
**Workplace atmospheres — Short term
detector tube measurement systems
— Requirements and test methods**

*Air des lieux de travail — Systèmes de mesurage par tube détecteur à
court terme — Exigences et méthodes d'essai*





COPYRIGHT PROTECTED DOCUMENT

© ISO 2015, 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	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Requirements	3
4.1 General.....	3
4.2 Detector tubes.....	3
4.2.1 Specified measuring range.....	3
4.2.2 Scale.....	3
4.2.3 Evaluation of the stain.....	4
4.2.4 Shelf life.....	4
4.2.5 Mechanical strength.....	4
4.2.6 Transportation temperature stability.....	4
4.2.7 Packing of the detector tubes.....	4
4.2.8 Interferences.....	4
4.2.9 Overloading.....	4
4.2.10 Environmental influences.....	4
4.2.11 Instruction for use for detector tubes.....	5
4.3 Detector tube pump.....	5
4.3.1 General.....	5
4.3.2 Stroke volume.....	5
4.3.3 Leakage.....	5
4.3.4 Mechanical strength.....	5
4.3.5 Mechanical durability.....	5
4.3.6 Explosion hazard.....	6
4.3.7 Instructions for use for detector tube pumps.....	6
5 Test conditions	6
5.1 General.....	6
5.2 Reagents.....	6
5.3 Apparatus.....	6
5.4 Independent method.....	6
5.5 Generation of test gas mixtures.....	6
5.6 Test conditions for detector tubes.....	7
5.7 Test conditions for detector tube pumps.....	7
6 Test methods	7
6.1 Detector tubes.....	7
6.1.1 Visual checks.....	7
6.1.2 Test procedures.....	8
6.1.3 Mechanical strength.....	9
6.2 Detector tube pumps.....	10
6.2.1 Stroke volume.....	10
6.2.2 Leakage.....	11
6.2.3 Mechanical strength.....	11
6.2.4 Mechanical durability.....	11
6.2.5 Explosion hazard (electrically driven detector tube pumps only).....	11
6.2.6 Instructions for use.....	11
7 Uncertainty of measurement	11
7.1 Potential sources of uncertainty.....	11
7.2 Estimation of the uncertainty components.....	12
7.2.1 Combined stain component.....	12
7.2.2 Pump-stroke volume.....	14

7.2.3	Effect of temperature	14
7.2.4	Effect of relative humidity	15
7.2.5	Test gas concentration used for evaluation	15
7.2.6	Stain-length reading.....	16
7.2.7	Analytical phenomena	16
7.2.8	Atmospheric pressure.....	16
7.2.9	Diffusive leakage into detector tube	16
7.2.10	Non-constant sampling flow.....	17
7.3	Combined standard uncertainty.....	17
7.4	Expanded uncertainty	18
8	Test report	18
8.1	Detector tubes	18
8.2	Detector tube pumps	18
9	Marking	19
9.1	Boxes.....	19
9.2	Detector tubes	19
9.3	Detector tube pumps	19
Annex A (normative) Test sequence		20
Annex B (normative) List of test instruments		21
Annex C (informative) Example for calculation of expanded uncertainty		22
Bibliography		25

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 146, *Air quality*, Subcommittee SC 2, *Workplaces atmospheres*.

Introduction

Many short-term detector tube measurement systems consist of a (length-of-stain) detector tube connected to an associated detector tube pump. When workplace air containing a particular chemical agent is drawn through the detector tube, a colour change takes place corresponding to the concentration.

Such short-term detector tube measurement systems have many applications. This International Standard refers to detector tubes used for workplace air monitoring. These detector tubes can be used for measurement tasks such as follows:

- determination of the presence or absence of an analyte;
- finding the approximate range of concentration;
- determination of the efficiency of control measurements;
- determination of emission sources and emission changes in time;
- determination of compliance with ceiling or short-term limit values, as long as the device covers the reference time period and the precision requirements for the measurement.

To cover the possible range of concentration that can be encountered in the workplace, a combination of two or more measurements using detector tubes with restricted but complementary and overlapping measuring ranges can also be used.

This International Standard will enable the manufacturers, test houses, certification bodies, and the users to adopt a consistent approach to the assessment of performance of short-term detector tube measurement systems.

Workplace atmospheres — Short term detector tube measurement systems — Requirements and test methods

1 Scope

This International Standard specifies requirements and test methods under prescribed laboratory conditions for length-of-stain detector tubes and their associated pump (detector tube measurement system) used for short-term measurements of the concentration of specified chemical agents in workplace air.

This International Standard is not applicable to measurements made to demonstrate compliance with long-term limit values to personal exposure with a reference period of more than 15 min.

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 6141, *Gas analysis – Requirements for certificates for calibration gases and gas mixtures*

ISO 6142, *Gas analysis — Preparation of calibration gas mixtures — Gravimetric method*

ISO 6143, *Gas analysis — Comparison methods for determining and checking the composition of calibration gas mixtures*

ISO 6144, *Gas analysis — Preparation of calibration gas mixtures — Static volumetric method*

ISO 6145-1, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 1: Methods of calibration*

ISO 6145-4, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 4: Continuous syringe injection method*

ISO 6145-6, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 6: Critical orifices*

ISO 6145-10, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 10: Permeation method*

ISO 9169, *Air quality — Definition and determination of performance characteristics of an automatic measuring system*

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.