Transmitted by the experts of ISO

Informal document **GRBP-79-30**
(79th GRBP, 6–9 February 2024
agenda item 6)

Proposal for Supplement 1 to the 02 series of amendments to UN Regulation No. 138

The text reproduced below was prepared by the experts from the International Organization of Standardization (ISO with the aim to reflect the latest status of the ISO/FDIS 16254 draft into R138 and to reflect the understanding of the intent of the QRTV working group. The amendment is based on formal document GRBP/2024/2. The proposal reflects the situation and input from ISO that due to the timing of the development of the ISO/FDIS draft and GRBP/2024/2, it was not possible to have the necessary review and vetting of the GRBP/2024/2 text, and ISO would deliver an informal document with any changes necessary. As GRBP/2024/2 already has text prepared in accordance with UN guidelines (bold, strikethrough). This text uses those same guidelines, but only in respect to GRBP/2024/2. Strikethroughs present in GRBP/2024/2 are retained.

I. Proposal

Paragraph 6.2., amend to read:

6.2. Acoustics characteristics

The sound emitted by the vehicle type submitted for approval shall be measured by the methods described in Annex 3 to this Regulation. ~~The speed range for operation is the range of greater than 0 km/h up to and inclusive 20 km/h.~~

The specifications of this Regulation are applicable **in forward and reverse driving condition** for the **mandatory** speed range of greater than 0 km/h up to and inclusive 20 km/h. Operation of an AVAS is permitted at vehicle speeds outside the ~~specification~~ **mandatory speed** range**, the maximum sound pressure levels for the AVAS sound specified in this Regulation in Table 2a and Table 2b of paragraph 6.2.8. apply. An AVAS sound is only allowed in forward driving direction of the vehicle in the speed range mentioned in Table 2a and for all speeds in reverse direction.**

AVAS characteristic beside the tested vehicle speeds during type approval can be declared either by manufacturer declaration in Annex 4 or by additional tests. These tests shall be agreed between the manufacturer and the type approval authority.

AVAS may be operational independent of the operation of an internal combustion engine inside or outside the **mandatory** speed range.

If ~~the~~ **a** vehicle that is not equipped with an AVAS fulfils the **minimum** overall levels as specified in Table 2a below with a margin of +3 dB(A) **by its natural sounds**, the specification for one-third octave bands as specified in paragraph ~~in~~6.2.8. Table 3 and the frequency shift **as specified in paragraph 6.2.3.** do not apply.

If a vehicle in scope of UN Regulation No. 165 equipped with an audible reverse warning system, providing an audible signal, that exceeds the minimum overall levels as specified in Table 2b of this regulation, the audible reverse warning signal is deemed to fulfil this regulation in reverse driving, without the sound from an AVAS.

Annex 3, Paragraph 2.3.1., amend to read:

"2.3.1. Measurement criteria for A-weighted sound pressure level

The background, or ambient noise, shall be measured for a duration of at least 10 seconds. A 10 second sample taken from these measurements shall be used to calculate the reported background noise, ensuring the 10 seconds sample selected is representative of the background noise in absence of any transient disturbance. The measurements shall be made with the same microphones and

microphone locations used during the test.

When testing in an indoor facility, the noise emitted by the roller-bench, chassis dynamometer or other test facility equipment, without the vehicle installed or present, inclusive of the noise caused by air handling of the facility and vehicle cooling, shall be reported as the background noise.

The overall sound pressure level of the background shall be reported as the largest overall sound pressure level from all microphones, L_{bgn}.

The one-third octave sound pressure level of the background shall be reported as the maximum one-third octave sound pressure level from all microphones in each individual one-third octave band, L_{bgn_BAND}.

Report one-third octave bands as specified in paragraph 6.2.8. Table 3.

~~The recorded maximum A-weighted sound pressure level from both microphones during the 10 second sample shall be reported as the background noise, L_{bgn}, for both left and right microphones.~~

~~For each 10 second sample at each microphone, the maximum to minimum range of the background noise, $\Delta L_{bgn,\ p\text{-}p}$, shall be reported.~~

~~The one-third-octave frequency spectrum, corresponding to the reported maximum level of background noise in the microphone with the highest background level, shall be reported.~~

As an aid for measurement and reporting of background noises see flowchart in Figure 4 of the Appendix to this annex.

Annex 3, Paragraph 3.4., amend to read:

3.4. Measurement readings and reported values

At least four measurements for each test condition shall be made on both sides of the vehicle.

The first four valid consecutive measurement results for each test condition $\boldsymbol{L_{MicRight_OA,\ j}}$ **and** $\boldsymbol{L_{MicLeft_OA,\ j}}$**,** within 2,0 dB(A) per side, allowing for the deletion of non-valid results, shall be used for the calculation of the intermediate or final result.

If a sound peak obviously out of character with the general sound pressure level is observed, that measurement shall be discarded.

For measurement of a vehicle in motion (forward and reversing) outdoor, the maximum A-weighted sound pressure level indicated during each passage, ($L_{test,j}$), shall be noted for each microphone position, to the first significant digit after the decimal place (for example XX,X).

The reference point for forward conditions is the front plane of the vehicle. The reference point for reverse conditions is the rear plane of the vehicle.

For minimum specifications as given in paragraph 6.2.8, results are reported over the distance covered by the reference point from AA' to PP'.

For maximum specifications as given in 6.2.8, results are reported over the distance covered by the reference point from AA' to PP' plus the vehicle length.

For measurement of a vehicle in motion indoor and in standstill (forward and reversing), the maximum A-weighted sound pressure level indicated during each period of 5 seconds for each microphone position, $L_{test,j,}$ shall be noted, to the first significant digit after the decimal place (for example XX,X).

Report one-third octave bands as specified in paragraph 6.2.8. Table 3.

~~$L_{test,j}$ shall be corrected according to paragraph 2.3.2 to obtain $L_{testcorr,j}$.~~

~~For each maximum A-weighted sound pressure level, the corresponding one-third octave spectrum shall be reported for each microphone position. No background correction shall be applied to any measured one-third octave result.~~

Annex 3, Paragraph 3.5., amend to read:

3.5. Data compilation and reported results

For each test condition described in paragraph 3.3., the ~~background corrected results, $L_{testcorr,j}$, and the corresponding one third octave spectra of both sides of the vehicle individually~~ overall Sound Pressure Level and the corresponding one-third octave spectra of both sides of the vehicle individually shall be arithmetically averaged and rounded to the first decimal place.

For the measurements of the opposite side of driving direction at method "B", "C", **and** "D"**,** additional microphones are necessary (see figure 2a , 2b).

The final A-weighted **overall** sound pressure level results $\boldsymbol{L_{crs,10}}$, $\boldsymbol{L_{crs,20}}$and $L_{reverse}$ to be reported are the lower values of the two averages of both sides, rounded to the nearest integer. ~~The final one third octave spectra to be reported are the spectra corresponding to the same side as the reported A-weighted sound pressure level. The **overall** level shall be reported on the side with the lowest level. sides.~~ **The one-third** octave band **frequency spectrum, shall be reported for both sides of the vehicle, $\boldsymbol{L_{MicLeftBAND}}$ and $\boldsymbol{L_{MicRightBAND}}$.**

Annex 3, Paragraph 3.5.1., amend to read:

3.5.1. Intermediate processing when 5 microphone array is used

For each vehicle operating condition, stationary or moving, the five left and right microphone results shall be processed to provide a single left and right result for each measurement run *j*.

The intermediate processing for each measurement run *j* and for the five microphone positions *i* will produce a single result for the overall sound pressure level for the left and right side of the vehicle and a single one-third octave spectra for the left and right side of the vehicle. All further processing is done using these results.

Figures 6 and 7 in the appendix to Annex A gives measurement criteria for overall sound pressure level and one-third octave band sound pressure levels in flowchart form as an aid to measurement and reporting results.

3.5.1.1. Overall sound pressure level

The value $\boldsymbol{L_{MicLeft_OA,\,j}}$ and $\boldsymbol{L_{MicRight_OA,\,j}}$ for each test run *j* shall be the arithmetic average of each of the five microphone positions *i* .

$$\boldsymbol{L_{MicLeft_OA,j}} = \left(\sum_{i=1}^{5} \boldsymbol{L_{MicLeft_i_OA,j}}\right)\Big/_{\mathbf{5}}$$

$$\boldsymbol{L_{MicRight_OA,j}} = \left(\sum_{i=1}^{5} \boldsymbol{L_{MicRight_i_OA,j}}\right)\Big/_{\mathbf{5}}$$

3.5.1.2. One-third octave band sound pressure level

The value $\boldsymbol{L_{MicLeft_BAND,\,j}}$ and $\boldsymbol{L_{MicRight_BAND,\,j}}$ for each test run *j* shall be the maximum hold of each of the five microphone positions *i* in all individual one-third octave bands for each measurement run *j*

$\boldsymbol{L_{MicLeft_BAND,\,j}}$ **= max(** $\boldsymbol{L_{MicLeft_i_BAND,\,j}}$ **)**

$$L_{\text{MicRight_BAND, } j} = \max(L_{\text{MicRight_}i\text{_BAND, } j})$$

Annex 3, Paragraph 3.5.2., amend to read:

3.5.2. Maximum A-weighted sound pressure level data compilation

For a given test condition and mode, the four *j* test runs are averaged to determine the intermediate result on each side.

For a given test condition and mode, the runs shall be averaged separately for each side.

Calculate $L_{\text{MicLeftOA}}$

Calculate $L_{\text{MicRightOA}}$

$$L_{\text{MicLeftOA}} = \left(\sum_{i=1}^{4} L_{\text{MicLeftOA},j}\right) \Big/ 4$$

$$L_{\text{MicRightOA}} = \left(\sum_{i=1}^{4} L_{\text{MicRightOA},j}\right) \Big/ 4$$

Calculate the final reported overall sound pressure level for each condition and mode as the lowest of the left and right side.

$L_{(\text{condition})} = \min(L_{\text{MicLeftOA}}, L_{\text{MicRightOA}})$

For each test condition described in paragraph 3.3., the overall Sound Pressure Level both sides of the vehicle individually shall be arithmetically averaged and rounded to the first decimal place.

For the measurements at the frontline of the vehicle according to annex 3 **Paragraph** 3.3.2. with Method B, C and D additional microphones are necessary and to be rounded to the first decimal place.

Annex 3, Paragraph 3.5.3., amend to read:

3.5.3. One-third- octave **band** sound pressure level data compilation

For a given test condition and mode, the four *j* test runs are averaged to determine the result on each side.

$$L_{\text{MicLeftBAND}} = \left(\sum_{i=1}^{4} L_{\text{MicLeftBAND},j}\right) \Big/ 4$$

$$L_{\text{MicRightBAND}} = \left(\sum_{i=1}^{4} L_{\text{MicRightOA},j}\right) \Big/ 4$$

Any further processing of the one-third- octave- band values shall use these results.

Both the $L_{\text{MicLeftBAND}}$ and the $L_{\text{MicRightBAND}}$ shall be reported.

Report one-third octave bands as specified in paragraph 6.2.8. Table 3.

Annex 3, 4.4.1., amend to read:

4.4.1. Test Method (A)

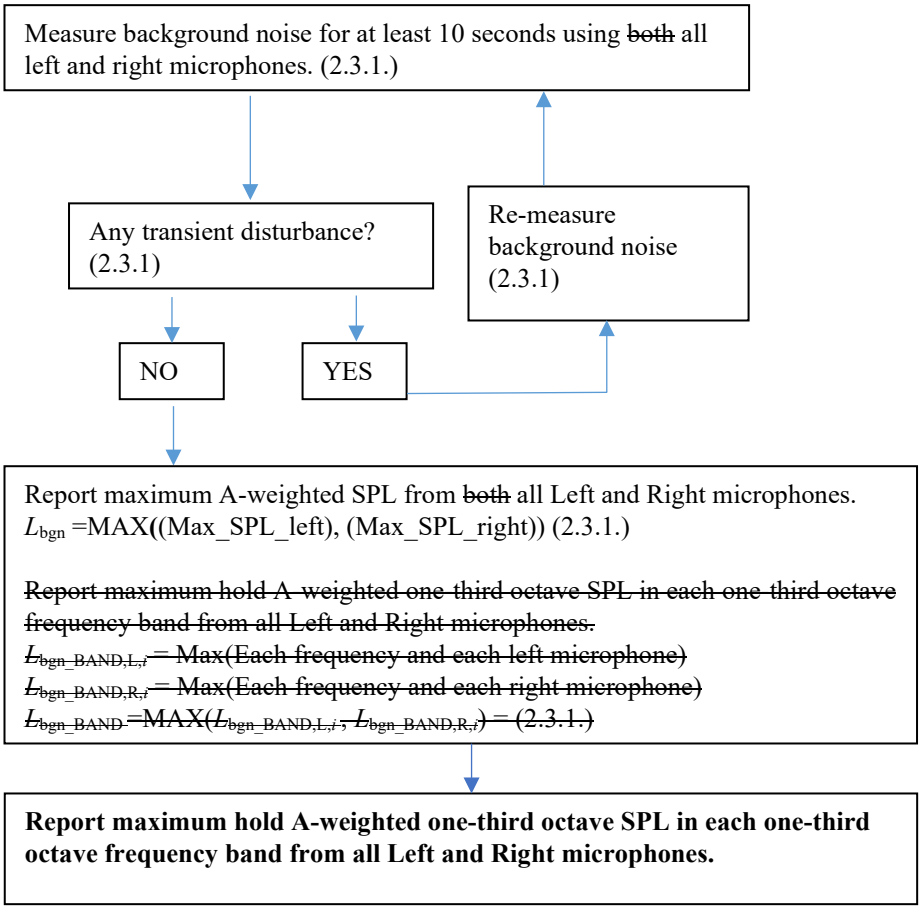
At least four measurements shall be made at every speed specified in paragraph 4.3.1. The emitted sound shall be recorded during each passage of the vehicle between AA' and BB' for each microphone position.

~~**For minimum sound requirements** **Ff**~~From each measurement sample a segment taken from AA until 1 meter before PP' shall be ~~cut out~~ **used** for further analysis.

~~**For maximum sound requirements for each measurement sample a segment taken from AA until PP' plus vehicle length be cut out for further analysis.**~~

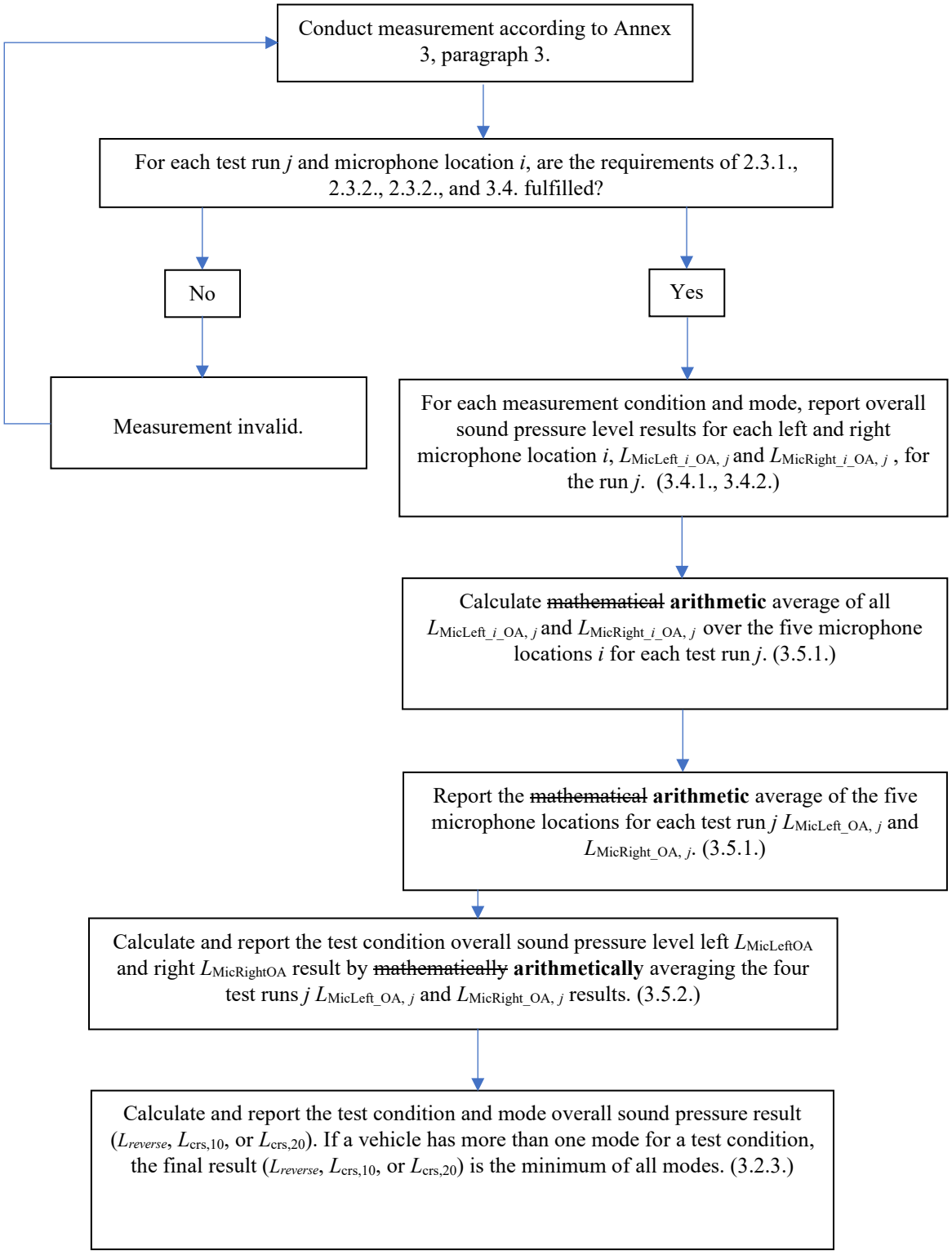
Annex 3, Appendix, Figure 4., amend to read:

Background Noise Measurement ~~Determination of the range of background noise~~



Annex 3, Appendix, Figure 6., amend to read:

Figure 6
~~Background noise requirements for analysis in one-third-octave bands~~
Flowchart for the procedure to measure and report overall A-weighted sound pressure levels



The purpose of Figure 6 is to show how to go from the five microphone results for each measurement run to a final answer. It conceptually has two major steps:

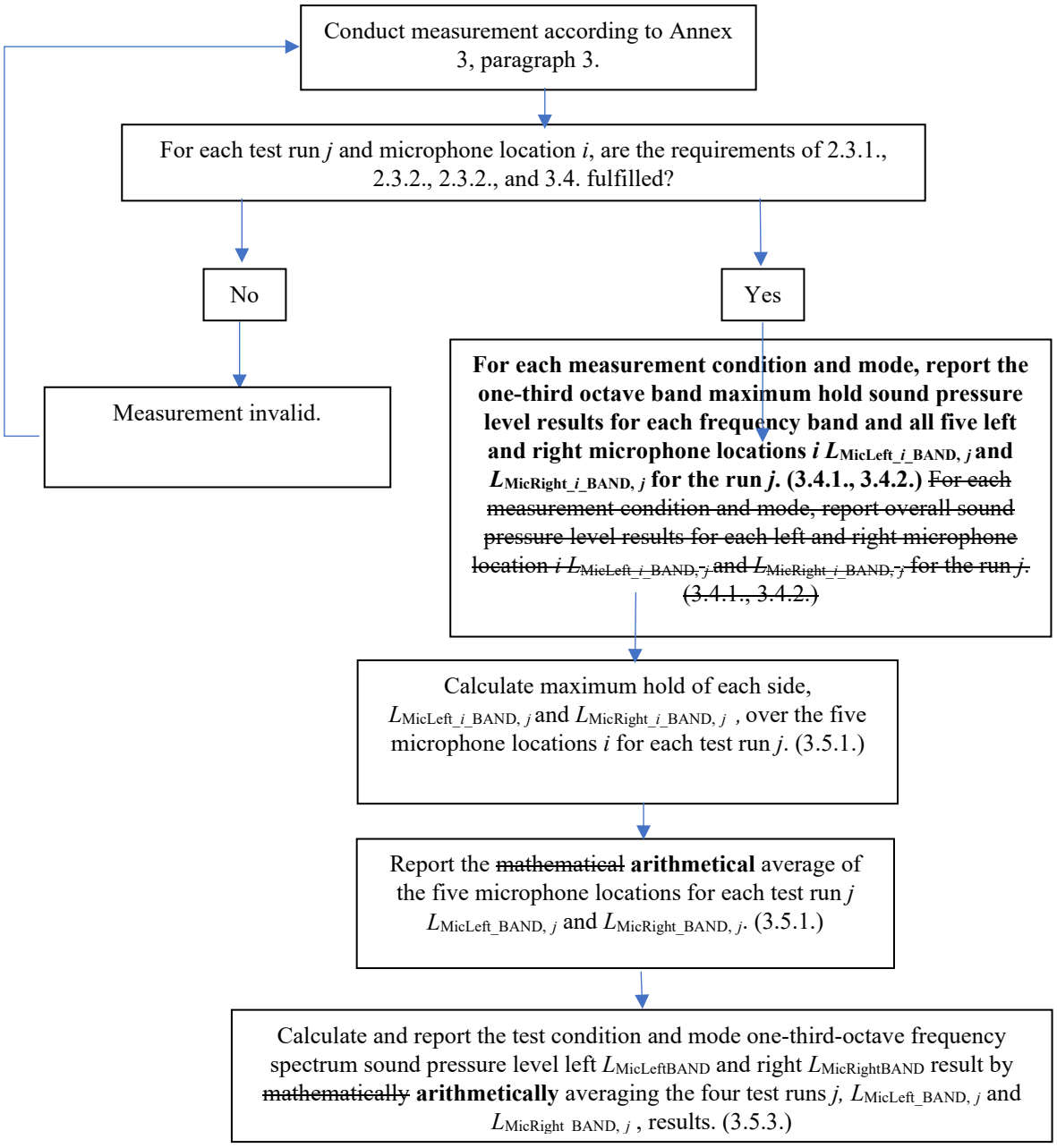
1) **First reduce the five microphones to a single result for each measurement run *j*. In this case, the maximum overall sound pressure level in each microphone *i* is arithmetically averaged to produce the final result.**

2) **Average the four *j* measurement runs to provide the final answer for the test condition and mode.**

Annex 3, Appendix, Figure 7., amend to read:

Figure 7.

Flowchart for the procedure to measure and report A-weighted one third octave sound pressure levels



The purpose of Figure 7 is to show how to go from the five microphone results for each measurement run to a final answer. It conceptually has two major steps:

1) **First reduce the five microphones to a single result for each measurement run *j*. In this case, the maximum one-third-octave sound pressure level in each frequency in each microphone *i* is measured. Then these five spectra are again reduced to a single spectrum by taking the maximum one-third-octave sound pressure level in each frequency. The result is then the reported frequency spectrum for a given test run *j*.**

2) **Average the four *j* measurement runs to provide the final answer for the test condition and mode.**

II. Justification

1. Extra “in” in the 5th paragraph deleted..

2. Clarification that the one-third octave spectrum shall be reported as a spectrum and giving the spectral range. Consistent with text of 6.2 of the main body.

3. Clarification that it is the overall sound pressure levels to which the 2dB data quality check applies, not the one-third octave spectral frequencies. Add new sentences to clarify how to determine the vehicle location relative to the specified points on the track. Add new sentences to clarify the measurement zone for different performance specifications in this regulation.

4. Clarification that the overall level is reported on the lower of the two sides. There is a conflict in the text in the fourth paragraph of this section. Further to specify that the one-third octave spectral results are reported on both sides of the vehicle, consistent with the need to provide safety performance at all positions of the vehicle. Some editorial corrections in paragraph two.

5. Clarify, by way of adding sub-paragraphs, the processing of the five microphone array location to come to a single left and right microphone result for both overall sound pressure level and one-third octave sound pressure level spectral results. This single microphone result is then used in the same manner as for previous versions of this regulation.

6. Clarify the correct equations for coming to the final test condition result when averaging the four overall sound pressure level j test runs. Also correct a spelling error in “paragraph”.

7. Clarify the correct equations for coming to the final test condition result when averaging the four one-third octave spectral result j test runs. Clarify the necessary reporting of one-third octave band results.

8. Clarify the measurement zone needed for frequency shift measurement. Remove specification regarding maximum sound levels as they do not belong in the frequency shift section. Maximum sound levels are now described in paragraph 3.4 of Annex 3.

9. Clarify flowchart to note different signal processing methods for calculating background noise levels for overall sound pressure levels and one-third octave sound pressure levels.

10. Add explanatory text to flowchart. Revised “mathematical” to” arithmetical” to avoid misunderstanding of which mathematical process to use.

11. Fix error that overall sound pressure levels were specified when one-third octaves are the correct result to be calculated. Also added explanatory text to the flowchart. Revised “mathematical” to ”arithmetic” to avoid misunderstanding of which mathematical process to use.