EDITORIAL

PRÜFTECHNIK

January 2017

HIGH RELIABILITY OF AIR SCREW COMPRESSORS BY SIMULTANEOUS MONITORING WITH VIBGUARD® COMPACT

PRUFTECHNIK developed a new Condition Monitoring system for simultaneous and continuous data collection, VIBGUARD® Compact.

PRUFTECHNIK Inc. USA, a Philadelphia-based company, coordinated with the nearby AstraZeneca in Frederick, MD to perform extensive functionality tests before the product launch.

AstraZeneca provided a two-stage oil-free rotary screw air-compressor that is currently monitored with the PRUFTECHNIK FFT-Analyzer VIBXPERT® II. This gave us the opportunity to compare vibration data and allowed us to verify plausibility.

As an integral asset to AstraZeneca's production chain, two compressors are available and work in an alternating operation.

Data was transmitted wirelessly to the PRUFTECHNIK Cloud Server. Access to this information was provided for both AstraZeneca and PRUFTECHNIK.

The compressors run in „unloaded" and „loaded" operating states with constant speed. The VIBGUARD® Compact received a hardwired trigger signal to classify the data into these two different states.

This is critical because the vibration behavior differs between each state. Only the „unloaded" data provided sufficient periodicity for reliable data analysis.

Pairing VIBGUARD® Compact with analysis software, OMNITREND® Center provides an option for selecting up to seven operating conditions. In this test, operating conditions are triggered by a digital input. Additionally, parameter levels such as speed or Modbus communication protocol may also be used as triggers.

During our six-week test period, we tested different measurement conditions. Due to the high gear mesh frequencies and their harmonics (approx. 10 to 40 kHz) we used the maximum FFT bandwidth of 50 kHz and configured time signals with a high sample rate in order to recognize the individual gear meshes. Exemplary time-based and frequency-based graphics can be found on the following page.

The field test was completed with a positive result through the excellent support of Thomas Harris, reliability engineer.
THOMAS: „With VIBGUARD® Compact, PRUFTECHNIK has developed a new, very convincing Online Monitoring System for complex applications. We are planning to use this handy system for temporary monitoring tasks and troubleshooting."

Figure 1:
The junction box was already installed for connecting the PRUFTECHNIK handheld VIBXPERT® II which is currently used for route based monitoring of the compressor.

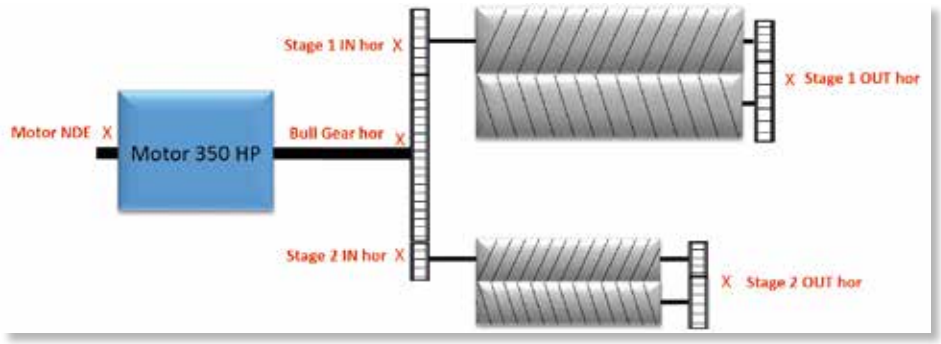

Figure 2:
For the handheld monitoring, eight sensors are installed.
Based on VIBGUARD® Compact´s six simultaneous analog channels, five measurement points were selected on the gearbox and one on the motor.

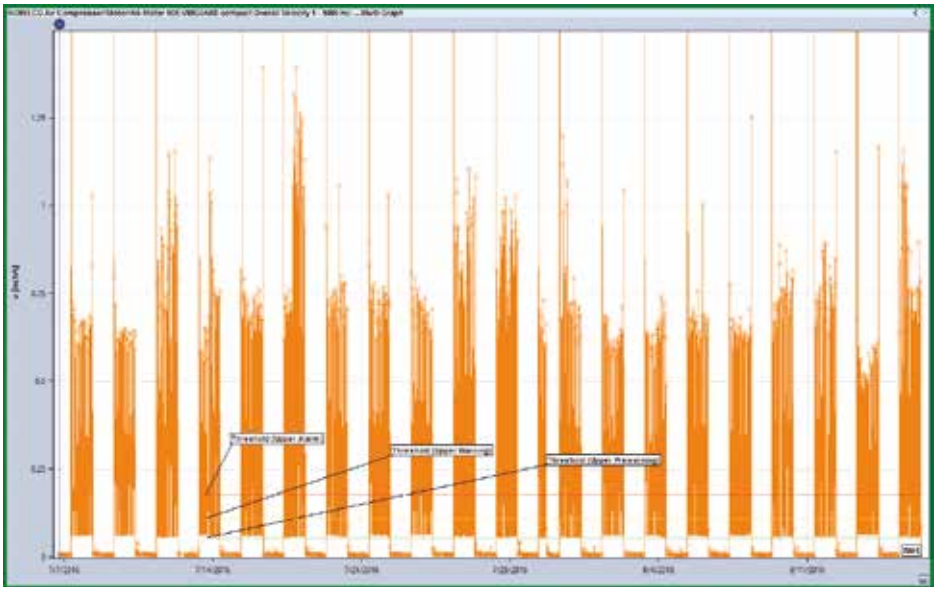

Figure 3:
Overall Velocity rms Trend measured on the Non-Drive End of the Motor.

There is significant overrun on motor side caused in the motor start. There is also significant vibration transfer during the compressor's downtime caused by the adjacent one.

This is also demonstrated in the XY-Plot of Figure 8.

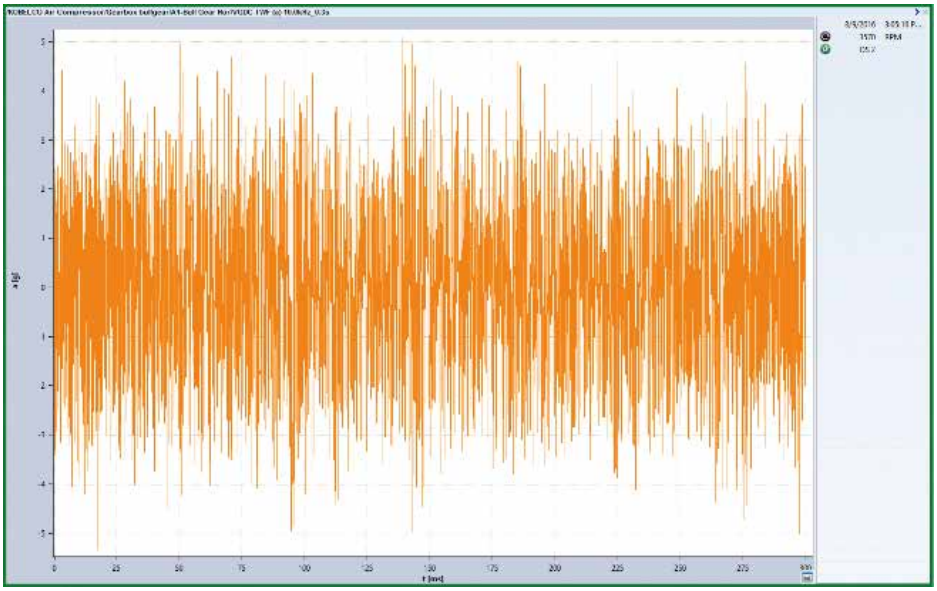

Figure 4a:
Time waveform with 26kHz sample rate of the bull gear

Figure 4b:
Zoomed view of the Time waveform accentuating the gear mesh frequency (9.16kHz = 0.11ms) of the bull gear

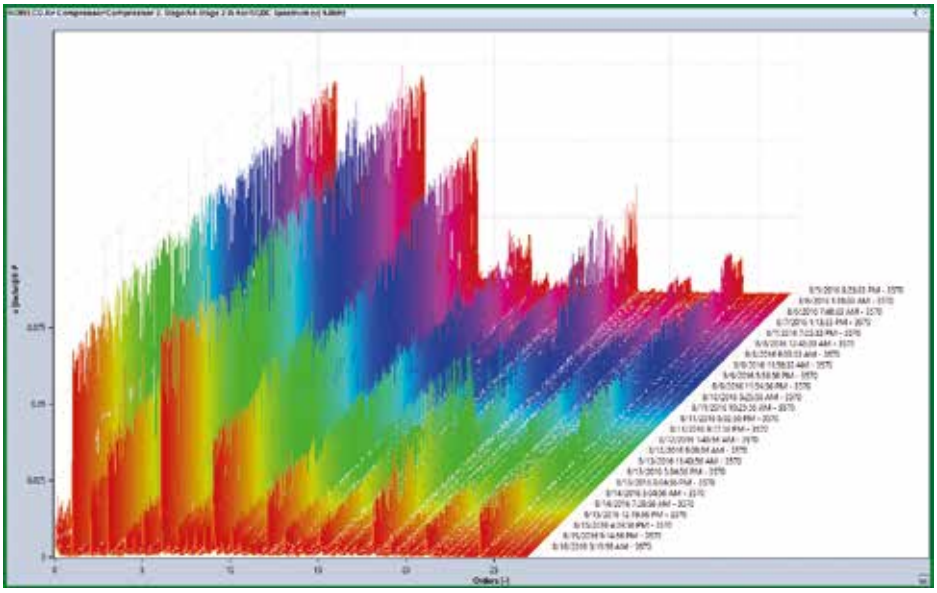

Figure 5a:
Cascade Diagram of Velocity

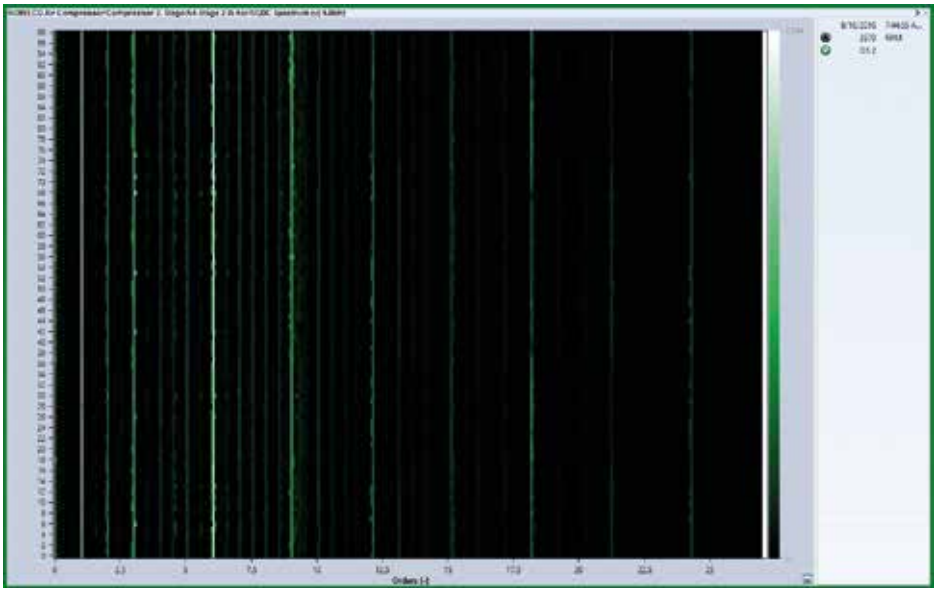

Figure 5b:
Spectrogram of Velocity - Dominated by the first and sixth harmonic of the bull gear frequency. This can be seen by the brighter lines, designating a higher amplitude.

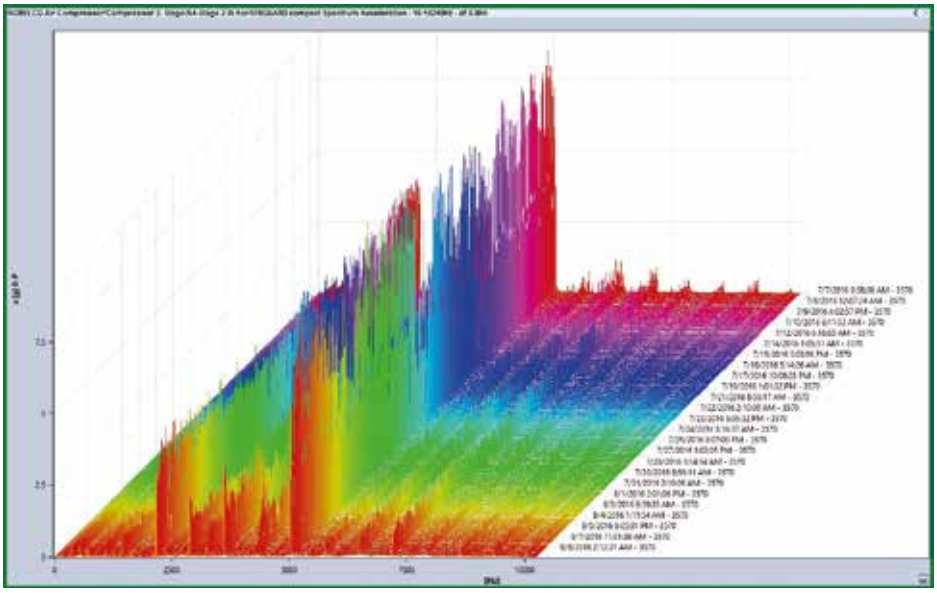

Figure 6a:
The dominant frequency of 360 Hz in the Acceleration spectrum is covered by a harmonic and Ball Pass Frequency (BPF) of the bearing.

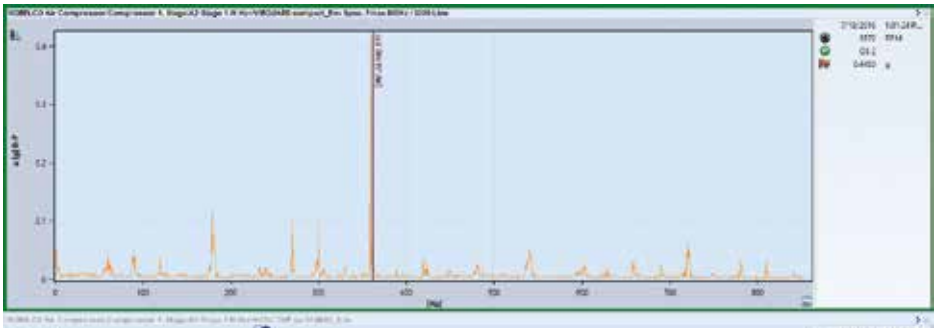

Figure 6b:
Envelope Spectrum on Stage one IN of the compressor

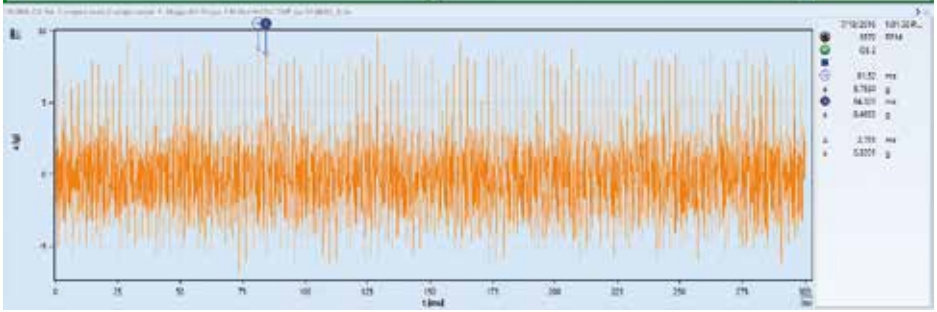

Figure 6c:
The Time waveform of Stage 1 IN shows significant pulses in the bearing frequency which underlines a bearing failure. Further investigation is recommended because the bearing frequency is almost identical with the third harmonic of the Stage 1 compressor speed.

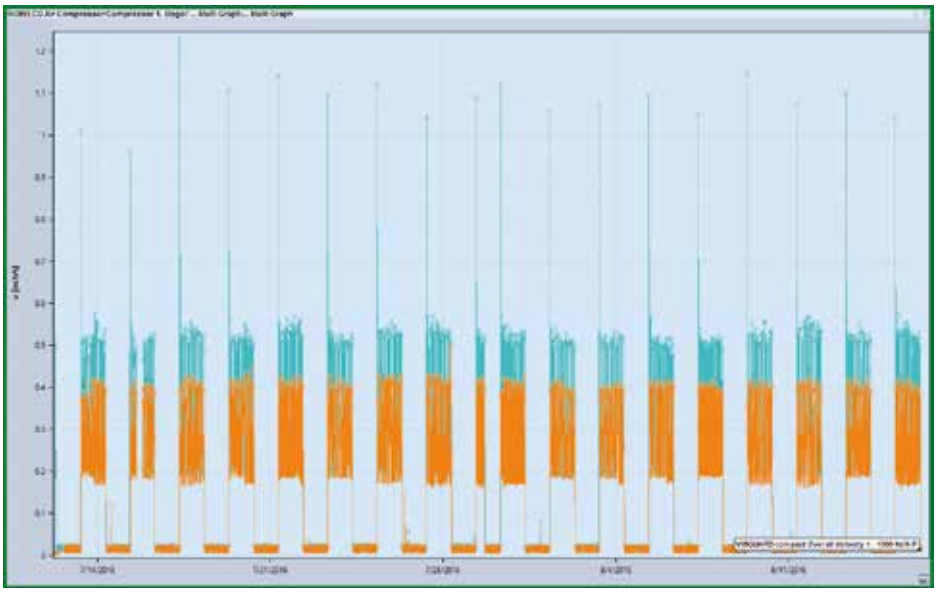

Figure 7:
Multi Graph Trend
blue: Stage 1 IN
orange: Stage 1 OUT

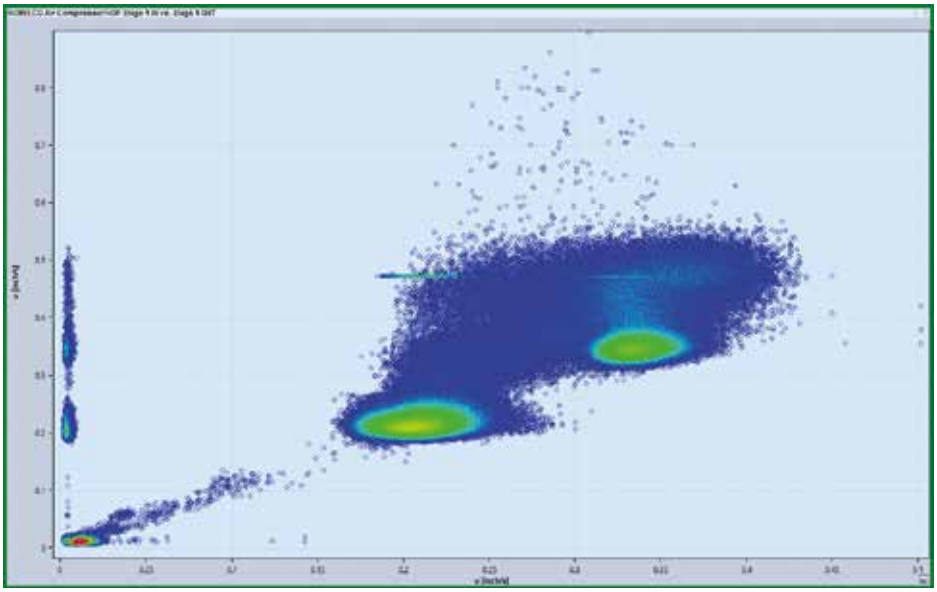

Figure 8:
The XY Plot visualizes particularly clear the vibration distribution in the different Operating States; Downtime, loaded (OP1) and unloaded (OP2)
x-axis: Stage 1 OUT
y-axis: Stage 1 IN

Author:
Christian Kaps

About PRUFTECHNIK:
The PRUFTECHNIK Group, with its subsidiaries and partners in more than 70 countries worldwide, continues to set new standards with innovative technological advancements in the field of machine alignment and vibration measurement technology in order to maximize and optimize the operational safety of machines and plants.

Press contact:
Anne-France Carter
Tel.: +49 89 99616-235
anne-france.carter@pruftechnik.com

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PRÜFTECHNIK Condition Monitoring GmbH
Oskar-Messter-Str. 19-21
85737 Ismaning, Germany
Tel.: +49 89 99616-0
Fax: +49 89 99616-200
info@pruftechnik.com
www.pruftechnik.com

A member of the PRUFTECHNIK group