Low Speed Trunnion Bearing Problems

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Low Speed Vibration Monitoring

ANIMAL FEED DRYER PLANT

Case Study 1 - Trunnion Bearing Problem

Gearbox Driven Drum Drive System

Dryer System Overview

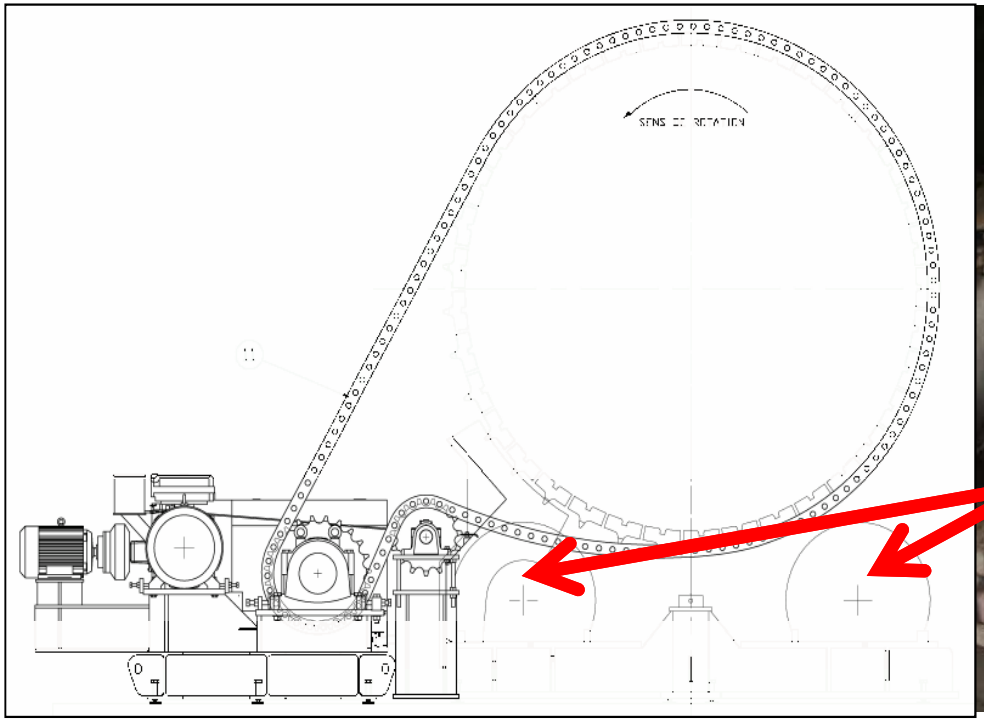
- Two Dryers on site A & B units.
- Critical to plant operation
- Removes excess water from high value DDGS product
- Reduced plant production rates if one dryer is offline

Drive System Overview

- Typical production speeds for each dryer:
- Inverter Driven Drive Motor (1375 RPM)
- Gearbox Output (12.7 RPM)
- Chain Pinion Support Bearings (12.7 RPM)
- Trunnion Support Bearings (9.5 RPM)
- Main Dryer Drum (2.6 RPM)

Drive System Overview

- 4 Supporting Trunions (8 Bearings) North/South

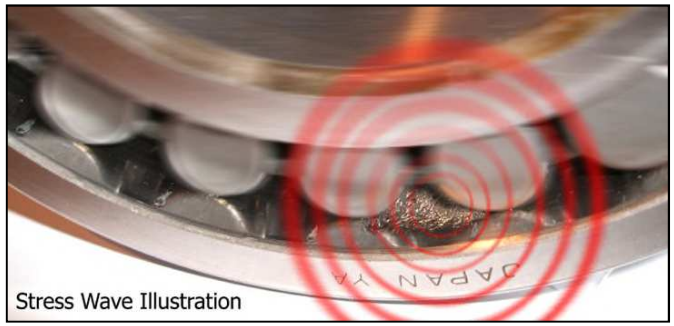


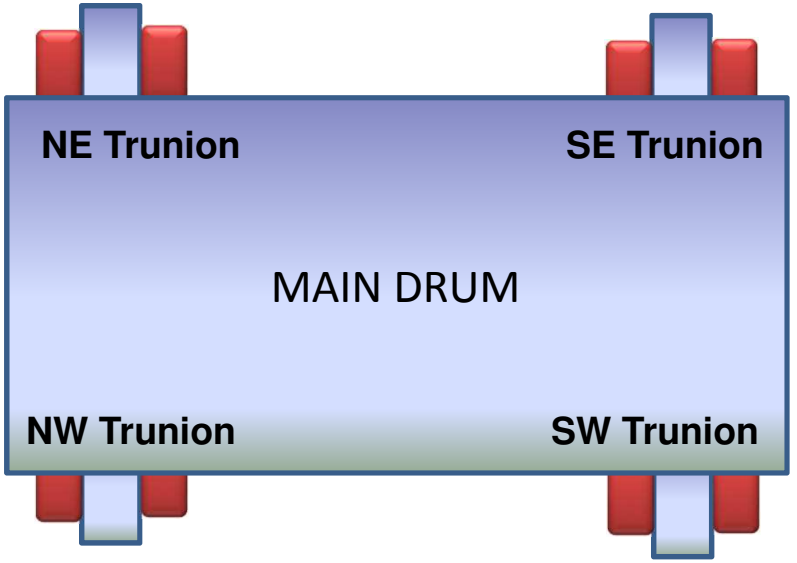
Condition Monitoring

- Drum Drive System set-up for routine condition monitoring since plant start-up.
- Monthly Vibration Analysis on Motor, Gearbox, & Trunnion Bearings.
- 3 Monthly Oil Analysis on gearbox.

Trunnion Bearing Monitoring

- Difficult to monitor using standard vibration techniques due to slow speed (9.5 RPM)
- **PeakVue Stress Wave** technology used.
- Very sensitive to impacting type faults such as bearing defects, looseness problems & gear faults.





Trunnion Bearing Monitoring
Slow Speed Setup

- Setup base around **PeakVue technology**
- Data collected in Acceleration
- To determine FMAX find highest defect freq of the bearing in orders of turning speed multiply by 8 (harmonics of the bearing defect freq)
- SKF 23164/CCW

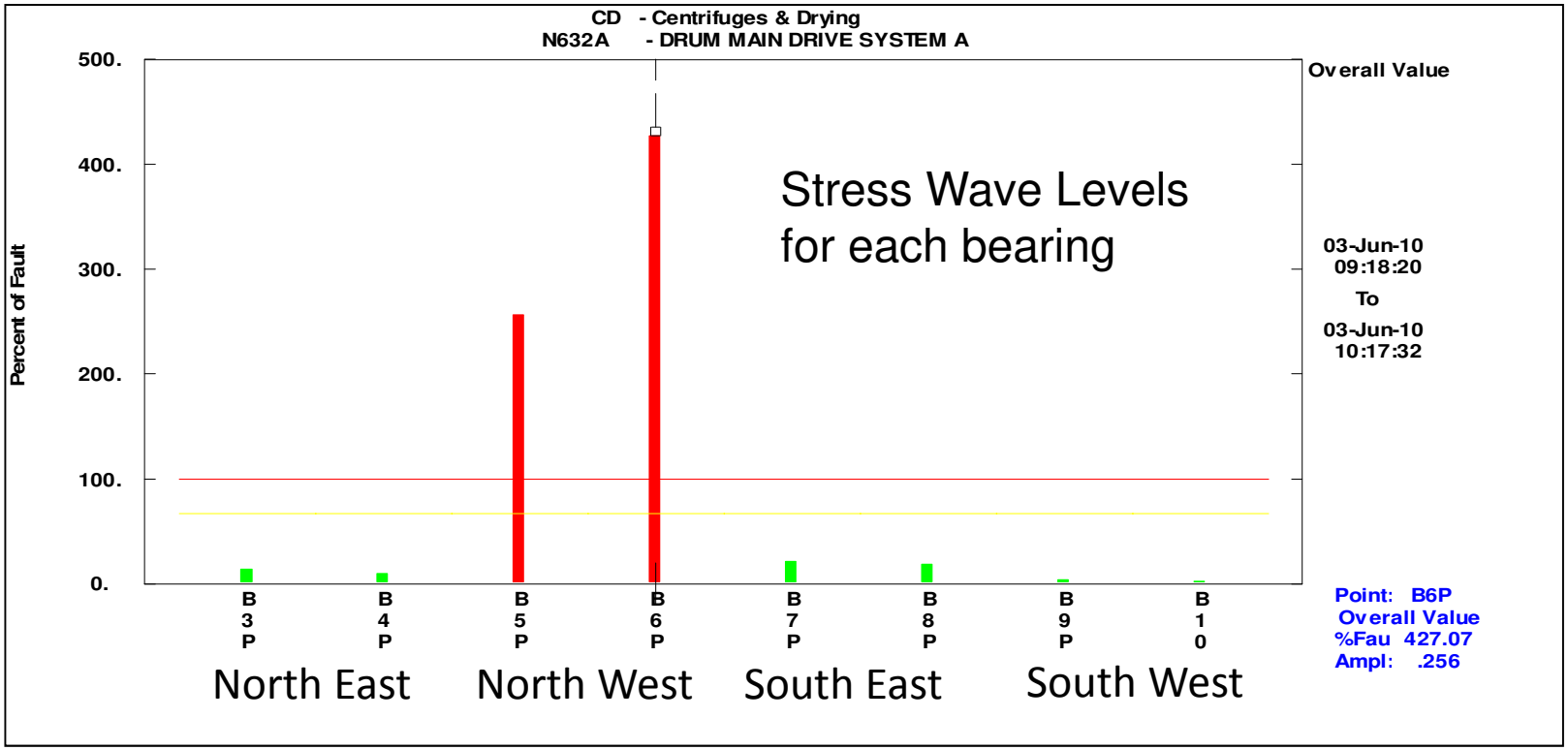
Cage Freq	0.43
Roller Spin Defect Freq	3.95
Outer Race Defect Freq	9.65
Inner Race Defect Freq	**12.34**

Trunnion Bearing Monitoring Slow Speed Setup

- Set FMAX to 8 x highest bearing defect freq :
- **8 x 12.32** (Inner Race Defect Freq) = **98.4 orders**
- So FMAX in Cycles per min = Fmax x shaft RPM
- 98.4 X 9.5 RPM = **934 Cycles Per Min FMAX**
- Analyser will select closest band to this range
- **PeakVue** set to **500 Hz HP Filter**
- Capture at least **10 Revs** on the time waveform, min **4096** points on waveform.
- Lines of resolution **1600**
- Averages **1**

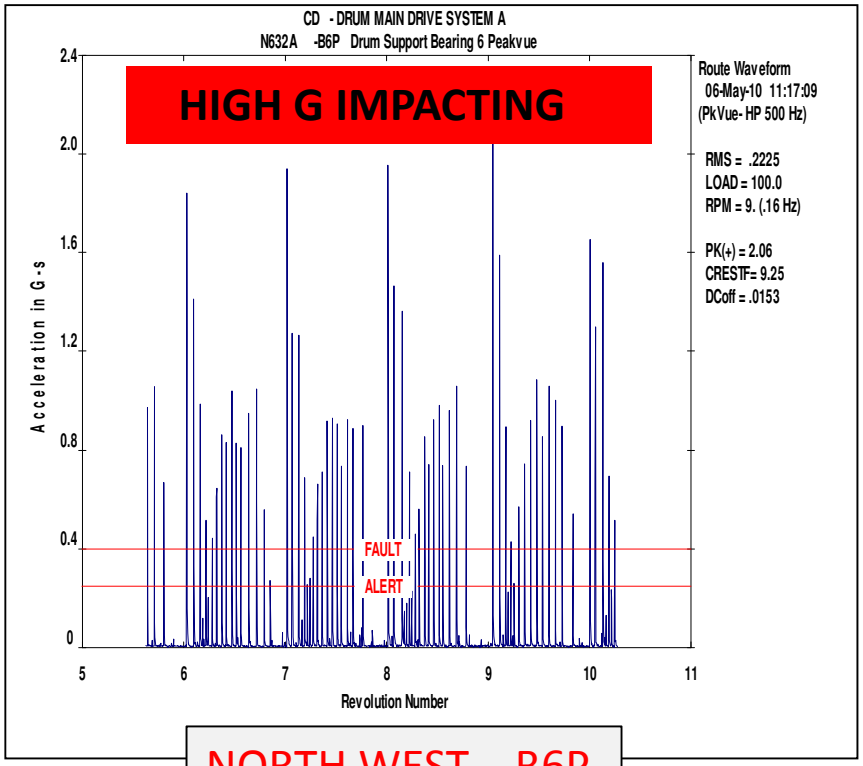
Trunnion Bearing Analysis (PeakVue)

- PeakVue Overall Stress Levels in G's
- **Data showed raised impacting levels on North West Bearings.**

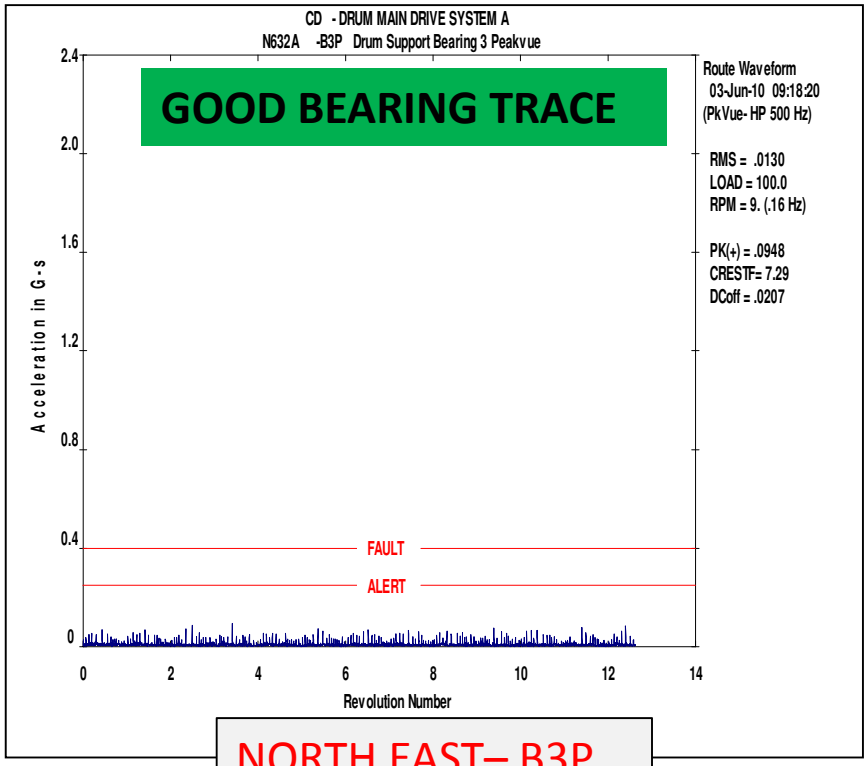


Trunnion Bearing Analysis (PeakVue)

- **Comparsion Time Waveforms,** High G Stress Wave impacting on the North West Bearing Pair



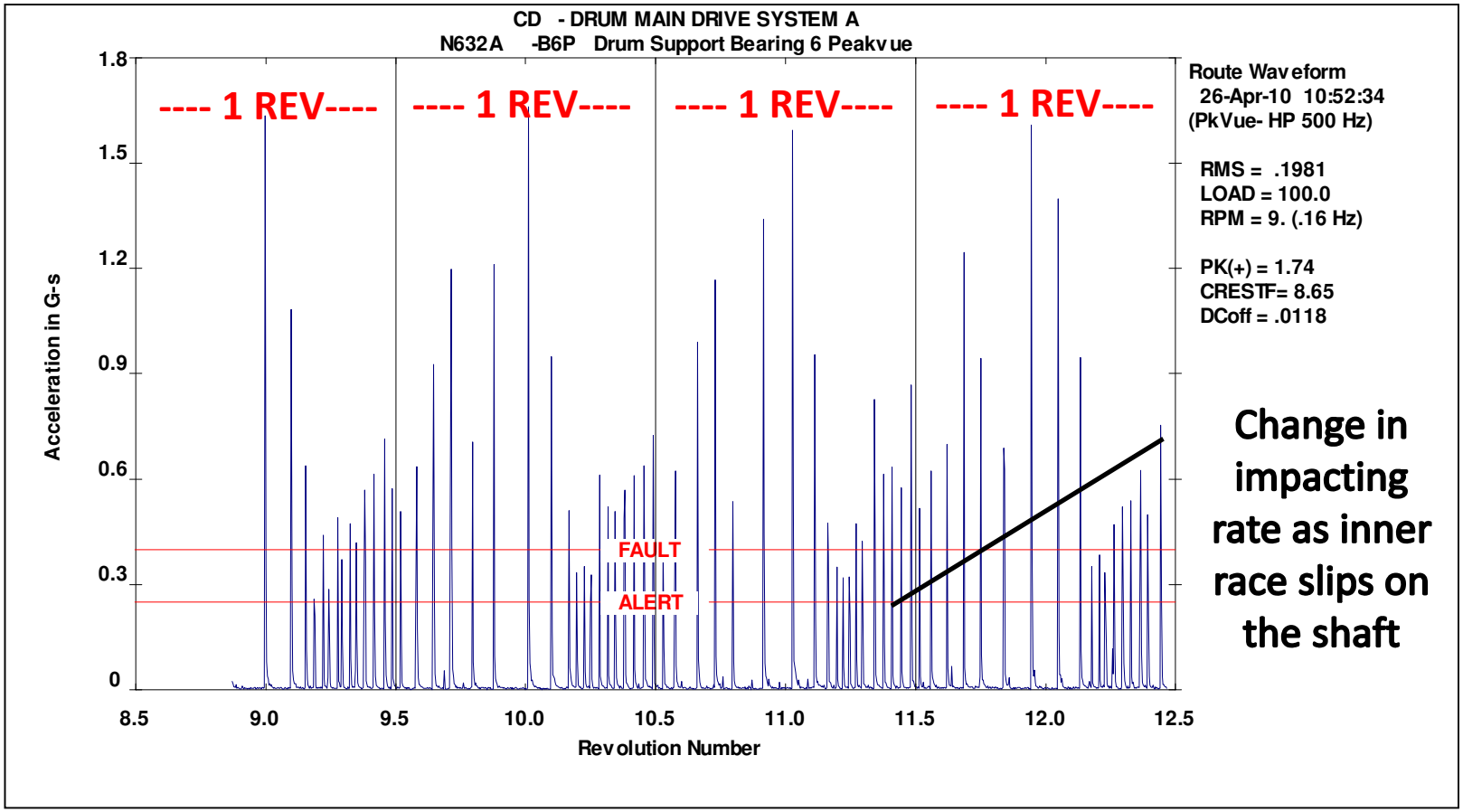
NORTH WEST – B6P



NORTH EAST– B3P

Trunnion Bearing Analysis (PeakVue)

- B6P North West showed highest levels.
- Data pointed to an **INNER RACE PROBLEM** as impacts were modulated at 1XRPM (Due to rotation of inner race) many harmonics from 9.5 CPM (Shaft turning speed)



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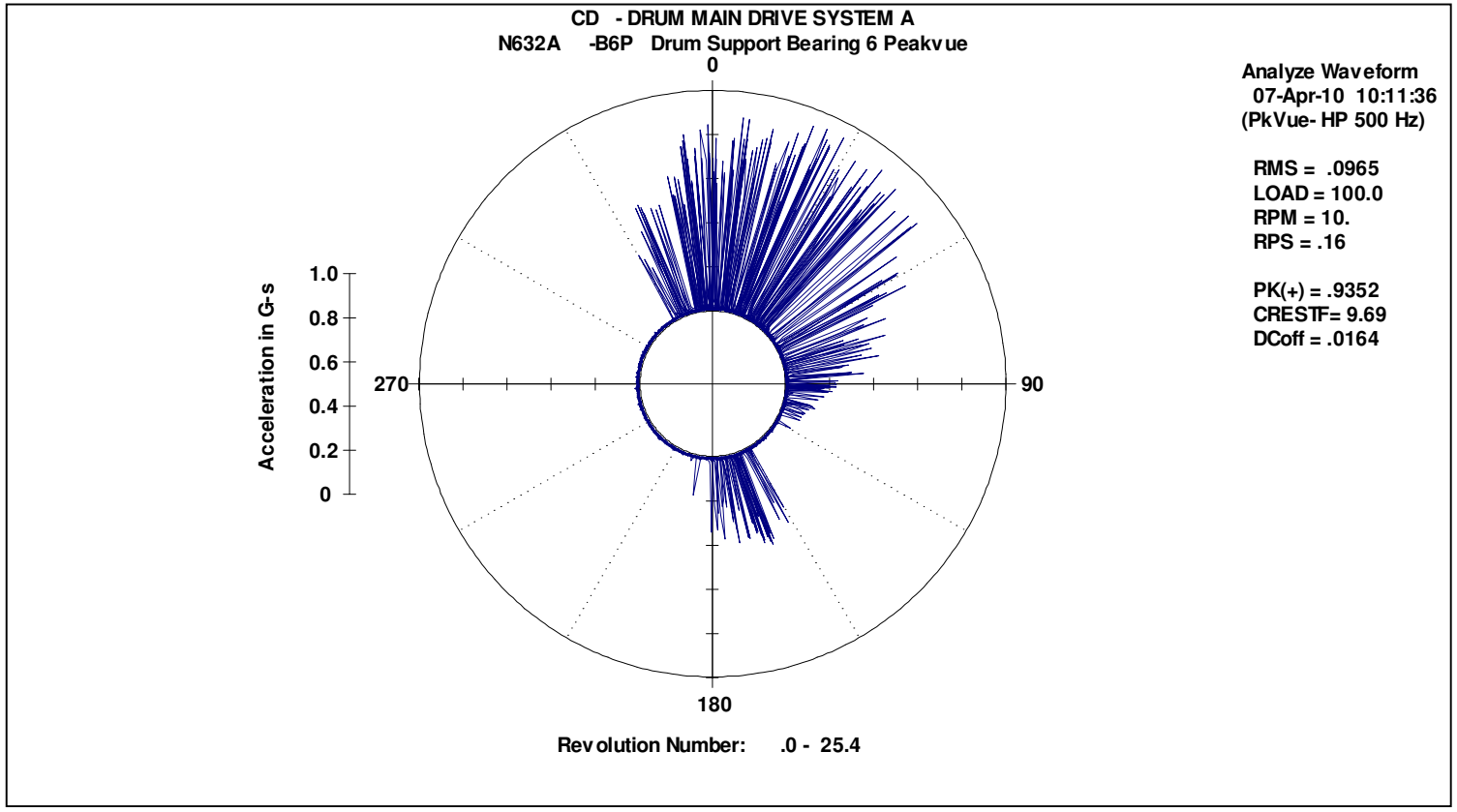
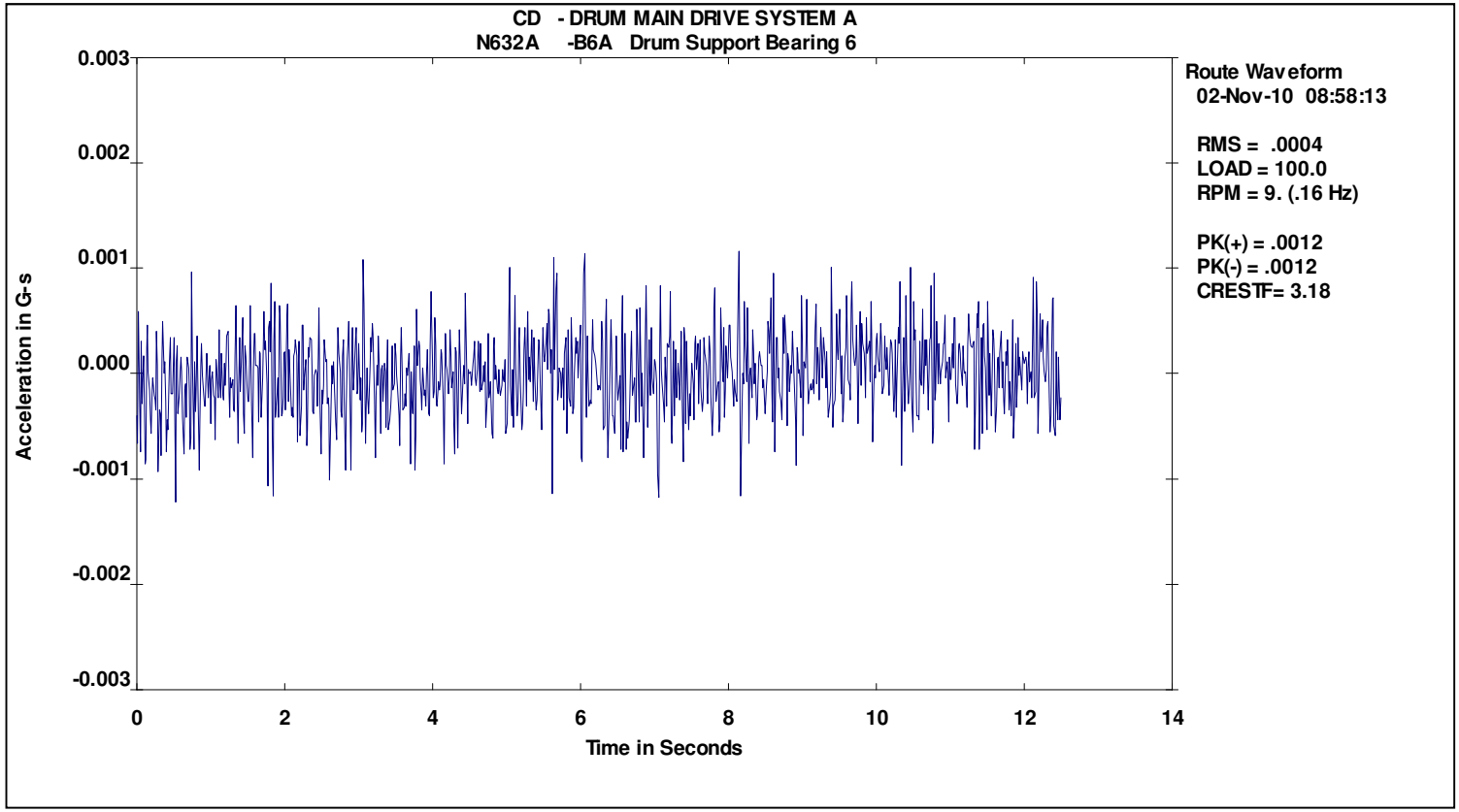


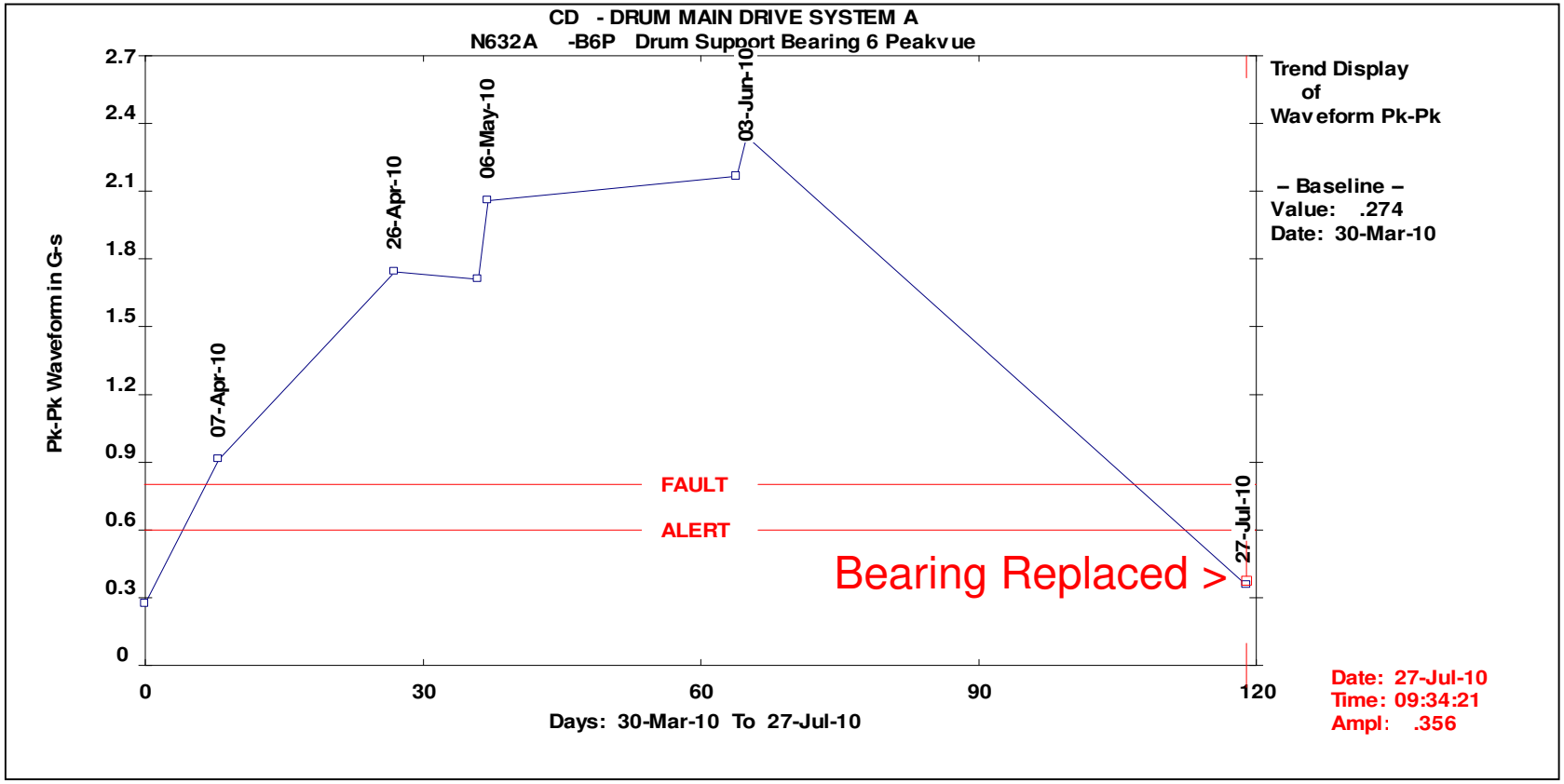
Trunnion Bearing Analysis (Standard)

- B6P North West Standard Data
- Data showed no impacting evident



Trunnion Bearing Analysis (PeakVue)

- **PeakVue Waveform PK-PK Trend** showed increasing levels over a 3 month period, 0.3 G's to 2.3 G's **RMS recommended North West Trunion replacement at July Shutdown**



Dryer A – N-W Roller Bearing Pictures

The inner race bearing track shows some slight staining but no surface damage could be identified.

The outer race inside diameter shows some indentation damage. The verical lines on the surface match the roller spacing.

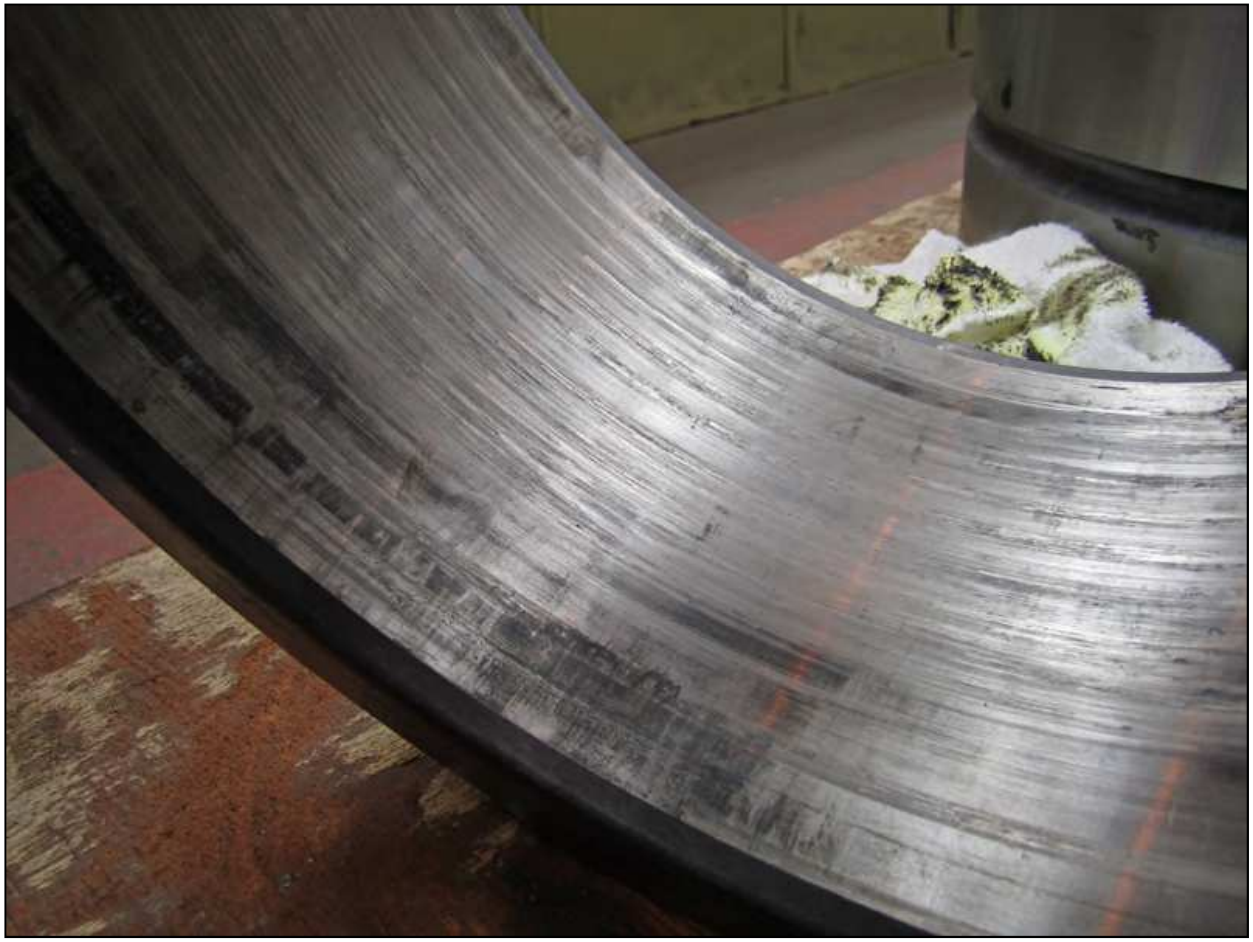
The cage needs to be cleaned to allow more detailed analysis. The grease is much darker in colour than the new grease and is contaminated with brass particles.

Dryer A – N-W Roller Bearing Pictures

- **Root Cause – Poor inference between inner race and shaft**

Roller Shaft – Horizontal scratches occurred during the removal of the bearing. The Damage around the surface of the bearing contact area is due to the bearing inner race rotating on the shaft.

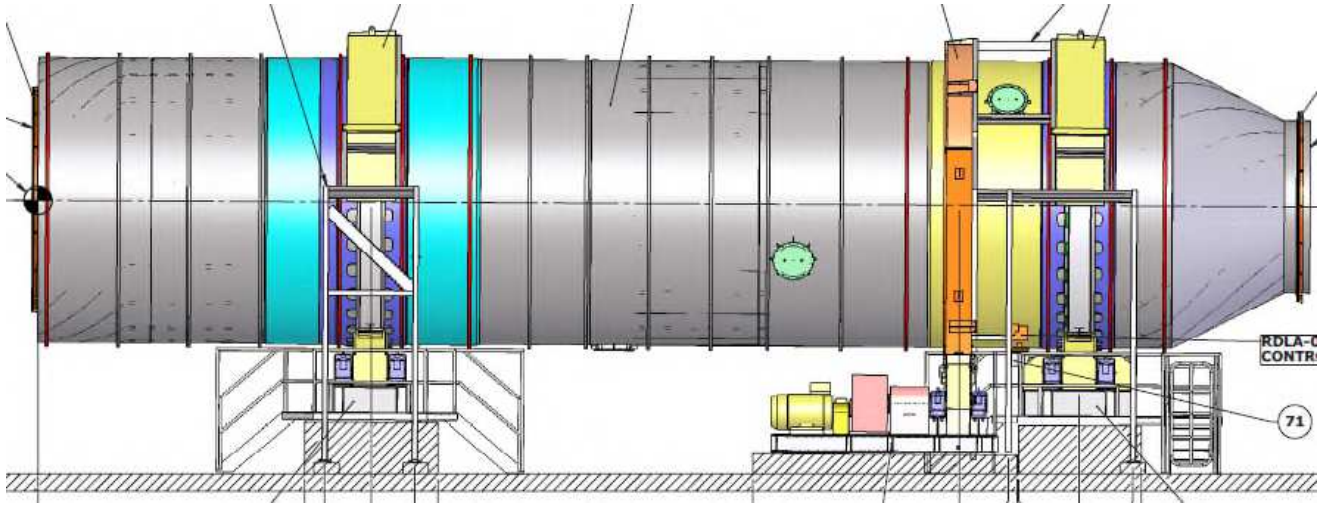
Dryer A – N-W Roller Bearing Pictures



The inside diameter of the bearing inner race shows rotational damage

Low Speed Vibration Monitoring

ANIMAL FEED DRYER PLANT

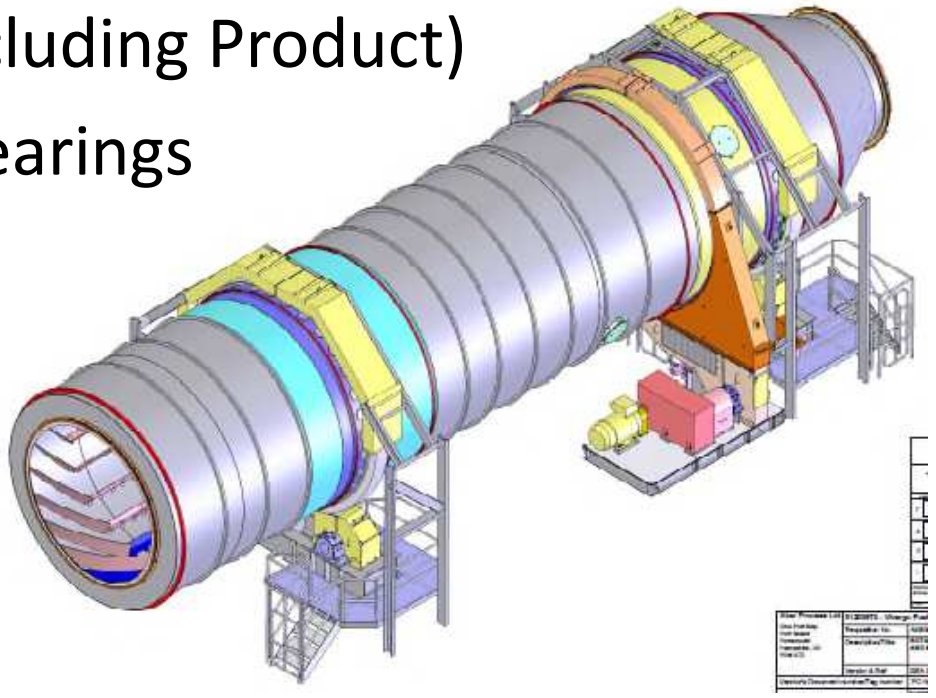


Case Study 2 - Trunnion Bearing Defect

Gearbox Driven Drum Drive System

Dryer Layout

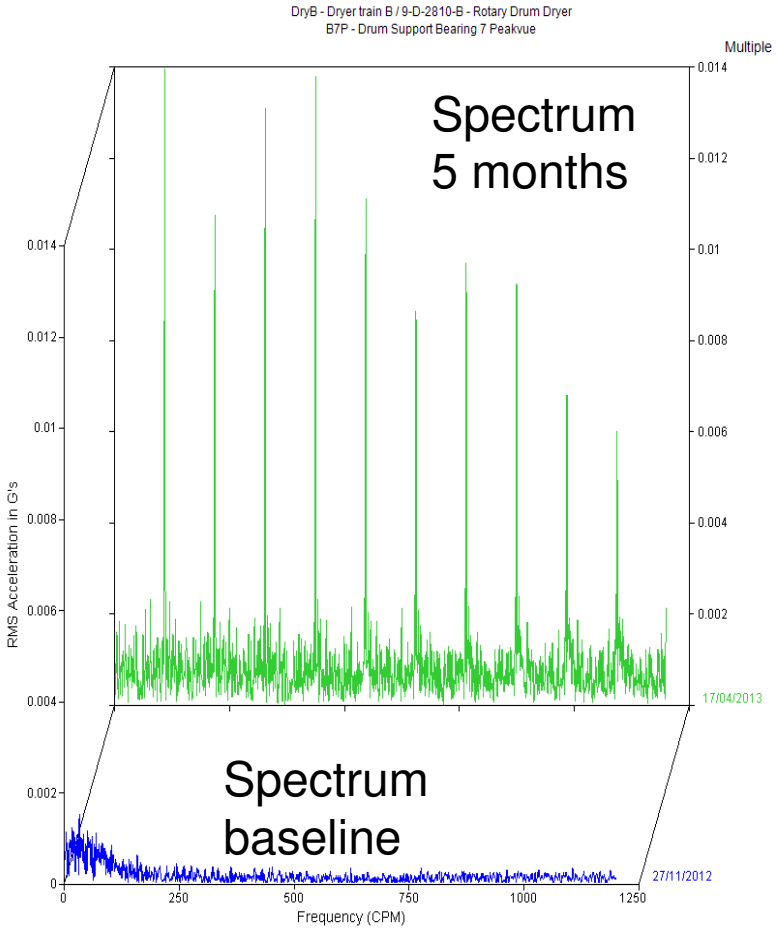
- New Machine first run 2012
- Motor/Gearbox/Chain drive system
- 317te Rotating Drum (Including Product)
- 8 Supporting Trunnion Bearings
- 2 Thrust roller bearings
- Slow Speed

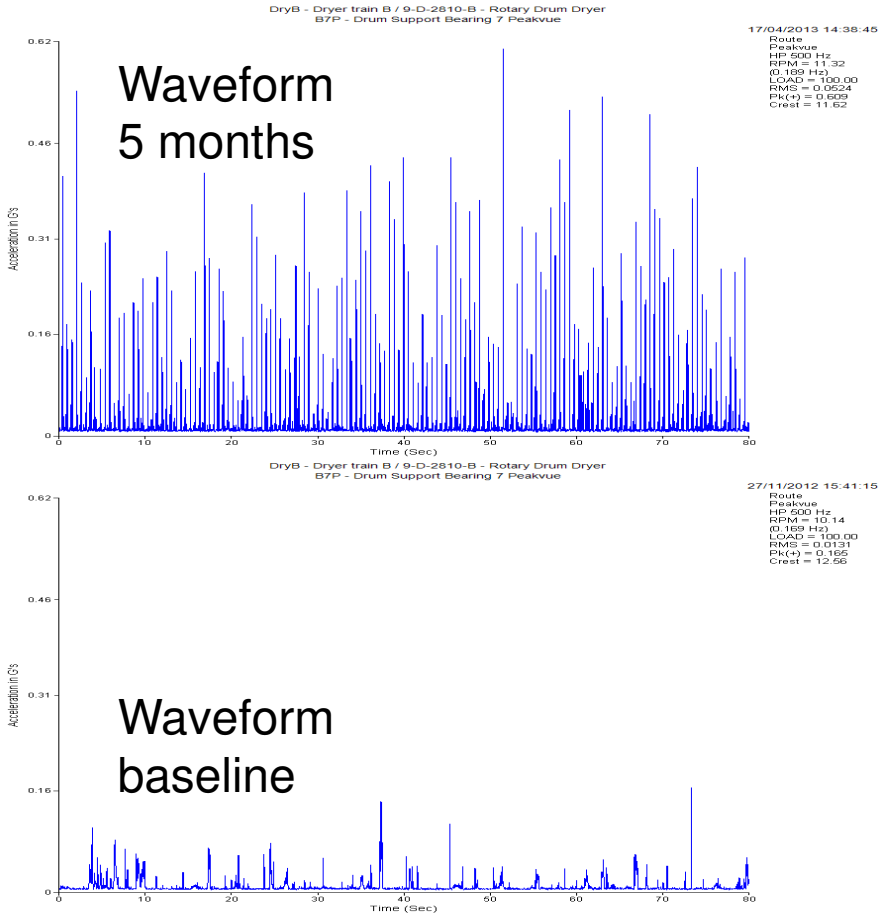


Dryer Setup

- Slow speed 11.3 RPM Trunnion bearing.
- PeakVue stress wave technology utilized
- PM setup for monthly readings

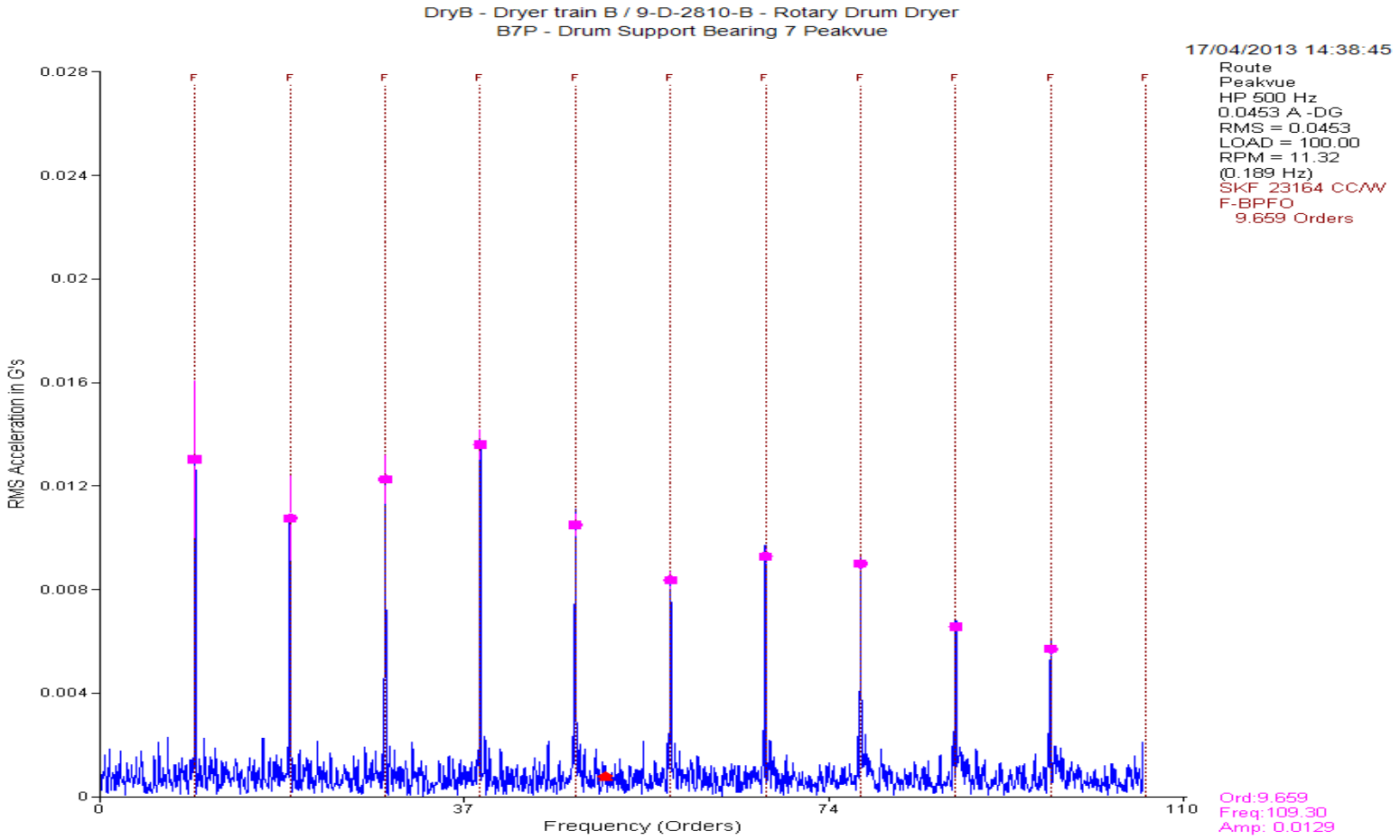
Dryer – Vibration Analysis





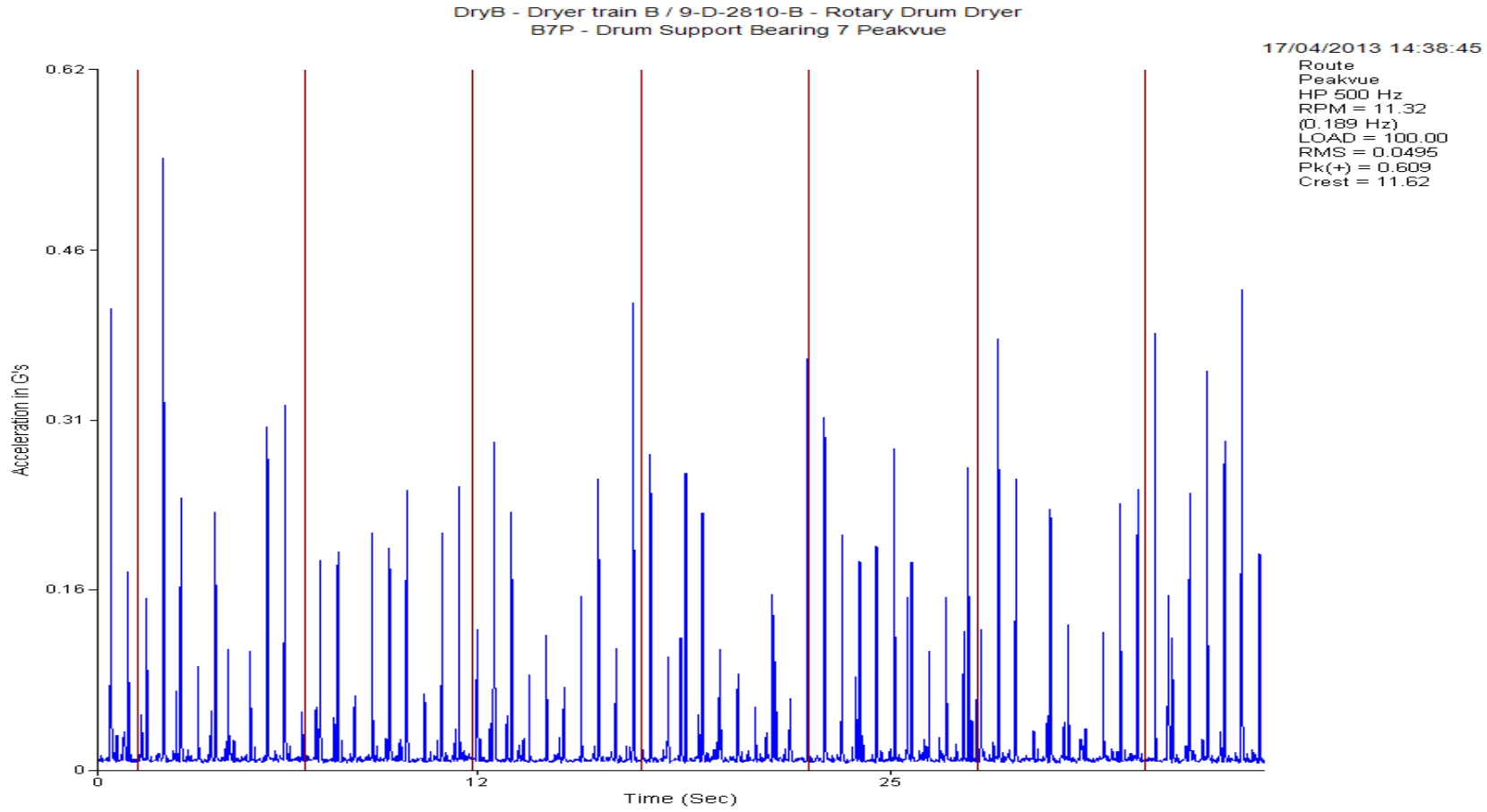
- Increase in spectral & waveform activity after 5 months of running on **B7P bearing**

Dryer – Vibration Analysis - B7P Brg



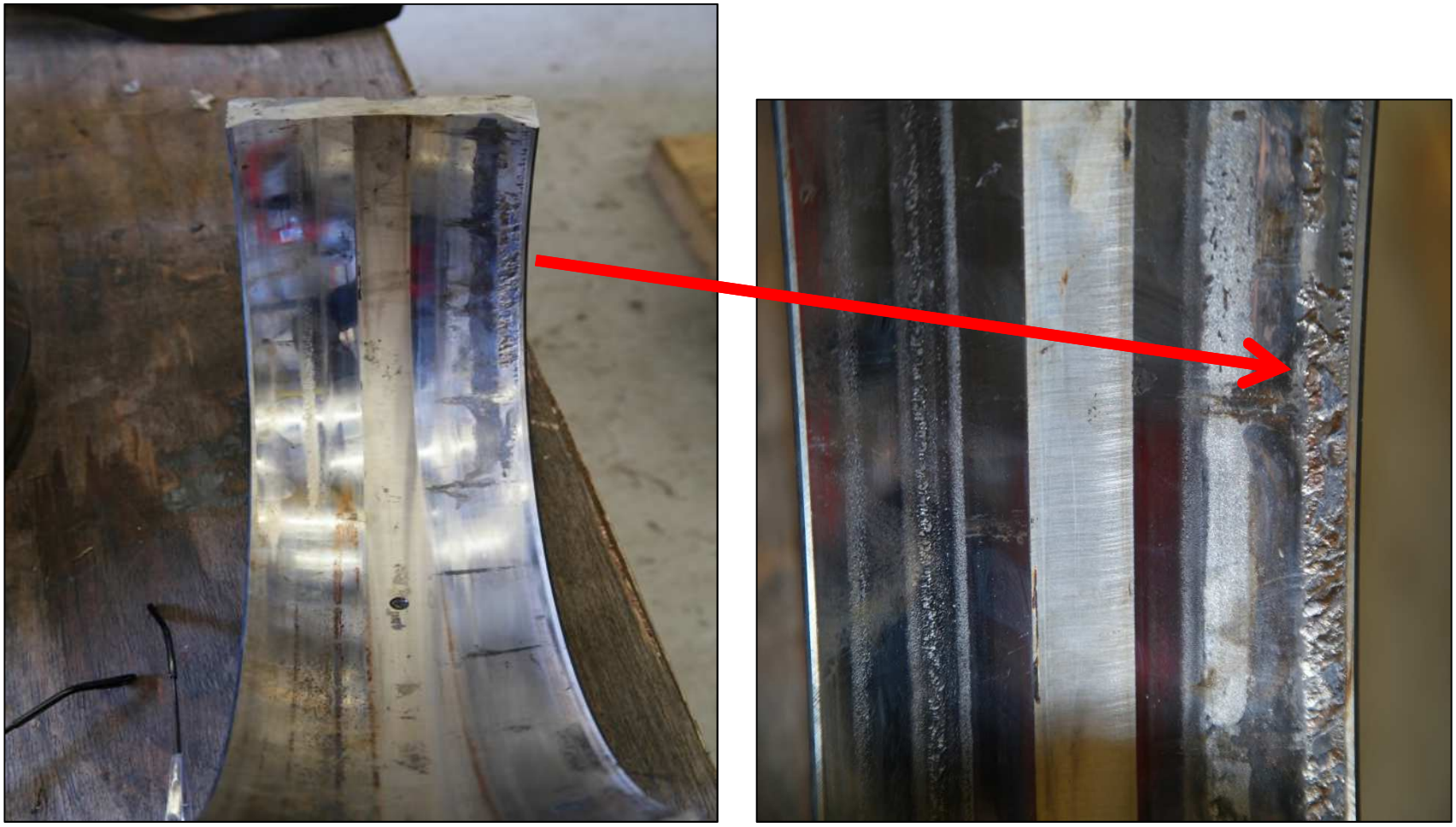
- Spectral data shows perfect match with **outer race defect freq for SKF 23164 CC/W (9.65 Orders)**

Dryer – Vibration Analysis - B7P Brg



- Time waveform data shows impacts spaced at outer race defect frequency raised G levels.

Dryer –B7P Bearing Inspection



- Inspection found advanced spalling on the outer race of the SKF 23164 CC/W bearing

Dryer –B7P Bearing Damage Root Cause

- Bearing was sent away for detailed analysis
- Bearing damage was caused by **Excessive axial loading**
- Further investigations found **Incorrect alignment** of the trunnion bearings