INTERNATIONAL STANDARD

ISO 20486

First edition
2017-12

Non-destructive testing — Leak testing — Calibration of reference leaks for gases

Essais non destructifs — Contrôle d'étanchéité — Étalonnage des fuites de référence des gaz

Reference number
ISO 20486:2017(E)

© ISO 2017



COPYRIGHT PROTECTED DOCUMENT

© ISO 2017, 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**

1 Scope **1**

2 Normative references **2**

3 Terms and definitions **2**

4 Nominal leakage rates **3**

5 Classification of leaks **3**
5.1 Permeation leak 3
5.2 Conductance leaks 3
5.2.1 Capillary leak 3
5.2.2 Aperture leak (orifice) 4
5.2.3 Compressed powder leak 4

6 Calibration by comparison **4**
6.1 Methods A, A_S, B and B_S 4
6.2 Applicability of comparison methods 4
6.3 Preparation of leaks and apparatus 5
6.3.1 Leak detector 5
6.3.2 Connection to the leak detector 5
6.3.3 Temperature accommodation 7
6.4 Measurement 7
6.4.1 Set-up 7
6.4.2 General measurement sequence 7
6.5 Evaluation for methods A, A_S, B and B_S (Comparison) 8
6.5.1 Determination of leakage rate 8
6.5.2 Influence factors to measurement uncertainty 9

7 Volumetric calibration **10**
7.1 Direct flow (Method C) 10
7.1.1 General 10
7.1.2 Equipment 10
7.1.3 Preparation of leaks and apparatus 10
7.1.4 Measurement 11
7.1.5 Evaluation for Method C (direct flow measurement) 13
7.2 Leak measurement under water (Method D) 14
7.2.1 General 14
7.2.2 Equipment 14
7.2.3 Preparation of leaks and apparatus 14
7.2.4 Measurement 15
7.2.5 Evaluation for Method D 16
7.2.6 Influence factors to measurement uncertainty 17
7.3 Calibration by (volumetric) gas meter (Method E) 17
7.3.1 General 17
7.3.2 Equipment 18
7.3.3 Preparation of leaks and apparatus 18
7.3.4 Measurement 18
7.3.5 Evaluation for Method E (gas meter) 18
7.3.6 Influence factors to measurement uncertainty 19
7.4 Calibration by pressure change in a known volume (Method F) 19
7.4.1 General 19
7.4.2 Preparation of leaks and apparatus 20
7.4.3 Measurement 22
7.4.4 Special situation in vacuum chambers 23
7.4.5 Evaluation for Method F (pressure change) 25
7.4.6 Influence factors to measurement uncertainty 25

© ISO 2017 – All rights reserved

7.5 Calibration by volume change at constant pressure (Method G) 26
7.5.1 Equipment 26
7.5.2 Preparation of leaks and apparatus 26
7.5.3 Measurement 26
7.5.4 Evaluation for Method G (volume change at constant pressure) 27

8 General influences 28

9 Report 28

10 Labelling of reference leaks 29

11 Handling of reference leaks 29
11.1 General 29
11.2 Permeation leaks (normally with reservoir fitted the leak outlet) 29
11.3 Conductance leaks (normally without reservoir) 29

Annex A (informative) **Calculation of leakage rate decrease due to tracer gas depletion in the reservoir 30**

Bibliography 32

 © ISO 2017 – All rights reserved

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 voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 135, *Non-destructive testing*, Subcommittee SC 6, *Leak testing*.

© ISO 2017 – All rights reserved

Non-destructive testing — Leak testing — Calibration of reference leaks for gases

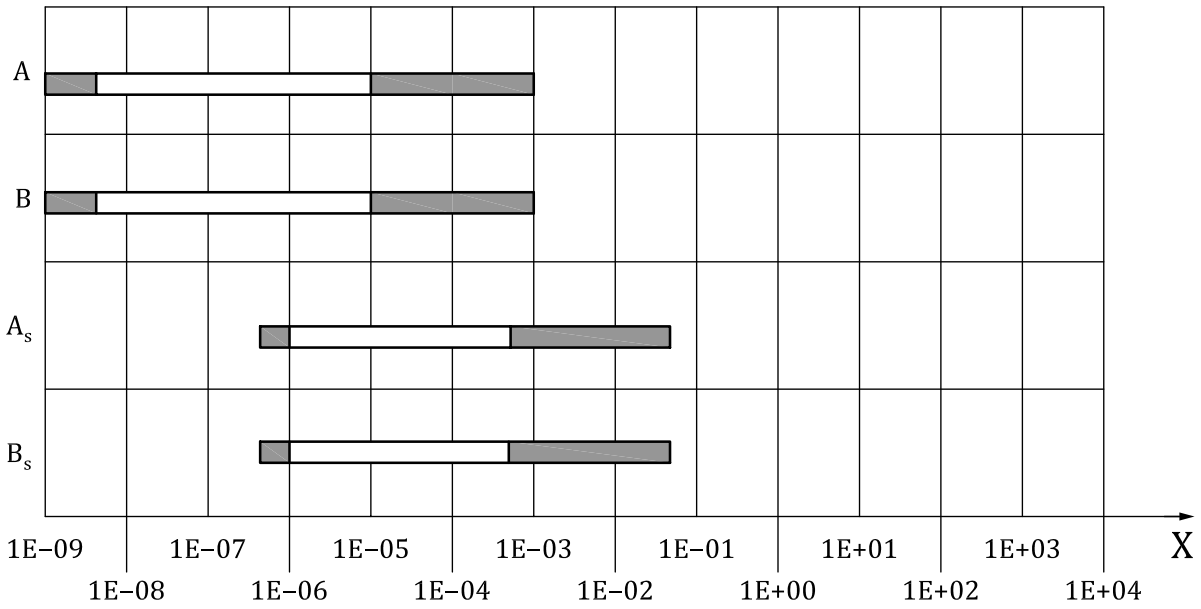
1 Scope

This document specifies the calibration of those leaks that are used for the adjustment of leak detectors for the determination of leakage rate in everyday use. One type of calibration method is a comparison with a reference leak. In this way, the leaks used for routine use become traceable to a primary standard. In other calibration methods, the value of vapour pressure was measured directly or calculated over a known volume.

The comparison procedures are preferably applicable to helium leaks, because this test gas can be selectively measured by a mass spectrometer leak detector (MSLD) (the definition of MSLD is given in ISO 20484).

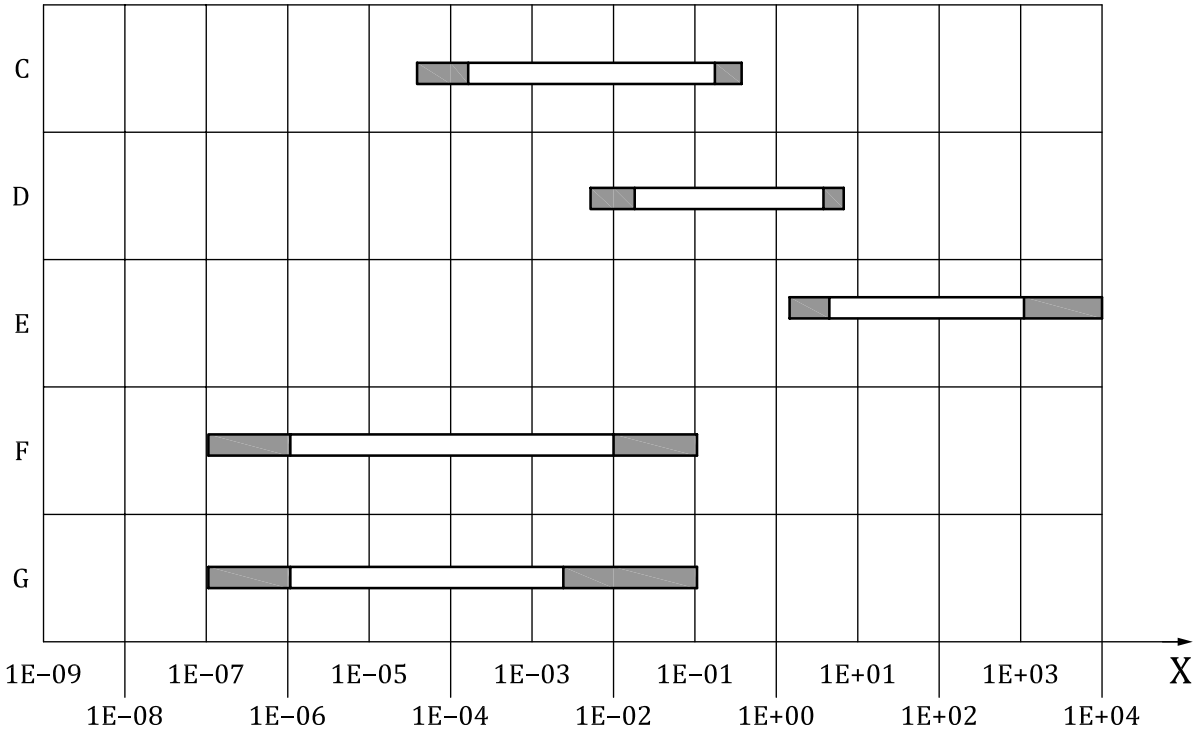
Calibration by comparison (see methods A, A_S, B and B_S below) with known reference leaks is easily possible for leaks with reservoir and leakage rates below 10^{-7} Pa·m^3/s.

Figure 1 gives an overview of the different recommended calibration methods.



a) Calibration by comparison

© ISO 2017 – All rights reserved



b) Calibration by direct measurement

Key

X	leakage rate in $Pa \cdot m^3/s$	C	Method C
A	Method A	D	Method D
B	Method B	E	Method E
A_S	Method A_S	F	Method F
B_S	Method B_S	G	Method G
	normal range		possible range

Figure 1 — Calibration ranges

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.

ISO 20484, *Non-destructive testing — Leak testing — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20484 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

© ISO 2017 – All rights reserved

3.1
unknown leak
leak having a stable and repeatable leakage rate of known order of magnitude that can be determined by calibration

3.2
reference leak
calibrated leak which may be used to calibrate another leak

Note 1 to entry: The uncertainty of the reference leak is lower than the required uncertainty of the leak to be calibrated.

3.3
calibration
set of operations which establish, under specified conditions, the relationship between leakage rate values represented by an unknown leak and the corresponding known values of the leakage rate

Note 1 to entry: In the case of calibration by comparison, the known values of the leakage rate are represented by a reference leak.

Note 2 to entry: Normally, the result of a calibration is given as the leakage rate value for the reference leak with a standard uncertainty.

3.4
nominal leakage rate
leakage rate of a leak calculated for specified reference conditions

Note 1 to entry: In leak detection, leakage rates are commonly given in units of pV-throughput ($Pa \cdot m^3/s$, mbar l/s, Std cm^3/min). These are only a precise measure of gas flow if the temperature is given and kept constant. Flow units such as mass flow (g/y) or molar flow (mol/s) are sometimes used to overcome this problem.

4 Nominal leakage rates

Calibrated leaks are only comparable under the same reference conditions. Nominal leakage rates shall be used for comparison. Recommended reference conditions are:

— Ambient temperature: 20 °C

— Atmospheric exhaust pressure: 1 000 mbar

— Vacuum exhaust pressure: < 100 mbar

The reference inlet pressure is given by the leak reservoir pressure or the application requirement.

5 Classification of leaks

5.1 Permeation leak

This type of leak is normally made with a tracer gas reservoir. It has the best long-term stability but an appreciable temperature coefficient (approximately 3,5 %/K). Typical leakage rates are in the range from 10^{-10} $Pa \cdot m^3/s$ to 10^{-4} $Pa \cdot m^3/s$.

5.2 Conductance leaks

5.2.1 Capillary leak

This type of leak is available with or without a tracer gas reservoir. It has a low temperature coefficient (approximately 0,3 %/K) but easily blocks if not handled with care. Typical leakage rates are greater than 10^{-7} $Pa \cdot m^3/s$.

© ISO 2017 – All rights reserved