INTERNATIONAL STANDARD

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Reciprocating internal combustion engines — Performance —

Part 3: Test measurements

Moteurs alternatifs à combustion interne — Performances —

Partie 3: Mesurages pour les essais

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3046-3 was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*.

This third edition cancels and replaces the second edition (ISO 3046-3:1989), which has been technically revised.

ISO 3046 consists of the following parts, under the general title *Reciprocating internal combustion engines — Performance*:

— *Part 1: Declarations of power, fuel and lubricating oil consumption, and test methods — Additional requirements for engines for general use*

— *Part 3: Test measurements*

— *Part 4: Speed governing*

— *Part 5: Torsional vibrations*

— *Part 6: Overspeed protection*

Reciprocating internal combustion engines — Performance —

Part 3: Test measurements

1 Scope

This part of ISO 3046 specifies the common measurement techniques of the main performance parameters of reciprocating internal combustion engines, in addition to the basic requirements defined in ISO 15550. This is to ensure that the required accuracy of measurement is achieved for comparison of the measured values with those values specified by the engine manufacturer. Where necessary, individual requirements may be given for particular engine applications.

This part of ISO 3046 applies to reciprocating internal combustion engines for land, rail-traction and marine use.

It may be applied to engines used to propel road construction machines, industrial trucks, and for other applications where no suitable International Standards for these engines exist.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15550:2002, *Internal combustion engines — Determination and method for the measurement of engine power — General requirements*

ISO 3046-1:2002, *Reciprocating internal combustion engines — Performance — Part 1: Declarations of power, fuel and lubricating oil consumption, and test methods — Additional requirements for engines for general use*

3 Terms and definitions

For the purposes of this part of ISO 3046 the terms and definitions given in ISO 15550 apply.

4 Symbols

For the symbols used in this part of ISO 3046, see Table 2 of ISO 15550. For subscript meanings, see Table 3 of ISO 15550.

5 Standard reference conditions

The requirements Clause 5 of ISO 15550 apply.

If an engine is tested using treated water ($t_{cr} = 29$ °C) then the resulting engine power established in accordance with 3.3.4 of ISO 15550 will be the same as if the engine had been tested using sea water ($t_{cr} = 25$ °C) or vice versa.

For marine applications, the charge air coolant temperature (T_{cr}) for treated (fresh) water or sea water is defined as:

T_{cr} = 302 K (t_{cr} = 29 °C) for treated (fresh) water;

T_{cr} = 298 K (t_{cr} = 25 °C) for sea or raw water.

Temperature T_{cr} takes into account the influence of the coolant source.

NOTE The charge air coolant temperatures given describe the influence of the coolant source at the air cooler inlet on supercharged engines. The engine designer and/or purchaser can select sea water or fresh water as the coolant. The charge air temperature after the cooler will be the same, whether sea water or fresh water is used.

The air cooler shall be specified by the engine designer according to the application coolant source.

6 Standard design conditions

In marine applications supervised by a member body of the International Association of Classification Societies (IACS), the charge air coolant temperature for treated (fresh) water or sea or raw water is defined as:

T_{cr} = 309 K (t_{cr} = 36 °C) for treated (fresh) water;

T_{cr} = 305 K (t_{cr} = 32 °C) for sea or raw water.

For nominal ambient conditions, see 11.4 of ISO 3046-1.

The standard design conditions are the baseline to be used to establish the engine cooler capacity necessary to maintain the specified maximum charge air coolant temperature at the declared engine power established in accordance with the requirements of 3.3.4 of ISO 15550.

NOTE Where IACS conditions are applied, the engine power remains unchanged when established in accordance with 3.3.4 of ISO 15550.

7 Requirements

7.1 Measurement accuracy

The requirements of 6.2.4.3.1 of ISO 15550 apply.

7.2 Operating conditions

The requirements of 6.2.4.3.2 of ISO 15550 apply.

7.3 Measurement methods

The requirements of 6.2.4.3.3 of ISO 15550 apply.

7.4 Permissible parameter deviation

The requirements of 6.2.4.3.4 of ISO 15550 apply.

7.5 Other regulations and requirements

For engines used on board ships and offshore installations which have to comply with rules of a classification society, the additional requirements of the classification society shall be observed. If this applies, the classification society shall be stated by the customer before placing the order.

For non-classed engines, such additional requirements are in each case subject to agreement between the manufacturer and customer.

If special requirements from regulations of any other authority, for example inspecting and/or legislative authorities, have to be met, the authority shall be stated by the customer before placing the order.

Any further additional requirements for reference and/or design conditions shall be subject to agreement between the manufacturer and customer.

8 List of parameters

The engine performance parameters measured during test are given in Table 4 of ISO 15550.

Additional parameters are listed in Table 1.

Table 1 — List of parameters

Parameter	Definition	Symbol	Unit	Permissible deviation
Engine brake torque [a]	Mean torque delivered by the engine, measured at the extremity of the engine driving shaft. Marine engines with a built in thrust bearing have no thrust load on the test bed. This is in contradiction to the torque measurements made on the propeller shaft on board ship. The engine designer may advise the customer of the torque absorbed in the thrust bearing. As a guide, a value of 0,5 % of the engine torque may be used.	T_{tq}	kNm	± 2 %
Boost pressure drop through the air cooler [b, c]	The pressure drop measured by a differential gauge at points before/after cooler as defined by the engine designer.	Δp_{ba}	kPa	± 10 %
Lubricating oil pressure [b, c]	Oil pressure(s) measured at defined point(s) in the lubricating system(s) (e.g. in individual circuits, after the pump, before and after filters, coolers and gauge board).	p_o	kPa	± 5 %
Charge air temperature [d, e] after the pressure charger	Air temperature measured at the pressure charger outlet.	T_b	K	± 4 K
Lubricating oil temperature [d, e]	Oil temperature(s) measured at given point(s) in the lubricating system(s) (e.g. in individual circuits before and after cooler).	T_o	K	± 2 K
Fuel temperature [d, e]	Fuel temperature measured before the preheater and before the engine.	T_f	K	± 5 K

[a] Measured by hydraulic brake, electric dynamometer or similar equipment.

[b] The permissible deviation of each pressure is given as a percentage of the gauge pressure.

[c] The unit bar may be used instead of kPa or MPa.

[d] Measured by electrical methods (resistance thermometers or a thermocouple with measuring apparatus) or fluid-type thermometers.

[e] The unit °C may be used instead of K.

Annex A
(informative)

Example for calculating uncertainties

A.1 Engine power

The engine power is calculated from the torque and speed using Equation (A.1):

$$P = \frac{T_{tq} \times n}{9{,}549\ 3} \tag{A.1}$$

where

P is the engine power in kW;

T_{tq} is the engine brake torque in kNm;

n is the engine speed in revolutions per minute.

The torque and the speed are declared in accordance with the requirements of Table 4 of ISO 15550, each with a permissible deviation of ± 2 %.

A.2 The total power uncertainty

The total uncertainty in the engine power, A, is calculated using Equation (A.2):

$$A = \sqrt{a^2 \times b^2} \tag{A.2}$$

where

a is the permissible deviation in engine brake torque;

b is the permissible deviation in engine speed.

$$A = \sqrt{0{,}02^2 + 0{,}02^2} = 0{,}028 \approx 3\ \%$$

In Table 4, 1.5 of ISO 15550 the allowed engine power uncertainty is given as ± 3 %.

A.3 Specific fuel consumption

The specific fuel consumption is calculated from power and absolute fuel consumption using Equation (A.3):

$$g = B/P \tag{A.3}$$

where

g is the engine specific fuel consumption in g/kWh;