Alternatives for data processing in R51.03 Annex 10

A short clarifying introduction on the principles

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5th GRBIG ASEP meeting Nov. 2006

What Alternatives are available

- 1 proposal (Germany/France)
- 3 concepts (Japan, DeGraaff, Gerhard)

  – Remark: Following the decisions in the 4th meeting, the 3 concepts have been reworked into a text version by this author and distributed as an interim paper by e-mail. Several assumptions had to be made in this text version. Although no comments where received prior to this meeting, not necessarily all assumptions may reflect the position of the proposer of the concept.

Basic differences of the 4 options

- X-axis
  - Japan, DeGraaf and Gerhard concept evaluate the noise as function of engine speed (Gerhard v*a, which is proportional to engine speed).
  - D/F proposal evaluates the noise as function of vehicle speed, taking into account the actual engine speed as parameter for engine noise.

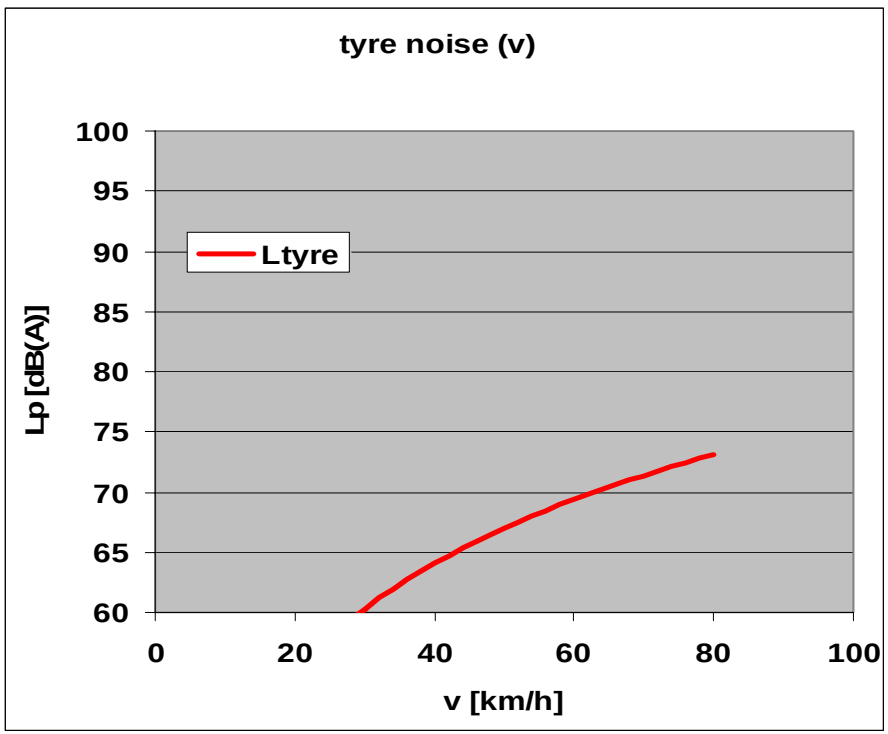
- Sub sources
  - Japan, DeGraaf and Gerhard concept do not take into account sub sources, only total vehicle noise
  - D/F proposal calculates the total vehicle noise on the basis of tyre noise and engine noise.

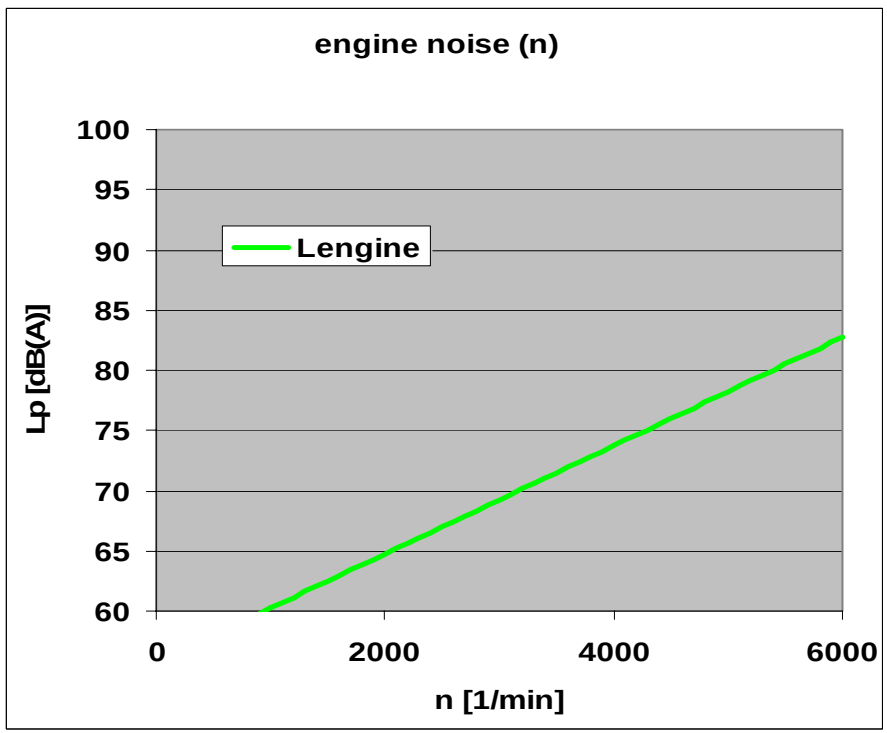
- Limit curves
  - D/F proposal an DeGraaff concept have separate limits for every “gear” (= combination of engine/vehicle speed).
  - Japan concept and Gerhard concept are assumed to have a single limit for all gears.

Basics of vehicle noise emission

Behavior of two principal noise sources:

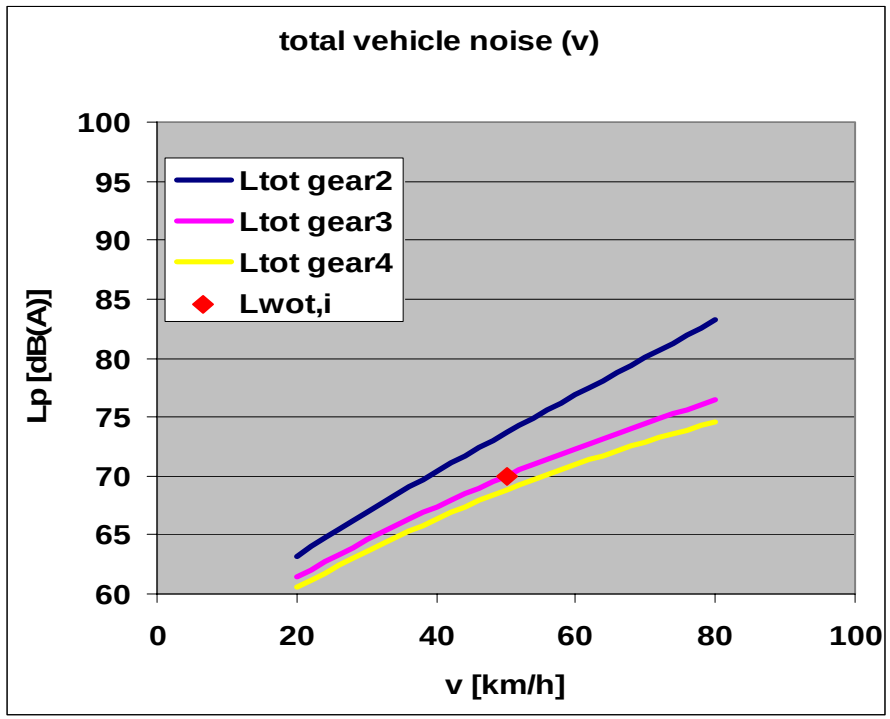
$L_{tyre} = f(v)$ $L_{engine} = f(n)$





Basics of vehicle noise emission

- Example of a vehicle with manual gearbox:
  - Separate curve for each gear
  - Difference between curves depends on
    - Gearbox ratios
    - ratio engine/tyre noise



Basic task for data processing:

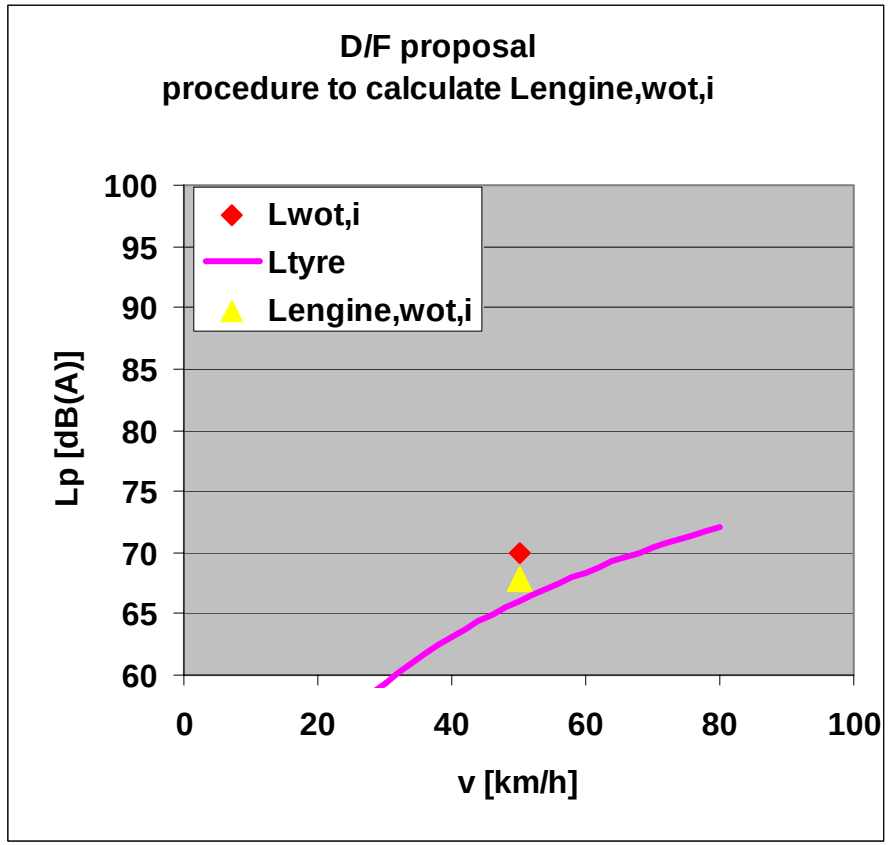
- How to compare measurements in
  - different “gears” (or different combinations of v and n)
  - all possible ratios of engine/tyre noise

NB Limit curves

- The curves that are shown here are only examples with a default value for the purpose of demonstrating the data processing principle.
- Actual values have to be discussed in a later stage

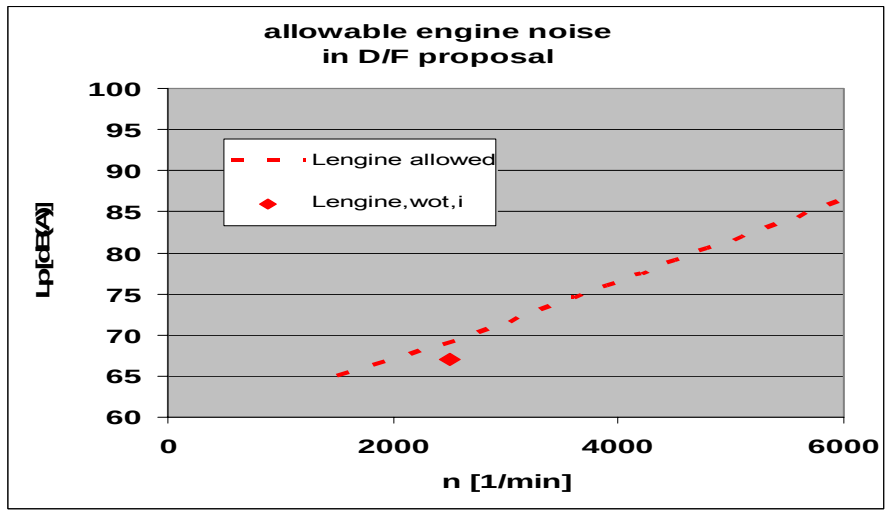
Option 1 D/F proposal (1 of 3)

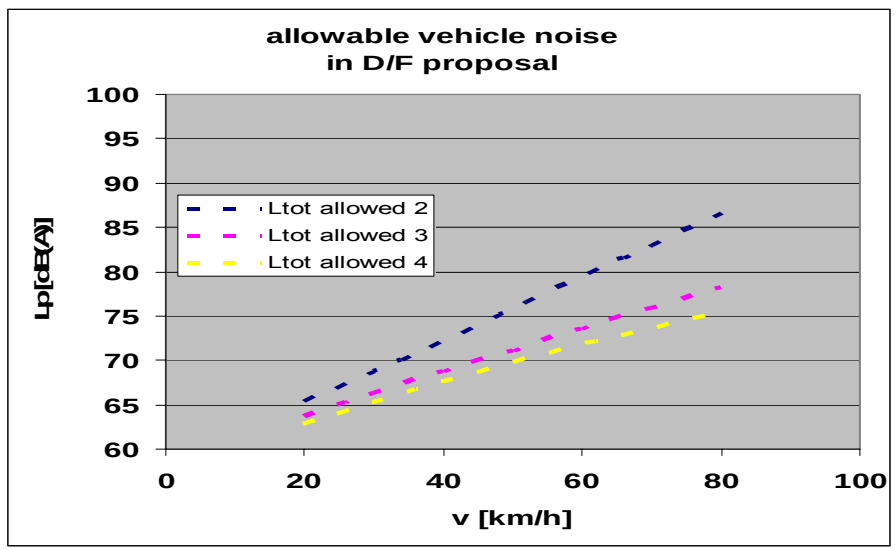
1. Measure Lwot,i in Annex 3
2. Measure tyre noise
3. Check Lwot,i – Ltyre ≥ 3 dB (linear subtraction)
4. Calculate engine noise from Lwot,i – Ltyre (energetic subtraction)



Option 1 D/F proposal (2 of 3)

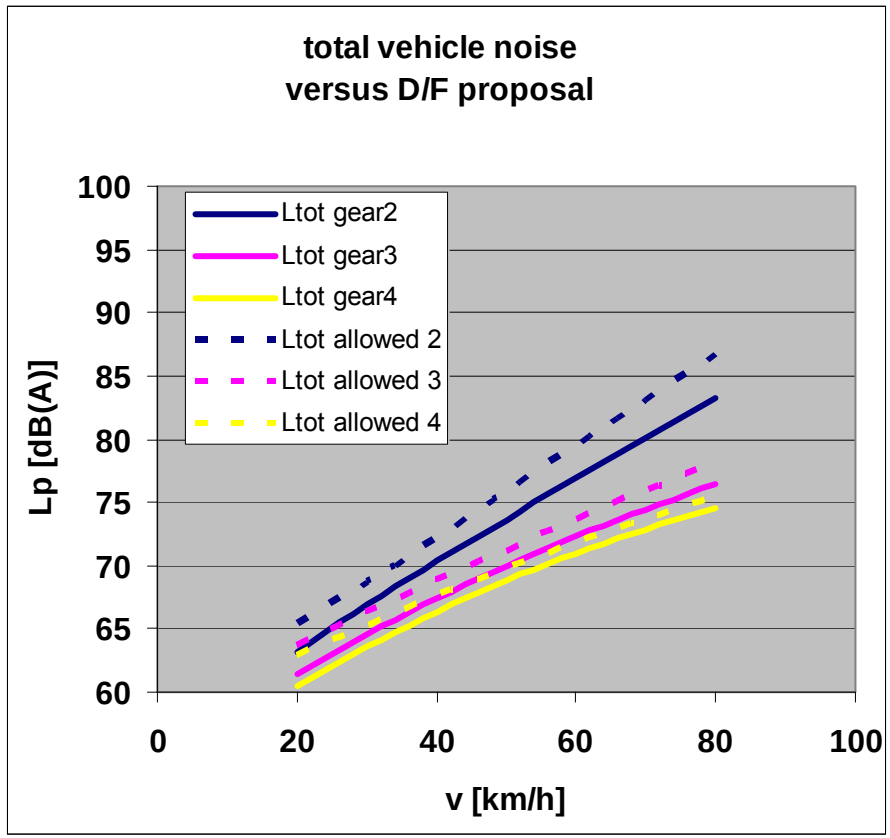
5. Extrapolate allowable engine noise behavior at other engine speed from limit value [slope and offset]
6. Calculate allowable total noise for every “gear” separately





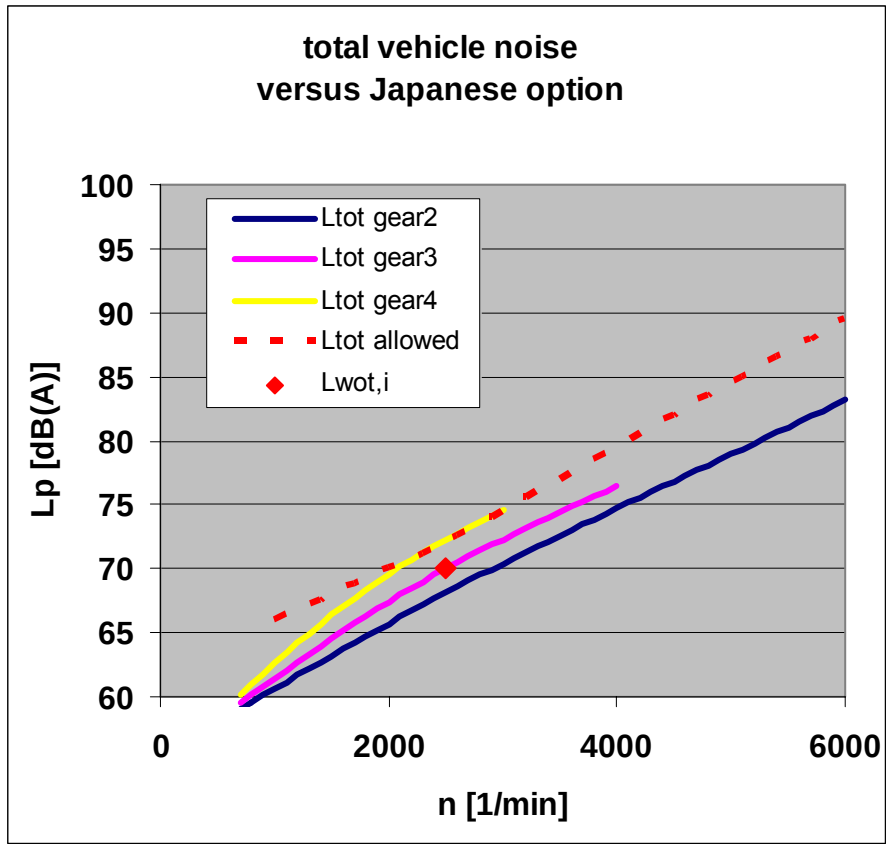
Option 1 D/F proposal (3 of 3)

7. Measure noise of [8] randomly distributed WOT accelerations
8. Evaluate these 8 points against allowable noise curves



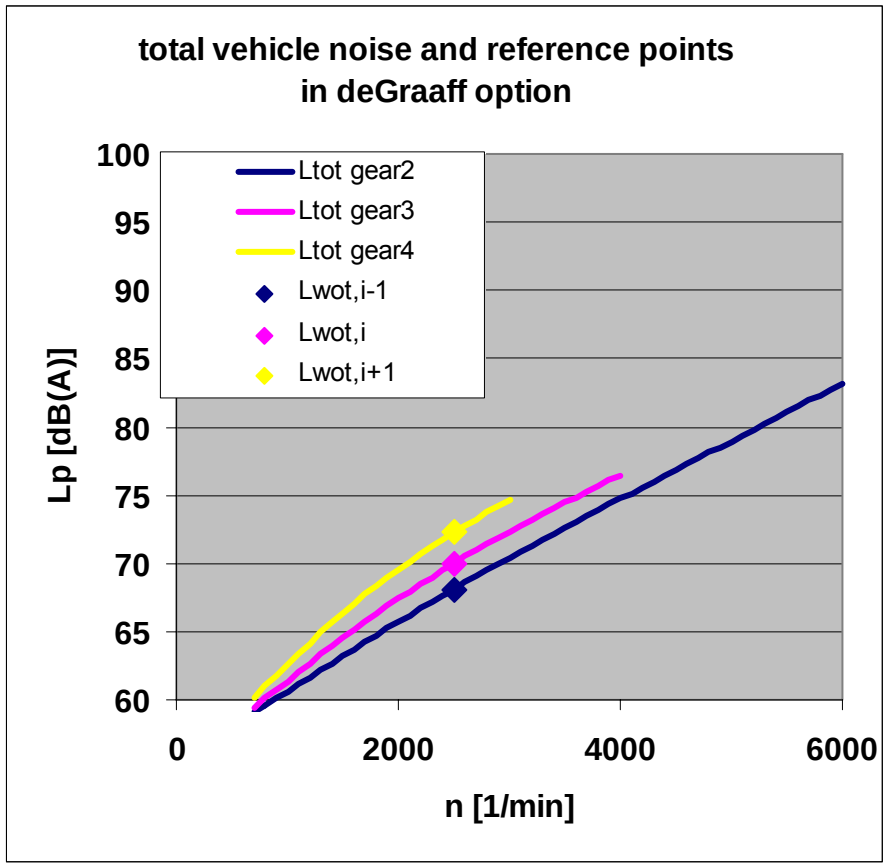
Option 2: Japanese concept

- Evaluate total noise as function of engine speed
- ? No different limit curves for different gears?
- ?construct limit curve from Lwot,i?



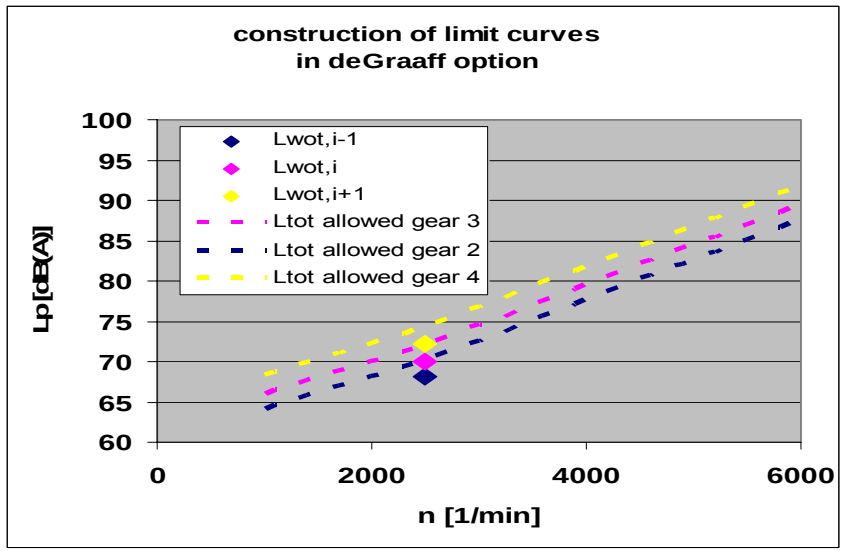
Option 3: DeGraaff concept (1 of 2)

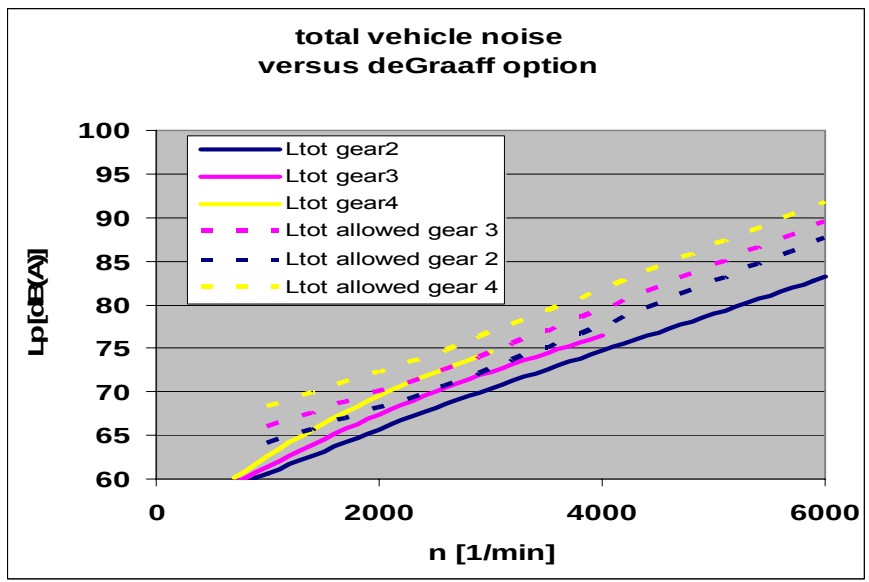
1. Evaluate total noise as function of engine speed (at least 8 points)
2. Measure a reference point for every gear at the same engine speed as Lwot,i



Option 3: DeGraaff concept (2of 2)

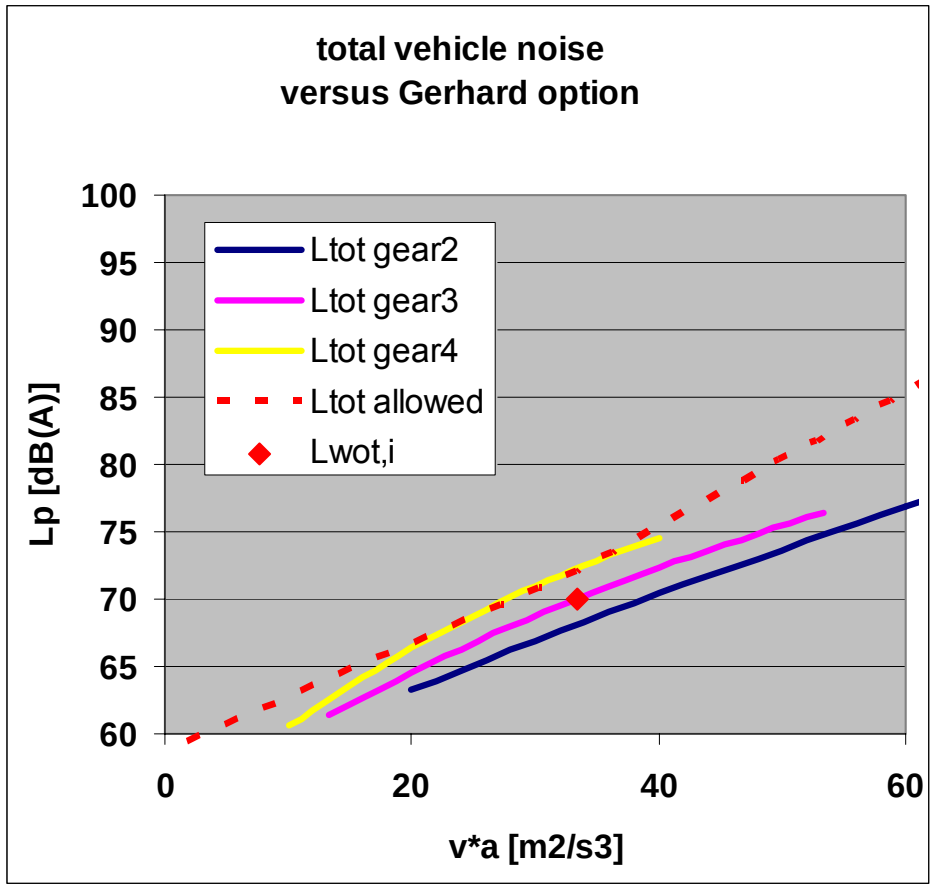
3. Determine limit curve for every gear separately, extrapolating from gear specific reference point
4. Evaluate measured noise against limit curve





Option 4: Gerhard concept

- Evaluate total noise as function of v*a
- ? No different limit curves for different gears?
- ?construct limit curve from Lwot,i?



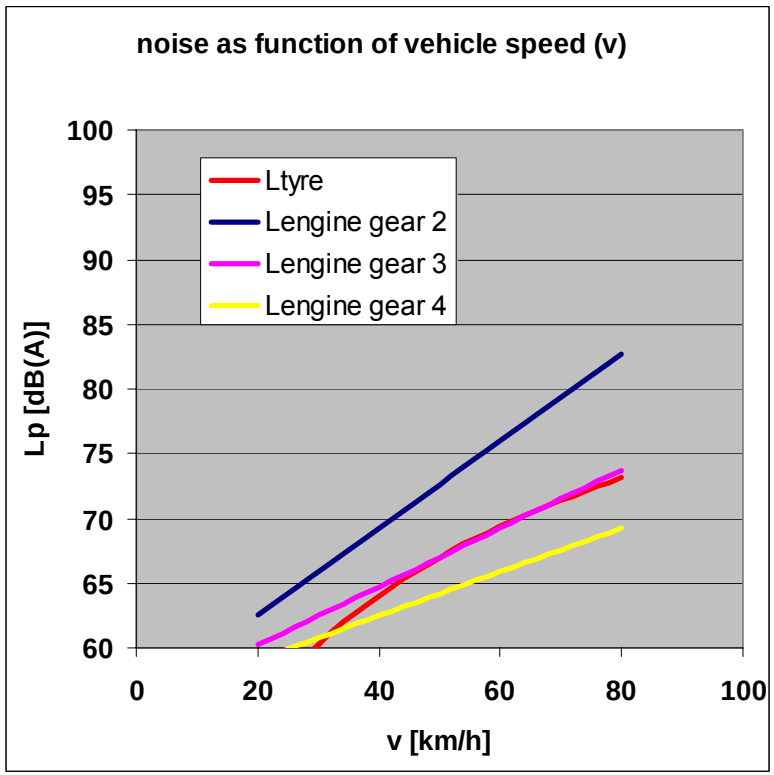
Some additional basic acoustics

- For a better understanding of the options and consequences

The behavior of the two principal noise sources is coupled via a gearbox

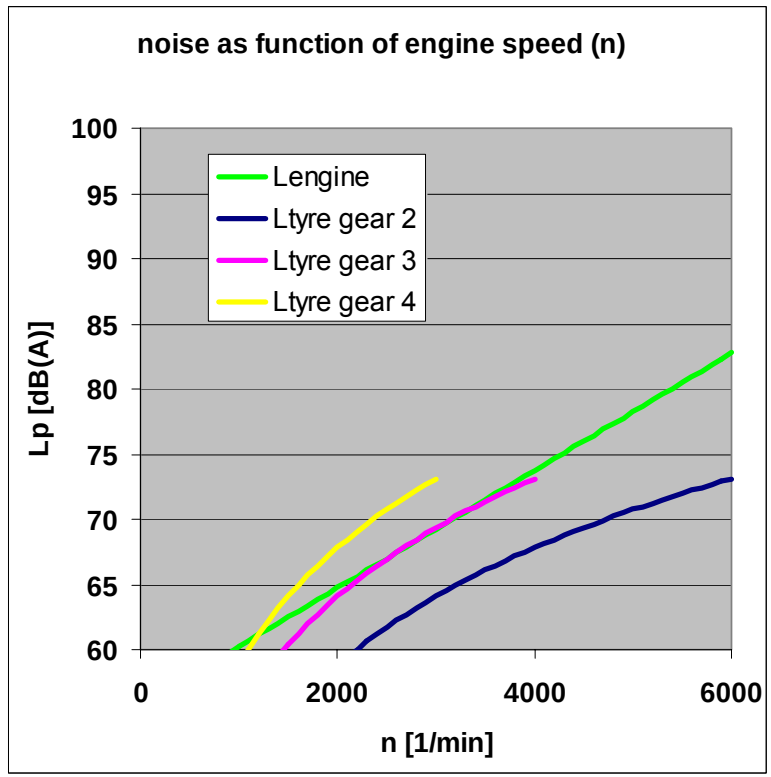
Evaluation can be done

as function of vehicle speed or



Lp as function of v means:
Lower gear = higher noise

as function of engine speed

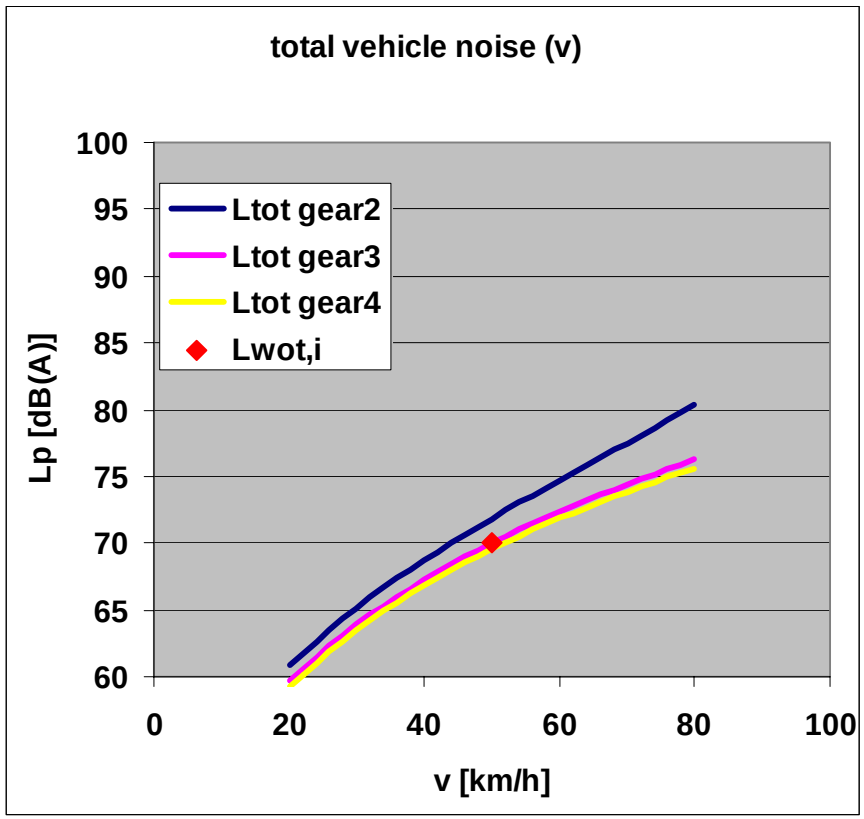


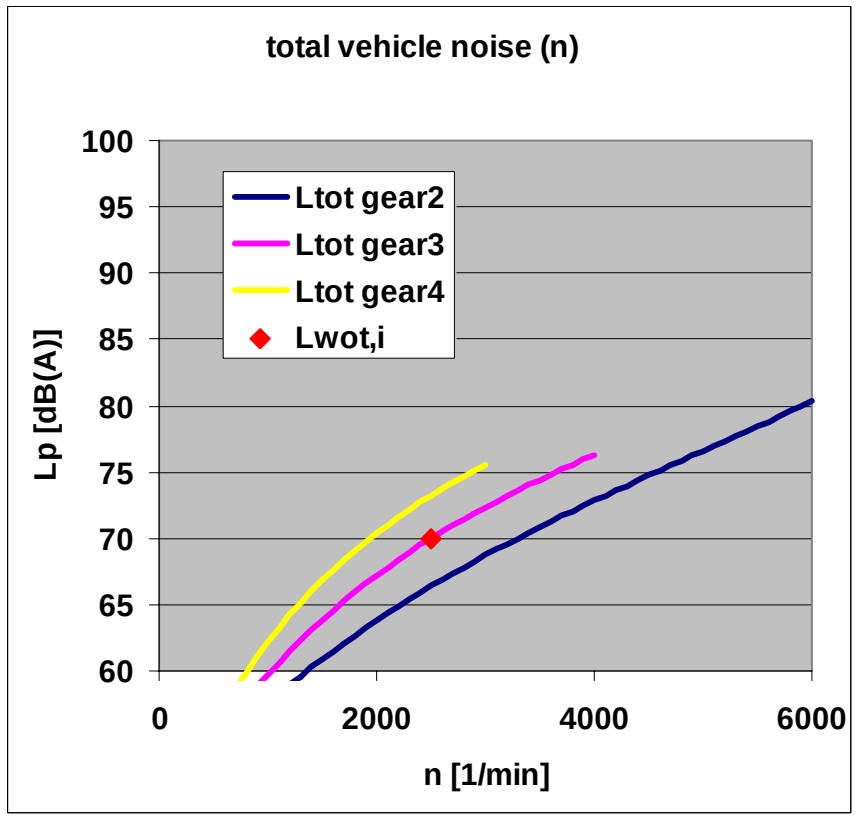
Lp as function of n means:
Lower gear = lower noise

Desire for easy visual interpretation of results

the choice of the X-axis depends on the dominant source

- In case of dominant tyre noise: vehicle speed



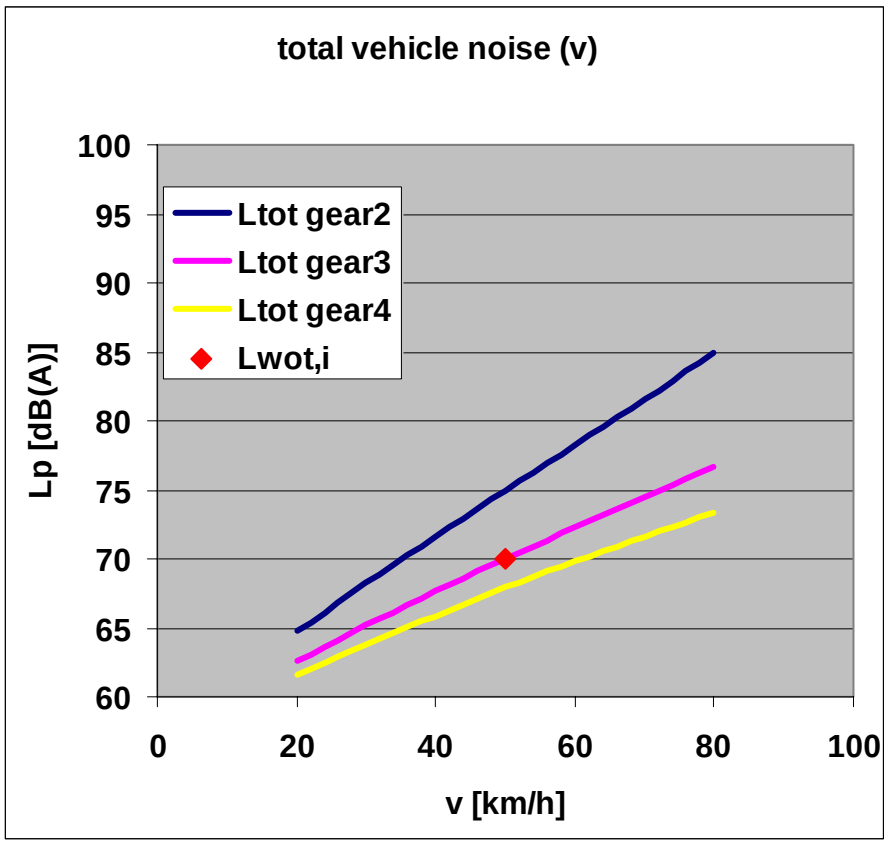


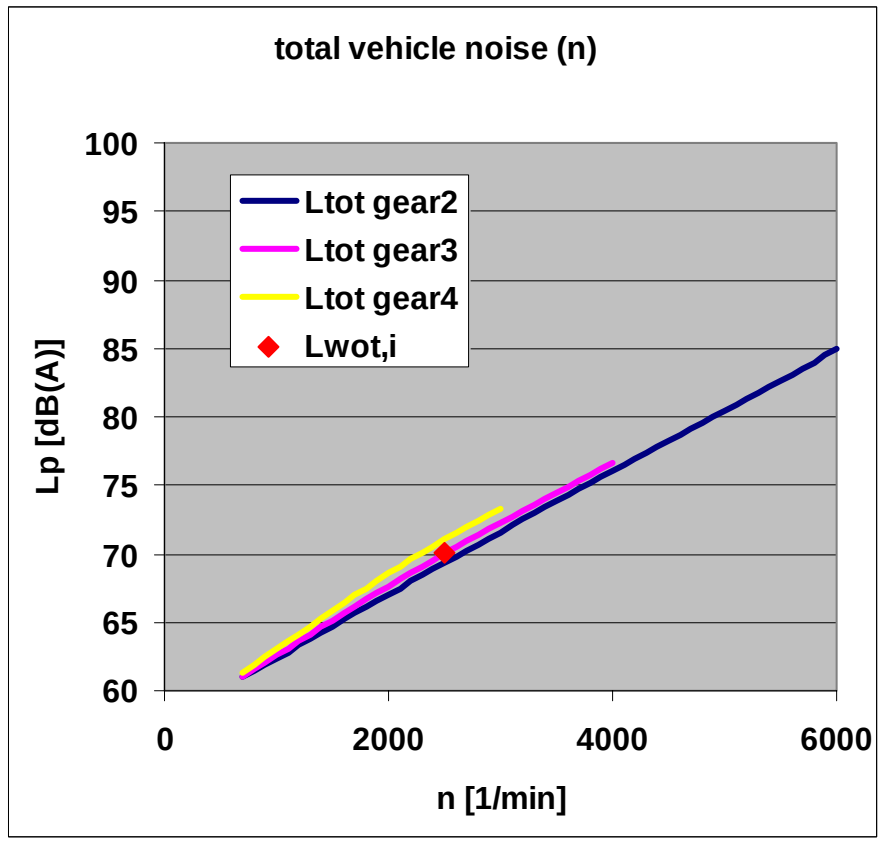
- Example: Ltyre = 80% of Lwot,i

Desire for easy visual interpretation of results

the choice of the X-axis depends on the dominant source

- In case of dominant engine noise: engine speed





- Example: Lengine = 80% of Lwot,i