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LawnMowers Noise issues: An Overview

From LaMoNoV Project

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What was the objective of this R&D project ?

▶ **design the product which can comply with the future European requirements on noise emission/radiation**

▶ **establish rational links between the physics of sound emission of lawnmower and the psycho-acoustic parameters, find the relevant sound quality metrics for evaluation of noise annoyance for typical use of lawnmowers**

▶ **to produce the knowledge and develop design tools in order to achieve low noise lawnmowers**

▶ **obtain credibility with the EC regulators**
  - ▶ industry serious about noise issues
  - ▶ seeking scientific evidence on the opportunities of reducing the limits further

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Project targets

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▶ **Identification of noise sources on existing products**

▶ **Psycho acoustic analysis using sound quality parameters**

▶ **Setting up a database of the products involved in the R&D project**

▶ **Building of virtual prototypes through the use of an appropriate software**

Partnership

Research Performer

▶ Cetim

▶ Arcus (University of Salford

▶ Head Acoustics GMBH

Industrial Partners

▶ **ALKO, Germany**

▶ **Honda, Belgium**

▶ **John Deere, Germany**

▶ **MTD, Germany**

▶ **Viking, Austria**

▶ **Toro, Belgium**

▶ **Briggs & Stratton, CH**

▶ **Wiedemann, Germany**

▶ **Gaby Samag, France**

▶ **Honda, France**

▶ **Outils Wolf, France**

▶ **Granja, France**

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Machine types

Ride-On

Huge & Deck

Walk-Behind

Ride-On

Main issues before labeling

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Main issues before labeling

▶ Noise generation

    ▶ Understanding Physics

    ▶ Modeling

▶ Which quantity?

    ▶ dBA versus Sound Quality

▶ Accuracy

    ▶ Dispersion

    ▶ Guaranteed level

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Source ranking

Objective: Sources ranking on 32 types of LM.
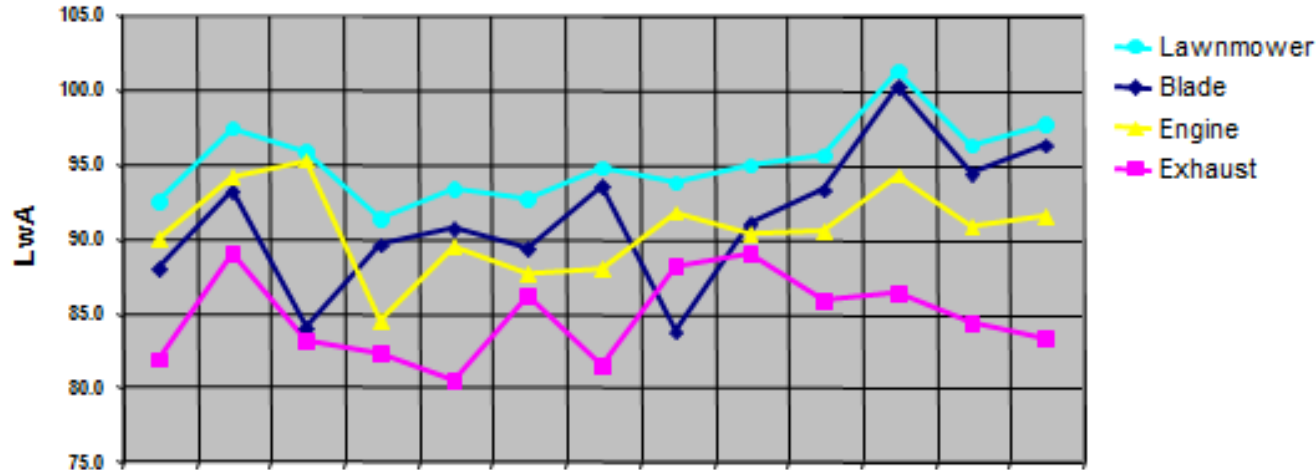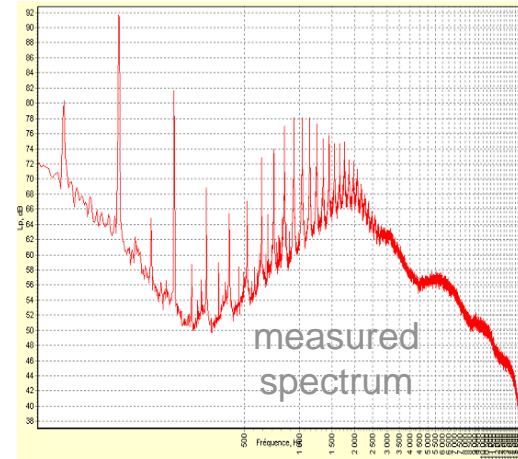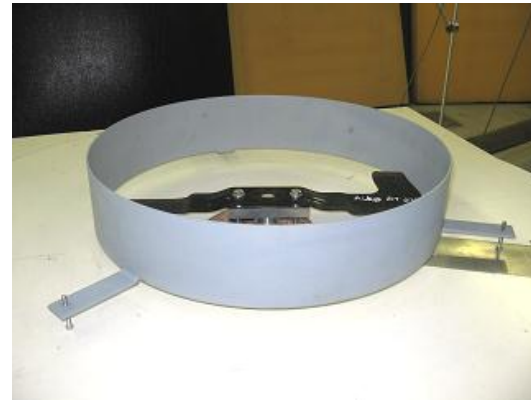

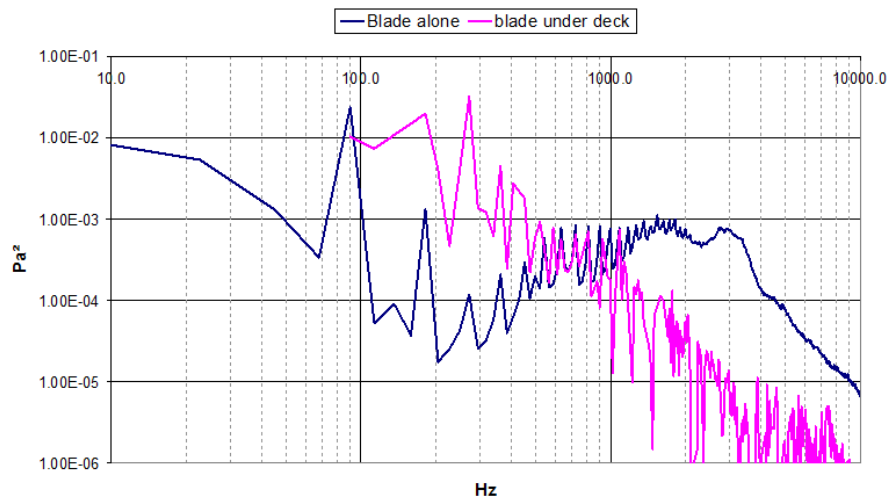· NB: For large multi-blades machines transmission noise to be added

Blade noise

measured
spectrum

▶ Special blade test-rig designed and used for blade tests.

▶ A database with the noise of 32 blades created.
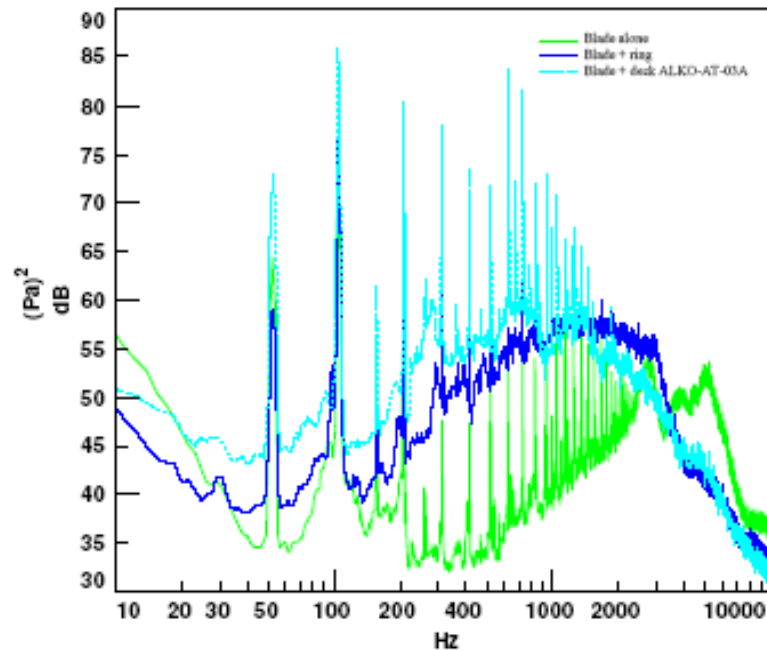
▶ An industrial test procedure defined for blade

Blade-deck interaction

Example of blade noise source, alone and on a machine.
Absorbing ground.

▶ Influence of ring : +4.2 dB(A)
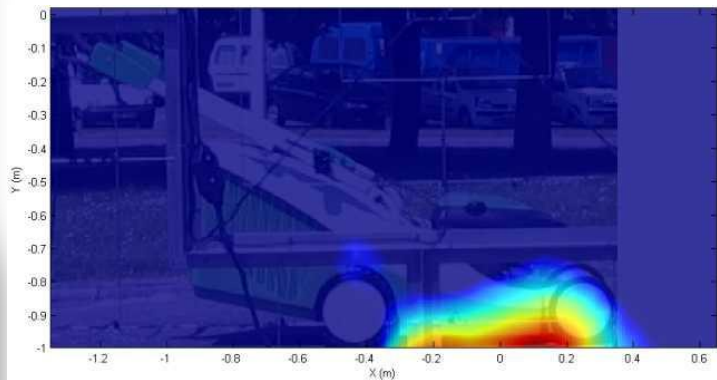▶ Influence of deck : +4.7 dB(A)

Engine noise

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▶ 3 forms: air borne (main), structure borne and exhaust.

▶ A comprehensive characterisation method for air-borne noise developed, based on partial sound powers.

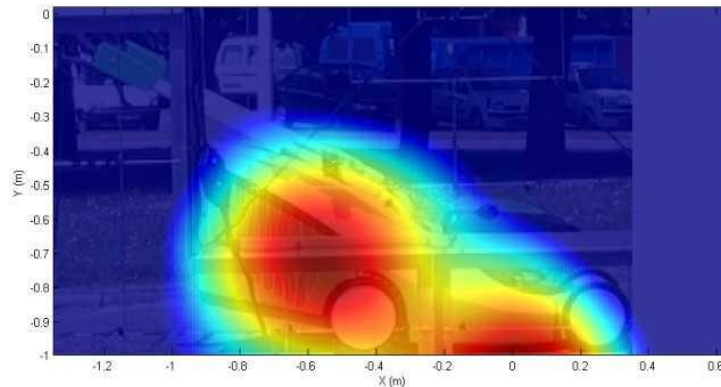▶ Simplified methods for structure-borne and exhaust noise characterisation developed as well.
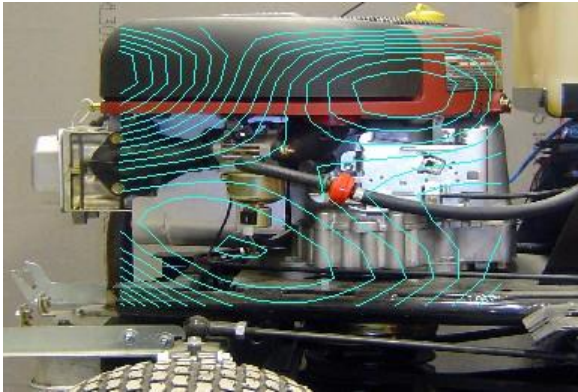
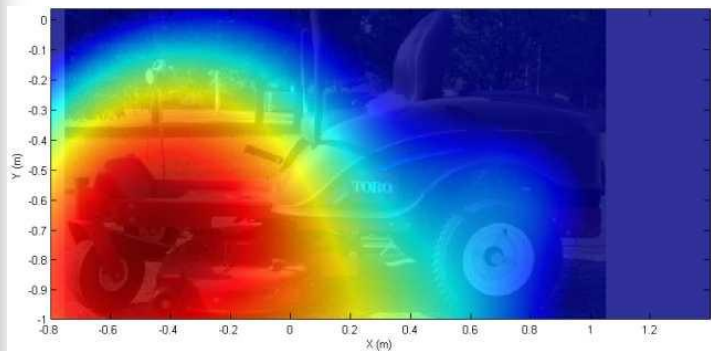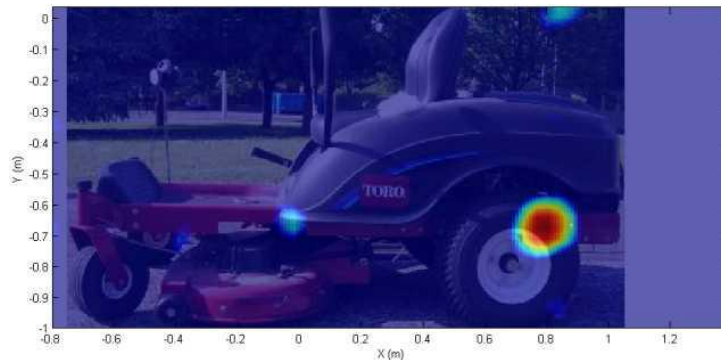# Sources and Transfer Paths (Airborne)

Mid and high frequency => Blade source

1300Hz to 1400Hz =>Blade and grass box sources

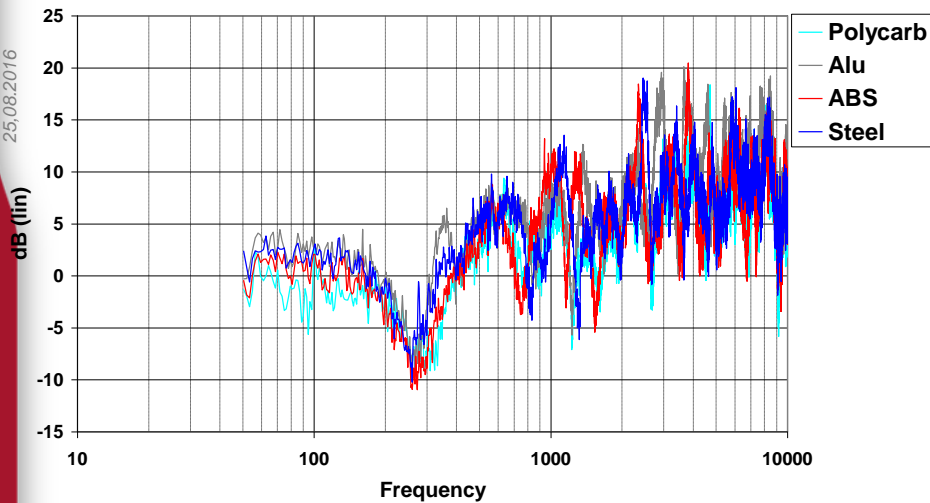"front Structure" source => 700Hz – 800Hz
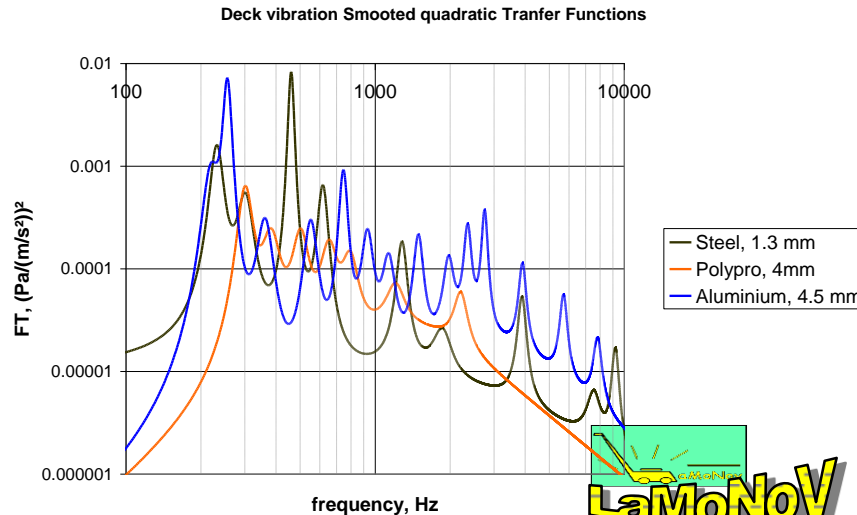

"Muffler" source => 3300Hz – 3800Hz

Sources and Transfer Paths (Structure-borne)

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Deck insertion loss, white noise source
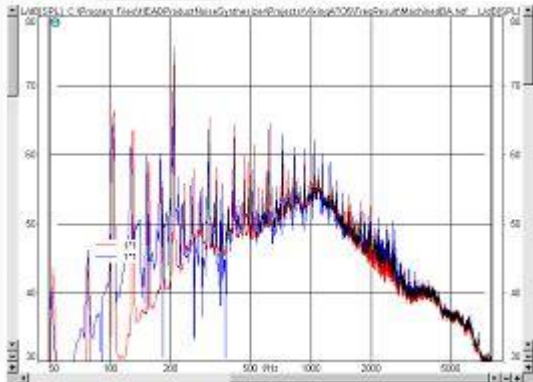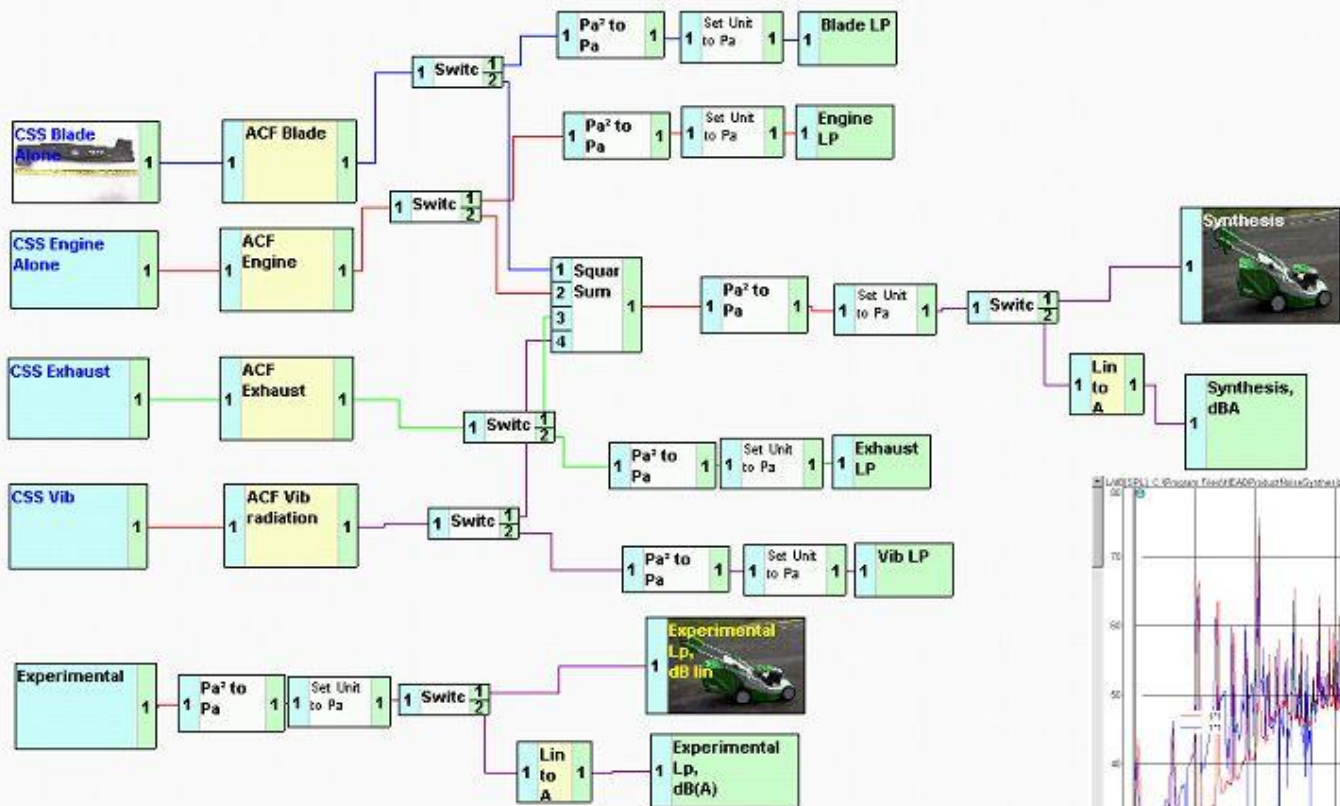

Deck Transmission loss for different materials
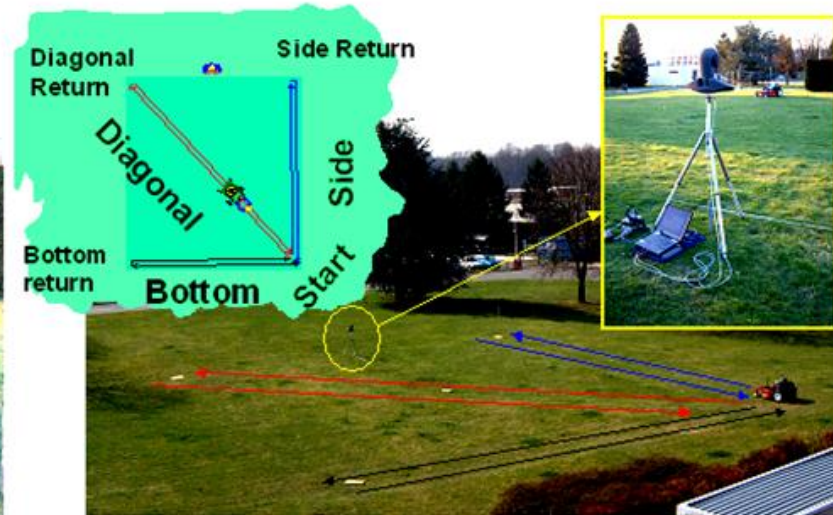
Deck Radiation for different materials

Deck vibration Smooted quadratic Tranfer Functions

Modeling

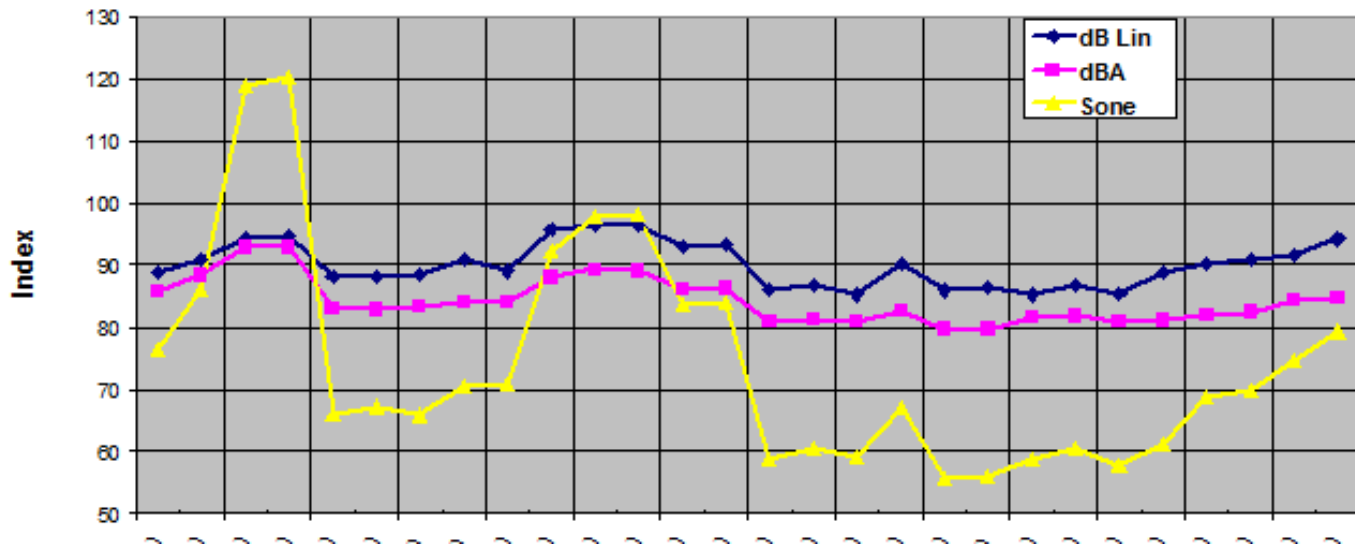# dB(A) versus Sound Quality

▶ 32 machines were recorded in static and dynamic conditions, from "driver" and "neighbours" point of view

  ▶ To allow test jury

  ▶ To find significant criteria
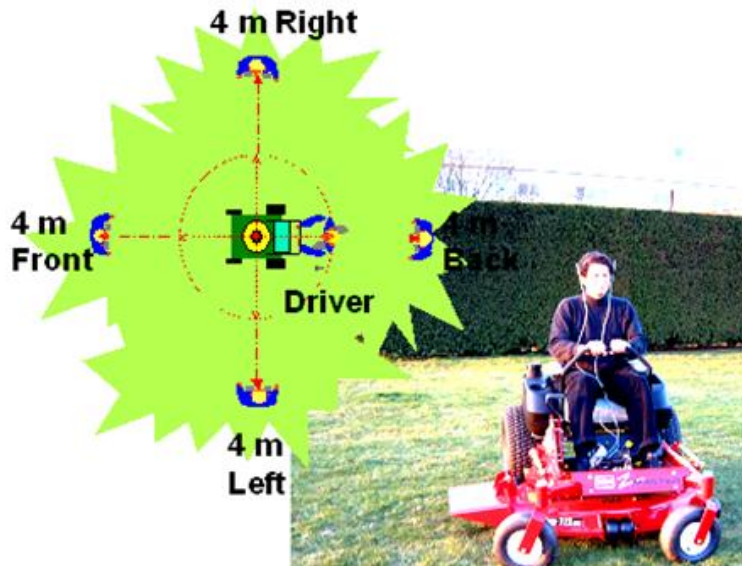
dB(A) versus Loudness

▶ Loudness is more sensitive to differences among machines

▶ Customers like to have "silent" and "Powerful" machines!

Production Dispersion

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	$L_w$mean	K factor	$L_w$guaranteed
LM 1	92,8	1,78	95
LM 2	94,0	2,38	96
LM 3	98,3	1,12	99
LM 4	97,0	2,43	99
LM 5	99,7	2,45	102
LM 6	101,4	0,97	102
LM 7	101,0	2,10	103
LM 8	104,4	0,59	105

Cutting width < 50 cm
Lw guaranteed limited to 96 dB(A)

Cutting width > 50 cm
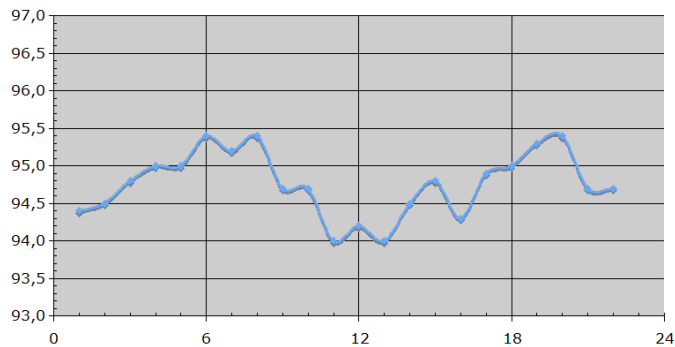Lw guaranteed limited to 100 dB(A)

Cutting width > 120 cm
Lw guaranteed limited to 105 dB(A)
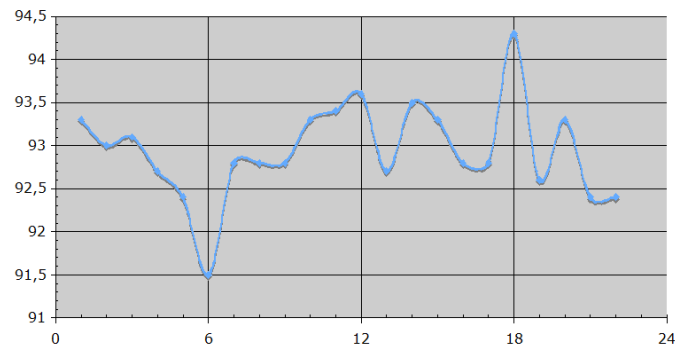
▶ 5 machines for each type taken from the same production
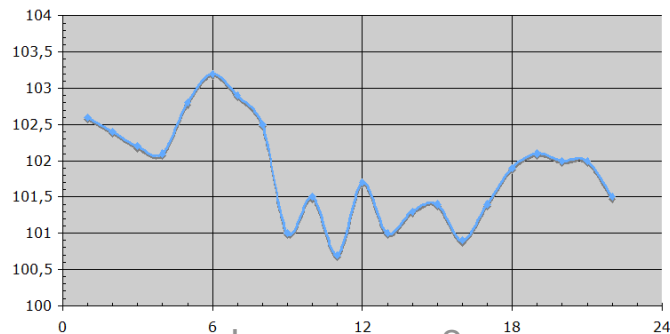
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Long Term Monitoring

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▶ 5 machines of 2 types and a reference source measured every month during 2 years

Reference Sound Source

Lawnmower 1

Lawnmower 2

▶ Range of variation:

  ▶ 2,5 and 2,8 dBA for LMs

  ▶ 1,4 dBA for the RSS

▶ Lw decreases of 1 dBA/20 °C

Buy Quiet?

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▶ Lawnmowers should cut grass! Decreasing the blade speed decreases the noise, but also the Quality of Cut (evaluated by jury).

▶ Blade noise is dominant, but interactions beetween components (blades, deck, engine) play a significant rôle

▶ Accuracy can't be better than 3dB (Lw, K)

▶ Loudness is a better indicator of annoyance (quietness?)

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Vers le futur