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

### **Part 9: Test cycles and test procedures for measurement of exhaust gas smoke emissions from compression ignition engines using an opacimeter**

*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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## Contents

	Page
<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vi</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>2</b>
<b>4 Symbols and abbreviated terms</b> .....	<b>4</b>
4.1 Symbols.....	4
4.2 Abbreviated terms.....	5
<b>5 Test conditions</b> .....	<b>5</b>
<b>6 Test fuels</b> .....	<b>6</b>
<b>7 Measurement equipment and accuracy</b> .....	<b>6</b>
7.1 General.....	6
7.2 Engine and ambient related testing equipment.....	6
7.3 Opacimeters.....	6
7.3.1 General.....	6
7.3.2 Types of opacimeters.....	7
7.3.3 Performance Specifications.....	7
7.3.4 Calibration of the opacimeter.....	7
<b>8 Test run execution</b> .....	<b>8</b>
8.1 Installation of the measuring equipment.....	8
8.1.1 General.....	8
8.1.2 Exhaust pipe.....	8
8.1.3 Rain caps.....	8
8.1.4 Field testing.....	9
8.2 Checking of the opacimeter.....	9
8.3 Test cycle.....	10
<b>9 Data evaluation and calculation</b> .....	<b>10</b>
9.1 Data evaluation.....	10
9.1.1 General requirements — Opacimeters.....	10
9.1.2 Beer-Lambert relationships.....	10
9.1.3 Data conversion.....	11
9.1.4 Effective optical path length input values.....	11
9.2 Signal filter algorithm.....	12
9.2.1 General.....	12
9.2.2 Calculation of filter rise time and Bessel constants.....	12
9.2.3 Calculation of Bessel filtered smoke.....	13
9.3 Alternative signal handling.....	14
9.3.1 General.....	14
9.3.2 Alternative specifications.....	14
<b>10 Opacimeter Design Specifications</b> .....	<b>14</b>
10.1 General.....	14
10.2 Full-flow opacimeter.....	15
10.2.1 General.....	15
10.2.2 Components of a full-flow opacimeter.....	15
10.3 Determination of effective optical path length ( $L_A$ ).....	16
10.3.1 General.....	16
10.3.2 External versus internal tailpipe dimensions.....	16
10.4 Partial-flow-opacimeter.....	19
10.4.1 General.....	19
10.4.2 Components of partial-flow opacimeter.....	20

This is a preview of "ISO 8178-9:2019". [Click here to purchase the full version from the ANSI store.](#)

<b>Annex A</b> (informative) <b>Overview particulate and soot measurement methods</b> .....	<b>23</b>
<b>Annex B</b> (informative) <b>Example of calculation procedure</b> .....	<b>25</b>
<b>Annex C</b> (informative) <b>Remarks on test cycles</b> .....	<b>37</b>
<b>Annex D</b> (normative) <b>Test cycle for variable-speed non-road engines</b> .....	<b>39</b>
<b>Annex E</b> (normative) <b>Test cycle for constant-speed non-road engines</b> .....	<b>46</b>
<b>Annex F</b> (normative) <b>Test cycle for marine propulsion engines</b> .....	<b>50</b>
<b>Annex G</b> (normative) <b>Test cycle for variable speed engines type F (rail traction)</b> .....	<b>56</b>
<b>Annex H</b> (informative) <b>Test at steady speeds over full-load curve</b> .....	<b>60</b>
<b>Annex I</b> (normative) <b>Reporting smoke test results</b> .....	<b>62</b>
<b>Bibliography</b> .....	<b>65</b>

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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](http://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](http://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](http://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 ISO 8178-9:2012 and ISO 8178-10:2002, which have been technically revised.

The main changes compared to the previous editions are as follows:

- ISO 8178-10:2002 has been incorporated in this document;
- terms and definitions have been harmonized within the ISO 8178 series and differences to other ISO standards have been described where applicable;
- redundant specifications of testing equipment, calibration and verification requirements have been deleted or replaced by references to other parts of the ISO 8178 series;
- ambient density smoke correction has been deleted;
- order of annexes has been changed;
- [Annex A](#) has been added - Overview particulate and soot measurement methods;
- [Annex H](#) has been added - Test at steady speeds over full-load curve;
- [Annex I](#) has been added - Reporting smoke tests results.

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](http://www.iso.org/members.html).

## 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 programs. Different smoke measurement methods exist to meet the needs of various regulatory agencies and industries.

The two smoke measurement methods typically used are (1) the FSN method, measuring light absorption based on the change in optical reflectance of visible light from a blackening filter paper relative to the clean filter (filter-type smoke meters) and (2) the exhaust gas opacity method, measuring transmittance based on light extinction caused by absorption and scattering of light (opacimeter-type smoke meters).

[Figure A.1](#) in [Annex A](#) shows an overview of the measurement methods specified by an ISO standard including FSN and opacity respectively.

ISO 8178-4 specifies a number of different test cycles to be used to characterize and control gaseous and particulate emissions from nonroad engines using a variety of steady-state and transient operating conditions. 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.