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Metallic materials — Tensile testing —

Part 4:
Method of test in liquid helium

Matériaux métalliques — Essai de traction —
Partie 4: Méthode d'essai dans l'hélium liquide

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 1, *Uniaxial testing*.

This first edition of ISO 6892-4 cancels and replaces ISO 19819:2004, which has been technical revised.

ISO 6892 consists of the following parts, under the general title *Metallic materials — Tensile testing*:

— *Part 1: Method of test at room temperature*

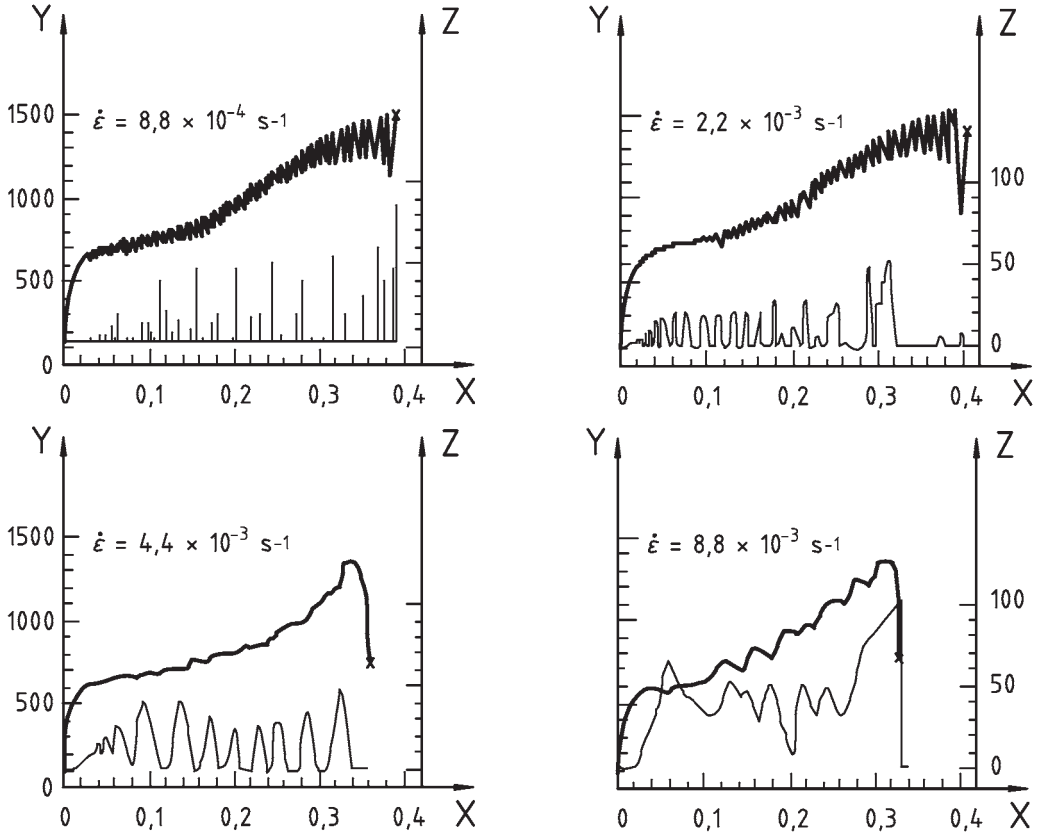
— *Part 2: Method of test at elevated temperature*

— *Part 3: Method of test at low temperature*

— *Part 4: Method of test in liquid helium*

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 test piece heating. Examples of serrated stress-strain curves for a typical austenitic stainless steel with discontinuous yielding are shown in Figure 1.



Key

1 stress, N/mm^2

2 strain

3 temperature, K

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

A constant test piece temperature cannot be maintained at all times during testing in liquid helium. Due to adiabatic heating, the test piece 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 test piece size and test speed. Typically, 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 more nearly isothermal and discontinuous yielding typically does not occur.

Strain control is the preferred control mode (Method A, 6892-1) and displacement control is the secondary method, according to Method B 6892-1.