

## **FILTER DEBRIS ANALYSIS BY ENERGY DISPERSIVE X-RAY FLUORESCENCE AS APPLIED TO US NAVY J52 ENGINES**

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The Joint Oil Analysis Program Technical Support Center (JOAP-TSC) has developed a technique to analyze the debris from in-line jet engine oil filters by energy dispersive x-ray fluorescence (FDA-EDXRF). Six beta prototype instruments were manufactured under a Productivity Reliability Availability and Maintainability (PRAM) project that are capable of performing FDA-EDXRF in an automated mode. US Navy J52 engines were suffering from what appeared to be sudden, catastrophic failures -- where the root cause of the failure began with the lack of lubrication in the 4 ½ bearing area followed by the fracturing of the 4 ½ bearing cage. Initially, analysis of oil samples by rotrode emission spectroscopy (RDE) did not indicate the failure mode. FDA-EDXRF was employed to establish EDXRF wear limits for the debris extracted from engine oil filters and diagnose the presence of abnormal bearing wear. Initially, J52 engine oil filter debris analyzed by FDA-EDXRF that did indicate abnormal amounts of bearing wear were present were also analyzed with scanning electron microscopy (SEM) by Pratt & Whitney Aerospace laboratory. The SEM results confirmed the presence of bearing wear. Subsequent teardowns of a portion of the engines removed and examined because FDA-EDXRF analysis indicated abnormal bearing wear was occurring, had fractured 4 1/2 bearing cages. This paper will outline how the JOAP-TSC FDA-EDXRF technology has kept the US Navy's J52 fleet flying.