

Activation Parameters of the Low Temperature Creep Controlling Mechanism in Martensitic Steels

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Abstract : Martensitic steels with an ultimate tensile strength beyond 2000 MPa are applied in the powertrain of vehicles due to their excellent fatigue strength and high creep resistance. However, the creep controlling mechanism in martensitic steels at ambient temperatures up to 423 K is not evident. The purpose of this study is to review the low temperature creep (LTC) behavior of martensitic steels at temperatures from 363 K to 523 K. Thus, the validity of a logarithmic creep law is reviewed and the stress and temperature dependence of the creep parameters α ; and β ; are revealed. Furthermore, creep tests are carried out, which include stepped changes in temperature or stress, respectively. On one hand, the change of the creep rate due to a temperature step provides information on the magnitude of the activation energy of the LTC controlling mechanism and on the other hand, the stress step approach provides information on the magnitude of the activation volume. The magnitude, the temperature dependency, and the stress dependency of both material specific activation parameters may deliver a significant contribution to the disclosure of the nature of the LTC rate controlling mechanism.

Keywords : activation parameters, creep mechanisms, high strength steels, low temperature creep

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