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
Project targets

- 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
Machine types

- Ride-On
- Huge & Deck
- Walk-Behind
- Ride-On
Main issues before labeling

- Noise generation
  - Understanding Physics
  - Modeling
- Which quantity?
  - dBA versus Sound Quality
- Accuracy
  - Dispersion
  - Guaranteed level
Source ranking

Objective: Sources ranking on 32 types of LM.

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

- 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 measurement.
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

- 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)

Deck insertion loss, white noise source

Deck Radiation for different materials

Deck Transmission loss for different materials
Modeling

Deck Transmission loss for different materials
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
Loudness is more sensitive to differences among machines.

Customers like to have "silent" and "Powerful" machines!
### Production Dispersion

<table>
<thead>
<tr>
<th></th>
<th>$L_w$ mean</th>
<th>$K$ factor</th>
<th>$L_w$ guaranteed</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM 1</td>
<td>92.8</td>
<td>1.78</td>
<td>95</td>
</tr>
<tr>
<td>LM 2</td>
<td>94.0</td>
<td>2.38</td>
<td>96</td>
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<tr>
<td>LM 3</td>
<td>98.3</td>
<td>1.12</td>
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<td>97.0</td>
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<td>LM 6</td>
<td>101.4</td>
<td>0.97</td>
<td>102</td>
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<tr>
<td>LM 7</td>
<td>101.0</td>
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</tr>
<tr>
<td>LM 8</td>
<td>104.4</td>
<td>0.59</td>
<td>105</td>
</tr>
</tbody>
</table>

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

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

Cutting width > 120 cm
$L_w$ guaranteed limited to 105 dB(A)

- 5 machines for each type taken from the same production
Long Term Monitoring

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

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?

- 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 between 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?)
5.0
Vers le futur
CETIM