
International Standard



1608/1

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Vapour vacuum pumps — Measurement of performance characteristics — Part 1 : Measurement of volume rate of flow (pumping speed)

Pompes à vide à jet de vapeur — Mesurage des caractéristiques fonctionnelles — Partie 1 : Mesurage du débit-volume

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1608/1 was developed by Technical Committee ISO/TC 112, *Vacuum technology*.

It was submitted directly to the ISO Council, in accordance with clause 5.10.1 of the Directives for the technical work of ISO. It cancels and replaces ISO Recommendation R 1608-1970, which had been approved by the member bodies of the following countries :

Belgium	India	Spain
Czechoslovakia	Israel	Sweden
Egypt, Arab Rep. of	Italy	Switzerland
Germany, F. R.	Japan	Thailand
Greece	Netherlands	Turkey
Hungary	Peru	United Kingdom

The member bodies of the following countries had expressed disapproval of the document on technical grounds :

France
USA

Vapour vacuum pumps — Measurement of performance characteristics —

Part 1 : Measurement of volume rate of flow (pumping speed)

0 Introduction

The purpose of this International Standard is to ensure that measurements of the performance characteristics of vapour vacuum pumps are, as far as possible, carried out by uniform procedures and under uniform conditions. It is hoped that, as a result, measurements conducted by different manufacturers or in different laboratories, and statements of performance quoted in manufacturers' literature, will be on a properly comparable basis to the benefit of both user and manufacturer.

It is envisaged that the complete International Standard will, in due course, deal comprehensively with the measurement of a wide range of performance characteristics of the main types of vapour vacuum pumps. In order, however, that useful agreements of more restricted scope may be implemented with the least possible delay, it is intended to publish this International Standard in parts.

1 Scope and field of application

This part of ISO 1608 specifies methods of measuring the volume rate of flow of vapour vacuum pumps.

The pumps considered comprise the following three classes of oil and mercury vapour pumps :

- diffusion pumps;
- ejector pumps;
- booster pumps (i.e. pumps capable of operation in both the molecular and laminar flow regions, so combining the properties of diffusion and ejector pumps).

These pumps may be with or without baffle(s) or trap(s).

2 Definitions

For the purposes of this International Standard, the following definitions apply.

2.1 volume rate of flow; pumping speed : Under ideal conditions, the volume of gas which flows in unit time through the pump inlet.

For practical purposes, however, the volume rate of flow (q_v) of

a given pump for a given gas is, by convention, taken to be the quotient of the throughput (P) of that gas and the equilibrium pressure (p) at a specified position in a given test dome, and under specified conditions of operation.

Thus $q_v = P/p$. The units adopted for the volume rate of flow are the cubic metre per hour (m^3/h) or the litre per second (l/s). For vapour pumps this form of expression of volume rate of flow is considered to be valid only if p exceeds $10 p_0$ where p_0 is the ultimate pressure measured by means of the same gauge (see 2.3).

2.2 test dome, test header : A chamber of specified form and dimensions attached to the inlet of the pump through which a measured flow of gas may be admitted to the pump, and which is equipped with means of pressure measurement.

2.3 ultimate pressure : The limiting pressure approached asymptotically in the dome, with the gas inlet valve closed and the pump in normal operation.

3 Apparatus

3.1 Test dome, cylindrical and of the form shown in the figure. The axial dimension of the dome is $1,5 D$, where D is the internal diameter, and the test gas entrance is on the axis at a distance D from the connecting flange and so arranged that the gas entrance into the dome is in a direction away from the pump mouth. The connection to the pressure measuring gauge is at a distance $0,5 D$ from the connecting flange with its axis perpendicular to that of the dome. The axis of the test dome shall be perpendicular to the plane of the inlet flange (or inlet) of the pump.

The internal diameter of the test dome shall be the same as that of the mouth of the pump, or of the inlet of any baffle or trap which may be incorporated.

NOTE — If internal parts of the pump protrude beyond the flange (or inlet plane) of the pump, the reference plane is at the highest point of these internal parts and at this plane the pump mouth diameter is defined by the arrangement specified by the manufacturer.

3.2 Pressure gauge, calibrated to an accuracy within $\pm 5 \%$ for pressures greater than or equal to 1 Pa^* and within $\pm 10 \%$ for lower pressures.

* $100 \text{ Pa} = 100 \text{ N/m}^2 = 1 \text{ mbar}$; $133 \text{ Pa} \approx 1 \text{ torr}$

3.3 Test gas.

Dry air shall be used unless otherwise specified.

3.4 Gas throughput measuring device.

The method adopted for measuring the throughput of gas will depend on the throughput required. The accuracy shall reach

- a) $\pm 3\%$ for throughputs greater than 1 W;
- b) $\pm 5\%$ for throughputs between 1 and 10^{-4} W;
- c) $\pm 10\%$ for lower throughputs.

4 Test method

4.1 Principle

The method adopted is the "constant-pressure" method, in which the pressure at the mouth of the pump is intended to be kept constant during the measuring procedure. In practice, this condition is considered satisfied if the pressure measured in the test dome remains constant.

4.2 Procedure

For measurement of the volume rate of flow, the test dome, pressure measuring gauge and flow meter shall be fitted to the pump in accordance with clause 3. For the purpose of the test, the pump shall be run with the prescribed charge and grade of fluid and at the heating power specified by the manufacturer. The ambient temperature shall be kept constant within $\pm 1^\circ\text{C}$, for the period of the test, in the range 15 to 25°C unless otherwise specified. The test dome shall be evacuated when isolated from the gas inlet system until, over a period of 1 h, no further pressure drop is observed in the dome and the pump has reached its equilibrium operating temperature. Gas shall then be admitted into the dome in such a manner as to produce the required measurement pressure and the system shall be allowed to reach a state of pressure equilibrium before measurements are commenced.

The volume rate of flow shall be measured at a series of pump inlet pressures, at least three measurements being taken within any one power of 10 of the inlet pressure. In all cases the series of measurements shall commence at the lowest pressure concerned. However, in the case of vapour booster pumps, it is desirable to include a corresponding series of measurements commencing at the highest pressure. For each measurement point, the inlet pressure, ambient atmospheric pressure and the throughput of gas shall be determined.

Inlet pressure and input flow of gas shall, as far as possible, be measured simultaneously. If the metering of the input gas takes more than 60 s, a pressure measurement shall be taken for each period of 60 s and the mean value recorded. If the highest and lowest readings differ by more than 10 %, the measurement shall be repeated.

5 Test report

5.1 Test results

The relation between the inlet pressure and the volume rate of flow shall be shown on a graph using a logarithmic abscissa for pressure, covering the range from the ultimate pressure up to atmospheric pressure, or such other range as may be appropriate to the design of pump, and a linear ordinate for the volume rate of flow. The corresponding relation between the inlet pressure and the throughput of gas shall be shown on a graph using a logarithmic abscissa for the pressure and a logarithmic ordinate for the throughput.

5.2 Test conditions

All test reports shall include a statement of the conditions existing during the test as follows :

- a) type and conditions of operation of all gauges used;
- b) type of gasket used on the pump inlet flange;
- c) type of any baffle(s) and/or trap(s) employed, and their temperatures during the test;
- d) maximum and minimum inlet and outlet temperatures, of vapour pump cooling water or refrigerant, during the test;
- e) cooling water flow rate;
- f) type and quantity of vapour pump fluid;
- g) type and flow rate of backing pump, if used;
- h) heating power of the pump and limits of variation during the test;
- i) backing pressure and the type of gauge used to measure it;
- j) ambient temperature.

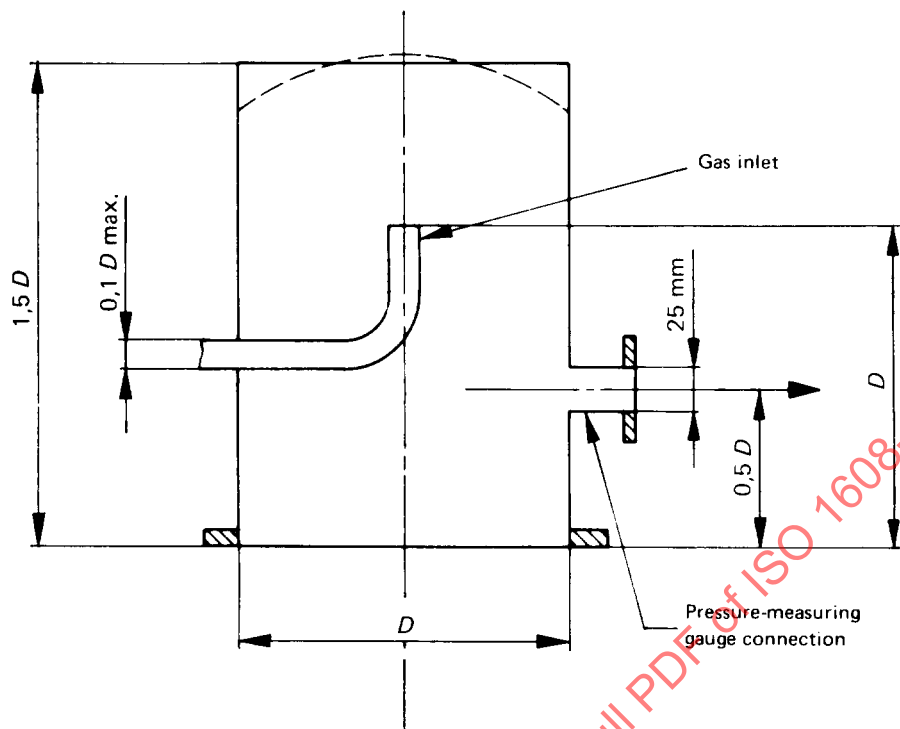


Figure — Recommended form of test dome

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