Transmitted by the expert from the Netherlands

Informal document No. **GRB-48-7**
(48th GRB, 1-3 September 2008,
agenda item 8)

Development of the SPERoN hybrid tyre/road noise model:

Test track sections

A short overview for GRB Sept 2008

Erik de Graaff, M+P consulting engineers

Optimisation of road surfaces, the history

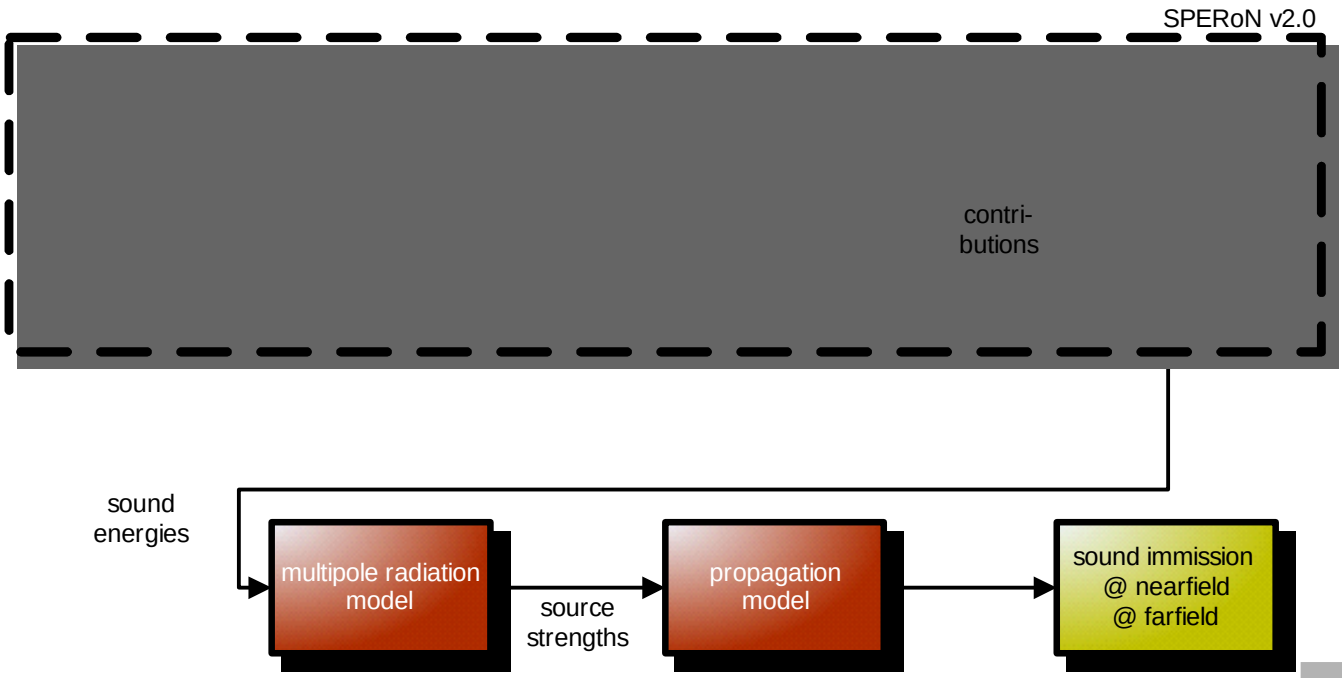
- First phase (in the past): observation of the spread and selection of the most silent
  - (top-top variation 5 dB(A))

- Second phase (current practice): optimisation by “educated guess”
  - Example 1: single layer absorbing road surface was copied from airport runways (reduced splash and spray)
  - Example 2: double layer absorbing road surface was optimisation of single layer both in absorption and in texture, but appeared to be too thick in its first trials (second optimisation necessary)
  - Top-top variation 10 dB(A)

- Third phase (in preparation): structured optimisation
  - Well structured variation in test fields
  - Computer programmes to optimise
  - Fundamental knowledge
  - Top top variation 15 dB(A)?

SPERoN= Statistical Physical Explanation of Rolling Noise

- Computer model of tyre/road noise
- First goal
  - Tyre: black box (the average tyre)
  - Road surface: to be optimized
- Development by Chalmers university, M+P and Müller-BBM

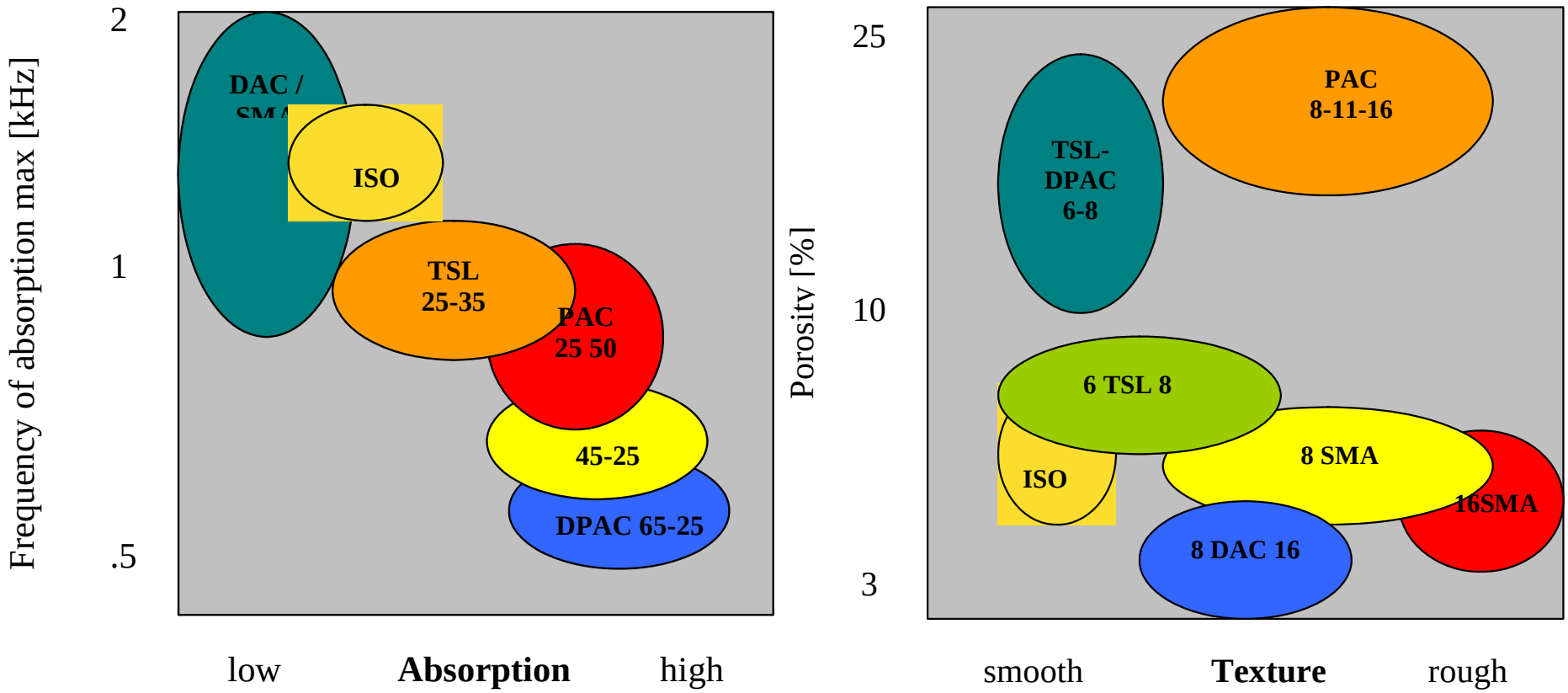


Data requirement for development

- Input to physical model:
  - Surface properties;
    - **2-1/2 D texture profile,**
    - **acoustic impedance,**
    - **mechanical impedance**,
    - flow resistance,
    - micro-texture.
  - Tyre properties:
    - 3D tyre profile,
    - tyre mobility,
    - tread hardness,
    - load and speed
- Input to statistical model:
    - Spectral sound power levels of all tyre/road/speed combinations
- Input to propagation model:
    - Source geometry, horn amplification, acoustic impedance, propagation geometry

44 different test sections where build on deserted road

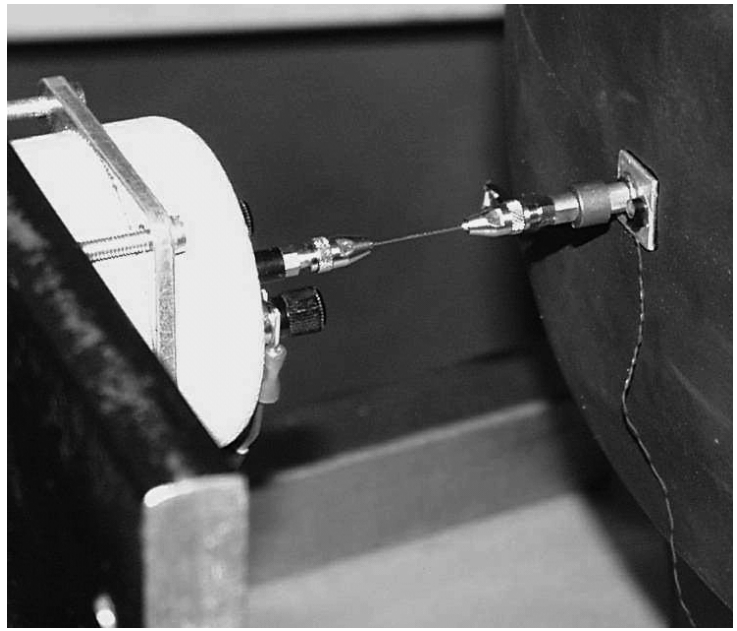
Choice of test sections to allow maximal spread in relevant surface properties



Instrumentation for determination of surface properties

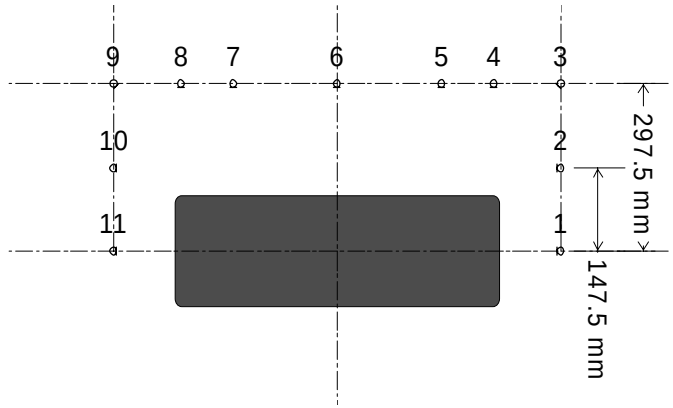
Measurement systems for determination of tyre properties

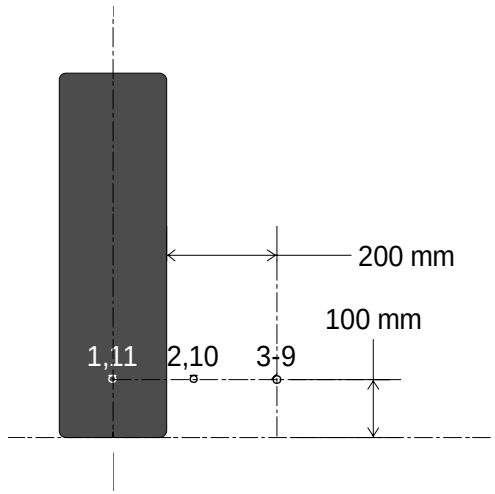
Shown profile scanner for C1 tyres, also used scanner for C3 tyres



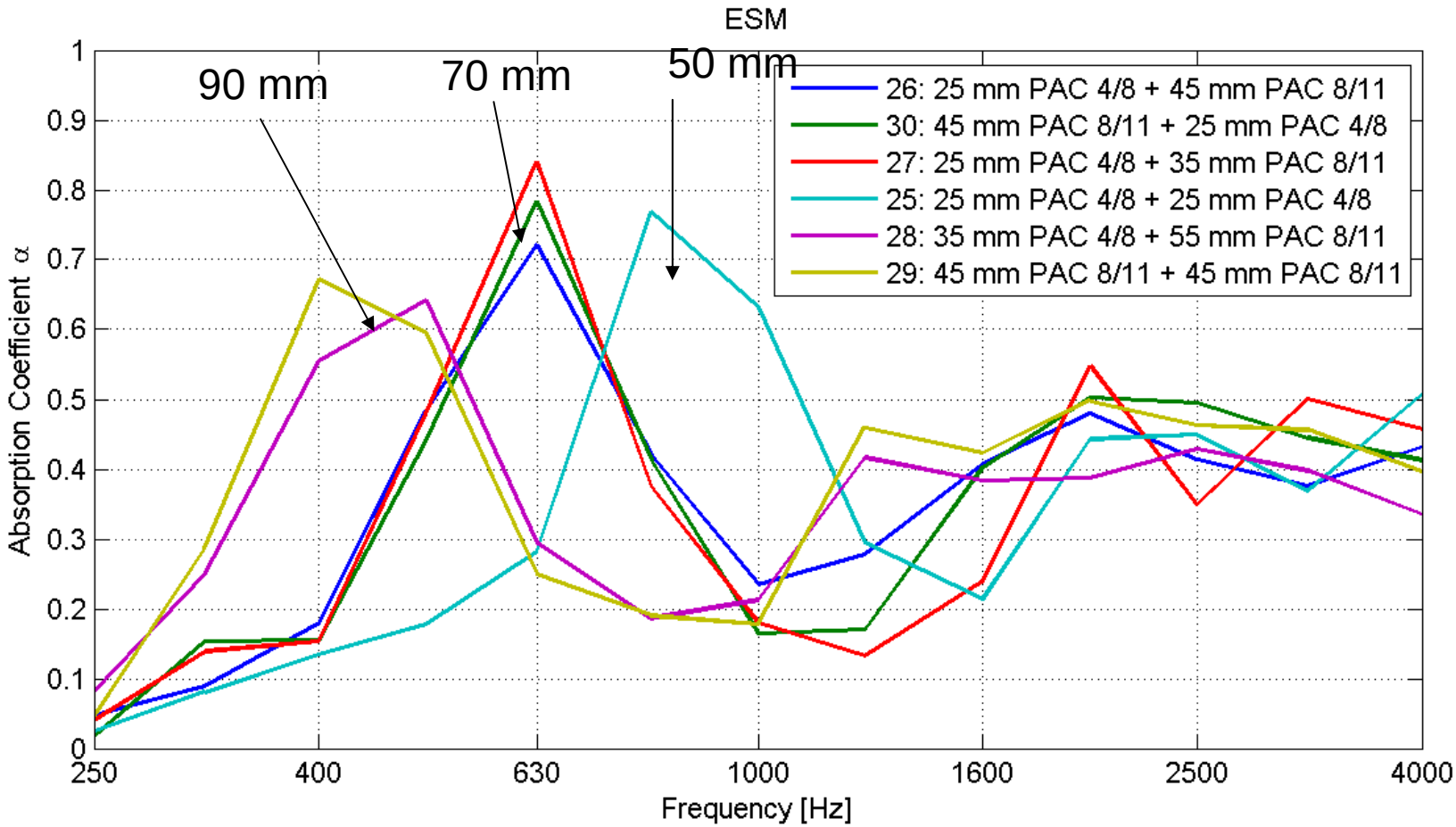
Tyre mobility measured by Chalmers University

Rolling noise measurement system (shown far car (C1) tyres), similar system for truck (C3) tyres.

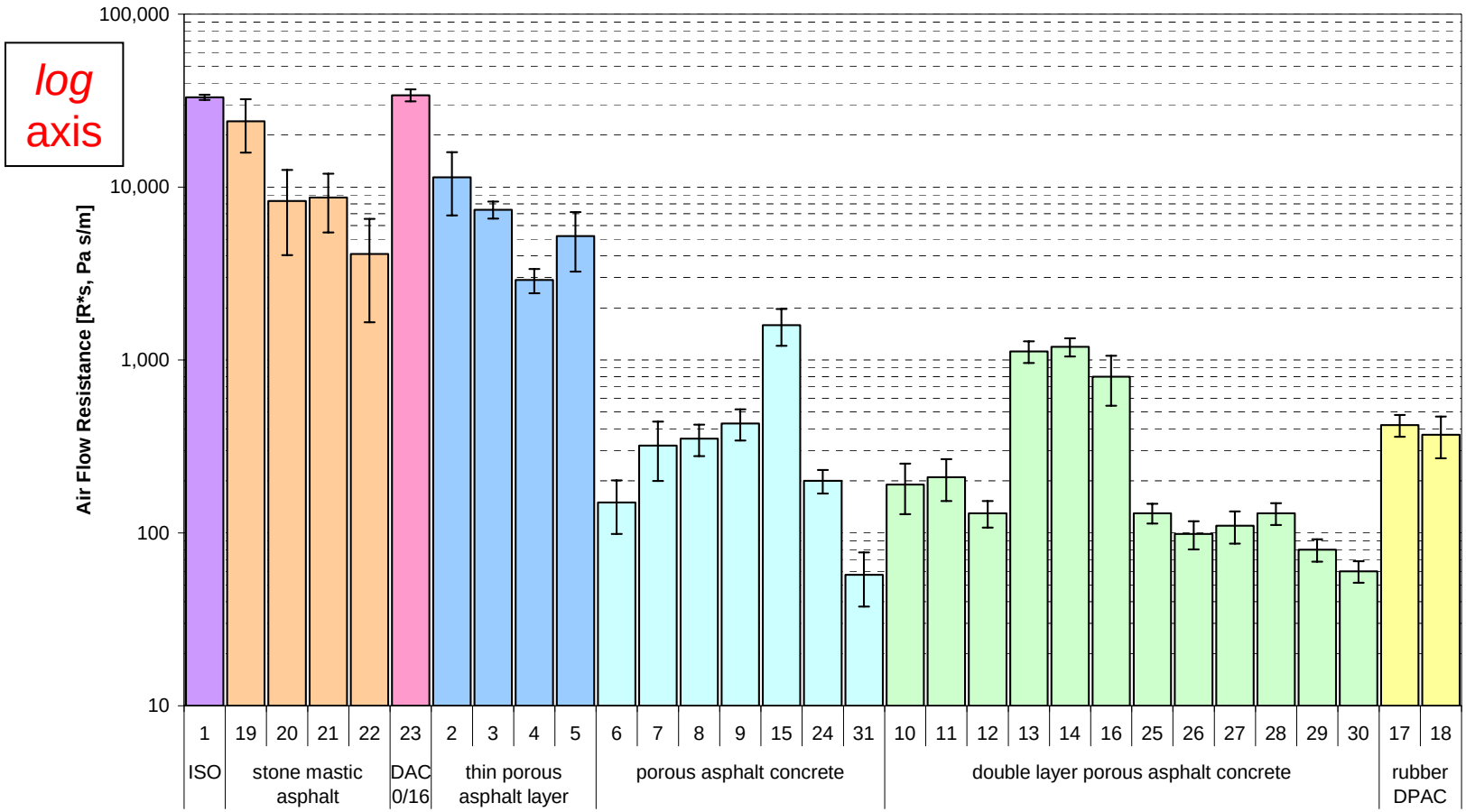




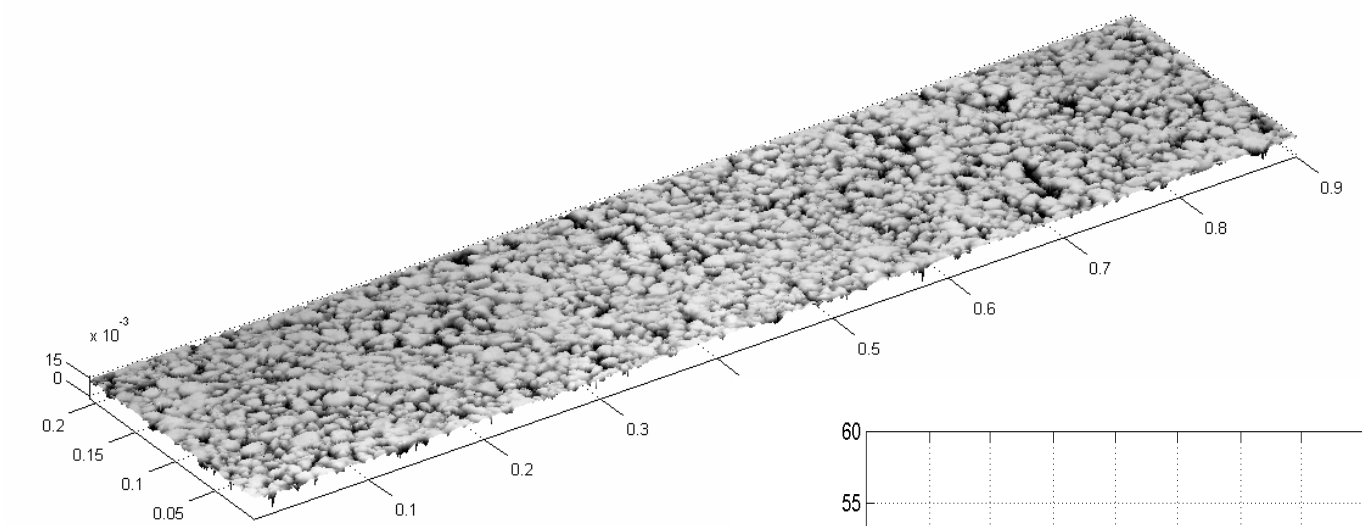
Sound absorption (extended surface method) (2)

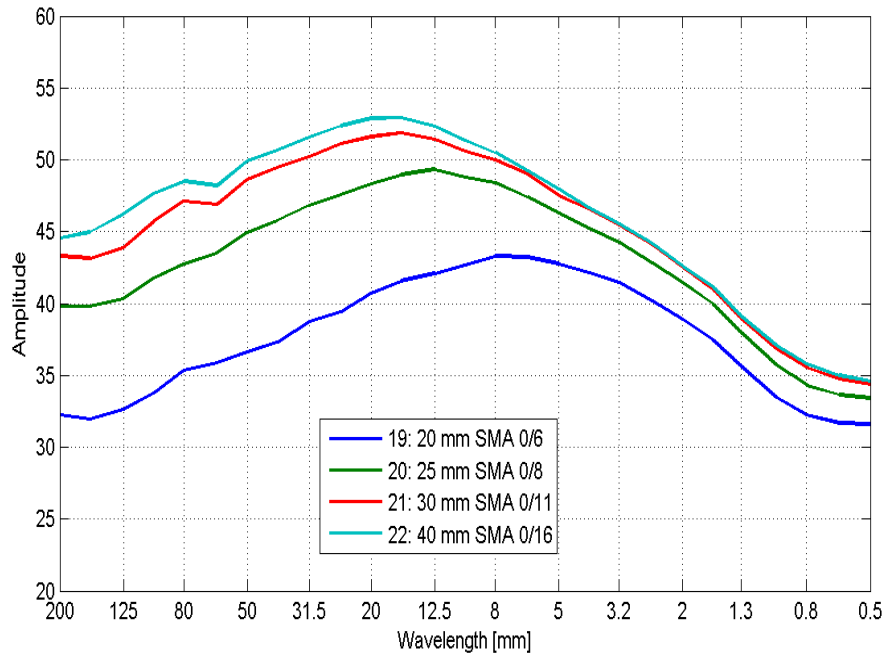


Air flow resistance

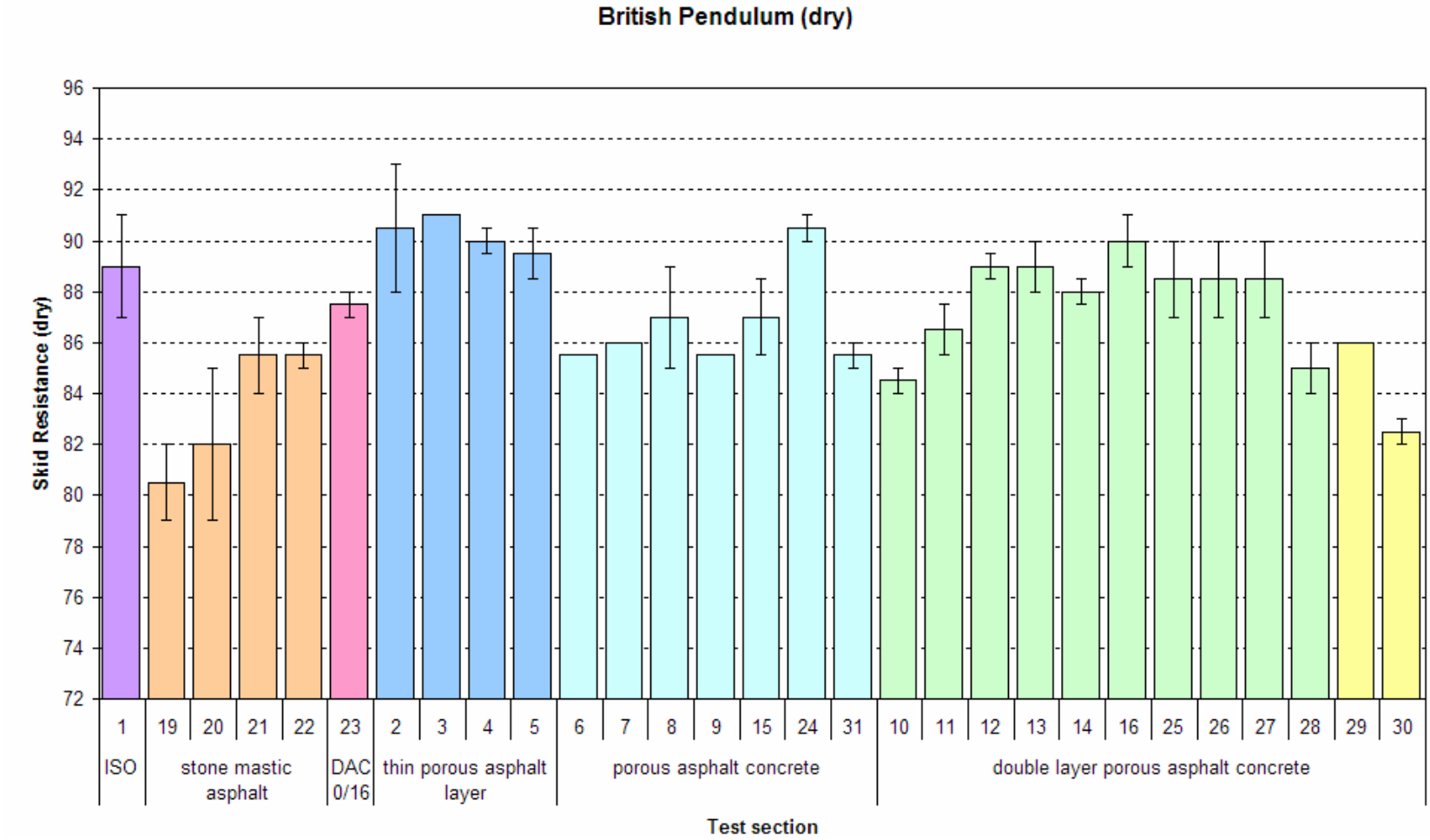


Surface texture



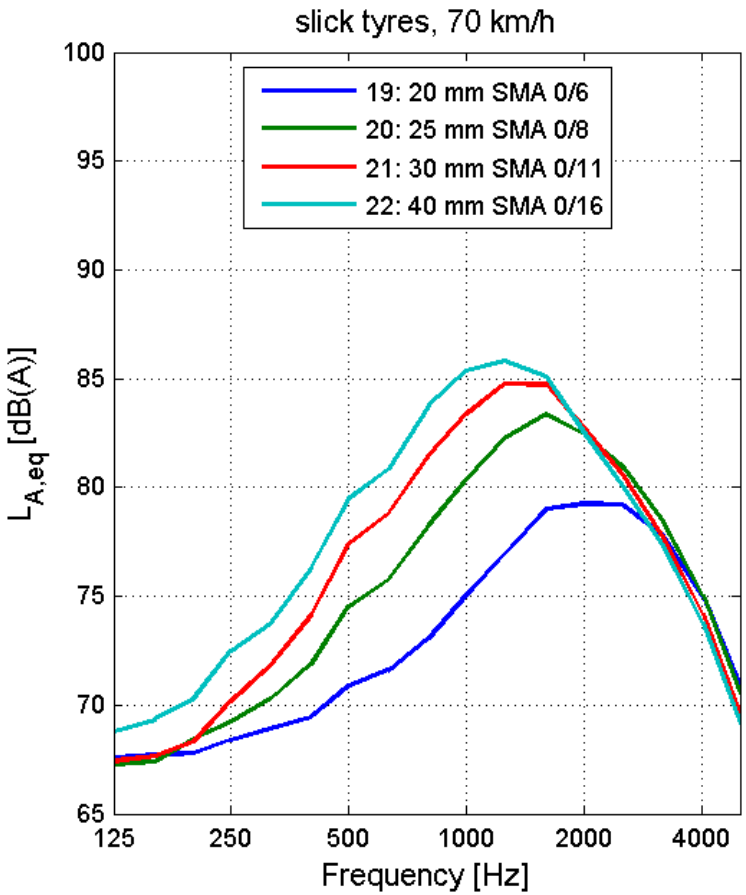


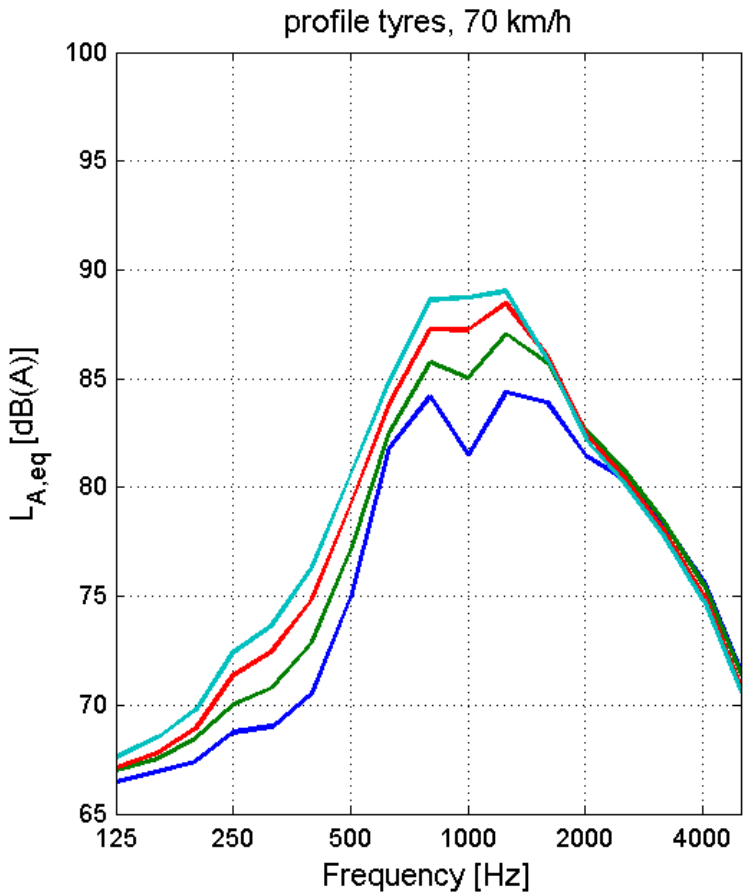
Micro Texture: skid resistance (British Pendulum Test)



Examples of near field rolling noise

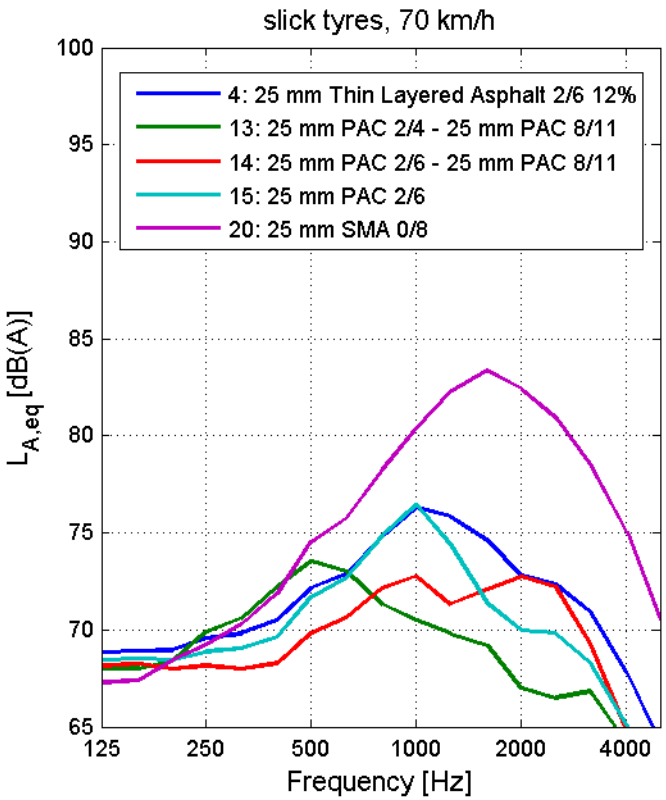
Effect of road surface texture on slicks and profiled tyres

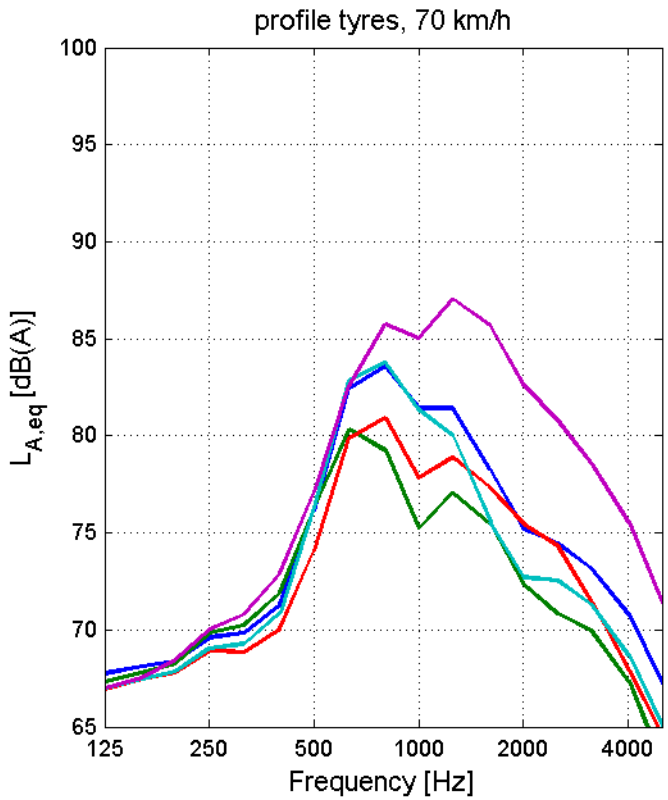




Examples of near field rolling noise

low texture fields, with varying acoustic absorption



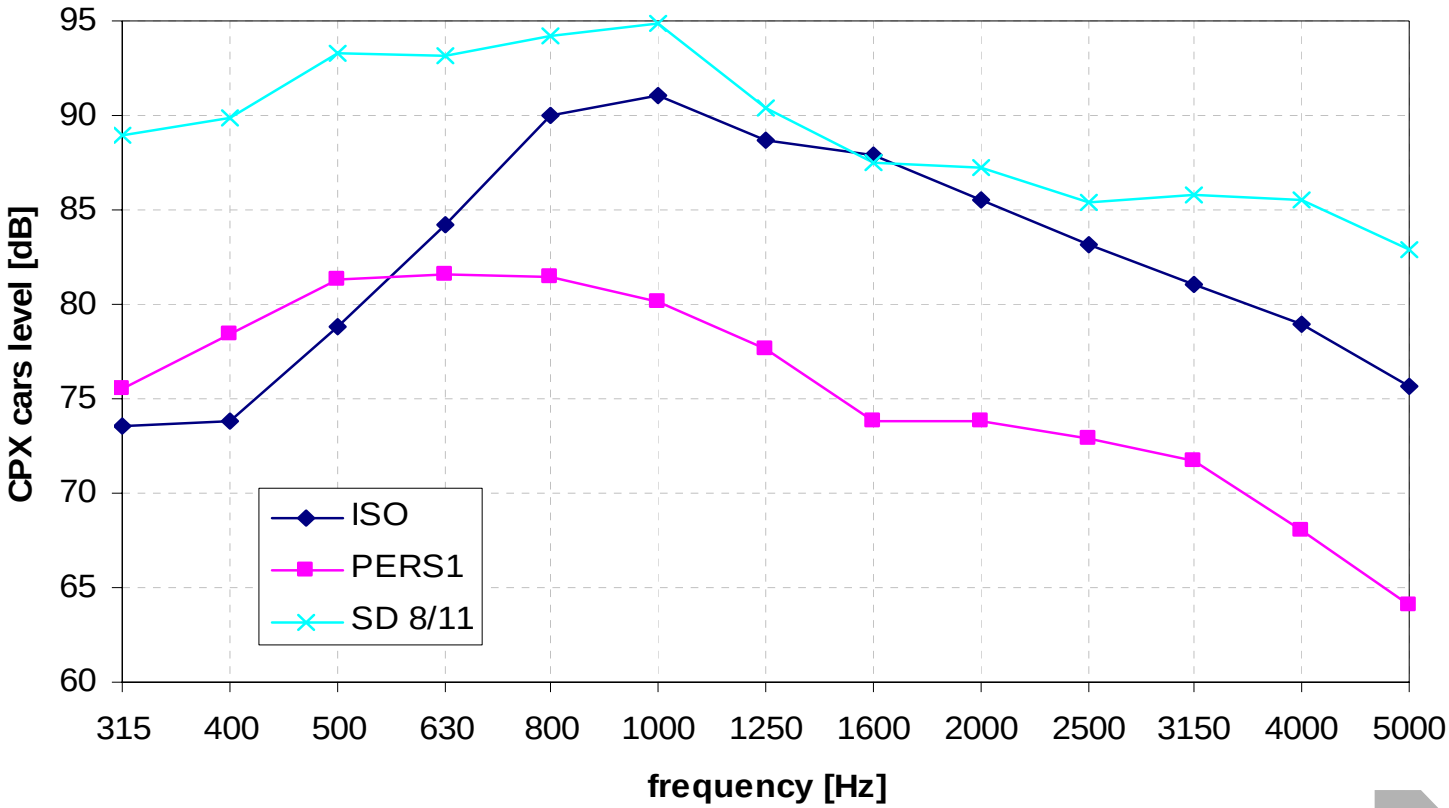


Phase II additions (among others)

- Testing of Japanese Poro Elastic Rubber Surfaces (with support from Dr. Meierashi PWRI)
- Decoupling of texture, mechanical impedance and acoustic impedance by application of PERS surface with modifications:
  - Sealed (no acoustic absorption)
  - Standard (limited acoustic absorption)
  - On porous layer (high acoustic absorption)

Results phase II surfaces

- Japanese Poro Elastic Road Surface shows high reduction potential
  - 10 to 15 dB over the entire frequency range compared to surface dressing
  - 10 dB at higher frequency range compared to ISO surface



Conclusions and outlook

- 44 Test sections represent wide variation in relevant acoustic surface properties (texture, absorption and mechanical impedance)
- Top-top differences in noise emission up to 15 dB(A)
- Computer model is reliable and can be used to further optimize the noise emission of road surfaces
- Other parameters of elastic road surfaces have to be checked
  - Rolling resistance
  - Resistance to emergency braking
  - Durability
  - Etc
- Next goals for computer model
  - Extend with Grip and Rolling Resistance
  - Extend to optimize tyre/road combinations
- Further information can be found on www.silentroads.nl