SoundBoat

Practical sound measurement for recreational craft

16 November 2004
METS Amsterdam

Programme

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- Recreational Craft Directive 2003/44/EC
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Introductions

- James Grazebrook, Halyard (M&I) Ltd, Chairman
- Nik Parker, British Marine Federation
- Ken Wittamore, SoundBoat Project Manager
- John Dixon, Institute of Sound and Vibration Research

Sound measurement requirements of the amended RCD (2003/44/EC)

Nik Parker
Technical Director BMF

Recreational Craft Directive

The RCD is a trade-enabling new approach directive that covers 30 ESR, supported by a mandate for 65 harmonised standards

Over the last 4 years an amendment to the RCD has been developed to cover environmental limits, to update a number of items in the existing directive and to bring PWC into scope for first time

Implementation dates…

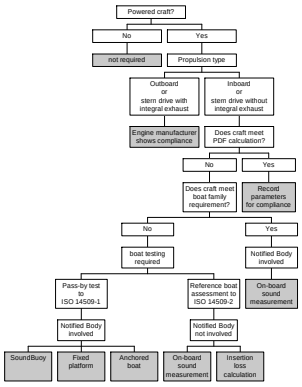
- National regulations in force from 1 January 2005
- Transition periods:
  - Non-powered craft 12 months
  - CI & 4T-SI powered craft 12 months
  - SI-2T engines 24 months
- Key elements mandatory January 2006

Sound emission limits

Single engine power (kw)	$LpAS_{MAX}$ (dB)
P < 10	67
10 < P < 40	72
P > 40	75
Twin installations have additional 3 dB allowance	

Requirement for compliance assessment

- Craft powered by stern drive with integral exhaust or outboard are not required to be assessed for sound emission by the boat builder – compliance is handled by the engine manufacturer making use of standard boat method under ISO 14509-1
- All other powered craft are required to be assessed by the boat builder



Sound emission compliance options

- Froude-Power/Displacement calculation
  Fn < 1.1, P/D < 40 kw/tonne – covers displacement boats
- Pass-by test to ISO 14509
  Under responsibility of notified body
- Reference boat assessment to ISO 14509-2
  Methodology under development

Current method for displacement boats

- Froude-Power/Displacement calculation:

$$Fn = \frac{V}{\sqrt{(g.L_{WL})}} \leq 1.1$$

  P/D < 40 kw/tonne

- ICOMIA www has PDF calculator

Example PDF calculations

Craft type	Narrow boat	Motor cruiser	Sailing yacht	Semi-displacement motor boat	Inboard engine speed boat
L_{WL} (m)	21.3	7	11.3	10.5	4.9
Displacement (t)	16	4	10	9	0.9
Power (hp)	40	35	56	430	150
Speed (kn)	6	8	9	22	30
Fn	0.21	0.47	0.44	1.11	2.22
P/D (kw/t)	1.88	6.66	4.20	35.83	125
Compliant?	**Yes**	**Yes**	**Yes**	**Possible**	**No**

Note: Power is quoted in hp – for calculation power is in kw = hp x 0.75
Speed is quoted in knots – for calculation speed is in m/s = kn x 0.514

ISO 14509 – part 1 pass by testing

Ken Wittamore
SoundBoat project manager

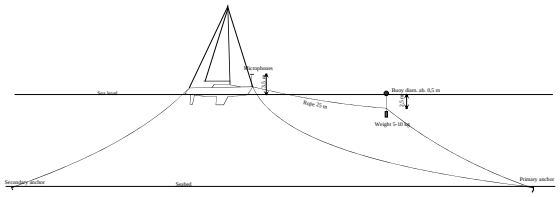
Current options for planing boats - ISO 14509 part I

- For semi displacement and planing craft of 24m or less, RCD requires testing to ISO 14509 part I:
  - Pass by test at 25m
  - Directional microphone height of 3.5m
  - Maximum boat speed up to 70kph (~38knots)
  - 100mm max wave height
  - 5 m/s max wind speed
  - Class I (traceable) instruments
  - Notified body certification

Practical application of ISO 14509 part I

- 25m distance marker required
- Microphone needs to be mounted on:
  - An anchored support boat
  - A fixed platform
- Weather conditions need to be unusually calm

Support boat




Fairline Targa 52


Fairline Squadron 74

Scale of potential problem

- RCD requires ALL model/engine variants to show compliance
- Many non-production builders essentially build one-off boats
- Large companies have many variants to be assessed, small companies have limited availability to test under contract terms

The SoundBoat project

The SoundBoat project

- SoundBoat is an EU CRAFT project
  - Collaborative R&D aimed at solving a generic problem
  - 50% funding from EU, matching 50% from industrial partners
  - R&D providers are 100% funded
  - Results belong to the industry partners
  - Obligation to exploit
- Total SoundBoat project cost is €1.5M

SoundBoat objectives

"To develop practical and innovative methods for demonstrating compliance with the forthcoming RCD noise limits."

SoundBoat will probably…

…. consist of on board measurements at prescribed positions whilst underway at full power. This will be followed by computer based analysis leading to prediction of 25m pass by sound levels.

Industry partners

- Halyard (Marine & Industrial) Ltd GB
- Nanni Diesel F
- British Marine Industry Association GB
- French Marine Industry Association F
- Swedish Marine Industry Association S
- Italian Marine Industry Association IT

Research partners

- VTT SF
- Volvo Penta S
- Institute of Sound and Vibration Research GB

SoundBoat programme

- Two year project, start date 1st Feb 2003
- Four main phases:
  i. Literature review, determination of main variables, development of test equipment and measurement methods
  ii. Data collection
  iii. Data analysis and development of alternative test methods
  iv. Validation by further testing

SoundBoat results

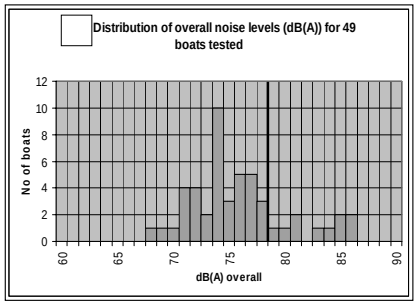
John Dixon
ISVR

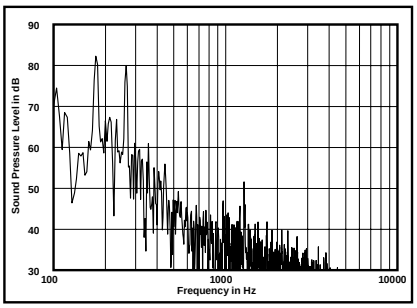
SoundBoat update

- **Summary of Boat Measurements to Date.**
- **Lessons Learnt.**
- **Alternative Method for Determining Boat Noise.**

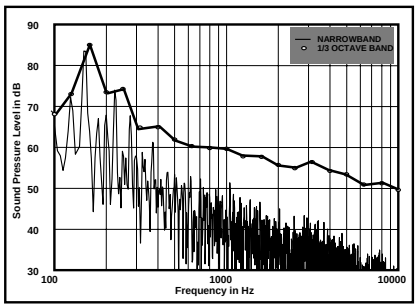
Good data obtained from 55 Boats

- 41 Twin Screw
- 3 Stern Drive
- 11.5 to 23.6 m LOA
- 147 to 2312 Kw
- 21 to 38 knots



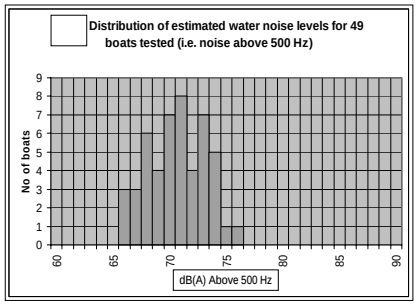


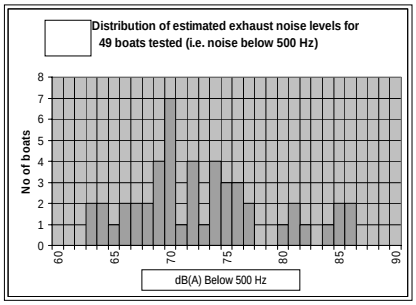
Typical Passby Noise Spectrum



Comparison of Analysis Bandwidth

Comparison of Passby Spectra for 13 Different 2 Engined Planing Vessels



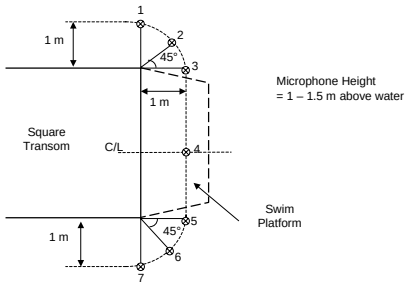


Lessons Learnt regarding Exhaust Noise Control

- Allocate sufficient space for mufflers and chambers.
- Match tailpipe length to passby engine speed.
- Ensure underwater exhausts really are underwater.

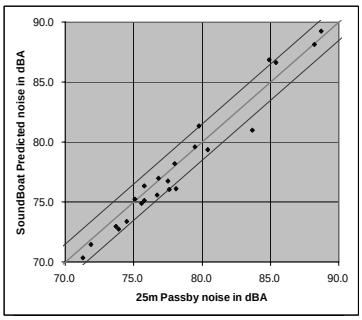
Alternative method for determining boat noise

1) **Measure on-board noise levels (sources).**
2) **Estimate distance, directivity and propagation effects (attenuations).**
3) **Predict exhaust noise contribution (i.e. 1x2).**
4) **Predict water noise contribution from a few hull parameters.**
5) **Predict Passby noise at 25m. (i.e 3+4).**



Proposed 7 microphone positions

Comparison between SoundBoat Method and 14509 pt1



Summary

- **55 boats tested.**
- **12 boats over limit.**
- **All boats over limit due to noisy exhaust.**
- **Water noise very similar for many boats.**
- **Simple alternative noise measurement methods have been demonstrated.**

SoundBuoy

Ken Wittamore

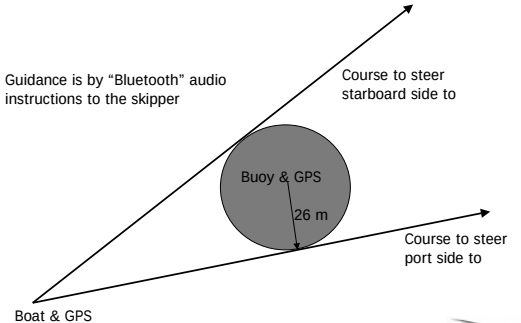
SoundBuoy

- Easier method for pass by testing
- Free floating buoy with:
  - Differential GPS navigation system
  - Type I sound level meter
  - Radio link to boat under test

SoundBuoy

- Deployed from boat under test
- On board modules:
  - Differential GPS receiver
  - Radio link
  - Note book computer for data processing and display
  - Blue tooth link for audio guidance to skipper

SoundBuoy



SoundBuoy

- No support boat and crew
- No anchoring
- Can be approached from any direction
- Real time navigation
- Real time audio guidance
- Engineering and ISO standard reports
- Simpler, safer and cheaper
- Air transportable – < 20kg in weight and modules <1m in length