ISO track and temperature correction

EVALUATION OF METHOD B

RENAULT – PSA – UTAC CERAM

ISO362-1 PROJECT MEETING - 06.03.2020 - SURESNES

Agenda

1	Method reminder
2	Renault cases
3	PSA cases
4	UTAC CERAM cases
5	Conclusion

1. Method reminder

Temperature during Type Approval

Rolling noise of a tire (same or different from the one used for Type Approval) on Type Approval track

Data of “Third party test” performed

REFERENCE DATA (FROM TYPE APPROVAL)		
$\delta_{REF,TA}$	7	°C

Comment: This information is needed for the correlation between the original type approval condition and the actual test.

REFERENCE DATA (FROM TYRE INFORMATION)		
$L_{TR,REF}$	65.5	dB(A)
$\delta_{REF,TYRE}$	7	°C
$L_{TR,REF}$ corrected to $\delta_{REF,TA}$	**65.5**	**dB(A)**

Comment:
This information is made available during type approval and not necessary part of discrete type approval test. During type approval a different tyre might have been used.

APPLIED GENERAL DATA		
Torque-Effekt Tyre	1	dB(A)

TEST DATA (SUBJECT TO CORRECTION)		
δ_{TEST}	14	°C
$L_{TR,TEST}$	63.9	dB(A)
$L_{CRS,REP}$	64.8	dB(A)
$L_{WOT,REP}$	67.6	dB(A)
$v_{BB,CRS,REP}$	49.8	km/h
$v_{BB,WOT,REP}$	56.4	km/h
$k_{P,TEST}$	0.31	
$L_{URBAN,TEST}$	**66.7**	**dB(A)**

CORRECTION (TEST TRACK & TEMP CORRECTION)		
ΔL_{COR} (inclusive ΔL_{δ})	**-1.6**	**dB(A)**

APPLIED CORRECTION (TEST TRACK & TEMPERATURE)		
$L_{TR,CRS}$	63.9	dB(A)
$L_{PT,CRS}$	57.4	dB(A)
$L_{TR,CRS,COR(TEX,\delta)}$	65.5	dB(A)
$L_{CRS,REP,COR}$	**66.1**	**dB(A)**
$L_{TR,WOT}$	66.7	dB(A)
$L_{PT,WOT}$	60.3	dB(A)
$L_{TR,WOT,COR(TEX,\delta)}$	68.3	dB(A)
$L_{WOT,REP,COR}$	**68.9**	**dB(A)**

$L_{URBAN,TEST,COR}$	**68.1**	**dB(A)**

Computation of:

- Rolling noise of the chosen tire at the Type Approval temperature
- Third party test results with compensation

⇒ Results to compare with the Type approval

2. Renault case 1 – PC M1

Reference test : France ISO 10844:1994		
$\delta_{REF,TA}$	18.4	°C

Comment: This information is needed for the correlation between the original type approval condition and the actual test.

REFERENCE DATA (FROM TYRE INFORMATION)		
$L_{TR,REF}$	66.4	dB(A)
$\delta_{REF,TYRE}$	24.4	°C
$L_{TR,REF}$ corrected to $\delta_{REF,TA}$	66.628	dB(A)

Comment:
This information is made available during type approval and not necessary part of discrete type approval test. During type approval a different tyre might have been used.

APPLIED GENERAL DATA		
Torque-Effekt Tyre	1	dB(A)

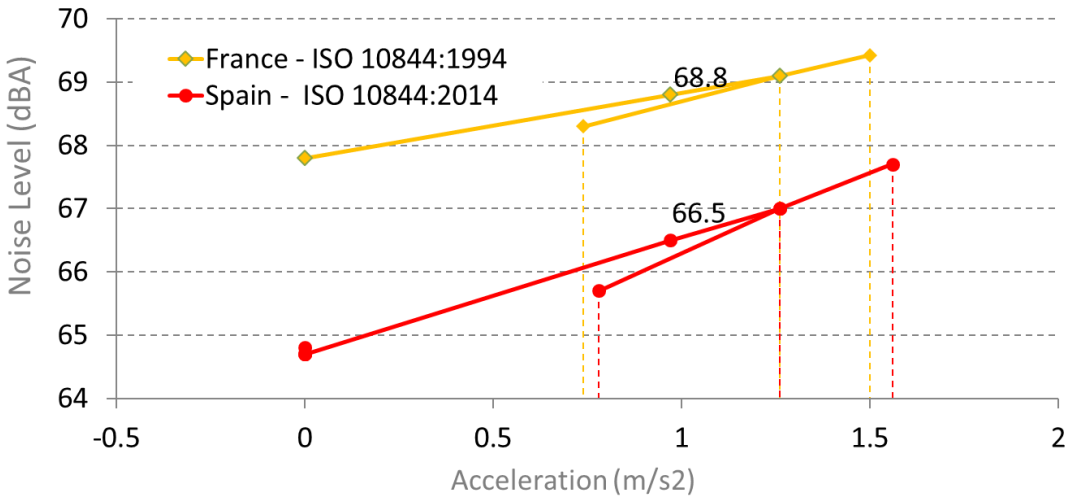
CORRECTION (TEST TRACK & TEMP CORRECTION)		
ΔL_{COR} (inclusive ΔL_{δ})	-2.928	dB(A)

TEST DATA : Spain ISO 10844:2011		
δ_{TEST}	24	°C
$L_{TR,TEST}$	63.7	dB(A)
$L_{CRS,REP}$	64.7	dB(A)
$L_{WOT,REP}$	67.0	dB(A)
$v_{BB,CRS,REP}$	50.1	km/h
$v_{BB,WOT,REP}$	55.2	km/h
$k_{P,TEST}$	0.23	
$L_{URBAN,TEST}$	66.5	dB(A)

APPLIED CORRECTION (TEST TRACK & TEMPERATURE)		
$L_{TR,CRS}$	63.7	dB(A)
$L_{PT,CRS}$	57.8	dB(A)
$L_{TR,CRS,COR(TEX,\delta)}$	66.6	dB(A)
$L_{CRS,REP,COR}$	67.2	dB(A)
$L_{TR,WOT}$	66.1	dB(A)
$L_{PT,WOT}$	59.8	dB(A)
$L_{TR,WOT,COR(TEX,\delta)}$	69.0	dB(A)
$L_{WOT,REP,COR}$	69.5	dB(A)
$L_{URBAN,TEST,COR}$	69.0	dB(A)

Ref. measurement :	68.8	dB(A)
Gap to Ref. measurement	0.2	dB(A)

Renault M1: 1.5l Diesel
Reference test: France – ISO 10844:1994
Third party test: Spain – ISO 10844:2011
Same vehicle and tire on both tracks



⇒ Gap of 0.2 dB(A)

2. Renault case 1 – Remark on temperature correction

- No temperature correction is proposed for the “test data” (subject to correction)
- Annex 3 and Ltyre tests are supposed to be done at the same temperature
- When verification tests is performed, Annex 3, Annex 7 and Ltyre tests may spread over hours. Temperature may change significantly.

⇒ **Request: add temperature correction for Verification test**

Reference test : France ISO 10844:1994		
$\delta_{REF,TA}$	18.4	°C

Comment: This information is needed for the correlation between the original type approval condition and the actual test.

REFERENCE DATA (FROM TYRE INFORMATION)		
$L_{TR,REF}$	66.4	dB(A)
$\delta_{REF,TYRE}$	24.4	°C
$L_{TR,REF}$ corrected to $\delta_{REF,TA}$	66.628	dB(A)

Comment:
This information is made available during type approval and not necessary part of discrete type approval test. During type approval a different tyre might have been used.

APPLIED GENERAL DATA		
Torque-Effekt Tyre	1	dB(A)

CORRECTION (TEST TRACK & TEMP CORRECTION)		
ΔL_{COR} (inclusive ΔL_{δ})	-2.928	dB(A)

TEST DATA : Spain ISO 10844:2011		
δ_{TEST}	24	°C
$L_{TR,TEST}$	63.7	dB(A)
$L_{CRS,REP}$	64.7	dB(A)
$L_{WOT,REP}$	67.0	dB(A)
$v_{BB,CRS,REP}$	50.1	km/h
$v_{BB,WOT,REP}$	55.2	km/h
$k_{P,TEST}$	0.23	
$L_{URBAN,TEST}$	66.5	dB(A)

APPLIED CORRECTION (TEST TRACK & TEMPERATURE)		
$L_{TR,CRS}$	63.7	dB(A)
$L_{PT,CRS}$	57.8	dB(A)
$L_{TR,CRS,COR(TEX,\delta)}$	66.6	dB(A)
$L_{CRS,REP,COR}$	67.2	dB(A)
$L_{TR,WOT}$	66.1	dB(A)
$L_{PT,WOT}$	59.8	dB(A)
$L_{TR,WOT,COR(TEX,\delta)}$	69.0	dB(A)
$L_{WOT,REP,COR}$	69.5	dB(A)
$L_{URBAN,TEST,COR}$	69.0	dB(A)

Ref. measurement :	68.8	dB(A)
Gap to Ref. measurement	0.2	dB(A)

2. Renault case 2 – LCV M1 > 2.5t

Reference test: France – ISO 10844:1994		
$\delta_{REF,TA}$	17,2	°C

Comment: This information is needed for the correlation between the original type approval condition and the actual test.

REFERENCE DATA (FROM TYRE INFORMATION)		
$L_{TR,REF}$	64,6	dB(A)
$\delta_{REF,TYRE}$	16	°C
$L_{TR,REF}$ corrected to $\delta_{REF,TA}$	64,528	dB(A)

Comment:
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APPLIED GENERAL DATA		
Torque-Effekt Tyre	1	dB(A)

CORRECTION (TEST TRACK & TEMP CORRECTION)		
ΔL_{COR} (inclusive ΔL_{δ})	**-0,718**	**dB(A)**

TEST DATA: Spain – ISO 10844:2011		
δ_{TEST}	26,1	°C
$L_{TR,TEST}$	63,81	dB(A)
$L_{CRS,REP}$	64,8	dB(A)
$L_{WOT,REP}$	67,9	dB(A)
$v_{BB,CRS,REP}$	50,4	km/h
$v_{BB,WOT,REP}$	55,0	km/h
$k_{P,TEST}$	0,26	
$L_{URBAN,TEST}$	67,1	dB(A)

APPLIED CORRECTION (TEST TRACK & TEMPERATURE)		
$L_{TR,CRS}$	63,8	dB(A)
$L_{PT,CRS}$	57,9	dB(A)
$L_{TR,CRS,COR(TEX,\delta)}$	64,5	dB(A)
$L_{CRS,REP,COR}$	**65,4**	**dB(A)**
$L_{TR,WOT}$	66,1	dB(A)
$L_{PT,WOT}$	63,3	dB(A)
$L_{TR,WOT,COR(TEX,\delta)}$	66,8	dB(A)
$L_{WOT,REP,COR}$	**68,4**	**dB(A)**
$L_{URBAN,TEST,COR}$	67,6	dB(A)

Actual measurement :	67,4	dB(A)
Gap to actual measurement	**0,2**	**dB(A)**

Renault M1>2.5t: 1.6l Diesel
Reference test: France – ISO 10844:1994
Third party test: Spain – ISO 10844:2011
Same vehicle and tire on both tracks

⇒ Gap of 0.2 dB(A)

3. PSA case 1 – PC M1 (SUV)

REFERENCE DATA (FROM TYPE APPROVAL)		
$\delta_{REF,TA}$	14	°C

Comment: This information is needed for the correlation between the original type approval condition and the actual test.

REFERENCE DATA (FROM TYRE INFORMATION)		
$L_{TR,REF}$	63.9	dB(A)
$\delta_{REF,TYRE}$	14	°C
$L_{TR,REF}$ corrected to $\delta_{REF,TA}$	**63.9**	**dB(A)**

Comment:
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APPLIED GENERAL DATA		
Torque-Effekt Tyre	1	dB(A)

CORRECTION (TEST TRACK & TEMP CORRECTION)		
ΔL_{COR} (inclusive ΔL_{δ})	**1.6**	**dB(A)**

TEST DATA (SUBJECT TO CORRECTION)		
δ_{TEST}	7	°C
$L_{TR,TEST}$	65.5	dB(A)
$L_{CRS,REP}$	66.4	dB(A)
$L_{WOT,REP}$	69.1	dB(A)
$v_{BB,CRS,REP}$	50.0	km/h
$v_{BB,WOT,REP}$	55.8	km/h
$k_{P,TEST}$	0.31	
$L_{URBAN,TEST}$	**68.3**	**dB(A)**

APPLIED CORRECTION (TEST TRACK & TEMPERATURE)		
$L_{TR,CRS}$	65.5	dB(A)
$L_{PT,CRS}$	59.1	dB(A)
$L_{TR,CRS,COR(TEX,\delta)}$	63.9	dB(A)
$L_{CRS,REP,COR}$	**65.1**	**dB(A)**
$L_{TR,WOT}$	68.1	dB(A)
$L_{PT,WOT}$	62.3	dB(A)
$L_{TR,WOT,COR(TEX,\delta)}$	66.5	dB(A)
$L_{WOT,REP,COR}$	**67.9**	**dB(A)**

$L_{URBAN,TEST,COR}$	**67.0**	**dB(A)**

Ref. measurement	**66.7**	**dB(A)**
Gap to ref. measurement	**0.3**	**dB(A)**

PSA M1: 1.6l Gasoline
Reference test: Germany – ISO 10844
Third party test: France – ISO 10844
Same model and same PWT on both vehicles
Different tires but same size

⇒ Gap of 0.3 dB(A)

3. PSA case 2 – PC M1

REFERENCE DATA (FROM TYPE APPROVAL)		
$\delta_{REF,TA}$	15	°C

Comment: This information is needed for the correlation between the original type approval condition and the actual test.

REFERENCE DATA (FROM TYRE INFORMATION)		
$L_{TR,REF}$	66.4	dB(A)
$\delta_{REF,TYRE}$	11	°C
$L_{TR,REF}$ corrected to $\delta_{REF,TA}$	66.2	dB(A)

Comment:
This information is made available during type approval and not necessary part of discrete type approval test. During type approval a different tyre might have been used.

APPLIED GENERAL DATA		
Torque-Effekt Tyre	1	dB(A)

CORRECTION (TEST TRACK & TEMP CORRECTION)		
ΔL_{COR} (inclusive ΔL_{δ})	**2.6**	**dB(A)**

TEST DATA (SUBJECT TO CORRECTION)		
δ_{TEST}	8	°C
$L_{TR,TEST}$	68.8	dB(A)
$L_{CRS,REP}$	69.3	dB(A)
$L_{WOT,REP}$	71.2	dB(A)
$v_{BB,CRS,REP}$	50.5	km/h
$v_{BB,WOT,REP}$	56.5	km/h
$k_{P,TEST}$	0.30	
$L_{URBAN,TEST}$	70.6	dB(A)

APPLIED CORRECTION (TEST TRACK & TEMPERATURE)		
$L_{TR,CRS}$	68.8	dB(A)
$L_{PT,CRS}$	59.7	dB(A)
$L_{TR,CRS,COR(TEX,\delta)}$	66.2	dB(A)
$L_{CRS,REP,COR}$	**67.0**	**dB(A)**
$L_{TR,WOT}$	71.4	dB(A)
$L_{PT,WOT}$	#NOMBRE!	dB(A)
$L_{TR,WOT,COR(TEX,\delta)}$	68.8	dB(A)
$L_{WOT,REP,COR}$	**#NOMBRE!**	**dB(A)**

$L_{URBAN,TEST,COR}$	#NOMBRE!	dB(A)

Ref. measurement	68.4	dB(A)
Gap to ref. measurement	NaN	dB(A)

PSA M1: 1.2l Gasoline
Reference test: Germany – ISO 10844
Third party test: France – ISO 10844
Same model and same PWT on both vehicles
Different tires and sizes

⇒ Computation failed because $L_{TR,WOT} > L_{WOT}$

3. PSA case 2 – Analysis of the $L_{TR,WOT}$ formula

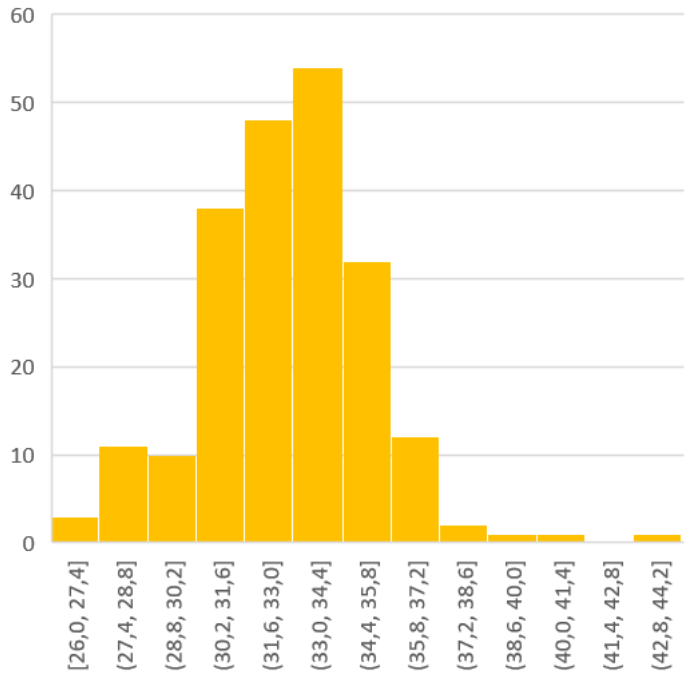
$$L_{TR,WOT} = 33 \times \log\left(\frac{v_{BB,WOT}}{v_{BB,CRS}}\right) + L_{TRQ}$$

This formula is used to adjust tire rolling noise to the representative vehicle speed during the acceleration test.

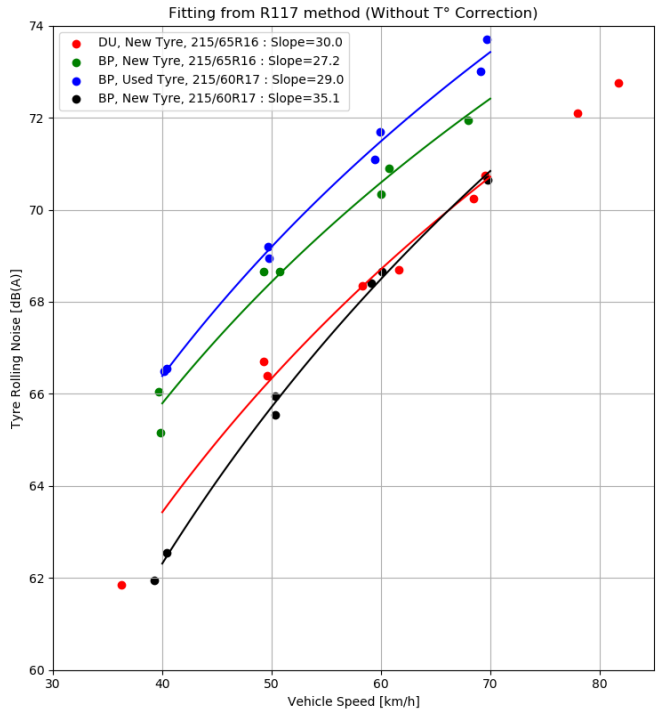
- Median at 32.8 for Renault M1 database (~200 vehicles)
- Median at 32.7 for Renault N1 database (~30 vehicles)
- Slope range of the PSA example: [27.2 ; 35.1]

⇒ A slope coefficient to 33 is a good hypothesis

⇒ Remark: impact of the chosen regression method ?

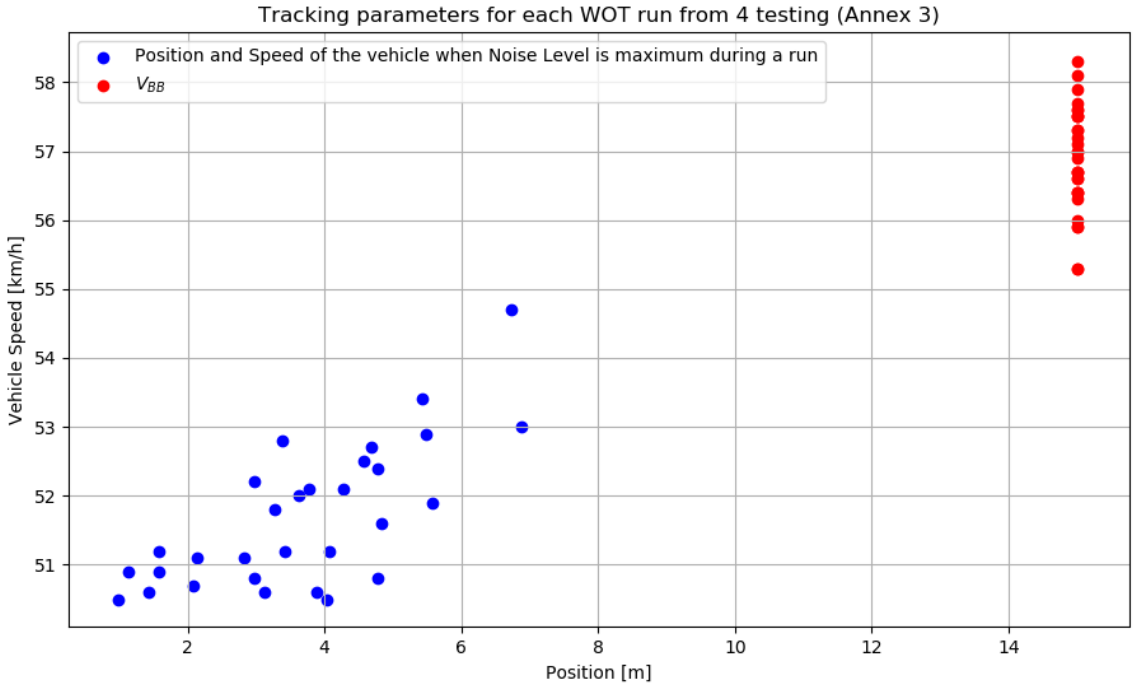


Tire noise speed coefficient by Renault



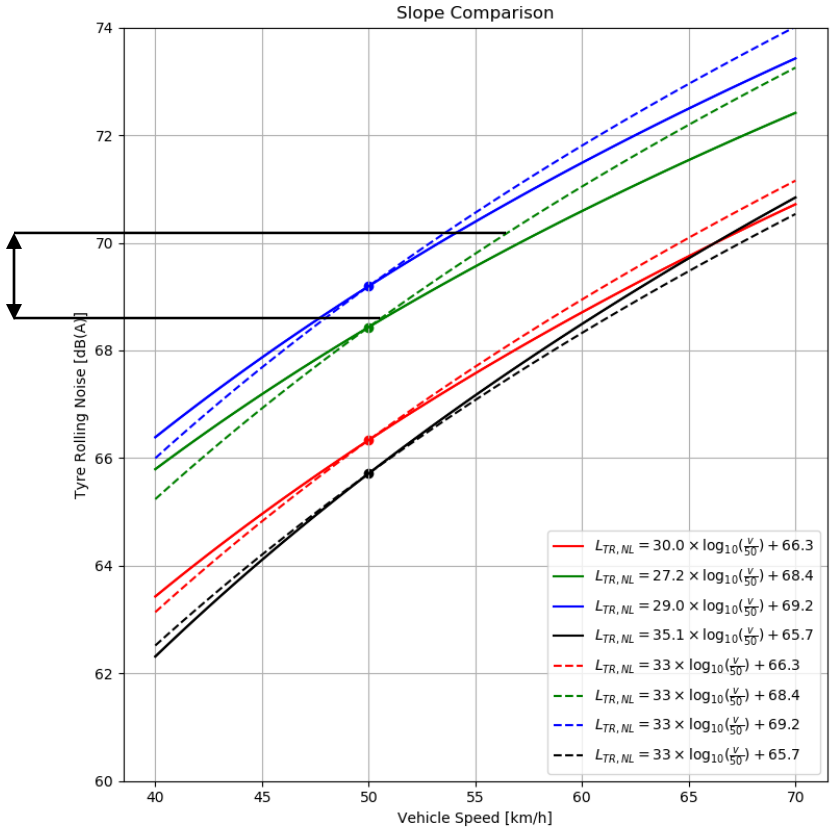
Example on 4 tyre rolling noise measurements by PSA

3. PSA case 2 – Analysis of the hypothesis: $V_{BB,WOT} = V_{LMAX,WOT}$



Delta between $V_{LMAX,WOT}$ and $V_{BB'}$ ≈ 4 km/h

Overestimation of ~2 dB(A) due to the $V_{BB'}$ approximation



⇒ Take $V_{BB'}$ hypothesis overestimates the L_{TR}

3. PSA case 2 – PC M1 with $V_{BB,WOT,REP} = V_{LMAX,WOT}$

REFERENCE DATA (FROM TYPE APPROVAL)		
$\delta_{REF,TA}$	15	°C

Comment: This information is needed for the correlation between the original type approval condition and the actual test.

REFERENCE DATA (FROM TYRE INFORMATION)		
$L_{TR,REF}$	66.4	dB(A)
$\delta_{REF,TYRE}$	11	°C
$L_{TR,REF}$ corrected to $\delta_{REF,TA}$	66.2	dB(A)

Comment:
This information is made available during type approval and not necessary part of discrete type approval test. During type approval a different tyre might have been used.

APPLIED GENERAL DATA		
Torque-Effekt Tyre	1	dB(A)

CORRECTION (TEST TRACK & TEMP CORRECTION)		
ΔL_{COR} (inclusive ΔL_{δ})	**2.6**	**dB(A)**

TEST DATA (SUBJECT TO CORRECTION)		
δ_{TEST}	8	°C
$L_{TR,TEST}$	68.8	dB(A)
$L_{CRS,REP}$	69.3	dB(A)
$L_{WOT,REP}$	71.2	dB(A)
$v_{BB,CRS,REP}$	50.5	km/h
$v_{BB,WOT,REP}$	52.1	km/h
$k_{P,TEST}$	0.30	
$L_{URBAN,TEST}$	70.6	dB(A)

APPLIED CORRECTION (TEST TRACK & TEMPERATURE)		
$L_{TR,CRS}$	68.8	dB(A)
$L_{PT,CRS}$	59.7	dB(A)
$L_{TR,CRS,COR(TEX,\delta)}$	66.2	dB(A)
$L_{CRS,REP,COR}$	**67.0**	**dB(A)**
$L_{TR,WOT}$	70.2	dB(A)
$L_{PT,WOT}$	64.1	dB(A)
$L_{TR,WOT,COR(TEX,\delta)}$	67.6	dB(A)
$L_{WOT,REP,COR}$	**69.2**	**dB(A)**

$L_{URBAN,TEST,COR}$	68.6	dB(A)

Ref. measurement	68.4	dB(A)
Gap to ref. measurement	0.2	dB(A)

PSA M1: 1.2l Gasoline
Reference test: Germany – ISO 10844
Third party test: France – ISO 10844
Same model and same PWT on both vehicles
Different tires and sizes

⇒ Gap of 0.2 dB(A)

4. UTAC CERAM case 1 – PC M1

REFERENCE DATA (FROM TYPE APPROVAL)		
$\delta_{REF,TA}$	20	°C

Comment: This information is needed for the correlation between the original type approval condition and the actual test.

REFERENCE DATA (FROM TYRE INFORMATION)		
$L_{TR,REF}$	65	dB(A)
$\delta_{REF,TYRE}$	20	°C
$L_{TR,REF}$ corrected to $\delta_{REF,TA}$	65	dB(A)

Comment:
This information is made available during type approval and not necessary part of discrete type approval test. During type approval a different tyre might have been used.

APPLIED GENERAL DATA		
Torque-Effekt Tyre	1	dB(A)

CORRECTION (TEST TRACK & TEMP CORRECTION)		
ΔL_{COR} (inclusive ΔL_{δ})	-0,9	dB(A)

TEST DATA (SUBJECT TO CORRECTION)		
δ_{TEST}	34	°C
$L_{TR,TEST}$	64,1	dB(A)
$L_{CRS,REP}$	66,2	dB(A)
$L_{WOT,REP}$	68,7	dB(A)
$v_{BB,CRS,REP}$	50,1	km/h
$v_{BB,WOT,REP}$	54,5	km/h
$k_{P,TEST}$	0,24	
$L_{URBAN,TEST}$	68,1	dB(A)

APPLIED CORRECTION (TEST TRACK & TEMPERATURE)		
$L_{TR,CRS}$	64,1	dB(A)
$L_{PT,CRS}$	62,0	dB(A)
$L_{TR,CRS,COR(TEX,\delta)}$	65,0	dB(A)
$L_{CRS,REP,COR}$	66,8	dB(A)
$L_{TR,WOT}$	66,3	dB(A)
$L_{PT,WOT}$	65,0	dB(A)
$L_{TR,WOT,COR(TEX,\delta)}$	67,2	dB(A)
$L_{WOT,REP,COR}$	69,2	dB(A)
$L_{URBAN,TEST,COR}$	68,6	dB(A)

Actual measurement :	68,9	dB(A)
Gap to actual measurement	-0,3	dB(A)

M1: 1.8l Gasoline
Reference test: China (1) – ISO 10844
Third party test: France – ISO 10844
Same vehicle and tire on both tracks

⇒ Gap of 0.3 dB(A)

4. UTAC CERAM case 2 – PC M1

REFERENCE DATA (FROM TYPE APPROVAL)		
$\delta_{REF,TA}$	20	°C

Comment: This information is needed for the correlation between the original type approval condition and the actual test.

REFERENCE DATA (FROM TYRE INFORMATION)		
$L_{TR,REF}$	65	dB(A)
$\delta_{REF,TYRE}$	20	°C
$L_{TR,REF}$ corrected to $\delta_{REF,TA}$	65	dB(A)

Comment:
This information is made available during type approval and not necessary part of discrete type approval test. During type approval a different tyre might have been used.

APPLIED GENERAL DATA		
Torque-Effekt Tyre	1	dB(A)

CORRECTION (TEST TRACK & TEMP CORRECTION)		
ΔL_{COR} (inclusive ΔL_{δ})	**-2,7**	**dB(A)**

TEST DATA (SUBJECT TO CORRECTION)		
δ_{TEST}	34	°C
$L_{TR,TEST}$	62,3	dB(A)
$L_{CRS,REP}$	64,1	dB(A)
$L_{WOT,REP}$	67,8	dB(A)
$v_{BB,CRS,REP}$	50,2	km/h
$v_{BB,WOT,REP}$	54,9	km/h
$k_{P,TEST}$	0,24	
$L_{URBAN,TEST}$	66,9	dB(A)

APPLIED CORRECTION (TEST TRACK & TEMPERATURE)		
$L_{TR,CRS}$	62,3	dB(A)
$L_{PT,CRS}$	59,4	dB(A)
$L_{TR,CRS,COR(TEX,\delta)}$	65,0	dB(A)
$L_{CRS,REP,COR}$	**66,1**	**dB(A)**
$L_{TR,WOT}$	64,6	dB(A)
$L_{PT,WOT}$	65,0	dB(A)
$L_{TR,WOT,COR(TEX,\delta)}$	67,3	dB(A)
$L_{WOT,REP,COR}$	**69,3**	**dB(A)**

$L_{URBAN,TEST,COR}$	68,5	dB(A)

Actual measurement :	68,9	dB(A)
Gap to actual measurement	-0,4	dB(A)

M1: 1.8l Gasoline
Reference test: China (1) – ISO 10844
Third party test: China (2) – ISO 10844
Same vehicle and tire on both tracks

⇒ Gap of 0.4 dB(A)

5. Conclusion – Status

	Vehicle	Energy	Tracks	Tyres	Lurban ref	Lurban w/o comp	Lurban w/ comp	Δ SPL w/o comp	Δ SPL w/ comp
Renault	PC M1 (same vehicle)	Diesel	France - Spain	Same tyres	68.8	66.5	69.0	-2.3	+0.2
Renault	LCV M1 >2.5t (same vehicle)	Diesel	France - Spain	Same tyres	67.4	67.1	67.6	-0.3	+0.2
PSA	PC M1 SUV (same model & PWT)	Gasoline	France - Germany	Different tyres but same size	66.7	68.3	67.0	1.6	+0.3
PSA	PC M1 (same model & PWT)	Gasoline	France - Germany	Different tyres and sizes	68.4	70.6	N/A	2.2	N/A
UTAC CERAM	PC M1 (same vehicle)	Gasoline	China (1) – France	Same tyres	68.9	68.1	68.6	-0.8	-0.3
UTAC CERAM	PC M1 (same vehicle)	Gasoline	China (1) – China (2)	Same tyres	68.9	66.9	68.5	-2.0	-0.4

- Method evaluated on 6 sets of data with a successful compensation for 5 sets
- Method takes into account different tested tyres between the reference and the third party tests
- Method does not seem to work when the Lpowertrain is low; it could be the case for EV
- Gap of measurement is in the measurement uncertainty

5. Conclusion – Proposals

- For the data of the third party test, the chosen hypothesis is that the cruise test and the rolling noise test are performed at the same track temperature

⇒ Introduce a temperature correction of the L_{TR} to be in line with the temperature of the L_{CRS}

- When Lpowertrain is low (L_{TR}>L_{CRS} or/and $L_{TR,WOT}$ > L_{WOT})
  - A slope coefficient to 33 is a good hypothesis

⇒ Replace $V_{BB'}$ by V_{LMAX} seems to give more precision on the L_{TR}

⇒ Introduce a maximum contribution factor of the rolling noise, as it is used in RD ASEP: X=90%

- Torque effect is a frozen value defined to 1 dB

⇒ **Investigations to conduct (sensitivity analysis?**)

- For vehicles > 3.5t

⇒ **Extend this method**

Thank you for your attention

R. BARBEAU