1016. The comparison of diagnostic features between the vertical and horizontal axis rotors

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Abstract. The development of modern rotating machines requires design of effective defect diagnostics methods for evaluation of technical conditions not only for the entire rotating system, but for each damaged element, e.g. journal and antifriction bearings, couplings, gears, etc. Optimization of rotating system goes through theoretical modeling based on FEM, bond graph theory, prototyping and experimental vibration testing rotating kits in labs and machines in situ. Nodal defects must be observed in early stage of their development. This article presents faults diagnostic for the vertically and horizontally oriented rotor rolling bearings. Studies were carried out at the original research setup. The research stand is composed of a rotor with a disc with the excitation mass fixed on it, rotor, driven by asynchronous AC motor controlled by frequency inverter. Rotor mounted in supports using single row deep groove ball bearings SKF 6004 – 2Z, class C3. During the research, the second non defected rolling bearing was replaced with rolling bearing with inner and outer ring race defects. Experiments were performed by changing the rotor axis of rotation from vertical to horizontal. Experiments were carried out with permissible imbalance (according to ISO 1940-1) and with more than 2 times higher than permissible, assessing the level of allowable imbalance magnitude, according to standard G6.3 class for rotary systems with flywheel impeller. Measurements of mechanical vibration acceleration are taken with 4 acceleration transducers, mounted on each of the supports. This article is focused on analyzing the second support y direction (gravity direction) transducer data: velocity spectrums, waterfall plots and cascades. Analysis of horizontally and vertically oriented rotor dynamics, characteristics of diagnostics and statistical analysis of measurement data was performed. New statistical parameter, "Defect visibility ratio (DVR)" was presented. This parameter helps in quantifiably assessing the influence of excitation characteristics of differently oriented rotors to dynamics diagnostics. The statements listed in conclusions are formulated according to results obtained during experiments only.

Keywords: diagnostics, vertical/horizontal axis rotors, dynamics, deep groove ball bearing, vibration.

1. Introduction

Rotating machinery with horizontal rotor axis is more widespread in the industry. For this reason, most of the scientific articles focus on the monitoring of the horizontal rotation axis machinery condition and fault diagnostics through vibration measurements. There is less data on vibration monitoring and fault diagnostics available in research materials, as vertical rotation axis machines are used relatively less frequently in industry. Comparing mechanisms with horizontal rotating axis, to ones with vertical rotation axis, the greatest difference in design is in their radial and axial bearing supports. Some scientists carried out rotor system researches with deep groove ball bearing diagnostics. The studies focused on a new way of vibration data statistical spectrum and cascade processing methods [1, 2]. Many papers studied different defects of deep groove ball bearings using analytical models and FEM [3, 4]. Valuable data is given on the fault development of rolling element bearings and their diagnostics [5, 6]. Flexible vertical rotor modeling and failure diagnostics with experimental testing in situ is presented in [7]. This data suggests more efficient ways in providing condition monitoring and prediction of unexpected failures in rotor systems