Monitoring Turboshaft Engine Bearings

Identifying damage at low speeds

Stress Wave Analysis (SWAN™) is highly effective at identifying turboshaft engine bearings as documented by this test. A group of four turboshaft engine bearings (all the same engine model) was tested. Three engines had no defective bearings and one engine had a core bearing with on oversized inner ring. While not a typical bearing defect, this resulted in a negative internal clearance within the bearing and unusually high normal forces between the rolling elements and the races.

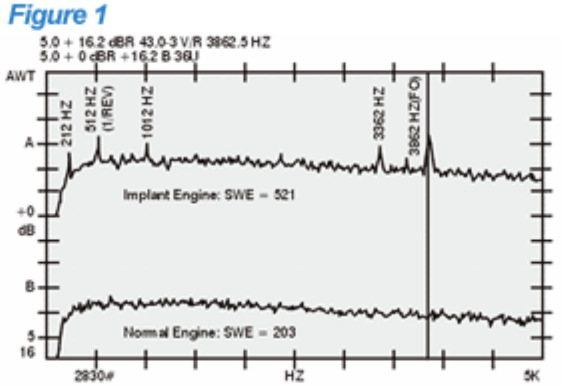
This effectively preloaded the bearing and caused abnormally high rolling friction that was measured as high Stress Wave Energy (SWE). Table 1 shows that for the four engines tested, the three normal engines had SWE readings of about 200. However, the bearing with the oversized inner ring read SWE - 521, more than 250 percent the normal amount of rolling friction. Furthermore, the narrow spread of SWE readings on the normal engines (SWE - 186 to 209) illustrates the degree of commonality of SWE readings from good bearings in different test environments - two on different aircraft engines and two on a test cell engine.

Table 1

Test Environment	SWE Reading	Remarks
On-Aircraft	186	Normal Bearings, No Spectral Data Available
On-Aircraft	209	Normal Bearings, Spectal Data showed no indication of any defects (no spectral lines)
Test Cell	203	Normal Bearings, Spectral Data showed no indication of any defects (no spectral lines)
Test Cell	521	Negative Internal Clearance in Mainshaft. Ball Bearing with split outer race. SWE is more than 2.6 times normal level ($\bar{M}$ = 199) Spectral lines more than 10 dB above background at outer race ball pass frequency (FO = 3862 HZ)

As noted in the 'Remarks' column of Table 1, the discrepant bearing's Stress Wave Pulse Train SWPT) also had distinctive spectral characteristics. This is due to the subject ball bearing having a split outer race.

Figure 1



Thus, the abnormally high internal forces within the bearing caused the balls to penetrate the lubricant boundary layer, and release a 'friction' pulse each time a ball passed over the race split line. A spectral comparison of the Stress Wave Pulse Trains from normal and discrepant bearings is shown in Figure 1.

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