VIBRATION ANALYSIS OF RESOURCES IN MOBILE TECHNICS

ВИБРОДИЯГНОСТИКА АВТОМОБИЛЬНОЙ ТЕХНИКИ

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Abstract: *Paper is treat about resources of vibration in mobile technics. Vibration analysis is one of the basic assumptions of operational reliability, safety and economy of operation of automobiles. In this paper I would assign to diferences between civil vehicles (Skoda Fabia) and heavy military vehicles such as AFV. This vibration measurements were made on diferent weight levels. The aim was to locate a fails.*

KEYWORDS*: VIBRATIONS*

1. *Introduction*

Oscillations (vibrations and pulsations) are very sensitive indicators of technical condition, stress and funkcionality of a machine. This problem is related mostly to shafts, crankshafts, cam mechanisms imbalanced rotating parts and mainly bearings. These vibration can be used for complete diagnosing of technical condition of a machine, in our case a specific engine.

For this purpose, two basic vibration methods are used most commonly:

- Measurement of total vibration level
- Frequency analyses

In the frequency analysis, complicated technical equipment is used for obtaining characteristic frequency spectrum of vibrations. The main principle is to measure the engine in a perfect technical condition at first and later, after the specified time period, this measurement is performed periodically, which means that without disassembly we can diagnose the technical condition of a particular engine as the individual parts wear out during the period of running and, as a result, the characteristic frequency spectrum changes as well.

The time flow of vibrations, which we will obtain, should be transformed into the frequency area, which means replacement of vibration with its frequency elements. This operation is called the frequency analysis, which uses either the spectrum of band gates or, as in our case, the fast Fourier transformation (FFT).
The operating diagnostic of the technical condition of an engine on the basis of vibrations can be divided into:

- The method using spectra with constant relative width of bands(CPB)
- The method using the FFT

1. Measurement of potency of engine vibrations

It is about determination of an effective value of oscillation speed in range from 1Hz to 1600 Hz with the subsequent comparison to norms or limit values specified by a producer.

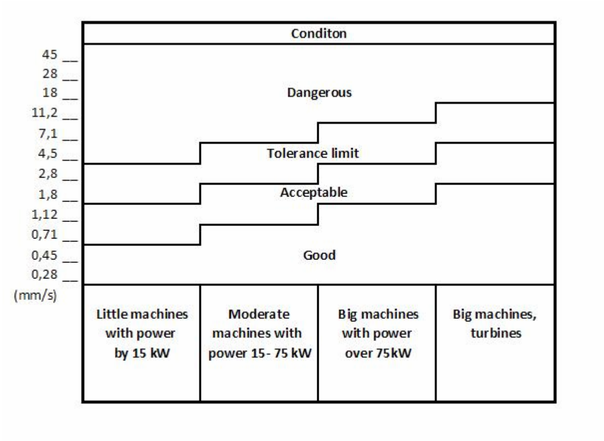

Fig. 1 Values of velocity oscillations

It is a simple, quick and cheap method. However, it provides only evidence about the engine's condition (faulty or not). This method does not provide an exact fault localization and therefore it is necessary to assign individual parts of the engine (Figure 2) to particular dominant frequencies, which is in some cases very difficult.

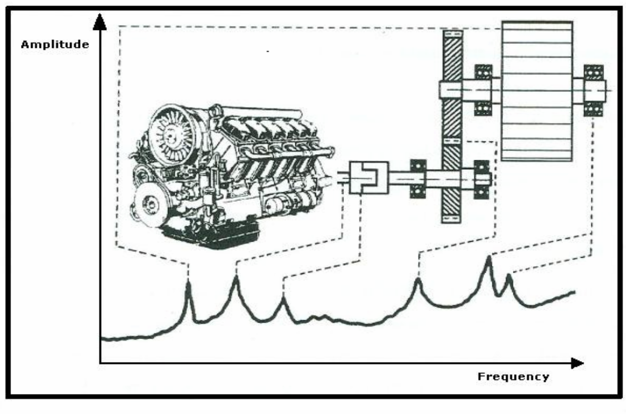

Fig. 2 Assign individual parts of the engine

The spectral analysis of vibrations enables detection of the following faults, even without disassembly:

- shaft eccentricity
- non-axiality of shafts
- shafts bend
- imbalance of rotating parts
- condition of gearing

Next, I would like to refer to different levels of allowed oscillations in regard to engine power (Figure 1). Our measurement was conducted in two different power areas - the volume-produced automobile Skoda Fabia 1.4 and the prototype of a hybrid engine from AFV. As we expected, the consequential accelerations were very different because of different power as well as application of the particular engines.

2. Analysis of Vibration Resources

2.1 Measurements on Skoda Fabia 1.4

The measurements took place in three different places, concretely on the console, cylinder head and engine cover. I am listing only the results of the console measurements because all frequency spectrums were very similar. When making graphs, I also included the limits of the total condition of the measured object in accordance to Figure 1. We conducted measurements at idle speed (Figure 7), at 1,700 rpm (Figure 8), then at 2,550 rpm (Figure 9) and at operational 3,100 revolutions per minute (Figure 10) without any load.

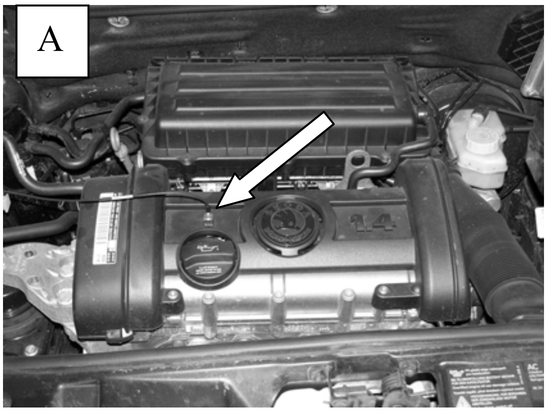

Fig. 3 Skoda FabiaCombi 1.4 / 16 V (location of the senzor „A“)

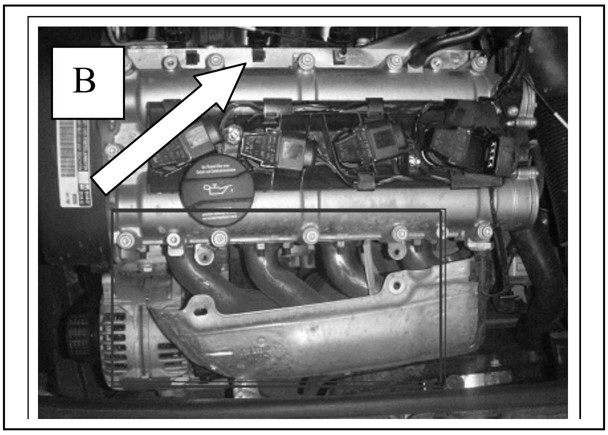

Fig. 4 Skoda FabiaCombi 1.4 / 16 V (location of the senzor „B“)

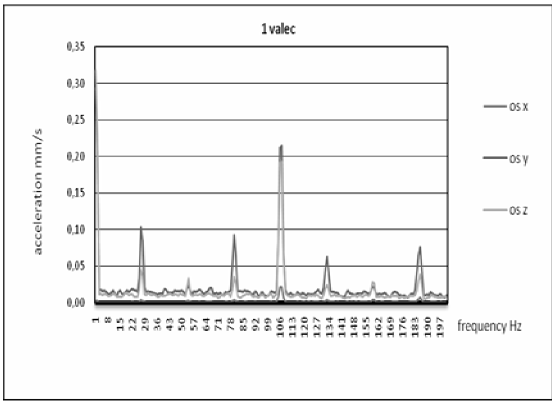

Fig. 5 Skoda FabiaCombi 1.4 / 16 V (results of the vibration analyzis 1. cylinder)

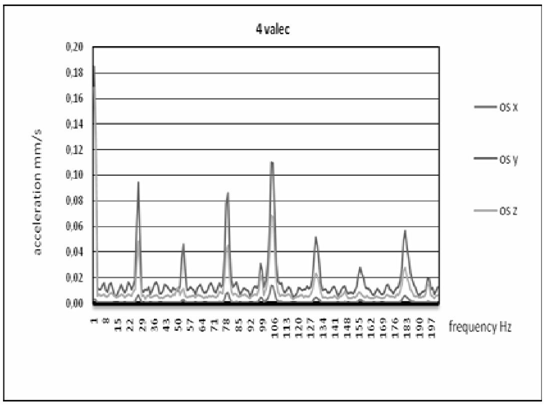

Fig. 6 Skoda FabiaCombi 1.4 / 16 V (results of the vibration analyzis 4. cylinder)

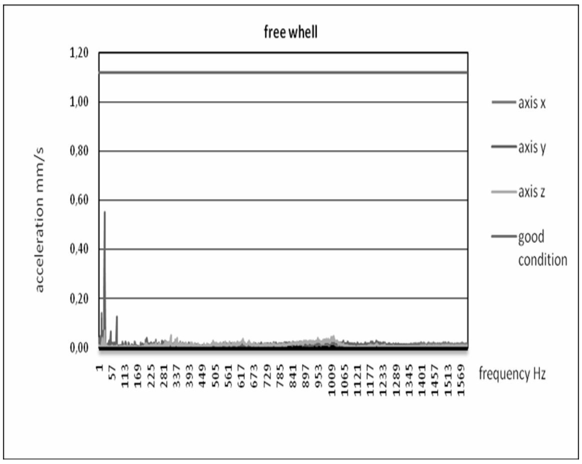

Fig. 7 Conducted measurements at idle speed at 600 rpm

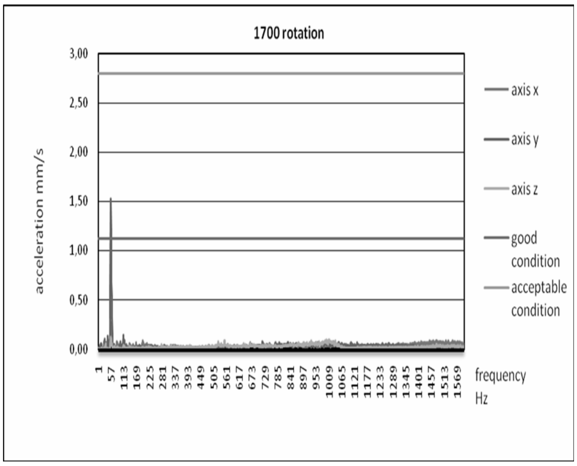

Fig. 8 Conducted measurements at idle speed at 1,700 rpm

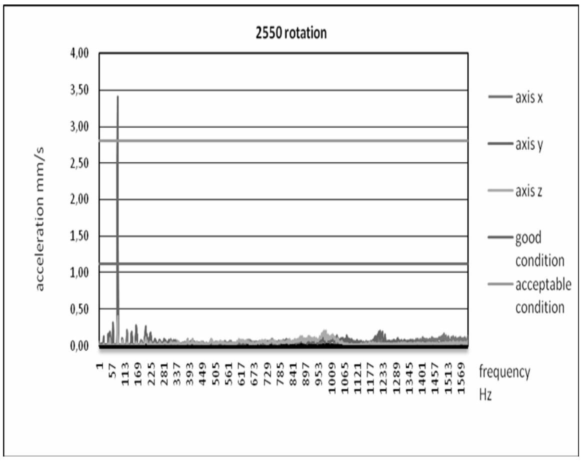

Fig 9 Conducted measurements at idle speed at 2,550 rpm

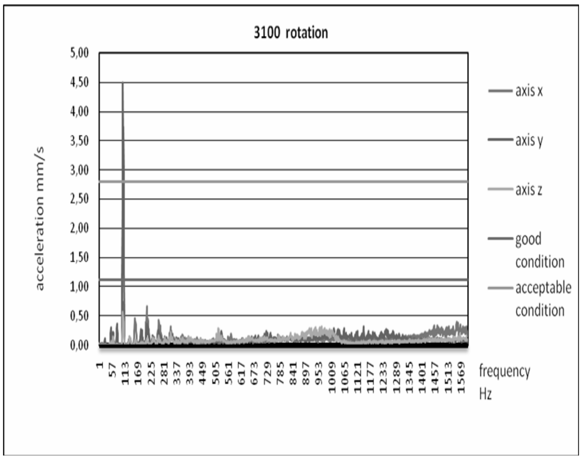

Fig. 10 Conducted measurements at idle speed at 3,100 rpm

2.1.1 Partial Summary

These results show that the total condition of the vehicle is good. One frequency is very high at 3,100 revolutions per minute. Our task is to detect which part vibrates at this frequency and at these revolutions. This task may be solved thanks to experience which we, however, lack because of a short time we have been dealing with this issue. The only possible solution we can consider is to conduct plenty of measurements directed at a particular frequency in different parts of the engine; in this way, we can detect some faults.

2.1.2 Partial summary after locations measurements

Directed measurement witch were made in range from 0 Hz to 200 Hz indicated that the real foult is localated in the zone around the third engine cylinder

3.Summary

It is important to remember that both measurements were specific in some aspects. During the first measurement the vehicle was at standstill (stationary test), so there was no real engine load. On the contrary, the hybrid engine was placed on a testing stand with a brake, so there was a real load. However, we cannot say how this engine will react after it is placed into a vehicle bed and connected to other functional parts. In the future I would like to continue the work I began on the vehicle Skoda Fabia; I am planning to carry on measurements of more vehicles of this series and achieve periodicity of measurements. Measurements during the real operation, measurements on an artificial test site and simulation of operational conditions are also challenging.

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4 Used literature

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