ABSTRACT

Timken South Africa manufacture and assemble AP tapered roller bearings which are used on rail journals. These are also assembled in numerous other facilities worldwide. The bearings are large and cumbersome to handle. On the assembly line there is no method of detecting the presence of cup (outer ring) nicks during the assembly process. A nick is a displacement of metal of very small size on the raceways. High spots of metal also exist. They are most frequently caused during the assembly of bearings. Cup nicks are known for repeat customer complaints due to rough rotation. The presence of the nick can induce premature fatigue spalling on the raceways, thus compromising the life of the bearing. Accelerometers were mounted on nicked and non-nicked cups and were analysed by completing Fast Fourier Transforms and Power Spectral Densities (PSD) while the assembly was rotated in a Lateral Machine. When analyzing the results with a PSD it was found that it was possible to define a baseline for a good defect-free bearing at different sampling rates. These were then transposed onto the PSD's of defective nicked bearings and it was found that the nicked bearings could be distinguished as having exceeded baseline limits. The frequencies at which this trigger occurred were not the associated bearing frequencies calculated for the ball pass outer frequencies. The energy associated with the rollers rotating over the nicked portion of the raceway excites frequencies with sufficient energy to transpose into the machine running frequency range as well natural frequencies of the bearing components. Different severity nicks were detectable as well as roller-spaced and non-roller-spaced nicks. The nicks with high spots excited the most energy. Tests were performed to show that a cone (inner ring) nick was also detectable by exceeding the baseline limit. Testing performed showed that the limits were also applicable when the accelerometer was mounted on a machine component and not directly on the cup. Recommendations include the implementation of the testing on the production line to increase the sample size of acceptable bearings for the baseline definition. The data analysis method can be fully automated to compare measured results to set limits in a reasonable time frame to not compromise production output. Nicks are detectable as long as a whole spectrum of frequencies is considered in the baseline limits and detection is not reliant on one defined frequency.