

Tribology-based condition monitoring and diagnostics for the safe operation of aircraft

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The work is devoted to predicting the state of the drive friction units of air units, as a tool for preventing unpredictable and costly violations, failures, plane crashes, and ensuring safety for the environment

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1. Introduction

In recent years, the approach to machine diagnostics has changed significantly. From simple condition monitoring, there has been a transition to active monitoring of the system, the use of corrective actions depending on diagnostic data. Friction units of machines and mechanisms are the most important systems for ensuring their performance.

2. The main part

The main goal of tribological diagnostics is to establish regularities that characterize the state of tribological systems in order to predict possible deviations in their operating modes and timely take the necessary measures to ensure trouble-free long-term operation with optimal characteristics. The requirement to improve the reliability of tribotechnics is closely related to the modern development of mechanical engineering and the tightening of working conditions in an increasingly wide range of temperatures, speeds and pressures.

Today, the urgent task is to prevent the failure of machinery, equipment and structures. As society becomes more and more high-tech, machines become more complex, and dealing with the consequences of failures, and sometimes disasters, becomes more expensive (plane crashes are one good example).

The technology for preventing destruction that leads to global pollution and poisoning of the environment is based on the development of more advanced and reliable structures and timely technical control using a specially developed diagnostic system.

One of the most important tasks of building an environmentally friendly diagnostic system is to find the parameters of the tribosystem that most accurately reflect the symptoms of wear.

3. Methods

For continuous diagnostics of tribological interfaces, a number of methods are used (table 1), based on the analysis of parameters of wear particles in oil, including the use of methods of ferrographic, computer morphological and atomic emission spectral analysis.

Table 1: A number of methods for analyzing the parameters of wear particles in oil used in the process of tribological diagnostics of aircraft drive units

Title	Designation
Standard Practice for Microscopic Characterization of Particles from In-Service Lubricants by Analytical Ferrography	ASTM D7690 - 11(2017)
Standard Test Method for Determination of Wear Metals and Contaminants in Used Lubricating Oils or Used Hydraulic Fluids by Rotating Disc Electrode Atomic Emission Spectrometry	ASTM D6595 - 17
Standard Test Method for Automatic Particle Counting and Particle Shape Classification of Oils Using a Direct Imaging Integrated Tester	ASTM D7596 - 14

4. Discussion

The abstract submission describes the ways of development and application of methods for tribodiagnostics of various friction units of aircraft developed at the Central Institute of aviation engine building named after P. I. Baranov in order to improve the safety of operation of Russian helicopters and aircraft [1, 2].

The main aspects of the ISO 14830-1 (2019) «Condition monitoring and diagnostics of machine systems - Tribology-based monitoring and diagnostics. Part 1: General requirements and guidelines», related to green tribology, in the development of which the Central Institute of aviation engine building named after P. I. Baranov took an active part, are also considered.

5. References

- [1] Shabalinskaya, L.A., Golovanov, V.V. et al., The study of the possibility of the tribodiagnostics of the technical condition of the helicopter main reduction gear, *J. Frict. Wear*, 2015, vol. 36, no. 1, pp. 96-101.
- [2] Shabalinskaya, L.A., Prodanov, E.S. et al., Tribodiagnostics of aviation reduction gears according to the stages of the surface fatigue wear for its units, *J. Frict. Wear*, 2017, vol. 38, no. 4, pp. 297-301.