
Reciprocating internal combustion engines — Vocabulary —

Part 1: Terms for engine design and operation

Moteurs alternatifs à combustion interne — Vocabulaire —

*Partie 1: Termes relatifs à la conception et au fonctionnement du
moteur*



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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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.

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*.

This second edition cancels and replaces the first edition (ISO 2710-1:2000) which has been technically revised.

New terms and definitions have been added and terms and definitions in ISO 2710-1:2000 which are no longer used have been deleted.

Reciprocating internal combustion engines — Vocabulary —

Part 1: Terms for engine design and operation

1 Scope

This document defines the basic terms relating to the design and operation of reciprocating internal combustion (RIC) engines.

Further terms relating to components and systems of RIC engines are defined in ISO 7967 (all parts), and performance is defined in ISO 15550, ISO 14396 and in ISO 3046 (all parts).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 Main definitions

3.1.1

reciprocating internal combustion engine **RIC engine**

mechanism delivering shaft power by the conversion of fuel chemical energy into mechanical work during combustion in one or more cylinders in which working pistons reciprocate

Note 1 to entry: When such a mechanism does not deliver shaft power, but power in the form of hot gas, the mechanism is known as a free piston gas generator.

3.1.2

rotary engine

internal combustion engine with a rotor which makes eccentric circular movements around the engine centreline and reciprocates the intake-compression-expansion-exhaust cycle between the housing

Note 1 to entry: This is not a reciprocating internal combustion engine (RIC engine). It is listed for reference.

3.2 Definitions for RIC engines classified by ignition method

3.2.1

compression ignition engine

engine in which the ignition is obtained solely from the temperature of the cylinder contents, resulting from their compression (self-ignition)

3.2.2

hot bulb engine

engine in which the ignition is obtained by the temperature of the cylinder contents, resulting not solely from their compression but also from a local hot surface

3.2.3

spark ignition engine

engine in which the ignition is obtained by means of an electric spark

Note 1 to entry: In some countries this engine is also known as an "Otto-engine".

3.2.4

convertible engine

engine which is designed and equipped so that, by some small changes to the construction of the engine, it can be converted from a compression ignition engine into a spark ignition engine and vice versa

Note 1 to entry: In some cases, the term "convertible engine" means an engine converted from its original purpose to another purpose.

3.2.5

pilot injection engine

engine in which a small quantity of liquid fuel is injected into the cylinders to initiate combustion

3.3 RIC engines classified by fuel type

3.3.1

liquid-fuel engine

engine which operates on a fuel that is liquid at standard ambient conditions

3.3.1.1

diesel engine

compression ignition engine in which air is compressed and liquid fuel (oil) is introduced into each cylinder near the end of this compression

Note 1 to entry: In engines with an exhaust gas recirculation system (EGR), air with recirculated gas is compressed in the cylinder.

3.3.1.2

spark ignition engine with carburettor carburettor engine

spark ignition engine in which a suitable mixture of air and fuel is formed outside the cylinder in a device called a carburettor

3.3.1.3

spark ignition engine with fuel injection

spark ignition engine in which fuel is injected either into the air intake manifolds or into the cylinders

3.3.1.4

multi-fuel engine

engine designed and equipped so that without modification it can operate on fuels of widely different ignition properties

3.3.2

gas engine

engine which operates on gaseous fuel

Note 1 to entry: Major gas fuels recently used for RIC engines are natural gas, bio gas and wellhead gas.

3.3.2.1**pilot injection gas engine**

compression ignition engine in which a mixture of gaseous fuel and air is compressed and ignited by the pilot injection of a small quantity of liquid fuel from the cetane family

3.3.2.2**spark ignition gas engine**

gas engine in which the ignition occurs by means of an electric spark

3.4 RIC engines classified by cooling method**3.4.1****liquid-cooled engine**

engine in which the cylinders and cylinder heads are directly cooled by liquid

Note 1 to entry: The term “water-cooled engine” is also used when the liquid is predominantly water. The term “oil-cooled engine” is used when the liquid is lubricating oil only.

3.4.2**air-cooled engine**

engine in which the cylinders and cylinder heads are directly cooled by air

3.4.3**heat insulated engine**

engine in which heat-loss from the cylinder and piston area is minimized by means of insulation

Note 1 to entry: This engine was called “adiabatic engine” but, because it is impossible to achieve the theoretical adiabatic process in practice, recently it is more commonly called “heat insulated engine”.

3.5 Fuel supply**3.5.1****injection of fuel**

introduction, under pressure, of fuel into the combustion air

3.5.1.1**air injection**

injection of liquid fuel into the cylinder by means of high pressure air

3.5.1.2**mechanical injection**

injection of fuel solely by raising the fuel pressure until a valve opens

Note 1 to entry: For mechanical injection using liquid fuel, the term “solid injection” is also used.

3.5.1.3**direct injection**

injection system in which fuel is injected into an open combustion chamber or the main part of a divided combustion chamber

3.5.1.4**indirect injection**

injection system in which fuel is injected into a divided combustion chamber

3.5.1.5**accumulator injection**

injection system in which fuel is injected by means of pressure from an accumulator, created before or during the operation of a fuel pump

3.5.1.6

pilot injection

injection system in which a small quantity of fuel is injected to start the combustion process and thus obtain smoother combustion with lower peak pressures when the main combustion occurs

Note 1 to entry: This is also called “pre-injection”.

3.5.2

induction of fuel

supply into the working cylinder of a mixture of fuel and air, formed outside the cylinder

3.6 Working cycle

3.6.1

working cycle

complete series of changes in the parameters of the working medium (mass, volume, pressure and temperature etc.) present in each cylinder of a reciprocating internal combustion engine, accomplished before repetition occurs

3.6.1.1

working medium

mixture of air, or air and fuel, and/or combustion products, present in the cylinder during the working cycle

3.6.1.2

intake stroke

piston stroke for inhaling charge air into the cylinder

3.6.1.3

compression stroke

piston stroke for compressing charge air or air-fuel mixture in two stroke or four stroke engines

3.6.1.4

expansion stroke

piston stroke for expanding combustion gas in the cylinder in two stroke or four stroke engines

3.6.1.5

exhaust stroke

piston stroke for exhausting combustion gas out of the cylinder in a four stroke engine

3.6.1.6

expansion

ratio of combustion gas volume at the end of expansion divided by the combustion gas volume at the beginning of expansion in Diesel or Sabathe cycle

3.6.1.7

cut-off ratio

ratio of the cylinder space volume at the end of expansion divided by the cylinder space volume at the beginning of expansion in Otto or Sabathe cycle

3.6.1.8

rate of explosion

ratio of maximum pressure after combustion divided by the maximum pressure at the end of the compression stroke of working medium in Otto cycle or Sabathe cycle

3.6.2

four-stroke cycle

working cycle which, for completion, needs four successive strokes of a working piston of a reciprocating internal combustion engine

3.6.2.1**four-stroke engine**

engine which works on the four-stroke cycle

3.6.3**two-stroke cycle**

working cycle which, for completion, needs two successive strokes of a working piston of a reciprocating internal combustion engine

3.6.3.1**two-stroke engine**

engine which works on the two-stroke cycle

3.6.4**Thermodynamic cycle****3.6.4.1****Otto cycle**

constant volume theoretical thermodynamic cycle which consists of isentropic compression, constant volume heat input, isentropic expansion and constant volume heat release of working medium, and which is the basis of spark ignition engines

3.6.4.2**Diesel cycle****constant pressure cycle**

theoretical thermodynamic cycle which consists of isentropic compression, constant pressure heat input, isentropic expansion and constant pressure heat release of working medium, and which is the basis of diesel engines

3.6.4.3**Sabathe cycle****combined cycle**

theoretical thermodynamic cycle which consists of isentropic compression, constant volume heat input, constant pressure heat input, isentropic expansion and constant volume heat release of working medium, and which is the basis of four stroke diesel engines

3.6.4.4**Miller cycle**

working cycle of RIC engine, in which the closing timing of intake air valve is intentionally delayed or advanced than the normal cycle at charge air intake stroke, to improve thermal efficiency

3.6.4.5**Atkinson cycle**

working cycle of RIC engine, in which the closing timing of intake air valve is mechanically delayed or advanced by using a linkage mechanism of cam and gear, to improve thermal efficiency

3.7 Gas exchange**3.7.1****natural aspiration**

air supply (or air-fuel mixture) into a working cylinder solely by the difference between atmospheric pressure and the pressure in the cylinder

3.7.2**pressure-charging**

air supply (or air-fuel mixture) into a working cylinder at a pressure raised above atmospheric pressure in order to increase the mass of charge and thus make it possible to burn more fuel

3.7.2.1

tuned intake pressure charging

pressure-charging system in which the fresh charge is pre-compressed by a pressure wave resulting from tuned resonance oscillations in the intake duct

3.7.2.2

independent pressure charging

pressure-charging in which the fresh charge is pre-compressed by means of a compressor which receives its power from a source other than the engine to be charged

3.7.2.3

mechanical pressure charging

pressure-charging in which the fresh charge is pre-compressed by means of a compressor driven mechanically (for example: by gears or chains) from the engine to be charged

Note 1 to entry: This is often called "super-charging".

3.7.2.4

turbocharging

pressure-charging in which the fresh charge is pre-compressed by means of a compressor driven by a turbine fed by the exhaust gas of the engine to be charged

3.7.2.5

pulse charging

pressure wave charging

pressure-charging in which the fresh charge is compressed by means of a pressure converter using the pulse of exhaust gas pressure

3.7.2.6

constant pressure charging

pressure-charging in which the exhaust ports are connected to a single exhaust manifold, the design of which ensures that its pressure is virtually constant

3.7.2.7

two-stage pressure charging

pressure-charging in which a fresh charge is pre-compressed by means of two compressors which act on the charge one after the other to raise its pressure to a higher value than could be achieved with just one compressor

3.7.2.8

surge

operating point at which the compressor of a pressure charger is unable to maintain a steady airflow at a given pressure ratio

Note 1 to entry: Reversal of the airflow gives a characteristic sound.

3.7.2.9

surge line

envelope of the points where surge occurs

3.7.2.10

turbocharger efficiency

adiabatic output power divided by the actual input power

3.7.2.11

equivalent area of turbine nozzle

figure specified for each particular design of turbocharger which affects the speed, and thus the pressure ratio, of a turbocharger

3.7.3

charge cooling

cooling of the charge after compression in a pressure-charger and before entering the working cylinder

3.7.3.1

charge air

air after the pressure charger and entering into the cylinder of the RIC engine

3.7.4

scavenging

expulsion of combustion gases from the working cylinder by a fresh charge admitted through the inlet valves or ports while the exhaust valves or ports are still open

3.7.4.1

Type of scavenging of two-stroke engines

3.7.4.1.1

uniflow scavenging

axial flow scavenging occurring when the inlet ports and the exhaust ports are at the opposite ends of the working cylinder

3.7.4.1.2

cross scavenging

transverse flow scavenging, occurring when the inlet ports and the exhaust ports are at the same end of the working cylinder and are substantially on opposite sides of the cylinder

3.7.4.1.3

loop scavenging

transverse flow scavenging, occurring when the inlet ports and the exhaust ports are at the same end of the working cylinder and are on the same side of the cylinder

3.7.4.2

Method of scavenging

3.7.4.2.1

crankcase scavenging

method of scavenging in which a fresh charge is induced into the cylinder by compression in the crankcase by the crankcase side of the working piston

3.7.4.2.2

scavenging by blower

method of scavenging in which a fresh charge is supplied by a blower

3.7.4.2.3

exhaust pulse scavenging

method of scavenging in which the expulsion of gases from the working cylinder is assisted by low exhaust pressure resulting from the low pressure part of the pressure pulse cycle in the exhaust manifold

3.7.4.2.4

port scavenging

method of scavenging using both the scavenging port and gas exhaust port of the cylinder wall

3.7.5

Airflow

3.7.5.1

specific air consumption

quantity of air entering the working cylinders per unit of power and time

3.7.5.2

overall air/fuel ratio

quantity of air entering the working cylinders divided by the quantity of fuel supplied to the engine during the same period of time

3.7.5.3

trapped air/fuel ratio

quantity of air trapped in a cylinder before combustion divided by the quantity of fuel supplied to the cylinder for one working cycle

Note 1 to entry: For liquid-fuel engines, air-fuel ratios are expressed as ratios of mass. For gas engines air-fuel ratios may be expressed as ratios of volume at the same temperature and pressure.

3.7.5.4

delivery ratio

mass of fresh charge supplied to a cylinder for one working cycle divided by the mass of fresh charge corresponding to the piston swept volume at the pressure and temperature conditions in the charge air manifold

3.7.5.5

trapping efficiency

mass of fresh charge trapped in a cylinder before combustion divided by the mass of fresh charge supplied to the cylinder for one working cycle

3.7.5.6

charging efficiency

mass of fresh charge trapped in a cylinder before combustion divided by the mass of fresh charge corresponding to the piston swept volume at the pressure and temperature conditions in the charge air manifold

Note 1 to entry: The charging efficiency is equal to the product of the delivery ratio and the trapping efficiency.

3.7.5.7

charge flow

mass of fresh charge supplied to a cylinder per unit of time

3.7.5.8

theoretical charge flow

nominal gas flow

theoretical mass of fresh charge supplied per unit of time corresponding to the piston-swept volume at the pressure and temperature conditions in the charge air manifold

3.7.5.9

scavenging efficiency

mass of fresh charge trapped in a cylinder before combustion divided by the sum of the mass of fresh charge trapped in a cylinder before combustion and the mass of residual gas from previous working cycles remaining in a cylinder after closing the exhaust port

3.7.5.10

relative total charge

sum of the mass of fresh charge trapped in a cylinder before combustion and the mass of residual gas from previous working cycles remaining in a cylinder after closing the outlet port divided by the mass of fresh charge corresponding to the piston-swept volume at the pressure and temperature conditions in the charge air manifold

3.7.5.11**charging pressure ratio**

ratio of the mean pressures of the charge air behind and before the pressure charger

3.7.5.12**rich mixture**

air-fuel mixture that contains more fuel than that theoretically required for complete combustion

3.7.5.13**lean mixture**

air-fuel mixture that contains more air than that theoretically required for complete combustion

3.7.5.14**stratified engine mixture**

mixture which is richer nearer the ignition plug and leaner further away

3.7.5.15**stoichiometric mixture**

mixture that contains exactly the theoretically required air-fuel ratio for complete combustion

3.7.5.16**excess air ratio**

actual air-fuel ratio divided by the stoichiometric air-fuel ratio

3.7.5.17**swirl**

rotational flow of gas around the central axis of the cylinder

3.7.5.18**swirl ratio**

ratio of swirl revolutions/minutes divided by the engine revolutions/minutes

3.7.5.19**squish**

rotational flow of gas inwards to the centre of the piston and downward into the piston bowl as the piston rises

3.7.5.20**residual gas**

combustion gas remaining inside the cylinder after exhaust stroke

3.7.5.21**blow down**

spout of combustion gas out of cylinder at opening of exhaust valve or port

3.8 Combustion chamber**3.8.1****combustion chamber**

space in which ignition and combustion occur

3.8.2**open combustion chamber**

combustion chamber which is not divided

3.8.3**divided combustion chamber**

combustion chamber divided into parts (main part and subsidiary parts) in such a way that communication between them is restricted

3.8.3.1

prechamber

subsidiary part of a divided combustion chamber into which the fuel is injected, communicating through one or more comparatively narrow passages with the other part of the combustion chamber

3.8.3.2

swirl chamber

subsidiary part of a divided combustion chamber into which fuel is injected, communicating through one large passage with the other part of the combustion chamber and designed to give a controlled swirl to the working medium

3.8.3.3

air chamber

subsidiary part of a divided combustion chamber into which fuel is not injected, and communication with the other part of the combustion chamber is restricted

3.8.4

piston chamber

part of the combustion chamber situated in the piston

3.8.5

ignition timing

instant in the engine cycle when sparking is initiated on the ignition plug of a spark ignition engine, generally expressed by the number of degrees of crank angle before top dead centre

3.8.6

diesel knock

noise caused by an uncontrolled extreme rate of pressure rise which occurs at the beginning of combustion

3.8.7

detonation

abnormally high rate of pressure rise during combustion

3.8.8

firing order

order of ignition in cylinders

3.8.9

ignition lag

time from a fuel air mixture reaches a certain pressure and temperature until ignition occurs

3.8.10

firing interval

time interval of ignition in multi-cylinder engine usually expressed by crank angle

3.8.11

flammability limit

upper and lower limits of fuel-air ratio for burning by flame propagation

3.8.12

combustible gas mixture

fuel-air mixture within flammability limits

3.8.13

unburned gas

unburned fuel-air mixture inside cylinders

3.8.14

burned gas

burned fuel-air mixture inside cylinders

3.8.15**end gas**

unburned fuel-air mixture left inside cylinders which burns at the end of combustion cycle

3.8.16**burning rate**

quantity of fuel or its calorific value burned per unit time or per crank angle

3.8.17**combustion efficiency**

ratio of heat produced by combustion of fuel divided by calorific value of supplied fuel usually based on lower calorific value

3.8.18**combustion products**

gaseous and solid materials produced by combustion

3.8.19**quench area crevice**

area inside the cylinder where the combustion flame does not reach, such as the space between the piston head and cylinder upper wall or clearance near to the cylinder wall

3.8.20**self-ignition**

ignition of fuel-air mixture not by an *external ignition source* but by its own pressure and temperature

3.8.21**surface ignition**

ignition of fuel-air mixture not by flame propagation but by the high temperature of the combustion chamber surface

3.8.22**pre-ignition**

surface ignition of fuel-air mixture which occurs before spark ignition

3.8.23**after-burning**

continuous burning of fuel-air mixture after the end of the combustion period

3.8.24**engine deposit**

combustion products deposited at various parts of engine components such as combustion chamber, piston and valves

3.9 Engine data**3.9.1****Dimensional data****3.9.1.1****cylinder bore**

nominal inner diameter of the working cylinder

3.9.1.2**piston area**

area of a circle of diameter equal to the cylinder bore

Note 1 to entry: For an engine in which a piston rod passes through the combustion space, this area must be reduced by the area of the cross-section of the piston rod.

3.9.1.3

stroke

nominal distance through which a working piston moves between two successive reversals of its direction of motion

3.9.1.4

dead centre

position of the working piston and the moving parts which are mechanically connected to it at the moment when the direction of the piston motion is reversed (at either end-point of the stroke)

3.9.1.4.1

bottom dead centre

location when the piston is nearest to the crankshaft

3.9.1.4.2

top dead centre

location when the piston is farthest from the crankshaft

Note 1 to entry: In engines with only one piston in each cylinder, the expression "outer dead centre" is sometimes used instead of "top dead centre" and "inner dead centre" instead of "bottom dead centre". However, for opposed-piston engines and free-piston engines, it is common to use those expressions in the opposite sense. Only the terms defined in 3.9.1.4.1 and 3.9.1.4.2 should be used.

3.9.1.5

stroke/bore ratio

ratio of the numerical values of stroke and bore

3.9.1.6

nominal volume

volume calculated from the nominal dimensions

Note 1 to entry: Nominal volumes are mainly used for mechanical but not for thermodynamic calculations.

3.9.1.6.1

nominal clearance volume

nominal volume of the space on the combustion side of the piston at top dead centre

Note 1 to entry: When applicable, this volume includes both parts of a divided combustion chamber.

3.9.1.6.2

piston-swept volume

nominal volume generated by the working piston when travelling from one dead centre to the next one, calculated as the product of piston area and stroke

Note 1 to entry: In opposed-piston engines, the piston-swept volume is defined as the sum of these nominal volumes for the pistons in one cylinder.

3.9.1.6.3

nominal cylinder volume

nominal volume of the space of the combustion side of the piston at bottom dead centre

Note 1 to entry: The nominal cylinder volume is equal to the sum of the nominal clearance volume and the piston-swept volume.

3.9.1.6.4

engine-swept volume

sum of all the piston-swept volumes of the engine

Note 1 to entry: This volume is sometimes known as the "cylinder capacity".

3.9.1.6.5**engine cylinder volume**

sum of all the nominal cylinder volumes of the engine

3.9.1.6.6**nominal compression ratio**

numerical value of the nominal cylinder volume divided by the numerical value of the nominal clearance volume

3.9.1.7**effective compression ratio**

numerical value of the effective cylinder volume divided by the numerical value of the effective clearance volume

3.9.1.7.1**working medium volume**

effective volume occupied by the working medium of the combustion side of the piston at a given point of the cycle

Note 1 to entry: For a double-acting engine, the volume on each side of the working piston is considered separately. For an opposed-piston engine, it is the volume between the pistons that is considered.

3.9.1.7.2**effective cylinder volume**

maximum working medium volume

3.9.1.7.3**effective clearance volume**

minimum working medium volume

Note 1 to entry: This volume is also known as the "compression space volume".

3.9.1.7.4**bumping clearance**

distance between the lower surface of the cylinder head and the upper surface of the piston crown when the piston is at top dead centre

Note 1 to entry: This volume is also known as the "top clearance".

3.9.1.8**number of cylinders**

number of working cylinders of a reciprocating internal combustion engine

Note 1 to entry: If one combustion chamber serves several working cylinders, these count as one working cylinder. If several combustion chambers are contained by one working cylinder it counts as one working cylinder.

3.9.1.9**connecting rod ratio**

ratio of the crank radius to the distance between the centres of the bores of the connecting rod's big and small ends

3.9.1.2.9**valve timing**

beginning and end of the valve motion, generally expressed in degrees of crank angle from a designated dead centre

3.10 Engine speed

3.10.1

engine speed

number of revolutions of the crankshaft in a given period of time

Note 1 to entry: In the case of free-piston engines the speed is the number of cycles per minute of the reciprocating parts.

3.10.1.1

maximum continuous speed

maximum engine speed at which the engine is allowed to run continuously at the continuous power declared by the manufacturer for a particular application

3.10.1.2

declared speed

engine speed at which the engine delivers the declared power

3.10.1.3

overload speed

engine speed at which the engine delivers the overload power declared by the manufacturer

3.10.1.4

idling speed

steady state engine speed without load

Note 1 to entry: This is also known as the "no load speed".

3.10.1.5

firing speed

engine speed to which an engine must accelerate from rest, by the use of an external supply of energy separate from the fuel feed system before it becomes self-sustaining

3.10.1.6

coefficient of speed fluctuation

variation of angular engine velocity during one cycle of rotation

$$\delta = (\omega_{\max} - \omega_{\min}) / \omega_{\text{mean}} \times 100$$

where

δ is the coefficient of speed fluctuation (%);

$\omega_{\max}$ is the maximum angular engine velocity;

$\omega_{\min}$ is the minimum angular engine velocity;

ω_{mean} is the mean angular engine velocity.

3.10.2

mean piston speed

mean velocity of the piston, calculated as twice the product of the stroke and the engine speed

3.11 Torque

3.11.1

torque

brake torque

turning moment delivered by the engine at the driving shaft

3.11.2**breakaway torque**

driving torque that has to be applied to the flywheel or the crankshaft to overcome the static frictional resistance of the main running gear and of the essential dependent auxiliaries at the beginning of rotation

Note 1 to entry: The terms “static friction torque” and “unsticking torque” are also used.

3.11.3**cranking torque**

sum of cranking resistance torque and acceleration torque

3.11.3.1**cranking resistance torque**

driving torque required to overcome the frictional resistance of the main running gear, the working cycle losses and the torque required by the essential dependent auxiliaries in order to maintain a constant engine speed after a given period of time from the beginning of rotation

3.11.3.2**acceleration torque**

torque required to accelerate the main running gear and the essential dependent auxiliaries during the speed acceleration period from the beginning of rotation

3.12 Power**3.12.1****indicated power**

total power developed in the working cylinders as a result of the pressure of the working medium acting on the pistons

3.12.1.1**indicator diagram**

diagram representing the variation of pressure of the working medium in a cylinder throughout a working cycle

Note 1 to entry: See Figure 4.

3.12.2**brake power**

power of the sum of the powers measured at the driving shaft or shafts

Note 1 to entry: Refer to ISO 15550:2002, 3.3.3 for a more precise definition.

3.12.2.1**brake mean effective pressure****BMEP**

work done per working cycle corresponding to the brake power divided by the engine swept volume

$$P_{me} = kP_e / nV_{st}$$

where

P_{me} is the brake mean effective pressure (MPa);

P_e is the brake power (kW);

n is the engine speed (min⁻¹);

V_{st} is the engine swept volume (l);

k is 120 (4 stroke engine);

= 60 (2 stroke engine).

3.12.2.2

brake thermal efficiency

brake power divided by the rate of supply of heat energy to an engine as fuel

Note 1 to entry: The heat energy of the fuel should be considered as the product of the mass of fuel and its lower calorific value.

3.12.2.3

indicated mean effective pressure

IMEP

work done per working cycle corresponding to the indicated power divided by the engine swept volume

$$P_{mi} = kP_i / nV_{st}$$

where

P_{me} is the brake mean effective pressure (MPa);

P_i is the indicated power (kW);

n, V_{st}, k refer to 3.12.2.1.

3.12.3

mechanical efficiency

brake power divided by the indicated power

3.12.4

load

general term describing the magnitude of the "power" or "torque" demanded from the engine by its driven machinery and usually expressed relative to a declared power or torque

Note 1 to entry: The term "load" is physically imprecise and should be avoided. For quantitative purposes, the terms "power" or "torque" should be used instead of "load", together with a statement of speed.

3.12.5

friction power

power necessary to overcome mechanical friction and to supply energy for all essential dependent auxiliaries

3.12.5.1

pumping loss

power necessary to overcome form and friction drags at intake and exhaust

3.12.5.2

heat loss

heat emission of supplied heat of fuel

3.12.5.3

exhaust loss

heat loss of exhaust gas

3.12.5.4

cooling loss

heat loss by cooling air and cooling fluid

3.12.5.5

heat balance

distribution of the heat energy of fuel supplied to the engine to engine power and various losses

3.12.6

indicated thermal efficiency

ratio of the indicated power to the rate of supply of heat energy to an engine as fuel

3.12.7

heat emission

heat emitted from an engine by radiation, convection and conduction into the surrounding atmosphere

3.12.8

declared power

value of the power, declared by the manufacturer, which an engine will deliver under a given set of circumstances

Note 1 to entry: In some applications, the declared power is named "rated power".

[SOURCE: ISO 15550:2002, 3.3.1, modified — Note 1 to entry has been added.]

3.12.9

net power

power obtained on a test bed at the end of the crankshaft or its equivalent at the corresponding engine speed with the equipment and auxiliaries specified for net power measurement

Note 1 to entry: Refer to ISO 15550:2002, 3.3.3.1 for a more precise definition.

3.12.10

gross power

power obtained on a test bed at the end of the crankshaft or its equivalent at the corresponding engine speed with the equipment and auxiliaries specified for gross power measurement

Note 1 to entry: Refer to ISO 15550:2002, 3.3.3.2 for a more precise definition.

3.12.11

continuous power

power which an engine is capable of delivering continuously, between the nominal maintenance intervals stated by the manufacturer, at the stated speed and under stated ambient conditions, the maintenance prescribed by the manufacturer having been carried out

[SOURCE: ISO 15550:2002, 3.3.4]

3.12.12

overload power

power which an engine may be permitted to deliver, with a duration and frequency of use depending on the service application, at stated ambient conditions, immediately after operating at the continuous power restricted to 1 h in a 12 h time span

[SOURCE: ISO 15550:2002, 3.3.5]

3.12.13

fuel stop power

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

[SOURCE: ISO 15550:2002, 3.3.6]

3.12.14

service power

power delivered under the ambient and operating conditions of an engine application

[SOURCE: ISO 15550:2002, 3.3.8]

3.12.15

specific power

brake power per unit of engine specification such as engine weight or cylinder volume

3.13 Consumption

3.13.1

fuel consumption

quantity of fuel consumed by an engine per unit of time

3.13.2

specific fuel consumption

SFC

quantity of fuel consumed by an engine per unit of power and time

Note 1 to entry: While for engines which burn liquid fuel, the fuel consumption and specific fuel consumption are normally expressed in terms of the mass of fuel, for gas engines it is normal to quote fuel consumption either in units of energy or as a volume at a specific temperature and pressure, together with the calorific value of the fuel.

3.13.2.1

brake specific fuel consumption

BSFC

specific fuel consumption based on brake power

3.13.2.2

indicated specific fuel consumption

ISFC

specific fuel consumption based on indicated power

3.13.3

lubricating oil consumption

quantity of lubricating oil consumed by an engine per unit of time

3.13.4

specific lubricating oil consumption

quantity of lubricating oil consumed by an engine per unit of power and time

3.13.5

heat consumption

rate of supply of heat energy to an engine per unit of time

Note 1 to entry: Heat consumption is calculated as the product of *fuel consumption* ([3.13.1](#)) and lower calorific value.

3.13.6

specific heat consumption

rate of supply of heat energy to an engine per unit of power and time

Note 1 to entry: The specific heat consumption is given a subscript according to the kind of power to which it refers.

3.13.6.1

brake specific heat consumption

specific fuel consumption based on brake power

3.13.6.2**indicated specific heat consumption**

specific fuel consumption based on indicated power

3.14 Pressures**3.14.1****compression pressure in a cylinder**

maximum pressure of the working medium present in a cylinder, at momentary fuel cut off or ignition switch off

3.14.2**maximum cylinder pressure**

maximum pressure of the working medium present in a cylinder attained during a working cycle

Note 1 to entry: This pressure is also known as "peak pressure".

3.14.3**ambient pressure**

pressure level of the atmosphere in the vicinity of where the engine takes its air

3.14.4**inlet pressure**

arithmetic mean absolute intake pressure at engine or pressure charger inlet

3.14.5**boost pressure**

arithmetic mean charge air pressure after a pressure charger

Note 1 to entry: Note 1 to entry: When the boost pressure is only slightly above atmospheric pressure, the term "scavenging pressure" is used in the case of two-stroke engines.

3.14.6**exhaust back pressure**

arithmetic mean of the pressure in the exhaust manifold or after the turbine

3.15 Temperature**3.15.1****ambient temperature**

temperature level of the atmosphere in the environment of the engine installation

3.15.2**inlet temperature**

temperature of the air entering an engine measured at a specific point in the inlet ducting

3.15.2.1**charge air temperature**

temperature of the air after a pressure charger

3.15.3**minimum engine starting temperature**

lowest site temperature at which an engine equipped with essential dependent auxiliaries can be brought to a self sustained speed under stated starting conditions within a given period of time after actuating the starting device

Note 1 to entry: Fluid lubricants, fuels and coolants are anticipated. The value of this temperature depends on whether a starting aid is used. For engines without preheating the lowest site temperature assumes that the engine has been completely cooled down to this temperature.

3.15.4

exhaust temperature

mean temperature of the exhaust gas leaving the cylinder

3.16 Design arrangement

3.16.1

single-acting engine

engine in which combustion takes place on only one and the same side of each working piston

3.16.2

double-acting engine

engine in which combustion takes place alternately on either side of each working piston

3.16.3

opposed-piston engine

engine, having in each cylinder two mechanically connected working pistons running in substantially opposite directions, with the working medium between them

3.16.4

trunk-piston engine

engine in which each connecting rod is hinged directly to its working piston, which transmits to the cylinder wall the side thrust caused by angularity of the connecting rod

3.16.5

cross head engine

engine in which the side thrust caused by the angularity of the connecting rod is transmitted through a linking mechanism (cross-head) to guides fixed outside the cylinder

3.16.6

uni-directional engine

engine in which the crankshaft is designed to always rotate in the same direction

Note 1 to entry: This can also be referred to as an "irreversible engine".

3.16.7

direct reversing engine

engine in which the direction of rotation may be changed by the operation of a control device

3.16.8

turbo-compound engine

engine in which the power is generated by multistage expansion of the working medium in an RIC engine and a power turbine

3.17 Cylinder arrangement

3.17.1

cylinder row

arrangement of cylinders in which the pistons are connected to the same crankpin of the crankshaft

3.17.2

cylinder bank

arrangement of cylinders in which the centre line of the crankshaft journals lies in or is parallel to the plane containing the centre line of the engine cylinders, all cylinders being on the same side of the crankshaft

3.17.3

in-line engine

engine with one cylinder bank

3.17.4**vertical engine**

engine with one or more cylinder banks each located in a vertical plane above its crankshaft

3.17.5**horizontal engine**

engine with one or more cylinder banks each located in a horizontal plane

3.17.6**inclined engine**

engine with one cylinder bank which is located in an inclined plane lying between the vertical and horizontal planes through the crankshaft

3.17.7**inverted engine**

engine with one or more cylinder bank each located in a vertical plane below its crankshaft

3.17.8**twin-bank engine**

engine with two parallel cylinder banks and two crankshafts

3.17.9**V-engine**

engine with two cylinder banks inclined at an angle to each other and with one crankshaft

3.17.9.1**V-angle delta**

Δ

angle between two planes containing the centre lines of the engine cylinders perpendicular to the crankshaft ($0^\circ < \Delta < 180^\circ$)

3.17.9.2**cylinder offset**

distance measured parallel to the crankshaft, between the centre lines of two pistons on opposite sides of the V of the engine that have connecting rods that work on the same crank pin

3.17.10**horizontally opposed engine**

engine with two cylinder banks located in the same plane on opposite sides of the crankshaft

3.17.11**broad-arrow engine**

engine with more than two cylinder banks inclined at an angle to each other and with one crankshaft, the inclined angle between the extreme banks being less than 180°

Note 1 to entry: A broad-arrow engine with three cylinder banks is known as a "W-engine".

3.17.12**X-engine**

engine with one crankshaft having four cylinder banks arranged in two planes, inclined at an angle to each other, the two banks in each plane being on opposite sides of the crankshaft

3.17.13**H-engine**

engine with two crankshafts having four cylinder banks in two parallel planes, the two banks in each plane being on opposite sides of a crankshaft