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Vacuum technology — Vacuum gauges — Characteristics for a stable ionisation vacuum gauge

Technique du vide — Manomètres à vide — Caractéristiques des manomètres à ionisation stable

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Foreword

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This document was prepared by Technical Committee ISO/TC 112 "*Vacuum 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.htmlwww.iso.org/members.html.

Introduction

The ionisation vacuum gauge is the only vacuum gauge type in the full range of high and ultrahigh vacuum [1]. The pertinent standardization committee for vacuum technology ISO TC 112 has indicated that important.[1] Important applications need better accuracy, reproducibility and known sensitivities for many gas species, properties which all presentcurrent types of ionisation vacuum gauges lack. This document provides the characteristics for a stable ionisation vacuum gauge so that this gauge is accurate, robust and long-term stable, with known sensitivity for nitrogen and known relative sensitivity factors, and can be built by any experienced manufacturer of other ionisation vacuum gauges.

Vacuum technology — Vacuum gauges — Characteristics for a stable ionisation vacuum gauge

1 Scope

This document describes a special design of an ionisation vacuum gauge which has a well-defined ionising electron path length[2]. [2] Due to the construction design, it promises leads to good measurement accuracy, long-term stability, as well as gauge independent and reproducible sensitivity for nitrogen and relative sensitivity factors[3][3] It is designed for the measurement range of 10^{-6} Pa to 10^{-2} Pa.

This document describes only those dimensions and potentials of the gauge head which are relevant for the electron and ion trajectories. This document does not describe the electrical components necessary to operate the ionisation vacuum gauge in detail. The gauge head can be operated by voltage and power sources and ammeters commercially available, but also by a controller specially built for the purpose of the operation of this gauge head.

The ionisation vacuum gauge described in this document can be built by any experienced manufacturer of other ionisation vacuum gauges. It is not subject to intellectual property protection.

It is assumed for this document that the applicant is familiar with both the physics and principles of ionisation vacuum gauges as well as high and ultra-high vacuum technology in general.

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.

EN ISO 13920:1996, *Welding - General tolerances for welded constructions - Dimensions for lengths and angles - Shape and position (ISO 13920:1996)*

ISO 2768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

ISO 3669, *Vacuum technology — Vacuum gauges — Specifications for hot cathode ionization gauges*

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

ISO 3669: *Vacuum technology — Bakeable flanges — Dimensions of knife-edge flanges*

ISO/IEC Guide 98-1:2009, *Uncertainty of measurement — Part 1: Introduction to the expression of uncertainty in measurement*

ISTA 2A:2011, *Partial simulation tests for testing of individual packaged products weighing 150 lbs (68 kg) or less when prepared for shipment, published by the International Safe Transit Association.*

53 Terms and definitions

The Terms and definitions clause is a mandatory element of the text.

For rules on the drafting of the Terms and definitions, refer to the ISO/IEC Directives, Part 2:2018, Clause 16.

To insert a new terminological entry, go to the *Structure* tab and click on *Insert Term entry*.

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

ISO and IEC maintain terminological 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
Wehnelt electrode or
Wehnelt
an electrode with cylindrical symmetry around the electron emitting cathode, mainly used for focusing of the electron beam

3.2
Ionisation ionisation space
the space in which ions generated by collision of gas molecules with high energy electrons reach the ion collector by means of a suitable electrostatic field

3.3
Faraday cup
metal cup or other piece of metal designed to catch charged particles in vacuum

Note 1 to entry: In the ionisation vacuum gauge described in this document, the Faraday cup is designed to capture the electrons emitted from the cathode

3.4
Envelope
envelope
the metallic wall at zero (earth) potential surrounding the gauge head at least in its full length

3.5
Electron electron transmission
the ratio of electron current measured at the Faraday cup divided by the electron current emitted from the cathode

64 Symbols and abbreviated terms

I	ion current at pressure p [A]
I_0	ion current at residual pressure p_0 [A]

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I_e	electron emission current [A]
p	pressure [Pa]
p_0	residual pressure [Pa]
r_x	relative sensitivity factor as defined in ISO 27894:2009 [1]
S	sensitivity (coefficient) [1/Pa]
S_{N2}	sensitivity for nitrogen [1/Pa]

85 General description of the design

8.25.1 Components

The ionisation vacuum gauge consists of the following functional parts:

a) electron emitting cathode,

b) Wehnelt electrode,

c) anode cage in two parts,

d) ion collector,

e) electron deflector,

f) Faraday cup,

g) envelope.

The functional components a) to f) need to be exactly dimensioned.

In addition, the gauge needs electrical feedthroughs, wires, mounting parts and insulators. The gauge shall be mounted on a DN40CF or on a DN63CF flange according to ISO 3669: with corresponding tube sizes DN40 or DN63 as envelope.

8.45.2 Mode of operation

A schematic for the illustration of the operation of the gauge is shown in Figure 1,Figure 1, for a detailed drawing see Figure 2Figure 2 in 7.2.7.2. For simplification, in Figure 1Figure 1 the anode cage (3) is not been divided in two parts as in Figure 2Figure 2 with (3a) and (3b) and the collector ring (6) in between.

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