 Proceedings of ICCES'08, pp.325-325

The Effect of Alloy Type, Specimen Geometry and Load Spectrum Variables on Fatigue Scatter in Three Structural Aluminum Alloys

D.L. DuQuesnay[1] and P.R. Underhill[1]

Summary

The scatter in fatigue data under variable amplitude loading for three high strength structural aluminum alloys is examined experimentally. The alloys examined are extruded 7050-T74511 and 7075-T6511, and forged 7175-T73. Variable amplitude load spectra derived from heavily loaded and fatigue sensitive locations on F18 aircraft were applied to double edge notch specimens in the laboratory. Two notch geometries with stress concentration factors of 2.1 and 1.6 were examined. As measured load spectra are typically edited of small cycles to shorten testing time, series of specimens were subjected to edited and unedited versions of the same spectra to observe the effects on the life distributions. Fatigue cracking was monitored using acetate replicas taken in the notch roots for multiple repeats of each load spectrum. A minimum of seven tests, and as many as 20 tests, were performed for each combination of load spectrum, alloy type, and notch geometry to study the resulting distributions of fatigue life. The general trend observed was that a log-normal distribution was a reasonable and conservative approximation to the distribution of fatigue life for all the alloys and specimen geometries for edited load spectra. However, as the spectra became longer and were essentially un-edited, i.e., still preserving most of the small cycle events, the life distributions deviated from being log-normal for the 7050 alloy and were better described as bi-modal. The life distributions for the other two alloys subjected to unedited spectra were less clearly defined. Furthermore, the standard deviations and hence the scatter in fatigue life were observed to be different in the three alloys. For determining safe-life of fighter aircraft aluminum structural components, it is typically assumed that the standard deviation for all aluminum alloys is about 0.11, which was found to be conservative for the 7050-alloy, but not for the 7175 and 7075 alloys under the conditions considered. The bi-modal distribution for unedited spectra in 7050 alloy is attributed to the distribution of particles near the surface of the specimens.

[1]Royal Military College of Canada