
**Reciprocating internal combustion
engines — Vocabulary of components
and systems —**

**Part 12:
Exhaust emission control systems**

*Moteurs alternatifs à combustion interne — Vocabulaire des
composants et des systèmes —*

Partie 12: Systèmes de contrôle des émissions de gaz d'échappement



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of 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 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 7967-12:2014), which has been technically revised.

The main changes are as follows:

- the editorial form of the text has been updated;
- the normative references have been updated;
- new terms have been added;
- the terms and definitions have been modified;
- inappropriate words or expressions have been revised;
- a bibliography has been added.

A list of all parts in the ISO 7967 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Reciprocating internal combustion engines — Vocabulary of components and systems —

Part 12: Exhaust emission control systems

1 Scope

This document establishes a vocabulary for emission control systems of reciprocating internal combustion engines.

In this document, the terms are classified as follows:

- a) exhaust emission matter;
- b) exhaust emission control systems and devices;
- c) parameters for exhaust emission control systems.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

3.1 Exhaust emission matter

3.1.1

exhaust emission

pollutants contained in the exhaust gas from internal combustion engines or phenomenon of emitting such pollutants

3.1.2

particulate matter

PM

particulates

material collected on a specified filter medium after diluting exhaust with clean filtered air to a specific temperature, primarily carbon, condensed hydrocarbons and sulphates with associated water

Note 1 to entry: For details see ISO 8178-1:2020, 3.26 and 8.1.4.

3.1.3

total suspended particulate (matter)

TSP

particulate matter (3.1.2) with a diameter less than 100 micrometres

3.1.4

soot

fine carbonic matter generated during the combustion process of fuels

3.1.5

exhaust gas smoke

diesel smoke

visible suspension of solid and/or liquid particles in gases resulting from combustion or pyrolysis

[SOURCE: ISO 8178-3:2019, 3.5, modified — Note 1 to entry removed.]

3.1.6

SO_x

<general> sulphur oxides, such as SO₂ and SO₃, contained in the exhaust gas

3.1.7

NO_x

<general> nitrogen oxides, such as NO and NO₂, contained in the exhaust gas

3.1.8

nitrous oxide

N₂O

gaseous *exhaust emission* (3.1.1) that is mainly produced by deoxidization reaction in the selective catalytic reduction system for internal combustion engines

3.1.9

carbon dioxide

CO₂

gaseous *exhaust emission* (3.1.1) that is produced by oxidization reaction of fuel and air in the combustion process of internal combustion engines

3.1.10

volatile organic compound

VOC

<general> suspended *particulate matter* (3.1.2), such as toluene, xylene, ethyl acetate, formaldehyde or acetaldehyde, which is mainly produced by evaporation of fuel or paint but also by the exhaustion of unburned fuel from reciprocating internal combustion engines

3.1.11

total hydrocarbon

THC

combined mass of organic compounds measured by the specified procedure for measuring total hydrocarbon

Note 1 to entry: Total hydrocarbon is expressed as a hydrocarbon with a hydrogen-to-carbon mass ratio of 1,85 (diesel), 1,93 [petrol (E10)], 2,525 (LPG), 4,0 (NG/biomethane) or 2,74 [ethanol (E85)].

Note 2 to entry: See ISO 8178-4:2020, H.3.4.

[SOURCE: ISO 8178-1:2020, 3.47, modified — Note 2 to entry added.]

3.1.12

blowby gas

combustion chamber gas leaked to the crankcase through the clearance between piston, piston rings and cylinder wall

3.1.13

photochemical smog

harmful mixture of smoke and fog in the ambient air which is produced by chemical reaction between pollutants in smoke and sunlight

3.1.14**non-methane hydrocarbon****NMHC**

sum of all hydrocarbon species except methane

3.1.15**carbon monoxide****CO**

poisonous gaseous emission which is produced by imperfect combustion of internal combustion engines

3.2 Exhaust emission control systems and devices**3.2.1****reactive manifold**

exhaust manifold with excessive volume to decrease combustible exhaust gas components by thermal oxidation reaction

3.2.2**exhaust port liner**

liner inserted in the exhaust port to keep the exhaust gas temperature high

3.2.3**thermal reactor**

equipment which reduces combustible emissions, such as hydrocarbon and carbon monoxide, by a thermal oxidation process

3.2.4**catalytic converter**

equipment which reduces *exhaust emissions* (3.1.1) using a catalyst

3.2.5**oxidation catalytic converter**

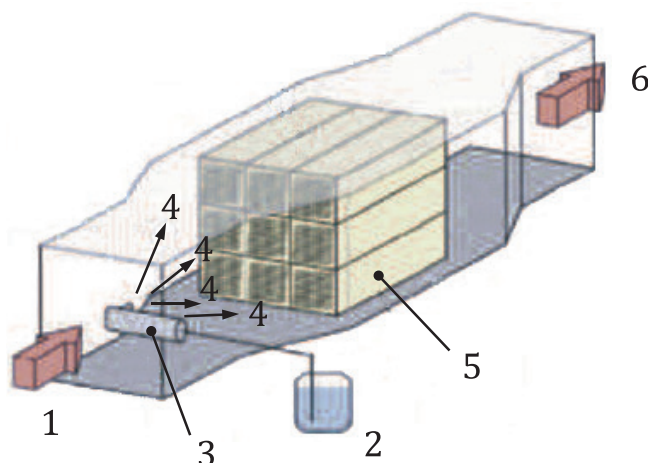
equipment which reduces hydrocarbon and carbon monoxide in the exhaust gas by an oxidation catalyst

3.2.6**selective catalytic reduction****SCR**

means to reduce NO_x emission in the exhaust gas by converting NO_x to N_2 and water using a catalyst

Note 1 to entry: See [Figure 1](#).

Note 2 to entry: Usually, ammonia or urea is used as the reducing agent.



Key

- | | |
|--------------------|---|
| 1 exhaust gas | 4 hydrolysis process of urea to ammonia |
| 2 urea water | 5 <i>catalytic converter</i> (3.2.4) (catalytic reaction of NO _x to N ₂ and H ₂ O) |
| 3 injection nozzle | 6 exhaust gas |

Figure 1 — Example of selective catalytic reduction

3.2.7

NO_x reduction catalytic converter

equipment which reduces NO_x in the exhaust gas by *selective catalytic reduction* (3.2.6)

3.2.8

deNO_x system

<general> exhaust after-treatment system designed to reduce NO_x, such as a passive and active lean NO_x catalyst, NO_x absorber and *NO_x reduction catalytic converter* (3.2.7)

3.2.9

three-way catalytic converter

equipment which reduces hydrocarbon, carbon monoxide and NO_x in the exhaust gas simultaneously by oxidation and deoxidization catalyst

3.2.10

oxygen sensor

λ (lambda) sensor

sensor for measuring oxygen content of exhaust gas

3.2.11

secondary air supply system

system which supplies additional air into the exhaust gas to oxidize and reduce unburned emissions

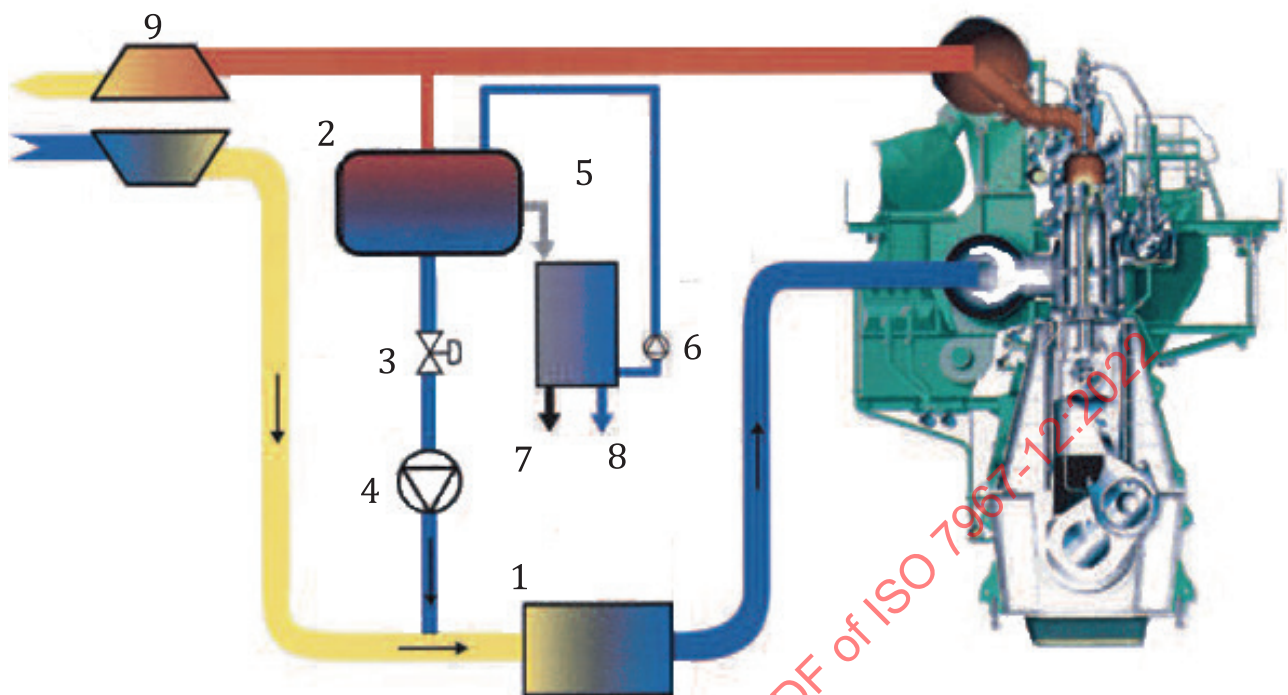
3.2.12

exhaust gas recirculation

EGR

means to reduce NO_x emission in the exhaust gas by recirculating a portion of the exhaust gas back to the engine to be mixed with the charge air

Note 1 to entry: See [Figure 2](#).

**Key**

- | | | | |
|---|------------------------|---|-----------------|
| 1 | scavenge air cooler | 6 | water pump |
| 2 | scrubber | 7 | sludge out |
| 3 | EGR valve | 8 | clean brine out |
| 4 | EGR blower | 9 | turbocharger |
| 5 | water treatment system | | |

Figure 2 — Example of *exhaust gas recirculation* (3.2.12) for marine applications

3.2.13**internal EGR**

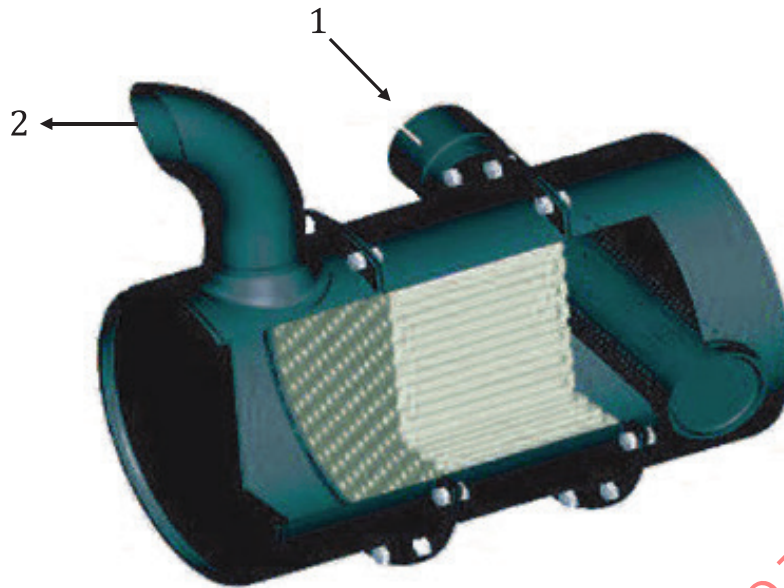
means to reduce NO_x emission in the exhaust gas by increasing the amount of residual gas in the cylinder at the scavenging process and with the same effect as *exhaust gas recirculation* (3.2.12)

3.2.14**diesel particulate filter****DPF**

<general> filter installed in the exhaust passage of a diesel engine to remove *particulate matter* (3.1.2)

Note 1 to entry: See [Figure 3](#).

Note 2 to entry: A diesel particulate filter with wash coat and precious metal which can help decrease the regeneration temperature of particulate matter collected on the filter is sometimes called a catalysed diesel particulate filter (CDPF).



Key

- 1 engine exhaust gas
- 2 purified exhaust gas

Figure 3 — Example of diesel particulate filter — Cut-out view

3.2.15

gasoline particulate filter

GPF

filter installed in the exhaust gas passage of a gasoline engine to remove the *particulate matter* (3.1.2)

3.2.16

particulate trap oxidizer

filter which is installed after the *diesel particulate filter* (3.2.14) and has the ability to burn off the collected *particulate matter* (3.1.2) in the diesel particulate filter

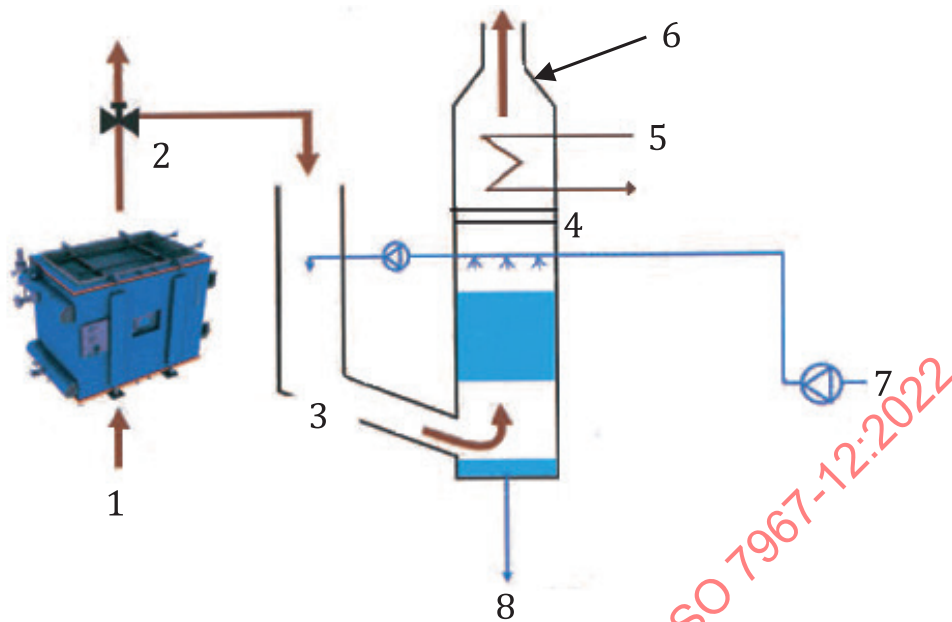
3.2.17

exhaust scrubber

equipment to reduce emission matters in exhaust gas by scrubbing with sea water, fresh water or dry sorbent material

Note 1 to entry: A scrubber using water is called a wet scrubber, while a scrubber using dry sorbent is called a dry scrubber.

Note 2 to entry: See Figure 4 for a wet-scrubber system.

**Key**

- | | |
|----------------------|-----------------------------|
| 1 engine exhaust gas | 5 steam or jacket water |
| 2 by-pass | 6 exhaust scrubber (3.2.17) |
| 3 jet scrubber | 7 sea water |
| 4 demister | 8 overboard |

Figure 4 — Example of exhaust scrubbing system for marine applications

3.2.18**NO_x absorber**

catalyst which traps NO_x in the exhaust gas and deoxidizes NO_x to N₂

3.3 Parameters for exhaust emission control systems**3.3.1****space velocity****SV**

exhaust gas volume flow rate divided by the volume of the catalyst

3.3.2**EGR ratio** **r_{EGR}**

ratio of recirculated exhaust gas mass flow to total inlet gas mass flow into cylinder

Note 1 to entry: EGR ratio can be calculated using the following formula:

$$r_{\text{EGR}} = m_{\text{EGR}} / (m_{\text{IN}} + m_{\text{EGR}})$$

where

r_{EGR} is the EGR ratio;

m_{EGR} is the recirculated exhaust gas mass flow;

m_{IN} is the inlet air mass flow.

3.3.3

emission index

EI

normalized indicator of emission levels

Note 1 to entry: For example, the emission index for NO_x is expressed as follows:

$$e_{\text{NO}_x} = \frac{m_{\text{NO}_x}}{m_f}$$

where

e_{NO_x} is the emission index for NO_x;

m_{NO_x} is the mass flow rate of NO_x in the exhaust gas (g/s);

m_f is the mass flow rate of fuel (kg/s).

3.3.4

specific emission

mass flow rate of pollutant per unit power output

Note 1 to entry: Specific emission is usually expressed in mg/J or g/kW-hr.

3.3.5

emission coefficient

emission factor

quantity of emitted pollutant per total quantity of used fuel

Note 1 to entry: This term is mainly used to indicate the measure for greenhouse gas production of the unit or plant.

3.3.6

(catalyst) conversion efficiency

percentage of concerned exhaust pollutant converted to harmless substances by the *catalytic converter* ([3.2.4](#))