

# ASEP Sound Model for EV

2018.11.06-08

ASEP IWG #10 meeting

@Tokyo

**JASIC**

1. Consideration of sound model for EV
2. Validation test result
3. Conclusion

# 1. Consideration of sound model for EV (1)

## ① Tyre Rolling Sound Model, $L_{TR}$

Same model can be used.

$L_{CRS,REP}$  and  $L_{REF,TR}$  should be same. (X=100%)

$$L_{TR} = \text{Slope}_{TR} * \log( v_{test} / 50 ) + L_{REF,TR}$$

$$L_{REF,TR} = 100 \% \text{ of } L_{CRS,REP}$$

## ② Power Train Base Mechanic Sound Model (No Load), $L_{PT,NL}$

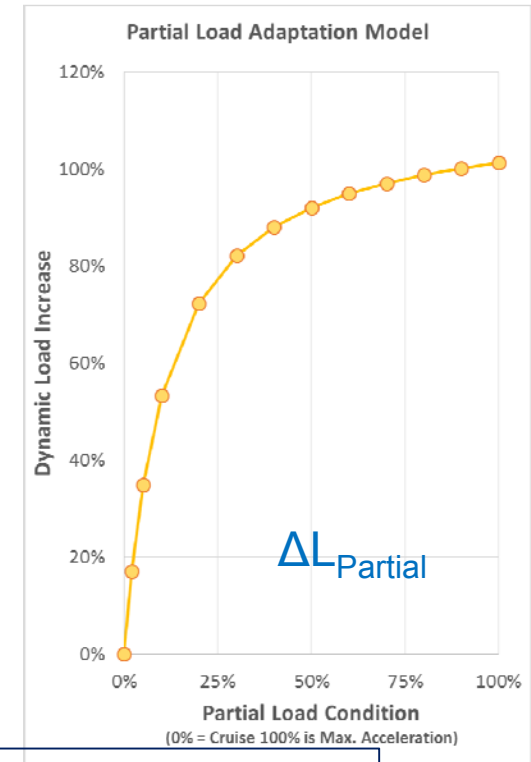
No relevant sound source from rotated mechanical sound.  
Mechanical sound model is not necessary.

~~$$L_{PT,NL} = \text{Slope}_{PT,NL} * \log(( n_{test} + n_{shift} ) / ( n_{CRS,REP} + n_{shift} )) + L_{REF,PT,NL}$$~~

# 1. Consideration of sound model for EV (2)

## 3 Dynamic Model, $L_{DYN}$

Main sound source is torque influence for tire noise.  
 It is function of acceleration.  
 If the other sources related to acceleration are interested, those are part of Dynamic model.  
 No relevant sound source from rotational sound.



$$L_{DYN} = \text{Slope} * \log\left(\frac{n_{test} + n_{shift}}{n_{WOT,REP} + n_{shift}}\right) + L_{REF,DYN,NL} + \Delta L_{DYN} \times \Delta L_{Partial}$$

$$L_{REF,DYN,NL} = L_{REF,PT,NL} - 15$$

$$\Delta L_{DYN} = [L_{WOT,REP} - L_{TR}(V_{WOT,REP}) - L_{PT,NL}(n_{WOT,REP})] - L_{REF,DYN,NL}$$

$$\Delta L_{Partial} \quad (\text{See left figure})$$

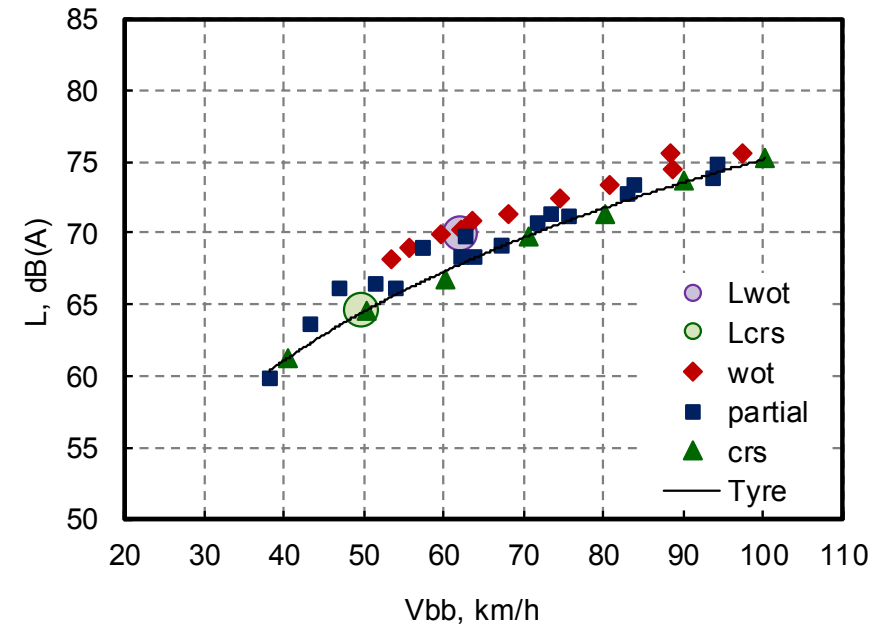
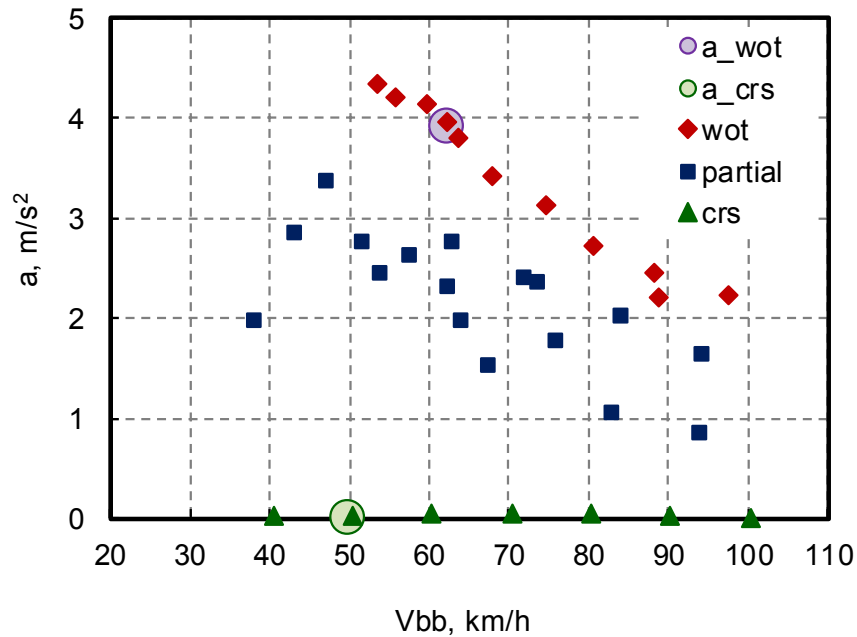
## 2. Validation test result (1)

### Test vehicle information

Test vehicle		Vehicle-07 (EV)	
Spec.	Category	M1	
	Power unit	Motor	
	Max. power	110 kW	
	mro	1605 kg	
	PMR	68.5	
	Tyre size	215/50R17	
R51-03 Annex 3		D-range	
Conditions	Gear	V, km/h	a, m/s <sup>2</sup>
Vehicle running (Wot, Partial, Crs)	D	10-100	0.9-4.4
Tyre rolling	N	40-100	



## 2. Validation test result (2)

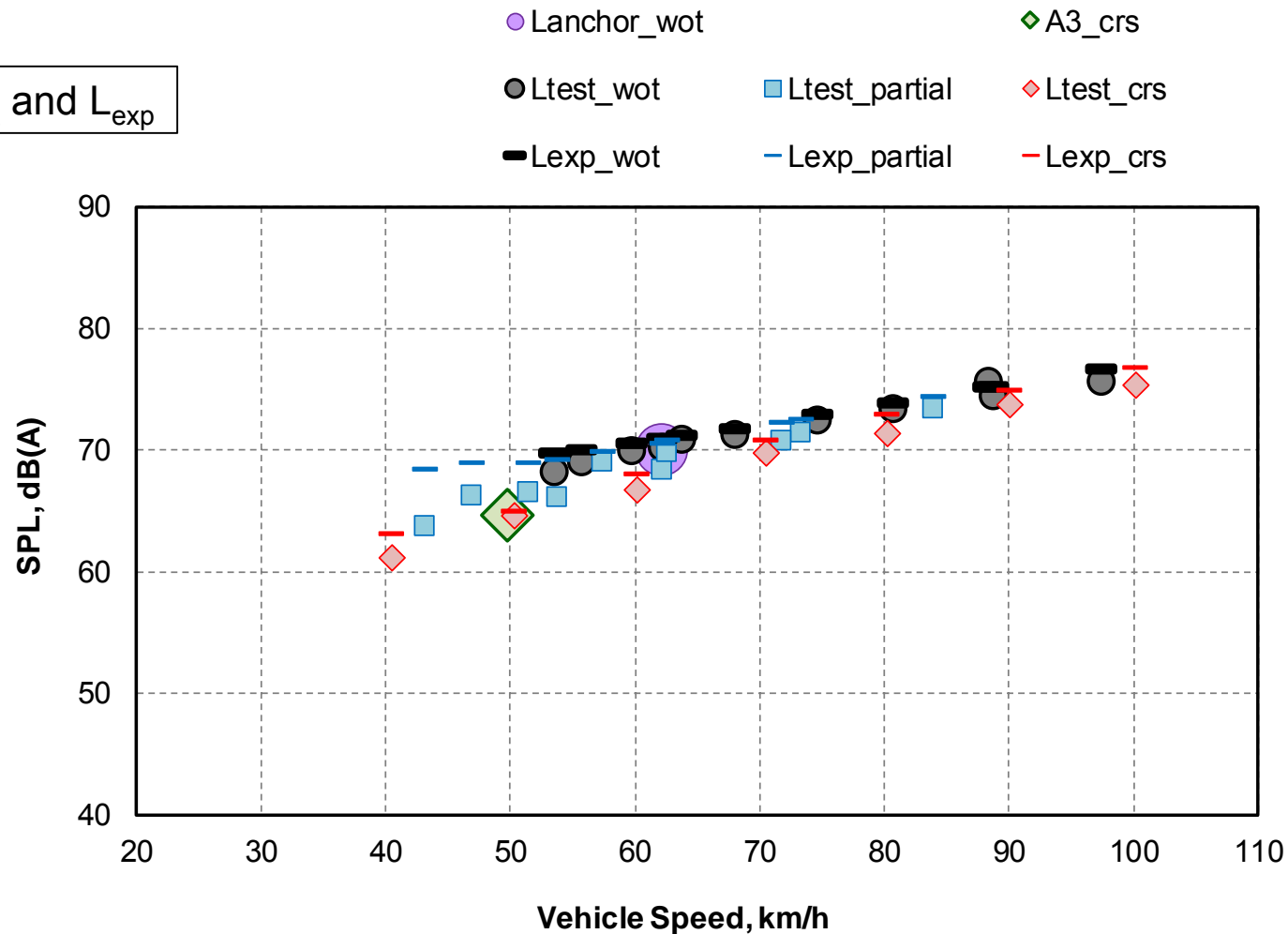


Wide range of acceleration is measured.

Higher acceleration makes higher sound level of tire noise with torque.

## 2. Validation test result (3)

$L_{\text{test}}$  and  $L_{\text{exp}}$



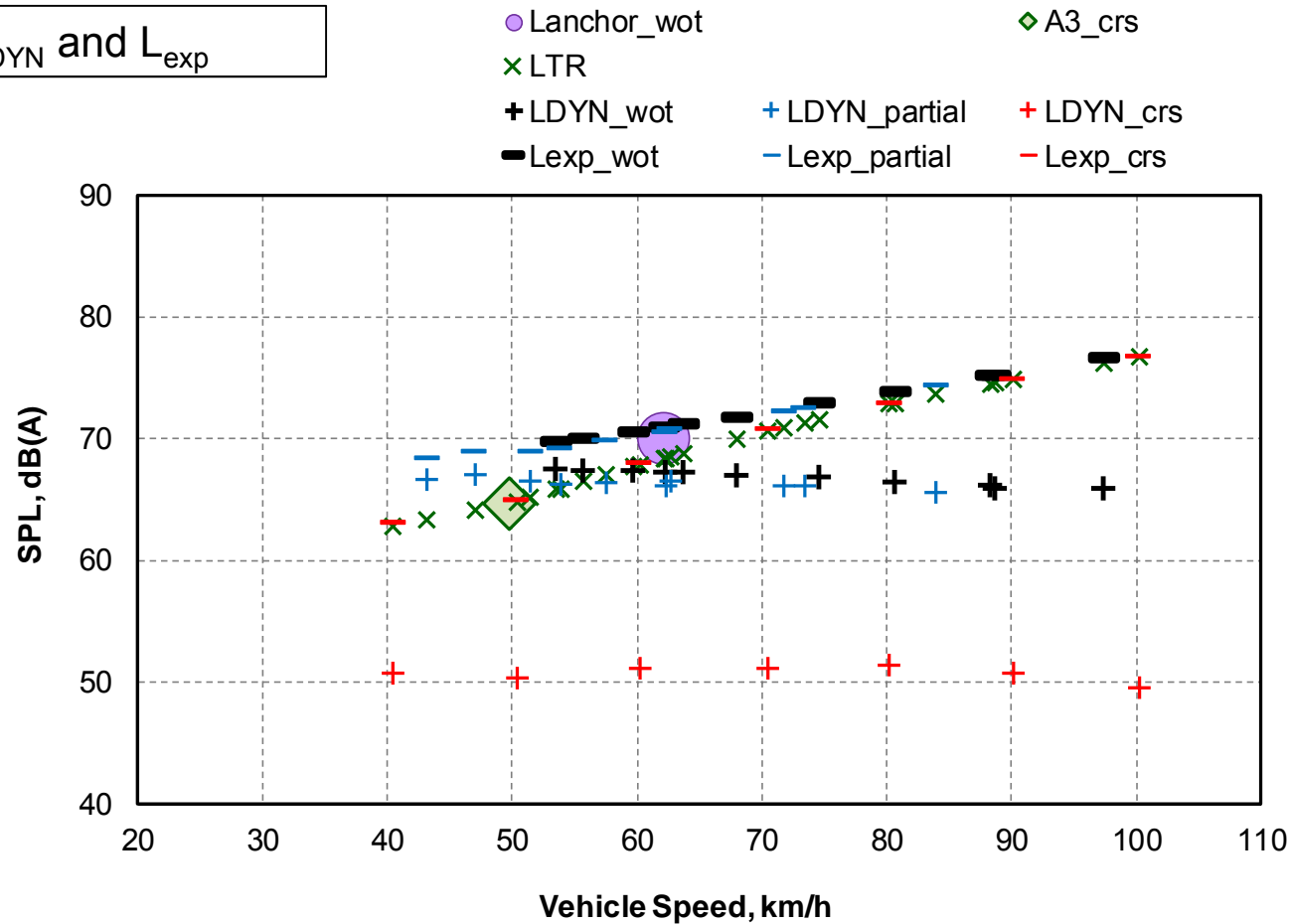
Expected sound level  $L_{\text{exp}}$  by sound model show similar to measured sound level  $L_{\text{test}}$  in any running condition.

Revised sound model for EV works well.

## 2. Validation test result (4)

Each element calculated by the sound model

$L_{TR}$ ,  $L_{DYN}$  and  $L_{exp}$





### 3. Conclusion

To apply ASEP sound model to EV;

- Can be used same equations for the sound model
- Should be deleted mechanical sound model
- Can cover tire torque effect by dynamic sound model with deletion of rotational part.

Validation test result shows Revised sound model works well.

Future study

Apply to Series hybrid system

***Thank you for your attention.***