Comments to TFRWS-23-08 and tuned proposals introduced in TFRWS-24-02

2021-07-03, Per-Uno Sturk, Volvo Technology

This presentation was produced to aid the discussions in the 24th meeting, however updated with regards to slide 11 on request of the meeting.
Non-self-adjusting

14.2.2.1: “Non-self-adjusting audible reverse warning device” or “Multiple audible reverse warning system” shall emit sound:

- **Low**: 45 – 60 dBA @ 7 m
- **Normal**: 60 – 75 dBA @ 7 m
- **High**: 80 – 95 dBA @ 7 m

**GREWUS**: \( \text{Delta SPL} = 20 \times \log \left( \frac{L_1}{L_2} \right) = +16.9 \text{ dBA} \) (where \( L_1=7 \text{ m} \) & \( L_2=1 \text{ m} \)):

Range and Average limit values @ 1m \((\text{max+min})/2 +16.9 \text{ dBA} \):

<table>
<thead>
<tr>
<th>Mode</th>
<th>Range @ 1 m</th>
<th>Average @ 1 m</th>
<th>State-of-the-art @ 1 m</th>
<th>SAE @ 1,2 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>62 - 77 dBA</td>
<td>69 dBA</td>
<td>72 dBA</td>
<td>77 ± 4 dBA</td>
</tr>
<tr>
<td>Normal</td>
<td>77 - 92 dBA</td>
<td>84 dBA</td>
<td>87 dBA</td>
<td>87 ± 4 dBA</td>
</tr>
<tr>
<td>High</td>
<td>97 - 112 dBA</td>
<td>104 dBA</td>
<td>102 dBA</td>
<td>107 ± 4 dBA</td>
</tr>
</tbody>
</table>
Reference sound for testing *self-adjusting*

6.4.7 A reference sound, simulating ambient noise, emitted by the loudspeaker has to play pink noise at three different SPLs:

- **Low level:** 45 dBA
- **Normal Level:** 60 dBA
- **High Level:** [80] 75 dBA

*Per-Uno:* To be aligned with non-self-adjusting.
Self-adjusting

6.4.8 Under the conditions set forth above, the sound-pressure level weighted in accordance with curve A shall comply to the following sound level values, including allowed variability of \([ \pm 4 \text{ dB}]\), for “Self-adjusting audible reverse warning device”

- **Low Verification level 1:** \(45 \text{ dB(A)} \) @ 7 m plus \([+22 \text{ dB(A)}] \pm 4 \text{ dB(A)}\) \(\Rightarrow 67 \pm 4 \text{ dB(A)} @ 1 \text{ m}\)
- **Normal Verification Level 2:** \([60] 55 \text{ dB(A)} \) @ 7 m plus \([+22 \text{ dB(A)}] \pm 4 \text{ dB(A)}\) \(\Rightarrow 82 \pm 4 \text{ dB(A)} @ 1 \text{ m}\)
- **Normal Level 2:** 70 dB(A) plus \([+22 \text{ dB(A)}] \pm 1 \text{ dB(A)}\) \(\Rightarrow 102 \pm 4 \text{ dB(A)} @ 1 \text{ m}\)
- **High Verification Level 3:** 80 dB(A) @ 7 m plus \([+22 \text{ dB(A)}] \pm 4 \text{ dB(A)}\) \(\Rightarrow 102 \pm 4 \text{ dB(A)} @ 1 \text{ m}\)

**GREWUS:**
The term : +5 dB(A) is not correct, it has to be +22 dB(A).
The reason: The ambient noise is around the vehicle homogenous. This means the same ambient noise at 1m behind the vehicle as well as 7m behind. If the SPL is just 5 dBA @ 1 m distance higher than the ambient noise, the SPL would be e.g. at 45 dBA ambient noise just 50 dBA which means as written above 50 dBA -16.9 dBA = 33,1 dBA at 7 m this is not loud enough.

**CLEPA** suggests \(\pm 4 \text{ dB(A)}\) (TFRWS-23-07)

**Per-Uno:** Replace 55 dB(A) with 60 dB(A) and delete “Normal level 2” to align with Non-self-adjusting.
6.4.9. Under the conditions set forth above, the recorded sound-pressure levels, weighted in accordance with curve A, divided into at least three separate sound level ranges, shall and then fall inside the following sound level modes for “Stepwise Self-adjusting audible reverse warning device”:

Alternative 1:
- equal to [62] dB (A) and not more than [77] dB (A) for the signal of “Low Level”
- equal to [77] dB (A) and not more than [92] dB (A) for the signal of “Normal Level”
- equal to [97] dB (A) and not more than [112] dB (A) for the signal of “High Level”

Alternative 2:
- equal to [72 ± 4] dB(A) for the signal of “Low Level”
- equal to [87 ± 4] dB(A) for the signal of “Normal Level”
- equal to [102 ± 4] dB(A) for the signal of “High Level”

Other distributions of sound level ranges are accepted as long as they cover the total range of at least 62+4 dB(A) to 112-4 dB(A).

… continue on next slide…

**GREWUS**: For non self-adjustable alarms and stepwise adjustable alarms the SPL values will be the same.
Stepwise self-adjusting

GREWUS: The following graphic explains the meaning:

Between 50dBA and 55dBA as well as 65dBA and 70dBA two modes are possible.

Explanation of this behaviour:

- The vehicle is in a quiet area, only few times the noise exceeds 50dBA than the Alarm remains in Low.
- Over a wide range from 50-70dBA it will stay in normal mode.
Self-adjusting

14.2.2.2. “Self-adjusting audible reverse warning device” shall be at least:

\[ + 5 \text{ dB(A)} \pm 1 \] in addition to the reference sound – measured at the test microphone – in the range of [40 to 95] dB(A)

**GREWUS:** This value is not meaningful; it belongs to a distance of 7m behind the vehicle because it is in the second part. The alarm can not be as low as 40-16,9= 23,1dBA.

**Per-Uno:** This value shall be understood as measured at the test microphone at 7 m and not as the output of the alarm. The corresponding alarm shall be 22 dB above the reference sound, measured at 1 m from the alarm.
Stepwise self-adjusting

14.2.2.3. “Stepwise self-adjusting audible reverse warning device”:

The sound pressure level, measured in accordance with 14.5, shall comply with the requirements below, with a tolerance of [± 4]:

- Low level, Verification level 1: [45] dB(A) plus x dB(A) [5] dB
- Normal Verification Level 2: [60] dB(A) plus x dB(A) [5] dB
- Normal Level 2: [70] dB(A) plus x dB(A) [5] dB
- High Verification Level 3: [80] dB(A) plus x dB(A) [5] dB

The vehicle verification test shall at least cover one of the prescribed levels under condition that the device has been proven to comply with the requirements described in Part I in this document.

GREWUS: Not needed because the stepwise should exactly as high as the non-self adjusting. The stepwise adjustable just automatically switches into the three modes.

Per-Uno: The reverse warning device mounted on the vehicle may only be verified at one background noise level, provided that the function already has been verified in accordance with the Part I test.
Part II: Measurement set-up & measured levels

The “background” sound level shall be the same at the self-adjusting RWS device and at the measurement microphone.

The alarm shall produce a sound that exceeds the background level measured at the microphone by more than $5 \pm 4$ dBA at 7 m.

Because the alarm is 7 m from the microphone the alarm shall produce a level of $17 + 5 \pm 4$ dBA higher than the background/reference sound level at 1 m – at the measurement position according to Part I.

Part I: Measured alarm level:
- Low level: $67 \pm 4$ dBA
- Normal Level: $82 \pm 4$ dBA
- High Level: $97 \pm 4$ dBA

Part II: Measured alarm level:
- Low level: $50 \pm 4$ dBA
- Normal Level: $65 \pm 4$ dBA
- High Level: $80 \pm 4$ dBA

Measured (reference) ambient level:
- Low level: $45$ dBA
- Normal Level: $60$ dBA
- High Level: $75$ dBA
Part I: Measurement set-up & measured levels

The loudspeaker for reference sound shall produce the same “background” sound level at the self-adjusting device and at the measurement microphone, simulating the background noise in a realistic situation.

The measurement shall first monitor the right reference sound level and secondly secure that the alarm produce a sound that exceed the background level by more than 17+5 ± 4 dBA.

1: Measured (reference) ambient level:
- Low level: 45 dBA
- Normal Level: 60 dBA
- High Level: 75 dBA

2: Measured alarm level:
- Low level: 67 ± 4 dBA
- Normal Level: 82 ± 4 dBA
- High Level: 97 ± 4 dBA