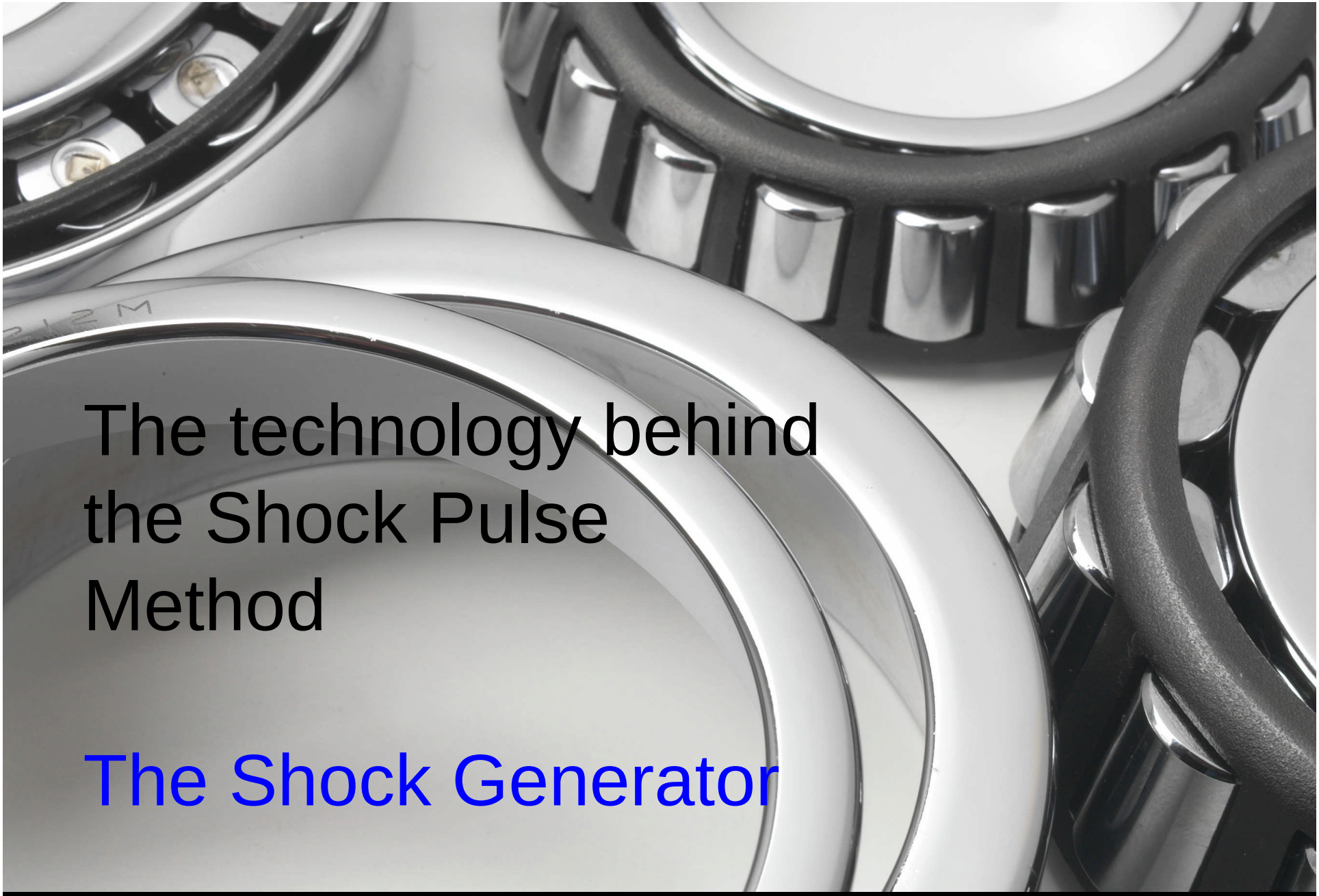
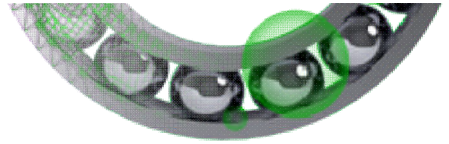

SPMHD



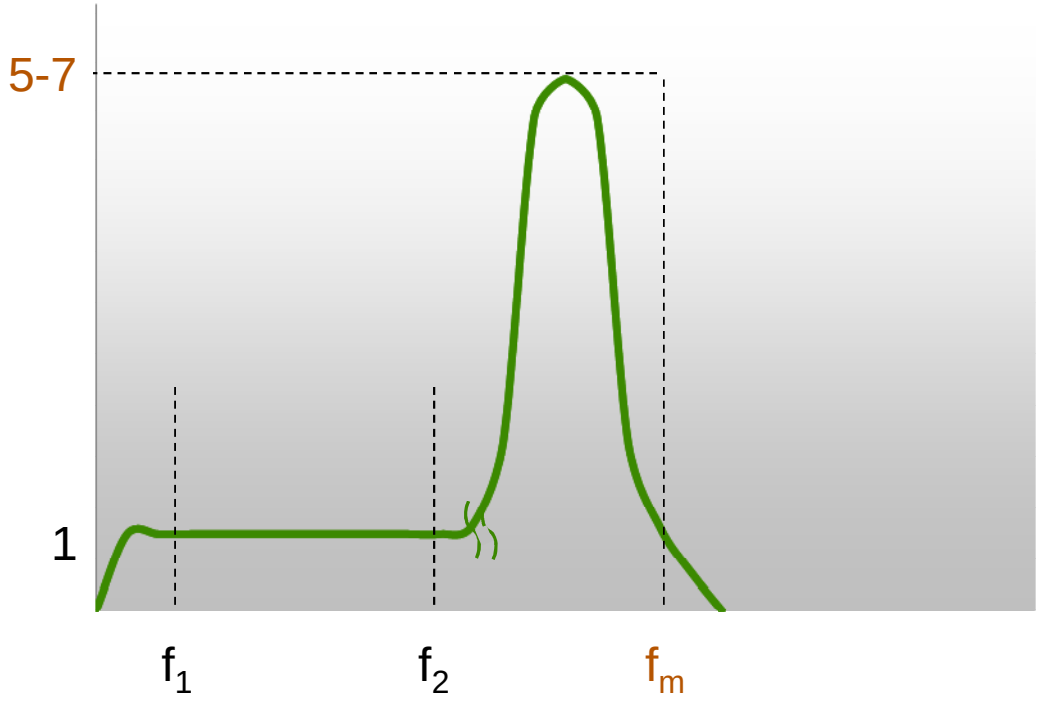
The technology behind the Shock Pulse Method

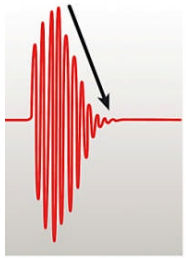
The Shock Generator

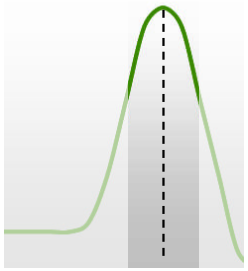


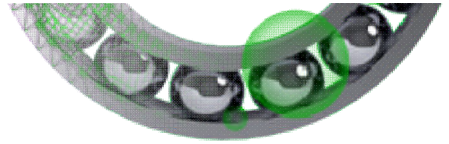
The technology behind the Shock Pulse Method

The Shock Pulse transducer



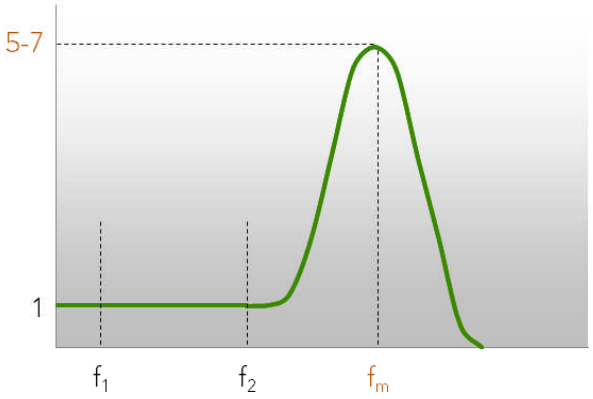


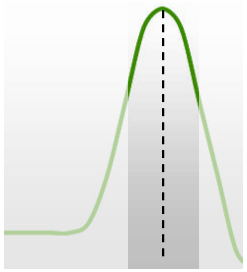


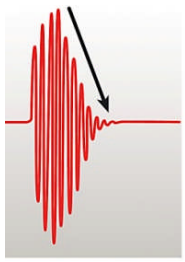


The SPM® Transducer

- 5-7 times more sensitive to shocks then vibration transducers
- Well defined amplitude response at its resonance frequency
- Mechanically tuned, filter out low frequency vibrations (band pass filter)
- Well defined and fast dampening of the resonance. Signal, “ringing”
- Electrical tuning

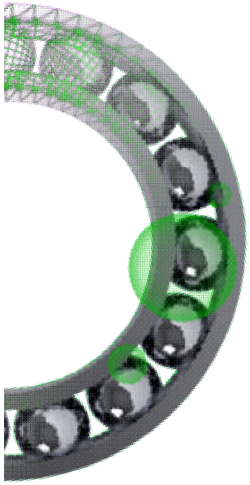






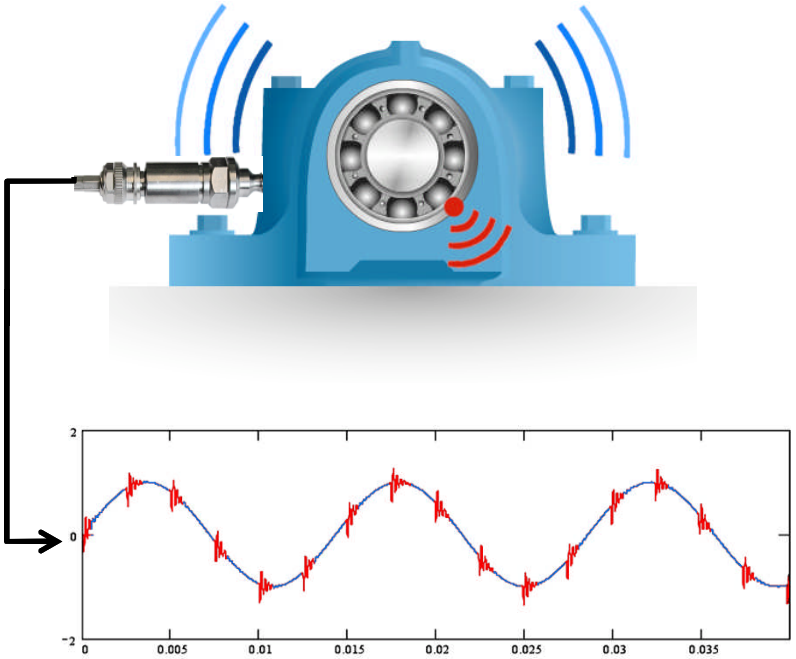
32
kHz

Data Acquisition

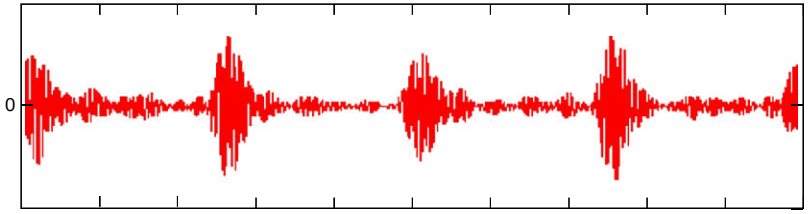


SPM HD

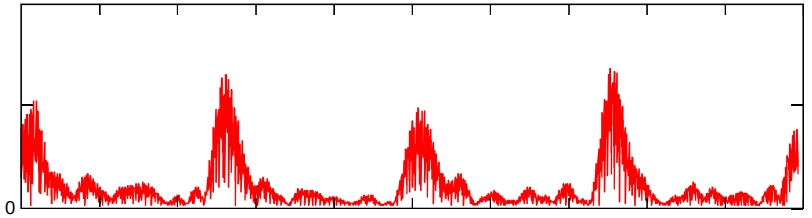
SPM Digital Enveloping



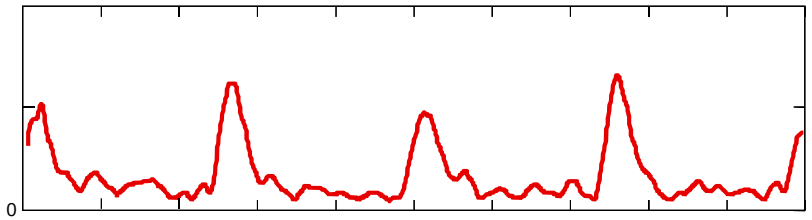
Signal after bandpass filter



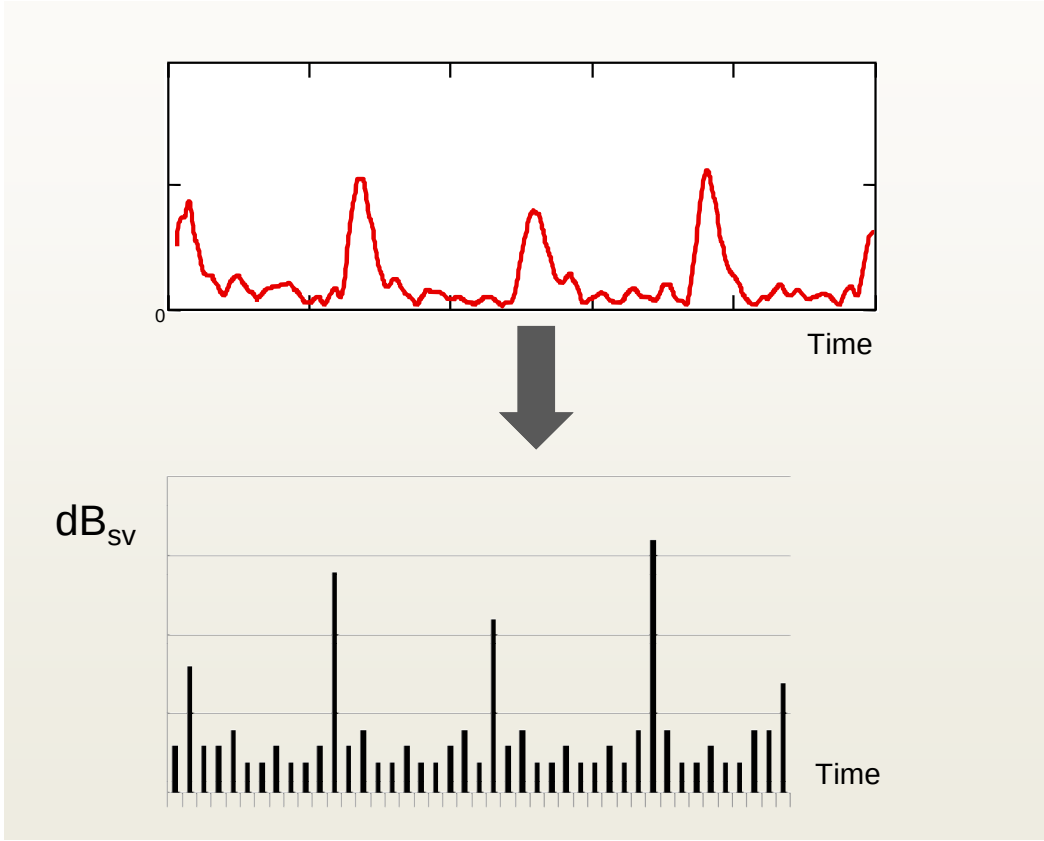
After rectifying



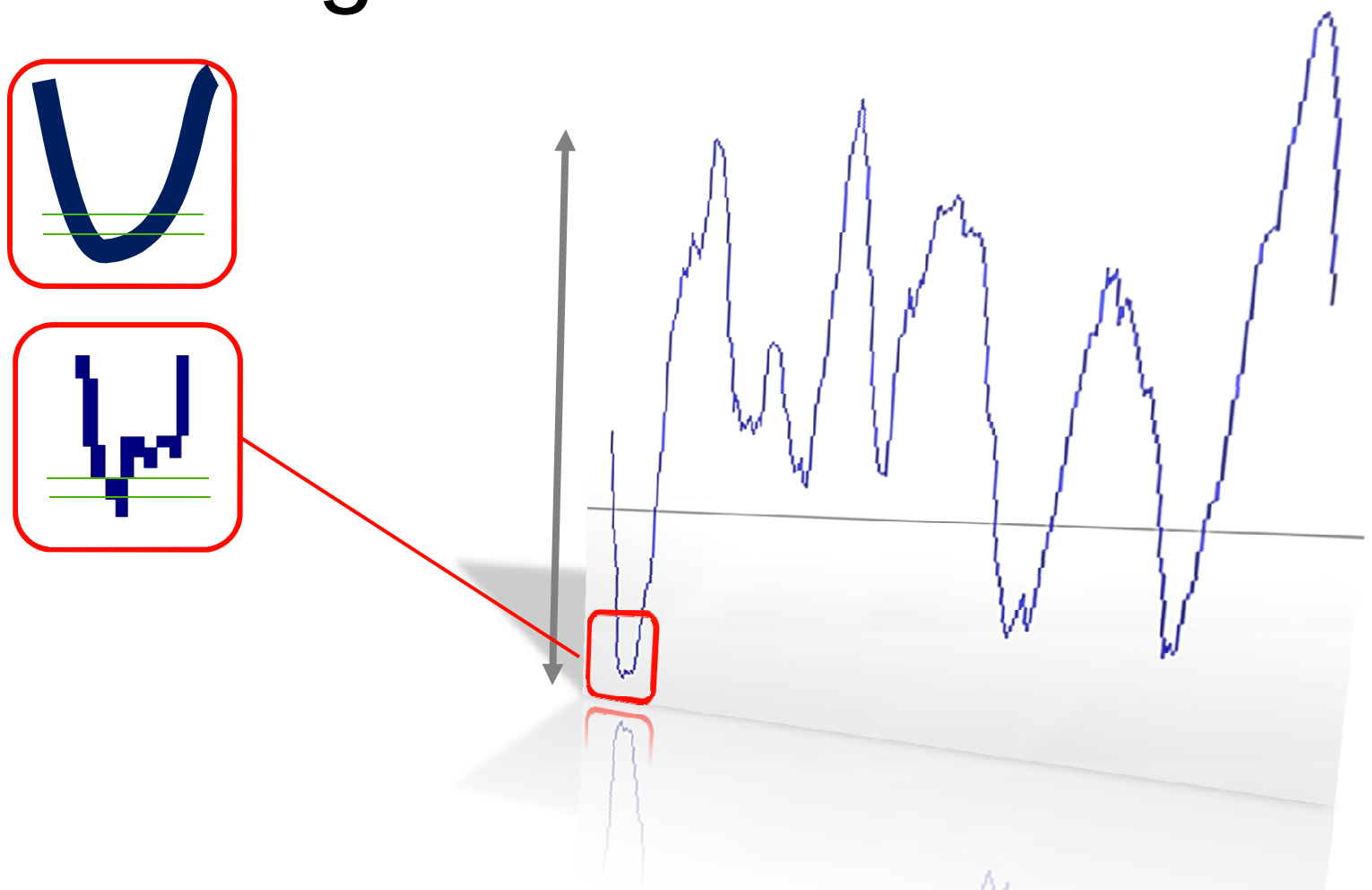
After enveloping



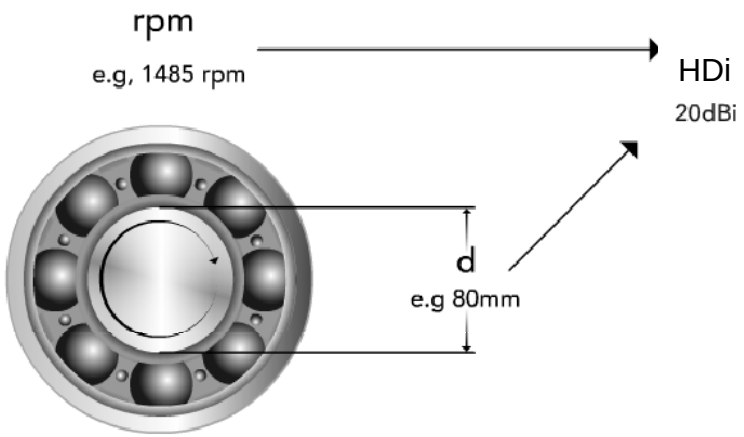
Transients from Shocks

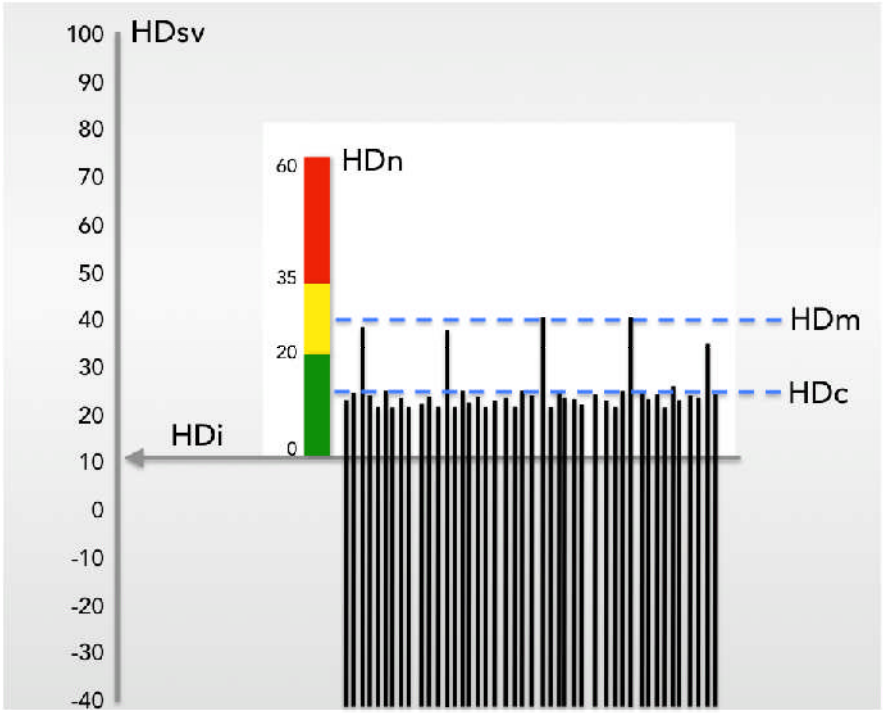


Signal to Noise Ratio



HD-Normalization





Development of SPM®HD

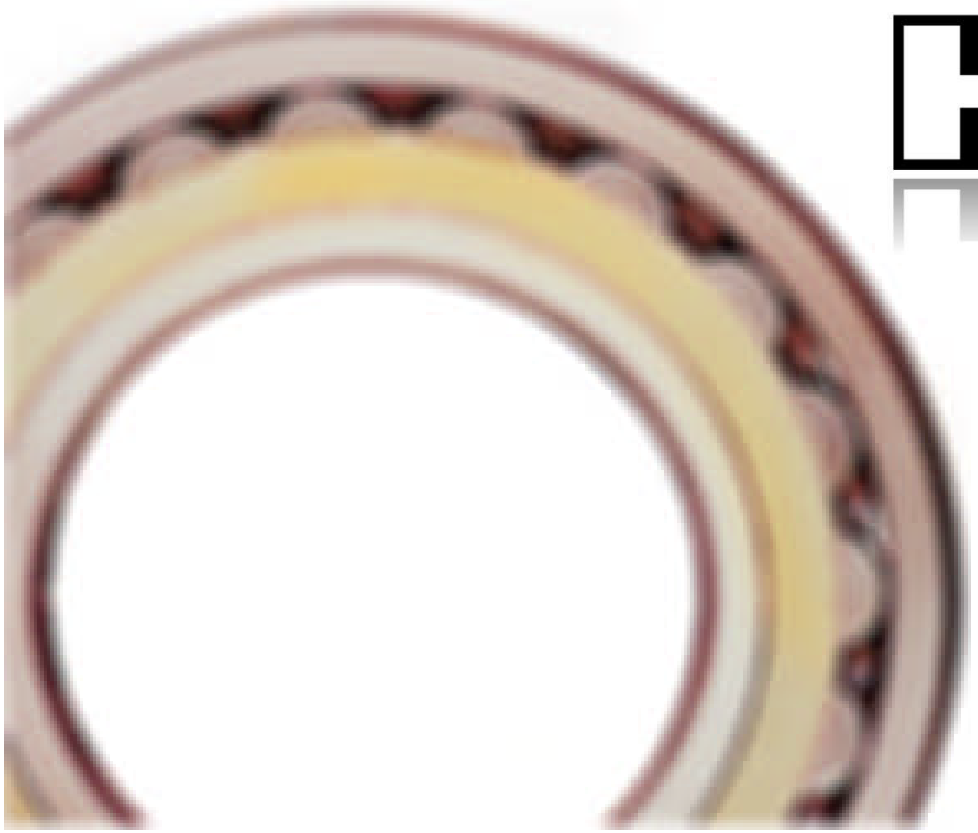
Industry challenges

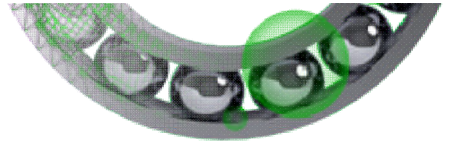
- Expensive breakdowns
- Short pre-warning time
- Long delivery times on replacements

Technical challenges

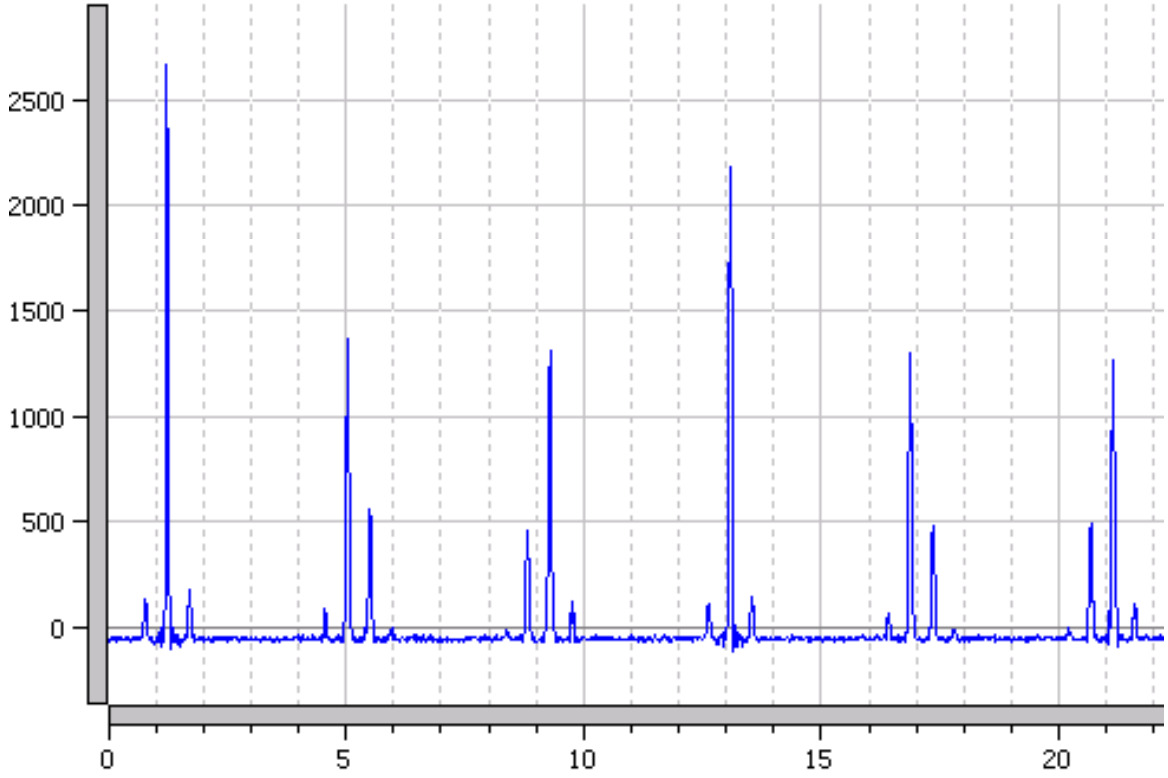
- Low rpm
- Changes in the process
- Disturbances

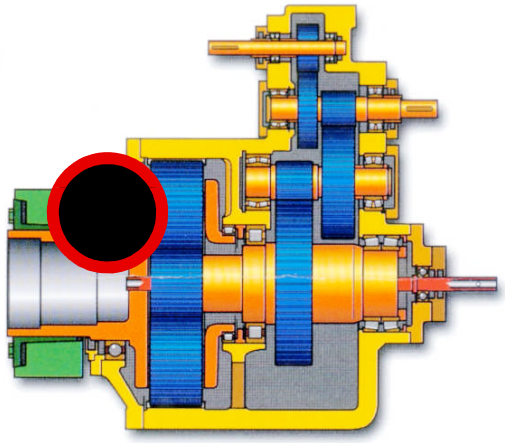
Higher Definition



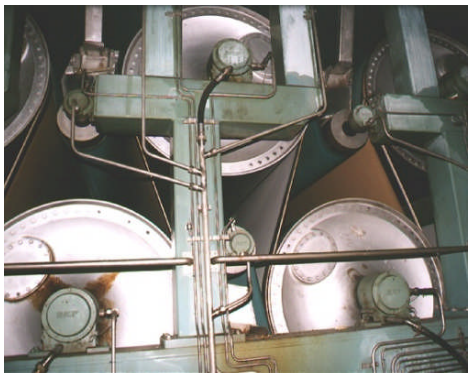
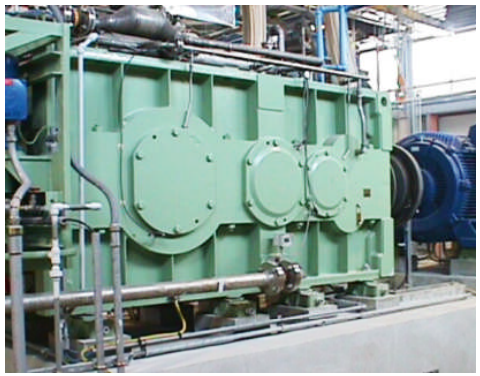


Extracting and enhancing relevant shocks





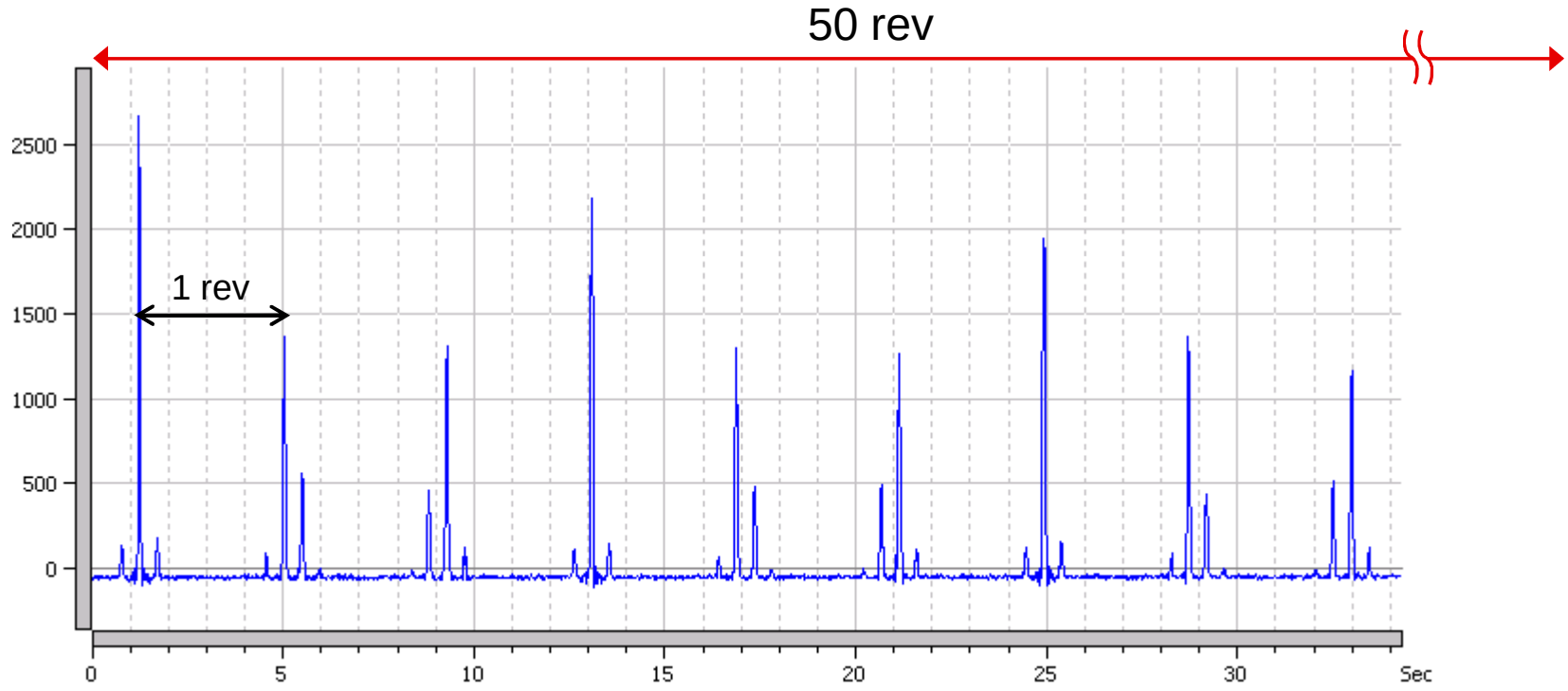
Wide Range of Applications

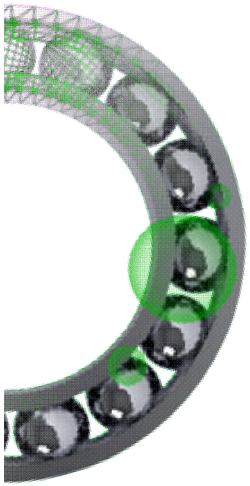

- Full rpm range
- Deal with disturbances

Measuring Time

15 rpm = 4 s/rev



Disturbance Rejecter



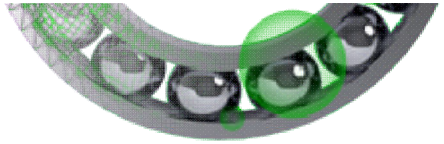
Data Acquisition

Disturbance Rejector

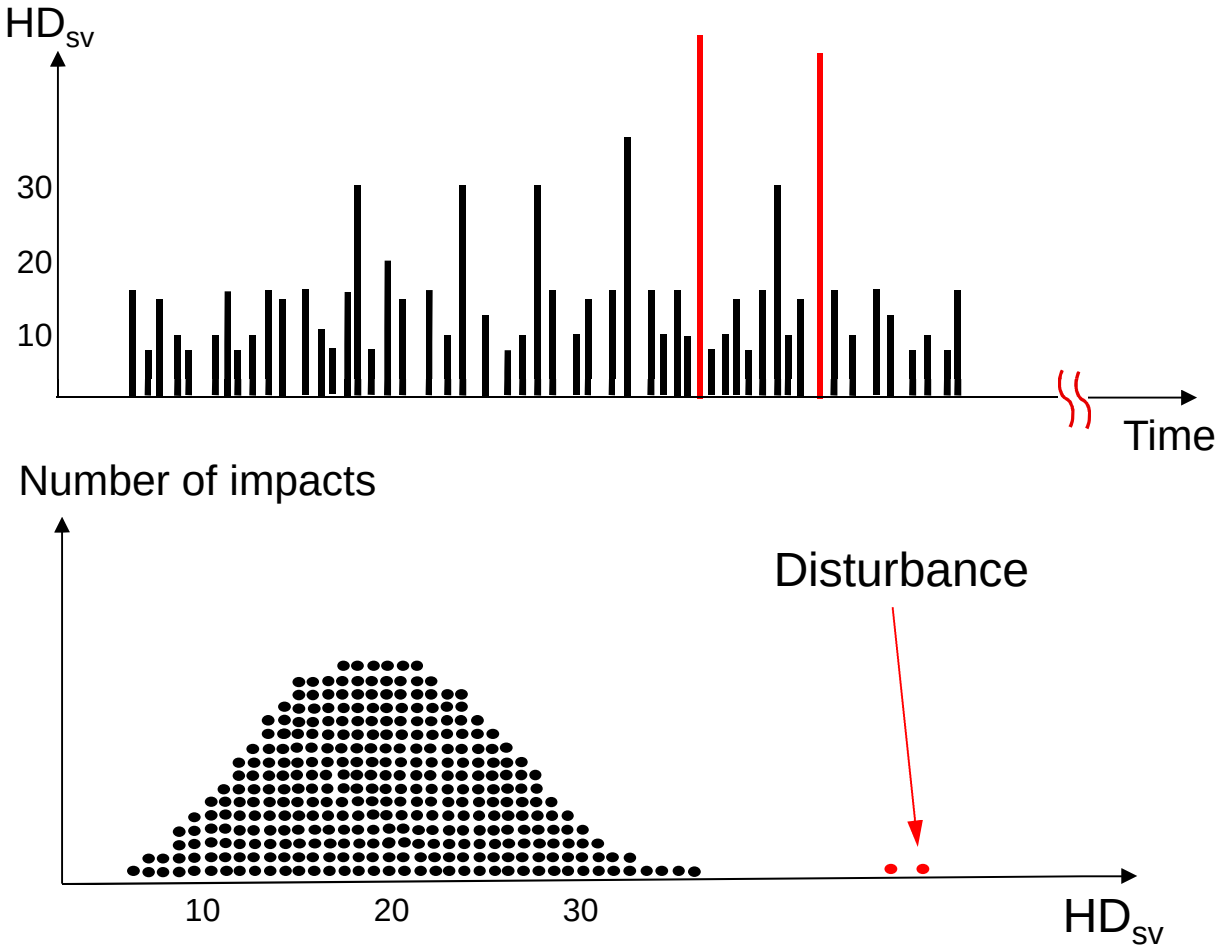
RPM

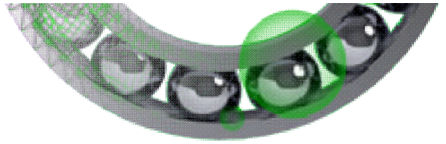
SPM HD

Gives accurate readings from a complex signal

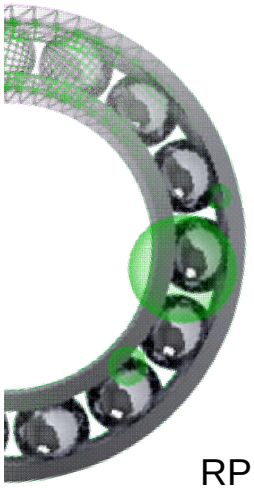


Random Impacts are filtered out





Direct evaluation



RPM

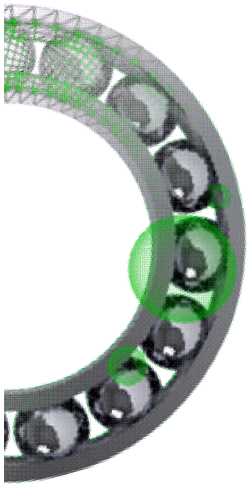
Data Acquisition

Disturbance Rejector

SPMHD

- Answers at the machine
- Long pre-warning time

Symptom Enhancer



RPM

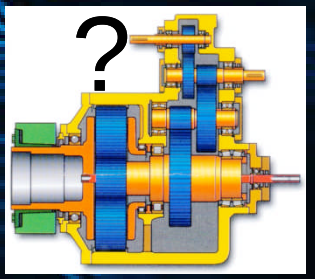
Data Acquisition

Disturbance Rejector

SPM HD

RPM Fluctuations Handler

Symptom Enhancer



SPM

Symptoms are used for Fault Recognition

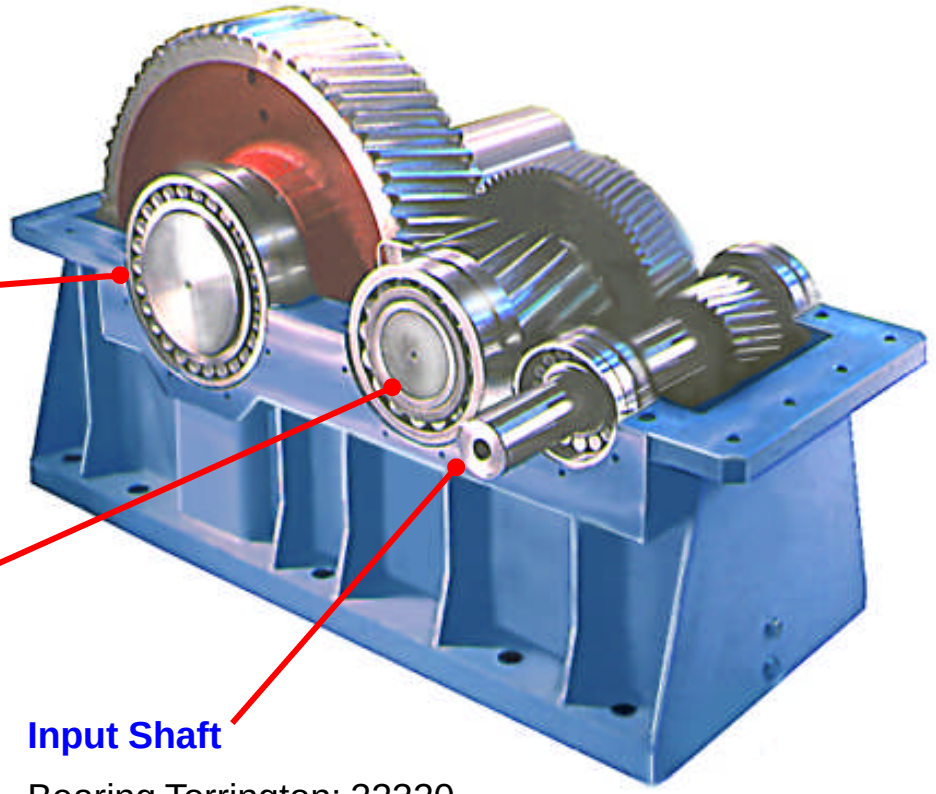
- ✓ Moving parts in a rotating machine contribute to the vibration at specific frequencies.
- ✓ Most symptoms are found under normal conditions (gear mesh or bearings) & increase with damage.
- ✓ Some symptoms only appear when the component is damaged (rotor bar fault).

Symptom Examples:

Bearing faults, Gear damage, Unbalance, Misalignment, Looseness, Resonance, Belt/Chain drive faults, Fan/Blade faults, Oil whirl, Rotor Bars, etc or you can define your own faults

Symptom selection

Example of Symptom inputs



Output Shaft

Bearing Torrington 110TDO456

(BPFO, BPFI, BPFIM, BSF, BSFM)

63 Gear Teeth + RPM

Intermediate Shaft

Bearing Torrington 22332

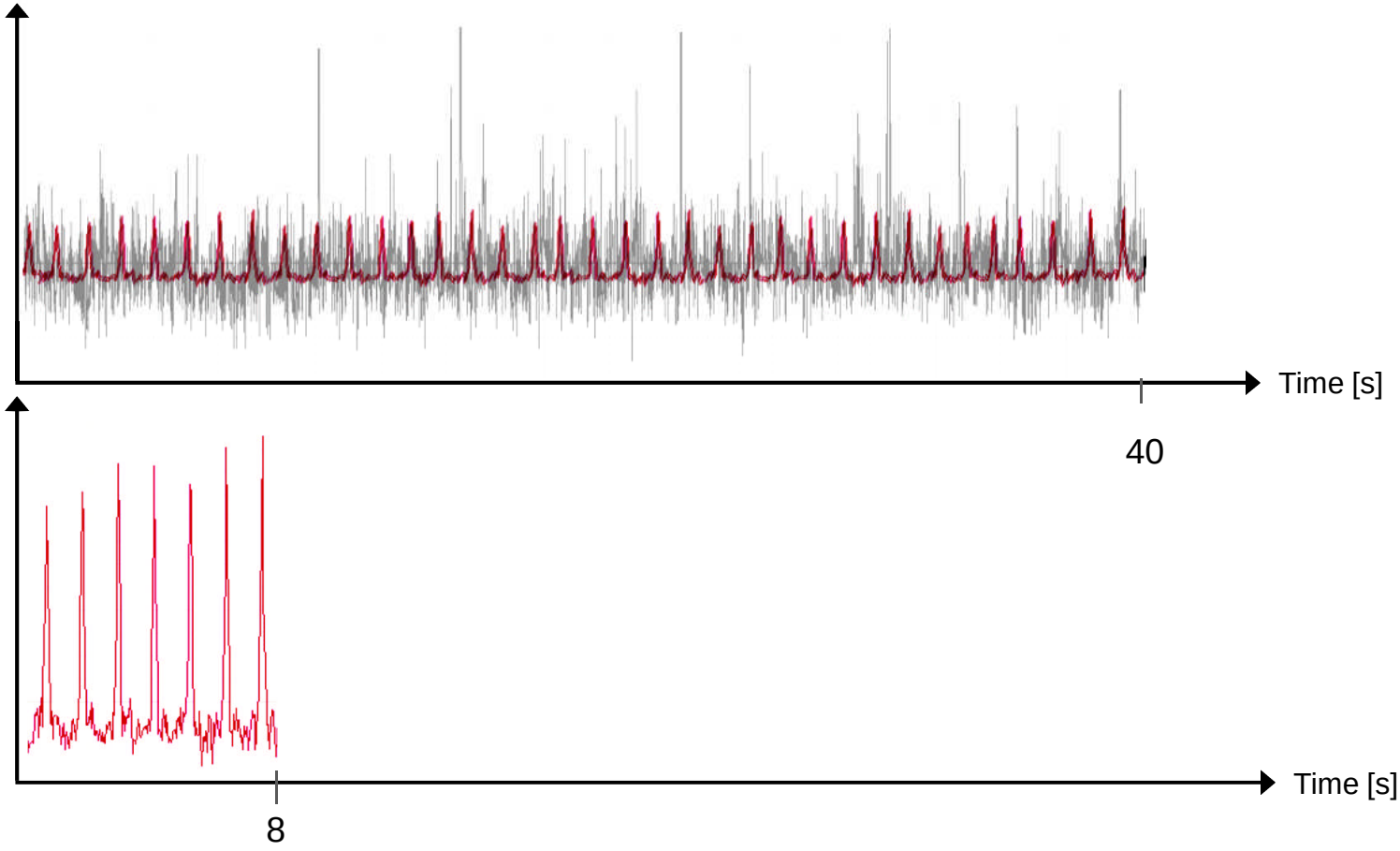
36 & 13 Gear Teeth + RPM

Input Shaft

Bearing Torrington: 22320

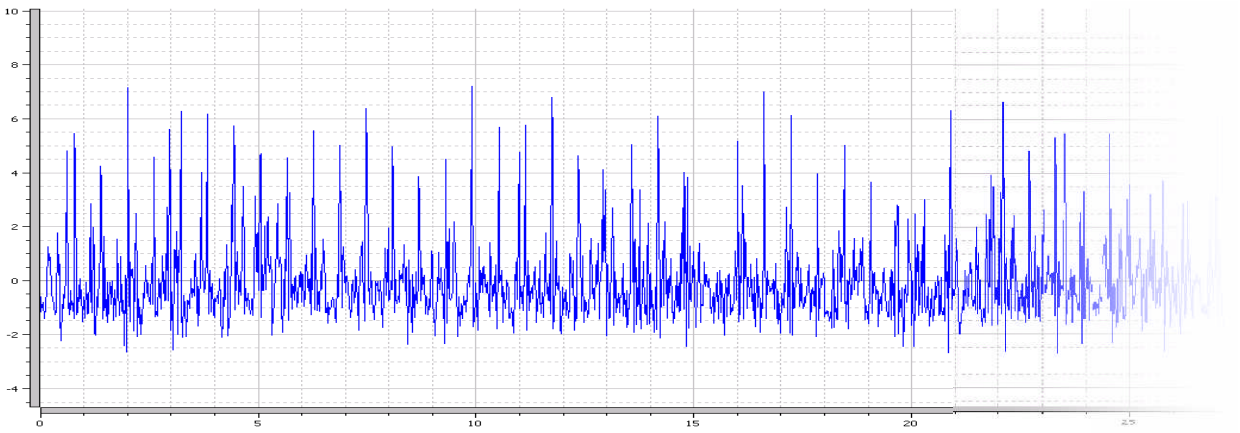
23 Gear Teeth + RPM

Enhancing repetitive signals

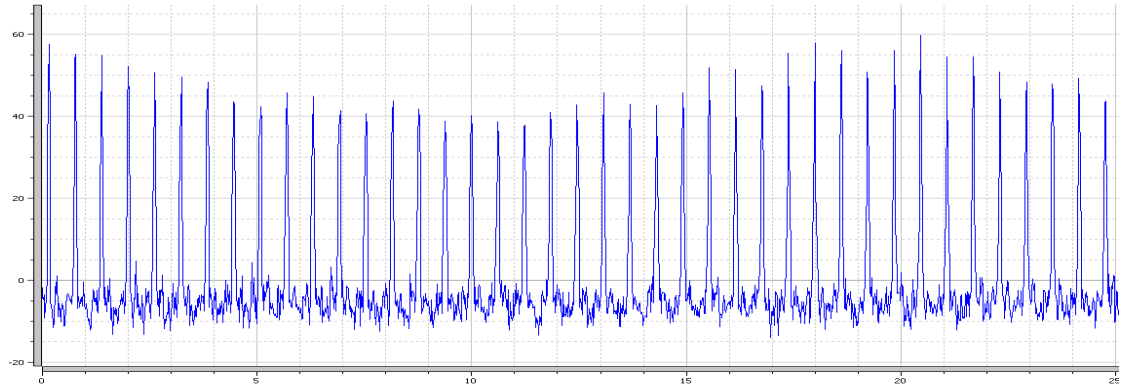


Symptom Enhancer in time domain

Off



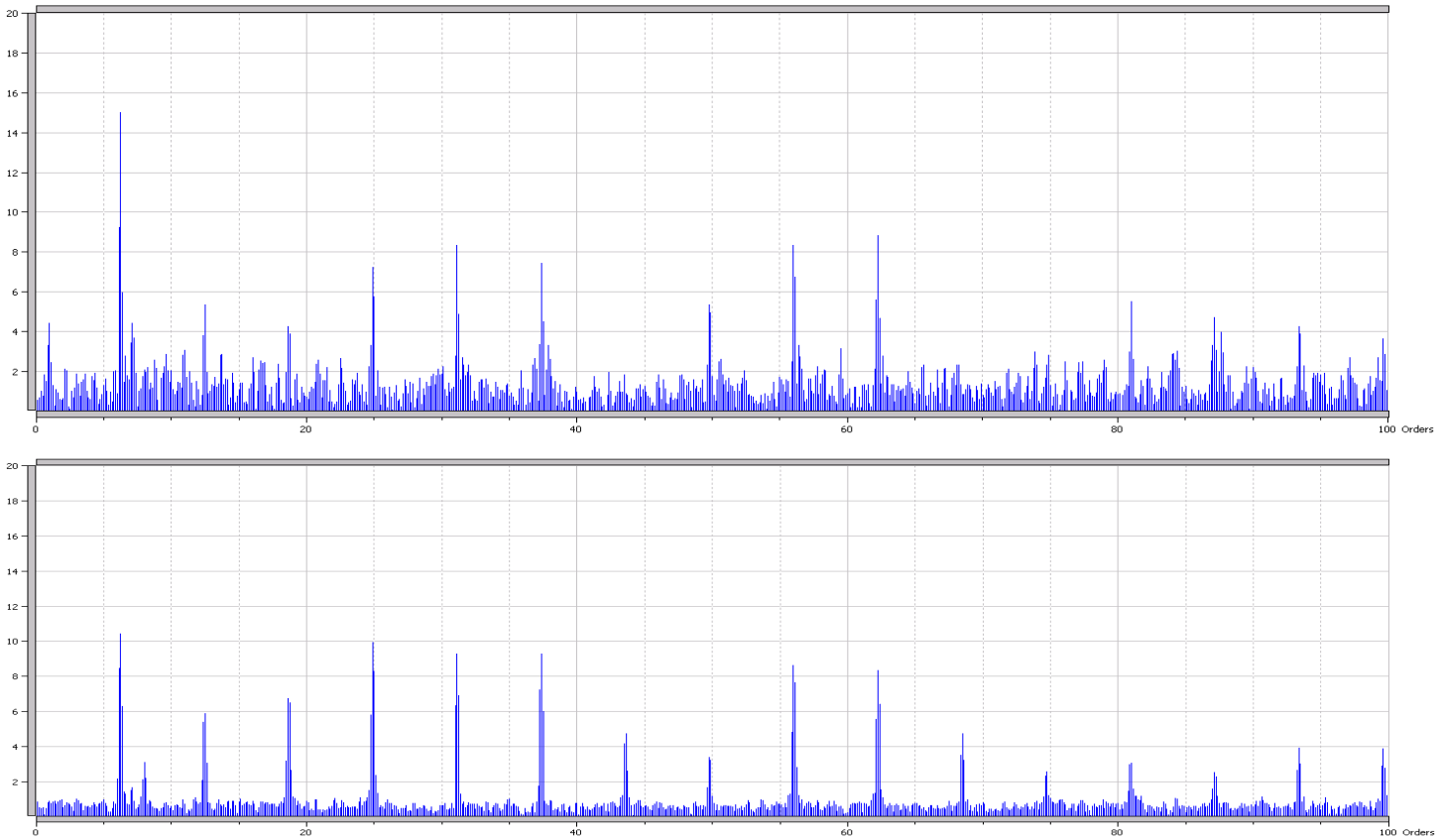
On



Symptom Enhancer in frequency domain

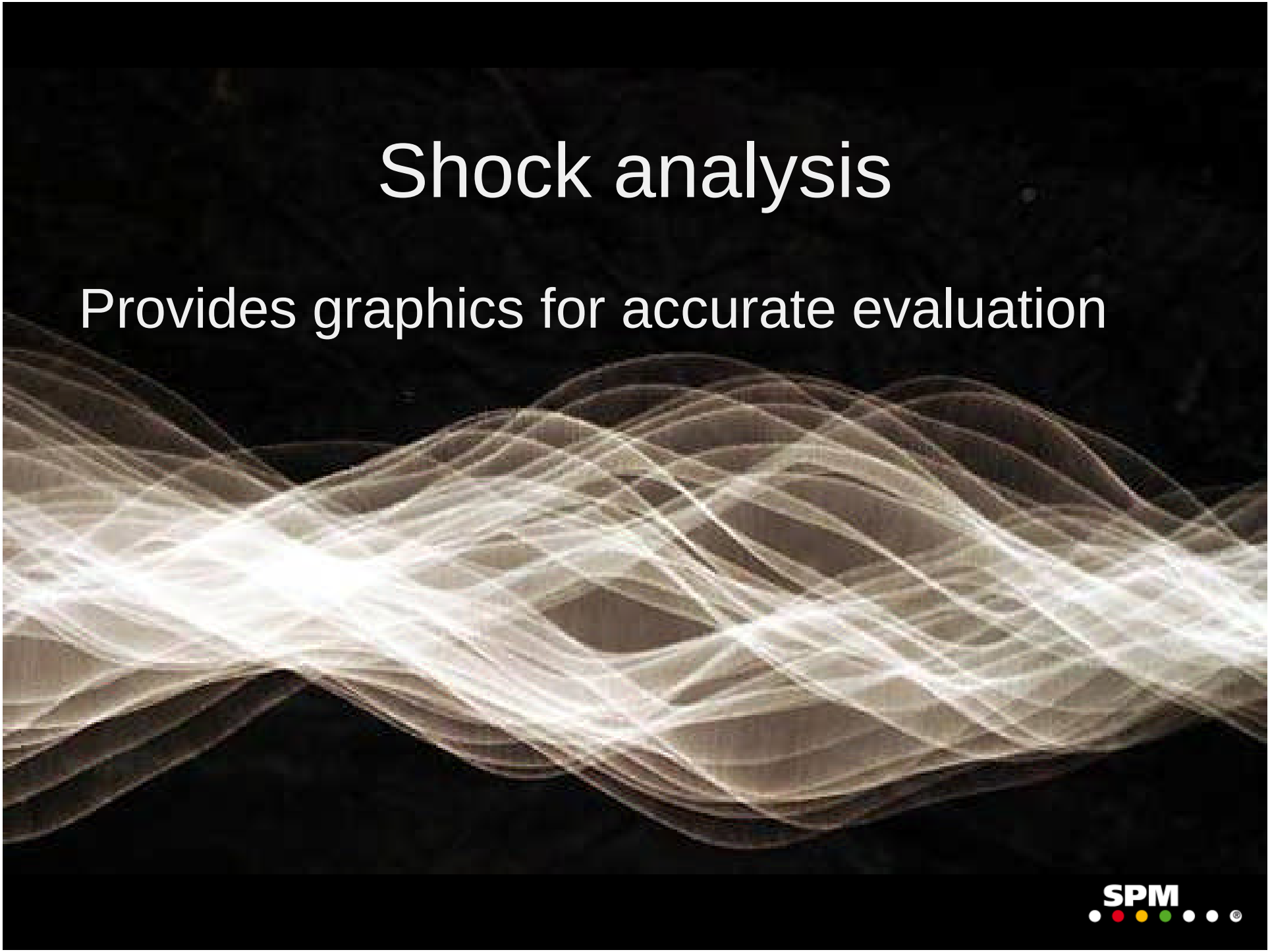
Off

On

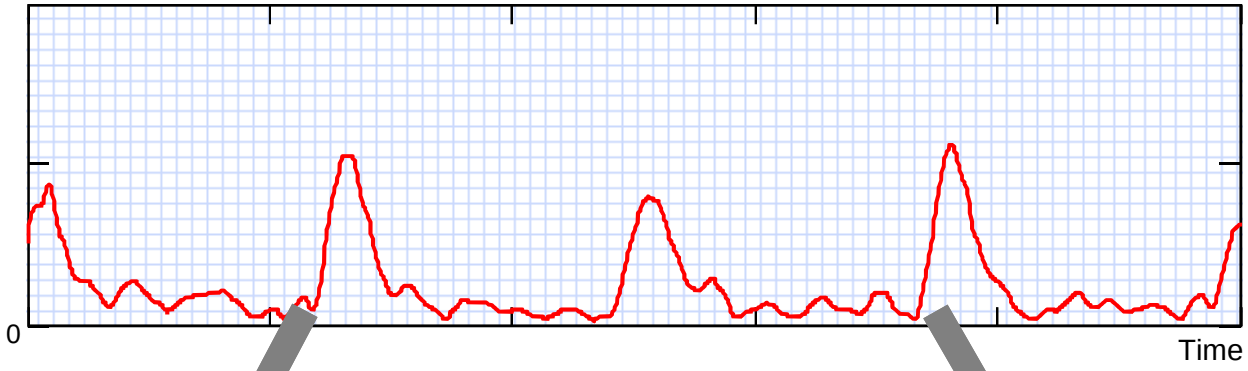


Shock analysis

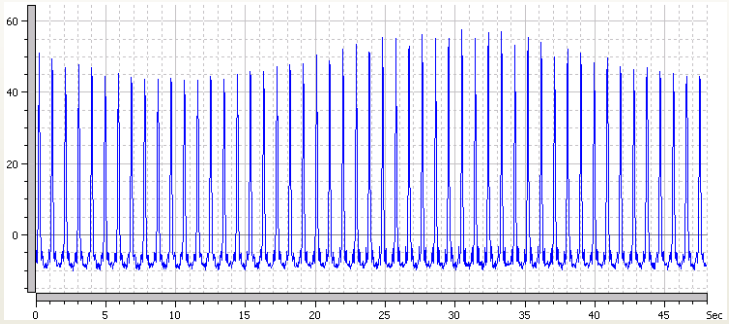
Provides graphics for accurate evaluation



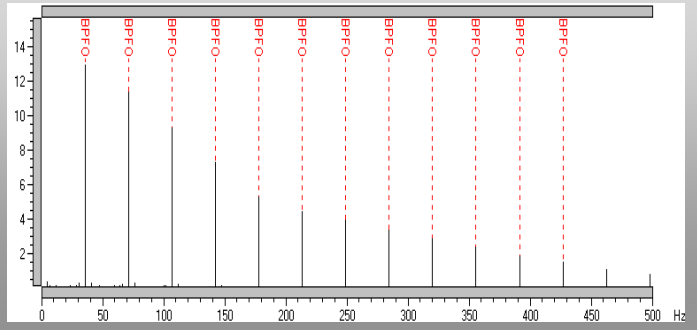
Two ways to analyze



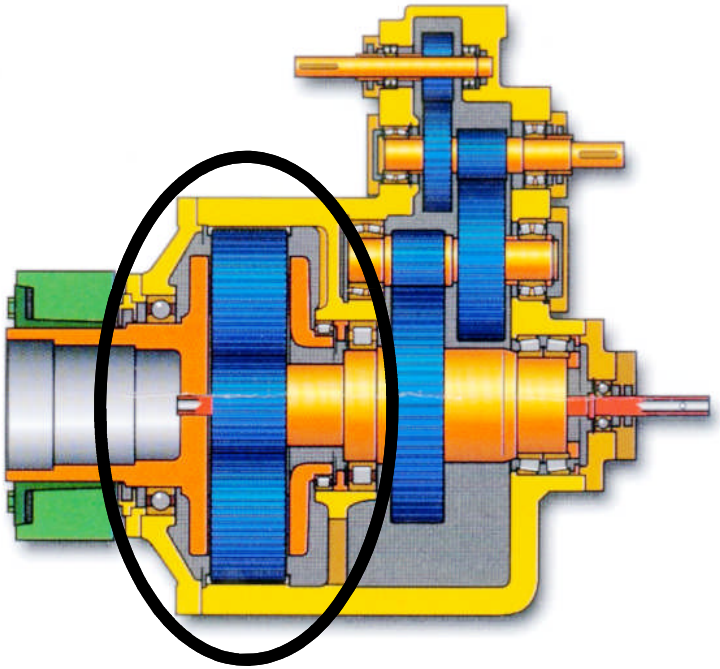
I. Time domain



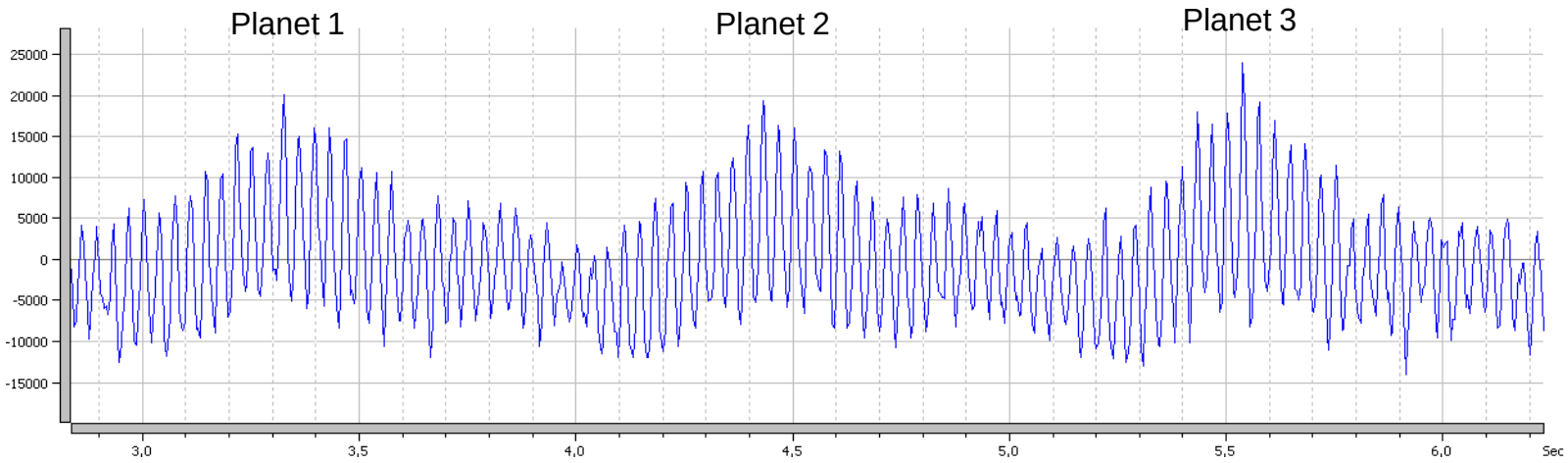
II. Frequency domain



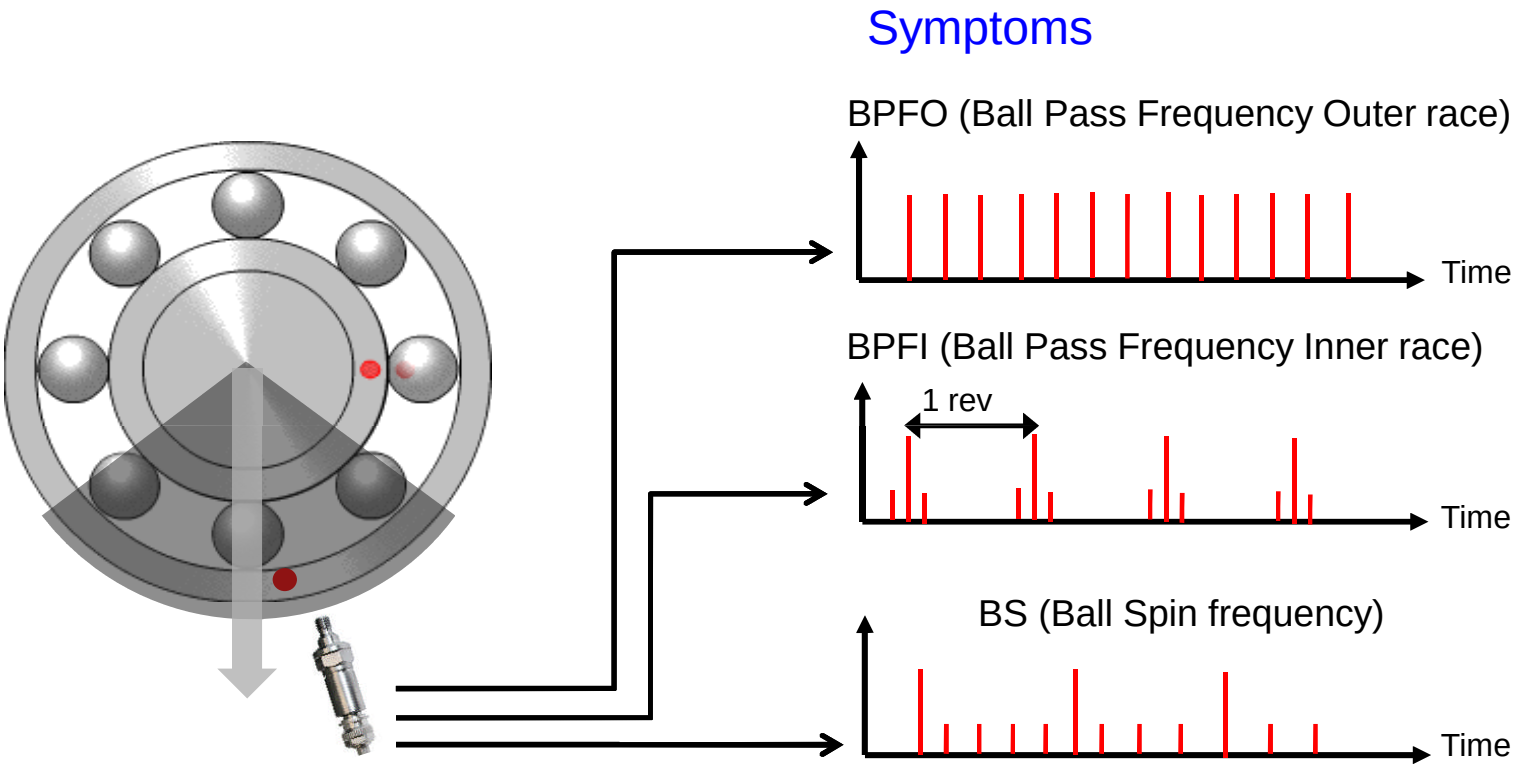
Planetary Gearbox



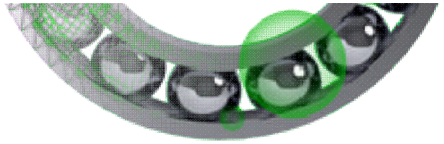
Time Signal from Planetary GB



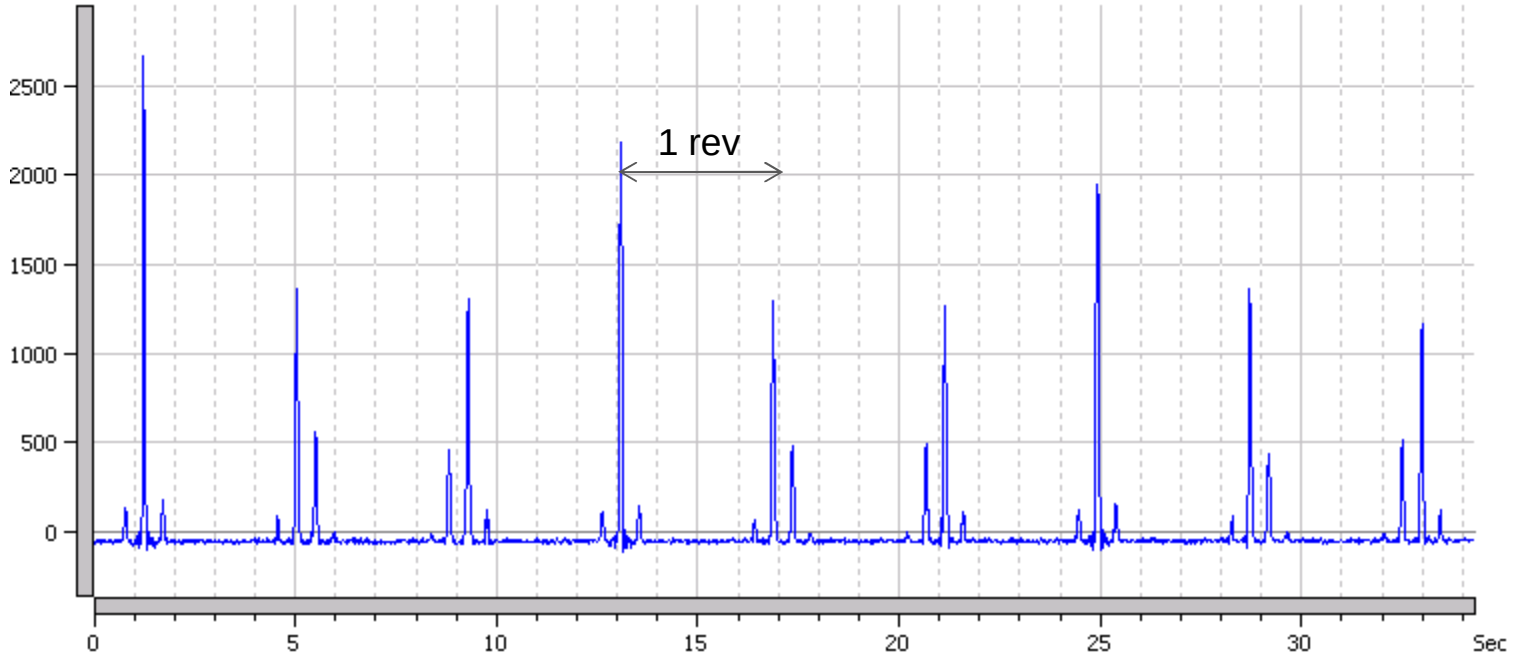
Time domain fundamentals



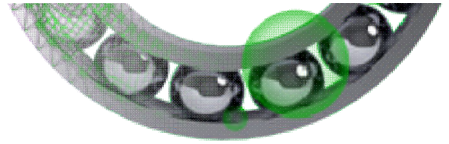
Inner ring damage



Time signal - Inner race damage

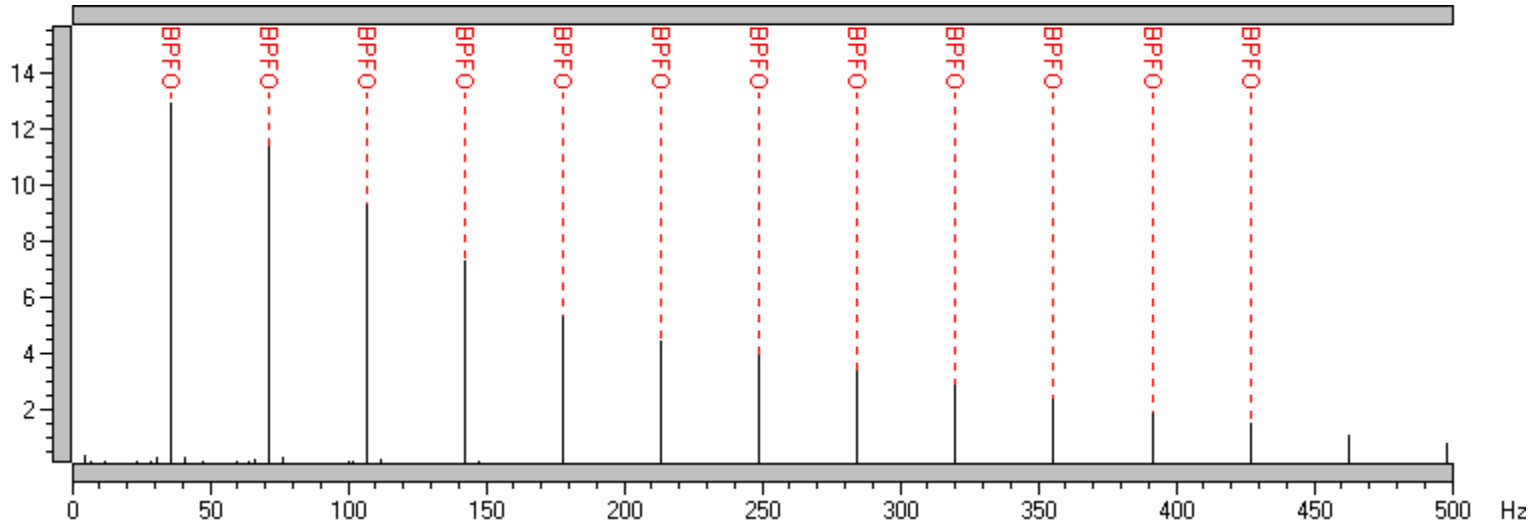


Outer race damage

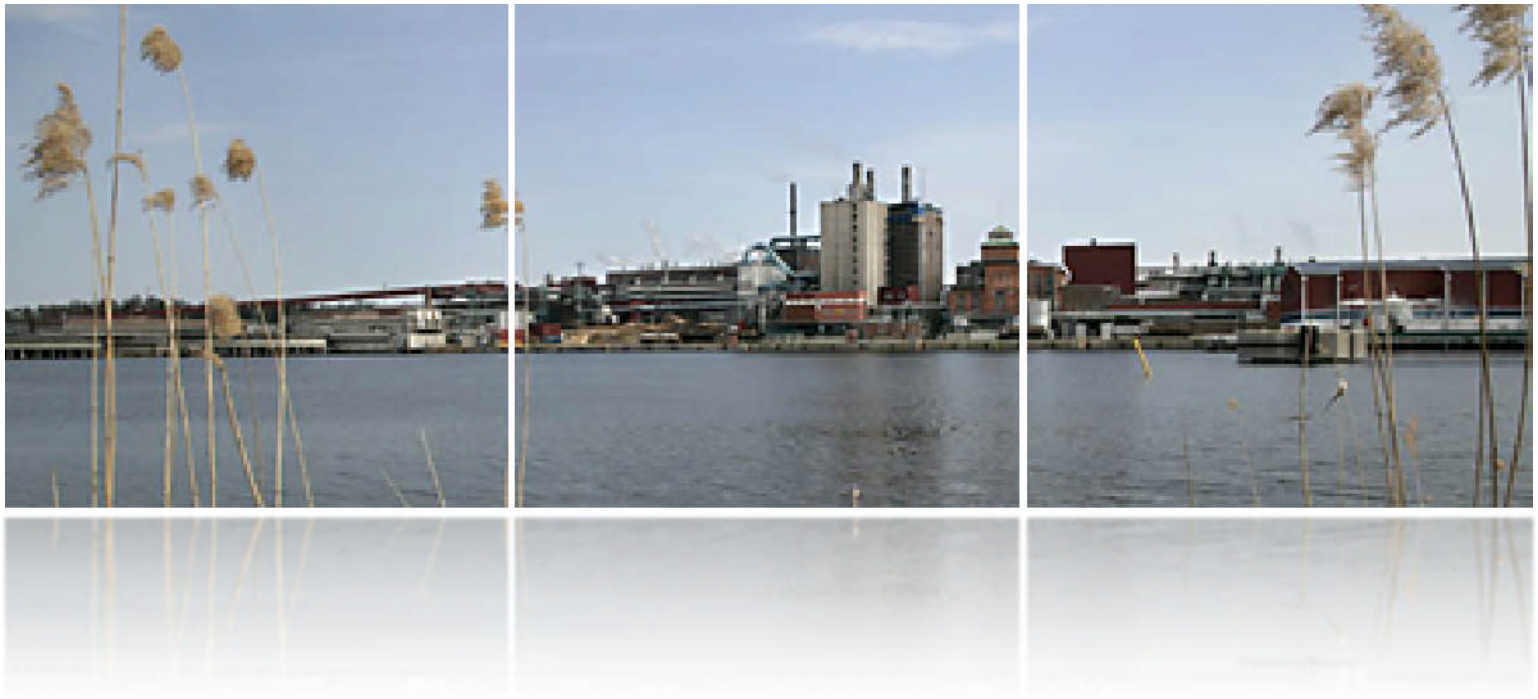


Shock Pulse Spectrum

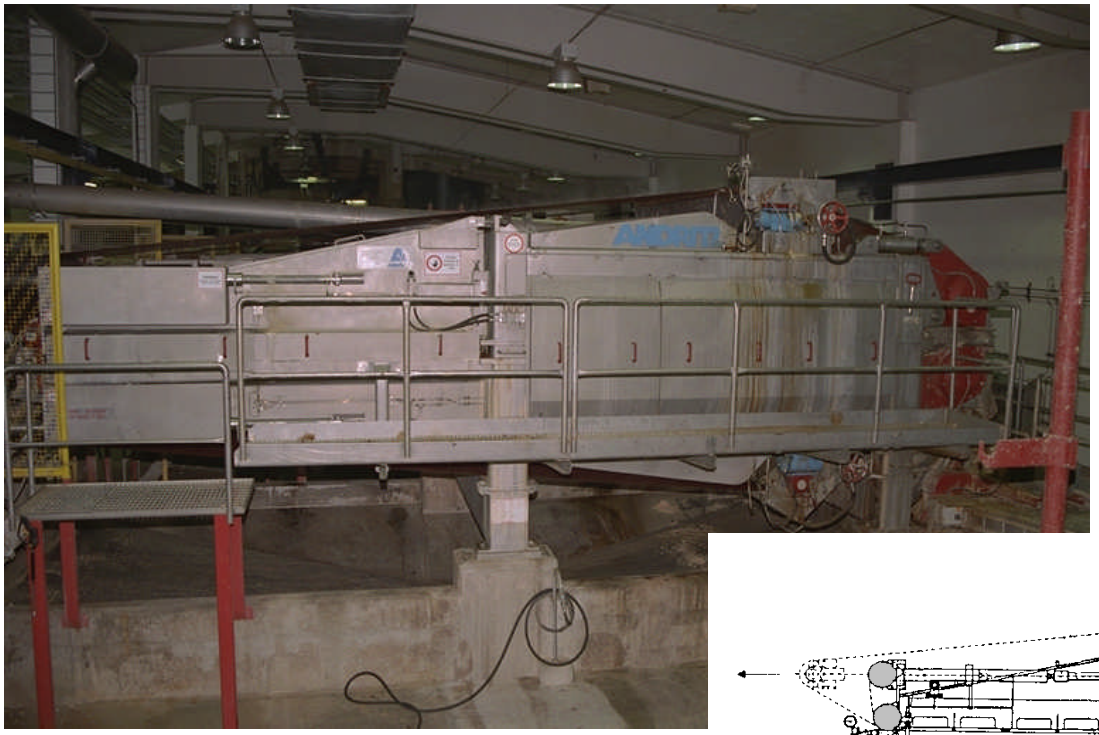
Outer race damage

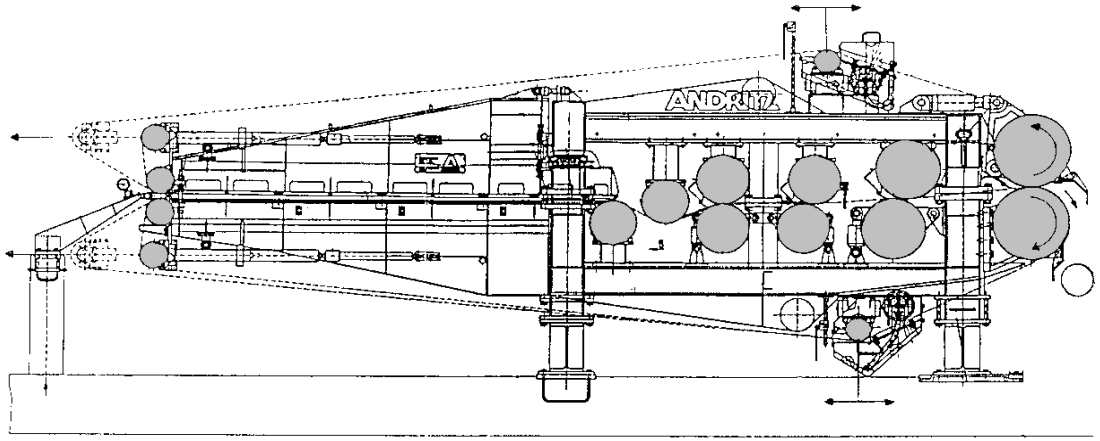


Cases from Hallsta Paper Mill

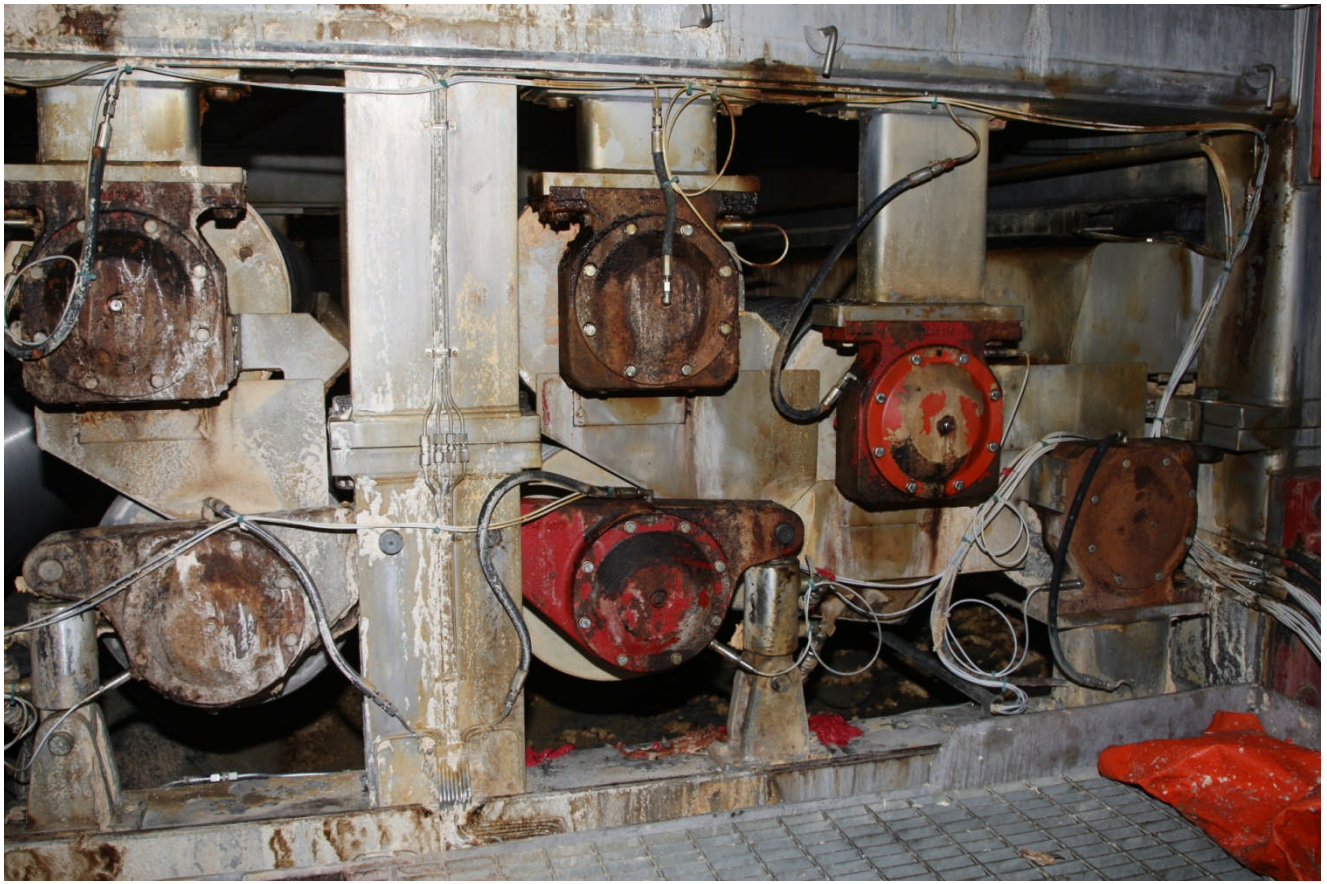


Twin Wire Press



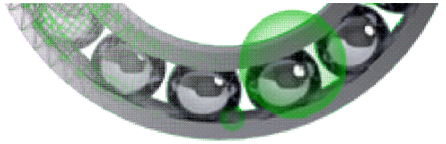


Press Nips & S-rolls



Twin Wire Press 13

S roll on lower section

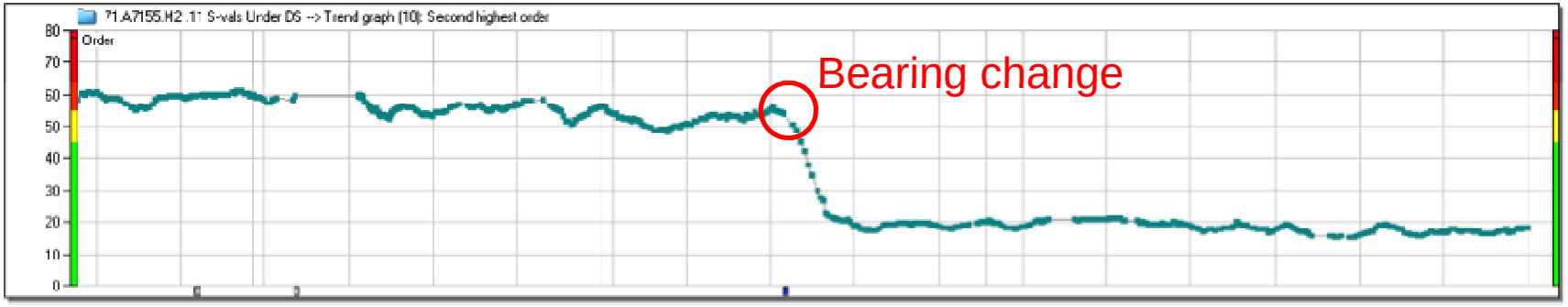


Twin Wire Press 13

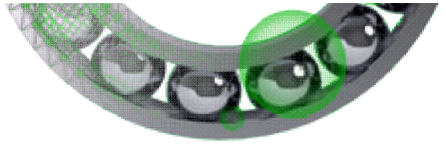
S roll on lower section

Spherical roller bearing, 15 rpm

HDm values from mid-October 2009. Decreased values after bearing replacement in December 2009.



October 2009 December2009

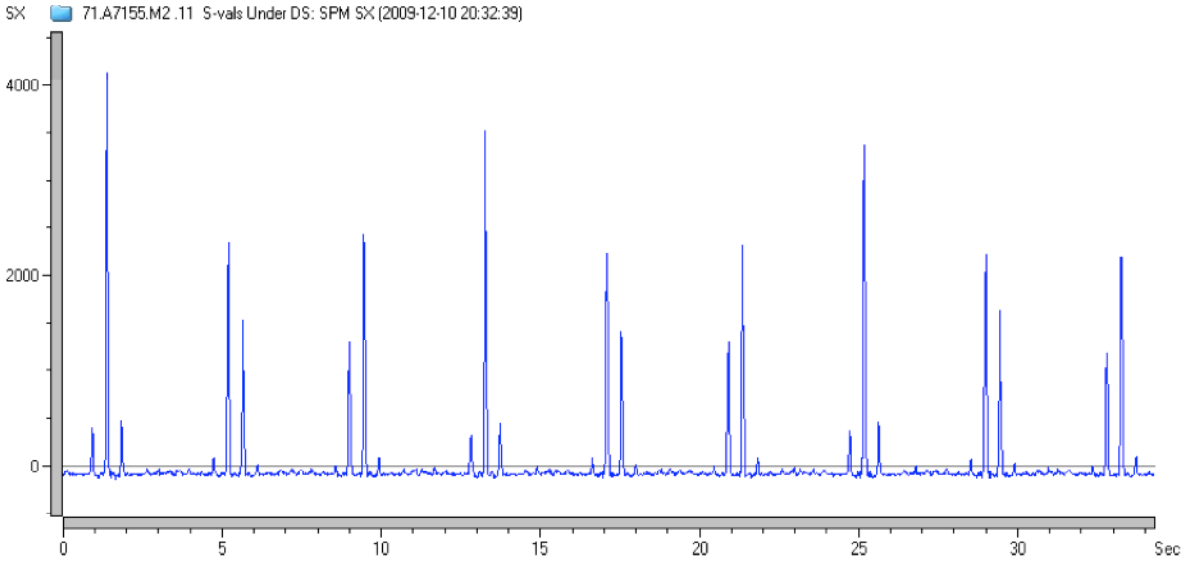


Twin Wire Press 13

S roll on lower section

Spherical roller bearing, 15 rpm

Time signal HD before bearing replacement in December 2009



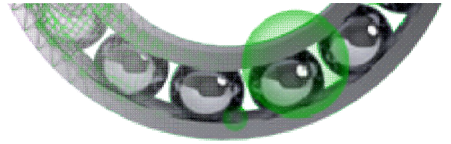
Cracked inner race

6 months' forewarning

Note the very high HDm values (>60dB) and the drop to 20dB after bearing replacement (100 times lower on a linear scale)

Twin Wire Press 13

S roll on lower section



Spherical roller bearing, 15 rpm

Time signal HD before bearing replacement in December 2009

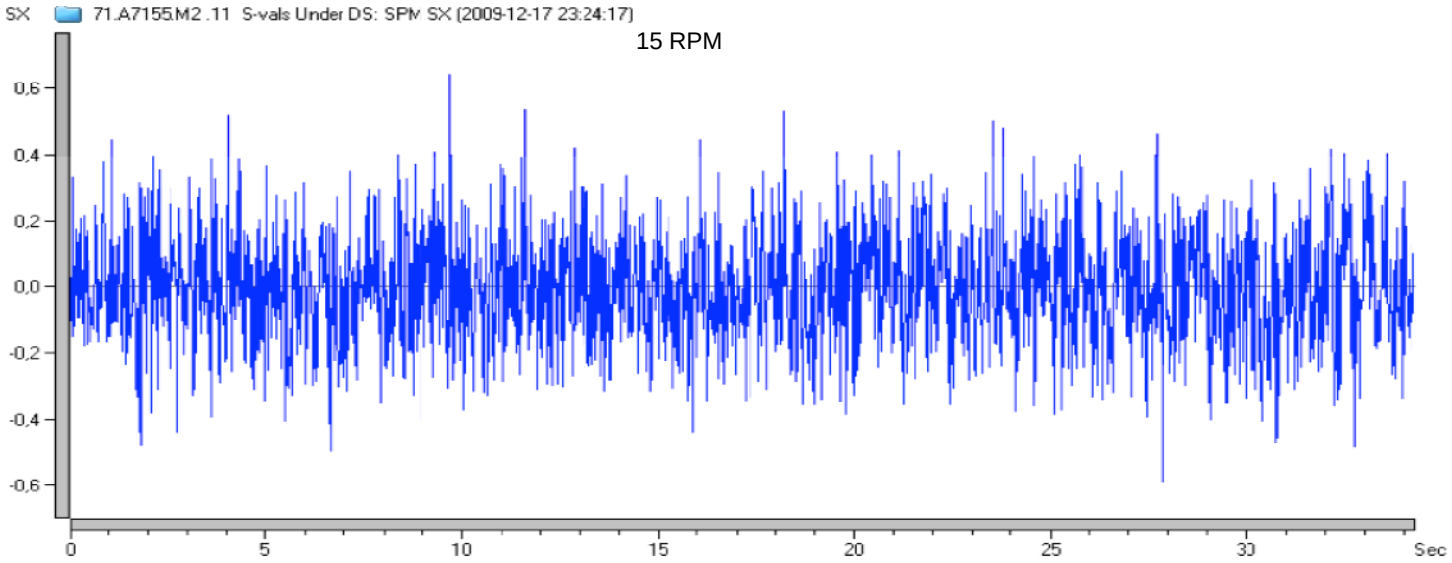
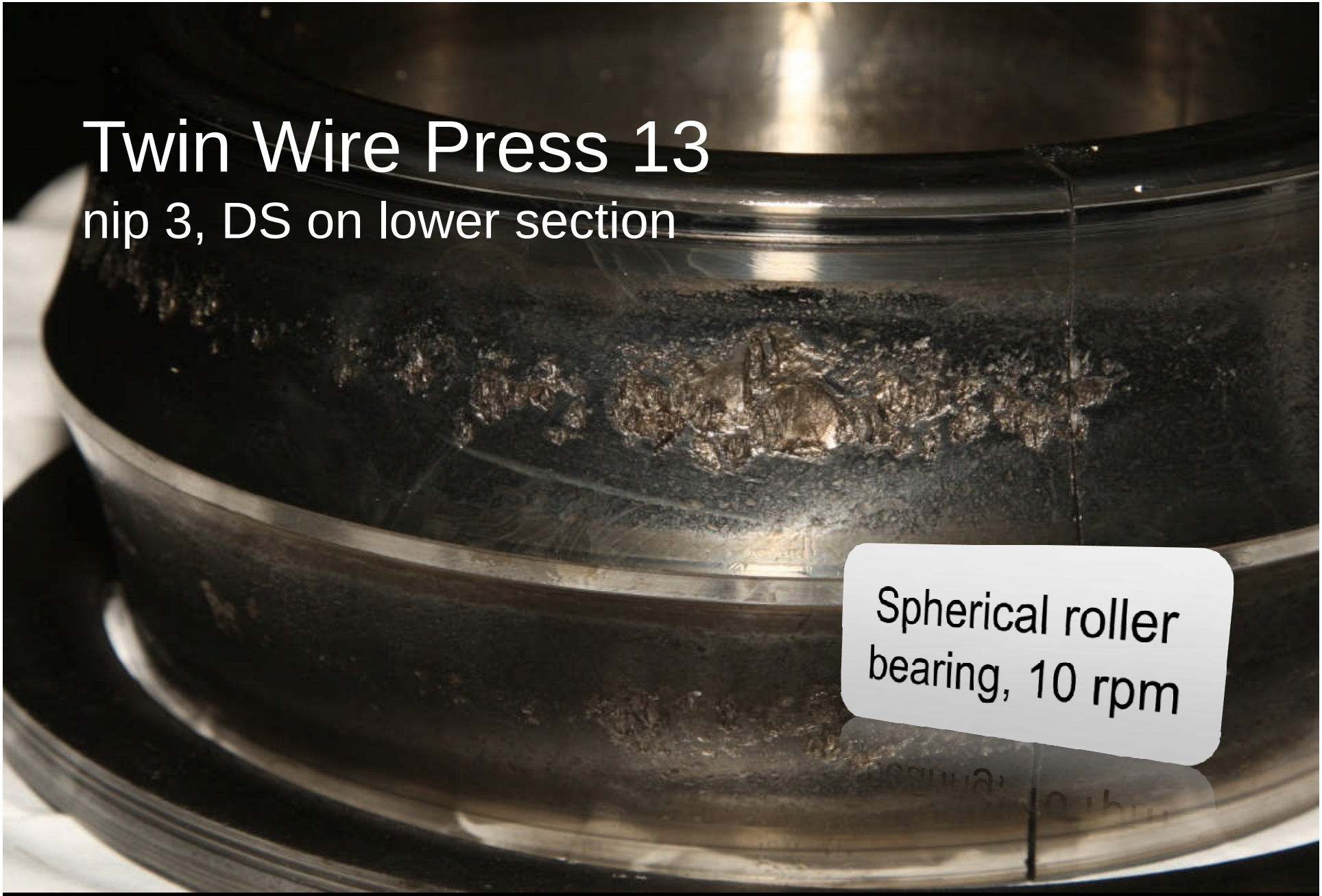


Fig 6. *Case 1: Time signal HD after replacement in December, 2009*

Twin Wire Press 13

nip 3, DS on lower section



Twin Wire Press 13

nip 3, DS on lower section

SPM HD Time signal from April 2009.

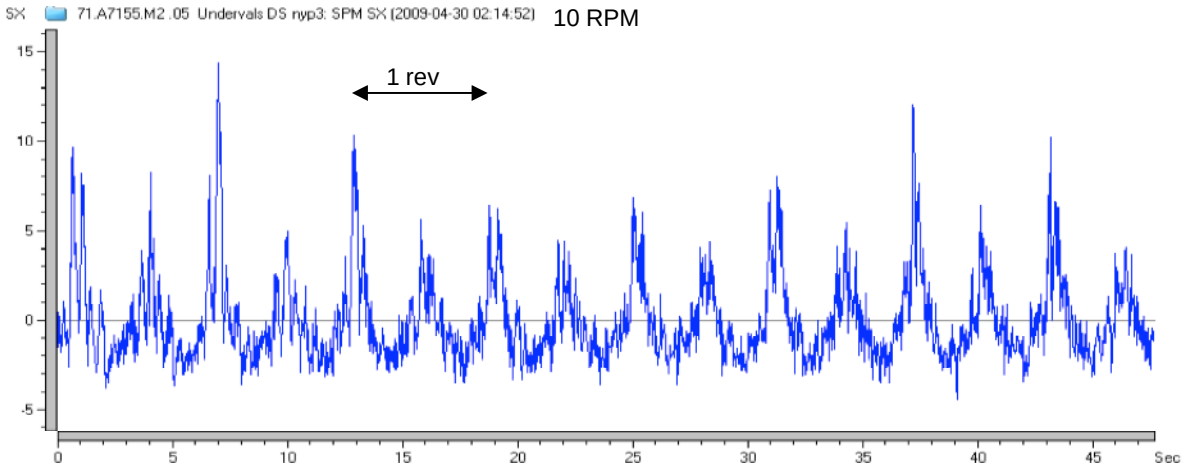
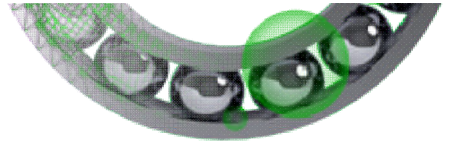


Fig 9. *Case 2: Time signal HD late April, 2009*

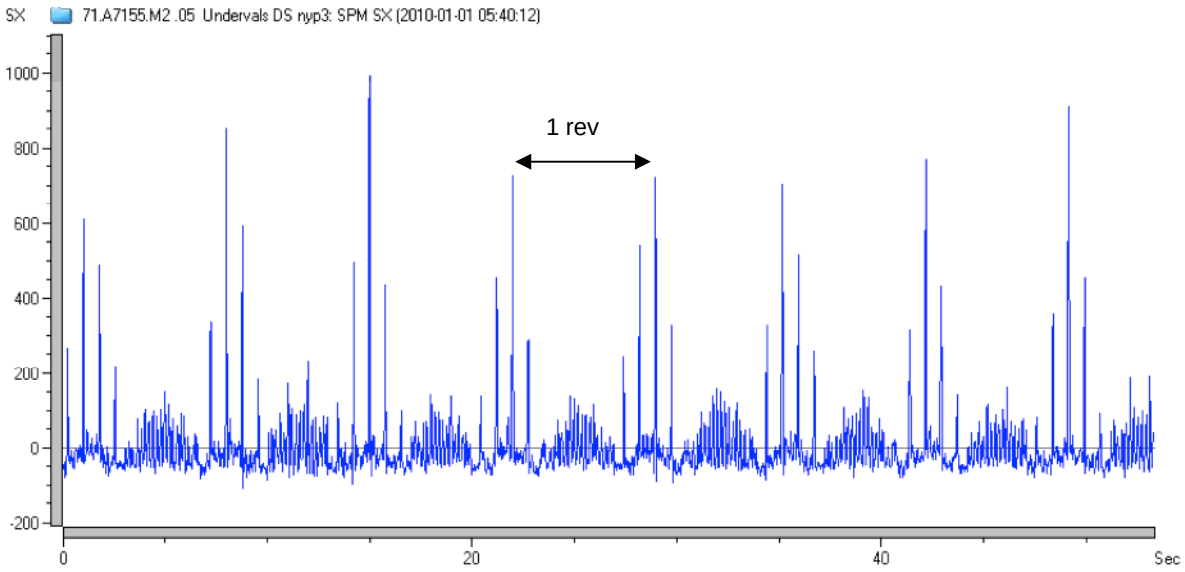


Twin Wire Press 13

nip 3, DS on lower section

Spherical roller bearing, 9 rpm

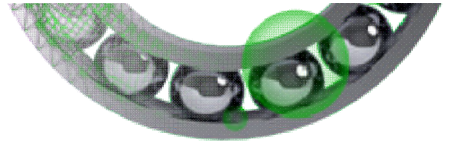
Time signal HD before bearing replacement in January 2010



Cracked inner race, spalling along entire inner race

4 months' forewarning

Note the typical, cracked inner race pattern

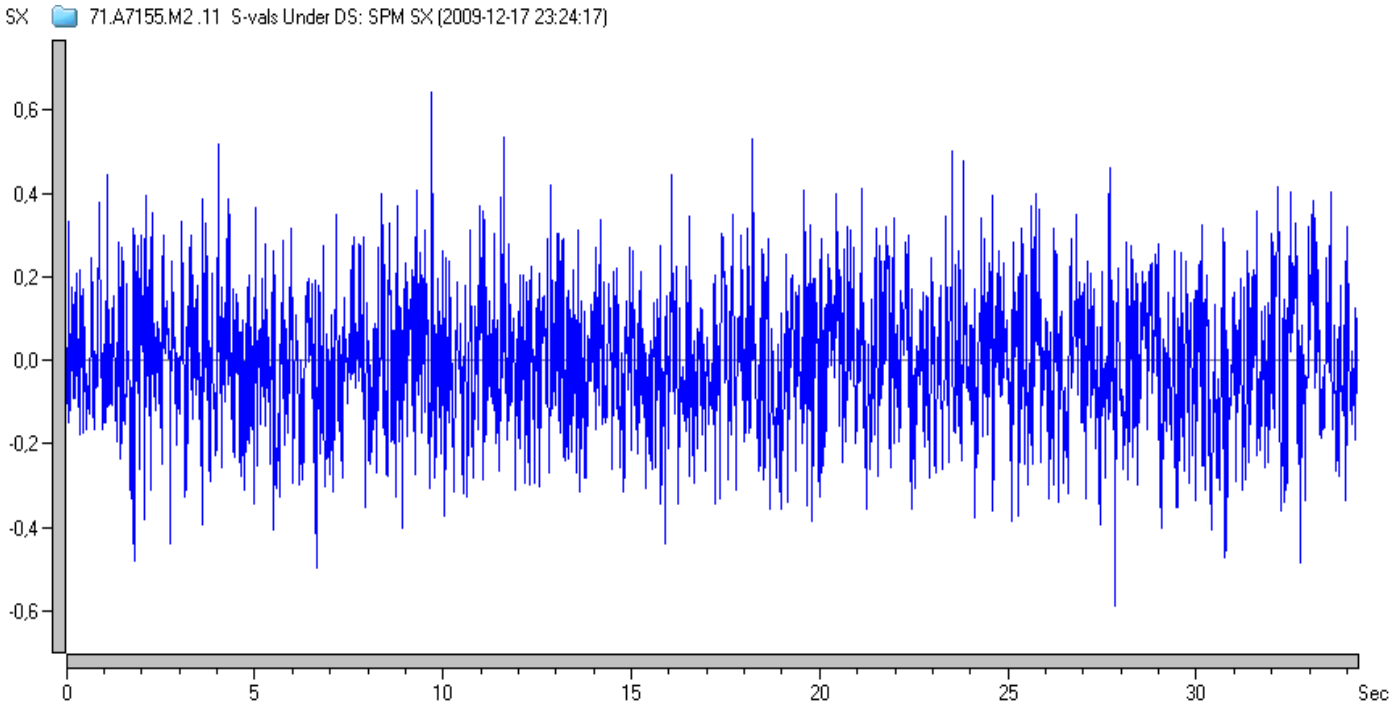


Twin Wire Press 13

nip 3, DS on lower section

Spherical roller bearing, 9 rpm

Time signal HD after bearing replacement in January 2010

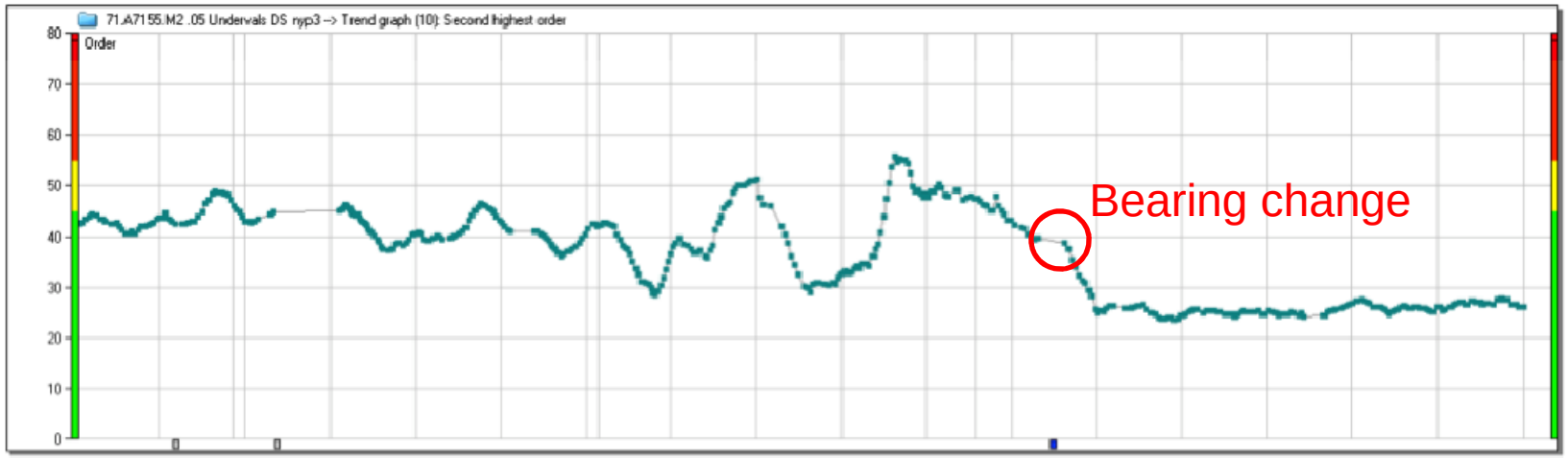


Twin Wire Press 13

nip 3, DS on lower section

Spherical roller bearing, 9 rpm

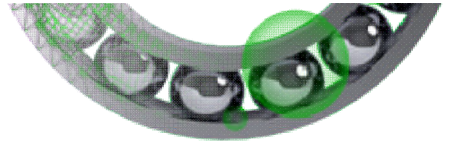
HDm values from mid-October 2009. Decreased values after bearing replacement in January 2010.



October 2009 January 2010

Twin Wire Press 12

Nip 2, FS on lower section

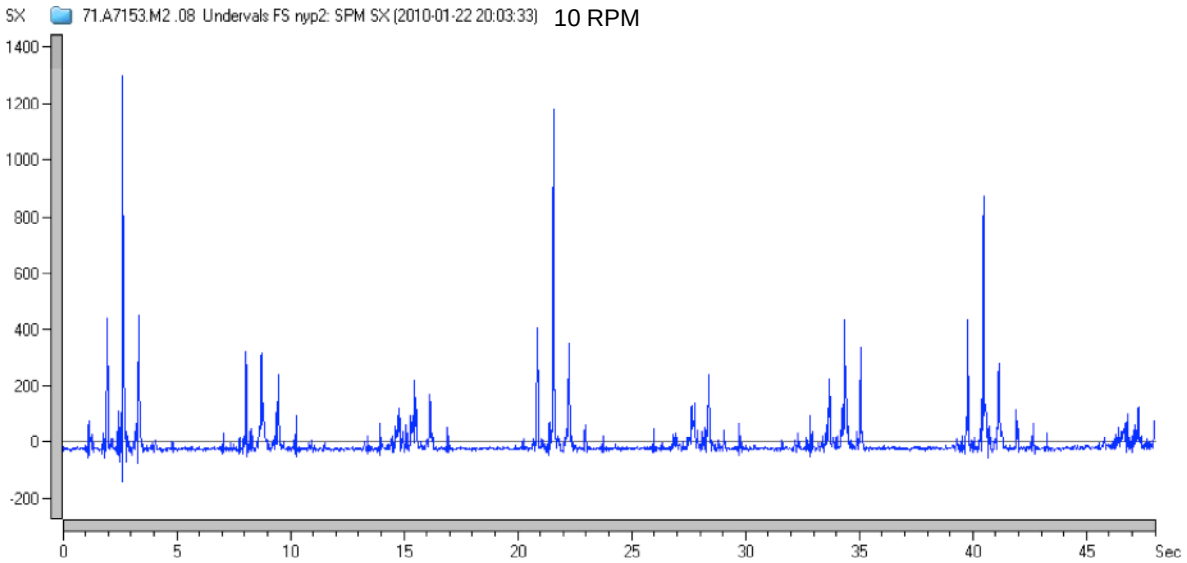


Twin Wire Press 12

Nip 2, FS on lower section

Spherical roller bearing, 10 rpm

Time signal HD before bearing replacement in February 2010



Cracked inner race, spalling on both inner and outer races

4 months' forewarning

Note the typical, cracked inner race pattern

Twin Wire Press 12

Nip 2, FS on lower section

HDm values after bearing replacement in February 2010.

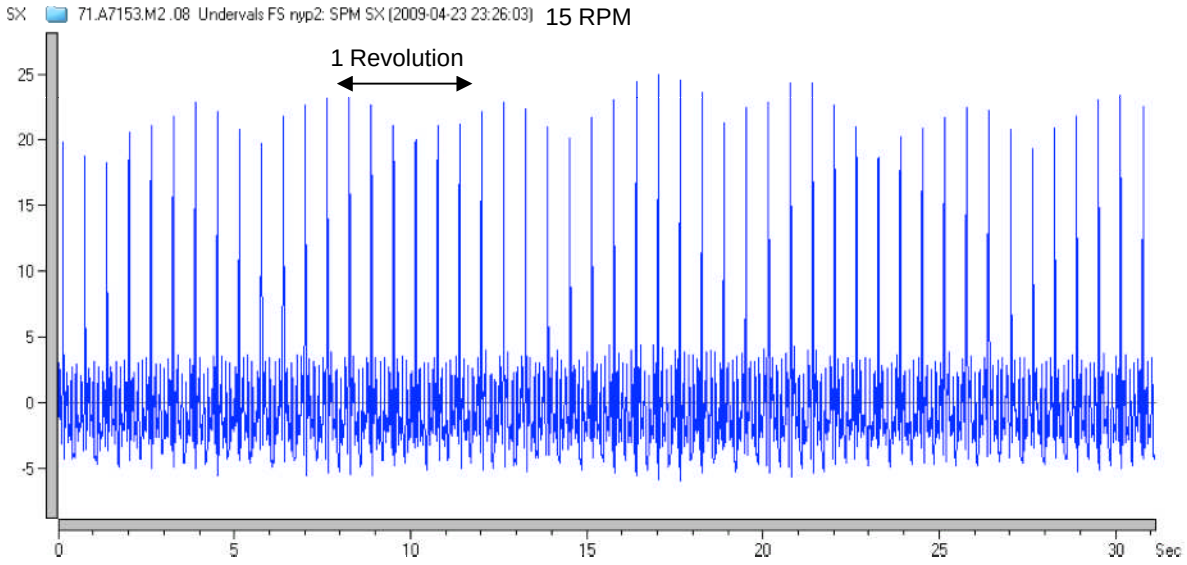
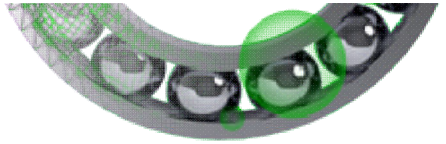


***Fig 14**. Case 3: Time signal HD late April, 2009*

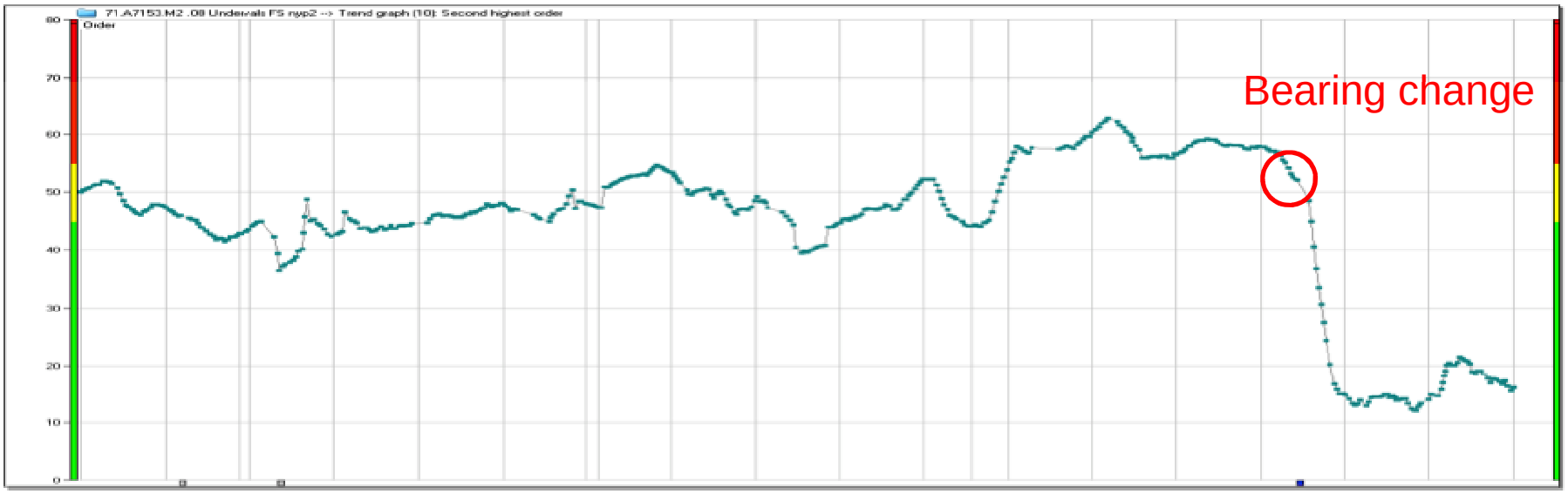


Twin Wire Press 12

Nip 2, FS on lower section

Spherical roller bearing, 10 rpm

HDm values from mid-October 2009. Decreased values after bearing replacement in February 2010.

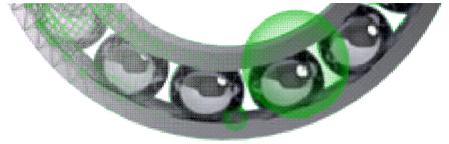


October 2009

February2010

Twin Wire Press 11

Nip 2, DS, Lower section



Twin Wire Press 11
Nip 2, DS, Lower section

Spherical roller bearing, 14 rpm

Time signal HD from January 2010 before replacement.

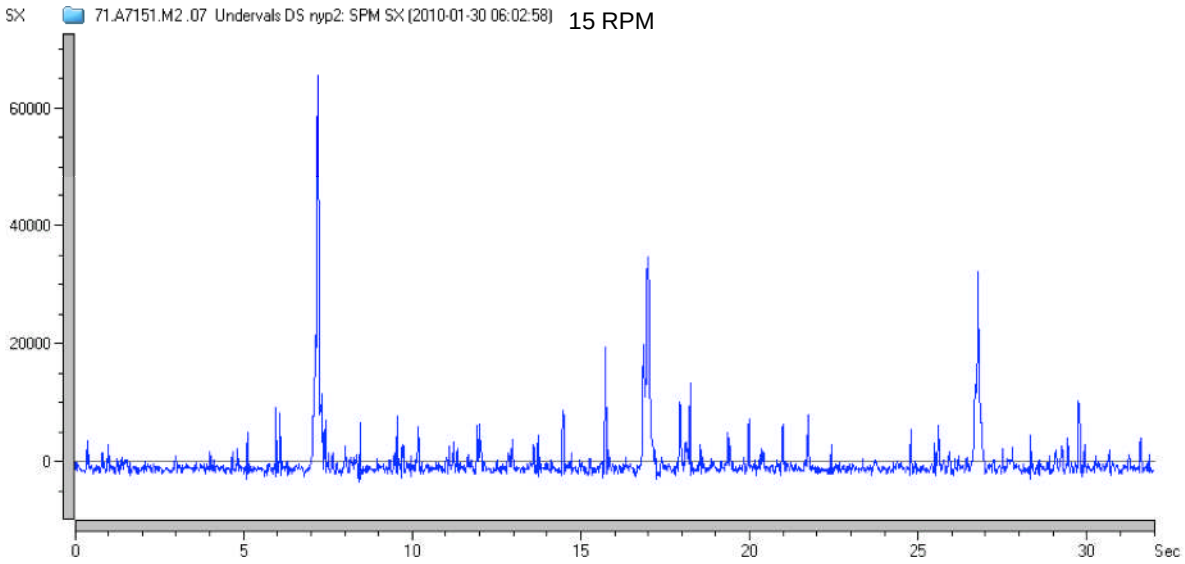
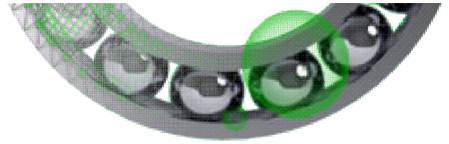


***Fig 21**. Case 4: Time signal HD late January, 2010*

Severely damaged outer race. Inner race no signs of damage

About 4 months' forewarning



Twin Wire Press 11
Nip 2, DS, Lower section

Spherical roller bearing, 14 rpm

HD Time signal November 2009 – after replacement.

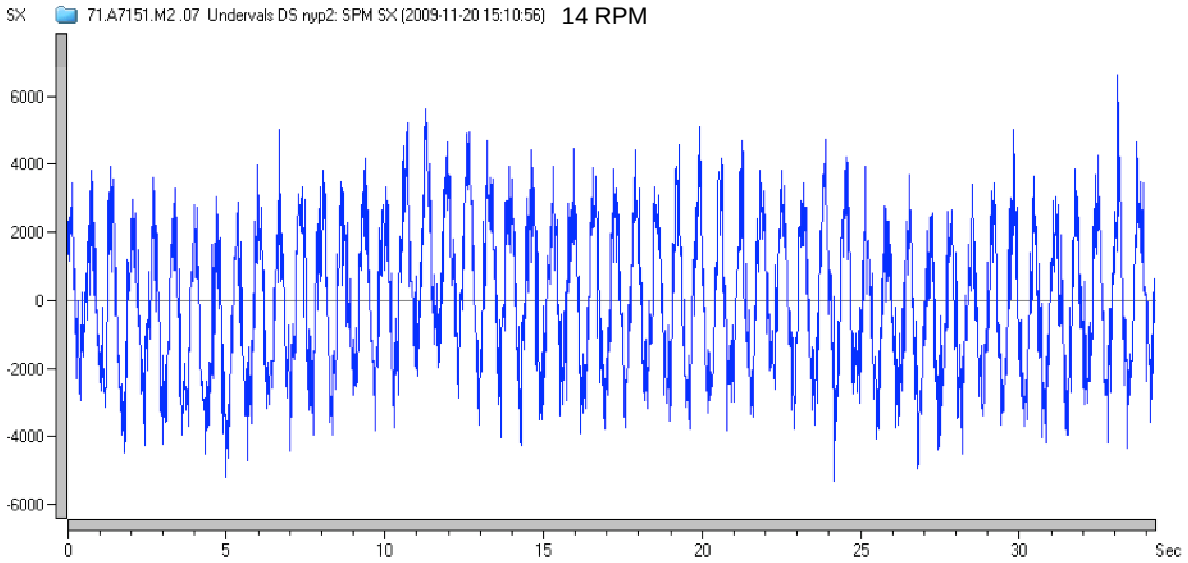
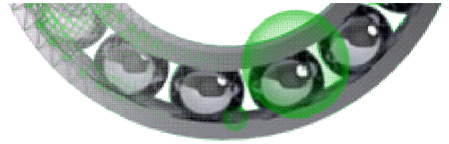


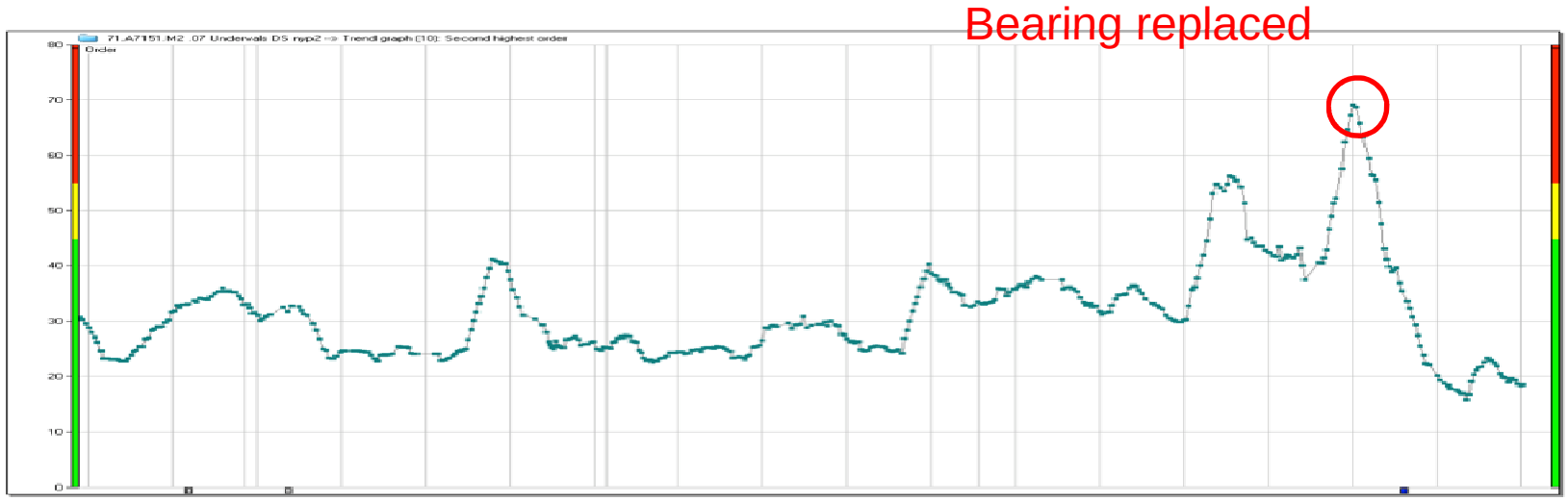
***Fig 20**. Case 4: Time signal HD November, 2009*



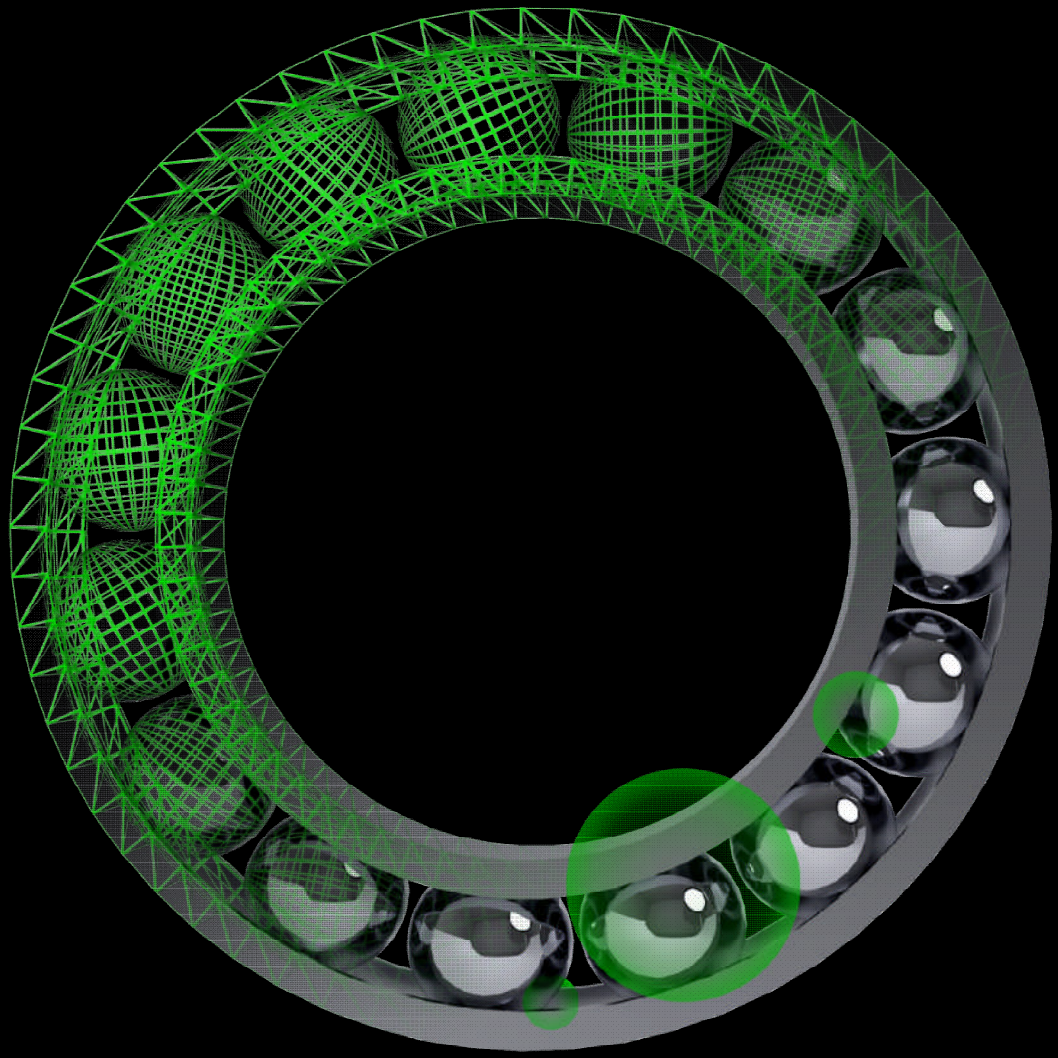
Twin Wire Press 11
Nip 2, DS, Lower section

Spherical roller bearing, 14 rpm

HDm values from mid-October 2009. Decreased values after bearing replacement in February 2010.



October 2009 November 2009 February 2010



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