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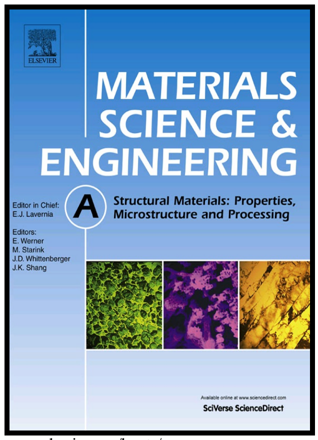


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**Localized creep characterization of 316LN stainless steel weld joint using Small Punch Creep test**

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**Abstract**

Type 316LN stainless steel (SS) weld joints are widely used in several high temperature applications. The variations of creep properties across the microstructurally heterogeneous regions of 316LN SS weld joint such as base metal, weld metal and heat affected zone (HAZ) have been evaluated using Small Punch Creep (SPC) technique at 923 K. Both the SPC rupture and deformation behaviors were investigated. The creep strength gradient across 316LN SS weld joint showed a smooth increasing trend from base metal to weld metal. However, the trend of the rupture life for weld metal shifted with change in load level. The SPC deformations of various regions of weld joint have been analyzed according to the equation, $\delta = \delta_0 + \delta_T\,(1 - e^{-\kappa t}) + \dot{\delta}_s\, t + \delta_3\, e^{[\varphi\,(t - t_r)]}$. The variations of transient, secondary and tertiary creep parameters were determined across the weld joint. The master curve for transient creep deflection was obtained for various regions of weld joint.

**Keywords** Small punch creep, 316LN SS, weld joint, HAZ, transient, tertiary

## 1. Introduction

Type 316LN stainless steel (SS) weld joints are largely employed in the structural components of several high temperature applications, especially, sodium cooled fast reactors. Type 316N SS containing 0.045-0.055 wt.% carbon and 0.06-0.10 wt.% nitrogen is preferred as the electrode for fabrication of 316LN SS weld joints [1]. The hot cracking and sensitisation issues arising during welding of austenitic stainless steels can be controlled with suitable chemical composition of the electrode. Hence, limits for Carbon and nitrogen are generally specified to provide weld joints with improved creep strength and to reduce sensitisation effects in the as-welded state. A minimum of 3 ferrite number (FN) is usually specified to check hot cracking in the weld metal. As delta ferrite undergoes phase changes to carbides and intermetallic phases at high temperatures, an upper limit of 7 FN is specified. Considering the complexity and size of weld, fusion welding is commonly used to fabricate the reactor vessel and piping [2].

The heterogeneity in composition and microstructure across the weld joint is a potential cause for its failure during service at elevated temperatures. Therefore the uniaxial creep tests have been largely conducted to study the creep behaviour of 316LN SS weld joint with due attention. The