



# Creep failure of low pressure turbine blade of an aircraft engine

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## ABSTRACT

A low pressure turbine blade of an aircraft engine was fractured during the ground test run. The failed as well as neighboring unfailed blades were studied during failure investigation. Microstructure of a virgin blade was also analyzed for reference.

The material of the blade was Udimet 500, a high strength Ni-base super alloy. The investigation revealed that the triple point creep cracks were initiated on the trailing edge of blade-airfoil near root region. Grain dropping was also observed within these cracks. One of these cracks was propagated under the high cycle fatigue mechanism, circumscribing almost 50% of the fracture area. When this fatigue crack might have propagated to a critical length, the airfoil of the blade fractured catastrophically under overload condition. The primary cracking was due to creep. Such cracks were also present on the same location of neighboring blades indicating that they were also prone to failure.

Microstructural study of the failed and unused blades revealed that except the creep crack problem at specific location, there was no other microstructural degradation typical of high temperature exposure in the failed blade. Hardness of the failed blade was closer to that of unused blade as well. The edges of the airfoil of blades were found grinded which was carried out on the instructions of the OEM. It is assumed that the stresses in the turbine region might gone higher either due to engine operating parameter or due to the change in original design of blade.

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## 1. Background

After a general overhaul, during the test bed run of an aircraft engine, severe vibration and change in the engine noise were observed. In the visual inspection, airfoil of a low pressure (LP) blade was found fractured near the root region. The hours since new (HSN) of the engine was 270 h. The failed blade, its two neighboring unfailed blades and an unused blade were analyzed during the study.

## 2. Experimental results

### 2.1. Macroexamination

The failed and a neighboring unfailed blade were inspected visually. The observations are summarized in the following sub-sections.

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