This is a free page sample. Access the full version online.

NSAI Standards

Irish Standard
I.S. EN ISO 18854:2015

Small craft - Reciprocating internal combustion engines exhaust emission measurement - Test-bed measurement of gaseous and particulate exhaust emissions (ISO 18854:2015)

© CEN 2015 No copying without NSAI permission except as permitted by copyright law.

This is a free page sample. Access the full version online.

I.S. EN ISO 18854:2015

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

This document is based on:	*Published:*
EN ISO 18854:2015	2015-04-22

This document was published under the authority of the NSAI and comes into effect on: 2015-05-09	ICS number: 47.020.20 47.080 NOTE: If blank see CEN/CENELEC cover page

NSAI 1 Swift Square, Northwood, Santry Dublin 9	T +353 1 807 3800 F +353 1 807 3838 E standards@nsai.ie W NSAI.ie	Sales: T +353 1 857 6730 F +353 1 857 6729 W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

This is a free page sample. Access the full version online.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 18854

April 2015

ICS 47.020.20; 47.080

English Version

Small craft - Reciprocating internal combustion engines exhaust emission measurement - Test-bed measurement of gaseous and particulate exhaust emissions (ISO 18854:2015)

Petits navires - Moteurs alternatifs à combustion interne mesurage des émissions de gaz d'échappement - Mesurage des émissions de gaz et de particules au banc (ISO 18854:2015)

Kleine Wasserfahrzeuge - Messung der Emission von Hubkolben-Verbrennungsmotoren - Prüfstandsmessung der gasförmigen Emission und der Partikelemission (ISO 18854:2015)

This European Standard was approved by CEN on 19 March 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

© 2015 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN ISO 18854:2015 E

This is a free page sample. Access the full version online.

Contents

Page

Foreword 3

Annex ZA (informative) **Relationship between this European Standard and the Essential Requirements of EU Directive 2013/53/EC** 4

This is a free page sample. Access the full version online.

Foreword

This document (EN ISO 18854:2015) has been prepared by Technical Committee ISO/TC 188 "Small craft".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2015, and conflicting national standards shall be withdrawn at the latest by October 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 18854:2015 has been approved by CEN as EN ISO 18854:2015 without any modification.

This is a free page sample. Access the full version online.

Annex ZA
(informative)
Relationship between this European Standard and the Essential Requirements of EU Directive 2013/53/EC

This European standard has been prepared under a mandate given to CEN by the European Commission to provide one means of conforming to Essential Requirements of the New Approach Directive 2013/53/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one member state, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1: Correspondence between this European Standard and Directive 2013/53/EC

Clauses/sub-clauses of this standard	Corresponding annexes/paragraphs of Directive 2013/53/EC	Comments
All Clauses of this Standard	Annex 1.B. 2. Exhaust emission requirements	In respect of measurement and evaluation methods for gaseous and particulate emissions
Clause 6	Annex 1.B. 2. Reference fuels	Fuels to be used for the emissions test for engines fuelled with petrol and diesel

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

This is a free page sample. Access the full version online.
I.S. EN ISO 18854:2015

INTERNATIONAL STANDARD

ISO 18854

First edition
2015-04-15

Small craft — Reciprocating internal combustion engines exhaust emission measurement — Test-bed measurement of gaseous and particulate exhaust emissions

Petits navires — Moteurs alternatifs à combustion interne mesurage des émissions de gaz d'échappement — Mesurage des émissions de gaz et de particules au banc

Reference number
ISO 18854:2015(E)

© ISO 2015

This is a free page sample. Access the full version online.

COPYRIGHT PROTECTED DOCUMENT

© ISO 2015

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

This is a free page sample. Access the full version online.

Contents

Page

Foreword ..... **vii**

Introduction ..... **viii**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Symbols and abbreviations **3**
- 4.1 General symbols 3
- 4.2 Symbols for fuel composition 5
- 4.3 Symbols and abbreviations for the chemical components 5
- 4.4 Abbreviations 6

5 Test conditions **7**
- 5.1 Engine test conditions 7
  - 5.1.1 Test condition parameter 7
  - 5.1.2 Test validity 7
- 5.2 Engines with charge air cooling 7
- 5.3 Power 8
- 5.4 Specific test conditions 8
  - 5.4.1 Engine air inlet system 8
  - 5.4.2 Engine exhaust system 8
  - 5.4.3 Cooling system 8
  - 5.4.4 Lubricating oil 9
  - 5.4.5 Adjustable carburettors 9
  - 5.4.6 Crankcase breather 9

6 Test fuels **9**

7 Application of the engine family concept and choice of parent engine **9**

8 Measurement equipment and data to be measured **10**
- 8.1 General 10
- 8.2 Dynamometer specification 10
- 8.3 Exhaust gas flow 10
  - 8.3.1 General 10
  - 8.3.2 Direct measurement method 10
  - 8.3.3 Air and fuel measurement method 11
  - 8.3.4 Fuel flow and carbon balance method 11
  - 8.3.5 Tracer measurement method 11
  - 8.3.6 Air flow and air-to-fuel ratio measurement method 12
  - 8.3.7 Total dilute exhaust gas flow 13
- 8.4 Accuracy 13
- 8.5 Determination of the gaseous components 14
  - 8.5.1 General analyser specifications 14
  - 8.5.2 Gas drying 15
  - 8.5.3 Analysers 15
  - 8.5.4 Sampling for gaseous emissions 17
- 8.6 Particulate determination 18
  - 8.6.1 General 18
  - 8.6.2 Particulate sampling filters 19
  - 8.6.3 Weighing chamber and analytical balance specifications 20

© ISO 2015 – All rights reserved

This is a free page sample. Access the full version online.

9 Calibration of the analytical instruments ... 20
9.1 General requirements ... 20
9.2 Calibration gases ... 21
9.2.1 General ... 21
9.2.2 Pure gas ... 21
9.2.3 Calibration and span gases ... 21
9.2.4 Use of gas dividers ... 21
9.2.5 Oxygen interference gases ... 22
9.3 Operating procedure for analysers and sampling system ... 22
9.4 Leakage test ... 22
9.5 Calibration procedure ... 22
9.5.1 Instrument assembly ... 22
9.5.2 Warm-up time ... 22
9.5.3 NDIR and HFID analyser ... 22
9.5.4 GC and HPCL ... 23
9.5.5 Establishment of the calibration curve ... 23
9.5.6 Alternative calibration methods ... 23
9.5.7 Verification of the calibration ... 23
9.6 Calibration of tracer gas analyser for exhaust flow measurement ... 23
9.7 Efficiency test of the NO_x converter ... 24
9.7.1 General ... 24
9.7.2 Test setup ... 24
9.7.3 Calibration ... 24
9.7.4 Calculation ... 25
9.7.5 Adding of oxygen ... 25
9.7.6 Activation of the ozonator ... 25
9.7.7 NO_x mode ... 25
9.7.8 Deactivation of the ozonator ... 25
9.7.9 NO mode ... 25
9.7.10 Test interval ... 25
9.7.11 Efficiency requirement ... 25
9.8 Adjustment of the FID ... 26
9.8.1 Optimization of the detector response ... 26
9.8.2 Hydrocarbon response factors ... 26
9.8.3 Oxygen interference check ... 26
9.8.4 Efficiency of the Non-Methane Cutter (NMC) ... 27
9.8.5 Methanol response factor ... 28
9.9 Interference effects with CO, CO_2, NO_x, O_2, NH_3, and N_2O analysers ... 28
9.9.1 General ... 28
9.9.2 CO analyser interference check ... 29
9.9.3 NO_x analyser quench checks ... 29
9.9.4 O_2 analyser interference ... 30
9.9.5 Cross-interference check compensation for NH_3 and N_2O measurement channels using IR and UV measurement techniques ... 31
9.10 Calibration intervals ... 33

10 Calibration of the particulate measuring system ... 33
10.1 General ... 33
10.2 Calibration procedure ... 33
10.2.1 Flow measurement ... 33
10.2.2 Exhaust gas analysers ... 33
10.2.3 Carbon flow check ... 33
10.3 Checking the partial-flow conditions ... 33
10.4 Calibration intervals ... 33

 © ISO 2015 – All rights reserved

This is a free page sample. Access the full version online.

11 Calibration of the CVS full-flow dilution system ... 34
11.1 General ... 34
11.2 Calibration of the Positive Displacement Pump (PDP) ... 34
11.2.1 General ... 34
11.2.2 Data analysis ... 34
11.3 Calibration of the Critical-Flow Venturi (CFV) ... 35
11.3.1 General ... 35
11.3.2 Data analysis ... 35
11.4 Calibration of the Subsonic Venturi (SSV) ... 36
11.4.1 General ... 36
11.4.2 Data analysis ... 36
11.5 Total system verification ... 37
11.5.1 General ... 37
11.5.2 Metering with a critical flow orifice ... 37
11.5.3 Metering by means of a gravimetric technique ... 37

12 Test cycles (running conditions) ... 38
12.1 Requirements ... 38
12.2 Test cycles ... 38
12.2.1 Applications ... 38
12.2.2 Test modes and weighting factors ... 39
12.2.3 Performing the test ... 40

13 Test run ... 40
13.1 Preparation of the sampling filters ... 40
13.2 Installation of the measuring equipment ... 40
13.3 Starting the dilution system and the engine ... 40
13.4 Adjustment of the dilution ratio ... 40
13.5 Determination of test points ... 41
13.6 Checking of the analysers ... 41
13.7 Test cycles ... 41
13.7.1 Test sequence ... 41
13.7.2 Analyser response ... 42
13.7.3 Particulate sampling ... 42
13.7.4 Engine conditions ... 42
13.8 Re-checking the analysers ... 42
13.9 Test report ... 42

14 Data evaluation for gaseous and particulate emissions ... 42
14.1 Gaseous emissions ... 42
14.2 Particulate emissions ... 43

15 Calculation of the gaseous emissions ... 43
15.1 General ... 43
15.2 Determination of the exhaust gas flow ... 44
15.3 Dry/wet correction ... 44
15.4 NO_x correction for humidity and temperature ... 46
15.5 Calculation of the emission mass flow rates ... 47
15.5.1 Raw exhaust gas ... 47
15.5.2 Dilute exhaust gas ... 48
15.5.3 Determination of the NMHC concentration ... 50
15.6 Calculation of the specific emission ... 51

© ISO 2015 – All rights reserved

This is a free page sample. Access the full version online.

16 Calculation of the particulate emission ... **51**
16.1 Particulate correction factor for humidity ... 51
16.2 Partial-flow dilution system ... 52
16.2.1 Isokinetic systems ... 52
16.2.2 Systems with measurement of CO_2 or NO_x concentration ... 52
16.2.3 Systems with CO_2 measurement and carbon balance method ... 52
16.2.4 Systems with flow measurement ... 53
16.3 Full-flow dilution system ... 53
16.4 Calculation of the particulate mass flow rate ... 53
16.5 Calculation of the specific emissions ... 54
16.6 Effective weighting factor ... 54

17 Determination of the gaseous emissions ... **55**
17.1 General ... 55
17.2 Main exhaust components CO, CO_2, HC, NO_x, O_2 ... 55
17.3 Ammonia analysis ... 60
17.4 Methane analysis ... 61
17.4.1 Gas chromatographic (GC) method (Figure 6) ... 61
17.4.2 Non-methane cutter (NMC) method (Figure 7) ... 63
17.5 Methanol analysis ... 64
17.6 Formaldehyde analysis ... 65

18 Determination of the particulates ... **67**
18.1 General ... 67
18.2 Dilution system ... 67
18.2.1 Partial-flow dilution system (Figures 10 to 18) ... 67
18.2.2 Full-flow dilution system ... 79
18.3 Particulate sampling system ... 82

Bibliography ... **86**

© ISO 2015 – All rights reserved

This is a free page sample. Access the full version online.

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 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 188, *Small craft*, SC 2, *Engines and propulsion systems.*

© ISO 2015 – All rights reserved

This is a free page sample. Access the full version online.

Introduction

This International Standard is intended for use as a measurement procedure to determine the gaseous and particulate emission levels of reciprocating internal combustion (RIC) engines for marine use in small craft. Its purpose is to provide a map of an engine's emissions characteristics which, through use of the proper weighting factors, can be used as an indication of that engine's emission levels under various applications. The emission results are expressed in units of grams per kilowatt-hour and represent the mass rate of emissions per unit of work accomplished.

Although this International Standard is designed for marine engines, it shares many principles with particulate and gaseous emission measurements that have been in use for many years for on-road engines. One test procedure that shares many of these principles is the process of mixing dilution air with the total exhaust flow prior to separating a fraction of the diluted exhaust stream for analysis (full-flow dilution method) as currently specified for certification of 1985 and later heavy-duty truck engines in the USA. Another is the procedure for direct measurement of the gaseous emissions in the undiluted exhaust gas, as currently specified for the certification of heavy-duty truck engines in Japan and Europe.

NOTE It is common in many full-flow dilution systems to dilute this fraction of pre-diluted exhaust a second time to obtain appropriate sample temperatures at the particulate filter (see Figure 19).

Many of the procedures described in this International Standard are detailed accounts of laboratory methods, since determining an emissions value requires performing a complex set of individual measurements, rather than obtaining a single measured value. Thus, the results obtained depend as much on the process of performing the measurements as they depend on the engine and test method.

© ISO 2015 – All rights reserved

This is a free page sample. Access the full version online.

Small craft — Reciprocating internal combustion engines exhaust emission measurement — Test-bed measurement of gaseous and particulate exhaust emissions

1 Scope

This International Standard specifies the measurement and evaluation methods for gaseous and particulate exhaust emissions from reciprocating internal combustion (RIC) engines under steady-state conditions on a test bed, necessary for determining one weighted value for each exhaust gas pollutant. Various combinations of engine load and speed reflect different engine applications.

This International Standard is applicable to RIC marine engines intended to be installed in small craft up to 24 m length of hull.

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 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

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

ISO 8178-6:2000, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 6: Report of measuring results and test*

ISO 8666, *Small craft — Principal data*

ISO 14396, *Reciprocating internal combustion engines — Determination and method for the measurement of engine power — Additional requirements for exhaust emission tests in accordance with ISO 8178*

ISO 15550:2002, *Internal combustion engines — Determination and method for the measurement of engine power — General requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8666 and the following apply.

3.1
particulates
material collected on a specified filter medium after diluting exhaust gases with clean, filtered air to a temperature 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

Note 1 to entry: Particulates consist primarily of carbon, condensed hydrocarbons, and sulfates and associated water.

© ISO 2015 – All rights reserved

SAI GLOBAL

This is a free preview. Purchase the entire publication at the link below:

Product Page

Looking for additional Standards? Visit Intertek Inform Infostore

Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation