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PII: S0142-1123(18)30212-3
DOI: https://doi.org/10.1016/j.ijfatigue.2018.05.025
Reference: JIJF 4697

To appear in: *International Journal of Fatigue*

Received Date: 1 April 2018
Revised Date: 22 May 2018
Accepted Date: 25 May 2018

Please cite this article as: Szusta, J., Fatigue life of metallic materials under uniaxial low-cycle loading at elevated temperature, *International Journal of Fatigue* (2018), doi: https://doi.org/10.1016/j.ijfatigue.2018.05.025

FATIGUE LIFE OF METALLIC MATERIALS UNDER UNIAXIAL LOW-CYCLE LOADING AT ELEVATED TEMPERATURE

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ABSTRACT: This paper reviews experimental tests of the fatigue life of metallic materials under uniaxial fatigue loading at elevated temperature. The influence of elevated temperature on the properties of different materials were investigated for monotonic and cyclic loads with high loading amplitude values. Models most commonly used to estimate the fatigue life of materials under these conditions are presented. Based on compiled results of experimental tests, an empirical model of fatigue damage accumulation was developed, making it possible to predict fatigue life under uniaxial, low-cycle loading conditions at elevated temperature. The model's structure was based on fatigue deformation curves obtained by way of experimental tests. The low number of material constants, which can be determined from fatigue tests at ambient temperature, is an advantage of the proposed model. The model was verified experimentally, and compiled test results were used for this purpose.

Keywords: Low-cycle fatigue, life prediction, elevated temperature, damage accumulation model, ENAW 2024T3, Ti-6Al-4V

INTRODUCTION

Machine parts are exposed to the action of cyclically loads at elevated temperature over the course of their operation, particularly in the energy, aviation, motorization, chemical, and petrochemical industries. The concept of elevated temperature can be defined here according to the works [1], [2], as the temperature corresponding to 2/3 of the melting point of bulk material T_c. As temperature increases, a material's strength and fatigue properties are reduced in a predictable manner until a certain threshold temperature value is reached, in most cases [3], [4]. Under these conditions, the operation of technical machinery may be safe when the material's response to loading conditions and the working environment are known. However if the conventional upper threshold of elevated temperature is crossed even slightly,