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Vacuum technology — Valves — Leak test

Technique du vide — Vannes à vide — Essai d'étanchéité des vannes à vide

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 27895 was prepared by Technical Committee ISO/TC 112, *Vacuum technology*.

Introduction

Vacuum valves are the most common parts in vacuum systems. Valve manufacturers provide technical data for vacuum valves based on their own test methods and end users use these data to select valves. However, until the time of publication, there has been no International Standard specifying leak test methods for vacuum valves even though leak rate data are among the most fundamental. For example, the leak rate of the valve may vary in the time interval between gas filling and leak testing.

There are three different types of leak: a) real leaks, i.e. macroscopic cracks or holes allowing gases to pass through; b) virtual leaks, caused by outgassing of volatile material inside a vacuum system or trapped volume; c) permeation leaks, i.e. microscopic holes of diameter comparable to that of an atom, which occur throughout the construction material, e.g. in elastomers.

Virtual leaks are not measurable by the leak test method specified in this International Standard. Valve design and the materials used should therefore be chosen to minimize the risk of virtual leaks occurring.

Vacuum technology — Valves — Leak test

1 Scope

This International Standard specifies methods for the leak testing of vacuum valves used for control of gas flow or vacuum pressure in a vacuum system. It is applicable to vacuum valves that can be closed to leak rates less than 1×10^{-5} Pa m^3/s for trace gas. The methods employ a sealing arrangement for the valve body, which is also specified in this International Standard. The methods are suitable for the verification of valve specifications.

A valve leak rate less than the nominal leak rate specified by the manufacturer during and after the operation enables the specification of such valve operating conditions as operating pressure range, permissible pressure difference between ports, bake-out temperature or operating temperature, and life cycle.

NOTE 1 The data for large valves and valves without a valve body can vary from those obtained during delivery inspection depending on the accuracy of the attachment surface of the vacuum device.

NOTE 2 The data obtained from this procedure is based on the testing conducted on an individual unit of a vacuum valve and they can be different from those obtained during delivery inspection if the test is performed with the valve incorporated into the equipment.

2 Normative references

The following referenced documents are indispensable for the application 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 3530, *Vacuum technology — Mass-spectrometer-type leak detector calibration*

3 Terms and definitions

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

3.1
leak rate
q
⟨vacuum valve technology⟩ throughput of a trace gas, which passes through a crack, hole or gap in the wall, seat or sealing material of a valve under specific conditions

NOTE 1 Adapted from ISO 3530:1979, 2.5.1.

NOTE 2 The leak rate is expressed in pascal cubic metres per second.

NOTE 3 The leak rate of the trace gas can be measured using a mass spectrometer-type leak detector. The leak rate depends on type of gas, pressure difference, and temperature.

NOTE 4 The definitions **standard air leak rate** (3.2) and **equivalent standard air leak rate** (3.3) are more specific.

3.2
standard air leak rate
throughput, through an opening such as a crack or hole, of atmospheric air having a dew point of less than –25 °C under standard conditions: an inlet pressure of (100 ± 5) kPa; an outlet pressure of less than 1 kPa; and a temperature of (23 ± 7) °C

NOTE 1 Adapted from ISO 3530:1979, 2.5.2.

NOTE 2 The standard conditions are taken from ISO 3530.

3.3
equivalent standard air leak rate
short-path leaks of the molecular type having standard air leak rates of less than 10^{-7} Pa m^3/s

EXAMPLE Helium (relative atomic mass 4) passes through such leaks more rapidly than air (average relative molecular mass 29,0), and a given flow rate of helium corresponds to a smaller flow rate of air.

NOTE 1 "Equivalent standard air leak rate" is taken as $(4/29)^{1/2} = 0{,}37$ times the helium leak rate under the standard conditions specified in ISO 3530.

NOTE 2 Adapted from ISO 3530:1979, 2.5.3.

3.4
trace gas
gas used to detect leaks

NOTE Mass-spectrometer-type leak detectors are used as the leak measurement instrument. If a helium mixture is used, the leak rate is reported as a helium-equivalent value.

3.5
operating pressure
p_o

⟨vacuum valve technology⟩ pressure range for a valve in working condition

NOTE If a pressure is within the operating pressure range, the valve can have a leak rate smaller than that specified by the manufacturer.

3.6
maximum operating pressure
$p_{o,\,max}$
⟨vacuum valve technology⟩ highest pressure at which the valve operates within its specifications

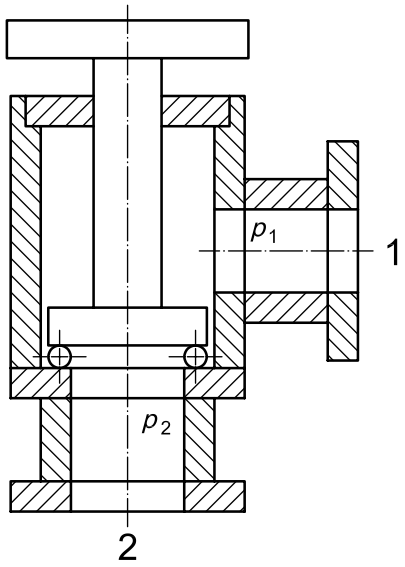
3.7 Pressure difference

NOTE 1 Figures 1 and 2 show schematic diagrams of angle valves and gate valves, respectively.

NOTE 2 Manufacturers of bellow-sealed angle valves often specify a maximum pressure difference separated as differential pressures in the opening and closing directions. Usually, the critical case is the differential pressure in the opening direction (p_1 at "vacuum" and p_2 at maximum pressure).

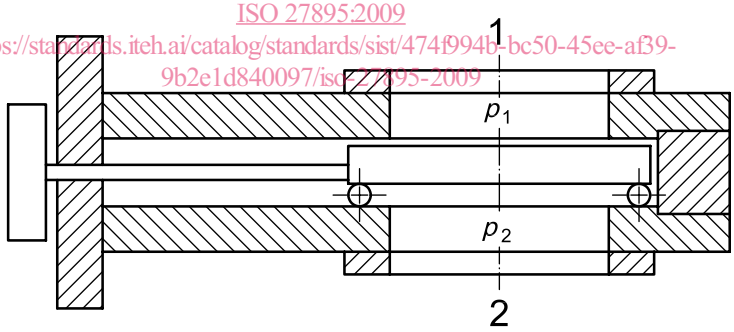
3.7.1
pressure difference
Δp
⟨conventional angle and gate valves⟩ pressure difference between p_1 and p_2, where p_2 is the pressure at the space toward the valve disc with elastomer on the valve seat and p_1 is the pressure of the opposite side within the valve

3.7.2
pressure difference
Δp
⟨bellow-sealed angle valves⟩ pressure difference between p_1 and p_2, where in the opening direction p_1 is the residual pressure at "vacuum" and p_2 is the maximum pressure



Key
1 port A
2 port B

Figure 1 — Angle valve



Key
1 port A
2 port B

Figure 2 — Gate valve

3.8
maximum pressure difference
Δp_{max}
greatest pressure difference at which the valve can operate normally

NOTE If a pressure difference is lower than Δp_{max}, the valve can have a leak rate smaller than that specified by the manufacturer.

3.9
pressure range of compressed air for a pneumatic valve
p_p
pressure range of the compressed air specified by the manufacturer for a pneumatic valve closed or opened by compressed air