

Ways to Prevent Increased Wear of the Drive Box Parts and the Central Drive of the Civil Aviation Turbo Engine Based on Tribology

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Abstract : The work is devoted to the rapid laboratory diagnosis of the condition of aircraft friction units, based on the application of the nondestructive testing method by analyzing the parameters of wear particles, or tribodiagnostics. The most important task of tribodiagnostics is to develop recommendations for the selection of more advanced designs, materials and lubricants based on data on wear processes for increasing the life and ensuring the safety of the operation of machines and mechanisms. The object of tribodiagnostics in this work are the tooth gears of the central drive and the gearboxes of the gas turbine engine of the civil aviation PS-90A type, in which rolling friction and sliding friction with slip occur. The main criterion for evaluating the technical state of lubricated friction units of a gas turbine engine is the intensity and rate of wear of the friction surfaces of the friction unit parts. When the engine is running, oil samples are taken and the state of the friction surfaces is evaluated according to the parameters of the wear particles contained in the oil sample, which carry important and detailed information about the wear processes in the engine transmission units. The parameters carrying this information include the concentration of wear particles and metals in the oil, the dispersion composition, the shape, the size ratio and the number of particles, the state of their surfaces, the presence in the oil of various mechanical impurities of non-metallic origin. Such a morphological analysis of wear particles has been introduced into the order of monitoring the status and diagnostics of various aircraft engines, including a gas turbine engine, since the type of wear characteristic of the central drive and the drive box is surface fatigue wear and the beginning of its development, accompanied by the formation of microcracks, leads to the formation of spherical, up to 10 μm in size, and in the aftermath of flocculent particles measuring 20-200 μm in size. Tribodiagnostics using the morphological analysis of wear particles includes the following techniques: ferrography, filtering, and computer analysis of the classification and counting of wear particles. Based on the analysis of several series of oil samples taken from the drive box of the engine during their operating time, a study was carried out of the processes of wear kinetics. Based on the results of the study and comparing the series of criteria for tribodiagnostics, wear state ratings and statistics of the results of morphological analysis, norms for the normal operating regime were developed. The study allowed to develop levels of wear state for friction surfaces of gearing and a 10-point rating system for estimating the likelihood of the occurrence of an increased wear mode and, accordingly, prevention of engine failures in flight.

Keywords : aviation, box of drives, morphological analysis, tribodiagnostics, tribology, ferrography, filtering, wear particle

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