

## **Proposal for an amendment to the Document of Reference: “A general approach how to handle measurement uncertainty” (GRBP-2022-09)**

The text below has been prepared by the experts of the Informal Working group on Measurement Uncertainties (IWB MU) in order to introduce a general guideline. The modifications to the existing text of the “Document of Reference” (GRBP2022-9) are marked in ~~strike through~~ for deleted characters.

### **I. Proposal**

*Paragraph 7, delete table 7.1 and 7.2*

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#### **7. Example of estimation of expanded uncertainty – UN Regulation No. 51 and ISO 362-1.**

In UN Regulation No. 51, the test method (Annex 3), for vehicles of categories  $M_1$  and  $N_1$ , and for vehicles of category  $M_2$  having a maximum authorized mass not exceeding 3,500 kg, is based on two driving conditions; a constant speed test,  $L_{crs}$ , and a wide-open throttle acceleration test,  $L_{wot}$ , to determine the final type-approval level,  $L_{urban}$ .

In table 7.1 below, the impact of the different quantities on these indicators has been estimated for the Run-to-run, Day-to-day, Site-to-site and Vehicle-to-vehicle situations.

Some of the different impacts are based on calculations from tolerances in the regulations, while others are based on experiences. Based on the probability distribution, the variance and the standard deviation is calculated. For each of the quantities, their contribution (in %) has been calculated and the colour scheme makes it easy to understand the influence of the quantity to the total uncertainty. Some of these quantities can be compensated for, like the influence of temperature and test track variations, while other is of random type, like instrumentation accuracy and cannot be compensated. In the example shown below, the estimated total expanded uncertainty has been calculated to  $\pm 3.45$  dB for a coverage factor of  $k = 2$  (95 per cent level of confidence).

Table 7.1\*\*

## Example of calculation of uncertainties for UN Regulation No. 51:

Measurement uncertainty table for an M<sub>1</sub> passenger car with combustion engine - stage 3 limit<sup>7</sup>

Situation	Input Quantity	Estimated deviations of the meas- result (peak-peak)		Impact on Lurb	Probability Distribution	Variance	Standard deviation	Share	Combined standard uncertainty	Uncertainty Budgets		
		Lwot	Lers							Type Approval	CoP	Field Tests
Run to Run	Microclimate wind effect	0,40	0,77	0,53	rectangular	0,02	0,152	1,0%	0,37	0,37	0,37	0,37
	Driver #1: Deviation from centred driving	0,50	0,50	0,50	rectangular	0,02	0,144	0,9%				
	Driver #2: Start of acceleration	0,50	0,00	0,33	rectangular	0,01	0,095	0,4%				
	Driver #3: Speed variations of +/- 1km/h	0,30	0,30	0,30	rectangular	0,01	0,087	0,3%				
	Driver #4: Load variations during cruising	0,00	0,50	0,17	gaussian	0,00	0,042	0,1%				
	Varying background noise	0,10	0,10	0,10	gaussian	0,00	0,025	0,0%				
	Variation on operating temperature of engine (WOT) and tyres (WOT&CRS) —> See ISO 3621 note	1,20	0,50	0,96	rectangular	0,08	0,278	3,2%				
Day to Day	Barometric pressure (Weather +/- 30 hPa)	0,60	0,00	0,40	gaussian	0,01	0,099	0,4%	0,68	0,68	0,68	0,62
	Air temperature effect on tyre noise (5-10°C)	1,00	2,00	1,34	rectangular	0,15	0,387	6,2%				
	Air temperature effect on tyre noise (10-40°C)	1,00	2,00	1,34	rectangular	0,15	0,387	6,2%				
	Varying background noise during measurement	0,60	1,00	0,74	gaussian	0,03	0,184	1,4%				
	Air intake temperature variation	1,50	0,00	0,99	gaussian	0,06	0,248	2,6%				
	Residual humidity on test track surface	0,70	1,00	0,80	rectangular	0,05	0,231	2,2%				
Site to Site	Altitude (Location of Test Track) 100 hPa/1000m (from 1015 to 915 hPa)	1,00	0,00	0,66	rectangular	0,04	0,191	1,5%	1,23	-	0,62	1,23
	Test Track Surface	3,50	5,00	4,01	rectangular	1,34	1,157	55,6%				

\*\* The acronyms and designations in tables 7.1 and 7.2 follow the 03 series of amendments to UN Regulation No. 51



Table 7.2\*\*  
 Uncertainty budget for determination of urban sound pressure level

Situation	Quantity	Peak to peak estimation $L_{\text{peak}}$	Peak to peak estimation $L_{\text{res}}$	Impact on $L_{\text{urban}}$	Probability distribution	Standard uncertainty	95% Uncertainty
		dB	dB	dB		± dB	± dB
Run to Run	Microclimate wind effect	0,5	0,5	0,50	gaussian	0,13	0,6
	Driver #1: Deviation from centered driving	0,5	0,5	0,50	rectangular	0,14	
	Driver #2: Start of acceleration	0,5	0,5	0,50	rectangular	0,14	
	Driver #3: Speed variations of ± 1km/h	0,3	0,3	0,30	rectangular	0,09	
	Driver #4: Load variations during cruising	0,3	0,5	0,37	gaussian	0,09	
	Varying background noise	0,1	0,1	0,10	rectangular	0,03	
	Variation on operating temperature of engine (WOT) and tyres (WOT&CRS) —> See ISO 362-1 NOTE	0,25	0,25	0,25	rectangular	0,07	
Day to Day	Barometric pressure (Weather ± 30 hPa)	1,0	0,0	0,66	gaussian	0,17	1,7
	Air temperature effect on tyre noise (5-10°C)	0,0	0,0	0,00	rectangular	0,00	
	Air temperature effect on tyre noise (10-40°C)	2,0	2,0	2,00	rectangular	0,58	
	Varying background noise during measurement	1,0	1,0	1,00	rectangular	0,29	
	Air intake temperature variation	1,5	0,0	0,99	rectangular	0,29	
	Residual humidity on test track surface	1,0	1,0	1,00	rectangular	0,29	
Site to Site	Altitude (Location of Test Track) -100 hPa/1000m (from 1015 to 915 hPa)	1,00	0,0	0,66	rectangular	0,19	2,7
	Test Track Surface	3,5	5,0	4,01	rectangular	1,00	
	Microphone Class 1 IEC 61672	0,6	0,6	0,60	gaussian	0,15	
	Sound calibrator IEC 60942	0,8	0,8	0,80	gaussian	0,20	
	Speed measuring equipment continuous at PP	0,1	0,1	0,10	rectangular	0,03	
	Acceleration calculation from vehicle speed measurement	0,5	0,0	0,33	rectangular	0,10	

## **II. Justification:**

*Removal of*

*Table 7.1 Example of calculation of uncertainties for UN Regulation No. 51 and*

*Table 7.2 Uncertainty budget for determination of urban sound pressure level*

1. For editing the working document GRBP-2022-09 the experts of the Informal Working Group on Measurement Uncertainties (IWG MU) provided these tables as an interim result of the different approaches to the chair. Since additional data have been included the investigations are still in progress and the values will change.
2. When the work on the tables will be finished, the IWG MU will send an informal document with the new updated tables inside. Target is to present the informal document until the 76<sup>th</sup> GRBP in September 2022.