



BSI Standards Publication

**Reactor technology — Nuclear fusion
reactors — Hot helium leak testing method
for high temperature pressure-bearing
components in nuclear fusion reactors**

National foreword

This British Standard is the UK implementation of [ISO 4233:2023](#).

The UK participation in its preparation was entrusted to Technical Committee NCE/9, Nuclear Installations, Processes & Technologies.

A list of organizations represented on this committee can be obtained on request to its committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient’s own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2023
Published by BSI Standards Limited 2023

ISBN 978 0 539 16692 7

ICS 27.120.20

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2023.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

INTERNATIONAL STANDARD

ISO
4233

First edition
2023-03-06

Reactor technology — Nuclear fusion reactors — Hot helium leak testing method for high temperature pressure-bearing components in nuclear fusion reactors

*Technologie du réacteur — Réacteurs à fusion nucléaire — Méthode
de contrôle d'étanchéité par détection de fuite d'hélium à chaud pour
les composants sous pression à haute température de réacteurs à
fusion nucléaire*



Reference number
ISO 4233:2023(E)
Documents
Document Sharing Hub
© ISO 2023



COPYRIGHT PROTECTED DOCUMENT

© ISO 2023, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols	2
5 Principles and techniques of detection	2
6 Personnel	5
7 Apparatus	5
7.1 General	5
7.2 Test component and vacuum chamber	7
7.3 The vacuum pumping system	7
7.4 Heating and temperature control system	7
7.5 Temperature uniformity requirement	7
7.6 Reference leak	7
7.7 Tracer gas leak detector	8
7.8 Other equipment	8
8 Test component preparation	8
8.1 Preliminary tests before hot helium leak test	8
8.2 Vacuum baking	9
9 Calibration	9
9.1 General	9
9.2 Response and cleanup time measurements	9
9.3 Leak detector validation and determination of minimum detectable leakage rate	9
10 Testing procedures	11
10.1 Installation of the component into the test system	11
10.2 Initial set-up of the leak testing system	11
10.3 Initial helium leak testing	11
10.4 Helium leak testing at elevated temperature	11
10.5 Cyclic hot helium leak testing	12
10.6 Final cold helium leak testing	12
11 Test report	12

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. 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. 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](#)

This document was prepared by Technical Committee ISO/TC 85, *Nuclear technology, nuclear technologies, and radiological protection*, Subcommittee SC 6, *Reactor technology*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Hot helium leak testing can realize more reliable leak tightness assessment than the conventional cold helium leak testing for components that run at elevated temperatures. It gives the total leakage rate of a component at its operating temperature and pressure, and could greatly reduce its operational leak risk.