
**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**

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

*Partie 9: Cycles et procédures d'essai pour le mesurage au banc
d'essai des émissions de fumées de gaz d'échappement des
moteurs alternatifs à combustion interne 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 2.

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

ISO 8178-9 was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*, Subcommittee SC 8, *Exhaust gas emission measurement*.

This second edition cancels and replaces the first edition (ISO 8178-9:2000, ISO 8178-9:2000/AMD 1:2004), which has been technically revised.

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 under field conditions*
- *Part 3: Definitions and methods of measurement of exhaust gas smoke under steady-state conditions*
- *Part 4: Steady-state 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*
- *Part 11: Test-bed measurement of gaseous and particulate exhaust emissions from engines used in nonroad mobile machinery under transient test conditions*

Introduction

On a global scale, there are currently many smoke measurement procedures in various forms. Some of these smoke measurement procedures are designed for test-bed testing and intended to be used for certification or type-approval purposes. Others are designed for field-testing and can 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 smoke meter method and the opacimeter.

The purpose of ISO 8178 is to combine the key features of several existing smoke measurement procedures as much as technically possible. ISO 8178-4 specifies a number of different test cycles to be used 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. Likewise, different smoke test cycles can be appropriate for different categories of nonroad engines and machines. Within ISO 8178-4 it was possible to characterize and control gaseous and particulate emissions from nonroad engines using a variety of steady-state operating points. To properly characterize and control smoke emissions from many engine applications a transient smoke test cycle is needed.

This part of ISO 8178 is intended for the measurement of the emissions of smoke from compression ignition internal combustion engines. It applies to engines operating under transient conditions, where the engine speed or load, or both, changes with time; note 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 smoke meters are intended to be used for making the smoke measurements described in this part of ISO 8178, which allows the use of either full-flow or partial-flow opacimeters and corrects 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.

The test cycle described in Annex E is representative for those engines that are used in applications as described in the E1, E2, E3 and E5 cycles of ISO 8178-4:2007.

The test cycle described in Annex F is representative for those engines that are used in applications as described in the F cycle of ISO 8178-4:2007.

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

1 Scope

This part of ISO 8178 specifies the measurement procedures and test cycles for the evaluation of smoke emissions from compression ignition engines on the test bed.

For transient smoke test cycles, smoke testing is conducted using smokemeters which 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 1 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, B, E and F to this part of ISO 8178 each contain 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.

For certain categories of non-road engines “at site” rather than “test bed” smoke test procedures can prove to be necessary. For engines used in machinery covered by additional requirements (e.g. occupational health and safety regulations), additional test conditions and special evaluation methods can apply.

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 8178-4:2007, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 4: Steady-state 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 8528-1, *Reciprocating internal combustion engine driven alternating current generating sets — Part 1: Application, ratings and performance*

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*