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R 1608

METHODS OF MEASUREMENT OF THE PERFORMANCE CHARACTERISTICS OF VAPOUR VACUUM PUMPS

PART I

MEASUREMENT OF THE VOLUME RATE OF FLOW (PUMPING SPEED)

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BRIEF HISTORY

The ISO Recommendation R 1608, *Methods of measurement of the performance characteristics of vapour vacuum pumps – Part I : Measurement of the volume rate of flow (Pumping speed),* was drawn up by Technical Committee ISO/TC 112, *Vacuum technology,* the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led to the adoption of Draft ISO Recommendation No. 1608, which was circulated to all the ISO Member Bodies for enquiry in June 1968. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Belgium	Israel	Sweden
Czechoslovakia	Italy	Switzerland
Germany	Japan	Thailand
Greece	Netherlands	Turkey
Hungary	Peru	U.A.R.
India	Spain	United Kingdom

The following Member Bodies opposed the approval of the Draft :

France
U.S.A.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 1608 August 1970

METHODS OF MEASUREMENT OF THE PERFORMANCE CHARACTERISTICS OF VAPOUR VACUUM PUMPS

PART I

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INTRODUCTION

The purpose of this ISO Recommendation and of others in this series 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 series of ISO Recommendations 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 these Recommendations separately.

1. SCOPE

This ISO Recommendation concerns 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 :

(*a*) vapour diffusion pumps;

(*b*) vapour ejector pumps;

(*c*) vapour booster pumps (i.e. vapour 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. EXPLANATION OF TERMS

For the purposes of this ISO Recommendation the following explanations of terms 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 $q_v = \frac{P}{p}$. 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 clause 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, page 8. 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 internal diameter of the test dome should be the same as that of the mouth of the pump, or of the inlet of any baffle or trap which may be incorporated.

NOTES

1. The axis of the test dome should be perpendicular to the plane of the inlet flange (or inlet) of the pump.
2. 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 ± 5 % for pressures greater than or equal to 1 N/m^2 (7.5×10^{-3} torr), and within ± 10 % for lower pressures.

3.3 *Test gas.* Dry air should 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 should reach

(*a*) ± 3 % for throughputs greater than 1 W (7.5 torr l/s);

(*b*) ± 5% for throughputs between 1 and 10^{-4} W (between 7.5 and 7.5×10^{-4} torr l/s);

(*c*) ± 10 % for lower throughputs.

4. TEST METHOD

4.1 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 measured pressure in the test dome remains constant.

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

The volume rate of flow should 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 should 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 should be determined.