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Fatigue life prediction based on equivalent initial flaw size for Al-Li alloy 2297 under spectrum loading

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ABSTRACT

Fatigue life prediction methods based on the Equivalent Initial Flaw Size (EIFS) concept under variable amplitude (VA) spectrum loading conditions were studied in this paper. Fatigue tests of Al-Li alloy 2297 under constant amplitude (CA) and VA loading cases were carried out. Based on the comparison of predictions and test results, different ways to determine the EIFSs and whether the load-interaction effects should be considered in VA fatigue life prediction were discussed to recommend their applicable cases. A good agreement is observed between EIFS model predictions and experimental data, especially in case of high maximum stresses in VA loading.

Keywords: EIFS; Life prediction; Fatigue crack growth; Spectrum loading; AA2297.

1. Introduction

Fatigue life prediction under variable amplitude (VA) loading, e.g. block-spectrum and random-spectrum loading, plays a significant role for airframe fatigue evaluation since most of the structures in service are subjected to complex load-time history. The most common and simple fatigue life prediction method for VA loading was established based on the linear cumulative damage rule[1,2]. The concept was applied by Pålmgren[3] in 1924. Miner[4] first expressed this concept in the now generally known mathematical form of the rule in 1945: $\sum n/N = 1$.