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**Small craft — Airborne sound emitted by  
powered recreational craft —**

Part 3:

**Sound assessment using calculation and  
measurement procedures**

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*Petits navires — Bruit aérien émis par les bateaux de plaisance  
motorisés —*

*Partie 3. Évaluation du bruit à l'aide de procédures de calcul et de  
mesure*

ISO 14509-3:2009

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**Contents**

Page

<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</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</b> .....	<b>2</b>
<b>5 Sound assessment method</b> .....	<b>3</b>
<b>6 Test report</b> .....	<b>3</b>
<b>Annex A (normative) Hull-form sound pressure level calculation</b> .....	<b>4</b>
<b>Annex B (normative) On-board sound pressure level measurement method</b> .....	<b>5</b>
<b>Annex C (informative) Example of test report form</b> .....	<b>10</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.

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 14509-3 was prepared by Technical Committee ISO/TC 188, *Small craft*.

ISO 14509 consists of the following parts, under the general title *Small craft — Airborne sound emitted by powered recreational craft*:

- *Part 1: Pass-by measurement procedures*
- *Part 2: Sound assessment using reference craft*
- *Part 3: Sound assessment using calculation and measurement procedures*

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## Introduction

The European Union Directive 2003/44/EC (Amendment to Directive 94/25/EC) introduces limits for sound emission from recreational craft and requires conformity for certain types of craft to be shown by using the ISO 14509 series. ISO 14509-1 provides a practical measurement method, ISO 14509-2 provides an assessment method using reference craft and this part of ISO 14509 provides a predictive measurement method based on the work of the SoundBoat project. SoundBoat was funded by the European Commission and various European Marine Industry Associations and industrial partners to develop alternative methods of testing sound emission from recreational craft. Over the two years of the project, more than 65 craft have been tested according to the ISO 14509-1 pass-by test. From this an algorithm has been developed that uses a combination of hull–water sound, derived from hull parameters, and exhaust outlet sound, derived by direct measurement on board the craft under test, to predict the sound pressure level that would be observed at 25 m had the craft undergone pass-by testing according to ISO 14509-1. The method specified in this part of ISO 14509 does not require a measurement platform to be established and testing can be carried out independently of location and weather restrictions. This method does not require a list of reference craft to be established and provides a reproducible assessment procedure comparable to ISO 14509-1 pass-by testing to within 2 dB.

The SoundBoat project has concentrated on specific craft types and has only tested craft with the following characteristics:

- bottom type configuration of not more than two chines;
- square transom configuration;
- length of hull 11 m or greater.

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The SoundBoat project was successfully completed in early 2005, but industry continues to gather data from on-water testing and, as the data model is refined with further validation of the concept, the parameters above will be revised appropriately. The SoundBoat project team do not believe that craft outside the above characteristics are unsuitable for assessment using this part of ISO 14509; however, where a significantly different craft is to be assessed, it might be beneficial to test according to ISO 14509-1.

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# Small craft — Airborne sound emitted by powered recreational craft —

## Part 3: Sound assessment using calculation and measurement procedures

### 1 Scope

This part of ISO 14509 specifies the procedures for assessing sound emission of powered monohull recreational craft of length up to 24 m with a Froude number greater than 1,1. It is not applicable for personal watercraft (PWC).

This part of ISO 14509 specifies the determination of the A-weighted sound pressure level by combining a calculation method and a measurement method.

### 2 Normative references

The following referenced documents are indispensable for the application 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 8665, *Small craft — Marine propulsion reciprocating internal combustion engines — Power measurements and declarations*

ISO 8666, *Small craft — Principal data*

ISO 10087, *Small craft — Craft identification — Coding system*

ISO 14509-1, *Small craft — Airborne sound emitted by powered recreational craft — Part 1: Pass-by measurement procedures*

IEC 60942, *Electroacoustics — Sound calibrators*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

### 3 Terms and definitions

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

#### 3.1

##### recreational craft

craft of any type, regardless of the means of propulsion, intended to be used for sports and leisure purposes

#### 3.2

##### maximum A-frequency weighted sound pressure level for recreational craft

maximum A-weighted sound pressure level

$L_{pAmax}$

maximum sound pressure level achieved from measurement at the passage of the craft under specified operating conditions, measured with frequency weighting A according to IEC 61672-1

NOTE It is expressed in decibels (dB).

#### 3.3

##### Froude number

$F_n$

$$F_n = \frac{v_{max}}{\sqrt{(g \cdot L_{wl})}} \tag{1}$$

where

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$v_{max}$  is the maximum boat speed, expressed in metres per second (m/s);

$g$  is the given gravitational constant  $g = 9,8 \text{ m/s}^2$ ;

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$L_{wl}$  is the length of the water line, expressed in metres (m).

NOTE Adapted from EU Directive 2003/44/EC.

### 4 Symbols

$L_H$  length of hull, as defined in ISO 8666, expressed in metres (m)

$L_{pAmax}$  maximum A-frequency weighted sound pressure level of the craft, expressed in decibels (dB)

$L_{pASmax}$  maximum A-frequency weighted, S-time weighted sound pressure level of the craft as measured in ISO 14509-1, expressed in decibels (dB)

$L_{pHF}$  A-weighted hull-form sound pressure level calculated according to Equation (A.1), expressed in decibels (dB)

$L_{pOB}$  average A-weighted on-board sound pressure level measured according to Equation (B.1), expressed in decibels (dB)

$T_{25}$  propagation attenuation from on-board measurements to 25 m as given in Equation (B.3), expressed in decibels (dB)



## 5 Sound assessment method

The hull-form sound pressure level shall be calculated according to Annex A. The on-board sound pressure level shall be measured according to Annex B. The estimated  $L_{pAmax}$  for the craft under assessment is the sum of the predicted  $L_{pHF}$  and the propagation-corrected  $L_{pOB}$ , and shall be calculated as follows:

$$L_{pAmax} = 10 \lg \left[ 10^{\left( \frac{L_{pHF}}{10} \right)} + 10^{\left( \frac{L_{pOB} - T_{25}}{10} \right)} \right] \quad (2)$$

The result of this calculation will be within  $\pm 2$  dB of  $L_{pASmax}$ , measured for the same craft according to ISO 14509-1, taking into account the stated measurement uncertainties of ISO 14509-1 and ISO 14509-3.

## 6 Test report

The assessment report shall include the following:

- a) a reference to this part of ISO 14509;
- b) a declaration that all of its requirements are met;
- c) the name and signature of the assessor and the date of the assessment;
- d) details of the measurement devices used, together with their serial numbers;
- e)  $L_{pHF}$ , calculated according to Equation (A.1);
- f) the individual A-weighted on-board sound pressure levels measured according to B.2 and the resulting  $L_{pOB}$  calculated according to Equation (B.1);
- g)  $L_{pAmax}$ , calculated according to Clause 5;
- h) details of the manufacturer and boat model (if available), according to ISO 10087;
- i) details of the engine manufacturer, engine and drive type.