# SURFACE VEHICLE STANDARD

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Superseding J1281 NOV2016

# Operator Sound Pressure Level Exposure Measurement Procedure for Powered Recreational Craft

RATIONALE

Review this standard and compare with changes to the ISO standard 14509-1, where the standard craft definitions originated. The table in 6.1 was updated to reflect the latest version of ISO 14509-1.

SAE J1281 has been reaffirmed to comply with the SAE Five-Year Review policy.

## 1. SCOPE

This SAE Standard establishes the procedure for determining the operator duty cycle sound pressure level $L_{odc}$ to which operators of powered recreational craft up to 24 m in length are exposed during typical operation as determined by marine engine duty cycle studies. This document describes the instrumentation, the required calibration procedures, the test site, the specifications for "standard craft", the craft operating conditions, microphone positioning, test procedure, engine speeds for each of the Duty Cycle modes and the formula and table for calculating the Duty Cycle operator ear sound pressure level.

This document is subject to change to keep pace with technical advances as well as other international standards and practices.

Changes in this Revision: The sound pressure level measurements performed while applying this document are based on the Five-Mode Marine Engine Duty Cycle instead of a single engine speed. A calculation is required to obtain the Duty Cycle operator ear sound pressure level ($L_{odc}$). Provisions for type testing are provided along with specifications for Standard Craft.





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## 2. REFERENCES

### 2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

#### 2.1.1 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

IEC 61672-1 Electroacoustics - Sound Level Meters - Part 1 Specifications

IEC 61672-2 Electroacoustics - Sound Level Meters - Part 2 Pattern Evaluation Tests

IEC 60942 Electroacoustics - Sound Calibrators

#### 2.1.2 ISO Publications

Copies of these documents are available online at http://webstore.ansi.org/

ISO 8178-4 Reciprocating internal combustion engines - Exhaust emission measurement - Part 4: Steady-state test cycles for different engine applications

ISO 8665 Small craft - Marine propulsion reciprocating internal combustion engines - Power measurements and declarations

ISO 8666 Small craft - Principal data

#### 2.1.3 ANSI Publications

Copies of these documents are available online at http://webstore.ansi.org/

ANSI S1.4 Specification for Sound Level Meters

### 2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

#### 2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J34 Exterior Sound Level Measurement Procedure for Pleasure Motorboats

SAE J1970 Shoreline Sound Level Measurement Procedure for Recreational Motorboats

SAE J2005 Stationary Sound Level Measurement Procedure for Recreational Motorboats

SAE Technical Paper 901596 Duty Cycle for Recreational Marine Engines

2.2.2 ASA Publications

Available from Acoustical Society of America, http://asa.aip.org, or from ANSI, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI S1.1 Acoustical Terminology

ANSI S1.13 Measurement of Sound Pressure Levels in Air

2.2.3 ICOMIA Publications

Available from International Council of Marine Industry Associations, Brigande Pironlaan 132, B-1080 Brussels, Belgium, www.icomia.com.

IMEC 17 F/05 Standard Boat Concept Sound Level Test Report

3. INSTRUMENTATION

3.1 The instrumentation system, including microphones and cables shall be used according to the manufacturer's specifications and shall meet the requirements for a Type 1 instrument as specified by ANSI Standard S1.4 and/or IEC 61672-1.

3.2 A microphone wind screen that does not affect the overall reading by more than ±0.5 dBA

3.3 A sound level calibrator as specified by IEC 60942.

3.4 A wind speed anemometer

3.5 An engine speed tachometer which is accurate to within ~50 rpm.

4. INSTRUMENTATION CALIBRATION

4.1 The overall acoustic performance of the instrumentation shall be checked according to the instructions of the manufacturer with a sound level calibrator at the beginning and at the end of each series of measurements and not less than the beginning and end of each measurement day.

4.2 At time intervals no longer than 2 years the sound level meter shall undergo laboratory verification for compliance with ANSI S1.4 and/or IEC 61672-1. The date of the last verification of compliance with the relevant standard shall be recorded.

4.3 The calibrator used for calibration of the sound level meter shall undergo laboratory verification with traceability to a primary standards laboratory every year.

5. TEST SITE

Measurements shall be performed on a flat, calm body of water, in the absence of precipitation, large enough to allow full speed runs. The background sound pressure level with the engine not operating (including wind effects) shall be at least 10 dB lower than the measured level of the craft being tested.

## 6. STANDARD CRAFT SPECIFICATIONS FOR TYPE TESTS FOR OUTBOARD MOTORS

6.1 Any series production craft with a V-hull shape meeting the dimensional, mass and operating characteristics given in the following table may be used as a standard craft.

***Table 1 - Standard craft specifications for outboard motors***

| Declared Propeller Shaft Power (According to ISO 8665) of the Outboard Motor Under Test (kW) | Length of Hull (According to ISO 8666) (m) | Mass Without Engine (kg) |
|---|---|---|
| P < 6 | 3.8 | 135 |
| 6 ≤ P < 25 | 4.2 | 220 |
| 25 ≤ P < 55 | 4.7 | 400 |
| 55 ≤ P < 115 | 5,5 | 800 |
| 115 ≤ P < 150 | 6.2 | 1100 |
| P ≥ 150 | 7.5 | 1650 |

6.2 A variation of ± 20 % is allowed in the dimensional characteristics (length of hull and maximum beam as given in the above table) and a variation of ± 25% is allowed in the mass of the craft. In addition, the craft shall have no unusual covers or extensions behind the transom which could affect the sound pressure level at the operator's ear.

## 7. STANDARD CRAFT SPECIFICATIONS FOR TYPE TESTS FOR STERNDRIVES WITH INTEGRAL EXHAUST SYSTEMS

7.1 Any series production craft with a V-hull shape meeting the dimensional, mass and operating characteristics given in the following table may be used as a standard craft.

***Table 2 - Standard craft specifications for petrol engines***

| Declared Propeller Shaft Power (According to ISO 8665) of the Sterndrive with Integral Exhaust Under Test (kW) | Length of Hull (According to ISO 8666) (m) | Mass with Engine (kg) |
|---|---|---|
| P < 78 | 5,0 | 700 |
| 78 ≤ P < 115 | 5,8 | 1600 |
| 115 ≤ P < 159 | 7,0 | 1900 |
| 159 ≤ P < 226 | 7,7 | 2200 |
| P ≥ 226 | 8,7 | 2600 |

***Table 3 - Standard craft specifications for diesel engines***

| Declared Propeller Shaft Power (According to ISO 8665) of the Sterndrive with Integral Exhaust Under Test (kW) | Length of Hull (According to ISO 8666) (m) | Mass with Engine (kg) |
|---|---|---|
| P < 78 | 6,0 | 1200 |
| 78 ≤ P < 115 | 7,0 | 1950 |
| 115 ≤ P < 159 | 7,5 | 2500 |
| 159 ≤ P < 226 | 8,5 | 2800 |
| P ≥ 226 | 9,5 | 3800 |

7.2 A variation of ±20% is allowed in the length of the hull and ± 25% is allowed for the mass of the craft. In addition, the craft shall have no unusual covers or extensions behind the transom which could affect the sound pressure level at the operator's ear.

7.3 Sterndrives with integral exhaust systems shall be fitted in the boat according to the manufacturer's specifications. No modifications on series production craft, such as applying additional absorbing components or trim tabs are permitted.

8. OPERATING CONDITION OF THE POWERED RECREATIONAL CRAFT

8.1 For type testing, craft with the power units installed inboard (e.g., inboards, sterndrives and sailboats) shall be tested with standard craft or as sold. For type testing, outboard motors and sterndrives with integral exhaust systems shall be tested on "standard craft" as specified in clause 6.1 or 7.1.

8.2 For monitoring tests all craft shall be tested with motors as installed. This may be equivalent to the type test in many cases.

8.3 Propeller equipped propulsion systems shall be tested with a standard propeller. The pitch of the propeller shall be such that at full throttle, the declared engine speed (±4%) is achieved in the steady state with the standard craft traveling in a straight line on calm water. If the declared engine speed (RPM) cannot be obtained with the available propellers, then it is allowed to modify the pitch and/or diameter of the standard propeller to achieve the correct declared engine speed. For controllable pitch propellers the pitch shall be fixed in the position required to obtain the declared engine speed at full throttle.

8.4 Jet pump equipped propulsion systems shall be tested with a standard impeller. The pitch of the impeller shall be such that at full throttle, the declared engine speed (±4%) is achieved in the steady state with the standard craft traveling in a straight line on calm water. If the declared engine speed (RPM) cannot be obtained with the available impellers, then it is allowed to modify the pitch and/or diameter of the standard impeller as well as the cross sectional area of the standard pump outlet nozzle to achieve the correct declared engine speed.

8.5 In the case of engines without a speed governor the declared engine speed shall be the mid-point of the full throttle speed range recommended by the manufacturer for propeller/impeller selection. In the case of engines with speed governors the declared engine speed shall be the governed speed specified by the manufacturer.

8.6 For propulsion systems which are equipped with adjustable trim, the trim angle shall be adjusted so that the propeller/impeller thrust is parallel to the surface of the water within ±2° when the craft is stationary in the loaded test condition, hereafter referred to as level trim, for all test conditions.

8.7 Measurements shall be performed on calm water and in the absence of precipitation. In situations where the wind exceeds 16 km/h (10 mph) the accuracy of the data is enhanced by taking the data while operating the craft in a down-wind direction.

8.8 Boats sold with convertible tops should be tested with the top down, since measurements taken with the top up are found to be inconsistent and spatially dependent.

9. MICROPHONE POSITION

9.1 For boats with an open cabin the measurements shall be performed with a free-field microphone positioned horizontally, oriented towards the stern of the craft and positioned on the inboard side of the operator's head, at a distance of 250 mm from the plane of the vertical centre line of the operator's head and in the plane of the operator's ear. In the event that the operator's station is within an enclosed cabin a random incidence microphone shall be used.

9.2 The operator shall be in a seated position during the measurements if a seat is provided. Any observer present to read the meter shall position himself such that any influence on the measured sound pressure level is avoided.