

Measuring equipment and software products in vibrodiagnostics

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Abstract. Master data are expounded on the nature of vibration of electric machines and possibility of exposure of their defects with application of vibrodiagnostic methods.

Key words: vibration, vibrocontrol, vibrometer, vibro-analyzer, diagnostic information, monitoring.

INTRODUCTION

At present the device providing is one of the most current problems of vibrodiagnostic which needs an urgent decision.

As known, a vibration and noise is natural processes in machines and equipment, and they are under the action of the dynamic efforts of investigation on their wear and various defects. Indisputably, vibration shows by itself an informing and effective diagnostic parameter, as swaying forces arise up directly in the place of defect, and a machine is “transparent” for a vibration[3, 5]. An important circumstance here is that vibrodiagnostic can be conducted directly in place, without sorting out and stopping of the equipment.

It should be noted that diagnostics following a vibration allows to find out the various defects of electric machines - disbalance, malalignment and out-of-parallelism of billows, loss of inflexibility and weakening of supports, precipice of wall screws, violation of geometry of line of vala and different defects of bearings knots, including problems with grease.

On the basis of the obtained information it is possible to optimize te planning of permanent and capital repair, increase the TBO period, cut down expenses on the purchase of repair parts and expense materials. Vibrodiagnostics can be valid for one occasion or periodic monitoring or deep survey.

Measurement of intensity of vibration after the standards of ISO can be executed by the row of portable diagnostic devices, and also with the use of the stationary

diagnostic systems together with the spectrology of vibration, measurement of shock impulses, by the spectrology of shock impulses and other measuring functions.

The state of equipment is diagnosed on the basis of the widely bar measurements of vibration with the delivery of middle quadratic values of parameters. The measurements are conducted in three directions: horizontal, vertical, axial. The best result is obtained reliant on the state of the diagnostic equipment.

After measuring, the intensity of vibration by ISO takes forms of presentation equipment in the color code system for traffic light “green, yellow, red” along with the issue of numerical measurement results.

Presupposition troubleshooting for machine vibration parameters is that vibration of the working machine may convey variable information on its condition. To use the program of vibrocontrol maintenance is essential that this information is properly taken from vibration signal.

Machinery vibration analyses (vibration spectrum analyzers) are divided into four main groups:

Single-channel or two-channel devices for vibration control, analysis of the shape and spectral content of signals, including vibrations, sustainable modes of equipment;

Single-channel or two-channel devices for vibration control, monitoring and diagnostics (including software) machinery and equipment with extended frequency and dynamic range, and wider range of algorithms signal analysis;

Multichannel devices or devices with high-speed switch channels, for parallel measurement and analysis of vibration machines in transient conditions of work, in particular, approach-stopway.

Cross-parallel devices for continuous recording of vibration and other processes with further detailed analysis of the recorded signals.

Development of basic principles and technical diagnostics of mechanical systems for the vibroacoustic characteristics accounted for the second half of the twentieth century. The principles were closely vibrational spectrum analyzer implementation vibration. Now the analyzer is the storage media of self-powered and low weight, wide range of problems solved vibrometrical, that can exchange information with computer systems “deep” analysis using expert systems.

Analysis functionality of vibroanalyzer was the subject of the work of several Russian experts and scientists - DV Sokolova (for “Promservis”); AV Barkow, NA Barkow and PP Jakobson (for “CCA”); VA Rusova (“Select Center”), firm representing developers of vibrodiagnostics systems, including spectrum analyzers vibration.

Vibration analyzer must meet the following requirements:

- versatility and multiple registration options;
- ease of use and portability;
- the ability to collect data - measuring results;
- informative indicator screen;
- expert program of informational character (embedded and external).

The basis of measurement and analysis of vibration signals are three types of devices that perform different operations:

- vibration sensor that converts vibrations to electrical signal;
- filter that selects the signal components in the required frequency domain;
- detector to measure the amplitude (power) of the selected component.

The filter can be designed as an electronic device, may be acoustic, for example - the resonator, or mechanical, for example - an intermediate plate, established between the sensor and the object of measurement.

Other devices include various combinations of these types depending on which information technology they use. The most crucial element of the collection of data is sensor vibration, which turns mechanical vibrations into an electrical signal. For many years different sensors of different types were successfully used. The most reliable among them today is the accelerometer, which also provides high accuracy of transformation. The most common type is the accelerometer with integrated charge amplifier, to which power comes from data assembler (or analyzer) on the same wire as the measured signal.

The most frequently used means of measurement are those realized on the basis of computer technology: analyzers forms, spectral analyzers and envelope spectrum analyzers, whose structure is shown in Figure 1. Features of waveform analyzer vibration and noise (Fig. 1, a) consist in measuring amplitudes and phases of individual signal components and comparative analysis of forming separate areas signal at the beginning and end, determined by the angle of rotation of the shaft. Such analyzers are widely used for diagnosing machinery of reciprocating-type and the rotors in the process of balancing. Spectrum

analyzer (Fig. 1, b) using the same type of items can reduce vibration signal processing. Introduction to this scheme of the spectrum envelope detector enables to detect damage of rolling bearings and mechanical elements in the early stages (Fig. 1, c).

Analyzers are issued that implement the features of personal computers (Fig. 1 d). Such measurement and analysis of the signals do not differ in sizes and are used in the laboratory or bench conditions. Development of construction vibration analyzer is inextricably linked with the development of computer technology and

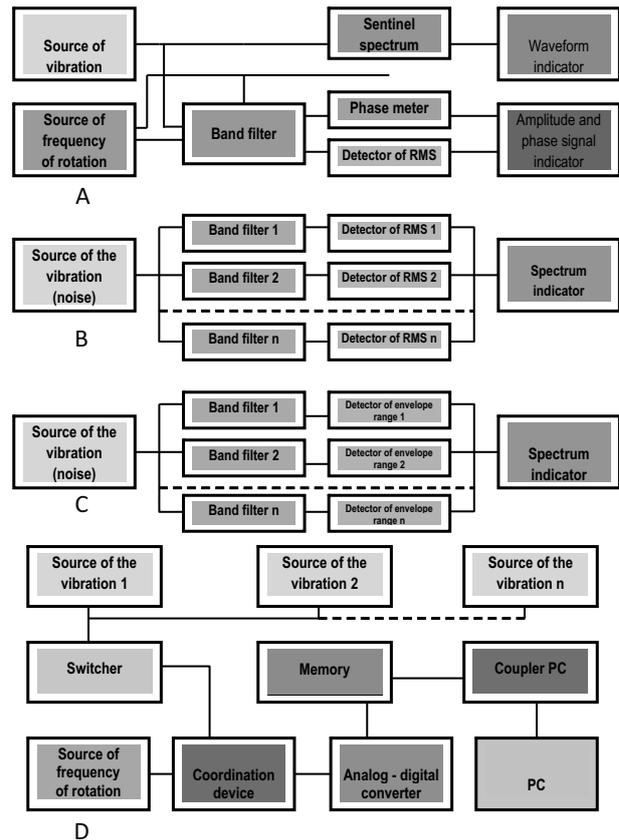


Fig. 1. Structural schemes of analyzers used in vibrodiagnostics: A - a waveform of vibration and noise, B - spectrum signals of vibration and noise; C - the range of the spectrum envelope detector vibration; D - range of analog - digital converter (ADC) and a personal computer(PC)

it focuses primarily on reducing the size, increasing memory capacity and the functions performed.

Vibration Spectrum Analyzers have the following possibilities:

- to analyze the temporal characteristics of signals and signal analysis time sweep (oscilloscope mode),
- spectral analysis of vibration - a division of vibration frequency components in a wide frequency range with a choice of frequency bands,
- spectral analysis of envelope of high frequency vibration signals with the possibility of restructuring the medium frequency band filter and limits the choice of different frequency range,
- provide sufficient resolution to 1600 lines / spectrum,

- provide the average values for the spectral characteristics,
- evaluation of vibration emission signal - definition of peak-factor,
- determine the overall level of vibration in the band are set in vibration control standards,
- perform measurements on the route,
- are able to transfer the accumulated measurements to a computer for further processing.

Additional features that must characterize the devices are self-balancing rotor bearings, availability of graphic LCD display, measurements downloadable by the route from your computer.

Portable vibrometer 795M-107V is designed to measure parameters (vibroacceleration, vibrospeeds and vibromoving) of working equipment in the frequency range from 2Hz to 10KHz and spectral analysis of vibration signals.

The device has a USB interface to connect to a PC.

Vibration Analyzer PROTON-EXPERT is a portable vibromeasuring complex with the function of dynamic balancing, implemented on the latest generation micro-processors, which can deal with many tasks of modern vibrocontrol and vibrodiagnostics.

The device has two built-in amplifiers for sensors such as ICP ® and charge sensors. Moreover it is possible to connect any other external sensors via adapters (up to 1000 channels). Availability of all necessary research functions (envelope spectrum, the general level, the peak - a factor amplitude / phase, range, acceleration / ran, etc.) extended frequency range device (0,1-25 600) Hz, integrated program of balancing, design reliability and high precision metrological characteristics make the spectrum analyzer indispensable tool of modern specialist vibrodiagnostics, repair and adjusting.

The device has a large low-temperature liquid crystal display with high resolution and backlighting.

Multi-channel simultaneous vibration signal analyzer and recorder (vibroanalyzer) Atlant-8 is a modern device designed for solving the most difficult tasks in fault diagnosis of equipment. The basis vibroanalyzer is a laptop that combines the functions of registration signal processing, storage. Function of the vibration signal processing, filtering and synchronous digital conversion are implemented in an external unit. Connected to this unit Vibration probe and index phase are used in balancing. Application of computer for signal processing removes almost all the limitations of conventional portable equipment vibrocontrol - small number of input channels, low speed, limited memory. The possibility of continuous registration of signals for tens of seconds or minutes can be used for such devices for registration of transients in the equipment as vibration control mechanisms are slow processes.

Stationary control system «VDR-8 includes a base unit and a set of sensors. The device “VDR-8” (Vibro Data Recorder) belongs to a class of modern electronic recorder-vibration signal analyzers, which additionally includes the functions of the expert fault diagno-

sis of machinery and equipment. The main purpose of “VDR-8” is the organization of patient monitoring parameters and diagnostics maintenance of pumps, fans, compressors.

The device solves the complex problem of monitoring equipment, as it will record vibrations, temperature and process parameters. Following treatment of primary information “VDR-8 can include anxious and alarm system, diagnose defects in equipment, developing, plan dates for the repair.

The presence of embedded device channel temperature control and process parameters allows parametric perform diagnostics of equipment. This expert system in diagnosing has new properties such as possibility of operational control of the flow of the pump unit efficiency rating, the organization’s work with a minimum energy consumption.

Software “Atlant “ is a program for diagnosing technical condition.

The software includes the following components:

- “Atlant” - a database of equipment, including technological and organizational hierarchy equipment at the enterprise, passports for diagnostic equipment, a database of all completed vibromeasure. This is the main piece of software that allows various types of diagnostic tests based on the same vibromeasure. User performs measure vibration on the equipment, so that you can perform any type of diagnostic calculations without additional measurements;

- Pallada+ - closed automated expert system development firm Vibro Center is designed to vibrodiagnostics condition of the equipment for the spectra of vibration signal. The system can diagnose dozens of different defects. The unique capabilities of this system include the possibility of removing heat from center in the complex equipment.

Program “Aurora” – is a combination of a database on equipment with unique properties for the expert system that provides: assessment of the current state of the unit - the general condition of the equipment is estimated by the measured vibration level as «good», «satisfactory» and «unsatisfactory». The program answers the basic questions that should solve the system of service facilities: Can you operate this machine? If possible, what is its remaining life? Why the vibration unit? When do you need to plan and carry out repairs that need to prepare for it?

Determination of defect – one needs to practice enough to know that vibration has increased. In most cases you need to know the cause of the vibration. Only this allows to plan renovation work at the right time to service. The program has a built-in expert system for searching for the cause of increased vibration measurements based on the general level vibrospeeds. Based on a minimum of information it allows sufficient reliability to diagnose 15 types of faults, including: a center indicating the plane of shear, bending rolls, no balances, axial shifts, wear of bearings, weakening their attachment, defects of the belt gear and others.

CONCLUSIONS

Proper instrumentation providing measurements of vibration is the key to obtaining accurate diagnostic information in determining the technical condition of machines and aggregates.

While choosing appropriate measurement instrument, one should first consider the tasks that are supposed to be decided by vibroacoustic diagnostics.

In problem solving and monitoring of process equipment, including submersible electropump units, multifunctional vibration analyzers must be used adapted to the work with computers, to the archiving of measurements and their operational processes.

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