



# Measurement Method Proposal for self-adjusting reverse warning devices

TFRWS - 8th Session

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# Definition of audible reverse warning devices

## *Self-adjusting options*

- 2.1.1. “Non-self-adjusting audible reverse warning device” means a device which gives an audible reverse warning sound independent of ambient sound levels
- 2.1.2. “Self-adjusting audible reverse warning device” means a device which *automatically adjusts its sound level, throughout a defined range, in order to maintain a sound level differential between the sound output of the device and the ambient sound measured by the device*

### Proposal:

- 2.1.3 “Stepwise self-adjusting audible reverse warning device” means a device which automatically adjusts to 1 of 3 fixed sound level modes (low, normal, high), depending on the ambient sound measured by the device

### Background:

- Measurements showed that **3 fixed sound levels** are sufficient for most environments. Stepwise self-adjusting devices overcome the disadvantage of the (mis-)judging of a driver choosing manually a sound level mode and running cables to the driver’s cabin. In every case a stepwise self-adjusting system is preferable to a non-self-adjusting audible reverse warning device for vehicles where the device is attached within the last meter of the vehicle (e.g. no vehicles with trailers).

# Frequency Range of Tonal Sounds

## 2.7

“*Tonal Sound*” means a sound which contains basically a single frequency, which is described as a pure tone sound commonly in the frequency range from [1200 Hz to 3500 Hz]

### Proposal:

- 2.7. “*Tonal Sound*” means a pure tone sound which contains a basic frequency with its harmonics, commonly in the frequency range from [1000 Hz to 3500 Hz]

### Background:

- Lower than 1200 Hz frequency ranges of tonal sounds are also in the market

# Frequency Range of Tonal Sounds

## 6.4.10.

To confirm the rated sound frequency (or frequency range) of audible reverse warning device the tests to measure this parameter using a spectrum analyzer with a frequency resolution of at least 1 Hz shall be conducted. The measured frequency (or frequency range) of the audible reverse warning device may differ from the rated sound frequency (or frequency range) no more than 10 per cent.

### Proposal

- To confirm the rated sound frequency (or frequency range) of audible reverse warning device the tests to measure this parameter using a spectrum analyzer with a frequency resolution of at least 1 Hz shall be conducted. The measured basic frequency (or frequency range) of the audible reverse warning device has to be within the range of 1k to 3.5k Hz. The frequency should be measured for 10 cycles and must not differ more than 10 per cent between each cycle. To measure the frequency (or frequency range) the loudspeaker for ambient noise simulation has to be switched off.

### Background:

- Not the deviation to the rated sound frequency but the **basic frequency** of the device should be tested. That would test if the frequency is within the **allowed range** of 1k to 3.5k Hz. If the rated sound frequency is equal to the actual frequency of a device is a question of quality and measured by the supplier or customer.

## 6.4. Measurement Method Proposal

*Stepwise-Self-adjustable audible reverse warning device to ambient sound emission*

### Proposal:

To **simulate ambient noise** a loudspeaker has to play pink noise at 4 different SPLs:

- Low level: 45dBA
  - Normal Level: 55 dBA
  - Normal Level: 70 dBA
  - High Level: 80 dBA
- 
- Definition of pink noise: Pink noise is defined as random noise, where each octave carries an equal amount of noise energy throughout the frequency range of at least 200 Hz to 8000 Hz.

# 6.4. Measurement Method Proposal

## *Stepwise-Self-adjustable audible reverse warning device to ambient sound emission*

### Background:

- For stepwise-selfadjustable alarms one can define SPLs of the ambient noise when the alarm has to switch to a certain level and when it can switch to a certain level, for example:

Ambient noise	Selfadjustable alarm setting	Remark
SPL < 45dBA	Low	The system <u>has to</u> switch in low sound mode
45 ≤ SPL < 55 dBA	Low	The system <u>can</u> switch in low but it is allowed to stay in normal sound
55 ≤ SPL ≤ 70 dBA	Normal	The system should stay in normal sound
70 < SPL < 80 dBA	High	The system <u>can</u> switch in high sound but is allowed to stay in normal
>80dBA	High	The System <u>has to</u> switch in high modus

Table 1

- For measurement procedure it is reasonable to test the levels where the alarm has to be in a certain sound mode, so for the levels **45dBA, 55dBA, 70dBA and 80dBA.**

# 6.4. Measurement Method Proposal

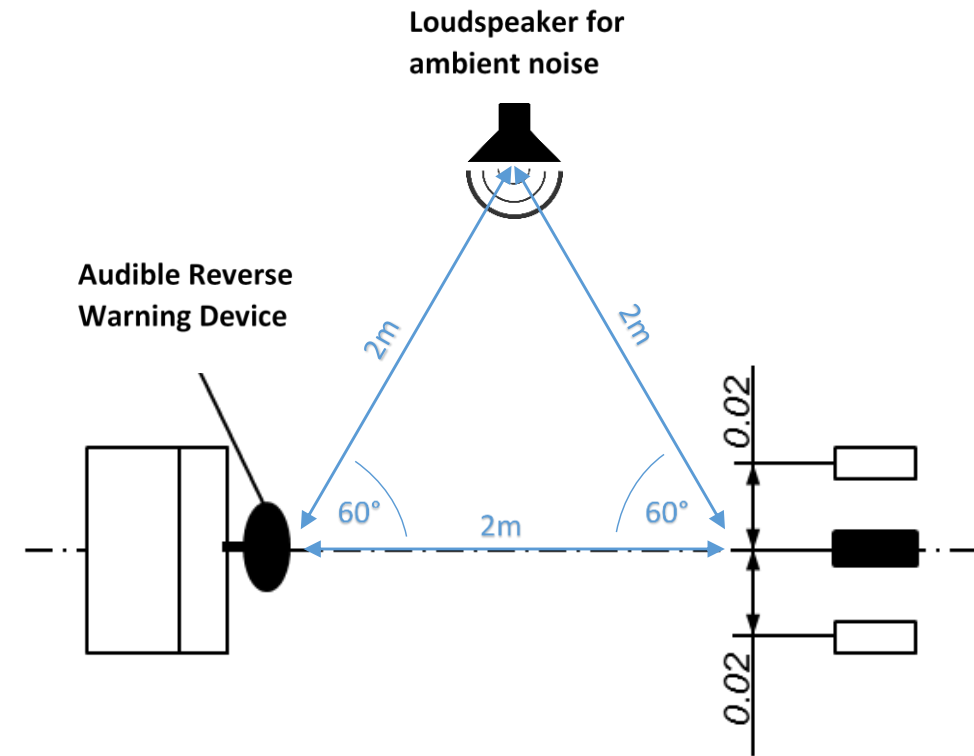
## *Stepwise-Self-adjustable audible reverse warning device to ambient sound emission*

### 6.4.2.

The audible reverse warning device to be tested, the microphone and the loudspeaker shall be placed at the same height. This height shall be  $1.20 \pm 0.05$  m. In alternative, the audible reverse warning device to be tested, the microphone and the loudspeaker may be placed in another traverse line which complies with Annex 3 specification for anechoic environment.

The microphone shall be so placed that its diaphragm is at a distance of  $2.00 \pm 0.05$  m from the plane of the sound outlet of the audible reverse warning device. The microphone must be positioned facing the front surface emitting sound of the audible reverse warning device in the direction in which the maximum sound level can be measured. The loudspeaker for ambient noise is placed at a distance of 2.00m from the audible reverse warning device and from the microphone, facing between the microphone and the audible reverse warning device.

See figure.



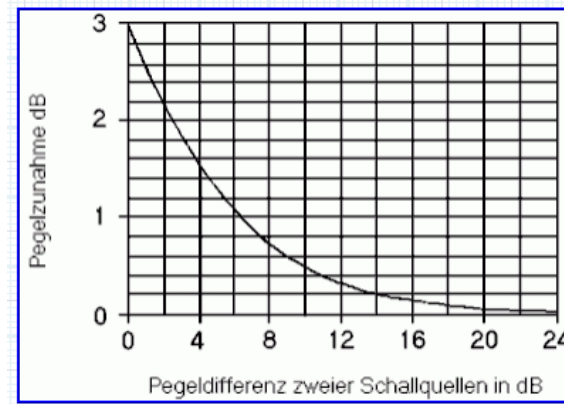


# 6.4. Measurement Method Proposal

## *Stepwise-Self-adjustable audible reverse warning device to ambient sound emission*

### Background:

- A loudspeaker should simulate ambient noise. **Pink noise** is proposed because it is a common measurement signal, has a uniform temporal characteristic and its frequency spectrum is most similar to average ambient noise.
- The position of the loudspeaker should have the same distance to the microphone and the alarm. This ensures the same ambient noise level at both positions.
- SPL gain from the summation of the two signals (alarm and ambient noise) is negligible:  
The SPL difference is  $\geq 5$  dB  
therefore the gain would be  $\leq 1$ dB.



# 6.4. Measurement Method Proposal

## 6.4.7 Sound pressure levels for stepwise-self-adjustable audible reverse warning devices

### Proposal:

Ambient noise SPL		Tonal warning sound		
		Min	Typ	Max.
Low Level	45	64	<b>67</b>	70
Normal Level	65	77	<b>81</b>	83
High Level	80	90	<b>96</b>	96

Ambient noise SPL		1/3 Octave warning sound		
		Min	Typ	Max.
Low Level	45	62	<b>64</b>	68
Normal Level	65	75	<b>78</b>	81
High Level	80	88	<b>93</b>	94

Table 2

### Additions to the SPLs:

- For special mounting positions the SPLs may be exceeded. Furthermore the test on the vehicle in [14.6] has to be passed
- For the case that the 1/3-octave band of the signal adapts dynamically to the ambient noise, the SPLs can be 3dB below.
- The required SPL has to be achieved after a maximum of 2 cycles of the warning sound

# 14.6. Measurement Method Proposal on stationary vehicle

## *Stepwise Self-adjusting audible reverse warning device*

### Proposal:

- 1/3 octave sound: microphone at 1m height, variation of height is not needed (like for tonal sounds)
- Type Approval for device has to be available (to assure self-adjusting function)
- The device has to be mounted at the position in conformity with the specification of the device type approval
- If the device is intended for a special mounting position, the manufacturer of the vehicle has to ensure that the required SPLs are reached.
  
- Measure present ambient noise
- Measure SPL of reverse warning device
  - Requirement: SPL of [Table 2] minus 11dB **for a distance of 7m**

# Attachment: Exemplary Measurement

## *6.4. Measurement of the sound characteristics (Stepwise-Self-adjustable audible reverse warning device to ambient sound emission)*

Signal	SPL in dBA
Pink Noise 45dBA	45.2
Reverse Warning Device LOW	64.2
Pink Noise 45dBA and Reverse Warning Device LOW	64.3
Pink Noise 55dBA	55.3
Reverse Warning Device NORMAL	77.4
Pink Noise 55dBA and Reverse Warning Device NORMAL	77.3
Pink Noise 70dBA	69.8
Reverse Warning Device NORMAL	77.1
Pink Noise 70dBA and Reverse Warning Device NORMAL	77.2
Pink Noise 80dBA	80.7
Reverse Warning Device HIGH	93.4
Pink Noise 80dBA and Reverse Warning Device HIGH	93.7



XL2 Sound Level Meter Broadband Reporting

Hardware Configuration:

Device Info: XL2, SNo. A2A-15730-E0, FW4.10  
Mic Type: NTi Audio M4261, SNo. 2409, Factory adjusted  
Mic Sensitivity: 16.3 mV/Pa  
Time Zone: UTC+02:00 (Europe/Berlin, DST)

Measurement Setup:

Timer set: 00:01:30  
Range: 30 - 130 dB