Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 152 (2016) 516 – 520

Procedia Engineering

www.elsevier.com/locate/procedia

International Conference on Oil and Gas Engineering, OGE-2016

Search technique of optimal operation procedures for rolling bearings for diagnostics purposes

Kostyukov V.N.[a], Kazarin D.V.[a], Basakin V.V.[a]*

[a]*Dynamics SPC, 108/1 Rabinovicha st., Omsk 644007, Russian Federation*

Abstract

The purpose of this work is to develop the search technique of optimal operation procedures for rolling bearings during their condition diagnostics. From the perspective of completing the task for a condition assessment the operation procedure providing minimum diagnostic errors (machinery condition identification error) is considered optimal. The regularities obtained by the developed technique were tried and tested and taken as the basis of the diagnostic technique. Such technique is implemented in modern means, particularly in bench systems of rolling bearings diagnostic.

Peer-review under responsibility of the Omsk State Technical University

Keywords: Rolling bearing, optimal operation procedures, diagnostics

1. Introduction

Rolling bearings are the most popular and important components of the modern machine industry. Performance reliability depends not only on the rolling bearings condition but on technology-related safety of the process in which machinery are involved [1].

The most effective technique which allows determining incipient and developed defects of rolling bearings is vibration acoustic technique of non-destructive testing [2].

The rolling bearings operation is related to the change of rotating frequency in a wide range, axial and radial loads. In order to assess the machinery condition with the vibration acoustic technique properly, it is required to determine optimal operation procedure of rolling bearings during diagnostics (rotating frequency, axial and radial

* Corresponding author. Tel.: +7(3812)254244; fax: +7(3812)254372.
E-mail address: post@dynamics.ru

Peer-review under responsibility of the Omsk State Technical University
doi:10.1016/j.proeng.2016.07.644

loads). The operation procedures may be different for the various types of bearings. It should be considered that the variation of specified parameters may be possible only in a narrow range, since the operation procedure of the bearings during the observation may be limited by the company's damage prevention conditions. The purpose of this work is to develop the search technique of optimal operations procedures of rolling bearings to assess the condition during the diagnostic.

To achieve the purposes of work, the following tasks should be completed:

-to develop the observation technique that allows determining the impact of axial and radial loads on the vibration parameters levels of rolling bearings;

-to determine a criterion of the operation procedure of the bearings during diagnostics.

2. Methods and study subject

According to the machinery condition assessment task, minimum diagnostic errors (machinery condition identification error) are considered optimal. In this case the bearing condition is a quality factor, while the operations procedures parameters are the quantitative factor.

Using the experimental design theory techniques allows completing the task of optimal operation procedure search [3, 4]. Diagnostic errors or single-valued monotone function are the parameters of the operation optimization.

Given that the rolling bearings condition is a quality factor and it cannot have fractional values it is advisable to assess the regression models empirically. The regression models determine the dependence of diagnostic features on parameters of bearings diagnostic procedure in operational or failure condition [5].

The subject of the research - a rolling bearing - is given schematically on Fig. 1.

The arrows on the left X_1, X_2, X_3 are the ways (or factors) of having an impact on the bearing:

- X_1 is the variety of rotating frequencies, min^{-1};
- X_2 is the impact of axial load, H;
- X_3 is the impact of radial load, H.

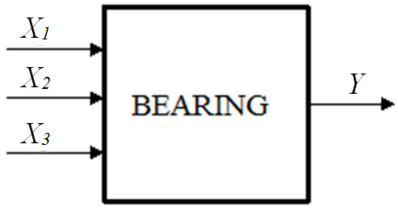

Fig. 1 The research subject scheme.

The arrow on the right is a quantitative factor reflecting the vibration parameters response to the impact:

$$Y = f(X_1, X_2, X_3) \qquad (1)$$

The functionality measure is a change of vibration parameters level, for example, the total level of vibration acceleration.

It is required to give the factor levels on the initial stage. The impact of the factors is under the research. The factor levels are the limits for the field of the research for the particular technological parameter. On the basis of the limits of the observation subject, the center of the plan (as shown on the Fig.2 flow-chart) and variation pitch are specified by the formula:

$$\Delta X_i = \frac{X_i^{max} - X_i^{min}}{2}, \qquad (2)$$