



Torque Influence on C3 category tyres

**The tyres when type approved according to R117.02
should not be overruled by R51.03**

Geneva WP29 / GRB 51st session

February 15-17, 2010



Regulations on Sound Emissions for Exterior Noise

Tyre type approval

- **All tyres have to fulfill UNECE R117 during constant rolling at 70 km/h with engine off**
(Uniform provisions concerning the approval of tyres with regard to rolling sound emissions)

Coast-by noise @ 70 km/h

Vehicle type approval

- **The tyre is part of the vehicle test UNECE R51 during pass-by at 35 km/h with accelerated vehicle, WOT**
(Uniform provisions concerning the approval of motor vehicles having at least four wheels with regard to their noise emissions)

**Pass-by noise (WOT)=
Coast-by noise @ 35 km/h
+ torque induced noise
+ vehicle noise**

Coherency between legal requirements of R117 and R51Amend. is needed.

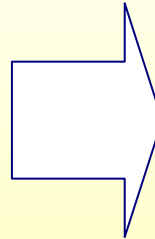
Drive-By – R51 – Method Evolution



• Current Test Method – R51-02

- Unloaded vehicle

- Reference point: vehicle front
- **Tyres at min tread depth can be used**
- Engine speed A-A: Prescribed $\frac{1}{2}$ (or $\frac{3}{4}$) of N_{Pmax}
- Engine speed B-B: divers 1600 – 2100 tpm (MX)
- **Gears: several**
F.e. 4 - 8 at 12-speed gearbox
- **Power train load: 10 % - 75 %**
- Overall max. SPL (left or right) determines result



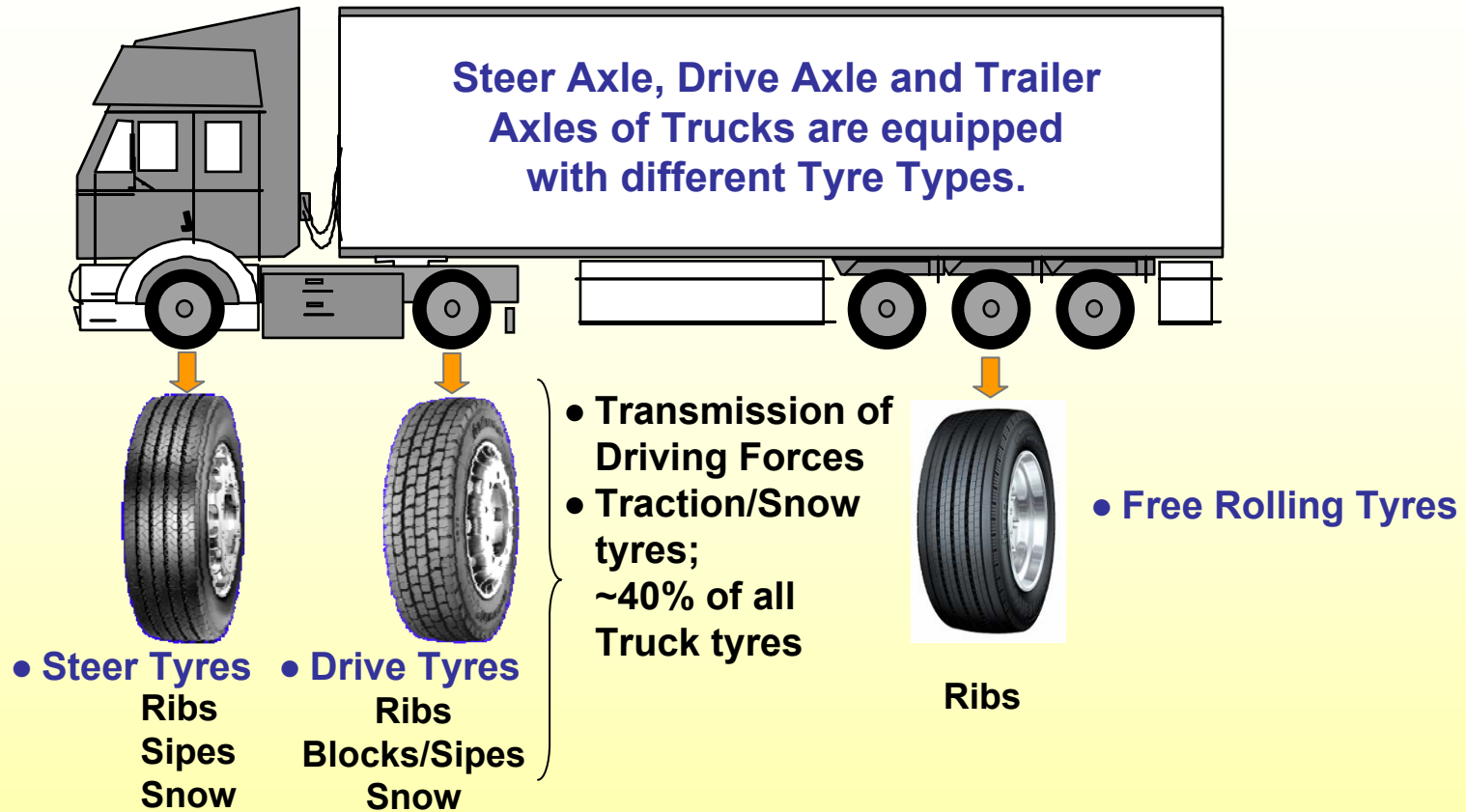
• Future Test Method – R51-03

- Partially loaded vehicle

- 50 kg/kW – rear axle 75% max
- Reference point: engine front
- **Tyres tread depth at min 80% of the full tread depth**
- Engine speed A-A: vehicle dependent
- Engine speed B-B: Min. 85% of N_{Pmax}
1615 tpm (MX)
- **Gears: 1 (sometimes 2)**
Gear with 35 km/h at 85% of N_{Pmax}
- **Power train load: 80 % - 100 %**
- Mean of max. SPL LE and max. SPL RI determines result

The two methods are different, not correlated and then can result on higher noise level.
Main impact for the tyre is the modification of constraint on tyre tread depth.

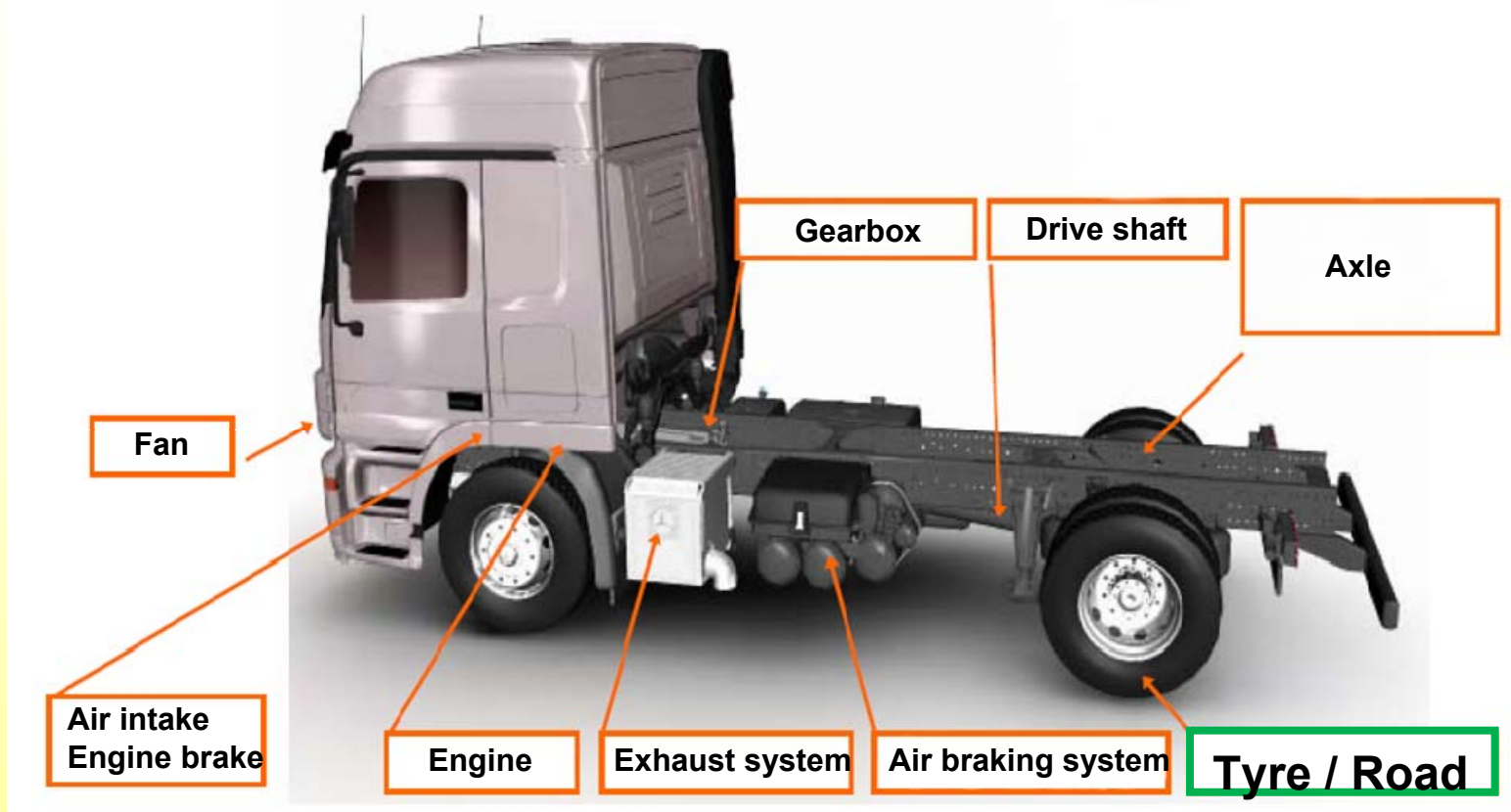
European Typical Configuration of Tractor-Trailer-Units



Different countries and different regions need / prefer different types

Pass-By R51.03

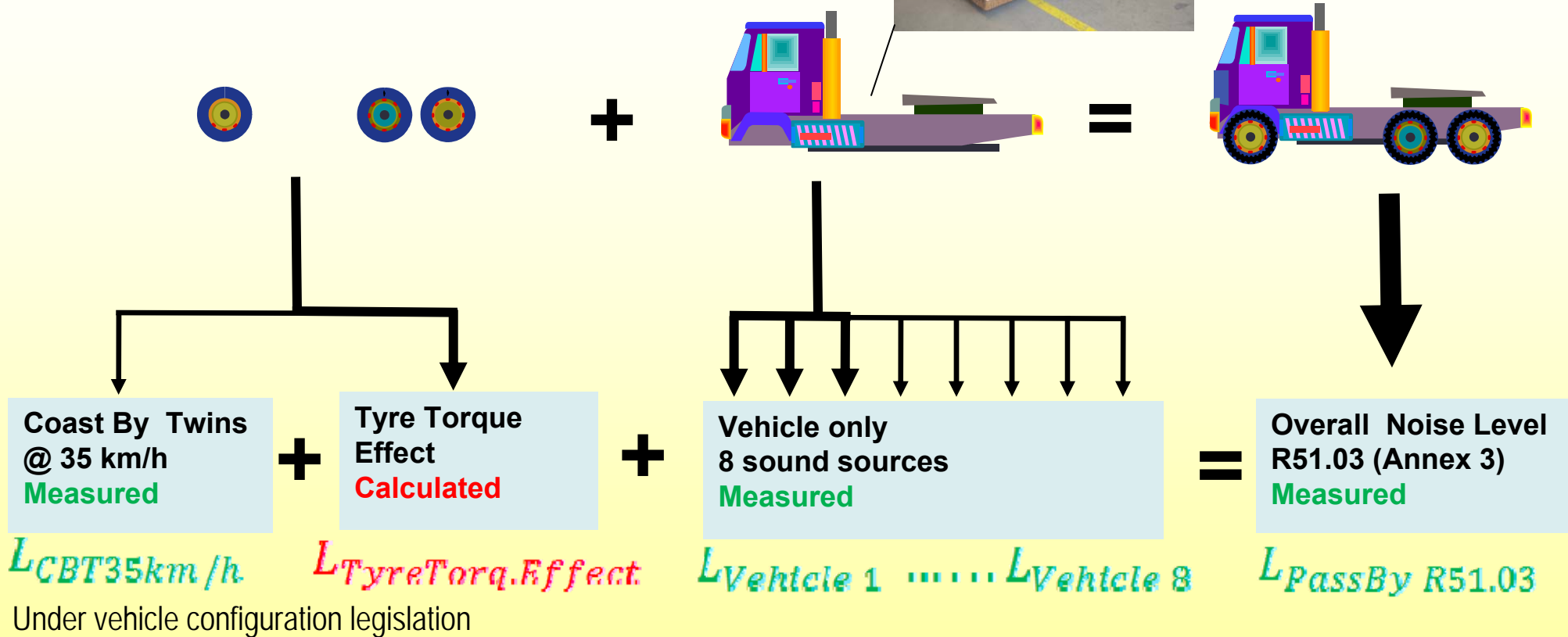
Principle Sound Sources



$$\boxed{\text{Tyre / Road}} + \boxed{\text{Vehicle only}} = \boxed{\text{Overall Noise Level R51.03}}$$

8 sources @ vehicle

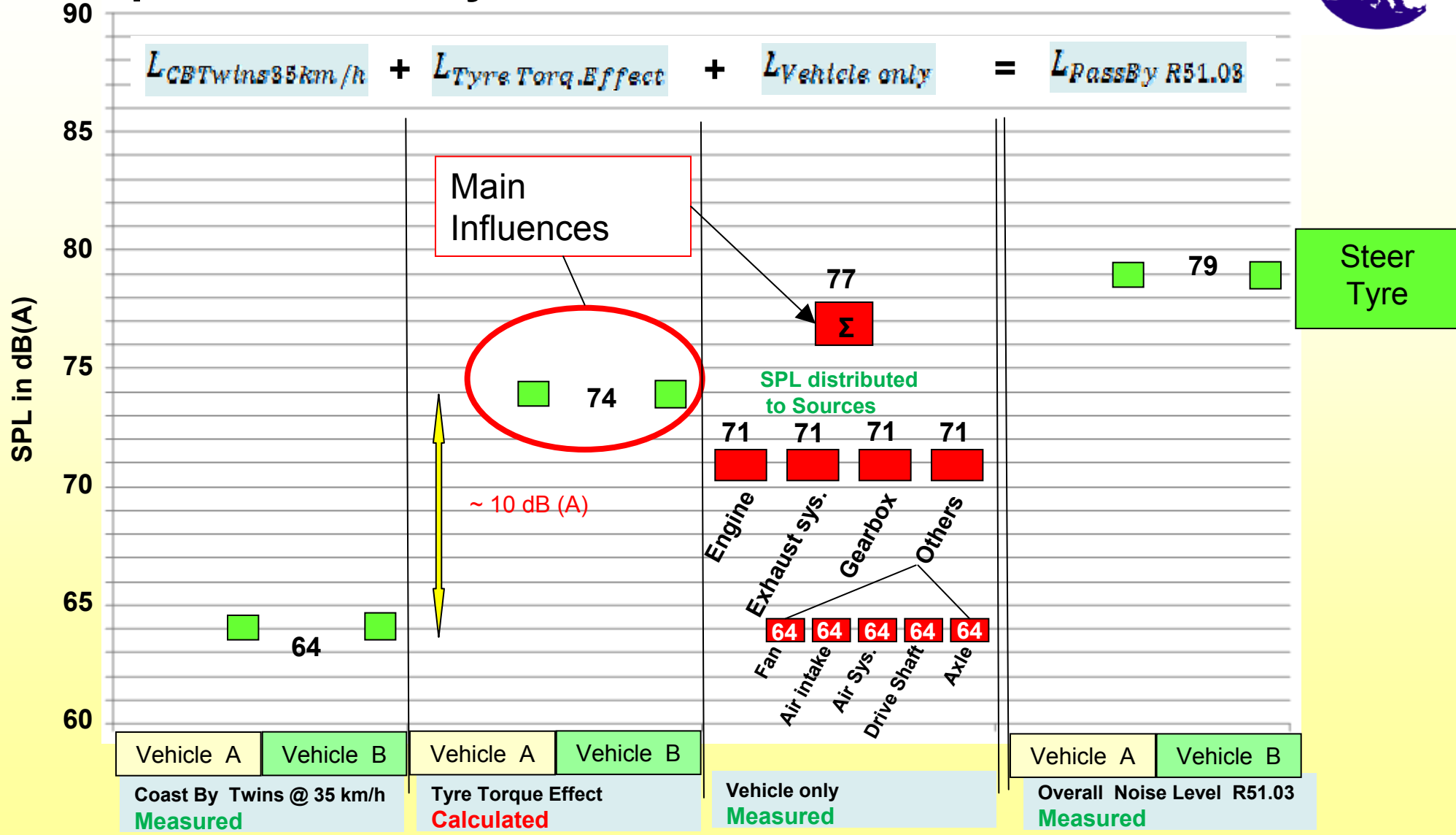
Pass-By Test Procedure for R51.03 SPL Calculation of Sound Sources



$$10 * \log_{10} * \left[10^{\frac{L_{CBT35km/h}}{10}} + 10^{\frac{L_{TyreTorq.Effect}}{10}} + 10^{\frac{L_{Vehicle 1}}{10}} + \dots + 10^{\frac{L_{Vehicle 8}}{10}} \right] = L_{PassBy R51.03}$$

Pass-By R51.03

Example for a steer tyre



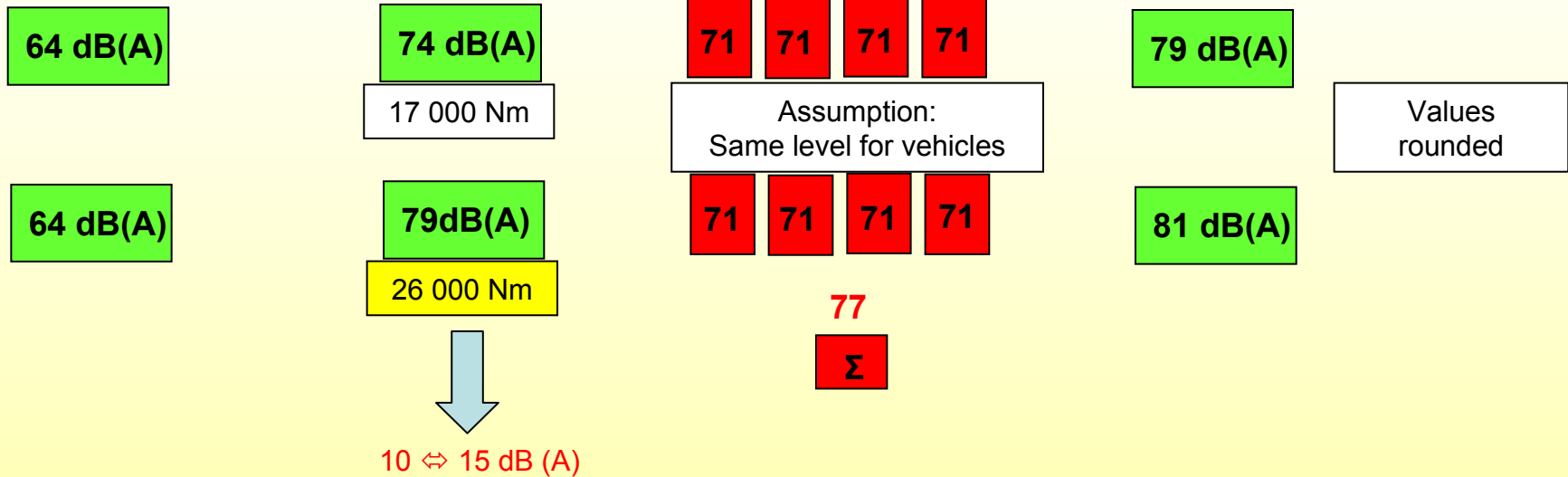


Pass-By R51.03

Calculation for Steer Tyre with higher Vehicle Torque

Linear Influence of Torque on Tyre Noise (0.6 db(A) /1000 Nm measured)

$$L_{CBT \text{ wins } 35 \text{ km/h}} + L_{\text{Tyre Torq. Effect}} + L_{\text{Vehicle only}} = L_{\text{PassBy R51.03}}$$



$L_{\text{Tyre Torq. Effect}}$ will increase for vehicle with high torque.

Engines with torque > 30 000 Nm are on the market

Vehicles with torque up to 26 000 Nm @ axle fulfill current limits (80 db(A) , only with smooth tyres



Test Program for R51.03 Induced Noise for N3-Vehicles

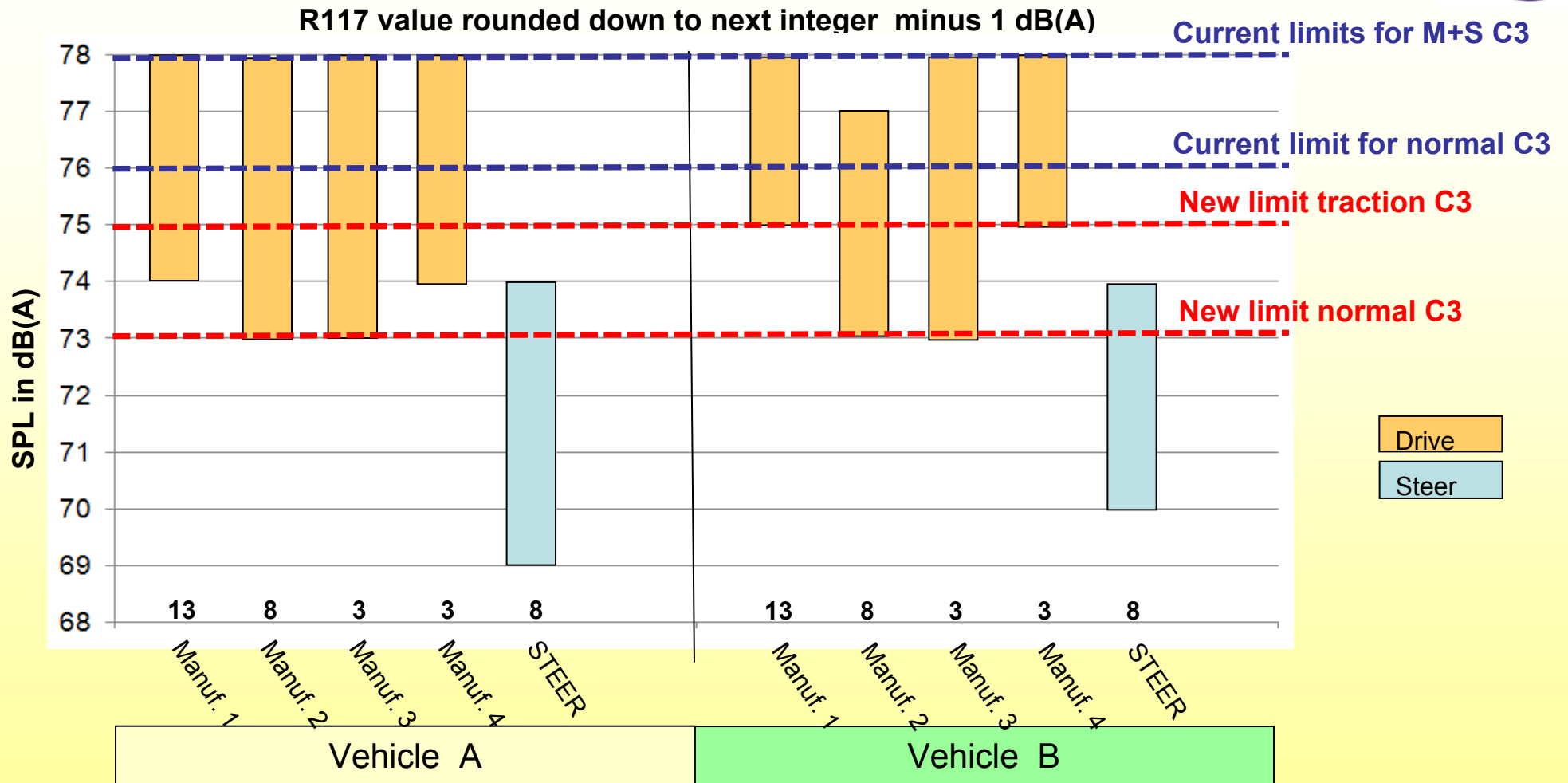
- As the tyre industry is not allowed to contribute to the results of the monitoring program of ECE and EC during the revision of R51.02, a measurement program was made by the tyre industry to study the influence of torque in the new procedure R51.03 as follows:
- Two vehicles from different manufactures with a torque of about 17 000 Nm @ axle and the same steer tyres at the steer axles were measured with different twins in 315/80 R22.5 at the drive axles:
 - 13 drive tyres from manufacturer A
 - 8 drive tyres from manufactures B
 - 3 drive tires from manufacturer C
 - 3 drive tyres from manufacturer D
 - 8 steer tyres from manufacturer A-D

All tyres fulfill the limit levels of the current R117.

All tyres were additionally tested and verified in this program



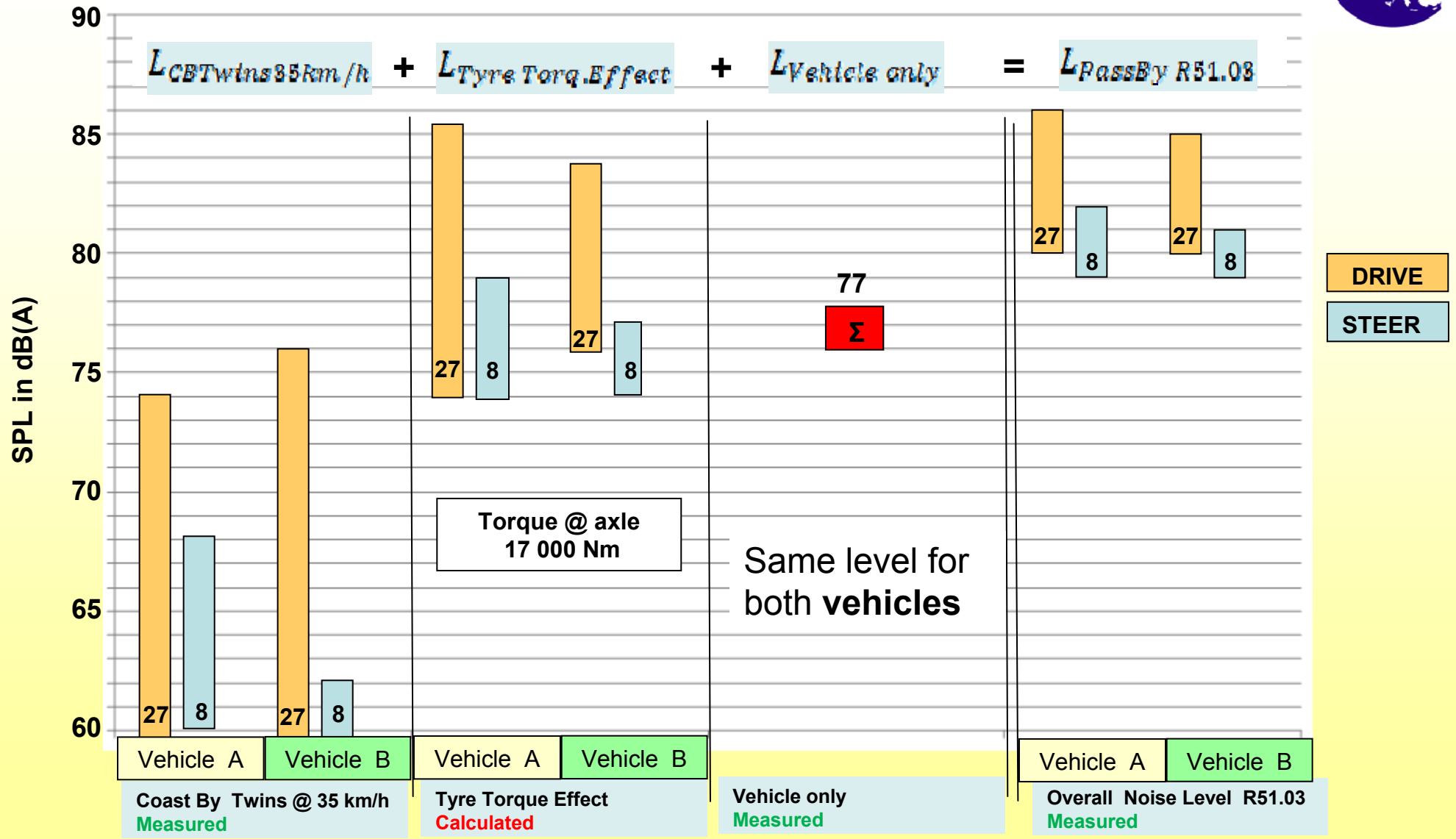
All tyres used in the test fulfill the current R117 limits



Different levels between vehicle A and vehicle B occur due to different wheelbases

Pass-By - R51.03

Results of 35 Sets



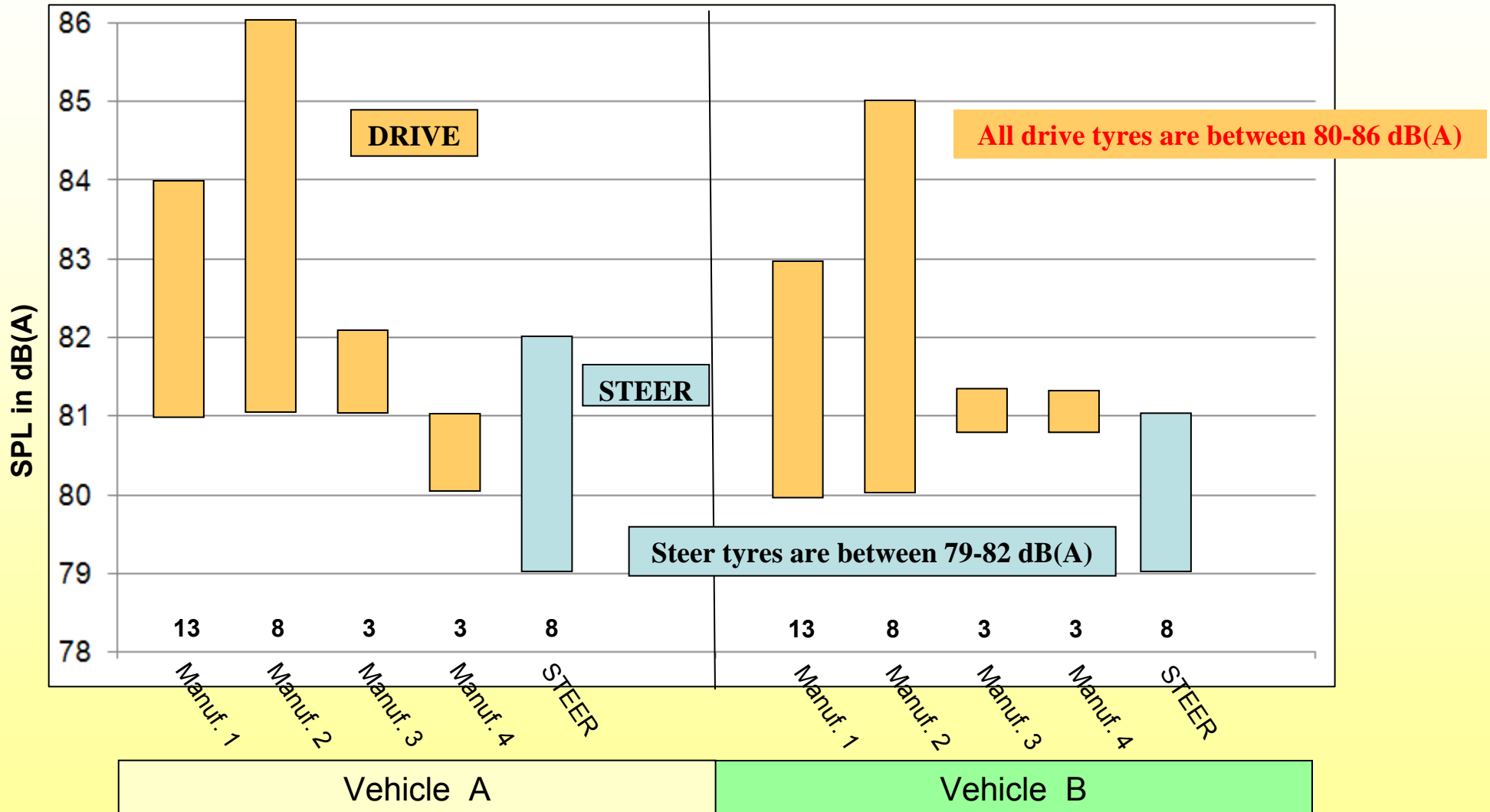
The European Tyre and Rim Technical Organisation

Pass-By R51.03 Overall Noise Level

L_{PassBy R51.03}



R51.03 value mathematical rounded



Pass-By R51.03 – Overall noise level



Conclusions

- ▶ With the evolution of the R51.03, the tyre has become the major noise source in the vehicle test.
- ▶ By increasing torque, the tyre/road noise increases. Torque effect as the main factor should be adequately considered in the regulation.
- ▶ Different tyre types are required to ensure vehicle stability and traffic safety.
- ▶ All measured tyres shown in the presentation fulfill the current tyre type approval levels (R117).
- ▶ All measured drive tyres have noise levels from 80 dB(A) to 86 dB(A) (R51.03), measured with axle torque of 17 000 Nm.
- ▶ Vehicles measured according to R51.03 have higher noise levels.
- ▶ **Tyres type approved to R117.02 should not be overruled by R51.03.**
- ▶ **Even tyres that will comply with future lower noise limits of R117.02 will not comply with this R51.03.**



End of presentation