
**Reciprocating internal combustion
engines — Exhaust emission
measurement —**

**Part 2:
Measurement of gaseous and
particulate exhaust emissions under
field conditions**

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

Partie 2: Mesurage des émissions de gaz et de particules sur site



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Contents

Page

Foreword.....	v
Introduction.....	vi
1 Scope.....	1
2 Normative references.....	1
3 Terms, definitions, symbols and abbreviated terms.....	2
3.1 Terms and definitions.....	2
3.2 Symbols.....	3
3.2.1 General symbols.....	3
3.2.2 Symbols for measured chemical components.....	3
3.3 Abbreviated terms.....	4
4 Discrete-mode steady-state tests in the field when it is intended to either conduct measurements at a single operating point or conduct a weighted cycle-based test.....	4
4.1 General.....	4
4.2 Test conditions.....	4
4.2.1 General requirements.....	4
4.2.2 Engine test conditions.....	4
4.2.3 Power.....	5
4.2.4 Engine air intake system.....	5
4.2.5 Charge air cooler.....	5
4.2.6 Engine exhaust system.....	5
4.2.7 Engines with exhaust after-treatment systems.....	6
4.2.8 Crankcase emissions.....	6
4.2.9 Cooling system.....	6
4.2.10 Lubricating oil.....	6
4.2.11 Test fuels.....	6
4.3 Installation of sampling probes and equipment.....	6
4.4 Measurement equipment and data to be measured.....	7
4.4.1 General.....	7
4.4.2 Zirconium dioxide (ZRDO) NO _x analyser.....	7
4.4.3 Alternative measurement procedures.....	8
4.4.4 Torque and speed.....	8
4.4.5 Exhaust gas flow.....	8
4.4.6 Accuracy of the data to be measured.....	9
4.4.7 Determination of the gaseous components.....	9
4.4.8 Determination of the particulates.....	9
4.5 Running conditions.....	10
4.5.1 Test cycles.....	10
4.5.2 Preparation of the engine.....	10
4.6 Test run.....	10
4.6.1 General.....	10
4.6.2 PM measurement.....	10
4.6.3 Dilution air for particulate measurement.....	10
4.6.4 Test sequence.....	11
4.6.5 Gas analyser drift validation and correction.....	11
4.6.6 Emissions evaluation and calculation.....	11
4.6.7 Test report.....	11
5 Measurement of gaseous emissions performance of engines during typical in-service operation under field conditions using portable emission measurement systems (PEMS).....	11
5.1 Test conditions.....	11
5.1.1 General requirements.....	11
5.1.2 Selection of engine for assessment of design performance.....	12

5.1.3	Machinery operation.....	12
5.1.4	Ambient conditions.....	13
5.1.5	Lubricating oil, fuel and reagent.....	13
5.1.6	Operating sequence.....	13
5.2	Data sampling methods.....	13
5.2.1	Continuous data sampling.....	13
5.2.2	Combined data sampling.....	13
5.2.3	Temporary signal loss.....	14
5.3	ECU data stream.....	14
5.3.1	General.....	14
5.3.2	Verification of availability and conformity of information.....	15
5.4	Test procedures.....	15
5.5	Data pre-processing.....	15
5.6	Determination of working events.....	15
5.6.1	General.....	15
5.6.2	Combining operating sequences.....	15
5.7	Test data availability.....	15
5.8	Calculations.....	15
5.8.1	General.....	15
5.8.2	Engines without communication interface.....	15
5.9	Test report.....	16
5.10	Instantaneous measured data file and instantaneous calculated data file.....	16
5.11	Overview of measurement and evaluation sequence.....	16
Annex A (normative) Portable Emissions Measurement System (PEMS).....		18
Annex B (normative) Test procedure for gaseous emission measurement with a PEMS.....		20
Annex C (normative) Determination of reference work and CO₂ for engines for which the applicable bench test cycle is solely NRSC.....		27
Annex D (normative) Data pre-processing for gaseous pollutant emissions calculations.....		29
Annex E (normative) Algorithm for the determination of working events during in-service testing.....		34
Annex F (normative) Determination of the instantaneous proxy power from CO₂ mass flow rate.....		40
Annex G (normative) Gaseous pollutant emissions calculations.....		42
Annex H (normative) Conformity of the ECU torque signal.....		49
Annex I (normative) ECU data stream information requirements.....		50
Annex J (informative) Test report for in-service testing.....		52
Annex K (normative) Performance specifications, calibration and response factor for Zirconium Dioxide (ZRDO) NO_x analyser.....		59
Bibliography.....		61

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*, Subcommittee SC 8, *Exhaust gas emission measurement*.

This third edition cancels and replaces the second edition (ISO 8178-2:2008), which has been technically revised.

The main changes are as follows:

- [Clause 4](#) has been amended to update requirements applicable for discrete-mode steady-state tests in the field when it is intended to either conduct measurements at a single operating point or conduct a weighted cycle-based test, reflecting changes in other parts of the ISO 8178 series;
- [Clause 5](#) has been expanded to set out requirements for measurement of gaseous emissions performance of engines during typical in-service operation under field conditions using portable emission measurement systems (PEMS) and moving average window data evaluation.

A list of all parts in the ISO 8178 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.

Introduction

Evaluating emissions from non-road engines is more complicated than the same task for on-road engines due to the diversity of non-road applications. For example, on-road applications primarily consist of moving a load from one point to another on a paved roadway. The constraints of the paved roadways, maximum acceptable pavement loads and maximum allowable grades of fuel, narrow the scope of on-road vehicle and engine sizes.

Non-road engines and vehicles include a wider range of size, including size of the engines that power the equipment. Many of the engines are large enough to preclude the application of test equipment and methods that were acceptable for on-road purposes. In cases where a laboratory test using a dynamometer is not possible, testing at site or under appropriate conditions can be a viable alternative.

Where it is not possible to use a test bed or where information is required on the actual emissions produced by an in-service engine, the site test procedures and calculation methods specified in this document are appropriate. It should be recognized that data obtained under these circumstances may not agree completely with previous or future data, obtained in a laboratory or in the field, due to the variability and uncontrolled nature of testing in the field.

Reciprocating internal combustion engines — Exhaust emission measurement —

Part 2:

Measurement of gaseous and particulate exhaust emissions under field conditions

1 Scope

This document specifies the measurement and evaluation methods for gaseous and particulate exhaust emissions from reciprocating internal combustion engines (RIC engines) in the field.

This document is applicable when the emissions from RIC engines used in non-road machinery, industrial equipment, marine installations, generating sets, diesel rail traction or similar machinery applications need to be measured in the field. [Clause 4](#) applies for the conduct of discrete-mode steady-state gaseous or particulate emission measurements at a single operating point or conduct a weighted cycle-based test in the field. [Clause 5](#) applies where it is necessary to assess gaseous emissions performance of engines during typical in-service operation under field conditions using portable emission measurement systems (PEMS).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 8178-1:2020, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 1: Test-bed measurement systems of gaseous and particulate emissions*

ISO 8178-4:2020, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 4: Steady-state and transient 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/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 27145-4, *Road vehicles — Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD) communication requirements — Part 4: Connection between vehicle and test equipment*

ISO 15765-4, *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 4: Requirements for emissions-related systems*

ISO 13400, *Road vehicles — Diagnostic communication over Internet Protocol (DoIP)*

ISO 15031-3, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electrical circuits: Specification and use*

SAE J1939-73, *Application layer – diagnostics*

ASTM E 29-06b, *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8178-1, ISO 8178-4 and the following apply.

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/>

3.1.1

event

data measured in an in-service test for the gaseous pollutant emissions calculations obtained in a time increment Δt equal to the data sampling period

3.1.2

field conditions

conditions under which the engine under test is installed in, and coupled with, the actual equipment or vehicle, which is driven by the engine, and conditions under which the equipment or vehicle is allowed to function in normal use

3.1.3

moving average window

period, measured in cumulative amount of work or CO_2 , over which each integration of gaseous pollutant emissions is performed

3.1.4

operating sequence

elapsed time of uninterrupted machinery operation and continuous data sampling during an in-service test

3.1.5

portable emission measurement system

PEMS

emission measurement system that is transportable and suitable for conducting in-service measurements

3.1.6

proxy power

value obtained by simple linear interpolation based on certain assumptions for the sole purpose of identifying non-working events when there is no torque signal from an Electronic Control Unit (ECU)

3.1.7

reference mass of CO_2

amount of cumulative CO_2 measured during a prior bench-test of the engine type or, where applicable, engine family, which is used to determine the size of the moving average CO_2 window

3.1.8

reference work

amount of cumulative work measured during a prior bench-test of the engine type or, where applicable, engine family, which is used to determine the size of the moving average work window