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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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Foreword

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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