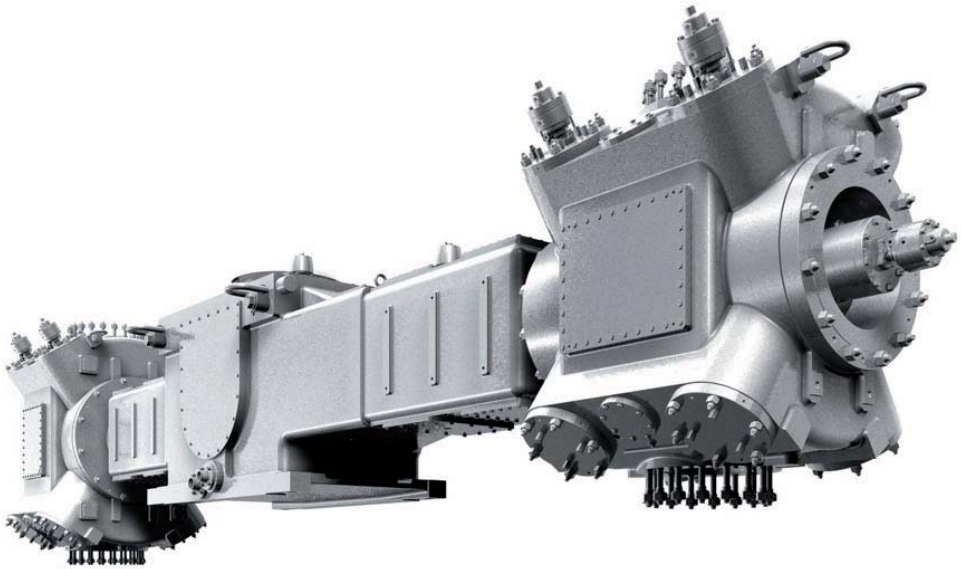
PROGNOST
Intelligence on Duty



Model-based Compressor Diagnostics

PROGNOST®-*Genuit*

PROGNOST®-*Genuit*

Maximizing machinery operating time through optimized MTBM with model based online diagnostics

Operators of rotating equipment are facing increasing cost pressure to produce efficiently and stay competitive. A key area where significant savings can be generated is by optimizing the meantime between maintenance (MTBM) of machinery. This is based on the principal that machinery operation time can be increased by utilizing current spare parts or by sourcing improved components. Successfully applying this strategy could lead to an increase of MTBM e.g. from 12 to 24 months. In any case the longest operating time between maintenance is determined by the component with the shortest lifecycle.

In many cases, great improvements in terms of reliability have been achieved and the number of unscheduled shutdowns has been decreased. Mostly, the applied maintenance interval of a machine depends only on a small number of components. Those components are mainly the cylinder sealing components e.g. suction/discharge valves, packings and piston rings. Hence, a precise and reliable online diagnosis of these components is a key element in assessing safe maximization of operating time. PROGNOST®-*Genuit* has been developed based on this requirement.

Challenges in maintenance planning

The major prerequisite for accurate maintenance planning is a repeatable operating life of each relevant wear component. However, industry surveys show that only 11% of all complex industrial machinery have a predictable lifecycle. 89% have an unpredictable MTBF behavior with the risk of unscheduled shutdowns during their entire lifecycle.

11% Predicable component lifetime

89% Unpredicable component lifetime

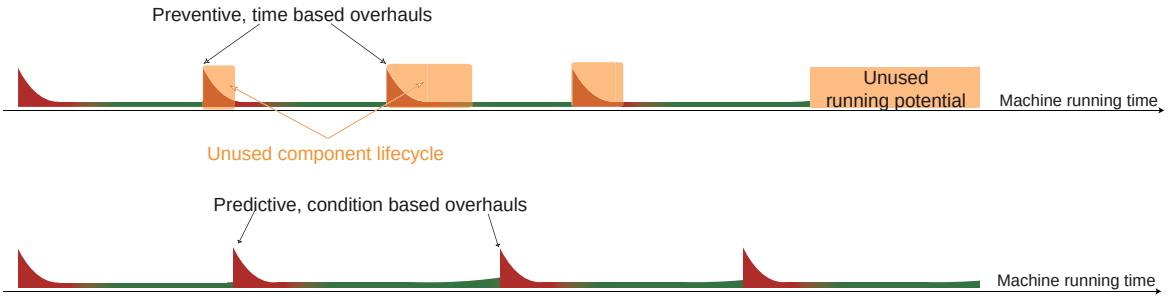
Industrial machinery and their predicable average running time in per cent[1]

How does PROGNOST®-*Genuit* maximize the use of wear potential?

The “Bath tub curve” describes the failure rate of components after overhauls or after initial machine start-up[2]. The risk of failures is high at the beginning (“infant mortality”) but drops down fast to a random failure rate for the main runtime. Identifying the true end of a components lifecycle and not wasting potential runtime is the key challenge, due to the inconsistancy in the wear behavior of components. With the true end of the lifecycle not clearly known, the risk of failures rises statistically towards the end of the lifecycle. Until today, operators managed this inconstancy with mostly preventive maintenance routines selecting a conservative time between overhauls.

However, the preventive exchange of components has its downside leaving the potential of the components unused with time based strategies. PROGNOST®-*Genuit* has been developed to close that gap providing precise online diagnostics for all cylinder sealing components and supporting decisions for accurate, predictive overhaul schedules.

“Bath tub curve”: High failure rate at initial start up (infant mortality), followed by a long period with only random failures. Based on wear, the failure rate increases at the end of the components lifecycle again.



Upper graphic:

Preventive, time based maintenance concept. Overhaul activities are based on manufacturer recommendations and experiences.The components lifetimes are not fully utilized. Consequently, the machine running potential is not fully used.

Lower graphic:

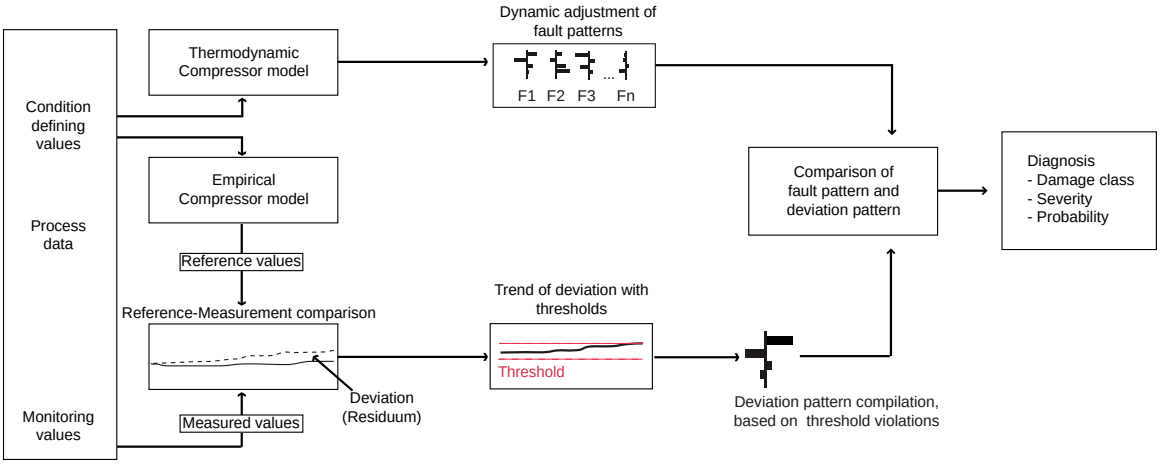
Diagnostic tools allow more efficient maintenance intervals without taking a risk of wear caused failures.

[1] Bob Di Stefano (CMRP) for Uptime Magazine, 2006

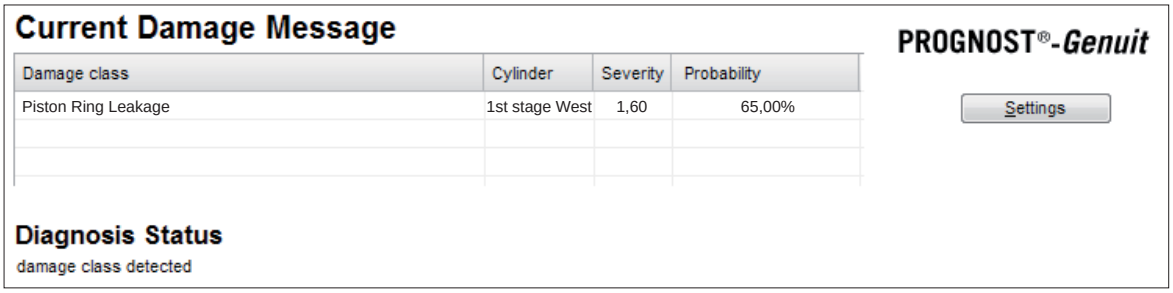
[2] RCMII by John Moubray

Early and reliable diagnosis through thermodynamic compressor model

PROGNOST®-*Genuit* is a diagnostic system. Its unique technology separates this diagnostics system from monitoring applications. Instead of monitoring single parameters such as temperature and pressure with absolute thresholds, PROGNOST®-*Genuit* monitors the deviation of calculated setpoints and online measured values. The setpoints are provided online by a theoretical compressor model that continuously calculates the expected values for each parameter (e.g. suction/discharge pressures and temperatures) based on the operating conditions. The deviation of both values, the so called “residuum”, is monitored with a threshold.



Ideally, the value of the residuum is zero, which means that the measured value is equal to the calculated setpoint. In case of an off-normal condition, e.g. a suction valve leakage, several residuum increase (e.g. stage pressures, valve temperatures) and violate their dedicated thresholds. The PROGNOST®-*Genuit* diagnosis module compares the pattern of the violated residuum with a database that contains patterns of typical sealing components failures. The database includes leakages of suction/discharge valves, piston rings, stuffing boxes and additionally, gas coolers. If the current pattern matches one in the database, a diagnostic clear text message is automatically generated. The diagnostic message includes information of the damage class, e.g. discharge valve failure, and a percentage value for the severity of the damage and the probability that the correct failure type has been diagnosed.



The automatically generated damage message includes the name and place of the damaged component, damage severity and damage probability in %

Why PROGNOST®-*Genuit*?

PROGNOST®-*Genuit* offers many well known advantages of the PROGNOST®-NT system such as remote access and an integration into existing process control systems providing a dedicated diagnostic tool for users that have a clear objective: Maximizing the lifecycle of the cylinder sealing elements.

The PROGNOST®-*Genuit* technology provides three main benefits which will assure it’s value to end users as:

The thermodynamic compressor model makes PROGNOST®-*Genuit* accurate over a range of variable operating conditions.

Diagnoses are based on temperature and pressure data that can generally be acquired from the DCS, providing a sophisticated online diagnostic without additional instrumentation on the compressor.

The monitoring of residuum values provides high certainty and the early detection of costly sealing component failures.

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