



# Additional Sound Emission Provisions

## Proposal from France

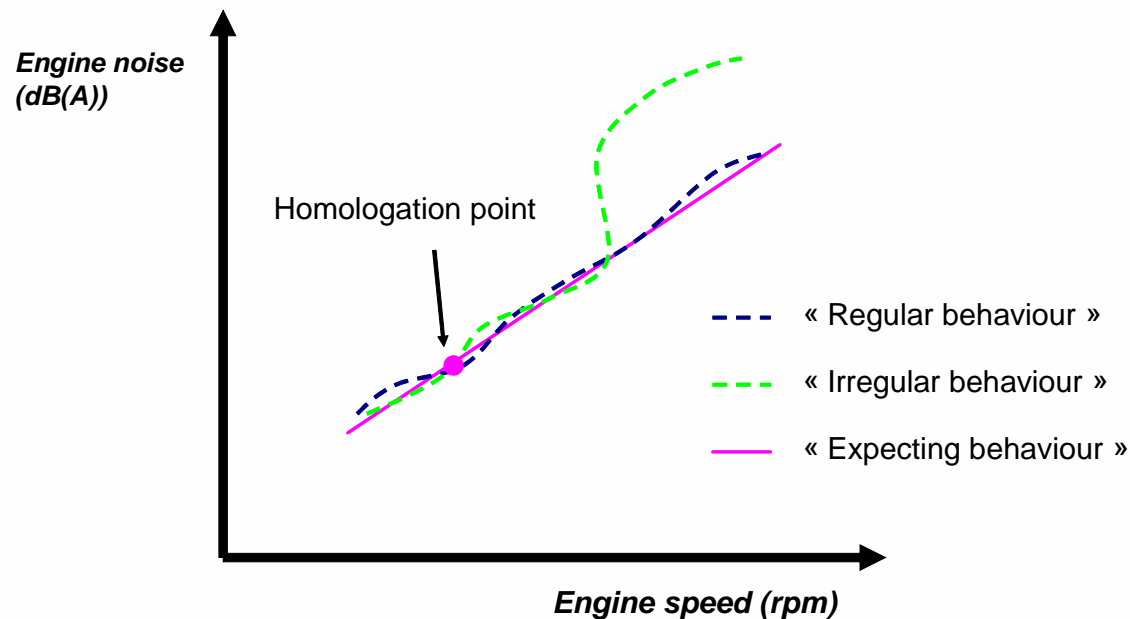
## Background

- New test method of ECE51 represents the actual behaviour of today's cars in urban traffic
- But this new procedure does not cover almost all realistic behaviours in urban traffic (higher engine speed)
- Most of vehicles under normal driving conditions does not differ significantly from a "normal behaviour"
- But what is a "normal behaviour" and how can we identify it ?

# “Normal behaviour”

- Irregular noise causes can be identify on engine  
(intake system, switches, exhaust system, controlled valves, adaptive software, ...)
- *Tyre/road doesn't make irregular noise*

→ Engine ONLY need to be studying IN CASE OF DOUBT



# Experimental approach and ASEP limit curve

- Tests made on full throttle condition on ISO 10 844 test track
- Engine noise is given by :  $L_{\text{engine}} = L_{\text{vehicle}} - L_{\text{tyre}}$
- Limit is given by the homologation point and Engine noise behaviour

Homologation point :

- Engine noise :

$$L_{\text{wot rep eng}} = L_{\text{wot rep}} - L_{\text{tyre}}(50 \text{ km/h})$$

- Engine speed

$$N_{L90} = 1,6509 \times \text{PMR}^{-0,3166}$$

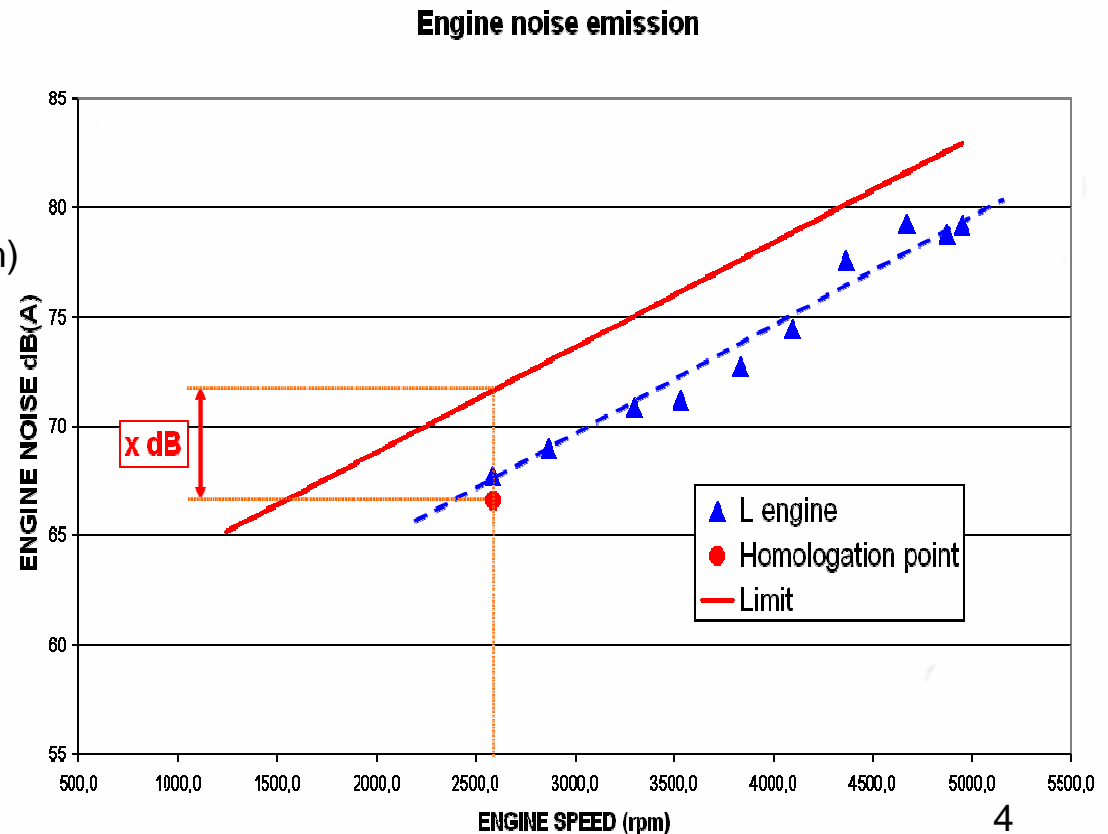
(ISO DIS 362-1 annexe A)

Engine noise behaviour : 5 dB / 1000 rpm

Limit :

$$0,005 \times (N - N_{L90}) + L_{\text{wot rep eng}} + x \text{ dB}$$

→ Criteria x to be defined



# Experimental approach - Example

## Vehicule 2 :

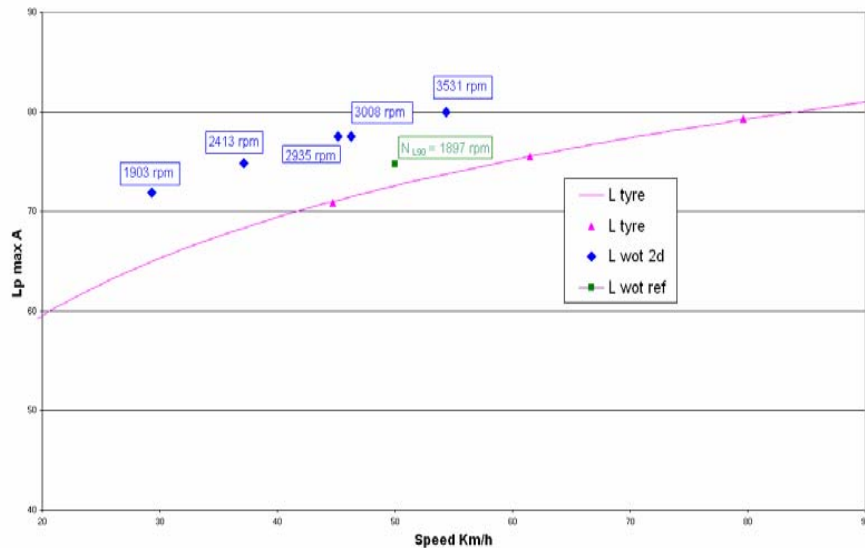
- 51 kW / 1000 kg
- diesel
- 5speed manual

- L wot ref = 74,7 dB(A)
- $N_{L90} = 1897$  rpm
- $N_{Pmax} = 4000$  rpm

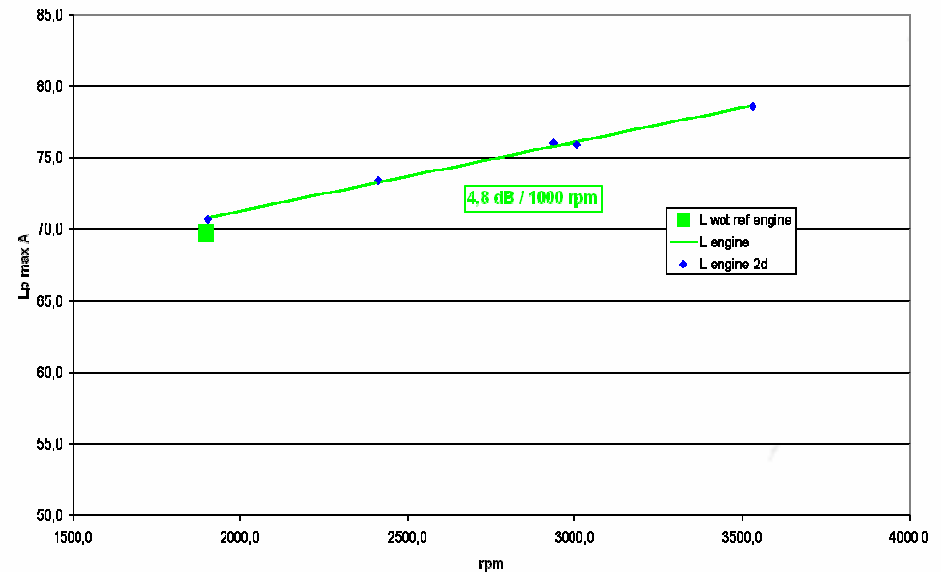
*Formula : L wot engine (N wot) = L wot (N wot, v wot) - L tyre cor (v wot, a wot)*

L wot dB(A)	N wot rpm	a wot m/s <sup>2</sup>	v wot km/h	L tyre dB(A)	Estimated torque effect dB(A)	L tyre cor dB(A)	L wot engine dB(A)
80,0	3531	1,92	54,4	73,8	0,7	74,5	78,6

Vehicule 2 - 51 kW / 1000 kg - diesel - 5speed manual



Vehicule 2 - 51 kW / 1000 kg - diesel - 5speed manual



# Limit curve of engine speed, speed and acceleration

Off Cycle Emission need to cover high engine speed and urban traffic behaviour :

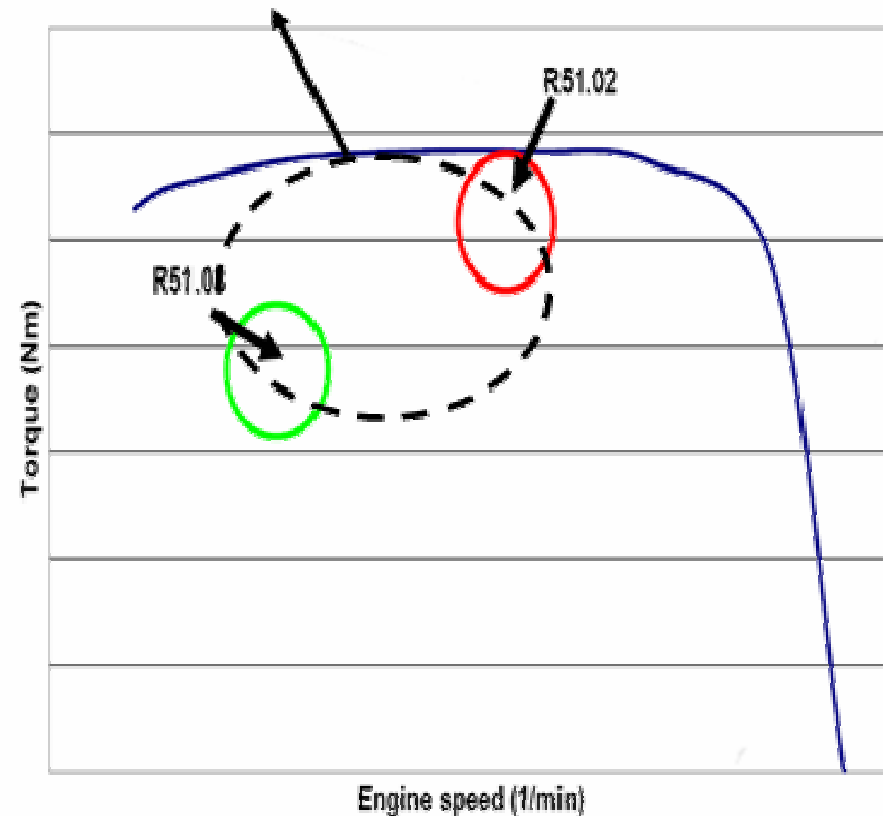
- Engine speed from  $N_{L90}$  to  $N_{max}$
- Speed from 20 to 70 km/h
- Acceleration under  $a_{max}$

Off Cycle Emission shall identify irregular noise :

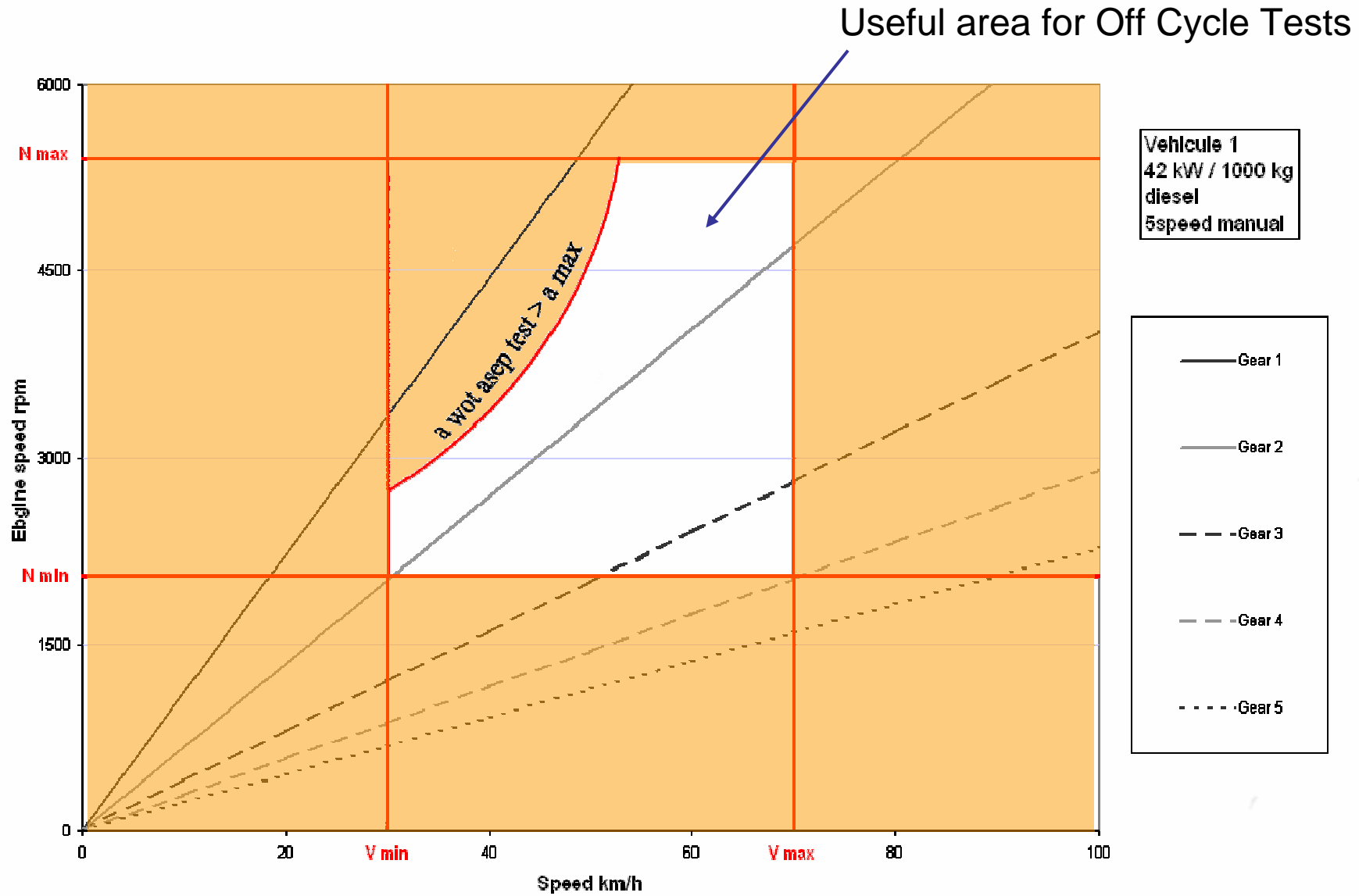
- Tyre noise must to be significantly lower than Engine noise

→ *Gear ratio is chosen in this range*

## Off Cycle Emission



# Limit curve of engine speed, speed and acceleration - Exemple



# Practical proposal

2 practical approaches to determine Engine noise :

## Several points



- Few Pass by to cover  $N_{L90}$  to  $N_{max}$
- Few Coast down to qualify Tyre noise

## Continuous line

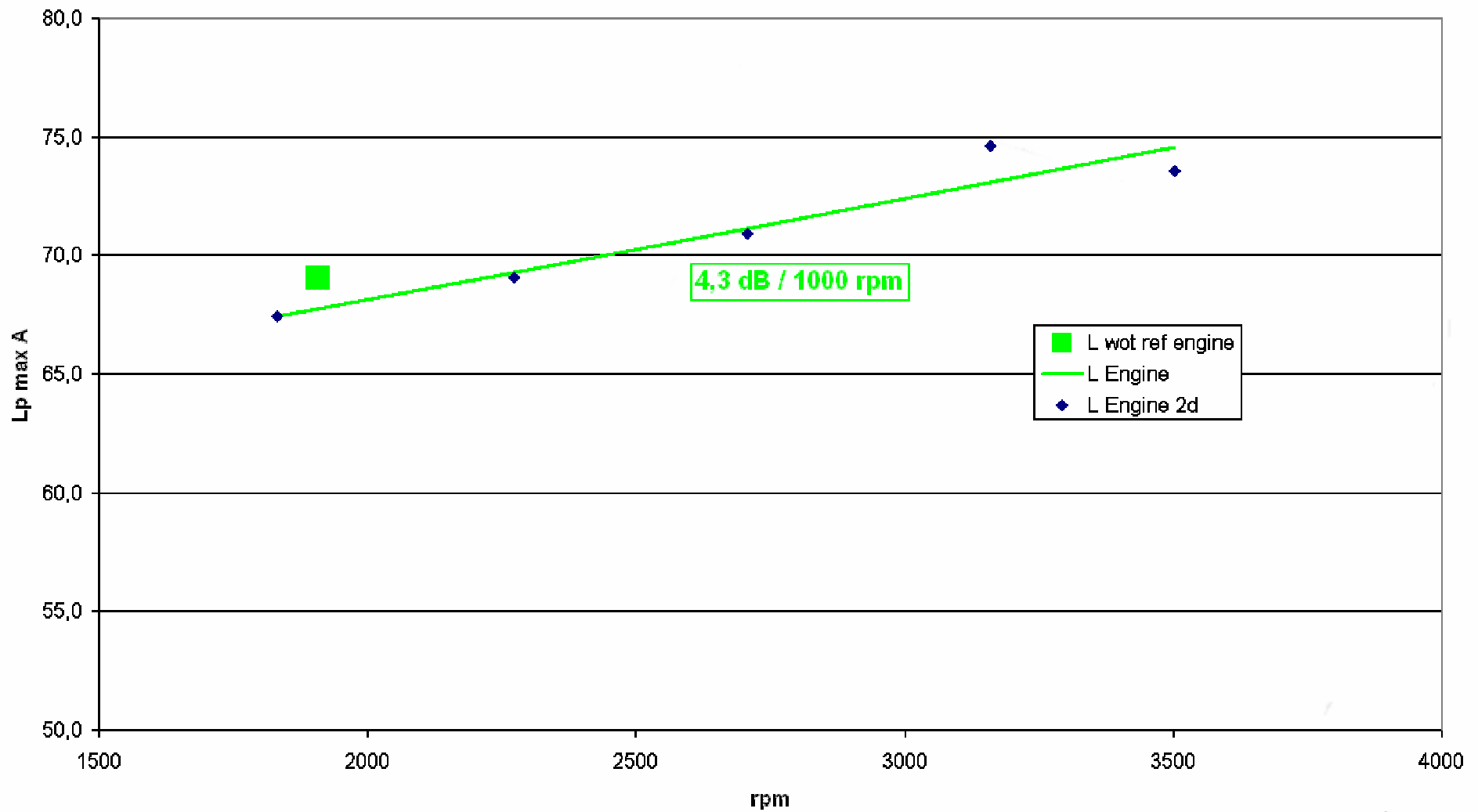


- One Pass by to adjust  $L_{wot}(7.5m)$  to  $L_{wot}(2.5m)$
- One Pass by to cover  $N_{L90}$  to  $N_{max}$
- Few Coast down to qualify Tyre noise



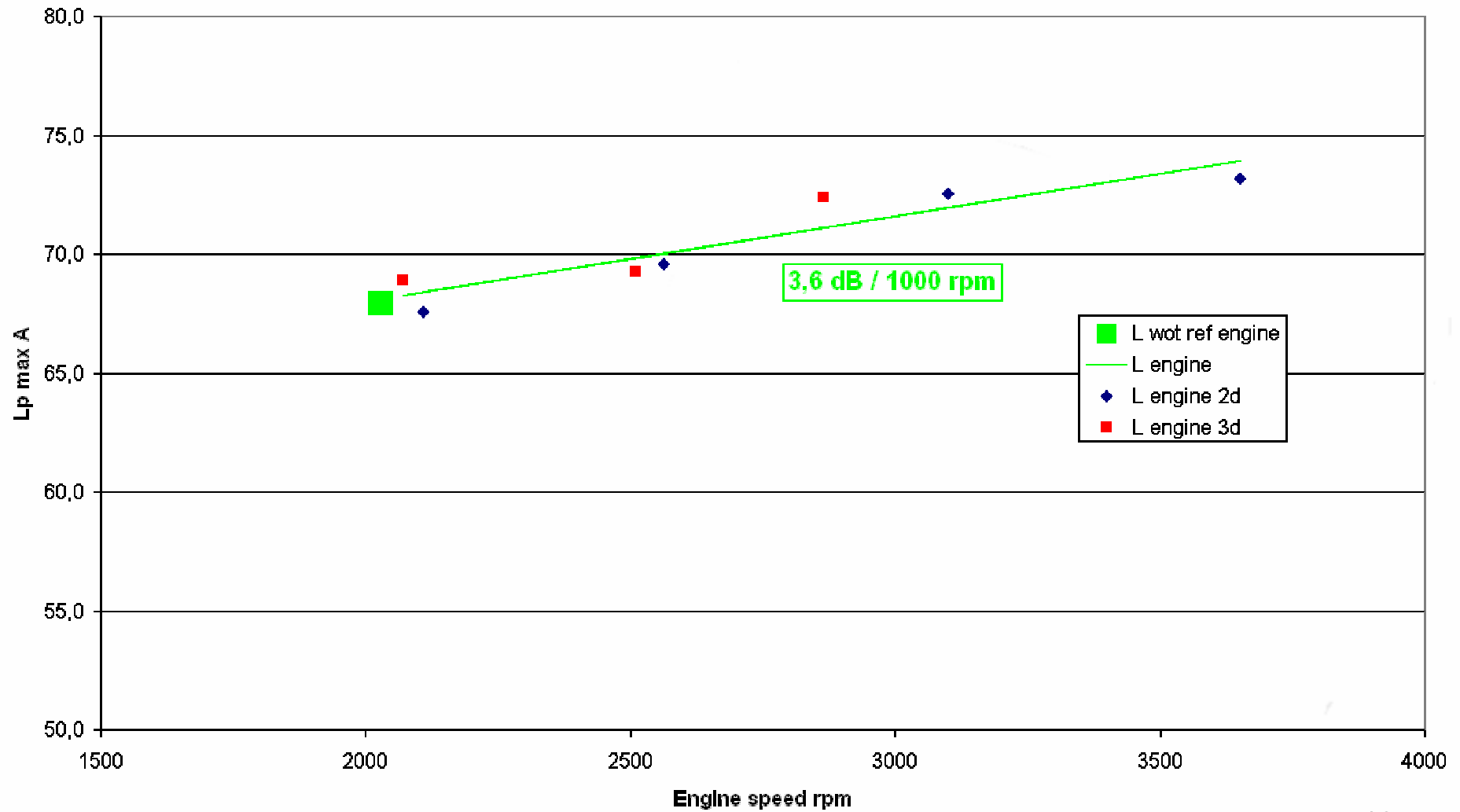
# Practical proposal – Example for several points

Vehicule 8 - 51 kW / 1000 kg - diesel - 5speed manual



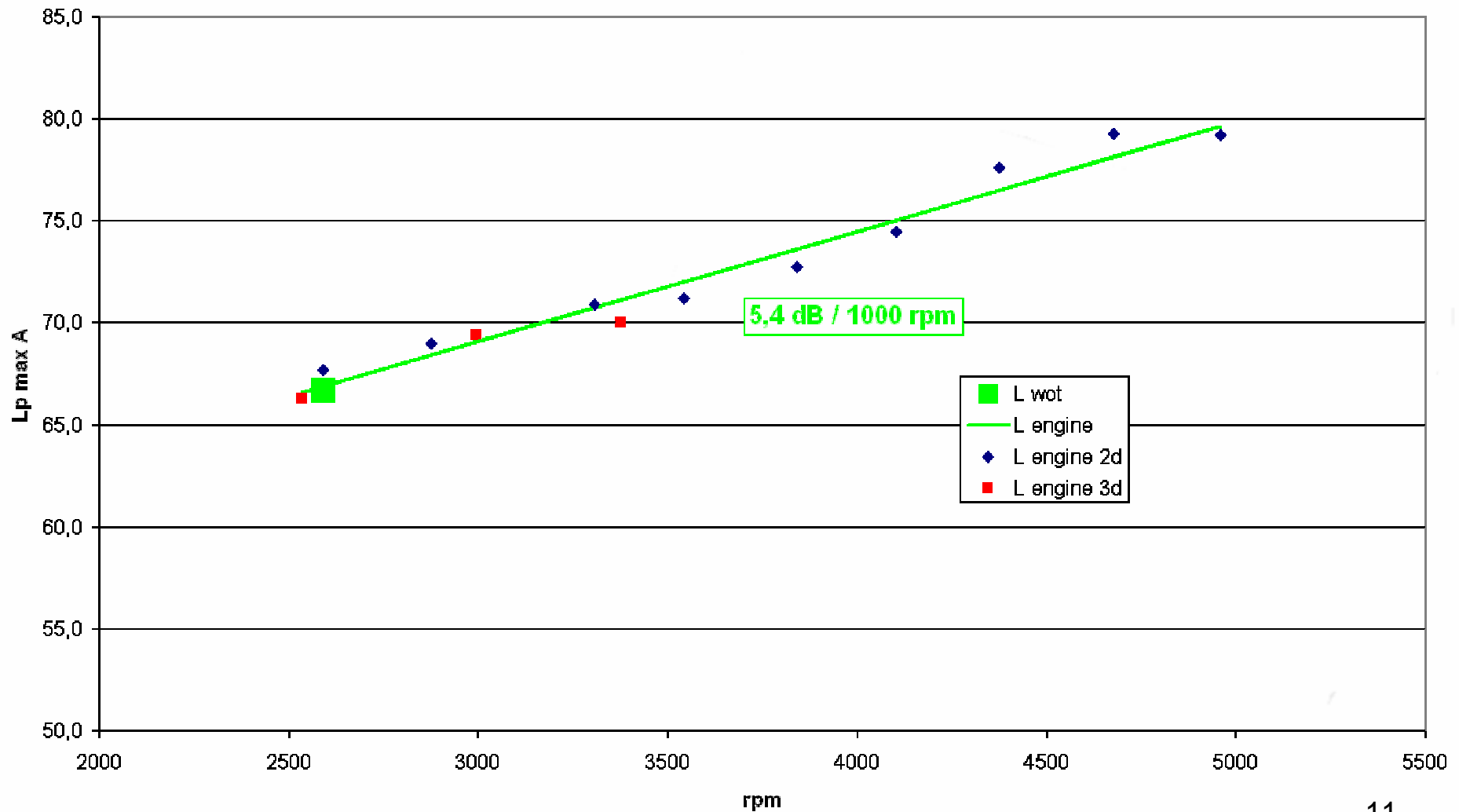
# Practical proposal – Example for several points

Vehicule 1 - 42 kW / 1000 kg - diesel - 5speed manual



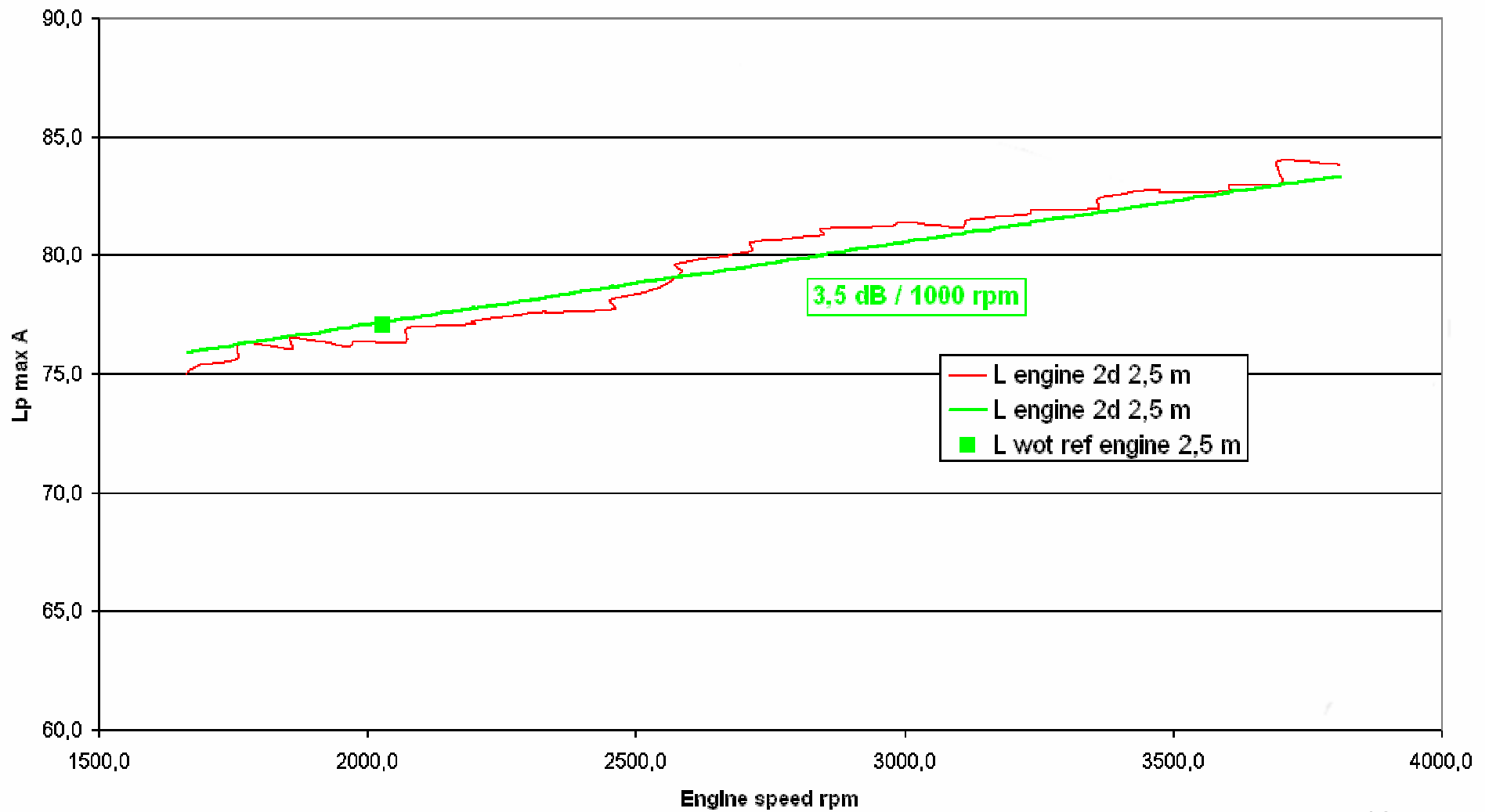
# Practical proposal – Example for several points

Vehicule 5 - 47 kW / 1000 kg - petrol - 5speed manual



# Practical proposal – Example for continuous line

Vehicule 10 - 42 kW / 1000 kg - diesel - 5speed manual



# CONCLUSIONS

This test method enables to detect *irregular noise on medium and high engine speed*.

*2 possible approaches :*

- The first approaches based on several points detection can be done just after homologation tests on the same facility and requires only few additional passes;
- The second approaches based on continuous line detection enables to cover engine map only on 1 or 2 passes.

*(test to adjust  $L_{wot}(7.5m)$  to  $L_{wot}(2.5m)$  must to be specified)*

*(Additional working need still to be done for automatic gearbox, torque effect and high tyre noise)*

*Limit curve is determined from the homologation point whatever the gearing of the transmission and the homologation choosing gear ratio(s).*

→ Engine noise behaviour and criteria x need to evaluate to reject only vehicles which differ significantly from a "normal behaviour".

## Explicit criteria and informations on the method

- Globally applicable
- Performance based on realistic behaviours in urban traffic (medium and high engine speed and urban speed and acceleration)
- In technology neutral : No definitive choose of gear
- Repeatable / reproducible
- Fitness for purpose : To identify irregular noise
- Relative limit based on Annexe 3 : L wot rep

1. **Gear selection : Variable**
2. **Entry speed : from 20 to 70 km/h**
3. **Target acceleration : No target acceleration**
4. **Maximum engine speed : to be define**
5. **Exit speed : Variable**
6. **Wide open throttle**
7. **Multiple test conditions : Yes**
8. **Engine speed range :  $N_{L90}$  to  $N_{max}$**
9. **Relating to “doubt” ?**
10. **Work load Only few passes need to be done**