

Specification for

# Testing of positive displacement compressors and exhausters —

**Part 2: Methods for simplified  
acceptance testing for air compressors  
and exhausters**

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## Foreword

BS 1571 was first published in 1949 under the title “Acceptance tests for positive-displacement compressors and exhausters” and this is the second Part of the metric revision.

The revision is published in two Parts, Part 1 “Acceptance tests” and Part 2 “Simplified acceptance tests for air compressors and exhausters”, and it covers the specifications previously contained in BS 726 “Measurement of air flow for compressors and exhausters” and BS 1571, both of which will now be withdrawn.

This Part of the standard complies with annex A of Part 1:1987 and specifies the conditions under which an air compressor or exhauster can be tested provided that a compressor or exhauster of the same series has already been type tested in accordance with Part 1 of this standard.

Such tests will generally be necessary to verify guarantees given for one or more of the following particulars:

- a) capacity;
- b) shaft input power or specific energy consumption;
- c) speed.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 20, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 1 Scope

**1.1 General.** This standard specifies acceptance tests for positive displacement air compressors and exhausters, the absolute intake pressures of which exceed approximately 1 mbar<sup>1)</sup>. In establishing the scope of this standard a positive displacement compressor is considered as a machine where a static pressure rise is obtained by allowing successive volumes of air to be aspirated into and exhausted out of an enclosed space by means of the displacement of a moving member. The standard applies to such machines as reciprocating and rotary compressors.

### 1.2 Guiding principles

**1.2.1** Only those measurements necessary to verify any guarantee given by the manufacturer to the purchaser shall be taken, together with any other observations called for when placing the contract or as may be subsequently agreed between the purchaser and the manufacturer.

**1.2.2** The test conditions shall be as close as is reasonably possible to the guarantee conditions, and deviations from these shall not exceed the limits specified below:

- speed  $\pm 5\%$ ,
- absolute intake pressure  $\pm 5\%$ ,
- temperature of cooling water  $\pm 8\text{ }^{\circ}\text{C}$ ,
- pressure ratio  $\pm 1\%$ .

Where it is not feasible to test a machine within the limitations specified above, special conditions of test or special corrections shall be agreed between the purchaser and the manufacturer.

**1.2.3** The compressor on test will be deemed to be acceptable provided the results obtained do not differ from the type test results by more than the allowances given in Table 1.

The need for simplified tests at other than full capacity shall be the subject of agreement between the manufacturer and the purchaser.

## 2 References

The titles of the British Standards referred to in this standard are listed on the inside back cover.

## 3 Definitions

For the purposes of this British Standard the following definitions apply.

### 3.1

#### total pressure

the pressure measured at the stagnation point when a moving air stream is brought to rest and its kinetic energy is converted by an isentropic compression from the flow condition to the stagnation condition. It is the pressure usually measured by a pitot tube. In a stationary body of air the static and the total pressures are numerically equal

### 3.2

#### static pressure

the pressure measured in such a manner that no effect on measurement is produced by the air velocity

### 3.3

#### dynamic (velocity) pressure

the total pressure minus the static pressure

### 3.4

#### atmospheric pressure

the absolute pressure of the atmosphere measured at the test place

### 3.5

#### gauge (effective) pressure

the pressure measured above the atmospheric pressure

<sup>1)</sup> 1 mbar =  $10^2\text{ N/m}^2$  = 0.1 kPa.

**3.6****absolute pressure**

the pressure measured from absolute zero, i.e. from absolute vacuum. It equals the algebraic sum of atmospheric pressure and gauge pressure

**3.7****vacuum**

the difference between the atmospheric pressure and the absolute pressure when the latter is the smaller

**Table 1 — Capacity and specific energy consumption: tolerances for simplified test**

| Compressor shaft input at normal load | 100 % capacity |                             | 50 % capacity |                             |               |
|---------------------------------------|----------------|-----------------------------|---------------|-----------------------------|---------------|
|                                       | Capacity       | Specific energy consumption | Capacity      | Specific energy consumption | No load power |
|                                       | %              | %                           | %             | %                           | %             |
| Below 10 kW                           | ± 6            | ± 7                         | —             | —                           | ± 20          |
| 10 kW to 100 kW                       | ± 5            | ± 6                         | ± 7           | ± 7                         | ± 20          |
| Above 100 kW                          | ± 4            | ± 5                         | ± 5           | ± 6                         | ± 20          |

**3.8****standard inlet point**

the inlet point considered representative for each compressor. This point varies with compressor design and types of installation

NOTE 1 The standard inlet point of a stationary compressor is generally at the inlet flange.

NOTE 2 The standard inlet point of a portable compressor is a point close to the compressor chosen so that the thermometer is unaffected by the compressor operation.

**3.9****standard discharge point**

the discharge point considered representative for each compressor. This point varies with compressor design and type of installation

NOTE 1 The standard discharge point of a stationary compressor is generally at the compressor discharge flange.

NOTE 2 The standard discharge point of a portable compressor is the outlet valve on the air receiver.

**3.10****inlet pressure**

the average absolute total pressure at the standard inlet point

NOTE The absolute total pressure may be replaced by the absolute static pressure if it can be shown that the effect on the test results is insignificant in relation to the accuracy of testing.

**3.11****discharge pressure**

the average absolute total pressure at the standard discharge point

NOTE The absolute total pressure may be replaced by the absolute static pressure if it can be shown that the effect on the test results is insignificant in relation to the accuracy of testing.

**3.12****pressure ratio**

the ratio of the discharge pressure to the inlet pressure

NOTE 1 Stage pressure ratio is the pressure ratio for any particular stage in a multistage compressor, the discharge pressure being taken before the intercooler.

NOTE 2 The overall stage pressure ratio is the pressure ratio for any particular stage in a multistage compressor, the discharge pressure being taken after the intercooler (including separators).

**3.13****total temperature**

the temperature that would be measured at the stagnation point if the air stream were brought to rest and its kinetic energy converted by an isentropic compression from the flow condition to the stagnation condition

**3.14****inlet temperature**

the total temperature at the standard inlet point of the compressor

**3.15****discharge temperature**

the total temperature at the standard discharge point of the compressor

**3.16****free air**

air at the atmospheric conditions of the site and unaffected by the compressor

**3.17****capacity of a compressor.** (Free air delivered, F.A.D.)

the actual volume rate of flow of air compressed and delivered at the standard discharge point, referred to conditions of total temperature, total pressure and composition (e.g. humidity) prevailing at the standard inlet point.

**3.17.1****capacity of a vacuum pump**

the actual volume rate of flow of air aspired and compressed by the first stage of a vacuum pump and referred to conditions of total temperature, total pressure and composition (e.g. humidity) prevailing at the standard inlet point

NOTE It is normally assumed that the final stage of the vacuum pump discharges to a pressure of 1 bar<sup>2)</sup> absolute.

**3.18****shaft input power (absorbed power)**

the power required at the compressor drive shaft. Losses in external transmissions such as gears and belt drives are not included

**4 Units and symbols**

**4.1 General.** For the purposes of this standard the units, symbols and subscripts of **4.2** and **4.3** apply. The list takes into account the following requirements.

- The same symbols shall be used for the same quantities regardless of the units used.
- For any one quantity a single symbol shall be used with subscripts added to indicate all values other than the primary one.
- The same symbols shall be used for a given concept regardless of the number of special values which occur.
- Letter subscripts shall be used to denote values under special conditions.
- Numerical subscripts shall be used to denote values at different points of a cycle.
- In general, capital letters denote absolute quantities, unless there are other overriding considerations.

**4.2 Units and symbols**

| Symbol | Description                                     | Unit                             |
|--------|-------------------------------------------------|----------------------------------|
| $h$    | Nozzle pressure drop                            | mmH <sub>2</sub> O               |
| $p$    | Pressure                                        | bar (in mm Hg for <b>9.5.2</b> ) |
| $P$    | Power                                           | W, kW                            |
| $q$    | Capacity (volume rate of flow, F.A.D.)          | litre/s                          |
| $T$    | Thermodynamic temperature, absolute temperature | K                                |
| $t$    | Temperature                                     | °C                               |

<sup>2)</sup> 1 bar = 10<sup>5</sup> N/m<sup>2</sup> = 100 kPa.

### 4.3 Subscripts

- 0 : condition of ambient atmosphere  
1 : condition at standard inlet point  
2 : condition at standard discharge point  
c : condition of contract (condition of guarantee)  
corr: corrected  
m : measured conditions  
w : condition of cooling water

## 5 Measuring equipment and methods

### 5.1 Measurement of temperature

#### 5.1.1 Methods

**5.1.1.1** In general, mercury-in-glass thermometers with etched stems, graduated with scales suitable for the measurements to be made, shall be employed for all measurements.

**5.1.1.2** Commercial or industrial metal-encased thermometers shall not be used.

**5.1.1.3** The thermometers shall be inserted directly into the air stream or, when this is not applicable, small thermometer pockets of thin steel tube shall be used. The pockets shall be clean and free from corrosion or oxide. They shall normally be filled with oil; if the temperature is likely to cause evaporation of the oil, mercury shall be used. Where the oblique position of the pockets does not allow liquid filling, copper-powder may be used. The thermometers or the pockets shall extend into the pipe a distance of 100 mm or one third the diameter of the pipe, whichever dimension is the less (see also **9.4.5**).

**5.1.1.4** In taking readings, the thermometer shall not be lifted out of the medium being measured, or out of the pocket, when such is used.

**5.1.1.5** All thermometers shall be calibrated for their appropriate temperature range.

**5.1.1.6** Other methods of temperature measurement may be used and are described in BS 1041.

**5.1.2** *Precautions to be observed.* Precautions shall be taken to ensure that:

- a) no appreciable quantity of heat is transmitted by radiation or conduction to or from the thermometer, other than that of the medium being measured;
- b) the immediate vicinity of the point of insertion and the projecting parts of the connection are well insulated, so that the pocket is sensibly at the same temperature as the medium being measured;
- c) the sensitive part of any thermometer or of the thermometer pocket is well swept by the air;
- d) the air velocity does not exceed 30 m/s at the point of measurement.

### 5.2 Measurement of pressure

#### 5.2.1 Normal and high pressures

**5.2.1.1** For pressures above 2 bar<sup>3)</sup> abs., calibrated Bourdon gauges or dead-weight gauges, mercury manometers or their equivalent shall be employed.

**5.2.1.2** Diaphragm gauges shall not be employed.

**5.2.1.3** The Bourdon gauges selected shall be of such size that 1 % pressure difference can easily be read and that the pressures to be read shall be between one quarter and three quarters of the total scale reading. Bourdon gauges shall be calibrated at frequent intervals against standard dead-weight test gauges and the calibration certificates shall be made available for inspection.

#### 5.2.2 Low pressures

**5.2.2.1** For all pressures of 2 bar abs. or below, manometers, columns or vacuum gauges shall be employed.

**5.2.2.2** Closed mercury columns known as absolute vacuum gauges should not be used.

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<sup>3)</sup> 1 bar = 10<sup>5</sup> N/m<sup>2</sup> = 100 kPa.