 OF 1 | |
| Rev.: | Date: | Dwg. No.: PROPOSAL | |

# EmissionShield – Installed base

## 6 compressors on 5 sites currently running

Running
Not running yet




**Gas treatment plant**
Pennsylvania
Ariel KBZ/6 compressor
6 cylinders, 2 stages
Running since April 2022

**Gas storage plant**
Sachsen-Anhalt
Halberstadt compressor
8 cylinders, 1 stage
Running since July 2023

**Gas transmission station**
West Virginia
2x Ariel JGD/4 compressors
4 cylinders, 1 stage
Running since September 2023

**Gas gathering station**
Oklahoma
Ariel JGT/4 compressor
4 cylinders, 3 stages
Running since April 2023

**Hydrogen storage plant**
NRW
Borsig BX36 compressor
4 cylinders, 2 stages
Start-up planned for Summer 2024

**Combined cycle power plant**
Veneto
Ariel JGD/2 compressor
2 cylinders, 1 stage
Running since September 2023

| Ref. | Gas | Lube | Stage | $P_{suction}$ | $P_{discharge}$ |
|---|---|---|---|---|---|
| 1 | Natural Gas | L | 1 | 20 bar | 45 bar |
| 1 | Natural Gas | L | 2 | 45 bar | 75 bar |
| 2 | Natural Gas | L | 1 | 1.7 bar | 6 bar |
| 2 | Natural Gas | L | 2 | 6 bar | 22 bar |
| 2 | Natural Gas | L | 3 | 22 bar | 76 bar |
| 3 | Natural Gas | L | 1 | 54 bar | 105 bar |
| 4 | Natural Gas | NL | 1 | 45 bar | 60 bar |
| 5 | Natural Gas | L | 1 | 16 bar | 76 bar |
| *6* | *Hydrogen* | *L* | *1* | *27 bar* | *81 bar* |
| *6* | *Hydrogen* | *L* | *2* | *81 bar* | *200 bar* |



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# THANK YOU !


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*because performance counts*