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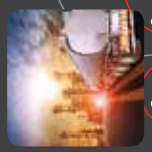
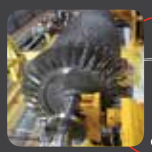




Condition Monitoring Specialists

RELIABILITY, PROCUREMENT AND SPARES MANAGEMENT

By Dennis Swanepoel, NDip Mechanical, Vibration CAT IV, lead technician RS division

INTRODUCTION

Effective asset optimisation plays a key rôle in boosting reliability as well as the efficient management of maintenance costs in any given operation. This Technical Bulletin discusses various scenarios in which maintenance costs can be reduced through improved procurement systems and better management of spares.

Dennis Swanepoel

Reliability does not only include precision maintenance of installed plant, but also the effective purchasing of new and overhauled equipment and parts, combined with spares management. In most cases, a reliable plant starts with the purchasing of new equipment, original equipment manufacturers' (OEM's) recommended spares and the management of overhauled spares.

Purchase procedures could be a ticking time bomb if they do not maintain an effective balance between:

- cost vs quality
- OEM part requirements vs in-house specification of parts

The purchase of spare parts can represent a substantial capital investment, therefore, when spares are obtained, they need to be cared for to ensure the investment yields good returns.

- Quality check points need to be in place
- Storage procedures should be established and maintained
- Spares management with regards to warranties and guaranties must be considered

If the purchase process fails, what could it lead to?

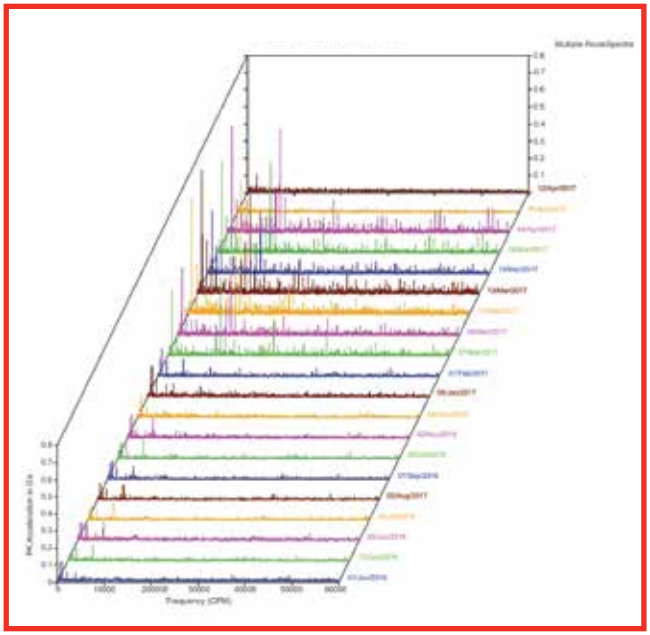
CASE 1: TUBE MILL GEARBOX

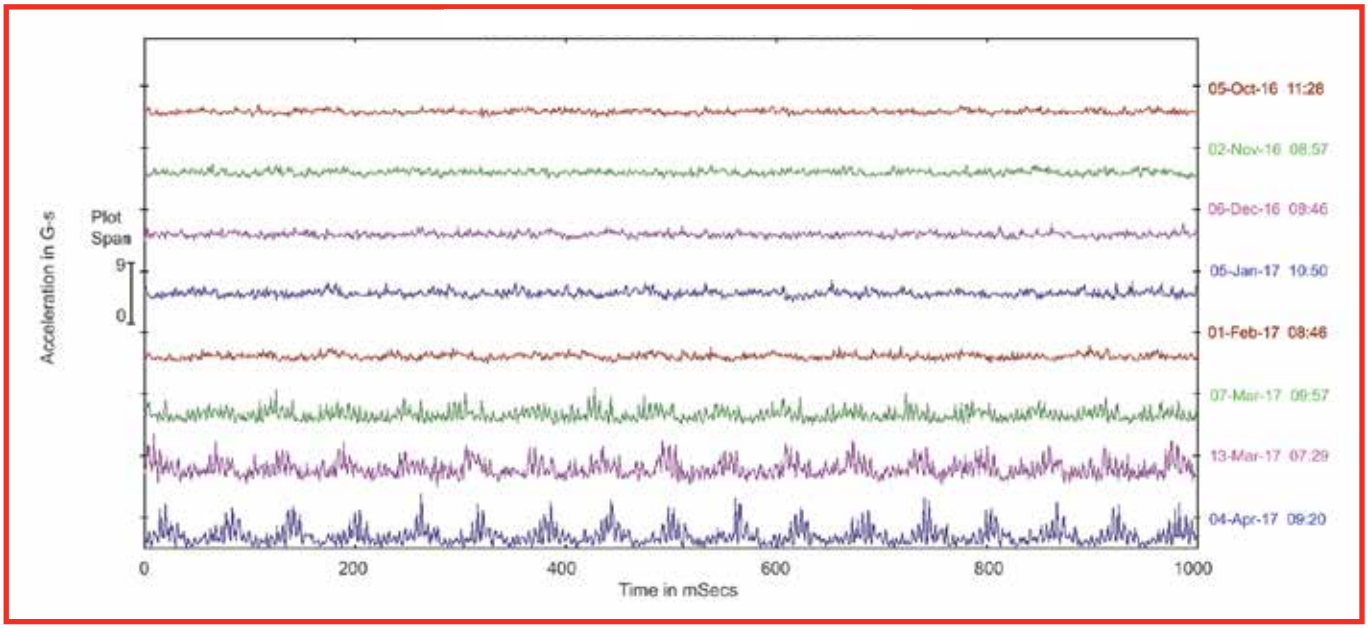
Scenario: Effective condition monitoring has established a weak point in a tube mill gearbox, namely the input shaft NDE (non-drive end) bearing. This bearing suffers from high loading, at times a lubrication deficiency, and installation defects. In this specific application, the bearings failed in a random pattern, but after repairs were carried out, the bearing would typically last for more than five years.

Then a procurement issue was experienced, as the specific bearing that normally failed was only manufactured on special order and the plant was experiencing a period where an abnormally high amount of gearboxes was indicated to be at risk of failure by the condition monitoring team.

The condition monitoring team does, however, indicate the defect well in advance of the failures and proper forward planning could be done for their repair.

During the risk assessment of these pending failures, the plant consulted the OEM and a substitute bearing was suggested by the OEM. The new specification was presented to the purchasing department and the risk seemed to have been alleviated.

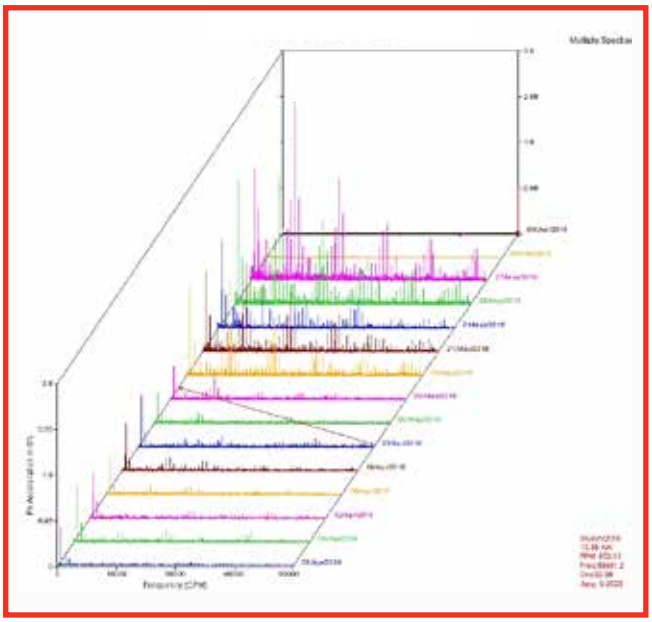




Typical Pre-warning Time (>6months)

After the first replacement with the new specification bearing, a high rate of infant mortality was experienced during the first two to four weeks after installation. The new bearing failed. An investigation was launched, and the following was concluded:

- The installation procedure and quality control plan were not adapted to suit the new bearings
- The specification that was presented to the purchasing department lacked sufficient detail. This caused the purchasing department to procure a bearing that did have the same bearing number as the OEM-recommended bearing, but – what was not considered – was the load rating of the bearing. The bearing that was purchased had 18 rollers, while the OEM-specified bearing had 19 rollers. The decreased number of rollers in the new bearing thus increased the load per roller beyond the load-bearing capacity of the bearing, leading to premature failure.



Replacement bearings initially function well and then fail due to incorrect specs

Learning points:

- When specifying replacement or new parts, the specification needs to be done as accurately as possible and with as much detail as possible to avoid incorrect parts procurement.

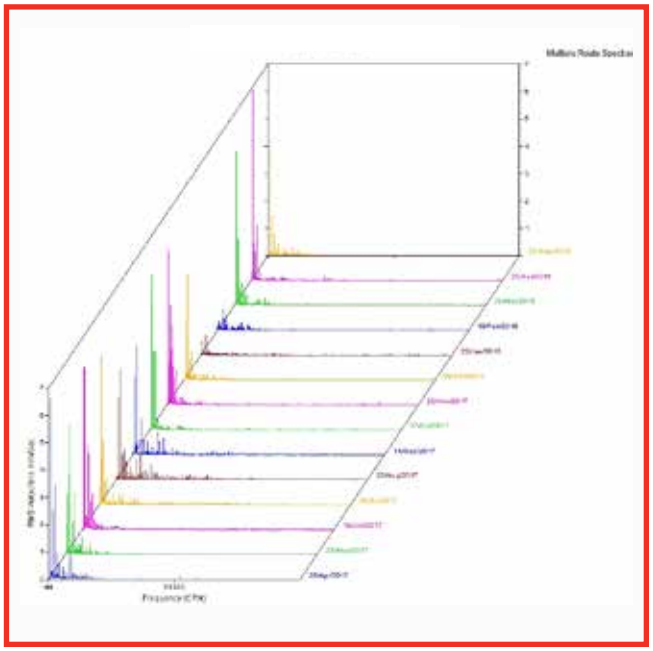
- When alterations are made to the part being used on site, a full management of change process needs to be followed to ensure that all spares management, maintenance and condition monitoring tasks can be adapted to ensure reliable plant operation.

CASE 2: DUST-HANDLING PLANT FAN

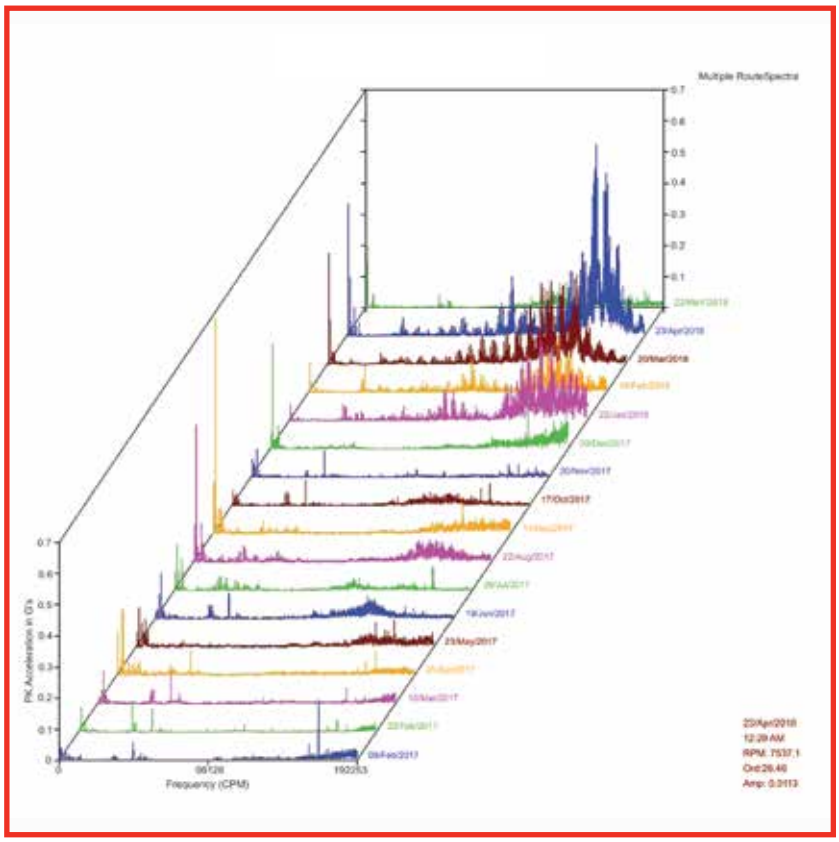
Scenario: Defects were identified on a dust-handling plant fan, and it was requested to schedule replacement of the fan bearings and housings. The maintenance team took action but did not follow the precise recommendation pertaining to the replacement of the fan bearings and motor, and they neglected to replace the bearing housings on the fan.

The internal bearing looseness on the fan bearings momentarily improved, but the motor condition deteriorated due to a serious inner race bearing defect that was identified. Due to the cost involved in the planned maintenance that had already been carried out, the plant was hesitant to replace the motor again within such a short period of time. However, after four months the motor deteriorated to a failure stage that could no longer be ignored.

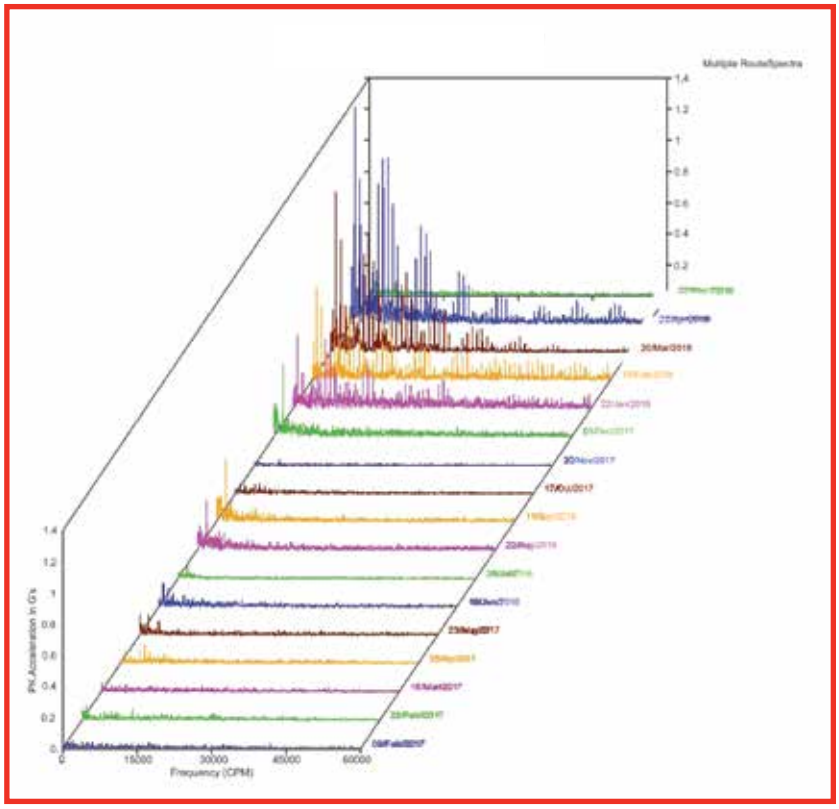
The financial impact of the second replacement amounted to R250 000, and the motor had been in storage for a prolonged period and was no longer under warranty. There was no evidence available to prove when the damage to the motor bearings occurred.



Internal looseness vibration decreased initially after the fan bearings were replaced, but the condition re-appeared within two months



Internal bearing looseness momentarily improves after replacement



Motor replacement is now necessary as this failure stage cannot be ignored

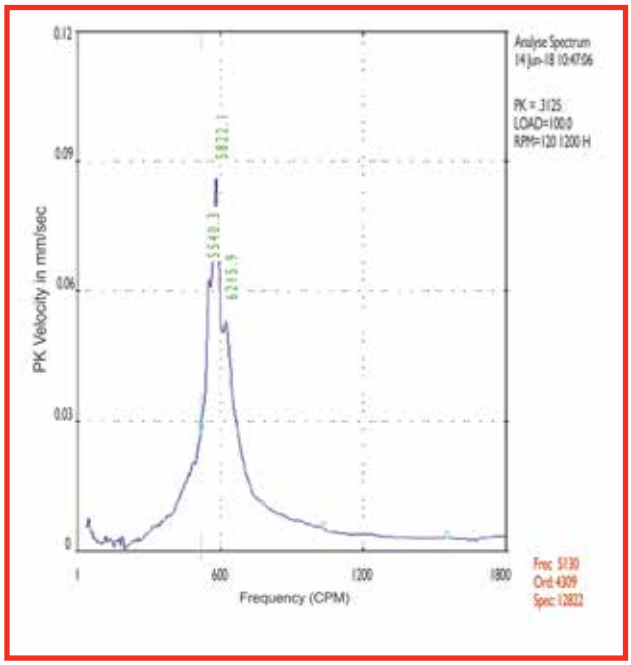
Learning points:

- New and overhauled equipment that is stored for prolonged periods needs to be managed in an effective way. Extended warranties can be negotiated with different vendors under certain conditions. This is typically a spares management process.
- On refurbished equipment, the quality control process had grey areas and did not include key components. It is important to understand the fine print.
- Vibration acceptance tests on the motor after repairs are not specified and verified. ISO 10816 only specifies overall vibration up to 1000Hz, and the bearing defect frequency harmonics only presented detectable amplitudes from around 550Hz upwards. The overall values are, however, not affected sufficiently to warrant a rejection of work performed on the motor.
- It is important to schedule hold points during the refurbishment of equipment so that proof/witness inspections can be done to ensure proper execution of tasks during an overhaul

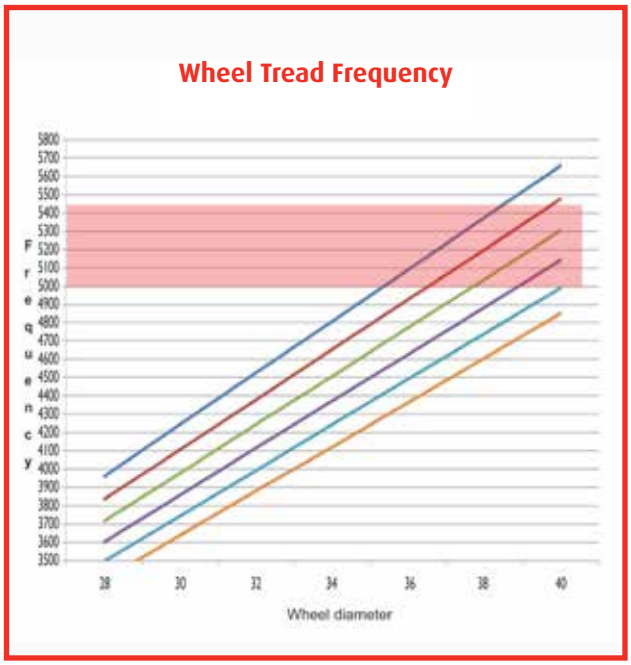
CASE 3: ON-HAUL TRUCK

Scenario: A 250 ton on-haul truck was experiencing excessive vibration at a speed range of 38-40km/h that caused operator discomfort. The haul truck was then limited to a maximum speed of 35km/h to continue production and an investigation was launched to find the cause of the vibration.

Preliminary investigations identified that the dominant frequencies that are generated are between 4300cpm (71.6Hz) and 5400cpm (83.3Hz) in the control cabin. As the truck is generating a multitude of forcing frequencies, it was initially established that the isolators between the cab and chassis were damaged.



Dominant frequencies are generated are between 4300cpm (71.6Hz) and 5400cpm (83.3Hz)



Source frequency evaluation

Replacement of the isolators alleviated the problem, but the frequencies were still present on the chassis after the replacement. Further investigation was done to pinpoint the source of these frequencies, and it was established that the wheel struts had a natural frequency that was excited by the wheel tread pattern at a certain speed, tyre pressure and loading conditions.

Learning points:

- When evaluating abnormal conditions, one can easily accept the obvious defects as the solution to a problem, but to solve the root cause might involve major redesign.
- In this case, the re-design of the wheel tread was considered uneconomical for the mine, leading to the question, "should the design issue that was identified have been a cost implication for the client and not the OEM?" The answer to this underlines, once again, the importance of implementing more educated procurement practices.

CONCLUSION

Procurement and spares management play an integral part in plant maintenance and reliability and should be conducted as carefully and precisely as any condition monitoring procedures.

Procurement divisions in companies are advised to rely on technical skills from plant specialists to ensure that they deliver spares and equipment to the correct and reliable standard that is required for plant reliability and optimum life cycle, and to avoid unplanned maintenance costs.

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