

BRITISH STANDARD CODE FOR
ACCEPTANCE TESTS FOR
TURBO-TYPE
COMPRESSORS AND
EXHAUSTERS

B.S. 2009 : 1953

THIS BRITISH STANDARD, having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 14th August, 1953.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 9,000, fully indexed and with a note of the contents of each, will be found in the BSI Catalogue which may be purchased from BSI Sales Department. The Catalogue may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standards :—

- B.S. 269. Rules for methods of declared efficiency of electrical machinery (excluding traction motors).
- B.S. 353. Testing of hydraulic turbines.
- B.S. 649. Reciprocating internal combustion engines for marine auxiliary and land service (excluding carburettor type).
- B.S. 707. Testing of mine fans.
- B.S. 726. Method of measurement of air flow and the free air delivered by compressors.
- B.S. 752. Acceptance tests for steam turbines.
- B.S. 848. Testing of fans for general purposes.
- B.S. 1042. Code for flow measurement.
- B.S. 1571. Acceptance tests for positive displacement compressors and exhausters.
- B.S. 1704. General purposes thermometers.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

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CO-OPERATING ORGANIZATIONS

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations :—

- *Admiralty
- *Air Ministry
- *Associated Offices Technical Committee
- Association of Consulting Engineers (Incorporated)
- British Chemical Plant Manufacturers' Association
- *British Compressed Air Society
- *British Electrical and Allied Manufacturers' Association
- British Electricity Authority and Area Boards
- *British Engineers' Association
- British Internal Combustion Engine Manufacturers' Association
- British Iron and Steel Federation
- British Railways, The Railway Executive
- Crown Agents for the Colonies
- D.S.I.—Mechanical Engineering Research Laboratory
- Engineering Equipment Users' Association
- *High Commission of India
- *Institute of Marine Engineers
- Institute of Petroleum
- *Institution of Civil Engineers
- *Institution of Gas Engineers
- Institution of Heating and Ventilating Engineers
- *Institution of Mechanical Engineers
- Institution of Mechanical Engineers (Automobile Division)
- Institution of Production Engineers
- Locomotive Manufacturers' Association
- Machine Tool Trades' Association
- Ministry of Fuel and Power
- Ministry of Labour and National Service (Factory Department)
- *Ministry of Supply
- Ministry of Transport
- Ministry of Works
- *National Physical Laboratory
- *War Office

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard :—

Institution of Engineering Inspection

BRITISH STANDARD CODE FOR ACCEPTANCE TESTS FOR TURBO-TYPE COMPRESSORS AND EXHAUSTERS

FOREWORD

The tests prescribed in this British Standard, prepared under the authority of the Mechanical Engineering Industry Standards Committee, are intended to provide an agreed basis by which guarantees given by manufacturers can be verified, or by which comparisons of the performance can be made. To achieve this, the standard recommends conditions for testing, and specifies the method of correcting test results in order to give values that may be compared with the guaranteed values.

The theory (see Appendix B) of this test code is based on obtaining similar velocity triangles and density changes on the test gas as on the guaranteed gas. Under these conditions it is assumed that the aerodynamic efficiency is the same. With gases of different gas constants the speed of test will be different from that guaranteed and the mechanical efficiency may not be constant. Where this speed difference is considerable, corrections for mechanical, frictional and leakage losses should be agreed beforehand between manufacturer and purchaser. To apply the code it is necessary to know the gas constant and the ratio of the specific heats for the test and guarantee gases ; and a method of calculating these quantities for a mixture of gases is given in Appendix A, which also includes a table of constants for a number of gases.

In preparing the standard, note has been taken of the recommendations published by the Compressed Air and Gas Institute of the U.S.A.

Detailed examples are given to illustrate the application of the code to various conditions, and the Institution would be grateful for any information that can be made available relating to the use of the tests given in this standard.

SPECIFICATION

SECTION ONE : GENERAL

SCOPE

1. This British Standard specifies the method of correcting the observed performance of turbo-compressors and turbo-exhausters, to allow for the difference between test and guarantee conditions. It also specifies methods of measurement and deals with the instruments to be used.

The standard deals with axial flow and centrifugal compressors and exhausters ; it does not deal with the following :—

- a. Positive displacement machines, which are dealt with in B.S. 1571, 'Acceptance tests for positive displacement compressors and exhausters.'

b. Machines giving a pressure rise of less than 1 lb/sq. in.

The testing of fans is covered by :

B.S. 707 : Testing of mine fans.

B.S. 848 : Testing of fans for general purposes.

PERMISSIBLE DEVIATION

2. The test conditions shall approximate as closely as possible to the guarantee conditions, and when the test and guarantee gases are the same the maximum deviation shall be as follows :—

Pressure rise/Inlet pressure	± 2 per cent
Difference between : cooling water inlet temperature minus gas inlet temperature, for test and guarantee conditions, $(T_{1wt} - T_{1t}) - (T_{1wg} - T_{1g})$	20°F.
Cooling water temperature rise	$\pm 5^{\circ}\text{F.}$
Ratio, inlet gas flow/r.p.m.	± 2 per cent

When test and guarantee gases are different, the limits given in Clauses 17 and 19 shall apply. (But see the second paragraph of the Foreword.)

The aerodynamic and thermodynamic principles underlying this code apply to a wide range of inlet pressures. The use of the code for testing the performance of a machine when full shaft power is not available is demonstrated in Example 2.

The deviations given above relate to the condition laid down in this code where only two observations are made, one on either side of the guarantee point. If several points are to be taken to establish a characteristic curve the amount of deviation may be exceeded provided one of the points is close to the guarantee point or provided that a sufficient number of the points are close enough to the guarantee point to achieve a comparable degree of accuracy.

In cases where the test inlet temperature is higher and/or the test gas constant is higher than for guarantee conditions, the compressor would have to be over-speeded to fulfil the test conditions. This over-speeding should be done only with the mutual agreement of customer and manufacturer and in no case should the test speed be more than 10 per cent higher than the maximum rated operating speed of the machine.

BASIS OF CORRECTION FACTORS

3. The basis of the correction factors given in this code is explained in Appendix B.

DURATION OF TEST

4. Before measurements to be used in the test are taken, the machine shall be run until steady conditions are obtained. The duration of the test shall be sufficient to demonstrate the uniformity of the readings, and shall not

be less than 20 minutes, or such longer period as may be necessary to determine the input power. During a test the instruments shall be read simultaneously every five minutes. The values so obtained, which may be the average of the readings of several instruments, shall not differ from the average over the whole test by more than the following amounts :—

Pressure rise	2 per cent
Temperatures	4°F.
Speed	1 per cent

PRESSURE MEASUREMENTS

5. a. General. All pressures in this code are in pounds per square inch absolute. Measured gauge pressure may be converted into absolute pressure by the relation :

$$\begin{array}{l} \text{Absolute pressure in pounds per square inch} \\ = \text{Gauge pressure in pounds per square inch} + \frac{\text{Height of barometer in inches of mercury at } 60^{\circ} \text{ F.}}{2.042} \end{array}$$

The atmospheric pressure shall be determined by means of a mercury-in-glass barometer. The value obtained from a local recognized Weather Bureau at the time of the test, corrected for any difference in level, may be used.

Inlet and outlet pressures shall be measured, at points within 6 in. of the inlet and outlet flanges or at agreed points, by two or more manometers or gauges and their average readings shall be taken as the observed pressure. Any difference greater than one per cent of the absolute pressure between a pair of instruments shall be investigated.

Care shall be taken that the manometer leg(s) subject to atmospheric pressure cannot be influenced by any local atmospheric condition differing from that to which the barometer is subjected.

Connecting piping shall be not less than $\frac{1}{4}$ in. bore, and shall be as short as possible. Gas tightness shall be tested with soap solution, and all leaks eliminated. Gauges shall be mounted in a position free from vibration.

Holes for the measurement of the static pressure shall be normal to, and flush with, the inside walls of the pipe, and shall be free from burrs or countersinks.

b. Low pressure. For pressures below 30 lb/sq. in. absolute, manometers containing a suitable liquid shall be used. Closed mercury columns shall not be used.

c. High pressure. For pressures above 30 lb/sq. in. absolute, manometers, calibrated Bourdon gauges or dead-weight gauges shall be used.

d. Manometers and Bourdon gauges. Manometers should be made of glass tubing of not less than $\frac{3}{8}$ in. bore for the single-limb type, and of not less than $\frac{3}{16}$ in. bore for the double-limb U-tube type. The scale shall be so graduated that it can be read to 0.05 in. or 1 mm.

Bourdon gauges shall be mounted vertically and shall be readable to 0.5 per cent of the full scale reading. They shall be used only between one quarter and three quarters of their full scale reading. They shall be calibrated against a dead-weight gauge before and after the test.

e. Velocity pressure. If the mean velocity pressure of the gas at the point where the pressure is measured is less than 1 per cent of the total (guaranteed) pressure rise across the compressor then either static or total pressures may be used, provided that the same type of pressure is used for guarantee and test conditions.

Where the mean total pressure is guaranteed the mean pressure shall be determined by one of the following methods :—

(i) Measured directly by means of a multiplicity of total head tubes, spaced across the duct in accordance with the methods described in B.S. 1042 'Code for flow measurement'.

(ii) Deduced from the temperature and static pressure and area of cross-section of the duct at the measurement station, and the mass flow. The velocity pressure is then :

$$\frac{G^2 RT}{A^2 P} \times 2.08 \times 10^{-10} \text{ lb/sq. in.}$$

where A is the area of cross-section of the duct in square feet. (For symbols see p. 12.)

Care is required in the application of this method. It should be used only if the measurement station is located in a length of straight duct of uniform section in which (1) the gas is free from swirl and (2) the static pressure as measured at any point around the duct at the measurement station does not vary by more than 1 per cent of the guaranteed compressor pressure rise.

TEMPERATURE MEASUREMENT

6. *a. Absolute temperature.* All temperature measurements in this code are in degrees Fahrenheit absolute (also called degrees Rankine), which are related to degrees Fahrenheit by the formula :

$$^{\circ}\text{F. abs} = ^{\circ}\text{F.} + 459.7$$

b. Methods. In general, mercury-in-glass thermometers with etched stems complying with B.S. 1704, 'General purpose thermometers' and calibrated by the National Physical Laboratory or checked against such a calibrated thermometer, shall be used.

The thermometers should be inserted directly into the gas stream, but if this is not convenient, thermometer pockets of thin steel tube shall be used. The pockets shall be clean and free from corrosion or oxide. They shall be filled with mercury, or with oil where the temperature is low enough not to evaporate the oil. The thermometers or pockets shall extend into the pipe a distance of 4 in. or to one-third of the diameter of the pipe, whichever is less. In taking readings, the thermometer shall not be lifted out of the fluid being measured, or out of the

pocket if one is used. It is recommended that the methods of measuring temperature in pipe lines specified in B.S. 1042, 'Code for flow measurement' be used.*

c. Precautions to be observed. Precautions shall be taken to ensure :

(i) That no appreciable quantity of heat, other than that of the fluid, is transmitted by radiation or conduction to or from the thermometer.

(ii) That the immediate vicinity of the point of insertion and the projecting parts of the connection are well insulated.

(iii) That the sensitive part of any thermometer or thermometer pocket is well swept by the fluid.

(iv) That the gas velocity does not exceed 150 ft/sec. at the point of measurement.

AIR FLOW MEASUREMENT

7. The gas flow, Q , shall be determined as provided in B.S. 726, 'Method of measurement of air flow and the free air delivered by compressors', or B.S. 1042 'Code of flow measurement'.

Sometimes test arrangements are adopted where the measured flow is incorrect because of the gland or labyrinth leakage either into or out of the machine. It is often impossible to measure this discrepancy directly, and in these circumstances an appropriate correction factor shall be agreed upon between manufacturer and purchaser. Additional care will be necessary when a compressor is being tested under reduced suction conditions.

MEASUREMENT OF SPEED

8. Speed shall be measured by a reliable tachometer which has been checked immediately before the test.

POWER CONSUMPTION

9. If the guaranteed power consumption is that at the input to the driving unit it shall be determined in accordance with the appropriate British Standard as follows :—

Electrical	B.S. 269**
Gas and oil engines	B.S. 649***
Hydraulic	B.S. 353†
Steam turbines	B.S. 752††

* These methods are to be included in a revision of B.S. 1042.

**B.S. 269, 'Rules for methods of declaring efficiency of electrical machinery (excluding traction motors)'.

*** B.S. 649, 'Reciprocating internal combustion engines for marine auxiliary and land service (excluding carburettor type)'.

† B.S. 353, 'Testing of hydraulic turbines'.

††B.S. 752, 'Acceptance tests for steam turbines'.

When the guaranteed power consumption of the machine is that at its coupling, it may be determined by one of the following :—

a. An electric motor, the efficiency of which has been determined in accordance with B.S. 269.

b. A torsion meter, the accuracy of which is within ± 1 per cent.

c. A driving unit which has previously been tested in accordance with one of the above-mentioned British Standards.

Where any intermediate form of power transmission, such as a belt drive or gear box, is interposed between the driving unit and the machine its power consumption shall be taken into account.

When the power consumption is guaranteed in terms of the power supply to the driving unit any variations in its performance due to differences between test and guarantee conditions shall be allowed for.

When the power consumption is guaranteed and the test has to be carried out at reduced power, errors will be introduced into the corrected power consumption because of those losses which are not strictly proportional to the total power. If possible an agreed correction should be made for these errors.

SECTION TWO : DEFINITIONS AND SYMBOLS

DEFINITIONS

10. For the purposes of this British Standard the following definitions and symbols shall apply :—

a. *Gas flow at inlet conditions* (denoted in the Code by the symbol Q). The volume of air, or gas, at the intake temperature and pressure, expressed in cubic feet per minute, which a machine will take in, compress and deliver at the stated delivery pressure.

b. *Horse power.*

(i) *Shaft horse power.* The power transmitted by the compressor coupling under specified conditions.

(ii) *Isothermal horse power.* The power for isothermal compression is :

$$\frac{144 \times P_1 \times Q}{33\,000} \times \log_e r \text{ horse power}$$

(iii) *Adiabatic horse power.* The power for adiabatic compression is :

$$\frac{144 P_1 Q \gamma}{33\,000 (\gamma - 1)} \left(r^{\frac{\gamma - 1}{\gamma}} - 1 \right) \text{ horse power}$$

NOTE. For symbols see Clause 11.

c. *Pressure ratio.* The ratio of the absolute delivery pressure to the absolute intake pressure (see Clause 5).

SYMBOLS

11. *a. Symbols.* The following symbols are used in this standard :

	<i>Symbol</i>	<i>Units.</i>
Pressure at intake	P_1	lb/sq. in. abs.
Pressure at delivery	P_2	lb/sq. in. abs.
Pressure ratio P_2/P_1	r	—
Absolute temperature at intake	T_1	°F. abs.
Absolute temperature at delivery	T_2	°F. abs.
Absolute temperature of cooling water at intake	T_{1w}	°F. abs.
Gas constant	R	ft. lb/lb/°F.
Ratio of specific heats	γ	—
Rate of flow of gas at inlet conditions	Q	cu. ft/min.
Mass flow	G	lb/min.
Speed	N	r.p.m.
Shaft horse power	HP	horse power
Number of sections in a cooled compressor	k	—

The following derived functions are useful in compressor calculations :

$$\frac{\left(r^{\frac{\gamma-1}{\gamma}} - 1\right) \gamma}{\gamma - 1} \quad \alpha \quad \text{—}$$

and for cooled machines

$$\frac{k-1}{k} \times \frac{(T_{1wt} - T_{1t}) - (T_{1wg} - T_{1g})}{T_{1g}} \quad f \quad \text{—}$$

$$\frac{\left(r^{\frac{\gamma-1}{k\gamma}} - 1\right) \gamma}{\gamma - 1} \quad \alpha' \quad \text{—}$$

b. Suffixes.

g refers to guarantee conditions.

t refers to observed values on test.

c refers to test values corrected to guarantee inlet conditions, and, where applicable, to guarantee speed.

Putting $P_{1c} = P_{1g}$ and $\gamma_c = \gamma_g$ makes the relations

$$\frac{P_2}{P_1} = r \quad \text{and} \quad \frac{\left(r^{\frac{\gamma-1}{\gamma}} - 1\right) \gamma}{\gamma - 1} = \alpha$$

apply whenever all the quantities have the same suffix, and enables P_{2c} to be found from α_c , which is given by Clauses 16 to 19. Calculations involving α , r and γ may be performed by means of the graphs in Figs. 7, 8, 9 and 10, as illustrated in Examples 1, 2, 3 and 5.

The number of sections in a cooled compressor, k , is obtained by adding one to the number of intercoolers. For a jacket cooled machine k may be taken as half the number of stages.

SECTION THREE : TESTING AND CORRECTION OF TEST RESULTS TO GUARANTEE CONDITIONS.

GENERAL

12. The test shall be carried out and the corrections applied in accordance with Clauses 16 to 19, as appropriate.

GAS CONSTANT

13. The gas constant, R , for the test and guarantee gases shall be determined as in Appendix A ; R_t may be taken as equal to R_g if the difference between them is less than 0.2 per cent.

SPECIFIC HEATS

14. The ratio of specific heats, γ , shall be determined as in Appendix A ; γ_t may be taken as equal to γ_g if the difference between them is less than 0.002.

INDUCTION MOTOR DRIVE

15. When the compressor is driven by a motor which has a fixed speed-power characteristic, the speed under guarantee inlet conditions shall be obtained from the relation :

$$IP_c = IP_t \times \frac{P_{1g} R_t T_{1t}}{P_{1t} R_g T_{1g}} \left(\frac{N_c}{N_t} \right)^3$$

$$\frac{IP_c}{N_c^3} = \frac{IP_t}{N_t^3} \times \frac{P_{1g} R_t T_{1t}}{P_{1t} R_g T_{1g}}$$

From the characteristic curve of the driving motor a graph of N against $\frac{IP}{N^3}$ may be drawn, and N_c can then be found from the above equation.

The corrected compression ratio for each test point may then be found by treating it as if the speed were guaranteed, and putting N_g in the appropriate clause of Clauses 16 to 19, equal to N_c found as above.

The method is illustrated in Example 5.

UNCOOLED MACHINES WHEN THE TEST AND GUARANTEE GASES ARE THE SAME

16. *a. When the speed is guaranteed.*

To ensure that the machine under test conditions is running in such a manner that the correction factors shall apply (see Clause 3), the following settings must be obtained :—

Speed.

Set the speed so that

$$\frac{N_t}{N_g} = \sqrt{\left(\frac{T_{1t}}{T_{1g}} \right)} \times (1 \pm 0.02)$$

Throttles.

Adjust the inlet and delivery throttles so that :

$$\text{either } \frac{Q_t}{Q_g} = \frac{N_t}{N_g} (1 \pm 0.02)$$

$$\text{or } \frac{r_t - 1}{r_g - 1} = 1 \pm 0.01$$

whichever condition is the easier to obtain.

At least two test points shall be taken, arranged so that at least one value of Q_t is greater, and at least one value is less, than :

$$Q_g \frac{N_t}{N_g}$$

A portion of the characteristic curves of pressure ratio and horse power against gas flow corrected to guarantee inlet conditions may then be drawn, as in Example 1.

The corrected values are obtained from the test values by the following equations :—

$$Q_c = Q_t \frac{N_g}{N_t}$$

$$HP_c = HP_t \times \frac{P_{1g}}{P_{1t}} \times \frac{T_{1t}}{T_{1g}} \times \left(\frac{N_g}{N_t} \right)^3$$

$$\alpha_c = \alpha_t \times \frac{T_{1t}}{T_{1g}} \times \left(\frac{N_g}{N_t} \right)^2$$

b. When the speed is not guaranteed.

To ensure that the machine under test conditions is running in such a manner that the correction factors shall apply (see Clause 3) the following settings must be obtained.

Speed and throttles.

Adjust the speed and throttle(s) so that :

$$\frac{Q_t}{Q_g} = \sqrt{\left(\frac{T_{1t}}{T_{1g}} \right)} \times (1 \pm 0.02) \quad \text{and} \quad \frac{r_t - 1}{r_g - 1} = 1 \pm 0.01$$

At least two test points shall be taken, arranged so that at least one value of Q_t is greater, and at least one value is less, than :

$$Q_g \sqrt{\left(\frac{T_{1t}}{T_{1g}} \right)}$$

A portion of the characteristic curves of horse power and speed against gas flow, corrected to guarantee inlet conditions and guaranteed pressure ratio may then be drawn, as in Example 2.

The corrected values are obtained from the test values by the following equations :—

$$Q_c = Q_t \sqrt{\left(\frac{T_{1g}}{T_{1t}}\right)}$$

$$HP_c = HP_t \times \frac{Q_c P_{1g} \alpha_g}{Q_t P_{1t} \alpha_t}$$

The speed at which the machine would have to run under guarantee inlet conditions to give the guaranteed pressure ratio at the corrected gas flow is approximately :

$$N = N_t \sqrt{\left(\frac{T_{1g} \alpha_g}{T_{1t} \alpha_t}\right)}$$

UNCOOLED MACHINES WHEN THE TEST AND GUARANTEE GASES ARE DIFFERENT

17. a. When the speed is guaranteed.

To ensure that the machine under test conditions is running in such a manner that the correction factors shall apply (see Clause 3), the following settings must be obtained :—

Speed and throttles.

Adjust the speed and throttle(s) so that :

$$\frac{Q_t}{Q_g} = \frac{N_t}{N_g} (1 \pm 0.02) \quad \text{and} \quad \frac{\log r_t}{\log r_g} = \frac{\gamma_t}{\gamma_g} (1 \pm 0.01)$$

At least two test points shall be taken, arranged so that at least one value of Q_t is greater, and at least one value is less, than :

$$Q_g \frac{N_t}{N_g}$$

A portion of the characteristic curves of pressure ratio and horse power against gas flow corrected to guarantee inlet conditions, may then be drawn, as in Example 3.

The corrected values are obtained from the test values by the following equations :—

$$Q_c = Q_t \frac{N_g}{N_t}$$

$$HP_c = HP_t \times \frac{P_{1g} R_t T_{1t}}{P_{1t} R_g T_{1g}} \times \left(\frac{N_g}{N_t}\right)^3$$

$$\alpha_c = \alpha_t \times \frac{R_t T_{1t}}{R_g T_{1g}} \times \left(\frac{N_g}{N_t}\right)^2$$

b. When the speed is not guaranteed.

To ensure that the machine under test condition is running in such a manner that the correction factors shall apply (see Clause 3), the following settings must be obtained :—

Speed and throttles.

Adjust the speed and throttle(s) so that :

$$\frac{Q_g}{Q_t} = \sqrt{\left(\frac{R_t}{R_g} \frac{T_{1t}}{T_{1g}} \frac{\alpha_t}{\alpha_g} \right)} \times (1 \pm 0.02)$$

and

$$\frac{\log r_t}{\log r_g} = \frac{\gamma_t}{\gamma_g} (1 \pm 0.01)$$

At least two test points shall be taken, arranged so that at least one value of Q_t is greater, and at least one value is less, than :

$$Q_g \sqrt{\left(\frac{R_t}{R_g} \frac{T_{1t}}{T_{1g}} \frac{\alpha_t}{\alpha_g} \right)}$$

A portion of the characteristic curve of horse power against gas flow, corrected to guarantee inlet conditions and guaranteed pressure ratio, may then be drawn.

The corrected values are obtained from the test values by the following equations :—

$$Q_c = Q_t \sqrt{\left(\frac{R_g}{R_t} \frac{T_{1g}}{T_{1t}} \frac{\alpha_g}{\alpha_t} \right)}$$

$$IP_c = IP_t \times \frac{Q_c}{Q_t} \frac{P_{1g}}{P_{1t}} \frac{\alpha_g}{\alpha_t}$$

The speed at which the machine would have to run under guarantee inlet conditions to give the guaranteed pressure ratio at the guaranteed gas flow is approximately :

$$N = N_t \sqrt{\left(\frac{R_g}{R_t} \frac{T_{1g}}{T_{1t}} \frac{\alpha_g}{\alpha_t} \right)}$$

COOLED MACHINES WHEN THE TEST AND GUARANTEE GASES ARE THE SAME

18. a. When the speed is guaranteed.

To ensure that the machine under test conditions is running in such a manner that the correction factors shall apply (see Clause 3), the following settings must be obtained :—

Speed.

Set the speed so that :

$$\frac{N_t}{N_g} = \sqrt{\left[\frac{T_{1t}}{T_{1g}} (1 + f) \right]} \times (1 \pm 0.02)$$