INTERNATIONAL STANDARD

ISO 8178-10

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Reciprocating internal combustion engines — Exhaust emission measurement —

Part 10: Test cycles and test procedures for field measurement of exhaust gas smoke emissions from compression ignition engines operating under transient conditions

Moteurs alternatifs à combustion interne — Mesurage des émissions de gaz d'échappement —

Partie 10: Cycles et procédures d'essai pour le mesurage sur site des émissions de fumées de gaz d'échappement des moteurs à allumage par compression fonctionnant en régime transitoire

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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 3.

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 part of ISO 8178 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8178-10 was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*, Subcommittee SC 8, *Exhaust gas emission measurement*.

ISO 8178 consists of the following parts, under the general title *Reciprocating internal combustion engines — Exhaust emission measurement*:

— *Part 1: Test-bed measurement of gaseous and particulate exhaust emissions*

— *Part 2: Measurement of gaseous and particulate exhaust emissions at site*

— *Part 3: Definitions and methods of measurement of exhaust gas smoke under steady-state conditions*

— *Part 4: Test cycles for different engine applications*

— *Part 5: Test fuels*

— *Part 6: Report of measuring results and test*

— *Part 7: Engine family determination*

— *Part 8: Engine group determination*

— *Part 9: Test cycles and test procedures for test bed measurement of exhaust gas smoke emissions from compression ignition engines operating under transient conditions*

— *Part 10: Test cycles and test procedures for field measurement of exhaust gas smoke emissions from compression ignition engines operating under transient conditions*

Annexes A, B and C form a normative part of this part of ISO 8178. Annex D is for information only.

Introduction

Throughout the world there currently exist many smoke measurement procedures in various forms. Some of these smoke measurement procedures are designed for test bed testing and may be used for certification or type-approval purposes. Others are designed for field testing and may be used in inspection and maintenance programmes. Different smoke measurement procedures exist to meet the needs of various regulatory agencies and industries. The two methods typically used are the filter smokemeter method and the opacimeter.

The objective of this part of ISO 8178 is to combine the key features of several existing smoke measurement procedures as much as is technically possible. This part of ISO 8178 is intended for the measurement of the emissions of smoke from compression ignition internal combustion engines under field conditions. It applies to engines operating under transient conditions – where the engine speed or load, or both, changes with time. It should be noted that the smoke emissions from typical well-maintained naturally-aspirated engines under transient conditions will generally be the same as the smoke emissions under steady state conditions.

Only opacimeter type smokemeters may be used for making the smoke measurements described in this part of ISO 8178. This part of ISO 8178 allows the use of either full-flow or partial-flow opacimeters. This part of ISO 8178 accounts for differences in response time between the two types of opacimeters, but does not account for any differences due to differences in temperatures at the sampling zone.

Reciprocating internal combustion engines — Exhaust emission measurement —

Part 10:
Test cycles and test procedures for field measurement of exhaust gas smoke emissions from compression ignition engines operating under transient conditions

1 Scope

This part of ISO 8178 specifies the measurement procedures and test cycles for the evaluation of smoke emissions from compression ignition engines under field conditions. This part of ISO 8178 is intended for use primarily as a support for in-use smoke testing programmes on engines that have been “certified” or “type approved” in accordance with the provisions of ISO 8178-9. ISO 8178-9 provides test procedures and test cycles for measurement of smoke from different applications of engines operating on the test bed.

Likewise, ISO 8178-4 specifies a number of different test cycles to be used in order to characterize gaseous and particulate emissions from nonroad engines. The test cycles in ISO 8178-4 were developed in recognition of the differing operating characteristics of various categories of nonroad machines.

For transient smoke test cycles, smoke testing is conducted using smokemeters that operate on the light extinction principle. The purpose of this part of ISO 8178 is to define the smoke test cycles and the methods used to measure and analyse smoke. Specifications for measurement of smoke using the light extinction principle can be found in ISO 11614. The test procedures and measurement techniques described in clauses 5 to 11 of this part of ISO 8178 are applicable to reciprocating internal combustion (RIC) engines in general. However, an engine application can only be evaluated using this part of ISO 8178 once the appropriate test cycle has been developed. Annexes A to C to this part of ISO 8178 each contains a test cycle that is relevant only for those specific applications listed in the scope of that annex. Where possible, the smoke test cycle described in the annex utilizes the engine and machine categories developed in ISO 8178-4.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 8178. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 8178 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 8178-4:1996, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 4: Test cycles for different engine applications*

ISO 8178-5, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 5: Test fuels*

ISO 8178-6, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 6: Report of measuring results and test*

ISO 8178-7, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 7: Engine family determination*

ISO 8178-8, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 8: Engine group determination*

ISO 8178-9:2000, *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*

ISO 11614:1999, *Reciprocating internal combustion compression-ignition engines — Apparatus for measurement of the opacity and for determination of the light absorption coefficient of exhaust gas*

3 Terms and definitions

For the purposes of this part of ISO 8178 the following terms and definitions apply.

3.1
exhaust gas smoke
visible suspension of solid and/or liquid particles in gases resulting from combustion or pyrolysis

NOTE Black smoke (soot) is mainly comprised of carbon particles. Blue smoke is usually due to droplets resulting from the incomplete combustion of fuel or lubricating oil. White smoke is usually due to condensed water and/or liquid fuel. Yellow smoke is caused by NO_2.

3.2
transmittance
τ
fraction of light, transmitted from a source through a smoke-obscured path, which reaches the observer or the instrument receiver

NOTE It is expressed as a percentage.

3.3
opacity
N
fraction of light, transmitted from a source through a smoke-obscured path, which is prevented from reaching the observer or the instrument receiver ($N = 100 - \tau$).

NOTE It is expressed as a percentage.

3.4 Optical path length

3.4.1
effective optical path length
L_A
length of the smoke-obscured optical path between the opacimeter light source and the receiver, corrected as necessary for non-uniformity due to density gradients and fringe effect

NOTE 1 It is expressed in metres. 9.2 describes how to determine L_A and how to install measuring equipment, on exhaust systems that may be encountered in the field.

NOTE 2 Portions of the total light source to receiver path length which are not smoke obscured do not contribute to the effective optical path length.