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# Short cracks growth in low cycle fatigue under multiaxial in-phase loading

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## Abstract

Crack propagation in full plastic regions is one of the main aspects of fatigue life design for components subjected to high strain concentrations. Residual life assessment for those components, in which high stress concentrations cause cyclic yielding of the material, can be considered as a crack propagation problem by assuming crack growth from the first load cycle. The aim of this paper is to study the crack growth behaviour of short cracks in low cycle fatigue under a multiaxial loading condition. In particular, a series of experiments in LCF regime at room temperature was performed to determine crack growth during axial, torsional and axial-torsional tests. Crack advancement was checked with the plastic replica technique, during test interruptions. Experimental results were compared, in terms of crack growth rates and fatigue life assessment, with those analytically calculated, considering different multiaxial fatigue parameters introduced in an exponential crack growth law and an approach based on the multiaxial cyclic J-Integral concept.

*Keywords:* Multiaxial Low Cycle Fatigue, short crack, J-Integral range, multiaxial fatigue criteria

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## 1. Introduction

Multiaxial low cycle fatigue life assessment is important for several components like rotor disks for turbines, which are subjected to stress cycles induced by centrifugal loads and by differential temperatures during startups and shutdowns [1, 2], or pipelines employed in challenging harsh environments, where they have to sustain severe loading conditions [3].

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