Accepted Manuscript

Comparison of fatigue crack growth stress ratio effects under simple variable amplitude loading using fractographic and strain measurements

P.D. White, S.A. Barter, N. Medhekar

PII: S0142-1123(18)30041-0
DOI: https://doi.org/10.1016/j.ijfatigue.2018.01.035
Reference: JIJF 4564

To appear in: International Journal of Fatigue

Received Date: 21 November 2017
Revised Date: 27 January 2018
Accepted Date: 30 January 2018

Please cite this article as: White, P.D., Barter, S.A., Medhekar, N., Comparison of fatigue crack growth stress ratio effects under simple variable amplitude loading using fractographic and strain measurements, International Journal of Fatigue (2018), doi: https://doi.org/10.1016/j.ijfatigue.2018.01.035

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
Comparison of fatigue crack growth stress ratio effects under simple variable amplitude loading using fractographic and strain measurements

P. D. White\textsuperscript{a,b}, S. A. Barter\textsuperscript{a}, N. Medhekar\textsuperscript{b}

\textsuperscript{a}Aerospace Division, Defence Science and Technology Group, 506 Lorimer Street, Fishermans Bend 3207, Australia.
\textsuperscript{b}Department of Materials Engineering, Monash University, Australia

Abstract

Crack closure, the contact between opposing crack faces above zero load, has traditionally been used to explain the observation that higher stress ratio fatigue cycles have faster growth rates than lower stress ratio cycles. Using new techniques to investigate the dependance of stress ratio on crack closure, we tested simplified variable amplitude loading sequences containing segments of 100 cycles at different stress ratios in AA7050-T7451 alloy. We compared the crack growth at different stress ratios at the start of a coupon with no closure and after 5 mm or more of crack growth where significant closure had developed as indicated by side and back-face strain gauges mounted on the coupon. Fractographic measurements of the fatigue growth from these sequences show the same stress ratio effect at the start of loading and after 5 mm of growth, suggesting that the stress ratio effect occurs soon after the commencement of growth and that crack closure is not the dominant cause of the stress ratio effect in the AA7050-T7451 alloy. Results from these tests using constant and varying maximum stress intensity $K_{\text{max}}$ also showed significantly different stress ratio effects. Traditional constant amplitude load tests over-predict the rate of crack growth for cycles in which the maximum load is varying. Obtaining crack growth rates for a range of different stress ratios from variable amplitude testing in this way can allow greater accuracy to be achieved in predicting the rate of crack growth for arbitrary variable amplitude loading sequences.

1. Introduction

The variation in the rate of fatigue crack growth as a function of the stress ratio $R = S_{\text{min}}/S_{\text{max}}$, where the maximum and minimum stress in a cycle is $S_{\text{max}}$ and $S_{\text{min}}$, was explained by Elber [1] as being partly due to crack closure, the premature contact occurring between mating fracture surfaces. From this observation he was able to propose a modification to the Paris-Erdogen equation [2] for the rate of crack growth to allow for the crack being closed below a threshold stress level known as the crack opening stress $S_{\text{op}}$, resulting in a reduction of the stress intensity range $\Delta K$ also known as the crack driving force, to produce an effective

\email{Paul.White@dst.defence.gov.au (P. D. White)}

January 28, 2018
دریافت فوری متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات