



**International
Standard**

ISO 27893

**Vacuum technology — Vacuum
gauges — Evaluation of the
uncertainties of results of
calibrations by direct comparison
with a reference gauge**

*Technique du vide — Manomètres à vide — Évaluation de
l'incertitude des résultats des étalonnages par comparaison
directe avec un manomètre de référence*

**Second edition
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Sample Document

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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 document 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).

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For an explanation of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 112, *Vacuum technology*.

This second edition cancels and replaces the first edition (ISO 27893:2011), which has been technically revised.

The main changes are as follows:

- added [Annex A](#), which describes how to evaluate Type A uncertainties.

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.

Vacuum technology — Vacuum gauges — Evaluation of the uncertainties of results of calibrations by direct comparison with a reference gauge

1 Scope

This document specifies a method for the determination and reporting of measurement uncertainties arising during vacuum gauge calibration by direct comparison with a reference gauge carried out in accordance with ISO 3567.

This document specifies methods for uniform reporting of uncertainties in vacuum gauge certificates. Uncertainties reported in accordance with the guidelines given in this document are transferable in the sense that the uncertainty evaluated for one result can be used as a component in the uncertainty evaluation of another measurement or calibration in which the first result is used.

This document specifies two measurement models that are sufficient to cover most practical cases. However, it is possible that the models given cannot be applied to newly developed vacuum gauges.

The final uncertainty to be reported in a certificate is evaluated from the uncertainties of the input quantities and influence quantities. The principal quantities that can affect the result of a vacuum calibration are described; however, a complete list of the possible quantities that can have an influence on the final result lies outside the scope of this document.

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 3567, *Vacuum gauges — Calibration by direct comparison with a reference gauge*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 99:2007, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3567, ISO/IEC Guide 98-3, ISO/IEC Guide 99 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

corrected reading

value resulting after the reading of the gauge has been corrected for systematic errors

EXAMPLE For the results given in the calibration certificate of the reference standard.

3.2

long-term instability

possible change of calibrated value after long periods of time

EXAMPLE Change resulting from transportation of the device.

Note 1 to entry: Long-term instability is different from reproducibility as defined in ISO/IEC Guide 99:2007, 3.7.

3.3

model

(uncertainty of measurement) mathematical model set out in ISO/IEC Guide 98-3

3.4

offset

zero error

(measuring instruments) datum measurement error where the specified measured quantity value is zero

Note 1 to entry: Adapted from ISO/IEC Guide 99:2007, 4.28.

EXAMPLE The reading when there is no pressure (absolute or differential) or a pressure far below the resolution limit applied to a vacuum gauge.

3.5

deviation of offset

possible difference of an *offset* (3.4) value between the time of the measurement of the *offset* (3.4) and the time when a pressure reading is taken

3.6

reference standard

reference gauge

standard, generally having the highest metrological quality available at a given location or in a given organization, from which measurements made there are derived

Note 1 to entry: Adapted from ISO/IEC Guide 99:2007, 6.6.

EXAMPLE The gauge or standard that gives traceability to the SI unit in the calibration apparatus in accordance with ISO 3567.

3.7

calibration pressure

(vacuum gauges) pressure evaluated from the *corrected reading* (3.1) of the *reference standard* (3.6) and all necessary corrections at the gauge port of the unit under calibration

EXAMPLE Necessary corrections can be for known differences between gauge ports.

3.8

Type A and Type B uncertainties

classifications used to indicate the two different ways of evaluating uncertainty components, which are intended only for convenience of discussion

Note 1 to entry: The classification is not meant to indicate any difference in the nature of the uncertainty components.

Note 2 to entry: Type A uncertainties are evaluated by the statistical analysis of series of observations.

Note 3 to entry: Type B uncertainties are evaluated by means other than the statistical analysis of series of observations.

Note 4 to entry: For more information, see ISO/IEC Guide 98-3.

4 Symbols and abbreviated terms

Symbol or abbreviated term	Designation	Unit
UUC	unit under calibration (vacuum gauge)	—
e	error of reading	in relative units
k	coverage factor to expand standard uncertainty, u	1
p_{UUC}	pressure indication of a UUC corrected for known deviations	Pa
$p_{\text{ind,UUC}}$	pressure indication of a UUC not corrected for any deviation	Pa
p_{std}	pressure indication of reference gauge (reference standard) corrected for known deviations	Pa
$p_{\text{ind,std}}$	pressure indication of reference gauge (reference standard) not corrected for any deviation	Pa
r_{UUC}	quantity determined by a calibration in the quotient model for the UUC	any unit
r_{std}	quantity determined by a calibration in the quotient model for the reference standard	any unit
S	sensitivity of the output of a vacuum gauge	any unit
u	standard uncertainty	any unit
U	expanded uncertainty	any unit
x_{UUC}	indication of a UUC	any unit
x_{std}	indication of a reference gauge	any unit
x_i	(often unknown) input quantities and corrections of gauge	any unit
X_i	(often unknown) input quantities and corrections of calibration method or condition	any unit
Δp	error of pressure reading in absolute units	Pa
δp_i	deviations in the pressure unit (often unknown)	Pa
δx_i	(often unknown) deviations in x_i	any unit
σ_{eff}	effective accommodation factor of a spinning rotor gauge	1

5 Basic concept and model

5.1 General

In a vacuum gauge calibration carried out in accordance with ISO 3567, the corrected reading of a reference gauge gives the value of the quantity that is traceable to the SI. All vacuum gauges shall be calibrated in terms of pressure. This means that the user of the vacuum gauge calibrated in accordance with ISO 3567 and this document obtains a clear assignment of the output quantity of the gauge to the SI unit of pressure, the pascal.