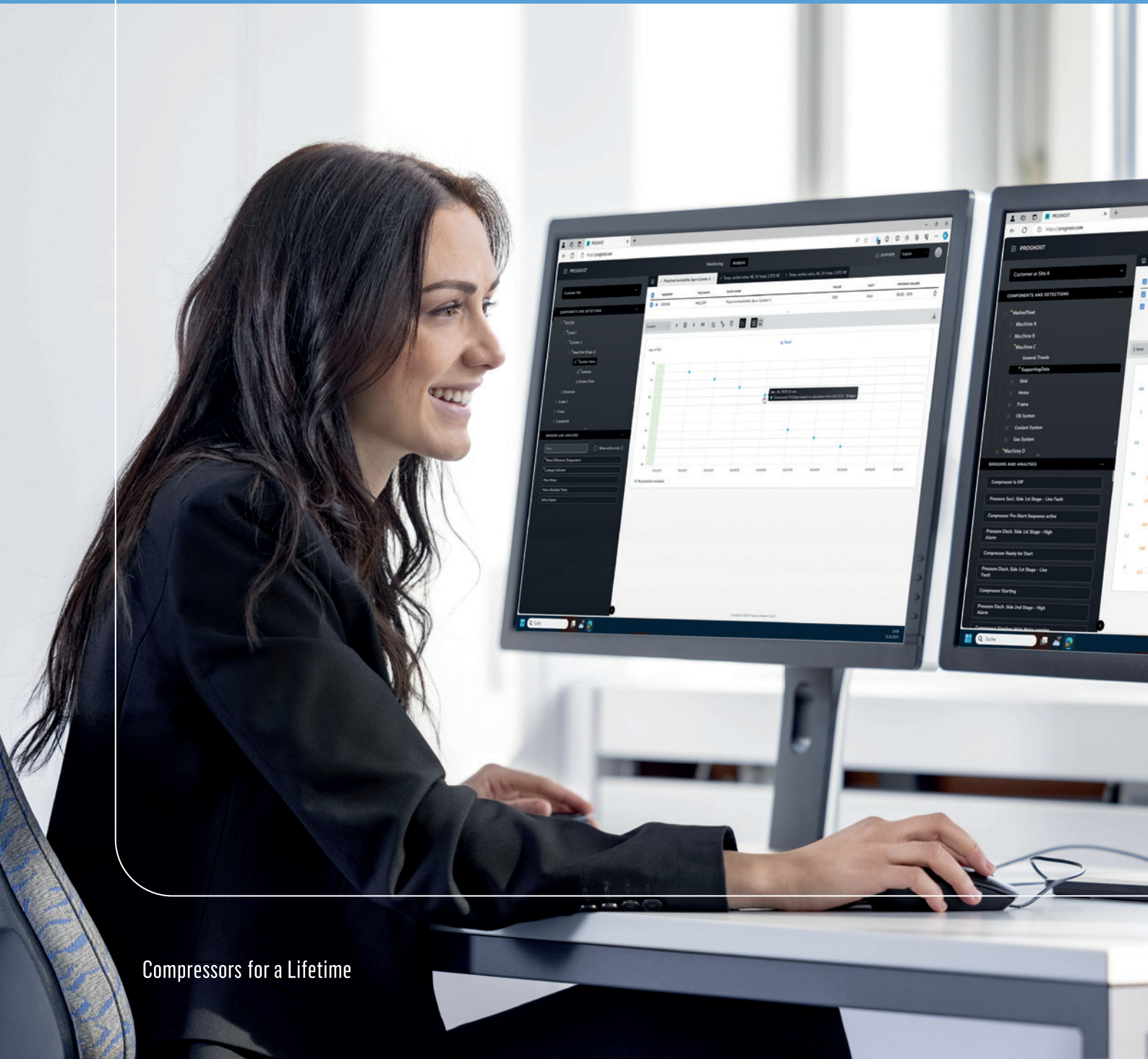


PROGNOST[®]-NT

Software module "Predictive Intelligence"
for version 21 systems



'Predictive Intelligence' at a glance

Software module to maximize profitability

The software module "Predictive Intelligence" is an advanced solution designed to predict the availability of reciprocating compressors. By leveraging real-time data from PROGNOST®-NT and add predictive analytics, it reduces unplanned downtime, prolongs lead time for maintenance planning, and allows full utilization component lifetime.

The two algorithms work independently of each other, use different signal sets and different calculation methods. This independence results in even more precision and trustworthiness of the calculation results.

Why focusing on valves and packings?

These two sealing elements are the most critical parts that cause the majority of unscheduled downtimes for compressors.

Predicting the compressor availability and the lifetime of the two most critical components give a longer lead time to plan maintenance interventions and costly components can be utilized over their real lifetime.

The new software module: How it supports you!

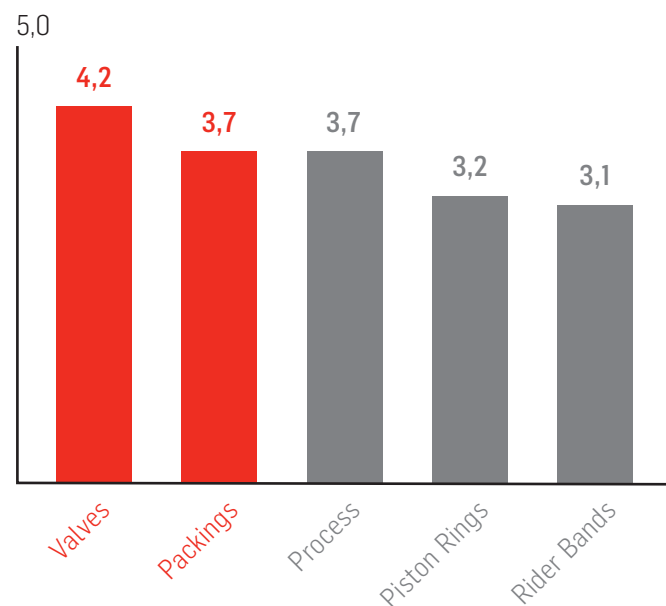
- 1. Optimized and efficient maintenance planning:**
Spare parts orders and personnel scheduling with the longer lead time.
- 2. No unscheduled compressor downtime:**
Alignment of calculated end of component life and maintenance interventions.
- 3. Increased asset lifespan:**
Extends the life of machinery and its components through real condition-based maintenance. Operators can take advantage of the full useful life of costly components, such as valves and packings, without taking the risk of unexpected deterioration.
- 4. Easy to understand:**
Calculation output in form of time windows and trend plots.

Calculates the Remaining Useful Life of your valves and packings

Replacement of parts just-in-time without the risk of being too late



EFRC Compressor Reliability Survey 2021
Criticality of components with respect to the unscheduled shut down
(1 - not critical / 5 - very critical)



Algorithm profiles and applications

Remaining Useful Life (RUL)

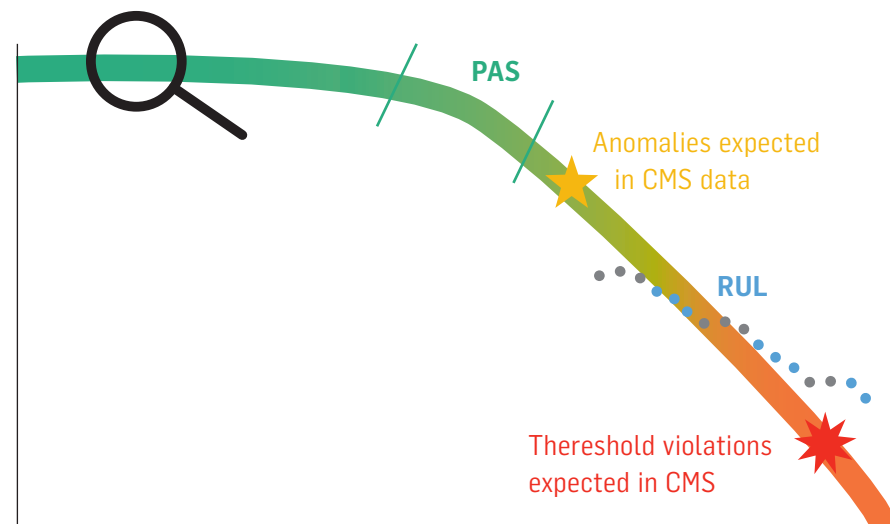
- Based on vibration signals
- For packings and valves on cylinder level
- For horizontal and Labyrinth compressors
- RUL forecast: maximum 58 days
- First results available after first anomaly finding in data set

Patent: EP2023/065418

Projected Availability Span (PAS)

- Based on pressure and temperature signals
- For SV/Packing or DV for all cylinders
- For Labyrinth compressors
- Calculates the timeframe in which the affected sealing elements components are expected to show no anomalies during operation
- First results available after 101 days of continuous compressor operation

Patent: EP4369127A1



- The p-f interval is the popular visualization of component or asset life, from "good condition" to "failure" over time.
- After a period of signal analyses, the two algorithms independently calculate their predictions.
- First, the Projected Availability Span (PAS) will be displayed and inform about the expected anomaly-free time period of operation.

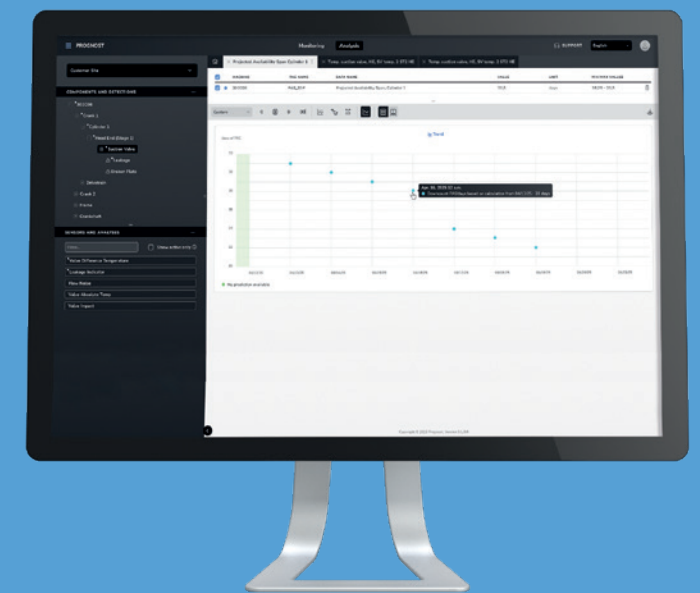
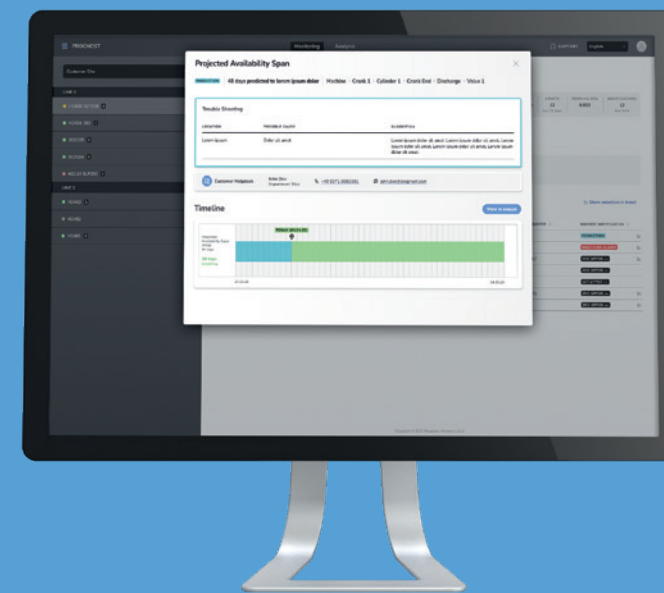
- After PAS is expired, and the RUL algorithm detected significant signal patterns, the Remaining Useful Life will be calculated and visualized in form of a trend over time.
- In parallel, user will see first threshold violations in the PROGNOST-NT® system, in parallel with the RUL trend.
- Maintenance teams are well informed for planning inspections. They use the RUL trend and the monitoring data to decide for how long the asset can be operated; e.g. until the next planned shutdown.

Display of prediction results

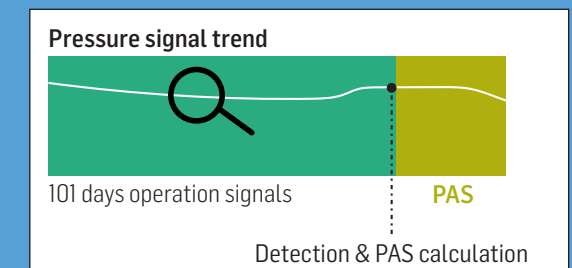
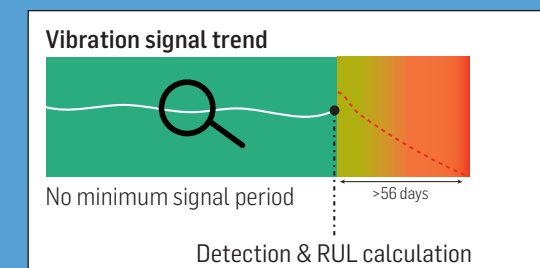
Results are available in a browser based interface

The timeframe of the Projected Availability Span (PAS) displays the expected anomaly-free operation period. Users see the total PAS and the remaining time until maintenance interventions should be considered.

This trend informs users about the Remaining Useful Life (RUL) of packings or valve on cylinder level. A threshold will notify users when a defined remaining time (days, weeks) has been reached.



Data Examination phases



The calculation of the Projected Availability Span (PAS) requires initially 101 days of measurements (daily uploads) as an observation time for the first results. This is needed only once per machine and not after each component exchange. Customers with historical data can provide data/access to let the algorithm examine for faster/immediate results.

The algorithms are not pre-trained or get trained during the Data Examination phase! They use different Machine Learning methods that do not require training.

The Data Examination is needed for PAS to statistically analyse operation condition monitoring data to identify patterns and anomalies. The RUL algorithm uses a different method and can predict as soon as patterns or anomalies are detected.

Prediction Validation service

The “Predictive Intelligence” software module comes with a new service from our machinery experts.

Bi-Weekly Prediction Validation

Twice per month PROGNOST Customer Support specialists...

- Compare prediction calculations with the relevant analyses results (data sources for the predictions)
- Deviations between the condition monitoring data and prediction calculations will be reported to the customer via email
- Customer will be actively contacted regularly, especially after machine stops, and asked for feedback about maintenance interventions, visual inspection of sealing elements or activities executed after calculated life of components expired.
- The feedback loop between end user – customer support – data science team is necessary to optimize parameters of the algorithms to be customized for individual compressors and processes



Software as a Service (SaaS)

The “Predictive Intelligence” software module is a software subscription model.

From a B2B industrial business perspective, the advantages of SaaS over lifetime licenses for cloud-based software are compelling:

Cost management: Industrial businesses often operate on tight budgets and need to manage cash flow carefully. SaaS allows for predictable, manageable monthly or annual expenses rather than a large upfront investment.

Flexibility and scalability: As your business grows or changes, SaaS solutions can easily scale with you. Whether you need to add more users, increase storage, or access additional features, SaaS can adapt without significant downtime or additional capital expenditure.

Continuous improvement: SaaS providers regularly update their software with new features, security patches, and performance improvements. This means your business always has access to the latest technology without the need for manual upgrades or additional costs.

Remote accessibility: In the industrial sector, operations can be spread across multiple locations. SaaS solutions can be accessed from anywhere with an internet connection, facilitating better coordination and collaboration

among teams, whether they are on-site, in the office, or working remotely.

Reduced IT burden: With SaaS, the responsibility for maintenance, security, and support lies with the provider. This reduces the burden on your internal IT team, allowing them to focus on more strategic initiatives rather than routine maintenance.

Risk mitigation: The subscription model of SaaS reduces the risk associated with large capital investments in software that may become obsolete or fail to meet evolving business needs. You can switch providers or adjust your subscription as needed without significant financial loss.

Trial and evaluation: Many SaaS providers offer free trials or short-term subscriptions, allowing industrial businesses to evaluate the software's effectiveness before making a long-term commitment. This can be particularly useful for ensuring the software meets specific operational requirements.

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