
British Standard

Reciprocating internal combustion engines: Performance

Part 1. Specification for standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption

Moteurs alternatifs à combustion interne : Performances

Partie 1. Spécification des conditions normales de référence et déclarations de la puissance et de la consommation de combustible et d'huile de lubrification

Kolbenverbrennungsmotoren : Leistungsfähigkeit

Teil 1. Spezifikation für Normalbezugsbedingungen und Erklärungen der Kraft, des Brennstoffverbrauches und des Schmierölverbrauches

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National foreword

This Part of BS 5514 has been prepared under the direction of the Machinery and Components Standards Committee and is identical with the 1986 revision of ISO 3046/1 'Reciprocating internal combustion engines— Performance— Part 1 : Standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption' published by the International Organization for Standardization (ISO).

This revision of this standard supersedes BS 5514 : Part 1 : 1982 which is withdrawn.

The above international standard is Part 1 of six Parts, other Parts being:

- Part 2 Test methods
- Part 3 Test measurements
- Part 4 Speed governing
- Part 5 Torsional vibrations
- Part 6 Overspeed protection.

Parts 1 to 6 are now published and they have been implemented as Parts 1 to 6 of this British Standard.

Terminology and conventions. The text of the international standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used throughout as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever the words 'part of ISO 3046' appear, referring to this standard, they should be read as 'Part of BS 5514'.

Cross-references

International standard	Corresponding British Standard
ISO 1000-1980	BS 5555 : 1981 Specification for SI units and recommendations for the use of their multiples and of certain other units (Identical)
ISO 1204-1972	BS 5672 : 1979 Specification for designation of direction of rotation of reciprocating internal combustion engines (Identical)
ISO 1205-1972	BS 5673 : 1979 Specification for designation of the cylinders of reciprocating internal combustion engines (Identical)
ISO 2710-1978	BS 5676 : 1979 Vocabulary for reciprocating internal combustion engines (Identical)
	BS 5514 Reciprocating internal combustion engines: Performance
ISO 3046/2-1977	Part 2 : 1978 Test methods (Identical)
ISO 3046/4-1978	Part 4 : 1979 Speed governing (Identical)
ISO 3046/6-1982	Part 6 : 1983 Specification for overspeed protection (Identical)

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

British Standard

Reciprocating internal combustion engines: Performance

Part 1. Specification for standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption

0 Introduction

The standard reference conditions of clause 5 have been changed, but it is still permissible to use the old standard reference conditions for a period of five years from the publication of this third edition. Where this is done, the values shall be stated.

The standard reference conditions in the second edition (ISO 3046/1-1981) were as follows :

Total barometric pressure : $p_r = 100 \text{ kPa}$
 Air temperature : $T_r = 300 \text{ K (27 °C)}$
 Relative humidity : $\phi_r = 60 \%$
 Air coolant temperature : $T_{cr} = 300 \text{ K (27 °C)}$

1 Scope

This part of ISO 3046 specifies the standard reference conditions and the methods of declaring the power, fuel consumption and lubricating oil consumption for reciprocating internal combustion engines using liquid or gaseous fuels. Where necessary, individual requirements are given for particular engine applications.

2 Field of application

This part of ISO 3046 covers reciprocating internal combustion engines for land, rail-traction and marine use, excluding engines used to propel agricultural tractors, road vehicles and aircraft.

This part of ISO 3046 may be applied to engines used to propel road construction and earth-moving machines, industrial trucks and for other applications where no suitable International Standard for these engines exist.

3 References

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units.*

ISO 1204, *Reciprocating internal combustion engines — Designation of the direction of rotation.*

ISO 1205, *Reciprocating internal combustion engines — Designation of the cylinders.*

ISO 2710, *Reciprocating internal combustion engines — Vocabulary.*

ISO 3046/2, *Reciprocating internal combustion engines — Performance — Part 2 : Test methods.*

ISO 3046/4, *Reciprocating internal combustion engines — Performance — Part 4 : Speed governing.*

ISO 3046/6, *Reciprocating internal combustion engines — Performance — Part 6 : Overspeed protection.*

4 Units and terms

4.1 The units used are those of the International System of Units (SI Units) described in ISO 1000.

4.2 The general engine terms used are as defined in ISO 2710.

5 Standard reference conditions

For the purpose of determining the power and fuel consumption of engines, the following standard reference conditions shall be used :

Total barometric pressure :

$$p_r = 100 \text{ kPa}$$

Air temperature :

$$T_r = 298 \text{ K (25 °C)}$$

Relative humidity :

$$\phi_r = 30 \%$$

Charge air coolant temperature :

$$T_{cr} = 298 \text{ K (25 °C)}$$

NOTE — Relative humidity of 30 % at a temperature of 298 K corresponds to a water vapour pressure of 1 kPa. Hence the corresponding dry barometric pressure is 99 kPa.

6 Auxiliaries

6.1 Introduction

In order to show clearly the conditions under which a power is determined, it is necessary to distinguish those auxiliaries which affect the final shaft output of the engine and also those which are necessary for the continuous or repeated use of the engine.

Items of equipment fitted to the engine and without which the engine could not in any circumstances operate at its declared power are considered to be engine components and are not, therefore, classed as auxiliaries.

(Such items as fuel injection pump, exhaust turbocharger and charge air cooler are in this category of engine components.)

6.2 dependent auxiliary : Item of equipment, the presence or absence of which affects the final shaft output of the engine.

6.3 independent auxiliary : Item of equipment which uses power supplied from a source other than the engine.

6.4 essential auxiliary : Item of equipment which is essential for the continued or repeated operation of the engine.

6.5 non-essential auxiliary : Item of equipment which is not essential for the continued or repeated operation of the engine.

7 Declarations of power

7.1 Introduction

7.1.1 Purpose of statement of power

Statements of power are required for two main purposes, as follows.

- a) The declaration by a manufacturer of the value of the power which his engine will deliver under a given set of circumstances. This declared value is known as the "rated power".
- b) The verification by measurement that the engine delivers the power which has been declared in a), under the same set of circumstances or after proper allowance has been made for any difference in circumstances.

To specify the set of circumstances under which the declared value of a power would be achieved, the declaration shall state :

- a) the kind of statement of power (see 7.4) and if necessary, the ambient and operating conditions (see 7.4.2);
- b) the kind of power output (see 7.3);
- c) the kind of power (see 7.2);
- d) the corresponding engine speed.

NOTES

- 1 The terms used in a) to c) may be combined, for example, continuous net brake fuel stop power.
- 2 Where appropriate to the engine application and the method of manufacture, the power achieved may be subject to a tolerance on the declared power. The existence of such a tolerance and its magnitude shall be stated by the manufacturer.
- 3 Measurement of the powers referred to in this part of ISO 3046 shall be determined in accordance with ISO 3046/2.

7.1.2 Unit of power

Power shall be expressed in kilowatts (kW).

7.1.3 Power and torque

For engines delivering power by a shaft or shafts, any power in this International Standard is a quantity proportional to the mean torque, calculated or measured, and to the mean rotational speed of the shaft or shafts transmitting this torque.

For engines delivering power other than by a shaft or shafts, reference shall be made to the appropriate International Standard for the driven machine.

7.1.4 Engine speed

The speed of an engine is the mean rotational speed of its crankshaft or crankshafts in revolutions per minute, except in the case of 'free piston' engines where the speed is the number of cycles per minute of the reciprocating components.

7.1.5 Engine with integral gearing

When stating the power of an engine fitted with an integral (built-in) speed increasing or reducing device, the speed of the driving shaft extremity shall also be given at the declared engine speed.

7.2 Kinds of power

7.2.1 indicated power : The total power developed in the working cylinders as a result of the pressure of the working medium acting on the pistons.

7.2.2 brake power : The power or sum of the powers at the driving shaft or shafts.

7.2.2.1 Any statement of brake power shall be supported by the following list of auxiliaries :

- a) essential dependent auxiliaries as defined in 6.2 and 6.4;
- b) essential independent auxiliaries as defined in 6.3 and 6.4;
- c) non-essential dependent auxiliaries as defined in 6.2 and 6.5.

The power absorbed by the essential independent and the non-essential dependent auxiliaries may be significant. In such cases, their power requirement shall be declared.

NOTE — Examples of typical auxiliaries are listed in annex A for guidance purposes. These lists are not necessarily complete.

7.2.3 Net brake power

Net brake power is the brake power measured when the engine is using only the auxiliaries listed in 7.2.2.1 a).

7.3 Kinds of power output

7.3.1 Continuous power

Continuous power is the power which an engine is capable of delivering continuously, between the normal maintenance intervals stated by the manufacturer, at the stated speed and under stated ambient conditions, the maintenance prescribed by the manufacturer being carried out.

7.3.1.1 Overload power

Overload power is the power which an engine may be permitted to deliver, at stated ambient conditions, immediately after working at the continuous power.

The duration and frequency of use of overload power which is permitted will depend on the service application but adequate allowance shall be made in setting the engine fuel stop to permit the overload power to be delivered satisfactorily. The overload power shall be expressed as a percentage of the continuous power, together with the duration and frequency permitted and the appropriate engine speed.

Unless otherwise stated, an overload power of 110 % of the continuous power at a speed corresponding to the engine application is permitted for a period of 1 h, with or without interruptions, within a period of 12 h of operation.

NOTES

1 The power of marine main propulsion engines is normally limited to the continuous power, so that the overload power cannot be given in service. However, for special applications, marine main propulsion engines may develop overload power in service.

2 If the engine application is not determined, the engine manufacturer shall specify the overload power and the corresponding engine speed.

7.3.2 Fuel stop power

Fuel stop power is the power which an engine is capable of delivering during a stated period corresponding to its application, and at stated speed and under stated ambient conditions, with the fuel limited so that the fuel stop power cannot be exceeded.

7.4 Kinds of statements of power

7.4.1 ISO powers

7.4.1.1 ISO power

ISO power is the power determined under the operating conditions of the manufacturer's test bed and adjusted to the standard reference conditions in clause 5.

7.4.1.2 ISO standard power

This is the name given to the continuous net brake power which the engine manufacturer declares that an engine is capable of delivering continuously, between the normal maintenance intervals stated by the manufacturer, and under the following conditions :

- at a stated speed under the operating conditions of the engine manufacturer's test bed;
- with the declared power adjusted to the standard reference conditions given in clause 5;
- with the maintenance prescribed by the engine manufacturer being carried out.

7.4.2 Service power

Service power is the power determined under the ambient and operating conditions of an engine application.

To establish service power, the following conditions shall be taken into account :

- the ambient conditions, or any nominal ambient conditions according to the special requirements of inspecting and/or legislative authorities and/or classification societies, as specified by the customer (see clause 12);

NOTE — For example, the following nominal ambient conditions apply to main and auxiliary RIC engines on ships for International Association of Classification Societies (IACS) unrestricted service :

Total barometric pressure :

$$p_x = 100 \text{ kPa}$$

Air temperature :

$$T_x = 318 \text{ K (45 °C)}$$

Relative humidity :

$$\phi_x = 60 \%$$

Sea water temperature

(charge air coolant inlet) :

$$T_{cx} = 305 \text{ K (32 °C)}$$

- the normal duty of the engine;
- the expected interval between maintenance periods;
- the nature and amount of the supervision required;
- all information relevant to the operation of the engine in service (see clauses 12 and 13).

8 Declarations of fuel consumption

8.1 Definitions

8.1.1 Fuel consumption

Fuel consumption is the quantity of fuel consumed by an engine per unit of time at a stated power and under stated ambient conditions.