

DESCRIPTION FOR THE GENERAL PUBLIC

The ever increasing requirements of customers and fierce global competition require devices and machinery manufacturers to continually develop products placed on the market. The main directions of development are to increase utility parameters of the products, reduce energy consumption and decrease dimensions of new structures. In order to achieve higher power and efficiency levels for smaller overall sizes of machines it is necessary to apply rotors operating at higher rotational speeds. It also requires the use of new unconventional bearing systems based on high-speed rotors that have to cope with adverse operating conditions.

Foil bearings are a relatively new solution, and they are hardly used in bearing systems found on the market today. The working principle of such bearings consists in applying additional elastic-damping elements, which considerably improve the performance of some of the essential characteristics of the bearing. Such elements are usually made of thin metal sheets with thicknesses around 0.1 mm and are called foils. The properly profiled foils with their surfaces coated with anti-friction material are installed between the journal and the bearing bush. During normal operation of foil bearings, these additional elements act as an auxiliary vibration damper and the suitably prepared sliding surfaces prevent rapid wear. These are the so-called self-acting bearings, which means that they do not require an additional lubrication system and the lubricating medium (e.g. air) may originate from the immediate vicinity of the bearing. The compliant elements installed between the journal and the bush allow active adaptation of the lubricating gap's geometry to actual operating conditions. Therefore, such bearings are also known as "bearings with variable geometry". The unique characteristics of these bearings make them extremely suitable for high rotational speed applications in which high reliability and efficiency of operation is required. Since foil bearings are self-lubricating, they are characterized by small overall dimensions, low power consumption and low manufacturing costs. Currently, these types of bearings are usually applied in gas turbines, small jet engines, compressors and turbo-expanders. The said machines are widely used in industries such as aviation or distributed power generation.

In view of a rather complex structure of foil bearings and the problems related to the huge difficulty of theoretically describing all physical phenomena occurring during operation, the development of a reliable numerical model of a foil bearing still represents a challenge. Therefore the creation of new foil bearings requires carrying out costly and time-consuming experimental research, which limits their further developments. Access to well-proven numerical models and, on the basis of them, creation of computer programs would allow for the dissemination of knowledge about this innovative bearing system, making further development of many technical devices and machines possible.

Within the framework of the project, research aimed at acquiring a more complete knowledge of dynamical processes taking place in high-speed foil bearings will be conducted. In particular, the research will be focused on the processes related to vibration damping in such bearings. The studies up to date have found that the actual anti-vibration properties of some bearings of this type turn out to be much better as indicated by preliminary computations and design assumptions. This is a very interesting observation – from the perspective of system's dynamical properties – and a clarification of the outcome of these studies would enable further development of numerical models applied for analysis of such systems. Under the project, the following actions have been planned: experimental research, works on new foil bearing models and computer simulations using newly developed models. The methods to be applied will be complementary, which will provide a better understanding of both structural and flow phenomena occurring in a mechanical system as complex as a high-speed self-acting bearing with variable geometry.