

TFVS-04-12
Management of
Noise emissions according to UN-R51-03 at low speeds
vs. AVAS compliant to UN-R138

Matching AVAS Requirements (UN R138) with RD-ASEP (UN-R51) Background “Minimum Sound Requirements”

- The regulation UN R138.01 on minimum sound requirements specifies minimum and maximum sound level for the speed range between > 0 km/h and 20 km/h under the driving conditions specified by the regulation.
- The US standards FMVSS 141 specifies minimum sound requirements for the speed range 0 km/h until 32 km/h. Maximum sound is not specified.
- Both standards do not mandate a specific maximum operation speed to enable manufacturer a flexible fading of eventual operating sound enhancement systems (AVAS).
- Manufacturer need a off-set to the minimum sound requirements for safe qualification. Manufacturer differentiate between low load vehicle operation (such as cruising) and medium/high load operation (acceleration) to properly safe the intention of the regulation.
- Vehicles compliant with UN R138 and FMVSS141 and other international standards on minimum sound (China GB/T 37153, Korea KMVSS 53-3, ...) shall not fail RD-ASEP.
- It is necessary to make UN R138.01 more specific regarding the operation range of AVAS for exclusion in RD-ASEP.
- Sound Systems operational beyond this range will then fall under the provisions of RD-ASEP. Therefore, RD-ASEP needs a proper hand-shake to UN R138.



PUBLIC LAW 111–373—JAN. 4, 2011
PEDESTRIAN SAFETY ENHANCEMENT
ACT OF 2010

The motor vehicle safety standard established under this subsection [...] shall allow the pedestrian to reasonably detect a nearby electric or hybrid vehicle in critical operating scenarios including, but not limited to, constant speed, accelerating, or decelerating.

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EN

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REGULATION (EU) No 540/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 16 April 2014

on the sound level of motor vehicles and of replacement silencing systems, and amending
Directive 2007/46/EC and repealing Directive 70/157/EEC

ANNEX VIII

MEASURES CONCERNING THE ACOUSTIC VEHICLE ALERTING SYSTEM (AVAS)

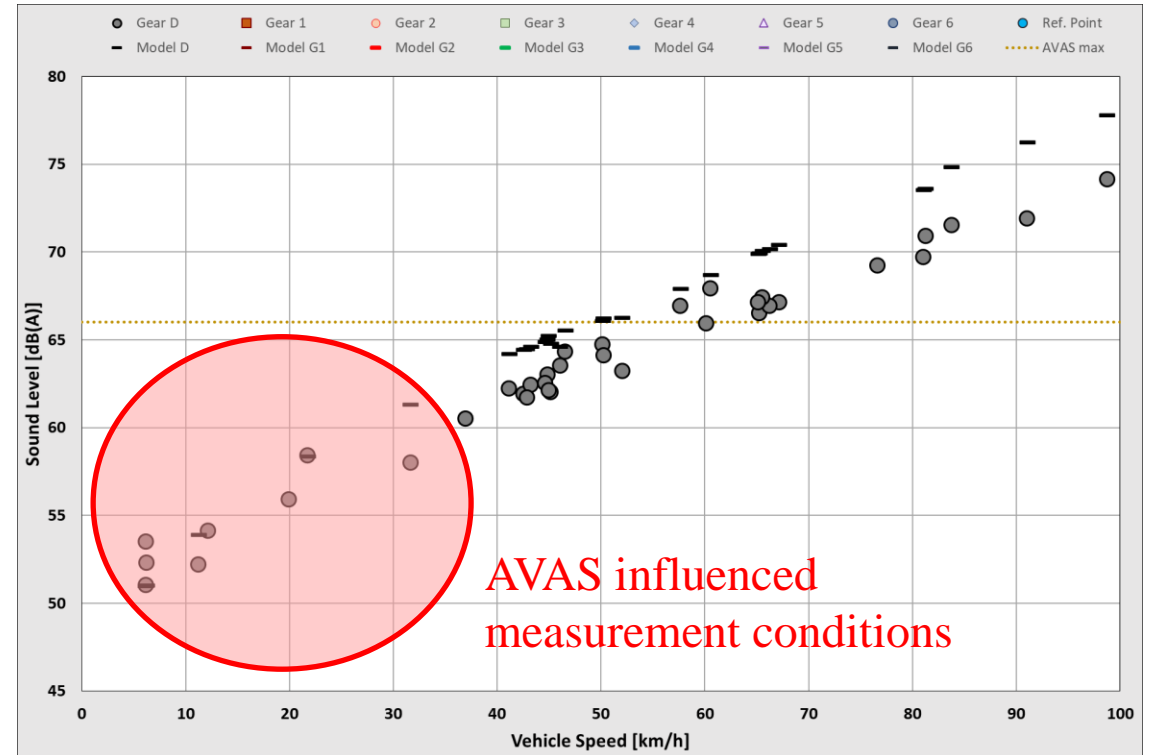
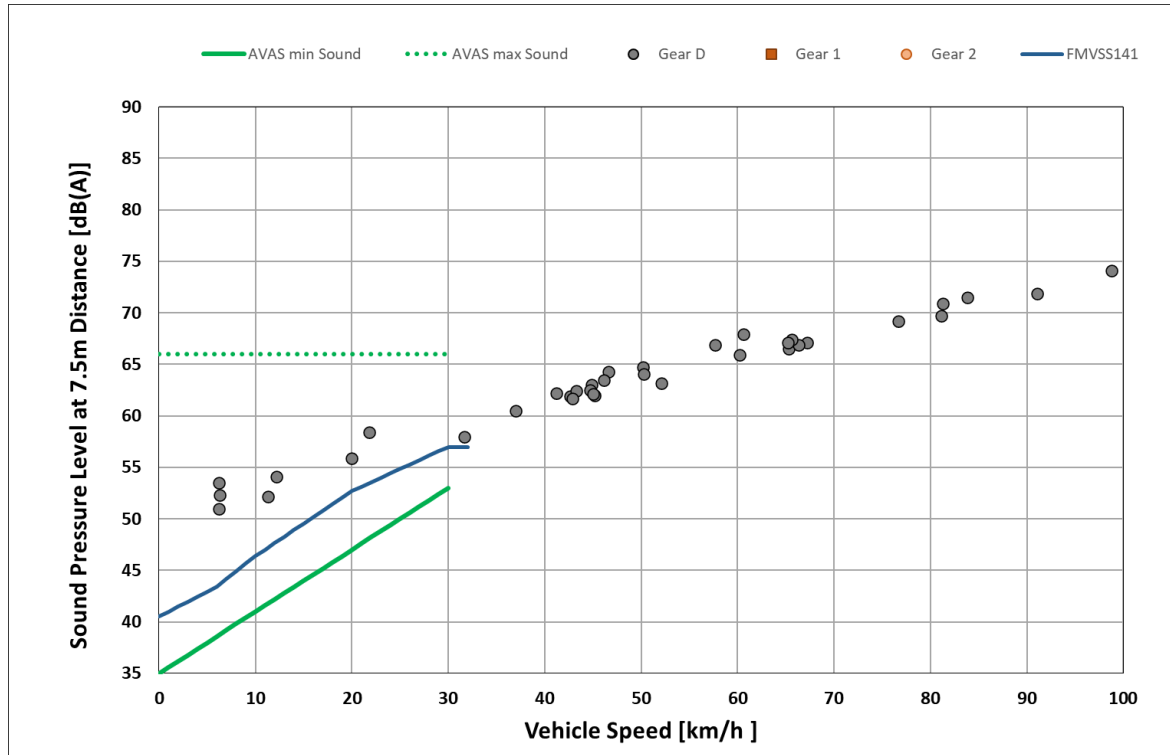
3. Sound type and volume

(a) [...] The sound should be easily indicative of vehicle behaviour and should sound similar to the sound of a vehicle of the same category equipped with an internal combustion engine.

(b) The sound to be generated by the AVAS shall be easily indicative of vehicle behaviour, for example, through the automatic variation of sound level or characteristics in synchronization with vehicle speed.

(c) The sound level generated by the AVAS shall not exceed the approximate sound level of a vehicle of the M1 category equipped with an internal combustion engine and operating under the same conditions.

Conflicts between UN R138 (AVAS Systems) and Draft UN R51.04 RD-ASEP



- Manufacturer have to equip their vehicles with AVAS devices to comply with minimum sound provisions.
- Such systems are operational at speed beyond the scope of UN R138 to meet specifications of other standards.
- According to draft UN R51.04, vehicles will have to comply to RD-ASEP when their sound systems operate outside the specification range of UN R138.
- **AVAS systems fail RD-ASEP especially at lower speeds.**
- It is necessary to create a handshake between UN R138 and UN R51.04 RD-ASEP

Grey Zones in UN R138.01

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 specifications of this Regulation are applicable for the 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 range.** AVAS may be operational independent of the operation of an internal combustion engine inside or outside of the specified operation range.



This provision was primarily made to

- Enable compatibility to USA FMVSS141
- Allow fade-out of sound instead of a sudden shut-off to avoid driver and pedestrian irritations

6.2.7. Specifications on maximum sound level for AVAS

When tested under the **conditions of Annex 3 paragraph 3.3.2.**, a vehicle which is equipped with an AVAS, shall not emit an overall sound level of more than 75 dB(A), if driving in forward direction.³



Annex 3 paragraph 3.3.2. specifies constant speed test only. No specifications are given for sound emission accelerated condition.

³ The maximum overall sound pressure level of 75 dB(A) measured at a distance of 2 m is corresponding to the overall sound pressure level of 66 dB(A) measured at a distance of 7.5 m. The limit value of 66 dB(A) at a distance of 7.5 m **is the lowest permitted maximum value in Regulations established under the 1958 Agreement.**



Refers to UN R63 for mopeds, which provides two limits for vehicles with maximum design speed below and above 25 km/h.

E/CE/324/Rev.1/Add.62/Rev.1
E/CE/TRANS/505/Rev.1/Add.62/Rev.1
Annex 4

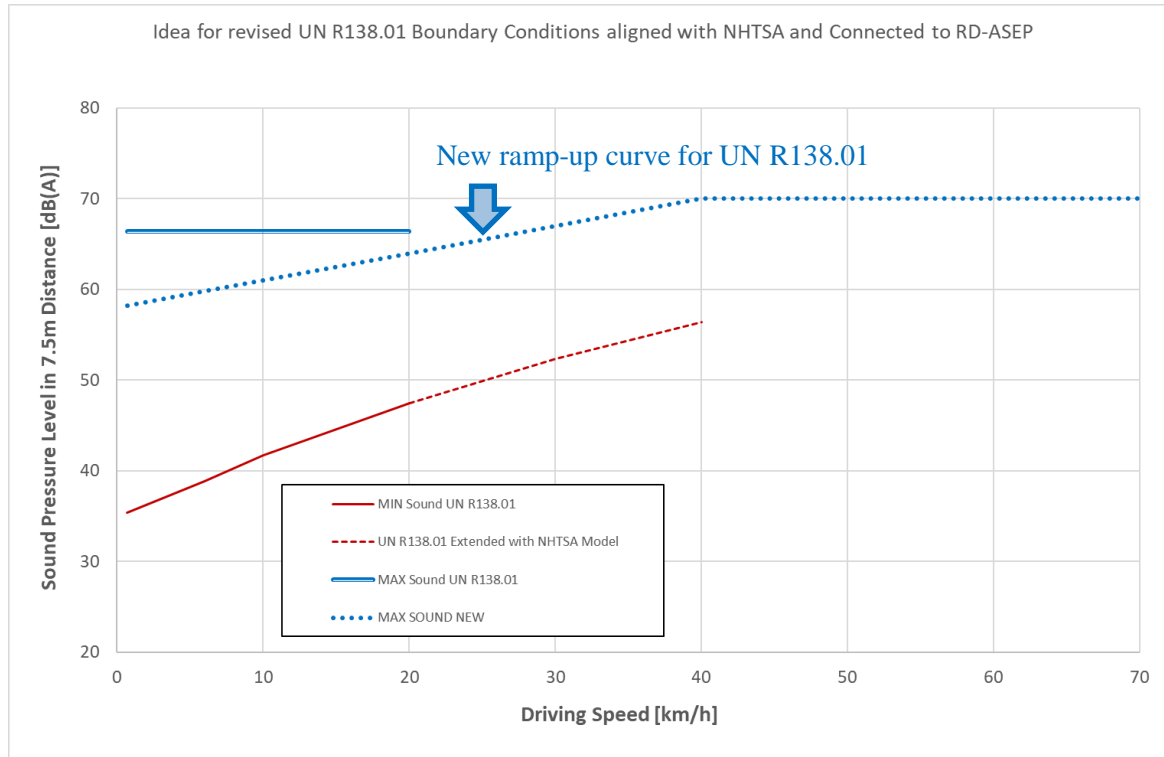
Annex 4

Maximum sound level limits (new mopeds)

| Category of two-wheeled mopeds | Maximum noise-level values in dB(A) |
|--------------------------------|-------------------------------------|
| ≤ 25 km/h | 66 |
| > 25 km/h | 71 |

Limits in force at the time UN R138.00 was developed

Approach for Clarifications in UN R138.01



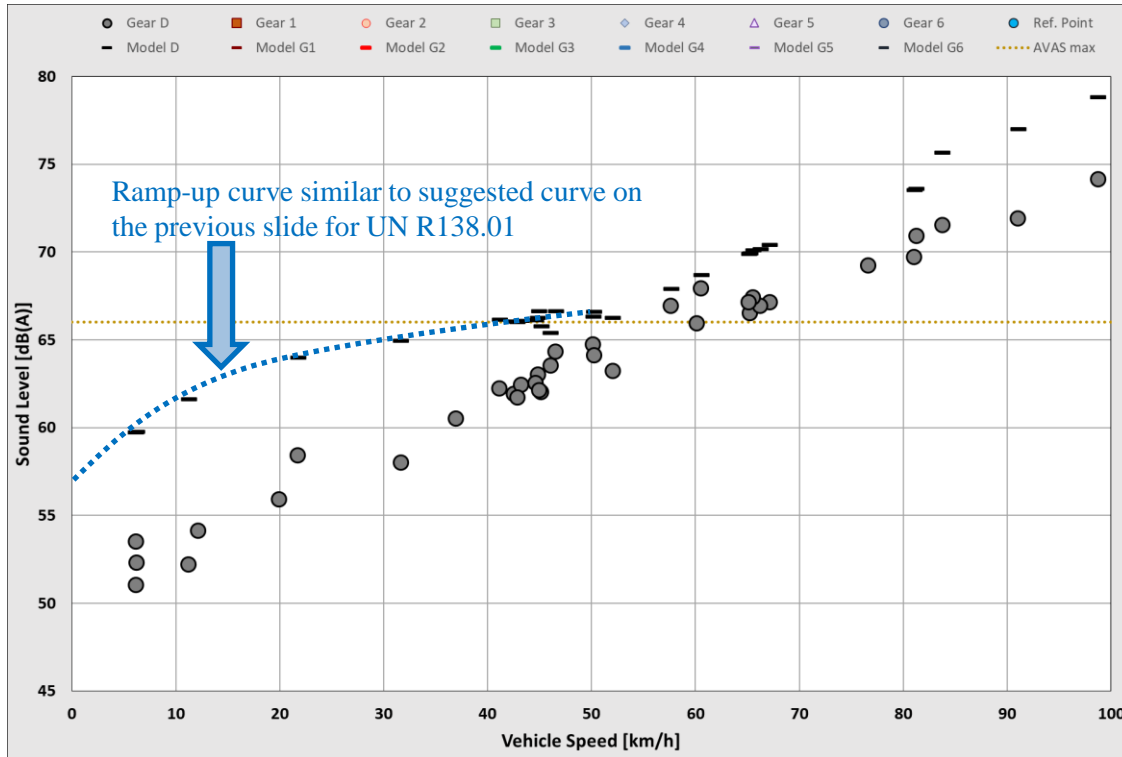
| Calculation of the Stopping Distances (NHTSA Approach) | | | | | | |
|--|-------|-------|--------------------|--------------------|------------|------------|
| Condition | Speed | Speed | t _{brake} | t _{react} | Stopp_time | Stopp_dist |
| | km/ h | m/ s | sec | sec | sec | m |
| Stationary | 0 | 0,0 | 0,0 | 1,5 | 1,5 | 0 |
| Backing | 6 | 1,7 | 0,3 | 1,5 | 1,8 | 3 |
| Cruise-by 10km/h | 10 | 2,8 | 0,5 | 1,5 | 2,0 | 5 |
| Cruise-by 20km/h | 20 | 5,6 | 1,0 | 1,5 | 2,5 | 11 |
| Cruise-by 30km/h | 30 | 8,3 | 1,5 | 1,5 | 3,0 | 19 |
| Cruise-by 40km/h | 40 | 11,1 | 2,1 | 1,5 | 3,6 | 28 |
| Cruise-by 50km/h | 50 | 13,9 | 2,6 | 1,5 | 4,1 | 39 |
| Cruise-by 60km/h | 60 | 16,7 | 3,1 | 1,5 | 4,6 | 51 |
| Cruise-by 70km/h | 70 | 19,4 | 3,6 | 1,5 | 5,1 | 64 |

| | Distance | Decades | Level Red per decade | Correction dB | Corr Rounded dB | NHTSA dB |
|------------------|----------|---------|-------------------------|------------------|--------------------|-------------|
| Stationary | 2 | 0,0 | 4,5 | 0,0 | 0 | 0 |
| Backing | 3 | 0,8 | 4,5 | 3,5 | 4 | 6 |
| Cruise-by 10km/h | 5 | 1,4 | 4,5 | 6,3 | 7 | 6 |
| Cruise-by 20km/h | 11 | 2,5 | 4,8 | 12,0 | 13 | 12,2 |
| Cruise-by 30km/h | 19 | 3,3 | 5,2 | 16,9 | 17 | 16,8 |
| Cruise-by 40km/h | 28 | 3,8 | 5,5 | 21,0 | 21 | 21 |
| Cruise-by 50km/h | 39 | 4,3 | 6 | 25,7 | 26 | 26 |
| Cruise-by 60km/h | 51 | 4,7 | 6 | 28,0 | 28 | 28 |
| Cruise-by 70km/h | 64 | 5,0 | 6 | 30,0 | 31 | 31 |

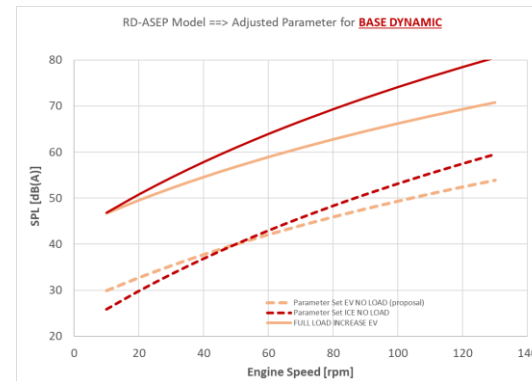
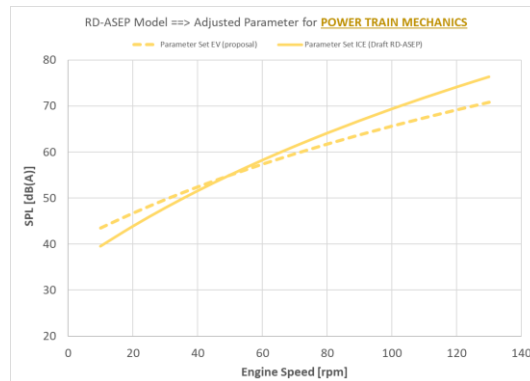
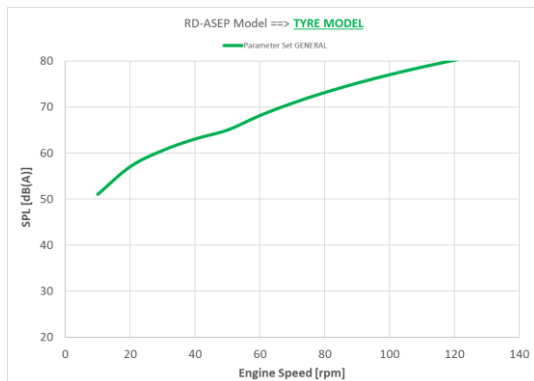
For clarity, the following modifications to UN R138.01 could be considered

- The AVAS operation range is expanded on the basis of the NHTSA model based on UN R138.01 minimum sound levels to allow manufacturer a matching with existing regulations.
- Minimum sound is defined up to 40 km/h.
- Maximum sound no longer constant, but ramped-up from > 0 km/h to 40 km/h and cannot become louder beyond 40 km/h.
- Maximum sound is applicable to any driving condition up to 3 m/s² acceleration, not only to constant speed.
- Vehicles which are equipped with an AVAS fully compliant to these provisions are exempted from RD-ASEP.
- Sound enhancement systems which are operational beyond that speed range are subject to UN R51.03 RD-ASEP → **SEE NEXT PAGE**

Reflection of AVAS and Sound Enhancement Systems into RD-ASEP



- The AVAS max sound ramp-up principle can be established in RD-ASEP by creating a transient between UN R138 to UN R51.04 RD-ASEP.
- The ramp-up function is only applicable to vehicles equipped with AVAS devices which exceed the UN R138.01 application range.
- In addition, the parameter table should be modified for electric vehicles
 - The slope of powertrain mechanics for operation conditions greater than the anchor point is lowered from 115 to 85.
 - The slope of base dynamics for operation conditions greater than the anchor point is lowered from 105 to 75.
 - EVs should be **MANDATED** to take measures to restrict the maximum acceleration during the test to 3 m/s².
 - The rating factor for performance is increased from 10 to 16



The suggested parameter for EVs set the power train and its dynamic in a way, that tyre rolling sound remains always the dominant source.