INTERNATIONAL STANDARD

ISO 6892-4

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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

Reference number
ISO 6892-4:2015(E)

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*

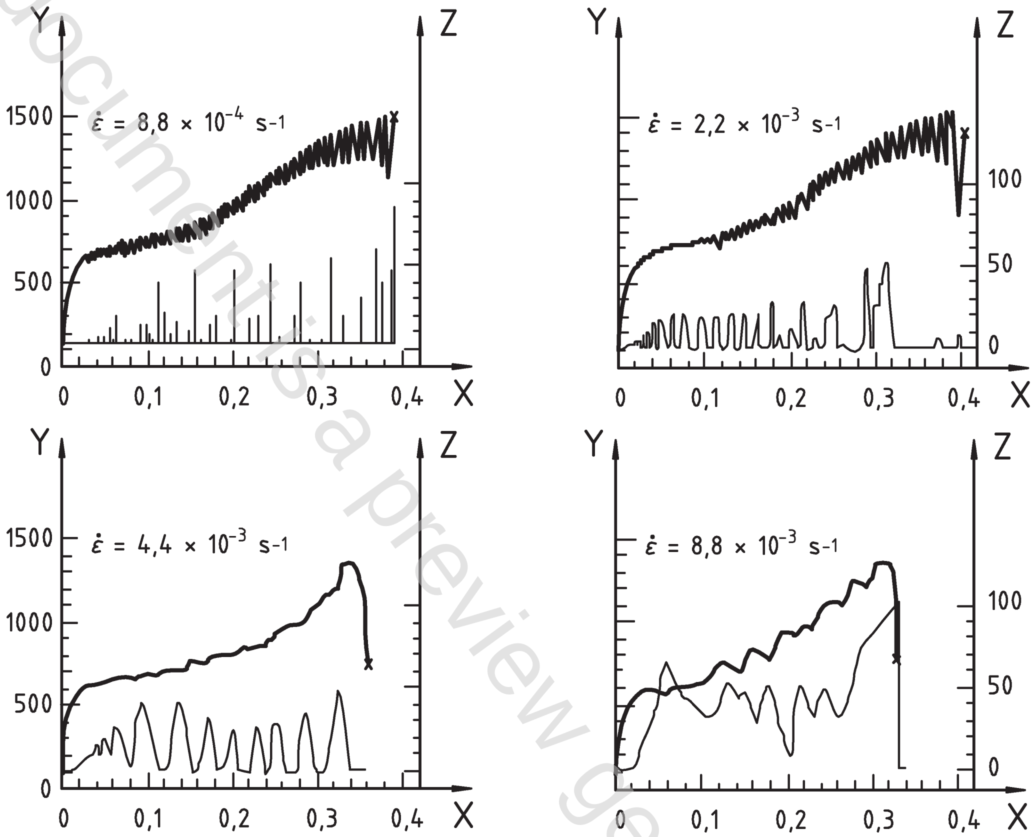
— *Part 2: Method of test at elevated temperature*

— *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.

Metallic materials — Tensile testing —

Part 4:
Method of test in liquid helium

1 Scope

This part of ISO 6892 specifies the method of tensile testing of metallic materials in liquid helium (the boiling point is –269 °C or 4,2 K, designated as 4 K) and defines the mechanical properties that can be determined.

This part of ISO 6892 may apply also to tensile testing at cryogenic temperatures (less than –196 °C or 77 K), which requires special apparatus, smaller test pieces, and concern for serrated yielding, adiabatic heating, and strain-rate effects.

To conduct a tensile test according to this part of ISO 6892 at 4 K, the test piece installed in a cryostat is fully submerged in liquid helium (He) and tested using displacement control at a nominal strain rate of 10^{-3} s^{-1} or less.

NOTE The boiling point of the rare ^3He isotope is 3,2 K. Usually, the tests are performed in ^4He or a mixture of ^3He and ^4He with a high concentration of ^4He. Therefore, the temperature is, as designated before, 4 K.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6892-1:—[1)], *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 6892-3, *Metallic materials — Tensile testing — Part 3: Method of test at low temperature*

ISO 7500-1[1], *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 9513, *Metallic materials — Calibration of extensometer systems used in uniaxial testing*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 6892-1 and in ISO 6892-3 apply.

3.1
adiabatic heating
internal heating of a test piece resulting from deformation under conditions such that the heat generated by plastic work cannot be quickly dissipated to the surrounding cryogen

1) To be published.

