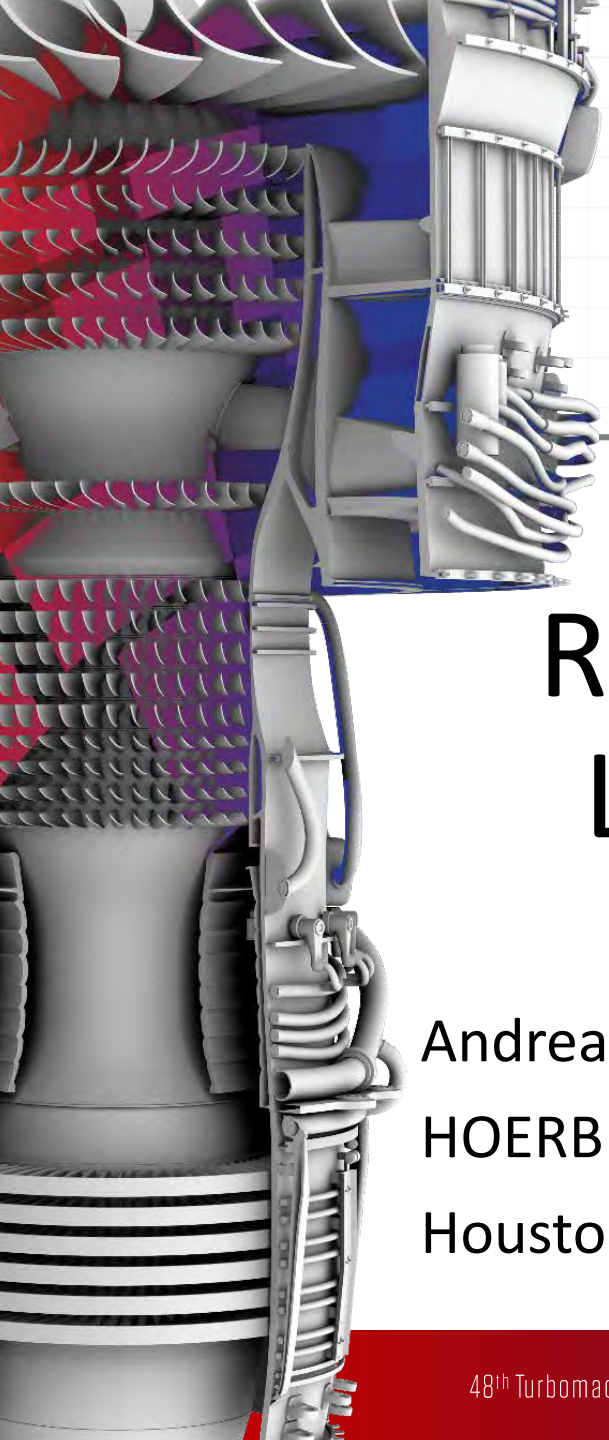


TURBOMACHINERY & PUMP SYMPOSIA

# High Reliability Pistons for Reciprocating Compressors – Non Lube Piston for 5 Year Run-Time

Andreas Brandl, Cory Bulloch

HOERBIGER Service Inc.

Houston, TX

HOERBIGER

# Authors

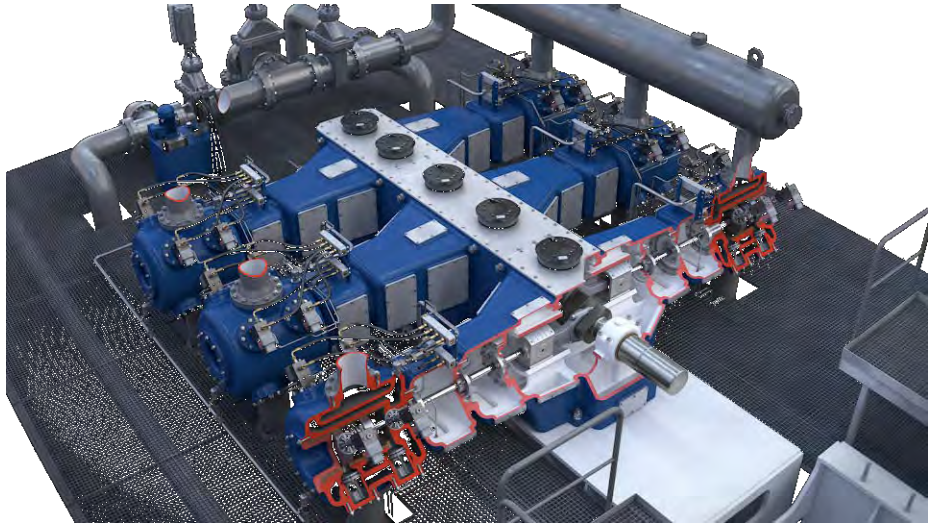
***Andreas Brandl*** *is the Engineering Manager at HOERBIGER Service Inc. in Houston, TX. His work focuses on Reciprocating Compressors for the Oil & Gas and Chemical/Petrochemical industry. Before coming to Texas he was working in the corporate R&D department for HOERBIGER in Austria. Andreas earned his Master's degree in mechanical engineering at the Vienna University of Technology and his MBA at the Jones Graduate School of Business at Rice University.*

***Cory Bulloch*** *is a Senior Designer at HOERBIGER Service Inc. in Houston, TX. His primary role is providing mechanical design, engineering, and drafting support for core products, repairs, and upgrades on reciprocating compressors. Prior to his current role Cory received his Bachelor's in Engineering Technology at Southern Utah University while working as a machinist for an aerospace components manufacturer*

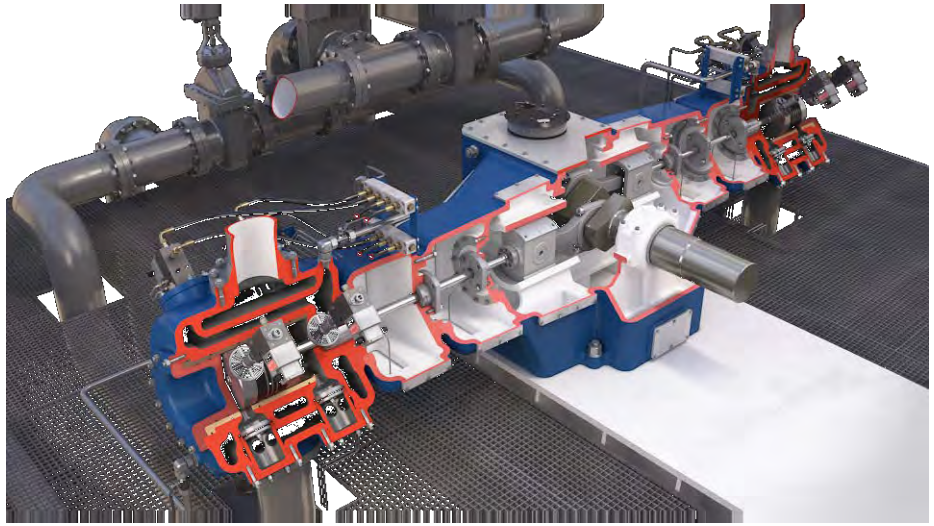
# Agenda

| | |
|---|---|
| 1 | **Introduction** |
| 2 | Problem Statement, Analysis and Recommended Changes |
| 3 | Model Verification |
| 4 | Summary |

# Introduction – Compressor Cylinder



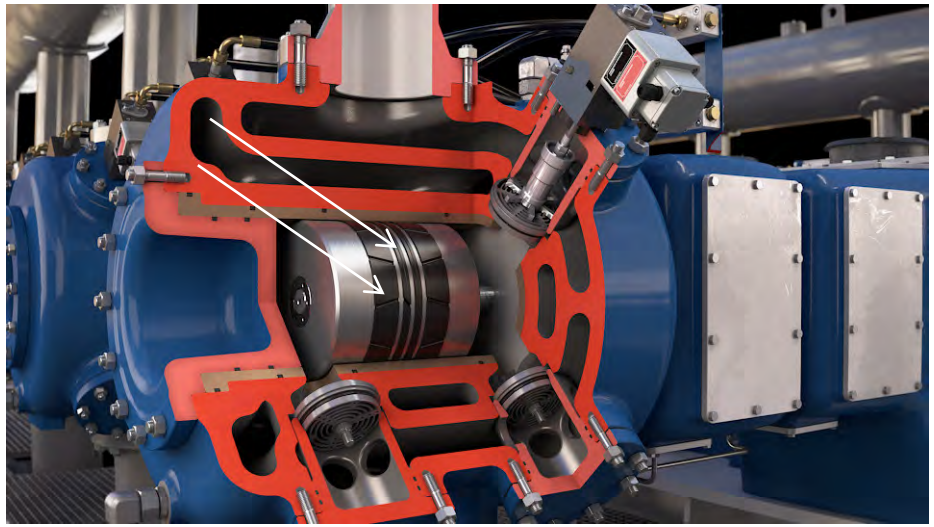
Six throw compressor



Cut through a two-throw compressor

Piston rings: Sealing

Rider bands: Weight

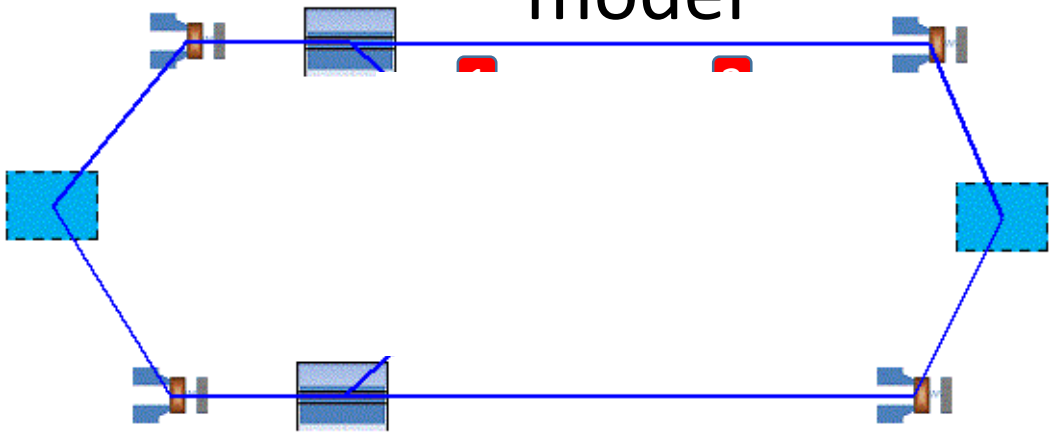


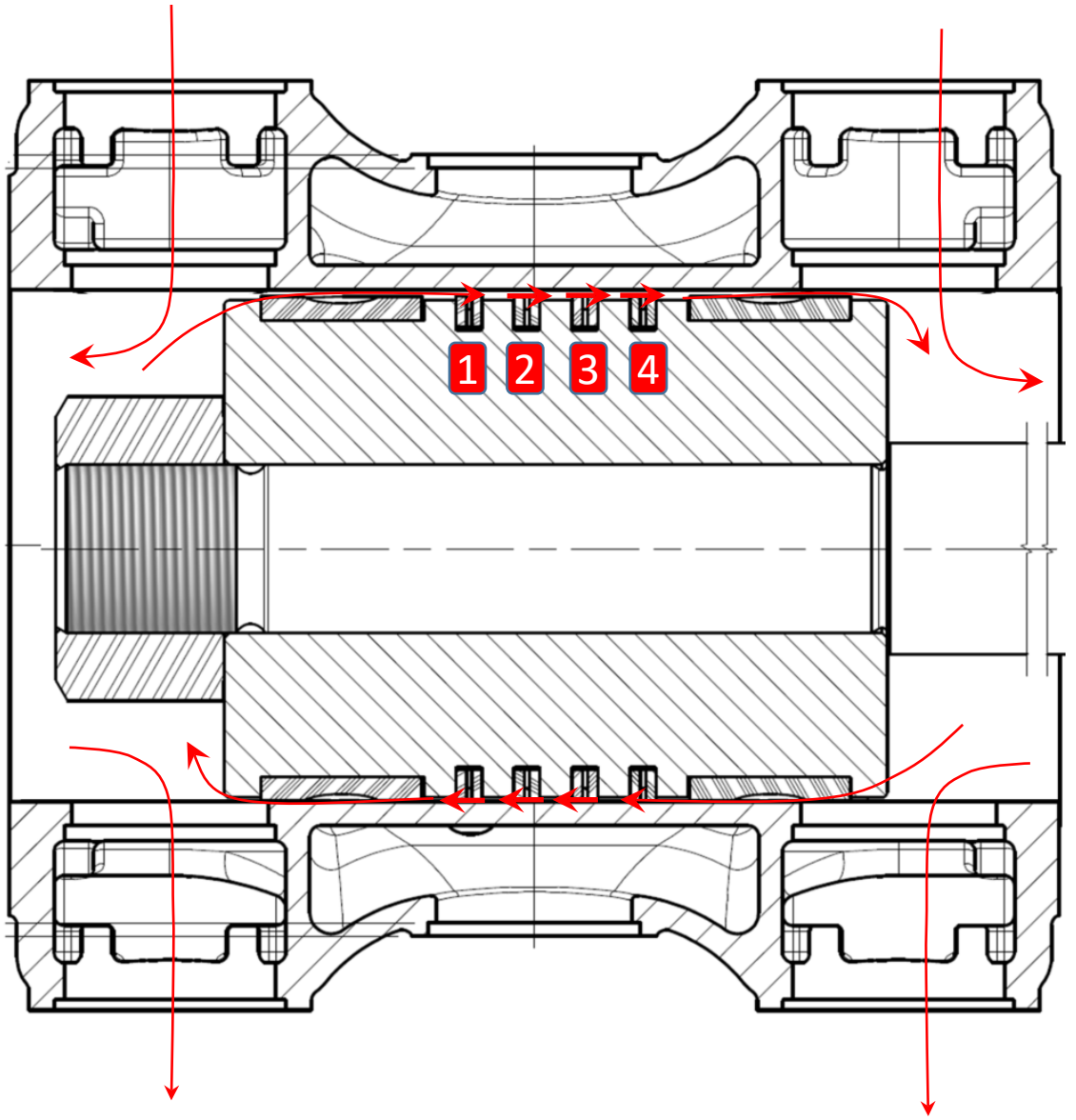
Cut through compressor cylinder

# New approach to model piston performance


Piston with slippage path

Simulation model





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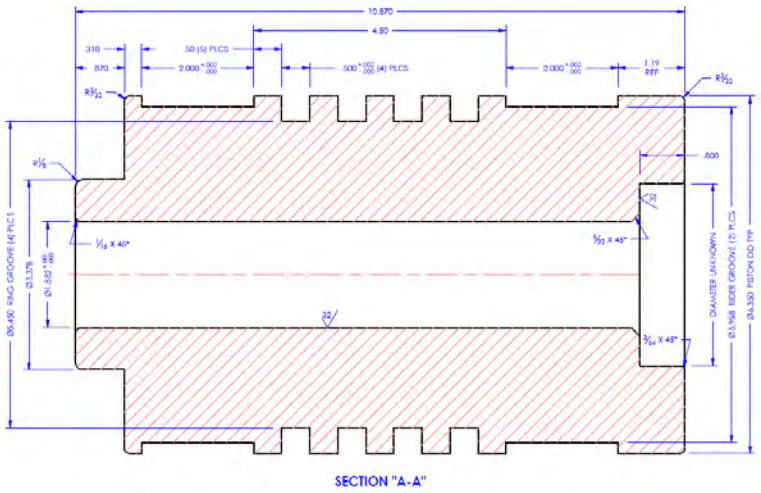
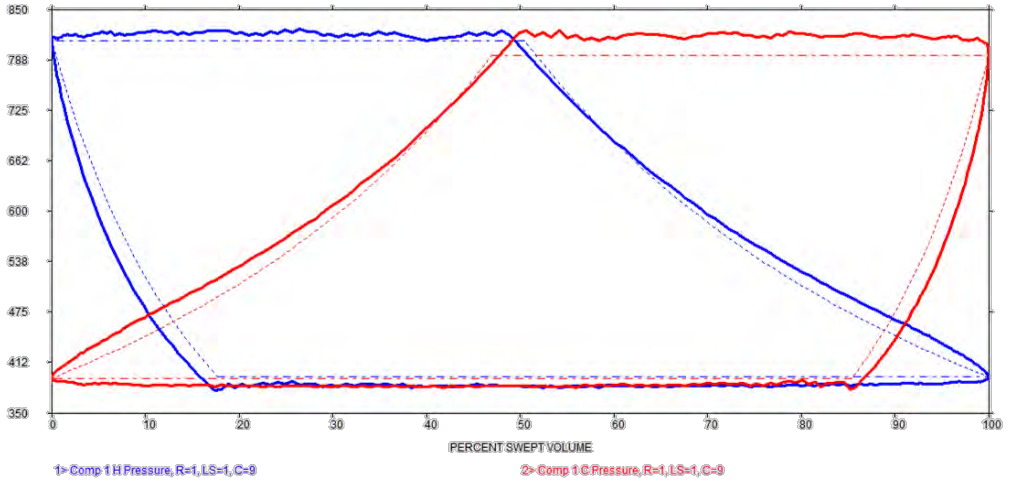
# Non-Lube H2: Capacity losses due to blow-by

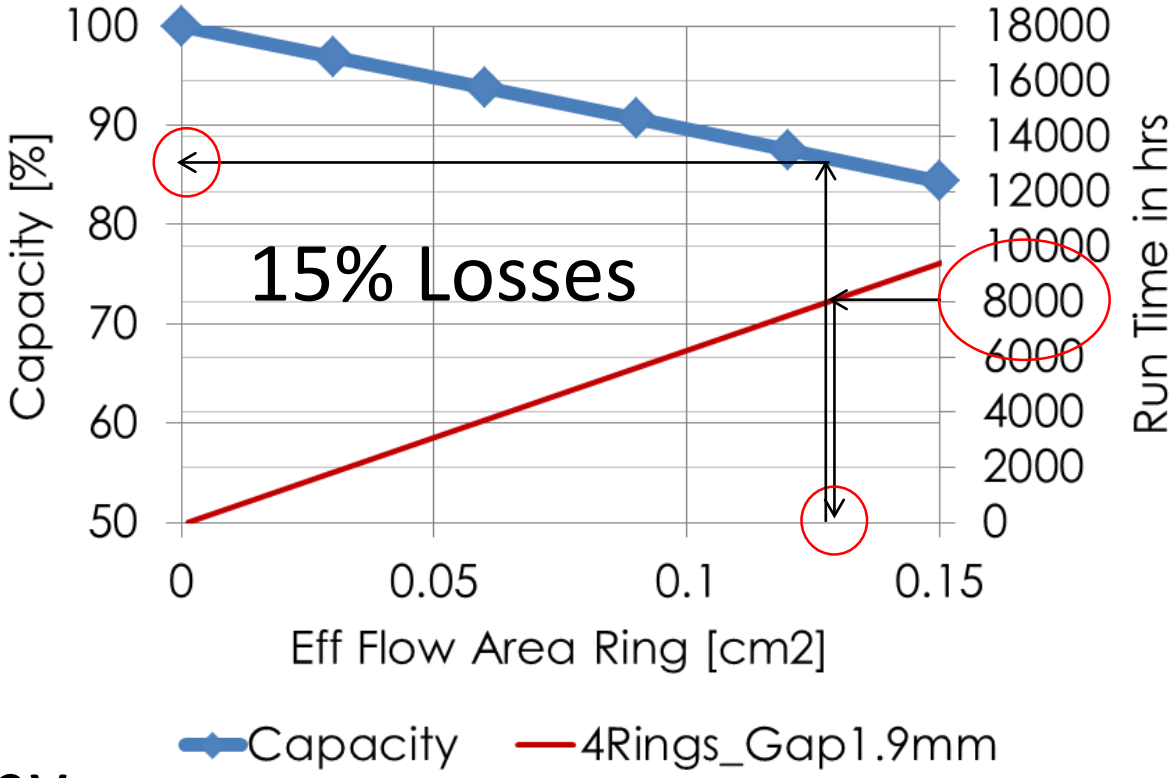
| Compressor Data | |
|---|---|
| Cylinder dia [in] | 6.5 |
| Stroke [in] | 9 |
| Speed [rpm] | 412 |
| Driver Power [hp] | 170 |
| Suction Pressure [psig] | 395 |
| Discharge Pressure [psig] | 810 |
| Cylinder Lubrication | Non-Lube |
| Avg Piston Speed [ft/min] | 618 |

| Single Throw Unit | |
|---|---|
| H2 | 99% |
| CH4 | 1% |
| Molecular Mass [kg/mol] | 2 |
| Isentropic exponent | 1.4 |



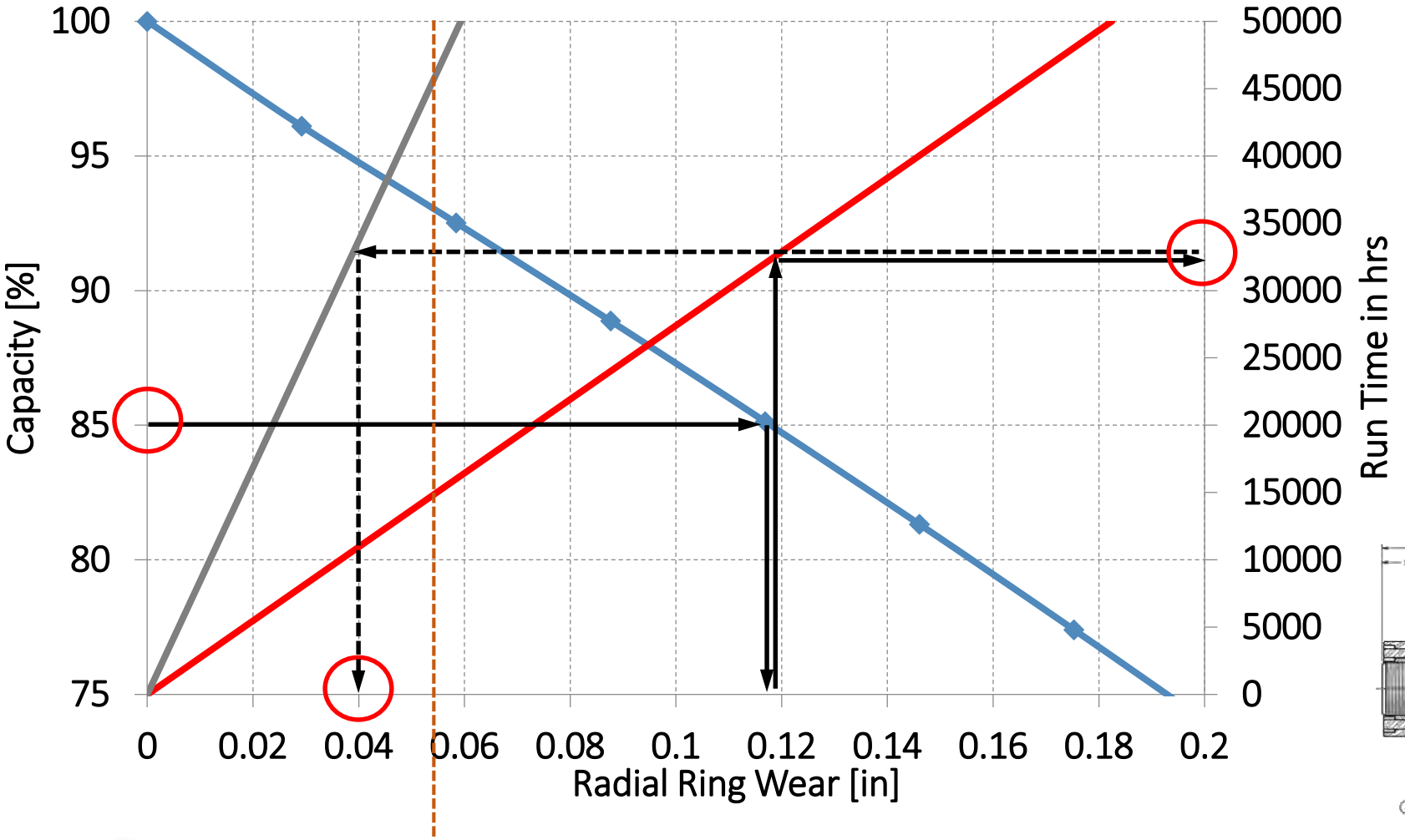
# Predicted capacity losses 15% after one year




Measured pV diagrams confirm the capacity losses due to blow-by

# Piston layout (Non-Lube) for Max Run-Time



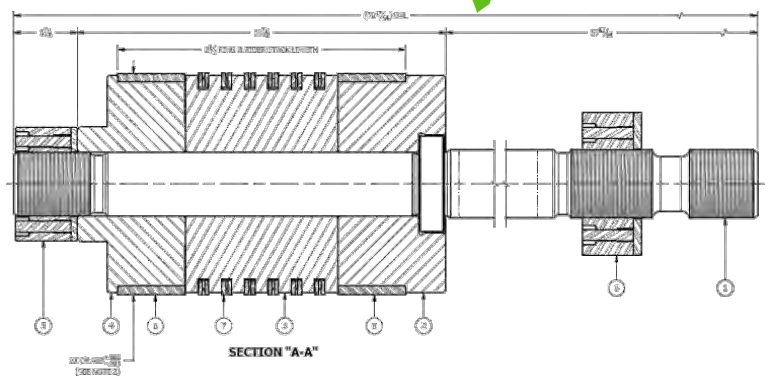

Max rider band wear: 0.055in

Required capacity: 85%

Achievable run-time: **4 years**

Rider band wear: 0.04in

Safety factor against liner contact: 37.5%



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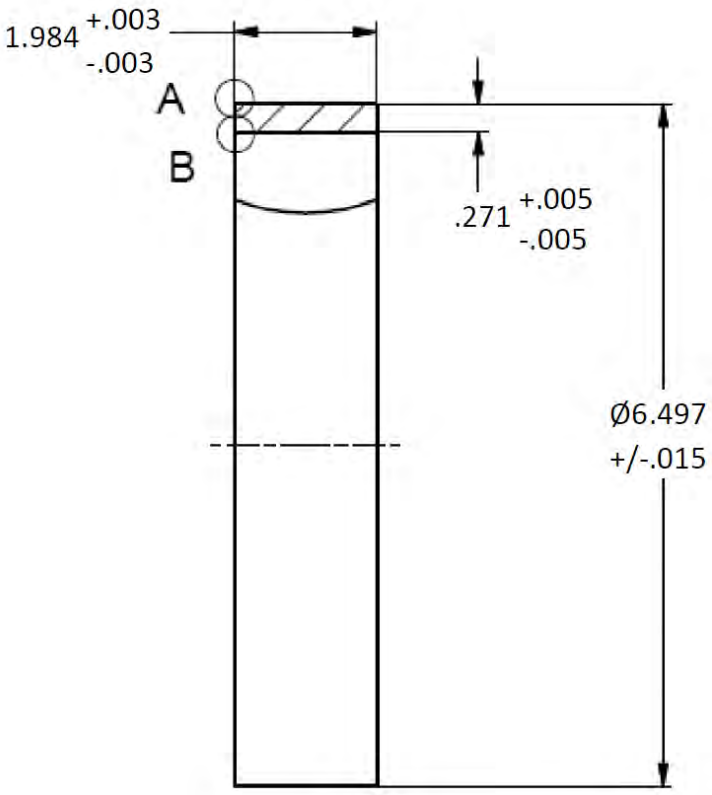
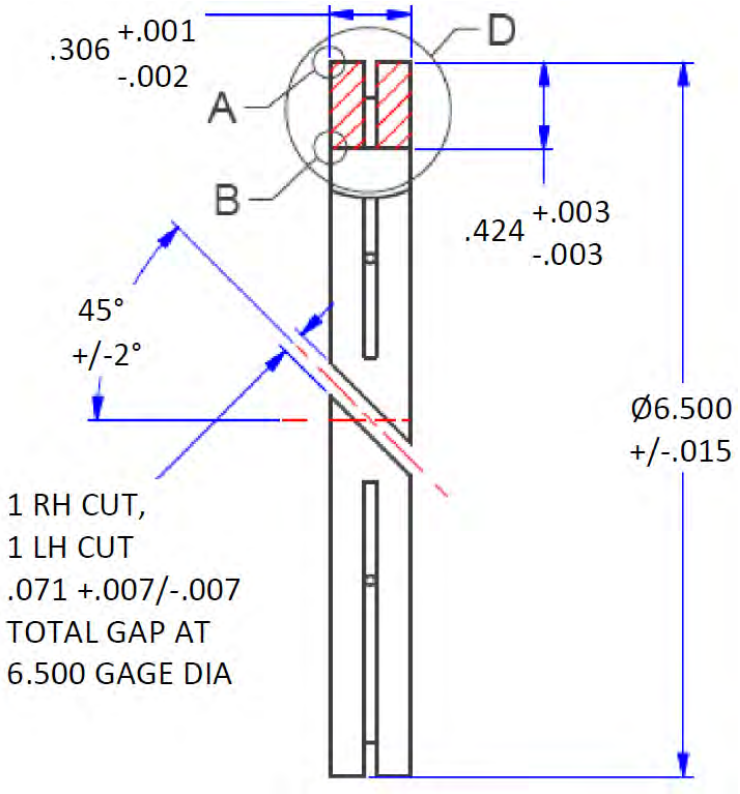
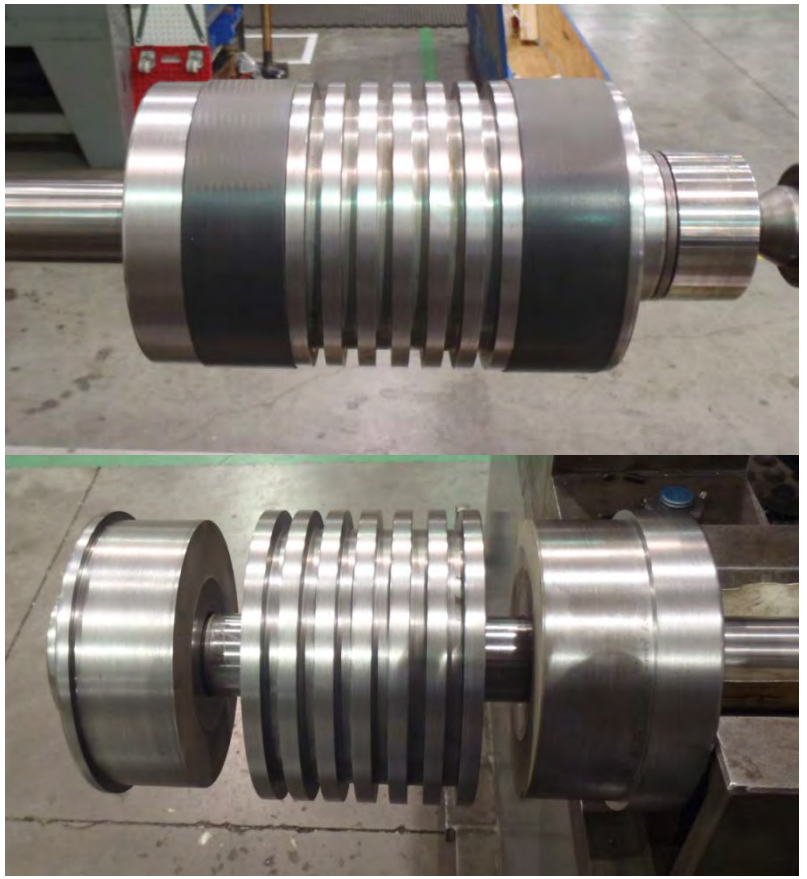
# Ring inspection after 20 months of run-time




Drawing of Uncut Rider Band

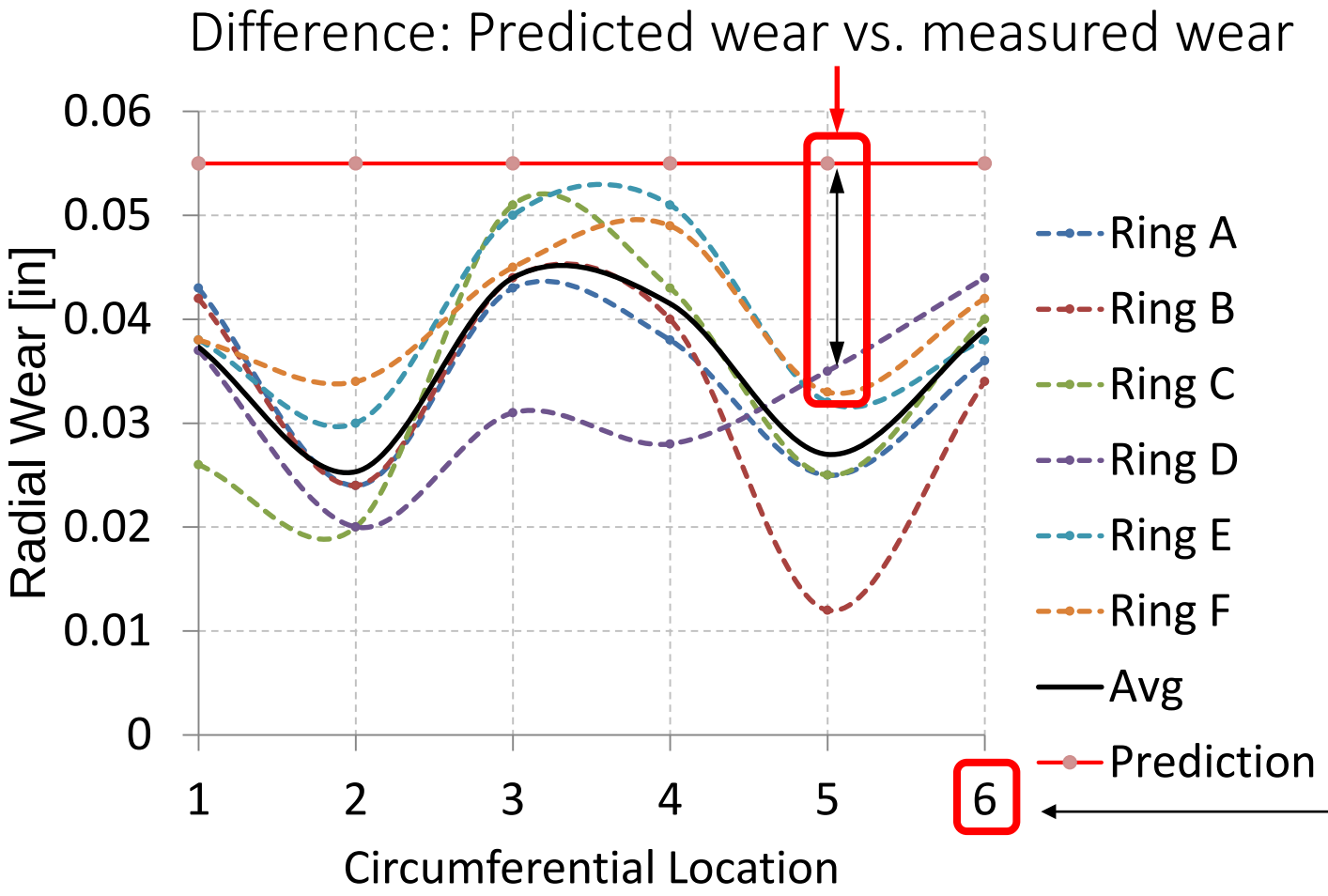


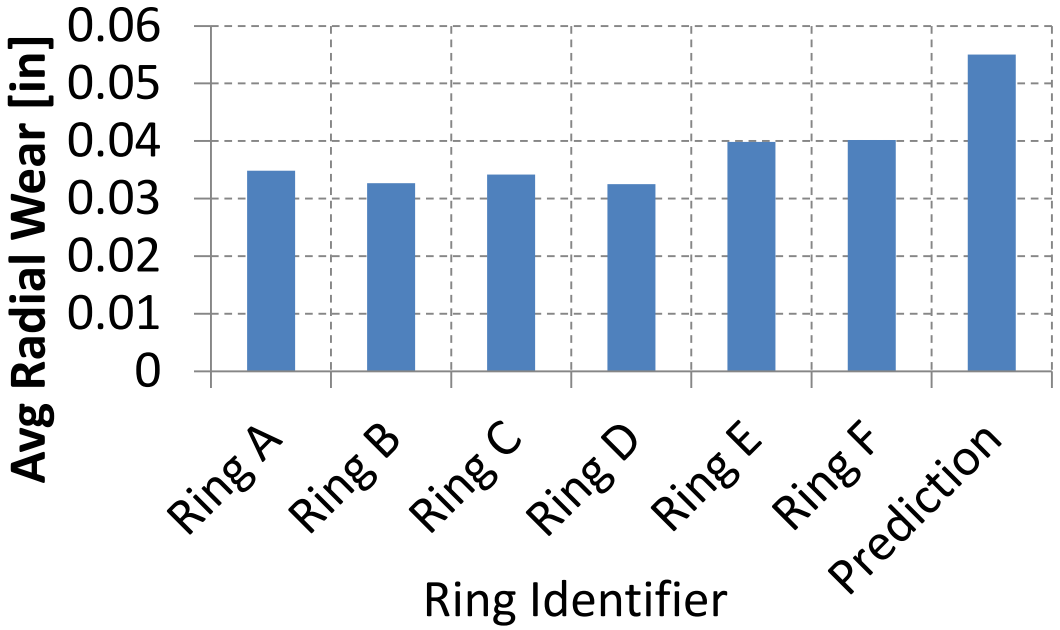

Drawing of Pressure Balanced Piston Rings

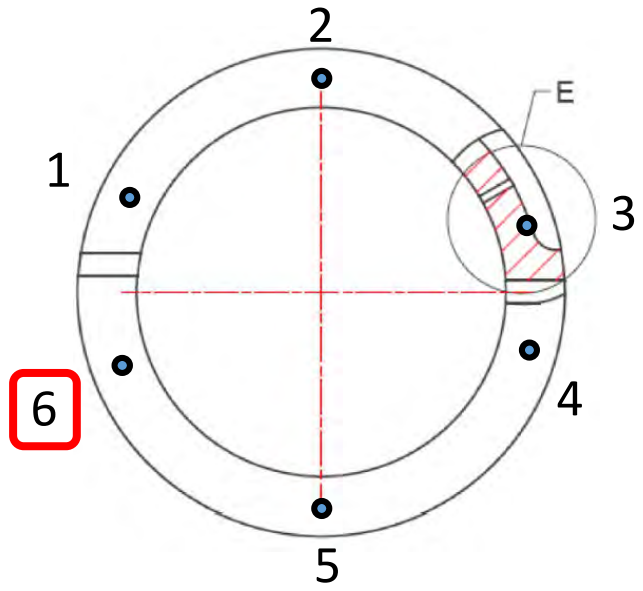


Piston after 20 months of run-time

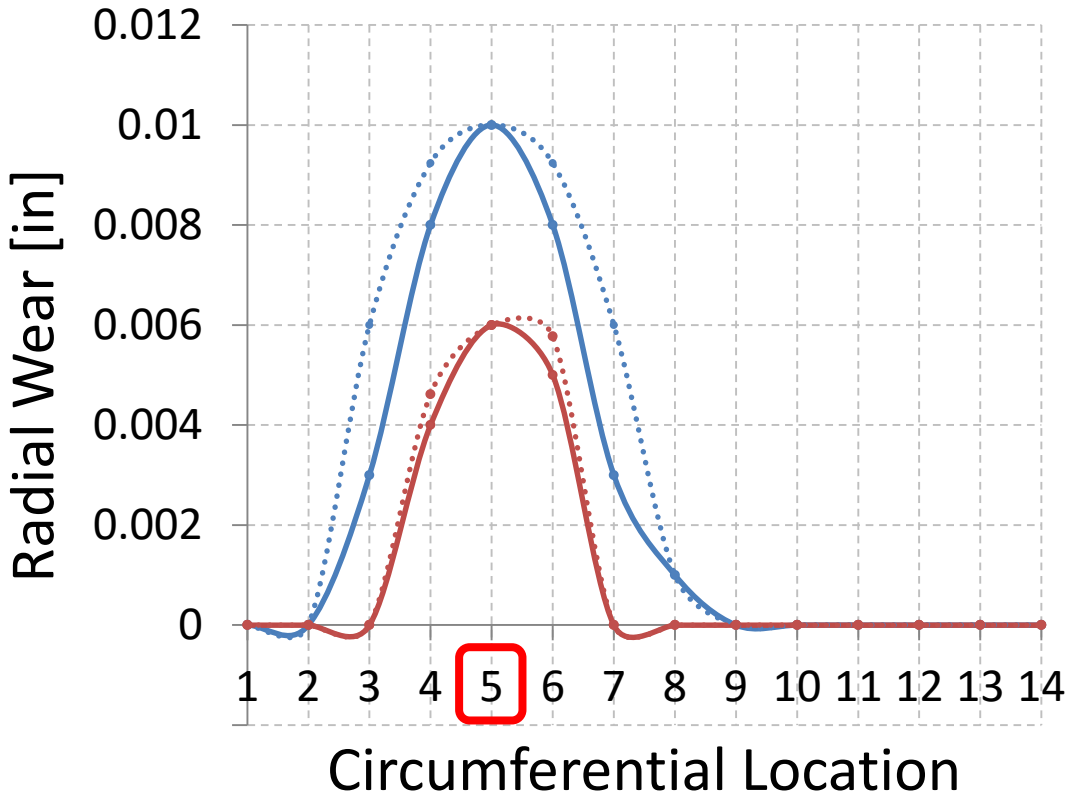
# Piston ring wear: 0.036in

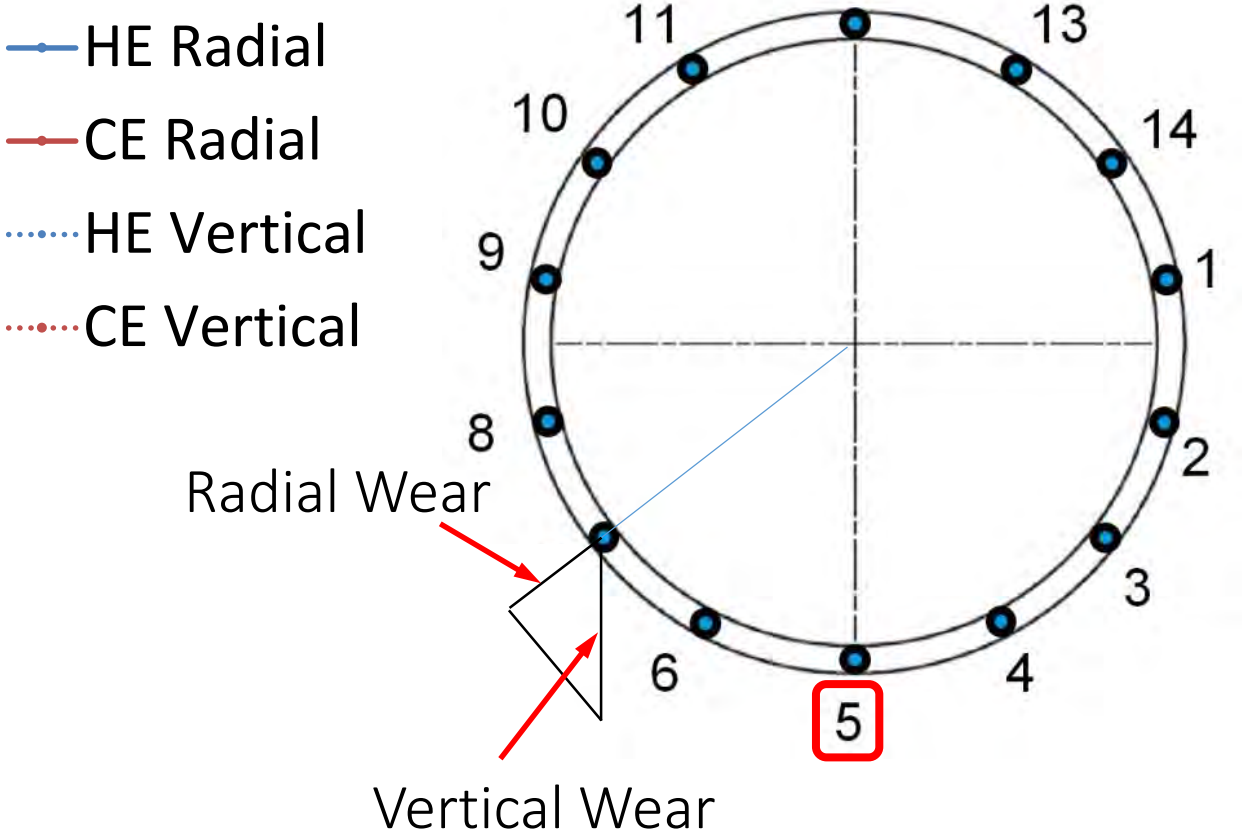


# Rider band wear: <0.01in




Avg. wear on HE rider: 0.0081in (Prediction: 0.018in)

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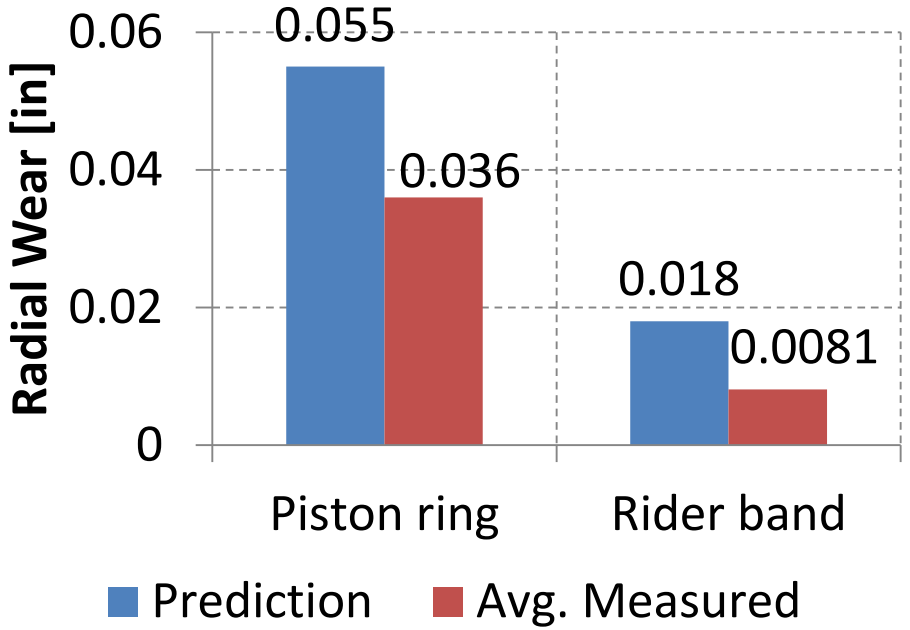
| **5** | **Summary** |

# Inspection after 20 months run-time

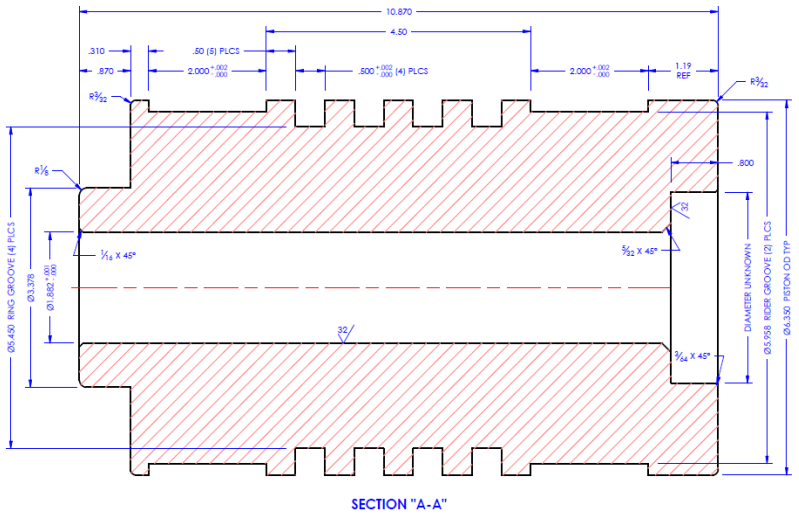
| | |
|---|---|
| Avg. contact pressure on piston rings [psi] | 14.3 |
| Avg. contact pressure on rider bands [psi] | 4.5 |
| Factor | 3.18 |
| Avg. wear on piston rings [in] | 0.036 |
| Avg. wear on rider band (HE) [in] | 0.0081 |
| Factor | 4.44 |

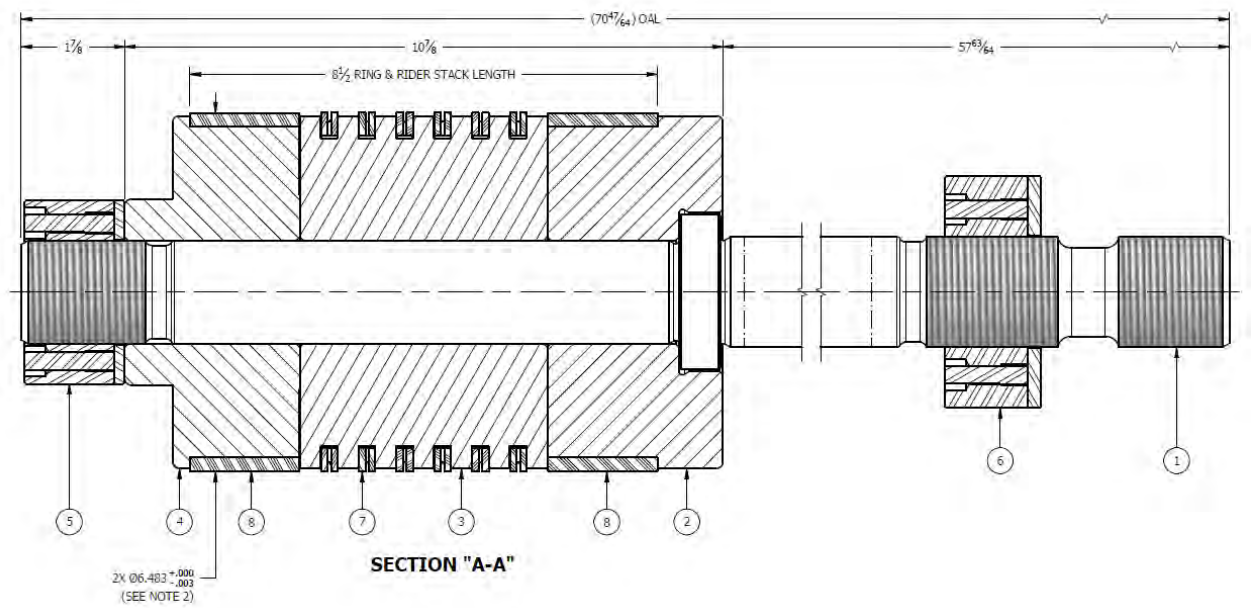



- Wear is higher on tips of the rings
- Wear pattern and absolute wear is comparable on all piston rings
- Wear is lower than predicted (especially on rider bands)
- → Non-Lube Piston design for 5 year run-time (prediction: 4 year run time)

# Thank you for your attention

"Making pistons more reliable by quantifying blow-by and wear in the engineering phase!"




andreas.brandl@hoerbiger.com