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 (Text with EEA relevance)

ANNEX VII

MEASURING METHOD TO EVALUATE COMPLIANCE
WITH THE ADDITIONAL SOUND EMISSION PROVISIONS

1.    GENERAL

This Annex describes a measuring method to evaluate compliance of the vehicle with the additional sound emission provisions (ASEP) set out in Article 7.

It is not mandatory to perform actual tests when applying for EU type-approval. The manufacturer shall sign the declaration of compliance set out in the Appendix. The approval authority may ask for additional information about the declaration of compliance and carry out the tests described below.

The procedure set out in this Annex requires the performance of a test in accordance with Annex II. The test specified in Annex II shall be carried out on the same test track under conditions similar to those required in the tests prescribed in this Annex.

2.    MEASURING METHOD

2.1    Measuring instruments and condition of measurements

Unless otherwise specified, the measuring instruments, the conditions of the measurements and the condition of the vehicle are equivalent to those specified in points 2 and 3 of Annex II.

If the vehicle has different modes that affect sound emission, all modes shall comply with the requirements of this Annex. In the case where the manufacturer has performed tests to prove to the approval authority compliance with those requirements, the modes used during those tests shall be reported in a test report.

2.2.    Method of testing

Unless otherwise specified, the conditions and procedures of points 4.1 to 4.1.2.1.2.2 of Annex II shall be used. For the purpose of this Annex, single test runs shall be measured and evaluated.

2.3.    Control range

Operation conditions are as follows:

Vehicle speed $V_{AA \text{ ASEP}}$:    $v_{AA} \geq 20$ km/h

Vehicle acceleration $a_{wot \text{ ASEP}}$    $a_{wot} \leq 5{,}0$ m/s$^2$

Engine speed $n_{BB \text{ ASEP}}$    $n_{BB} \leq 2{,}0 * PMR^{-0{,}222} * s$ or

$n_{BB} \leq 0{,}9 * s$, whichever is the lowest

Vehicle speed $V_{BB \text{ ASEP}}$:

if $n_{BB \text{ ASEP}}$ is reached in one gear    $v_{BB} \leq 70$ km/h

in all other cases    $v_{BB} \leq 80$ km/h

gears    $K \leq$ gear ratio i as determined in Annex II

*Regulation (EU) No 540/2014 of the European Parliament and of the Council of...*
*ANNEX VII*
*Document Generated: 2024-02-03*

3

If the vehicle, in the lowest valid gear, does not achieve the maximum engine speed below 70 km/h, the vehicle speed limit is 80 km/h.

2.4.    Gear ratios

The ASEP requirements apply to every gear ratio K that leads to test results within the control range as defined in point 2.3 of this Annex.

In case of vehicles with automatic transmissions, adaptive transmissions and CVTs tested with non-locked gear ratios, the test may include a gear ratio change to a lower range and a higher acceleration. A gear change to a higher range and a lower acceleration is not allowed. A gear shift which leads to a condition that is not in compliance with the boundary conditions shall be avoided. In such a case, it is permitted to establish and use electronic or mechanical devices, including alternate gear selector positions. In order for the ASEP test to be representative and repeatable (to the approval authority), the vehicles shall be tested using production gearbox calibration.

2.5.    Target conditions

The sound emission shall be measured in each valid gear ratio at the four test points as specified below.

The first test point $P_1$ is defined by using an entry speed $v_{AA}$ of 20 km/h. If a stable acceleration condition cannot be achieved, the speed shall be increased in steps of 5 km/h until a stable acceleration is reached.

The fourth test point $P_4$ is defined by the maximum vehicle speed at BB' in that gear ratio within the boundary conditions in accordance with point 2.3.

The other two test points are calculated using the following formula:

Test Point $P_j$: $v_{BB\_j} = v_{BB\_1} + ((j-1)/3) * (v_{BB\_4 - vBB\_1})$ for j = 2 and 3

Where:

| | | |
|---|---|---|
| $v_{BB\_1}$ | = | vehicle speed at BB' of test point $P_1$ |
| $v_{BB\_4}$ | = | vehicle speed at BB' of test point $P_4$ |

Tolerance for $v_{BB\_j}$: ±3 km/h

For all test points the boundary conditions as specified in point 2.3 shall be met.

2.6.    Test of the vehicle

The path of the centreline of the vehicle shall follow line CC' as closely as possible throughout the entire test, starting from the approach to line AA' until the rear of the vehicle passes line BB'.

At line AA' the accelerator shall be fully depressed. To achieve a more stable acceleration or to avoid a down shift between line AA' and BB' pre-acceleration before line AA' may be used. The accelerator shall be kept in depressed condition until the rear of the vehicle reaches line BB'.

For every separate test run, the following parameters shall be determined and noted:

The maximum A-weighted sound pressure level of both sides of the vehicle, indicated during each passage of the vehicle between the two lines AA' and BB', shall be mathematically rounded to the first decimal place ($L_{wot,kj}$). If a sound peak obviously out of character with the general sound pressure level is observed, the measurement shall be discarded. Left and right side may be measured simultaneously or separately.

The vehicle speed readings at AA' and BB' shall be reported with the first significant digit after the decimal place ($v_{AA,kj}$; $v_{BB,kj}$).

If applicable, the engine speed readings at AA' and BB' shall be reported as a full integer value ($n_{AA,kj}$; $n_{BB,kj}$).

The calculated acceleration shall be determined in accordance to the formula in point 4.1.2.1.2 of Annex II and reported to the second digit after the decimal place ($a_{wot,test,kj}$).

3.        ANALYSIS OF RESULTS

3.1.        Determination of the anchor point for each gear ratio

For measurements in gear i and lower, the anchor point consists of the maximum sound level $L_{woti}$, the reported engine speed $n_{woti}$ and vehicle speed $v_{woti}$ at BB' of gear ratio i of the acceleration test in Annex II.

$$L_{anchor,i} \quad = \quad L_{woti,Annex\ II}$$
$$n_{anchor,i} \quad = \quad n_{BB,woti,Annex\ II}$$
$$v_{anchor,i} \quad = \quad v_{BB,woti,Annex\ II}$$

For measurements in gear i+1 the anchor point consists of the maximum sound level $L_{woti+1}$, the reported engine speed $n_{woti+1}$ and vehicle speed $v_{woti+1}$ at BB' of gear ratio i+1 of the acceleration test in Annex II.

$$L_{anchor,i+1} \quad = \quad L_{woti+1,Annex\ II}$$
$$n_{anchor,i+1} \quad = \quad n_{BB,woti+1,Annex\ II}$$
$$v_{anchor,i+1} \quad = \quad v_{BB,woti+1,Annex\ II}$$

3.2.        Slope of the regression line for each gear

The sound measurements shall be evaluated as a function of engine speed in accordance with point 3.2.1.

3.2.1.        Calculation of the slope of the regression line for each gear

The linear regression line is calculated using the anchor point and the four correlated additional measurements.

$$Slope_k = \frac{\sum_{j=1}^{5}(n_j - \bar{n})(L_i - \bar{L})}{\sum_{j=1}^{5}(n_j - \bar{n})^2}$$

(in dB/1 000 min$^{-1}$)

With
$$\bar{L} = \frac{1}{5}\sum_{j=1}^{5} L_j$$
and
$$\bar{n} = \bar{n}\frac{1}{5}\sum_{j=1}^{5} n_j$$

where $n_j$ = engine speed measured at line BB'

3.2.2.        Slope of the regression line for each gear

The $Slope_k$ of a particular gear for the further calculation is the derived result of the calculation in point 3.2.1 rounded to the first decimal place, but not higher than 5 dB/1 000 min$^{-1}$.

3.3.        Calculation of the linear sound level increase expected for each measurement

*Regulation (EU) No 540/2014 of the European Parliament and of the Council of...*
*ANNEX VII*
*Document Generated: 2024-02-03*

5

The sound level $L_{ASEP,kj}$ for measurement point j and gear k shall be calculated using the engine speeds measured for each measurement point, using the slope specified in point 3.2 to the specific anchor point for each gear ratio.

For $n_{BB\_k,j} \leq n_{anchor,k}$:

$$L_{ASEP\_k,j} = L_{anchor\_k} + (Slope_{k-Y}) * (n_{BB\_k,j - nanchor,k})/1\ 000$$

For $n_{BB\_k,j} > n_{anchor,k}$:

$$L_{ASEP\_k,j} = L_{anchor\_k} + (Slope_k + Y) * (n_{BB\_k,j - nanchor,k})/1\ 000$$

Where Y = 1

### 3.4. Samples

On request of the approval authority two additional runs within the boundary conditions in accordance with point 2.3 shall be carried out.

### 4. INTERPRETATION OF RESULTS

Every individual noise measurement shall be evaluated.

The sound level of every specified measurement point shall not exceed the limits given below:

$$L_{kj} \leq L_{ASEP\_k.j} + x$$

With:

| | | |
|---|---|---|
| x | = | 3 dB(A) for vehicle with a non-lockable automatic transmission or non-lockable CVT |
| x | = | 2 dB(A) + limit value – $L_{urban}$ of Annex II for all other vehicles |

If the measured sound level at a point exceeds the limit, two additional measurements at the same point shall be carried out to verify the measurement uncertainty. The vehicle is still in compliance with ASEP, if the average of the three valid measurements at this specific point fulfils the specification.

### 5. REFERENCE SOUND ASSESSMENT

The reference sound is assessed at a single point in one discrete gear, simulating an acceleration condition starting with an entry speed at $v_{aa}$ equal to 50 km/h and assuming an exit speed at $v_{bb}$ equal to 61 km/h. The sound compliance at this point can either be calculated using the results of point 3.2.2 and the specification below or be evaluated by direct measurement using the gear as specified below.

### 5.1 The determination of gear K is as follows:

| | | |
|---|---|---|
| K | = | 3 for all manual transmission and for automatic transmission with up to 5 gears; |
| K | = | 4 for automatic transmission with 6 or more gears |

If no discrete gears are available, e.g. for non-lockable automatic transmissions or non-lockable CVTs, the gear ratio for further calculation shall be determined from the acceleration test result in Annex II using the reported engine speed and vehicle speed at line BB'.

### 5.2. Determination of reference engine speed $n_{ref\_K}$

The reference engine speed, $n_{ref\_K,}$ shall be calculated using the gear ratio of gear K at the reference speed of $v_{ref} = 61$ km/h.

5.3.      Calculation of $L_{ref}$

$L_{ref} = L_{anchor\_K} + Slope_K * (n_{ref\_K - nanchor\_K})/1\ 000$

$L_{ref}$ shall be less than or equal to 76 dB(A).

For vehicles fitted with a manual gear box having more than four forward gears and equipped with an engine developing a rated maximum net power greater than 140 kW and having a rated maximum net power/maximum-mass ratio greater than 75 kW/t, $L_{ref}$ shall be less than or equal to 79 dB(A).

For vehicles fitted with an automatic gear box having more than four forward gears and equipped with an engine developing a rated maximum net power greater than 140 kW and having a rated maximum net power/maximum-mass ratio greater than 75 kW/t, $L_{ref}$ shall be less than or equal to 78 dB(A).

6.      EVALUATION OF ASEP USING THE PRINCIPLE OF $L_{urban}$

6.1      General

This evaluation procedure is an alternative selected by the manufacturer to the procedure described in point 3 of this Annex and is applicable to all vehicle technologies. The manufacturer shall be responsible for determining the correct manner of testing. Unless otherwise specified, all testing and calculation shall be as specified in Annex II.

6.2.      Calculation of $L_{urban\ ASEP}$

From any $L_{wot\ ASEP}$ as measured in accordance with this Annex, $L_{urban\ ASEP}$ shall be calculated as follows:

(a)      calculate $a_{wot\ test\ ASEP}$ as specified in point 4.1.2.1.2.1 or point 4.1.2.1.2.2 of Annex II, as applicable;

(b)      determine the vehicle speed ($V_{BB\ ASEP}$) at BB' during the $L_{wot\ ASEP}$ test;

(c)      calculate $k_{P\ ASEP}$ as follows:

$k_{P\ ASEP} = 1 - (a_{urban}/a_{wot\ test\ ASEP})$

Test results where $a_{wot\ test\ ASEP}$ are less than $a_{urban}$ shall be disregarded.

(d)      calculate $L_{urban\ measured\ ASEP}$ as follows:

$L_{urban\ measured\ ASEP} =$

$L_{wot\ ASEP} - k_{P\ ASEP} * (L_{wot\ ASEP} - L_{crs})$

For further calculation, use the $L_{urban}$ from Annex II without rounding, including the digit after the decimal (xx.x).

(e)      calculate $L_{urban\ normalized}$ as follows:

$L_{urban\ normalized} = L_{urban\ measured\ ASEP} - L_{urban}$

(f)      calculate $L_{urban\ ASEP}$ as follows:

*Regulation (EU) No 540/2014 of the European Parliament and of the Council of...*
*ANNEX VII*
*Document Generated: 2024-02-03*

7

$$L_{\text{urban ASEP}} =$$

$$L_{\text{urban normalized}} - (0,15 * (V_{\text{BB ASEP}} - 50))$$

(g)      compliance with sound level limits:

$L_{\text{urban ASEP}}$ shall be less than or equal to 3,0 dB.

Appendix

Model statement of compliance with the Additional Sound Emission Provisions

(Maximum format: A4 (210 × 297 mm))

(Name of manufacturer) attests that vehicles of this type (type with regard to its sound emission pursuant to Regulation (EU) No 540/2014) comply with the requirements of Article 7 of Regulation (EU) No 540/2014.

(Name of manufacturer) makes this statement in good faith, after having performed an appropriate evaluation of the sound emission performance of the vehicles.

Date:

Name of authorized representative:

Signature of authorized representative:

**Changes to legislation:**

There are outstanding changes not yet made to Regulation (EU) No 540/2014 of the European Parliament and of the Council. Any changes that have already been made to the legislation appear in the content and are referenced with annotations.

View outstanding changes

**Changes and effects yet to be applied to the whole legislation item and associated provisions**

–   Signature words omitted by S.I. 2022/1273 reg. 75(10)
–   Annex 7 s. 1 words substituted by S.I. 2022/1273 reg. 76(7)
–   Annex 8 s. 3.5 words substituted by S.I. 2022/1273 reg. 76(8)
–   Annex 4 s. 1 words substituted by S.I. 2022/1273 reg. 76(5)
–   Annex 9 Appendix 3 image substituted by S.I. 2022/1273 reg. 76(9)(n)(i)
–   Annex 9 Appendix 1 point 1.5 word substituted by S.I. 2022/1273 reg. 76(9)(k)
–   Annex 9 Appendix 2 Addendum word substituted by S.I. 2022/1273 reg. 76(9)(l)
–   Annex 9 Appendix 3 image words omitted by S.I. 2022/1273 reg. 76(9)(n)(ii)
–   Annex 9 Appendix 2 notes words substituted by S.I. 2022/1273 reg. 76(9)(m)
–   Annex 6 s. 3 words substituted by S.I. 2022/1273 reg. 76(6)
–   Annex 1 Appendix 2 heading word substituted by S.I. 2022/1273 reg. 76(2)(j)(i)
–   Annex 1 Appendix 2 Addendum word substituted by S.I. 2022/1273 reg. 76(2)(l)
–   Annex 1 Appendix 2 words inserted by S.I. 2022/1273 reg. 76(2)(j)(ii)
–   Annex 1 Appendix 1 heading words substituted by S.I. 2022/1273 reg. 76(2)(i)(i)
–   Annex 1 Appendix 1 point 9(1) words substituted by S.I. 2022/1273 reg. 76(2)(i)(ii)
–   Annex 1 Appendix 2 notes words substituted by S.I. 2022/1273 reg. 76(2)(k)(i)
–   Annex 1 Appendix 2 notes words substituted by S.I. 2022/1273 reg. 76(2)(k)(ii)
–   Art. 3(1) words substituted by S.I. 2022/1273 reg. 75(4)(b)
–   Art. 3(5) words substituted by S.I. 2022/1273 reg. 75(4)(c)
–   Art. 3(21) word substituted by S.I. 2022/1273 reg. 75(4)(d)