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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

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 70, *Internal combustion engines*

ISO 7967 consists of the following parts, under the general title *Reciprocating internal combustion engines — Vocabulary of components and systems*:

— *Part 1: Structure and external covers*

— *Part 2: Main running gear*

— *Part 3: Valves, camshaft drive and actuating mechanisms*

— *Part 4: Pressure charging and air/exhaust gas ducting systems*

— *Part 5: Cooling systems*

— *Part 6: Lubricating systems*

— *Part 7: Governing systems*

— *Part 8: Starting systems*

— *Part 9: Control and monitoring systems*

— *Part 10: Ignition systems*

— *Part 11: Fuel systems*

— *Part 12: Exhaust emission control systems*

Reciprocating internal combustion engines — Vocabulary of components and systems —

Part 12: Exhaust emission control systems

1 Scope

This part of ISO 7967 establishes a vocabulary for emission control systems of reciprocating internal combustion engines.

ISO 2710-1 gives a classification of reciprocating internal combustion engines and denotes basic terms and definitions of such engines and their characteristics.

In this part of ISO 7967, terms are classified as the following:

a) exhaust emission matter;

b) exhaust emission control system and device;

c) parameters for exhaust emission control system.

2 Normative references

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

ISO 8178-1:2006, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 1: Test-bed measurement of gaseous and particulate exhaust emissions*

ISO 8178-9:2012, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 9: Test cycles and test procedures for test bed measurement of exhaust gas smoke emissions from compression ignition engines operating under transient conditions*

3 Terms and definitions

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
particulates
PM
<general> particles contained in the exhaust gas which consist primarily of carbon, condensed hydrocarbons and sulfates, and associated water

Note 1 to entry: "Particulate matter" is defined more precisely for the measurement or regulation purposes as "material collected on a specified filter medium after diluting exhaust gases with clean, filtered air to a temperature of greater than 315 K (42 °C) and less than or equal to 325 K (52 °C), as measured at a point immediately upstream of the primary filter". Refer to ISO 8178-1:2006, 3.1.

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 8178-9:2012, 3.1]

3.1.6
SO_x
<general> sulphur oxides, such as SO_2 and SO_3, contained in the exhaust gas

3.1.7
NO_x
<general> nitrogen oxides, such as NO and NO_2, contained in the exhaust gas

3.1.8
nitrous oxide
N_2O
gaseous *exhaust emission* (3.1.1) that is mainly produced by deoxidization reaction in SCR system for internal combustion engines

3.1.9
carbon dioxide
CO_2
gaseous *exhaust emission* (3.1.1) that is produced by oxidization reaction of fuel and air in 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, which is mainly produced by evaporation of fuel or paint but also produced by the exhaustion of unburned fuel from RIC engines

3.1.11
total hydrocarbon
THC
total quantity of hydrocarbons which remain in the exhaust gas as a result of unburning or imperfect burning of fossil fuel and lubricant

Note 1 to entry: "Total hydrocarbon" is defined more precisely for the measurement or regulation purposes as "combined mass of organic compounds measured by the specified procedure of measuring total hydrocarbon, expressed as a hydrocarbon with a hydrogen-to-carbon mass ratio of 1,85:1". Refer to UN, Global technical regulation No.11, 3.1.69.[6]

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 smog (a 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

3.2 Exhaust emission control system and device

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 HC and CO, by thermal oxidation process

3.2.4
catalytic converter
equipment which reduces *exhaust emissions* (3.1.1) using catalyst

3.2.5
oxidation catalytic converter
equipment which reduces HC and CO in the exhaust gas by 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 catalyst

Note 1 to entry: For example, see Figure 1.

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

3.2.7
NO_x reduction catalytic converter
equipment which reduces NO_x in the exhaust gas by *SCR* (3.2.6)

3.2.8
deNO$_x$ system
<general> exhaust after-treatment systems designed to reduce NO$_x$, such as passive and active lean NO$_x$ catalysts, NO$_x$ absorbers, and *NOx reduction catalytic converter* (3.2.7)

3.2.9
three-way catalytic converter
equipment which reduces HC, CO, 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 re-circulating a portion of the exhaust gas back to the engine to be mixed with the charge air

Note 1 to entry: For example, see Figure 2.

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 scavenging process and with the same effect as *EGR* (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: For example, see Figure 4.

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

3.2.15
gasoline particulate filter
GPF
filter installed in the exhaust gas passage of gasoline engine to remove the *particulate matter* (3.1.2)

3.2.16
particulate trap oxidizer
filter which is installed after *DPF* (3.2.14) and has the ability to burn off the collected *PM* (3.1.2) in DPF

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 “wet scrubber” while the scrubber using dry sorbent is called “dry scrubber”.

3.3 Parameters for exhaust emission control system

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 re-circulated exhaust gas flow to total inlet gas flow into cylinder

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

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

where

r_{EGR} is the EGR ratio;

m_{EGR} is the re-circulated exhaust gas flow;

m_{IN} is the inlet air flow.

3.3.3
emission index
EI
normalized indicator of emission levels

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

$$EI_{NO_x} = \frac{m_{NO_x}}{m_f}$$

where

EI_{NOx} is the emission index for NO_x;

m_{NOx} 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: It 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)

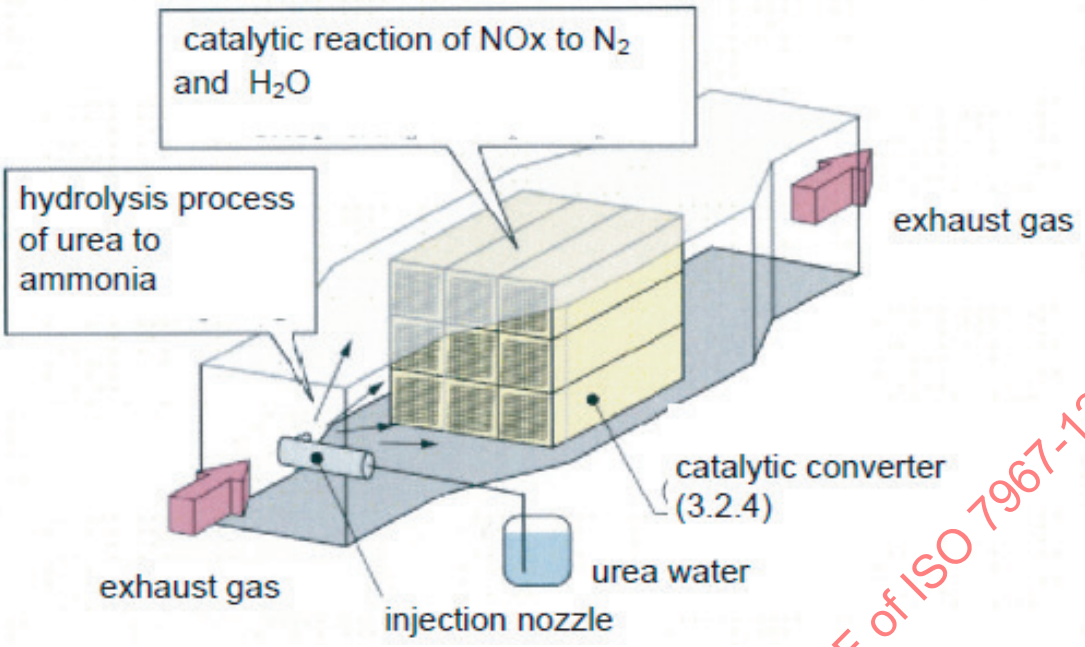

Figure 1 — Example of selective catalytic reduction (SCR, 3.2.6)

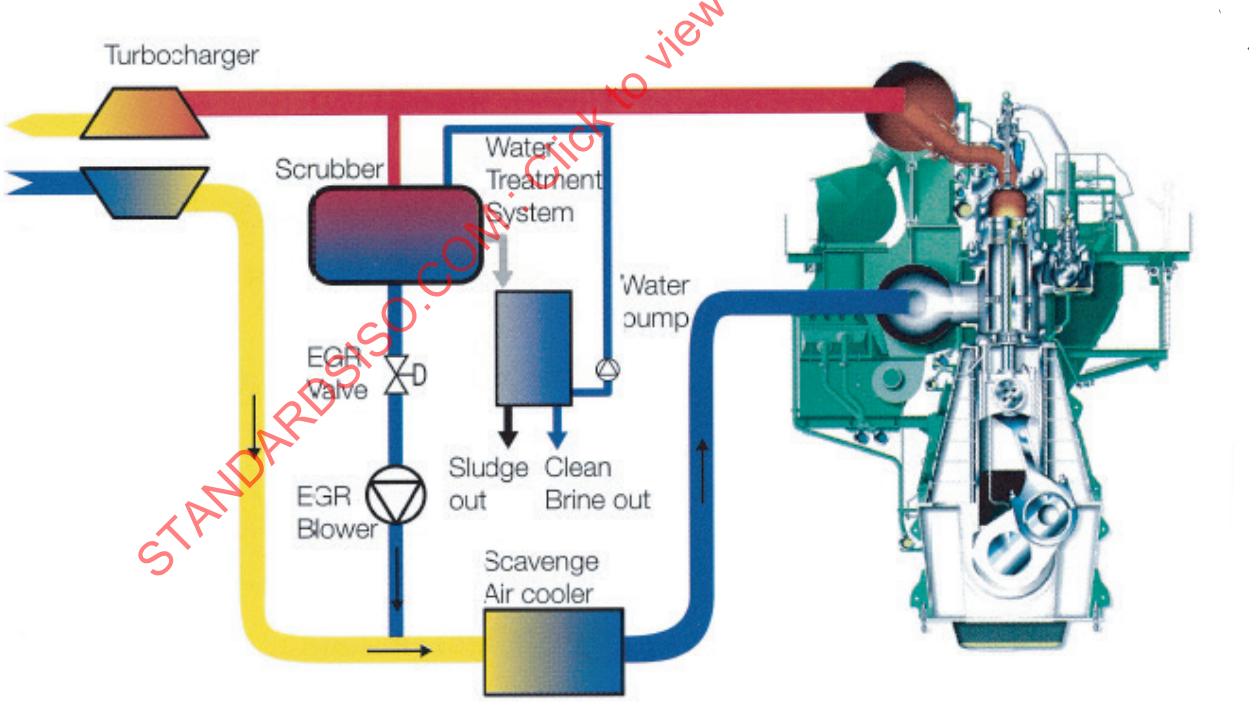

Figure 2 — Example of exhaust gas recirculation (3.2.12) for marine applications

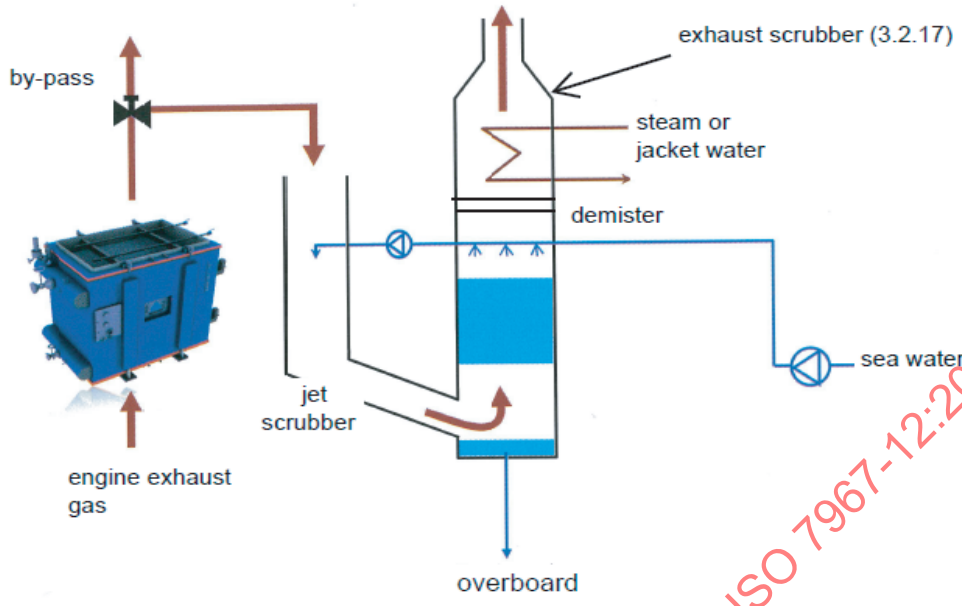

Figure 3 — Example of exhaust scrubbing system for marine applications

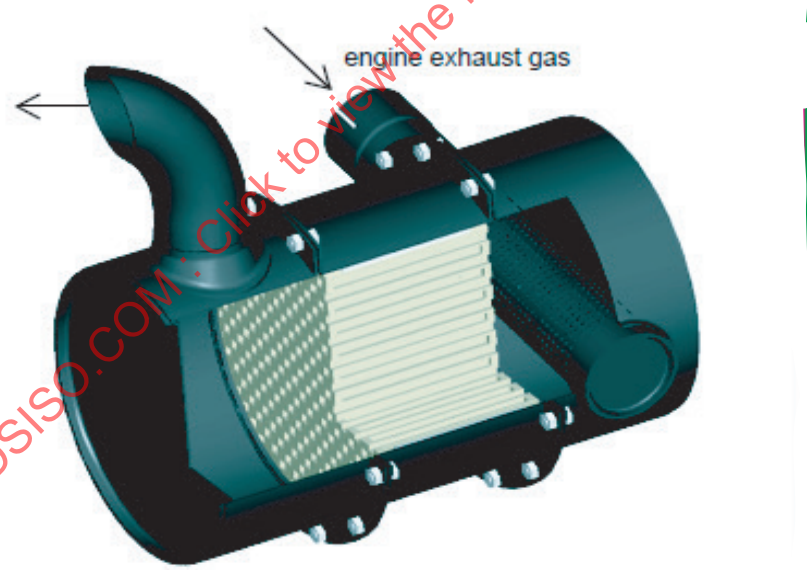

Figure 4 — Example of diesel particulate filter (DPF, 3.2.14) — Cut-out view