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Creep-Fatigue Design Rules for Cyclic Softening Steels

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Abstract

Based on existing lifetime and damage models a new approach is developed for the assessment of creep-fatigue lifetime of components made out of cyclic softening steel, in particular EUROFER97. For the application of the new creep-fatigue rules among others lifetime data from special tests, in particular creep tests on pre-fatigued specimens are required. Therefore, a test matrix is proposed and conducted for EUROFER97 in which the efforts are minimized by utilizing the Monkman-Grant relationship and its independence on pre-cyclic deformation and cyclic softening, respectively. To facilitate their implementation in existing design criteria the new creep-fatigue rules are simplified by introducing the cyclic softening stress factor with which the impact of cyclic softening on creep rupture time is considered. The assessment of creep-fatigue in LCF tests with hold-times performed on EUROFER97 using the new rules demonstrates their applicability to cyclic softening ferritic-martensitic steels without being overly conservative. A draft for implementing the simplified rules in the respective chapter of structural design code is elaborated in addition.

Keywords: EUROFER97, creep-fatigue, cyclic softening, design rules, failure.

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