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**Vacuum technology - Vacuum gauges - Characterization of
quadrupole mass spectrometers for partial pressure
measurement**

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foreword

This document is in accordance with the provisions of GB/T 1:1-2020 "Guidelines for Standardization Work Part 1: Structure and Drafting Rules for Standardization Documents"

drafting:

This document is equivalent to ISO /T S20175:2018 "Characteristics of quadrupole mass spectrometers for vacuum technology vacuum gauges for partial pressure measurement":

The document type is adjusted from the ISO technical specification to the national standardization guidance document of our country:

Please note that some contents of this document may refer to patents: The issuing agency of this document assumes no responsibility for identifying patents:

Introduction

Quadrupole mass spectrometers (QMS) are now used not only for leak monitoring and residual gas analysis in vacuum technology, but also as a

An instrument used to provide quantitative analysis and industrial process control in processes such as physical, chemical vapor deposition, and corrosion: In EUV light

In the engraving, semiconductor and medical industries, the outgassing rate is an important characteristic of vacuum components, and the quantitative test of these outgassing rates also uses a quadrupole mass spectrometer:

The total pressure, the composition of the mixed gas, the setting of the QMS and the past use of the QMS will all affect the measurement signal, uncertainty and

Apps have a noticeable impact: Therefore, it is unrealistic to calibrate the QMS in all possible application scenarios, but to use the QMS according to the QMS

Calibrate under specific or standard conditions: This document is used to determine these

calibration conditions:

In order to ensure that users can compare different brands of QMS manufacturers and use the QMS correctly, it is also necessary to label these conditions:

standardized:

This document provides standardized calibration procedures for some important applications of QMS: These procedures are excerpts from an international

Research results of the project EMRP (European Metrology Research Project) IND12: During the research and development process of this project, the research scope involved quadrupole mass spectrometry

Manufacturers, distributors and users of the instrument:

Vacuum Technology Vacuum Gauge

Quadrupole Mass Spectrometer Characteristics for Partial Pressure Measurements

1 Scope

This document specifies the characteristics of a quadrupole mass spectrometer whose ion source is of the electron bombardment type and whose atoms have a small mass-to-charge ratio (m/z)

at 300:

This document does not apply to quadrupole mass spectrometers equipped with other types of ion sources, such as chemical ionization, photoionization, or field

Ionization-type ion sources are also not suitable for analysis and measurement of quadrupole mass spectrometers with large mass-to-charge ratios (m/z), which are mainly used to detect organic materials:

According to published literature, the metrological characteristics of a quadrupole mass spectrometer depend on the instrument settings, total pressure and gas mixture composition, so

Therefore, it is impractical to calibrate a quadrupole mass spectrometer for all application conditions: The characterization methods specified in this document include vacuum system

Continuous leak monitoring, leak rate measurement with tracer gas, residual gas analysis and material outgassing rate testing: Users can choose to suit their needs

Other application situations can also refer to the characteristic method of this document:

It is known that the stability of some parameters of quadrupole mass spectrometer is poor, especially the sensitivity: Therefore, the calibrated parameters, when higher accuracy is

required, still

Repeated recalibration is required: Under actual working conditions, it can only be calibrated on site: Therefore, this document not only describes the capabilities of a calibration laboratory or national metrology institute:

How to calibrate a quadrupole mass spectrometer with direct traceability to the International System of Units (SI), and describes how the calibrated can be inspected and maintained in the field

parameter:

According to its physical principle, quadrupole mass spectrometer needs high vacuum environment: By reducing the inlet size or by using a special ion source in combination with a split flow pump

Combined, the operating range of a quadrupole mass spectrometer can be extended to higher pressures, up to atmospheric pressure: However, this document does not apply to

Gas technology quadrupole mass spectrometer: Therefore, the pressure range at the inlet of the quadrupole mass spectrometer in this document does not exceed 1Pa:

This document does not specify how the manufacturer or distributor should adjust the initial parameters of the quadrupole mass spectrometer, these initial parameters are mainly used to provide

An exact m/z , constant mass resolving power or constant transmission probability, these are the fundamental parameters of the device: Conversely, this document has by default

A parameter readjustment program provided by the manufacturer, the user can readjust the parameters in the field: This procedure is designed to ensure the characteristics of the quadrupole mass spectrometer

The parameters are all in the optimal state:

This document is intended to allow users to obtain the best metrological results from their quadrupole mass spectrometer: The survey found that, in most cases, the ability to scan

This effect is obtained in "mode": Histograms may also exhibit adequate metrological characteristics, depending on the software used for

Evaluate data acquired by a quadrupole mass spectrometer: However, on the mass scale, a shift in the peak position causes a change in the ion current, which can be seen in the mass spectrum

introduce additional uncertainty: Therefore, scan mode is superior to most of the measurement procedures in this document:

It is not the purpose of this document to determine all parameters for each quadrupole

mass spectrometer: However, to specify or measure the parameter values in this document (For example, for inspection and testing), it is necessary to follow the procedures specified in this document:

This document assumes that the user is familiar with the operation of a quadrupole mass spectrometer, as well as high vacuum and ultra-high vacuum techniques:

2 Normative references

The contents of the following documents constitute the essential clauses of this document through normative references in this document: Among them, dated references

For documents, only the version corresponding to the date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to

this document:

GB/T 34873-2017 Calibration for direct comparison of vacuum gauges with standard vacuum gauges (ISO 3567:2011, IDT)