

# Indoor pass by noise

## *France*

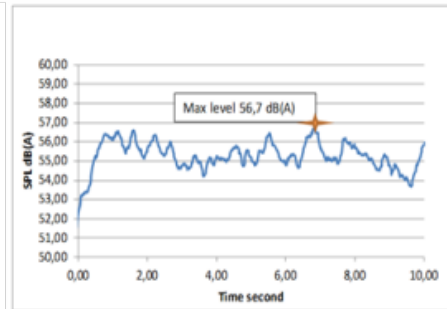
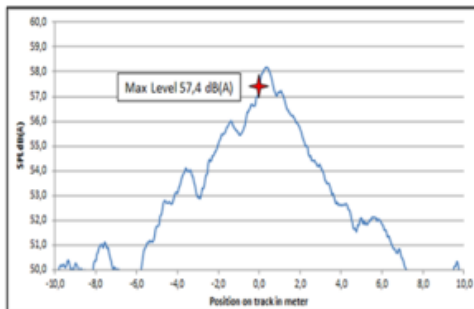
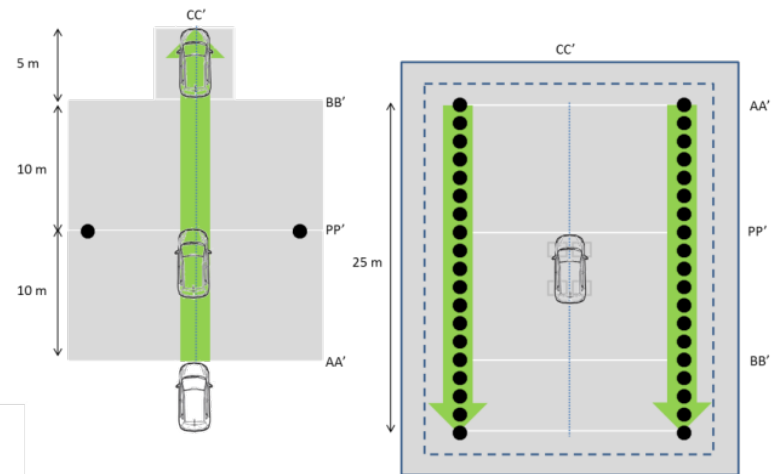
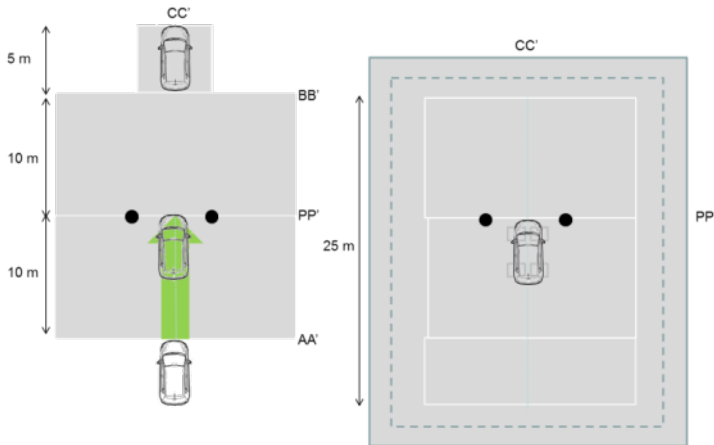
*Presented by Louis-Ferdinand PARDO*

GRB 67th session

# Indoor in standardization

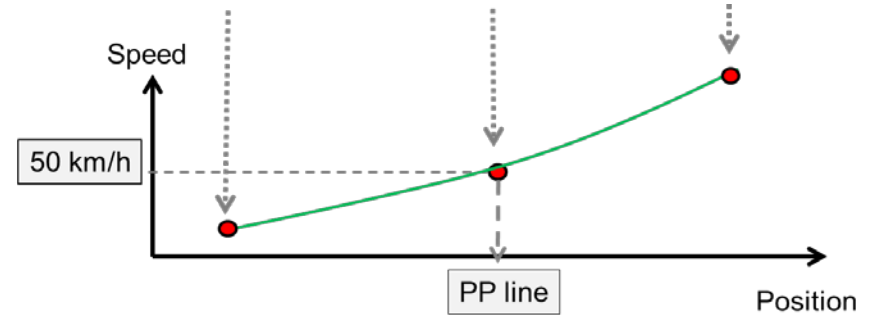
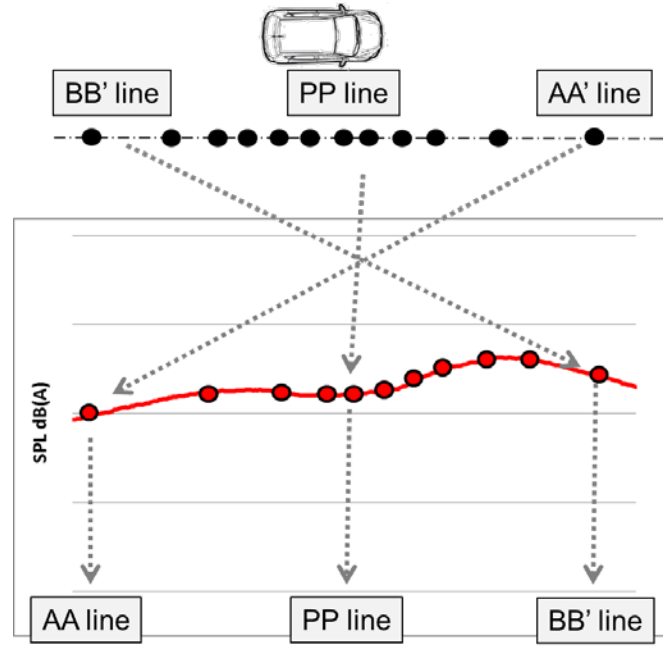
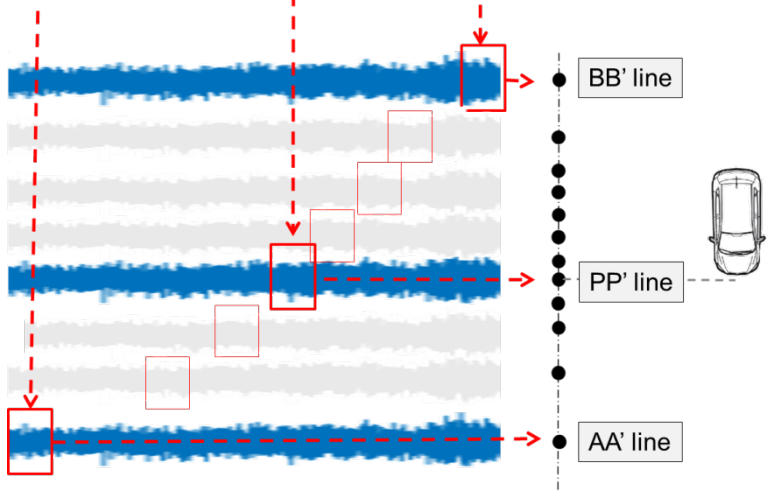
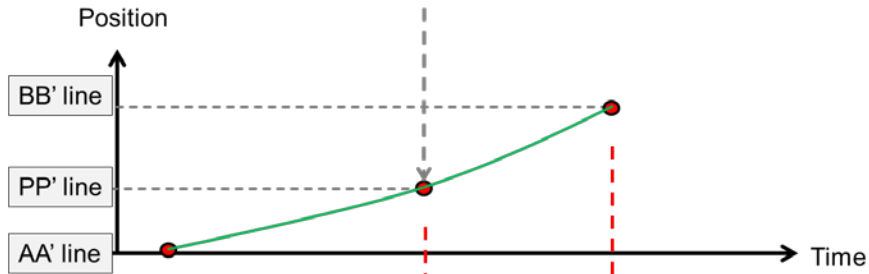
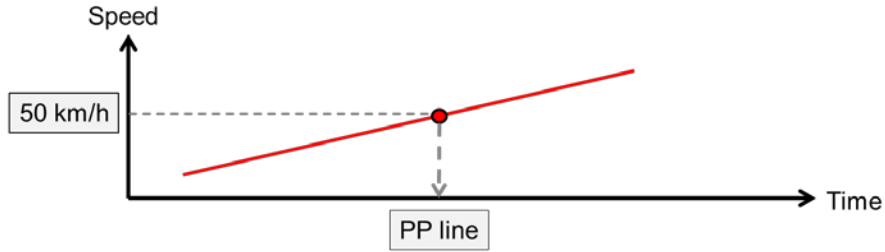
First indoor regulation UN ECE138  
for QRTV

Indoor pass-by noise :  
ISO 362-3 and proposed in  
UN ECE51



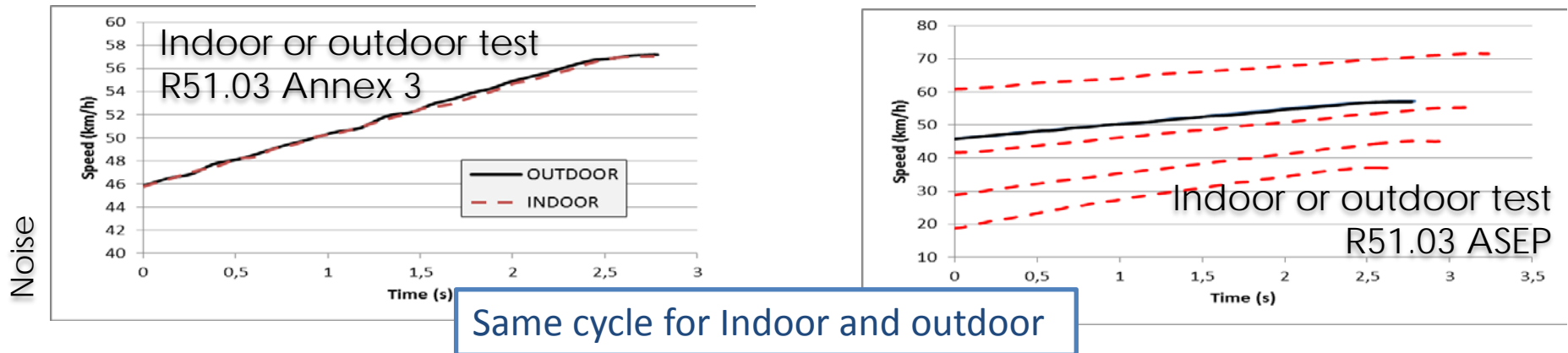
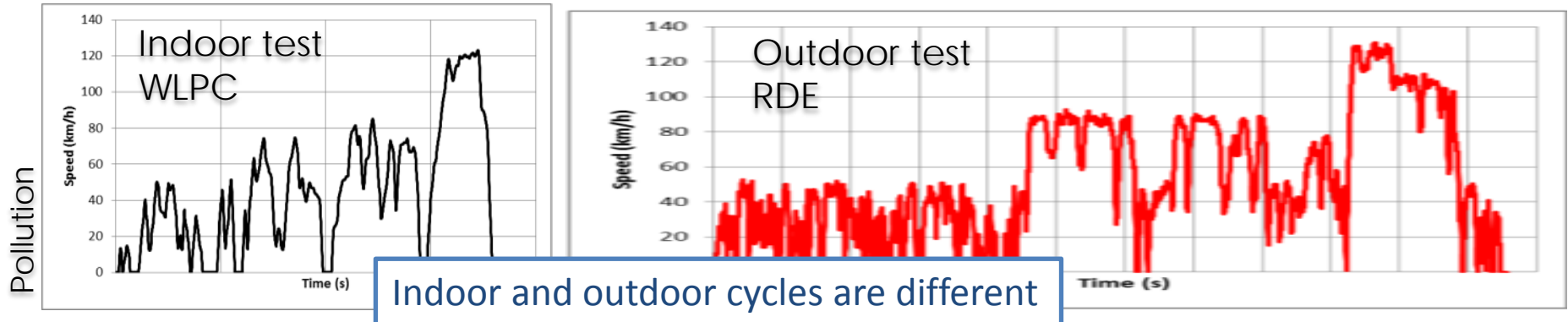
*Simulated Pass-By*

# Indoor processing



# Political questions

- Laboratory vs Real Driving

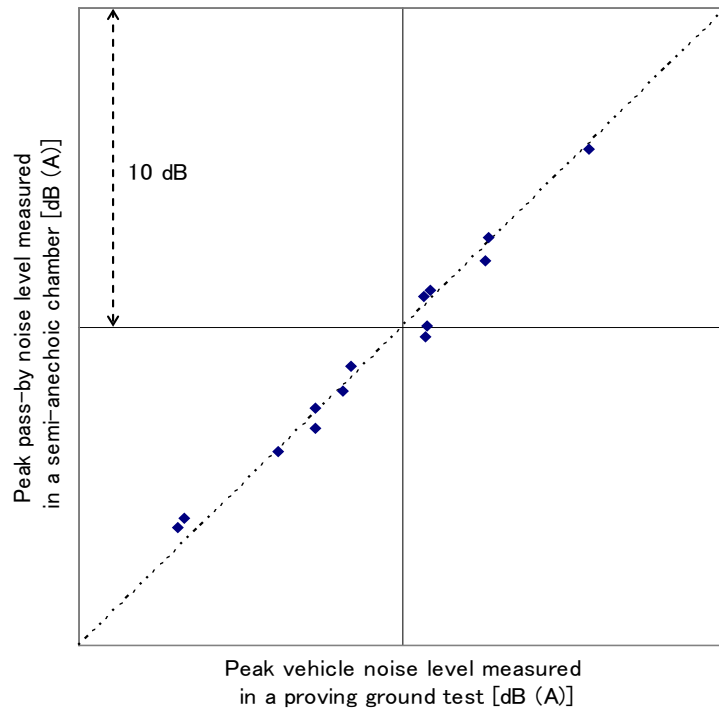


# Political questions

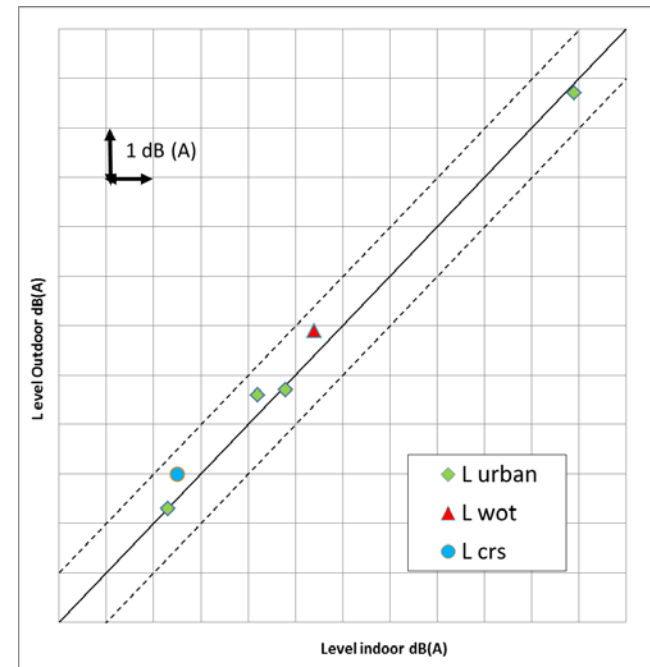
For indoor application, the manufacturer shall provide to the technical service documentation.

- Validation of facility e.g. free field propagation, dyno and air handling noise background noise level, dyno dynamic performance, software.
- Procedures to be applied for indoor testing, e.g. dyno and software set-up, loading and tie-down, air-handling and vehicle's temperature management,
- Coast down and tyre input sound level data used for calculation of dynamometer load coefficients and tire sound data used for determination of final reported results, e.g. testing, data management
- **Testing results on a representative selection of the manufacturer's production to demonstrate that indoor testing delivers comparable results as outdoor testing within acceptable accuracy.**

# Correlations from states of art



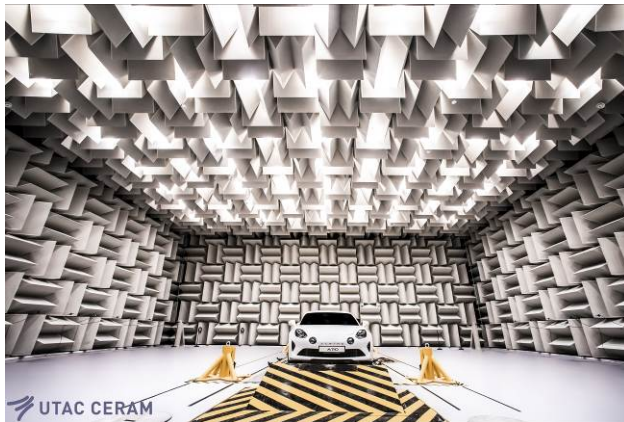
Development of Pass-by noise Measurement System on a Chassis Dynamometer, Daisuke ŌMorie, Yoshihiro Shirahashi and AI; SAE 2008



*Kramer and ald, Comparison of pass-by noise from real track and simulated measurement at the roller test bench, internoise, 2016*

# Validation tests

- Test programs were performing by UTAC CERAM in its indoor and outdoor facilities



- The objective is :
  - to validate applicability of the method and
  - to estimate potential of correlation indoor/outdoor.

# Instrumentation

## *1. Measuring instruments*

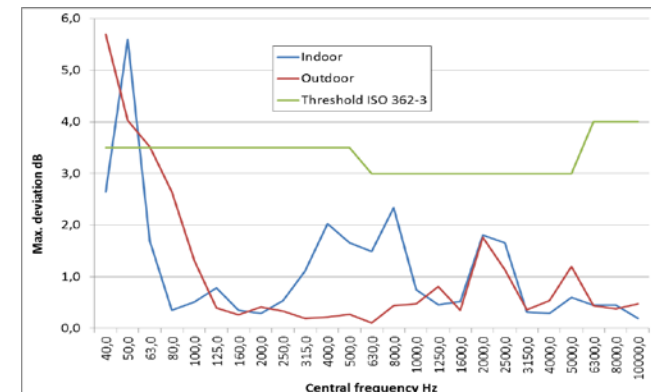
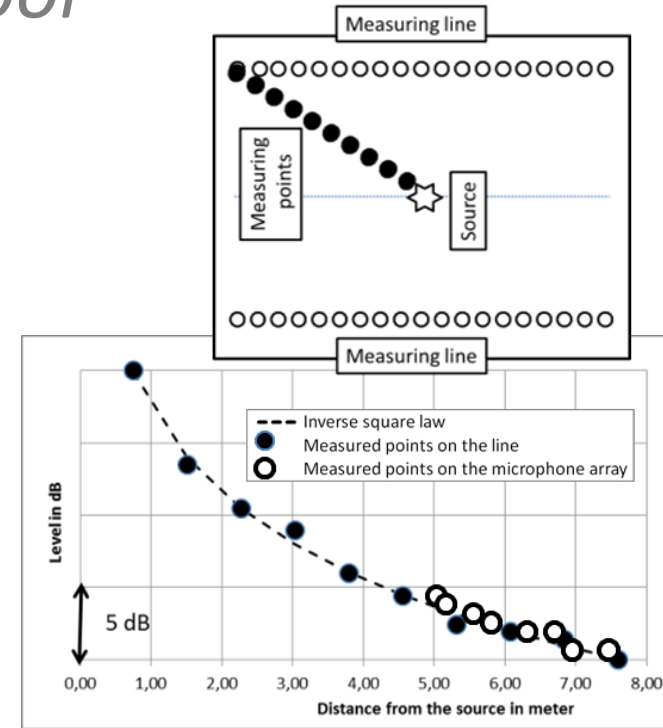
- All measuring instruments have same or better precision than outdoor.
- Indoor uses « virtual sound level meter » with different processing techniques which is able to provide comparable results to a single type 1 sound level meters (sound level meter compliance method for virtual sound level is an application of IEC 61672-1 and 3 type 1).



# Room acoustic performance

## 2.1.2. Test Site Indoor

- ISO 362-3 requires ISO 26101 for free-field validation.  
UN R138 refers also to ISO 26101 requirement.
- Indoor acoustic's propagation is comparable to outdoor acoustic's propagation. All measurement facilities, either indoor or outdoor have similar deviations.

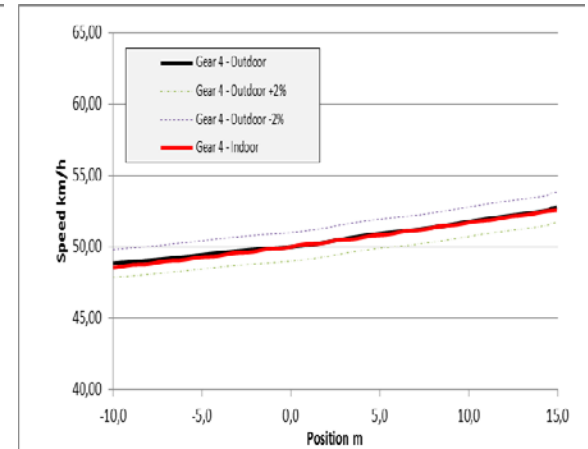
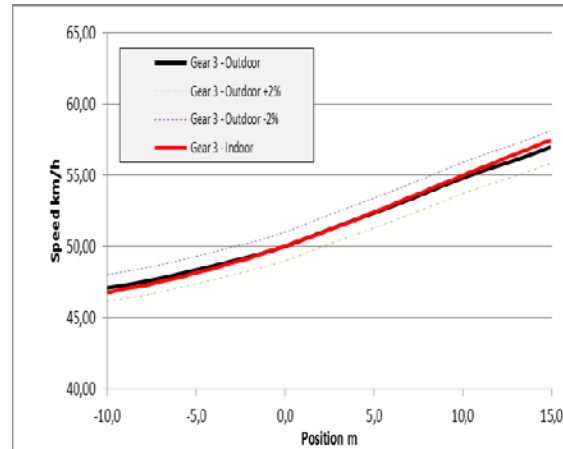
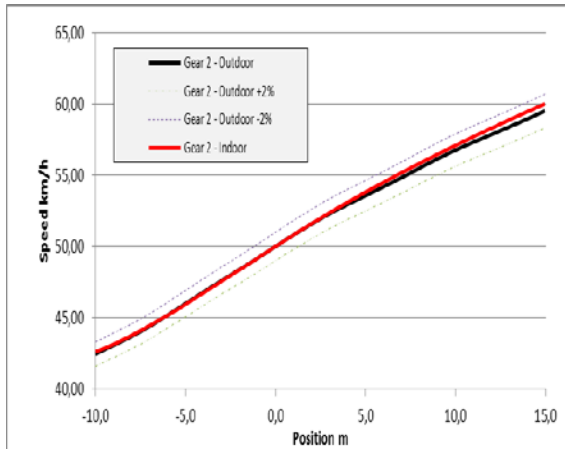


# Vehicle dynamic

## 2.1.2. Test Site Indoor

- Using coast-down data from emission/pollution, indoor is able to provide comparable dynamic between indoor and outdoor.

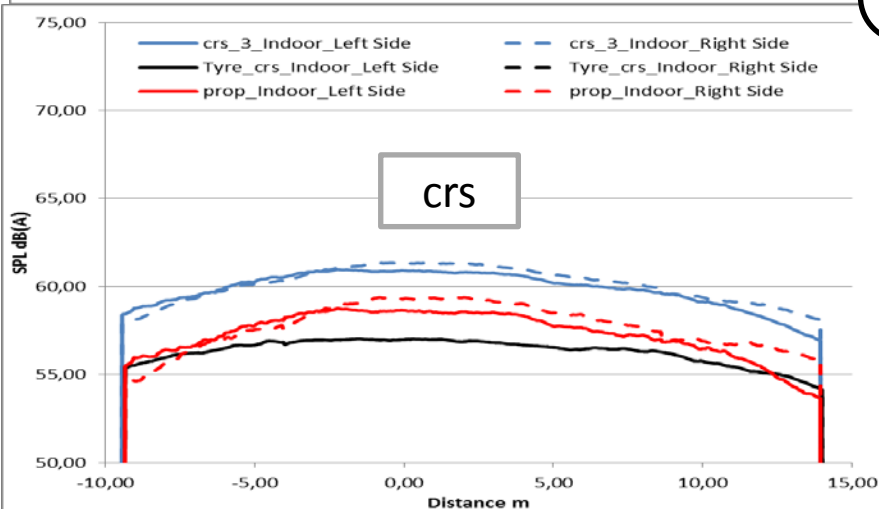
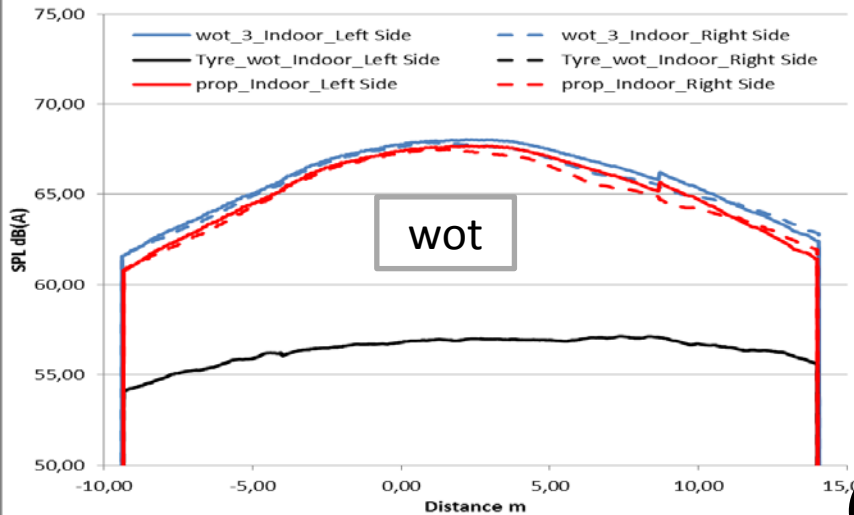
Deviation indoor % outdoor			
	gear 2	gear 3	gear 4
Mean	0,4%	0,5%	1,1%
Max	0,7%	1,2%	1,6%
Limit	2,0%	2,0%	2,0%



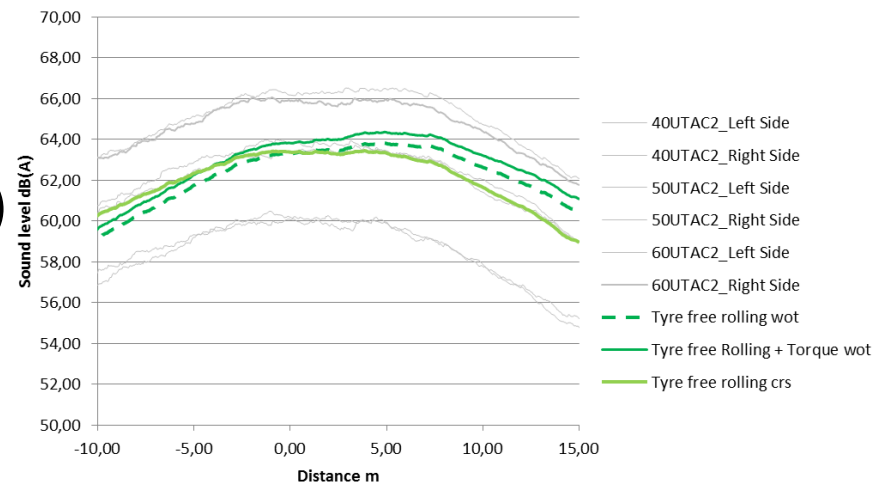
# Methods of testing

## 3.1.3. Interpretation of results

Indoor testing → Propulsion sound level



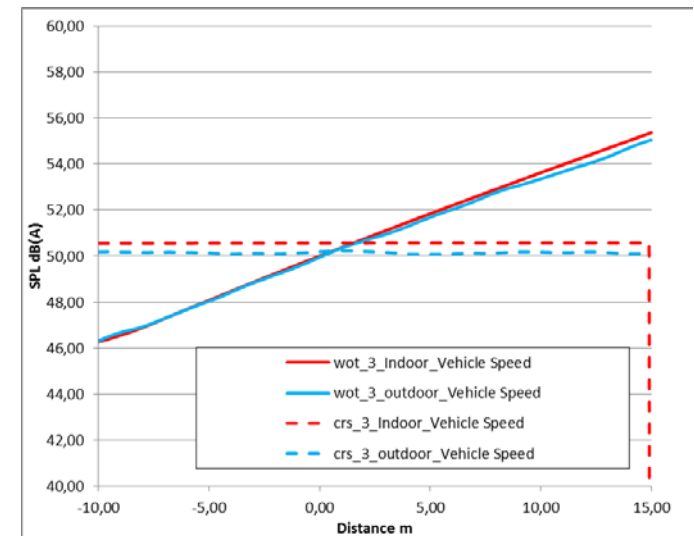
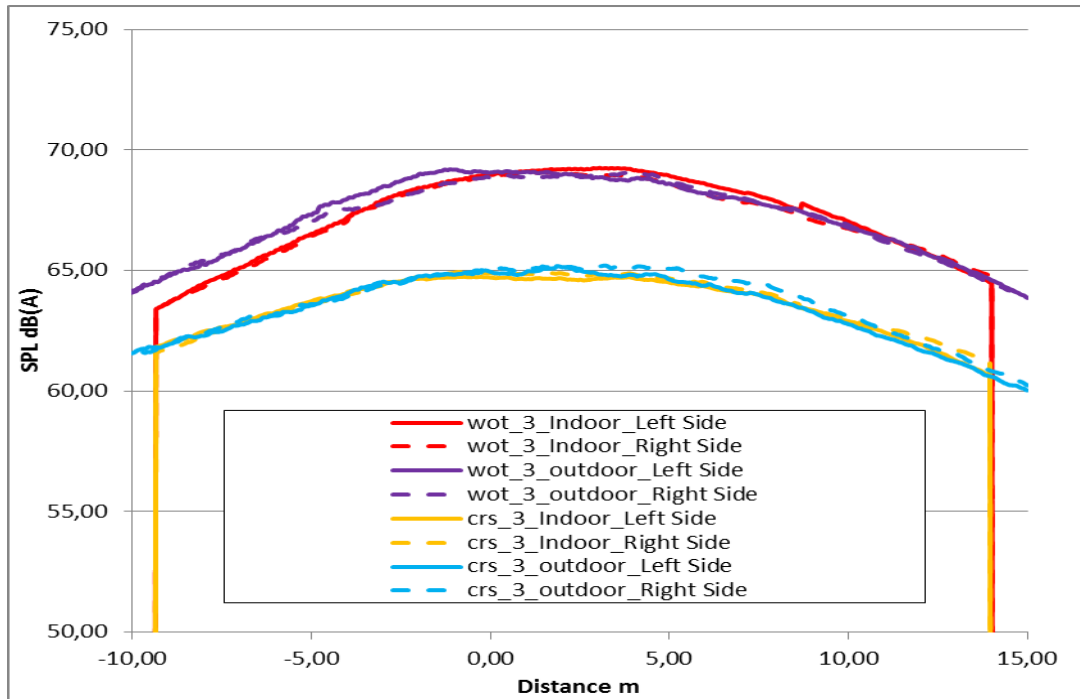
Outdoor testing → Tyre sound level



# Methods of testing

## 3.1.3. Interpretation of results

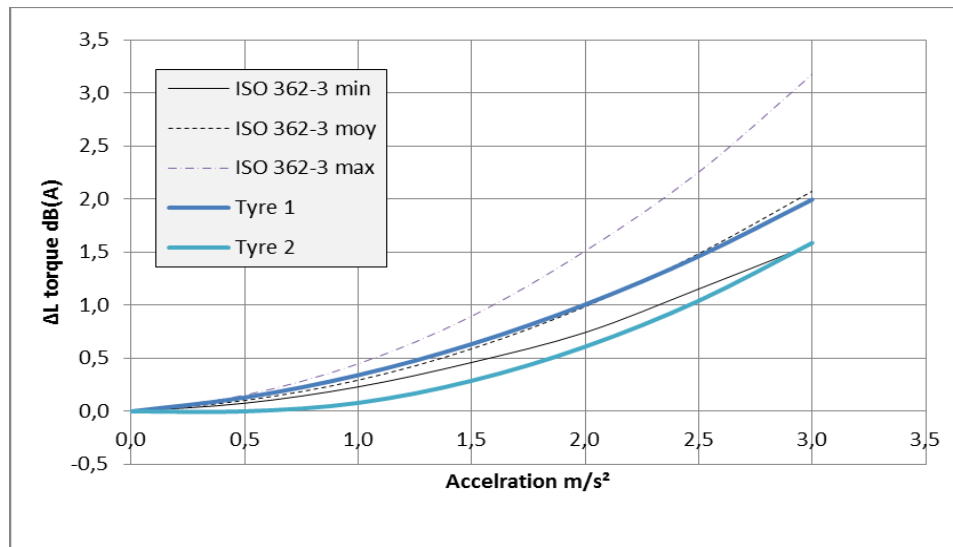
- Indoor testing uses and presents results in same format as outdoor (vehicle speed, engine speed and sound level as function of distance).



# Tyre testing

## *Annex 8 §2.3. Tyre/road sound*

- Using silent vehicle (e.g. EV), ISO 362-3 provides method for full tyre sound level evaluation (free rolling + torque).
- Tests results on tyres are comparables to default values from ISO 362-3.

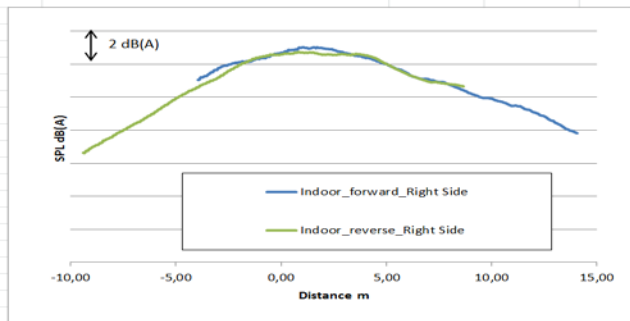
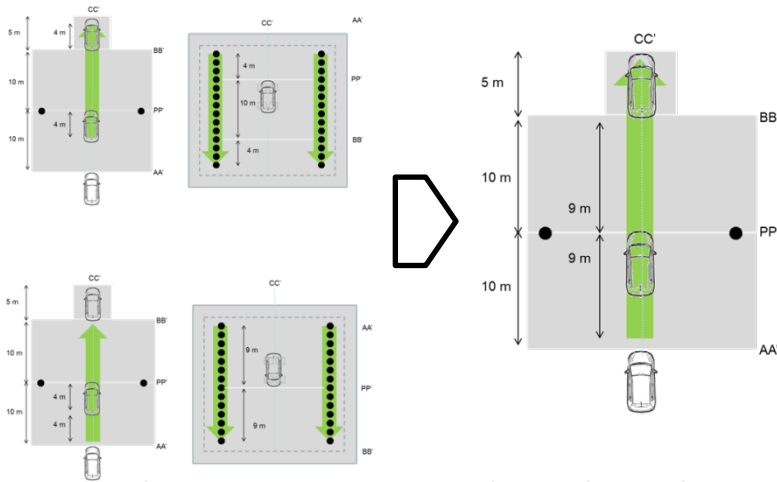


# Room extension

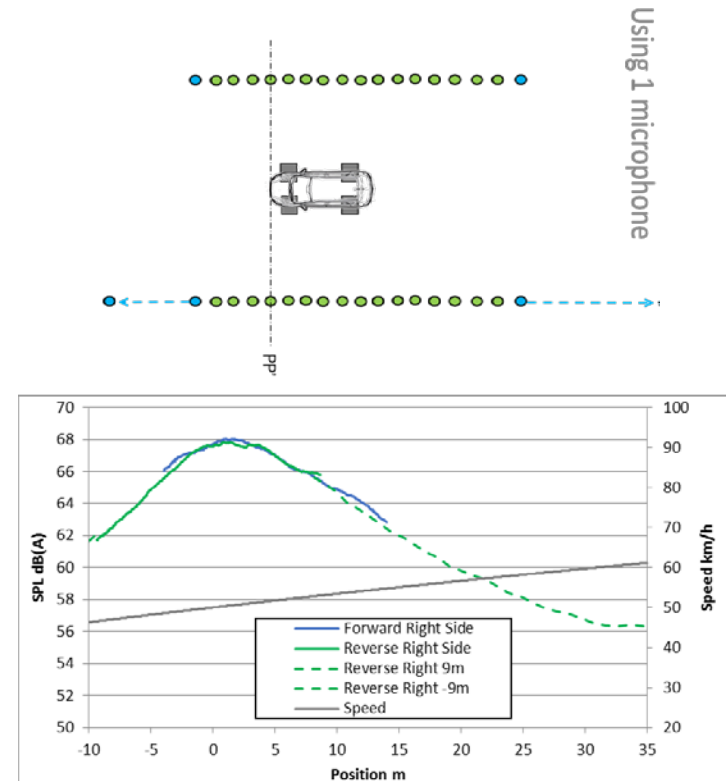
## *Annex 8 §4. Adjustment of room dimensions*

- Indoor testing in smaller room than 25m length is able to deliver consistent results :

ex. Using both direction

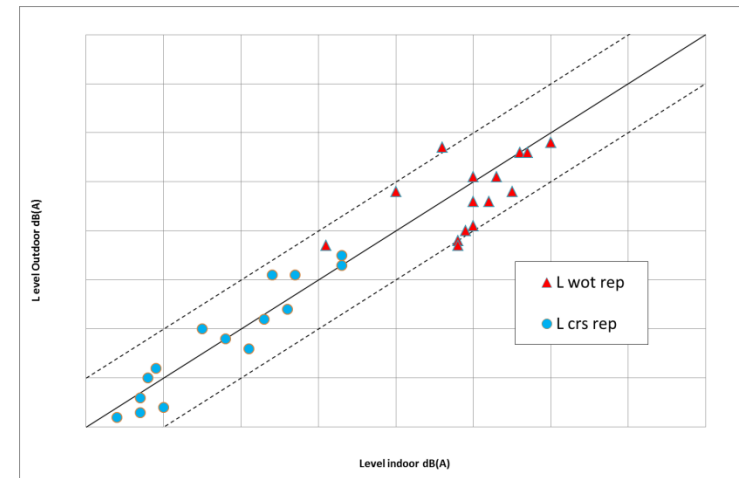
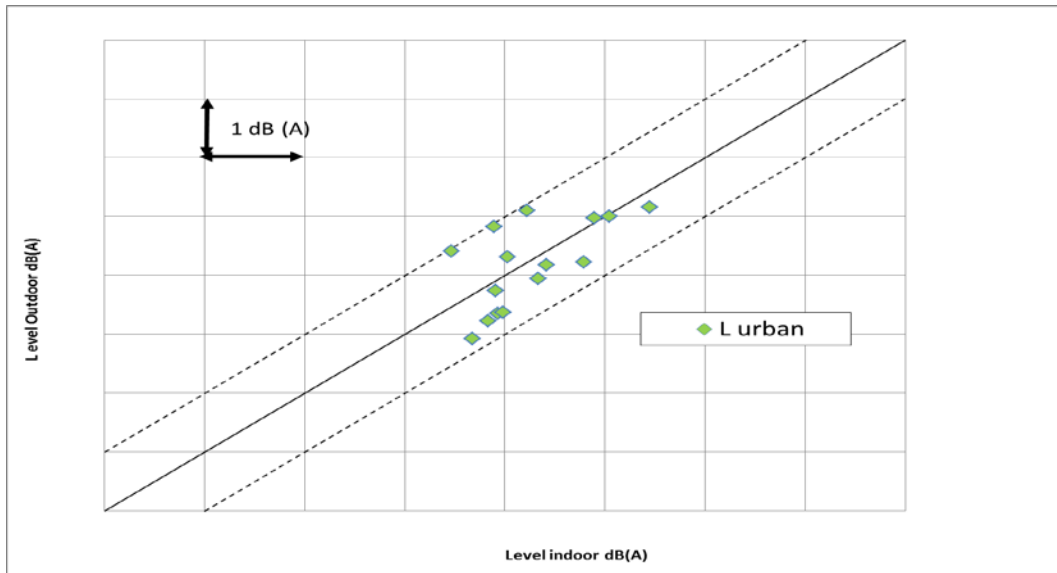


ex. Using acoustic's propagation



# Indoor/outdoor correlations

- Tests on 4 vehicles  
*under different testing conditions (tracks, tyres, day-to-day)*



- Indoor testing is able to deliver comparable results as outdoor testing within acceptable accuracy.

# Conclusions

- Indoor testing is applicable.
- Specific tools permit to provide comparable behaviour as outdoor (free field, virtual sound level meter, vehicle dynamic, room length ...).
- Indoor testing is able to deliver comparable results as outdoor testing within acceptable accuracy ...  
... if tests procedures are defined for each facility and manufacturer's production.  
(Technical documentation).



# Conclusions

- Indoor offers several benefits compared to outdoor :
  - Controlled environment conditions to perform tests without weather constraints and dispersion.
  - Reproducible cycles for reliable results (several modes and set-up testing, back-to-back tests, ...).
- Indoor homologation is the first step to virtual homologation.

Thank you for attention