

Metallic materials — Tensile testing in liquid helium

ICS 74.040.10

National foreword

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Summary of pages

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Foreword

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ISO 19819 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 1, *Uniaxial testing*.

Introduction

The force-time and force-extension records for alloys tested in liquid helium using displacement control are serrated. Serrations are formed by repeated bursts of unstable plastic flow and arrests. The unstable plastic flow (discontinuous yielding) is a free-running process occurring in localized regions of the parallel length at higher rates than nominal strain rates with internal specimen heating. Examples of serrated stress-strain curves for a typical austenitic stainless steel with discontinuous yielding are shown in Figure 1.

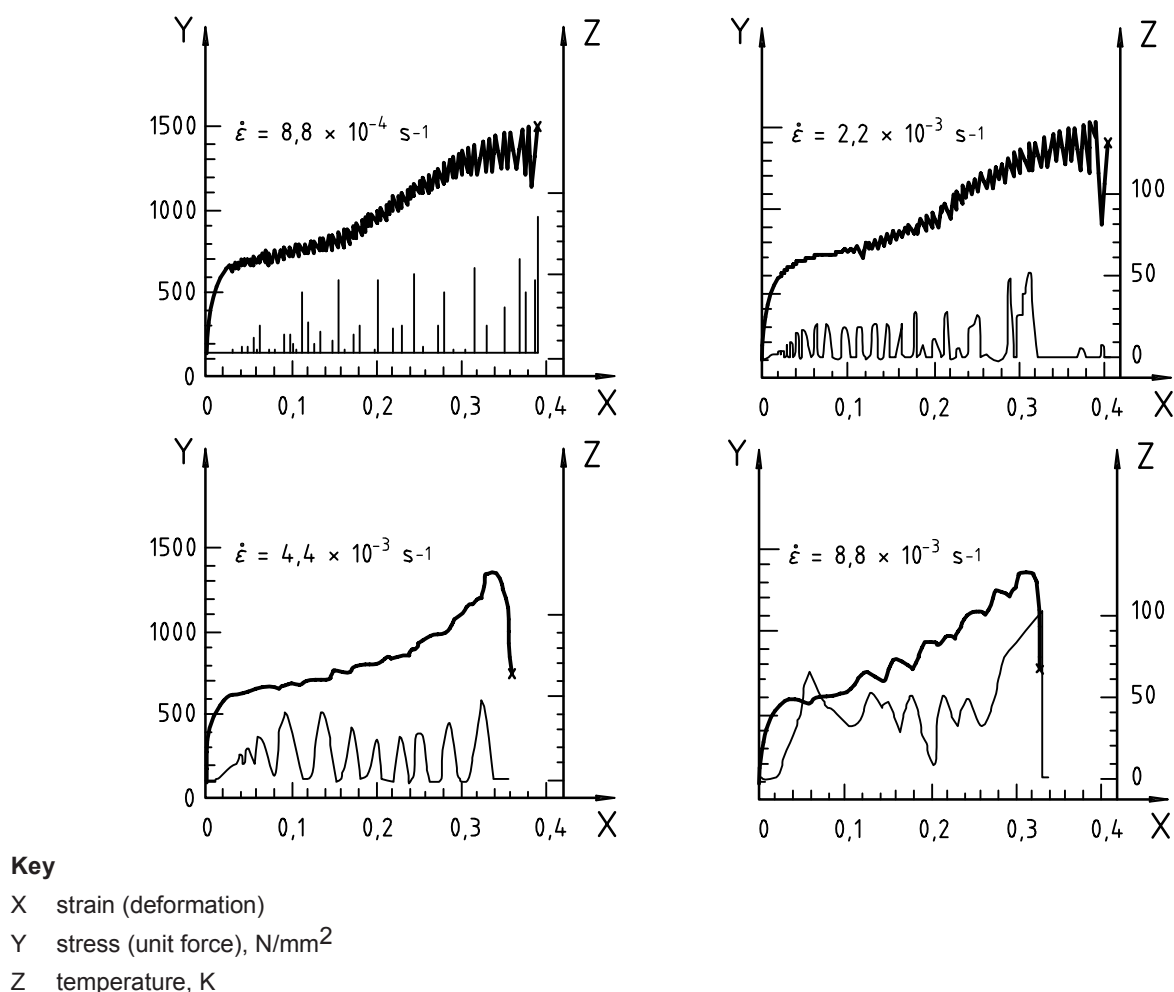


Figure 1 — Example of typical stress-strain curves and specimen temperature histories at four different nominal strain rates, for AISI 304L stainless steel tested in liquid helium

A constant specimen temperature cannot be maintained at all times during testing in liquid helium. Due to adiabatic heating, the specimen temperature at local regions in the parallel length rises temporarily above 4 K during each discontinuous yielding event (see Figure 1). The number of events and the magnitude of the associated force drops are a function of the material composition and other factors such as specimen size and test speed. Altering the mechanical test variables can change the type of serration but not eliminate the discontinuous yielding, therefore, tensile property measurements of alloys in liquid helium (especially tensile strength, elongation and reduction of area) may lack the usual significance of property measurements at room temperature where deformation is nearly isothermal, and discontinuous yielding typically does not occur.