TC 112

# INTERNATIONAL STANDARD ISO 1608/II

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

## Vapour vacuum pumps — Measurement of performance characteristics — Part II : Measurement of critical backing pressure

*Pompes à vide à jet de vapeur — Mesurage des caractéristiques fonctionnelles — Partie II : Mesurage de la pression critique de refoulement*

**First edition — 1978-12-01**



**UDC 621.527 : 531.787** **Ref. No. ISO 1608/II-1978 (E)**

**Descriptors** : pumps, vacuum pumps, performance evaluation, performance tests, pressure measurement, critical pressure.

Price based on 3 pages

## 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/II was developed by Technical Committee ISO/TC 112, *Vacuum technology*, and was circulated to the member bodies in October 1977.

It has been approved by the member bodies of the following countries :

| | | |
|---|---|---|
| Australia | Germany, F.R. | South Africa, Rep. of |
| Belgium | India | Spain |
| Brazil | Italy | Turkey |
| Bulgaria | Korea, Rep. of | United Kingdom |
| Chile | Mexico | U.S.A. |
| Czechoslovakia | Netherlands | Yugoslavia |
| France | Romania | |

No member body expressed disapproval of the document.





Printed in Switzerland

# Vapour vacuum pumps — Measurement of performance characteristics — Part II : Measurement of critical backing pressure

## 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.

Part I deals with the measurement of the volume rate of flow (pumping speed).

This present document for the measurement of critical backing pressure constitutes part II of the overall International Standard.

## 1 SCOPE AND FIELD OF APPLICATION

**1.1** This part of the International Standard specifies a method of measuring the critical backing pressure of vapour vacuum pumps.

The critical backing pressure is that backing pressure above which the operating conditions of the pump are affected in such a manner that its performance ceases to be satisfactory.

The dependence of the performance of a vapour pump on the backing pressure can only be completely described by means of a curve relating the inlet and backing pressures over the range of operation.

In many cases it is adequate to specify the critical backing pressure by a single parameter which is defined in 2.1. In some cases, however, especially where ultra-high vacuum performance is of interest, or where gases such as hydrogen and helium are concerned, the complete curve may be required.

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

- vapour jet vacuum pump;
- diffusion pumps;
- diffusion-ejector pumps.

## 2 DEFINITIONS

For the purpose of this International Standard the following definitions apply :

**2.1 critical backing pressure :**

**2.1.1** General case — For a stated throughput, the lowest value of the backing pressure at which a small percentage increment in the backing pressure causes a specified percentage rise in the inlet pressure.

NOTE — For the purpose of this International Standard, the minimum value of this specified increment is 10 %.

**2.1.2 "no-load" critical backing pressure :** The value of the critical backing pressure corresponding to zero admitted throughput.

**2.1.3 "full-load" critical backing pressure :** The value of the critical backing pressure corresponding to the maximum throughput for stable operation of the pump.

**2.2 test dome; test header :** A chamber of specific 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.

NOTE — In practice the limiting pressure is considered as having been reached after pumping for sufficient time to establish that further reduction in pressure will be negligible.

## 3 APPARATUS

**3.1 Test dome,** as shown in figure 1 and described in ISO 1608/I.

The general arrangement of the test equipment should be as shown in figure 2. The following equipment is required :

1) A controllable valve (A) for admitting gas to the test dome, combined with a suitable throughput-measuring device.

2) A controllable gas admittance valve (B), mounted at the inlet on the backing pump, to regulate the backing pressure.

3) A gauge (C) for measuring the pressure in the backing line adjacent to the outlet of the vapour pump. This gauge is fitted in a straight uniform portion of the backing line, the diameter of which should be equal to that of the outlet of the vapour pump. Its tubulation should be perpendicular to the axis of this portion of the backing line and should terminate flush with its internal surface.

4) A gauge (D) for measuring the pressure in the test dome. This gauge shall not protrude into the test dome more than 0,5 gauge-tubulation diameter ($d_2$).

The gauges for the measurement of pressure shall be calibrated to an accuracy within ± 5 % for pressures above or equal to 1 Pa* and within ± 10 % for lower pressures.

**3.2 Test gas :** dried air should be used unless otherwise specified.

NOTE — The drying of the air by means of silica-gel, for example, is normally adequate.

## 4 TEST METHOD

### 4.1 General

For the purpose of measurement of the critical backing pressure the vapour pump shall be run with the prescribed quantity and type of pump fluid, heating power and cooling specified by the manufacturer.

The room temperature shall be between 15 and 25 °C throughout the test. The pump shall have reached its thermal equilibrium before the tests are carried out. The dome shall be evacuated until limit pressure is obtained before the introduction of any gas.

In these conditions, the temperature of the apparatus above the pump inlet (see figure 1) and of the piping between pump outlet flange and valve B (see figure 2) should be steady to ± 1 °C and shall be between 15 and 25 °C.

### 4.2 "No-load" procedure

When the limit pressure has been reached in the test header, the gas admittance valve (B) in the backing line is gradually opened and the backing pressure increased in small increments. This is continued until the condition specified in the note to 2.1.1 is approximately located. This critical region is then explored in more detail by appropriate manipulation of the admittance valve (B). A curve of the inlet pressure as a function of the backing pressure is derived. The point on this curve corresponding to the condition specified in the note to 2.1.1 then identifies the "no-load" critical backing pressure. The initial pressure in the backing line with no gas flow should be less than 10 % of the measured critical backing pressure.

### 4.3 Full load and intermediate load procedures

**4.3.1** The gas admittance valve (A) on the test header is then opened until a desired vapour pump inlet pressure is reached, and the throughput measured. The procedure of admitting gas through valve (B) as described in 4.2 is then repeated, valve (B) being closed between successive operations, until the maximum throughput for normal stable pump operation is reached.

NOTE — The maximum throughput for normal stable pump operation may depend on the flow rate of the backing pump. When this flow rate is not larger than the value corresponding to the rated maximum throughput for normal operation of a vapour pump divided by the critical backing pressure at this throughput, it is necessary that this test procedure be carried out using a sufficiently large capacity backing pump to allow the attainment of this rated maximum throughput.

**4.3.2** During the tests described in 4.2 and 4.3.1, the power input to the vapour pump shall be kept within ± 4 % of its nominal value, and shall be held within these limits for at least 30 min prior to the commencement of the test. The cooling rate shall be maintained constant to within ± 10 % of the value recommended by the manufacturer.

## 5 TEST REPORT

### 5.1 Test results

The critical backing pressure should be expressed in pascals (Pa) and the throughput in pascal litres per second (Pa·l/s). The relation between the critical backing pressure and the throughput of gas should be shown on a graph unless otherwise specified. The percentage rise in inlet pressure used to define the critical backing pressure in 2.1.1 shall be noted on this graph.

In cases where there is no abrupt increase in the pressure on the high vacuum side, a curve showing the relation between the backing pressure and the pressure on the high vacuum side with no throughput should be provided.

### 5.2 Test conditions

All reports of test results should include a statement of the following conditions existing during the test :

a) type and conditions of operation of all gauges used;

b) heating power of the pump and limits of variation during the test;

c) maximum and minimum inlet and outlet tempera-

* 100 Pa = 100 N/m$^2$ = 1 mbar

tures of vapour pump cooling water or refrigerant during the test, if applicable;

d) cooling water flow rate, if applicable;

e) maximum and minimum ambient temperatures during the test;

f) type and quantity of the vapour pump fluid;

g) where applicable, any special features of the heat transfer to the environment.

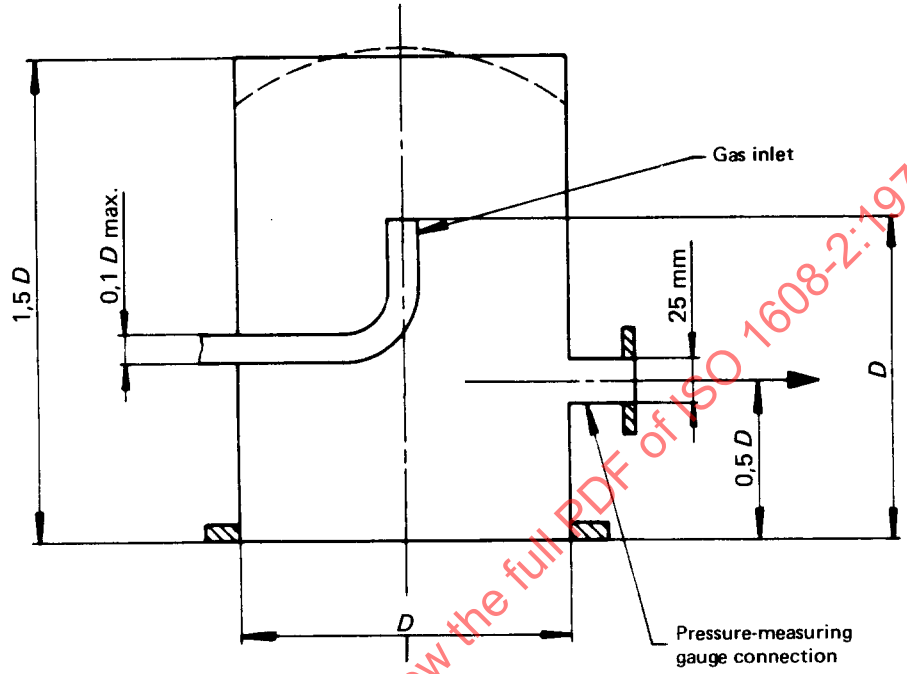


FIGURE 1 – **Recommended form of test dome**

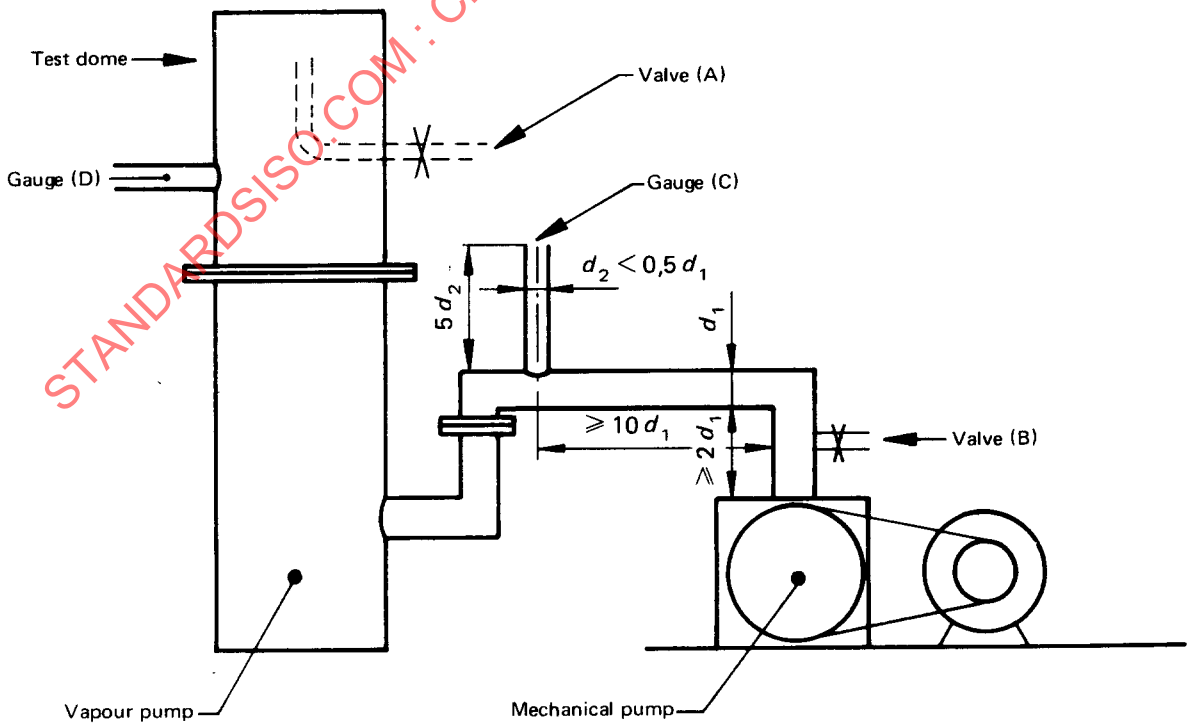


FIGURE 2 – **Arrangement of test equipment**