

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Radiation protection instrumentation – System of spectral identification of liquids in transparent and semitransparent containers (Raman systems)**

**Instrumentation pour la radioprotection – Système d'identification spectrale des liquides dans des récipients transparents et semi-transparentes (systèmes Raman)**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

#### IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

#### IEC online collection - [oc.iec.ch](http://oc.iec.ch)

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

---

### A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

### A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

#### Recherche de publications IEC -

[webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

#### Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [sales@iec.ch](mailto:sales@iec.ch).

#### IEC online collection - [oc.iec.ch](http://oc.iec.ch)

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



---

**Radiation protection instrumentation – System of spectral identification of liquids in transparent and semitransparent containers (Raman systems)**

**Instrumentation pour la radioprotection – Système d'identification spectrale des liquides dans des récipients transparents et semi-transparentes (systèmes Raman)**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 13.280

ISBN 978-2-8322-9896-1

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references .....	7
3 Terms and definitions .....	8
4 Requirements .....	9
4.1 Structure and appearance.....	9
4.2 Functions .....	9
4.2.1 Alarm.....	9
4.2.2 Displayed data.....	9
4.2.3 Recording and storage of identification data .....	9
4.2.4 Error diagnostics and self-verification .....	10
4.2.5 Access control software.....	10
4.3 Performance .....	10
4.3.1 Testing conditions .....	10
4.3.2 Time for single inspection .....	11
4.3.3 Requirements for minimum volume of liquid to be inspected .....	11
4.3.4 Requirements for container wall thickness .....	11
4.3.5 Requirements for container wall transparency.....	12
4.3.6 Requirements for detectable spectral range.....	13
4.3.7 Reproducibility of identification result .....	13
4.3.8 Selectivity of substance identification .....	14
4.4 Laser safety .....	15
4.4.1 General .....	15
4.5 Electrical safety .....	15
4.5.1 Main power connection.....	15
4.5.2 Stability at mains power supply.....	16
4.5.3 Battery connection.....	16
4.5.4 Stability to battery charge level.....	16
4.6 Mechanical stability.....	16
4.6.1 General .....	16
4.6.2 Requirements .....	17
4.6.3 Test method .....	17
4.7 Environmental requirements .....	17
4.7.1 Environmental suitability test .....	17
4.7.2 Mechanical vibration testing.....	17
4.8 Electromagnetic compatibility.....	18
4.8.1 Immunity testing .....	18
4.8.2 Emission test.....	19
5 Marking and documentation.....	19
5.1 Raman analyzer marking .....	19
5.2 Documentation.....	19
Annex A (informative) Raman spectra of test samples .....	20
A.1 Raman spectrum of test samples 1 and 2.....	20
A.2 Raman spectrum of test sample 3 .....	21
A.3 Raman spectrum of test sample 4 .....	22

A.4	Raman spectrum of test sample 5 .....	23
A.5	Raman spectrum of test sample 6 .....	24
Figure 1	– Test on container wall thickness.....	12
Figure 2	– Test on container wall transparency .....	13
Figure A.1	– Raman spectrum of test samples 1 and 2 (cyclohexane) with four reference peaks ( $384\text{ cm}^{-1} \pm 2\text{ cm}^{-1}$ , $801\text{ cm}^{-1} \pm 2\text{ cm}^{-1}$ , $1\,444\text{ cm}^{-1} \pm 2\text{ cm}^{-1}$ , $2\,853\text{ cm}^{-1} \pm 2\text{ cm}^{-1}$ ) to verify the spectral range of $300\text{ cm}^{-1}$ to $3\,000\text{ cm}^{-1}$ .....	20
Figure A.2	– Raman spectrum of test sample 3 (water) with the reference band to verify the spectral range $3\,000\text{ cm}^{-1}$ to $3\,600\text{ cm}^{-1}$ .....	21
Figure A.3	– Raman spectrum of test sample 4 (10 % ethanol in water) with three reference peaks of ethanol in water ( $879\text{ cm}^{-1} \pm 2\text{ cm}^{-1}$ , $1\,455\text{ cm}^{-1} \pm 2\text{ cm}^{-1}$ , $2\,935\text{ cm}^{-1} \pm 2\text{ cm}^{-1}$ ) and the reference band of water in the spectral range $3\,000\text{ cm}^{-1}$ to $3\,600\text{ cm}^{-1}$ .....	22
Figure A.4	– Raman spectrum of test sample 5 (50 % methanol + 50 % ethanol) .....	23
Figure A.5	– Raman spectrum of test sample 6 (33,3 % methanol + 33,3 % ethanol + 33,3 % isopropanol) .....	24
Table 1	– Reference condition and standard test conditions.....	10
Table 2	– Key apparatus for tests and technical requirements.....	11
Table 3	– Reproducibility test results table.....	14
Table 4	– Ambient requirements .....	17
Table 5	– Tests and requirements for mechanical stability .....	18

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RADIATION PROTECTION INSTRUMENTATION –  
SYSTEM OF SPECTRAL IDENTIFICATION OF LIQUIDS IN TRANSPARENT  
AND SEMITRANSPARENT CONTAINERS (RAMAN SYSTEMS)**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 63085 has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
45B/979/FDIS	45B/984/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

**IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

This document establishes standard test methods and objects for evaluating the capabilities of Raman systems used for the spectral identification of liquids and liquids mixtures. The main focus is made on testing the functionality of the equipment (Raman analyzer); the reliability of identification result for liquids in containers with different light transmittance properties and stability of the equipment performance under various environmental conditions. The design of the optical scheme of the Raman analyzer, geometric and mass characteristics are not discussed and left to the discretion of the manufacturer. This document does not specify the circumstances and purposes of the inspection of liquids, the methods of detection of the container, and also the safety techniques for handling unknown liquids. Hence, the imposed requirements for the functionality of the Raman analyzer are equally suitable for its use in the fields of security, analysis of pharmaceutical solutions and other liquid chemicals. Annex A provides Raman scattering spectra of test samples, referred to in the test methods.

# **RADIATION PROTECTION INSTRUMENTATION – SYSTEM OF SPECTRAL IDENTIFICATION OF LIQUIDS IN TRANSPARENT AND SEMITRANSSPARENT CONTAINERS (RAMAN SYSTEMS)**

## **1 Scope**

This document provides technical performance requirements, testing methods, requirements for operational performance and accompanying documents, packaging, transportation and storage conditions for the system of spectral identification of liquids in transparent and semitransparent containers (hereinafter referred to as “system”), based on the method of inelastic (Raman) light scattering by molecules.

This document applies both to stationary and hand-held systems; geometric and mass parameters are not concerned in the tests. This document is applicable to substance identification testing criteria as well as verification, approval and operating criteria of the system. Since this document considers only the functionality of Raman analyzers and their ability to identify single- or multicomponent fluids, it is equally suitable for verifying the Raman analyzers assigned to security screening of threats, inspection of medical solutions, liquid chemicals, etc.

## **2 Normative references**

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60038:2009, *Standard voltages*

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60825-4:2006, *Safety of laser products – Part 4: Laser guards*

IEC 60825-4:2006/AMD1:2008

IEC 60825-4:2006/AMD2:2011

IEC 61000-6-1:2016, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

IEC 61000-6-3:2020, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for equipment in residential environments*

ISO 3696:1987, *Water for analytical laboratory use – Specification and test methods*

ISO 9058:2008, *Glass containers – Standard tolerances for bottles*