Chapter 8
Component Failure Analysis of J69-T-25A Engine

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ABSTRACT

Reliability and serviceability of jet engines in the aviation industry is of paramount importance and is directly related to flight safety. Tight maintenance programs, including scheduled and preventive inspection are in place worldwide for jet engines to ensure air worthiness of aircraft. Old age provides maintenance maturity to the system, but on other hand, it requires focused efforts to ensure reliability due to aging factor. J69-T-25A falls in the same category, as it has been in service for the last six decades. Despite all maintenance efforts, a variety of defects are being faced on J69 engines. The major defects include RPM fluctuation, noise, oil gain, vibration, and smoke. The troubleshooting process identifies a number of components that cause these problems. this chapter is based on statistical analyses of component failure in terms of frequency and fault isolation. The top ten components were selected based upon failure rates and were compared against reported problems to establish a relationship between defects and failed components. Based upon the result, various remedial measures are suggested to reduce defects in the future and increase engine reliability.

INTRODUCTION

J69-T-25A engine was designed by Continental Aviation Engineering (CAE). This is a robust designed jet engine which has been in service for more than six decades. The engine has been utilized on many air vehicles, but most prominent and famous installation is on T-37 aircraft. The aircraft has been in service with numerous Air Forces around the world to meet the basic flying training needs. The aircraft has been called "Tweety Bird" because of engine sound.

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The engine has served to its best performance during its six decades of service. Noise is the known weak area for this engine, which requires extra efforts to overcome. RPM fluctuation and vibration are also the known weak areas. Maintenance of known and unknown defects requires a healthy amount of finance in terms of man hours and spares support. This makes an important part of Life Cycle Cost (LCC) (Khan & Manarvi, 2010).

Statistical and Trend Analysis of the regularly collected defects data is of foremost importance in aircraft and its components management system, and in estimating Mean Time Between Failure (MTBF), Mean Time To Repair (MTTR), and production Delays (Khan & Manarvi, 2010; Manarvi & Umer, 2009). Bath Tub Curve Model and Spoon Shaped Curve Model have provided the different phases of component life. These have also provided relationship between product life and maintenance from angle of its maintainability (Manarvi & Umer, 2009; Qi, Lu, & Song, 2005). The cost of scheduled maintenance is less than unscheduled maintenance cost (Kumar, Croker, & Knezrvic, 1999). Efforts can be made to improve traditional maintenance policies and practices to overcome unscheduled removals and to enhance components life, which will result in more engine operating hours.

The concept of Defect Prevention (DP) can be used effectively to reduce unscheduled engine removals. In this data of present defects is analyzed to suggest preventive measure for future (Jalote & Agarwal, 2012). Scheduled inspections are planned inspections; therefore, these do not affect MTBF or MTTR whereas unscheduled removals or premature failures do have direct impact in MTBF or MTTR (Younus & Manarvi, 2010). Unscheduled removals or premature failures play an important role in enhancing or reducing reliability.

METHODOLOGY

The defects were collected from Log Books of engines for last two and half year (30 months). This data selection was done intentionally, with the aim to forecast and suggest remedial measures for remaining six months of Year 2011 through data analysis. Hours from last inspection and total operating life of top ten failed components was also collected from Log Books. The collected data was based upon following information:

1. Date on which defect was reported.
2. Defect category and nature.
3. Root cause identifying defective component.
4. Reason for component failure.

Total failures for each year were calculated. All scheduled and unscheduled engine removals were taken into consideration and in total 32 different components were identified. Top ten failed components were selected for analysis. The factors, affecting performance of components or contributing towards failure of component, like operating hours and operating conditions were used for failure analysis. During component failure analysis flight hours, schedule, and unscheduled removals cannot be over looked. Any failure during schedule inspection is expected that is the reason for schedule inspection after specified interval, whereas unscheduled removal is the major stakeholder for component failure analysis. The unscheduled removals help to decide component life, remedial measures, redefining inspection intervals, One Time Inspections (OTIs) and other steps to arrest the trend.

IDENTIFICATION OF DEFECTIVE COMPONENTS

The Log Books of the engine were reviewed. The year wise data for scheduled removals and unscheduled removals was segregated. Figure 1

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