Brüel & Kjær Vibro

Application Note

Case study – Diagnosing rolling-element bearing damage in a hospital air-conditioner fan

Brüel & Kjær Vibro

Application Note

Case study – Diagnosing rolling-element bearing damage in a hospital air-conditioner fan

ABSTRACT

When a hospital machine maintenance customer requested a demonstration of the Brüel & Kjær Vibro portable vibration analysing instrument, itwas used to carry out measurements and to analyse and diagnose a faulty rolling-element bearing in an air-feed fan of an air-conditioning system.

Figure 1. Drive-end (left) and non-drive end (right) of the air-conditioner fan showing the reference sensor setup.

Introduction

After mounting the vibration sensors at the two bearings of the fan and setting up the reference sensor to provide a speed reference and phase signal, the Overall vibration and BCU values were measured and recorded as the first step in the vibration investigation. The table below shows the results of these preliminary measurements where there had been a sharp increase in the BCU value at the DE bearing.

Machine: ZK Ventilator Date: 14.03.2013		
Channel	**Overall**	**BCU**
DE bearing	4.5 mm/s	1.6
NDE bearing	3.8 mm/s	0.2
Speed	1,874 rpm	
Rolling-element	2.157	67.3
Rolling-element 2nd harmonic	4.135	134.7

Table 1. Bearing monitoring results.

To determine the cause of the high BCU value at the DE bearing a Constant Percentage Bandwidth (CPB) spectrum was taken at this bearing. A CPB-spectrum was used instead of a standard FFT-spectrum to avoid that any short-term speed changes in the fan would cause variations in the spectrum as they would in the case of an FFT-spectrum. The Figure 2 below shows the clear evidence of vibrations from the motor, fan impeller and belt.

However there was no indication of any source of vibrations that would cause a high BCU value.

This is to be expected since a CPB-spectrum is very suitable for fast fault detection but not for detailed signal analysis where an

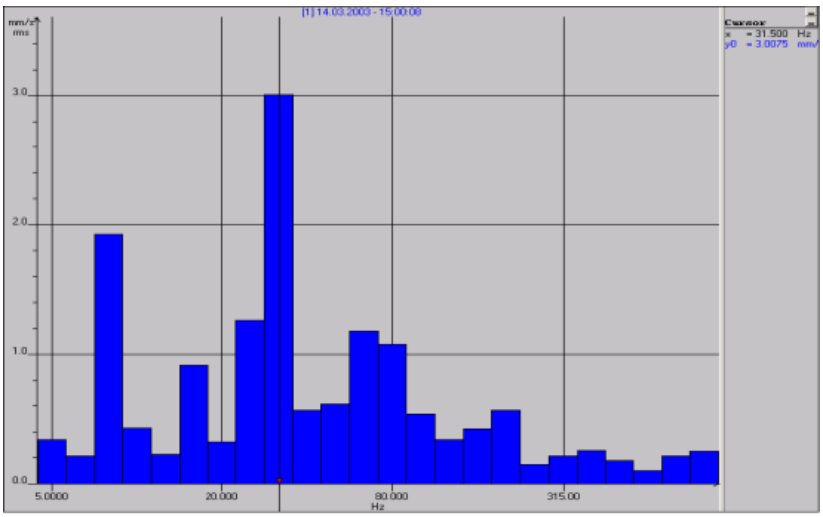

Figure 2. CPB-spectrum taken at the DE bearing.

FFT or envelope analysis spectrum is better.

Before proceeding further with the analysis, the rolling-element bearing type for the DE of the fan was determined and the frequency factors for possible bearing damage were searched in a bearing database programme.

Figure 3 below shows the bearing database menu with the SKF bearing type 2311 - which is installed at the DE side of the fan - and the main bearing damage frequency factors highlighted.

This bearing database operating in the software programme assigns a specific bearing to the measurement point and is able to display the calculated symptom frequencies on the envelope spectrum to simplify diagnosis of rolling-element bearing faults. The frequency factors taken from the menu, when multiplied by the machine speed, give the actual symptom frequencies created by the damaged components in the bearing (as shown in Table 1).

A comparison of the BCS-spectrum measurement taken at the NDE bearing showed the clear difference between the two bearings. As a result the 2311 bearing at the DE side was replaced after which the BCU value was once again measured at approximately the same level as the NDE side bearing.

This demonstrates that an increase in the measured BCU value is a reliable early identifier of a fault in a rolling-element bearing and that an envelope analysis spectrum such as BCS, which is conceived especially for analysing impulse-type vibrations from rolling-element bearings, efficiently identifies vibrations arising from damaged bearing components.

The powerful and user-friendly measurement functions of the portable instrument and xms predictive maintenance software can quickly simplify the formerly complex task of analysing and diagnosing faulty rolling-element bearings.

Machine speed 1.874 U/min (31,23 Hz)		
Component	**Frequency factor**	**Symptom frequency (Hz)**
Cage	7,28	227,4
Inner race	7,28	227,4
Outer race	4,72	147,4
Rolling-element	2,16	67,5

Table 2. Bearing fault frequencies.

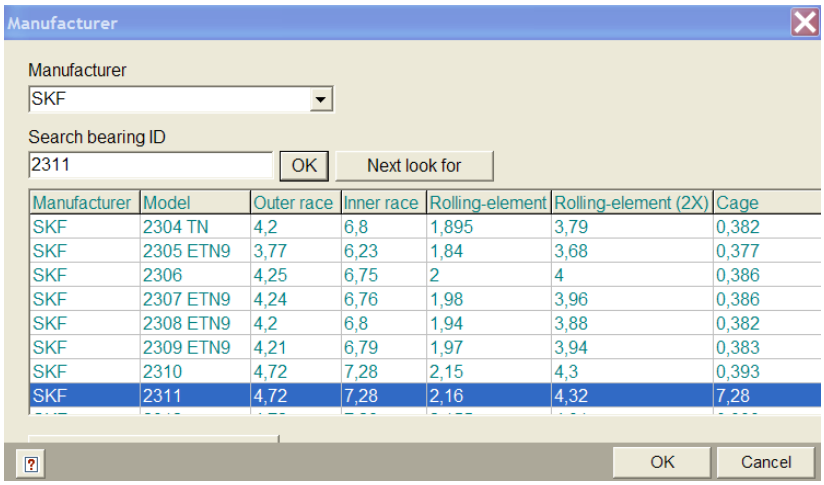

Figure 3. The xms bearing database with bearing symptom frequency factors and the calculated bearing damage frequencies.

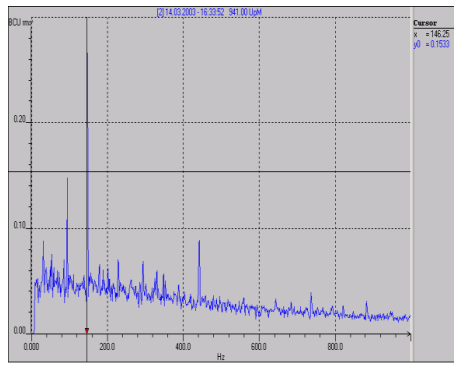

Figure 4. Bearcon signature envelope spectrum showing the clearly identifiable frequencies that coincided with the frequencies calculated from the frequency factors in the bearing database.

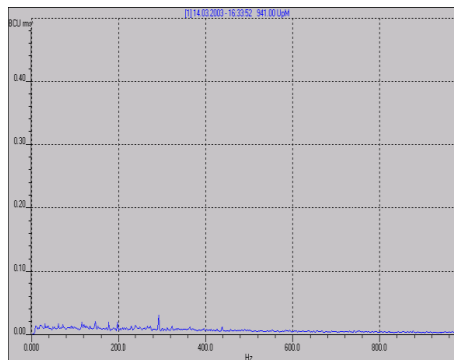

Figure 5. Bearcon signature envelope spectrum from the NDE bearing.

Brüel & Kjær Vibro GmbH
Leydheckerstrasse 10
64293 Darmstadt - Germany
Phone: +49 (0) 6151 428 11 00
Fax: +49 (0) 6151 428 12 00
info@bkvibro.com
www.bkvibro.com

BAN 0038-EN-12
Date: 08-06-2015