



EUROPEAN COMMISSION

Brussels, 9.12.2011  
COM(2011) 856 final

2011/0409 (COD)

Proposal for a

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL  
on the sound level of motor vehicles**

**(Text with EEA relevance)**  
{SEC(2011) 1504 final}  
{SEC(2011) 1505 final}

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## **EXPLANATORY MEMORANDUM**

### **1. CONTEXT OF THE PROPOSAL**

#### **• Grounds for and objectives of the proposal**

The objective of the proposal is to ensure a high level of health and environmental protection and to safeguard the Internal Market for motor vehicles as regards their sound level.

The proposal aims at reducing environmental noise by introducing a new test method for measuring noise emissions, by lowering the noise limit values, by including additional sound emission provisions in the type-approval procedure. It aims also at ensuring road and occupational safety by introducing requirements regarding the minimum noise for electric and electric-hybrid vehicles.

#### **• General context**

Initially the EU type-approval requirements on noise were based on Internal Market objectives and focused mainly on setting harmonised noise limits for motor vehicles. As more information about the health impacts of noise became available, the need for a higher level of protection of EU citizens through further EU-wide measures became more imminent. The European Commission Green Paper on Noise from 1996<sup>1</sup> estimated that around 20 % of the then EU population suffered from noise levels that scientists and health experts consider to be unacceptable. Based on information from EU Member States, the European Environment Agency has estimated, that half of the population in urban areas is exposed to noise levels above 55 dB(A) as a result of ambient road noise.

Over the years, considerable research effort, including large EU-funded projects, has been dedicated to the quantitative assessment of the relationship between environmental noise and its effects. Although the approaches and the scope of the various studies differ, common ground can be found in the terms of harmful effects and annoyance that noise generates. These findings have been confirmed by the 2008 WHO-report ‘Economic valuation of transport-related health effects, with a special focus on children’.

The Communication from the European Commission regarding a European strategy on clean and energy efficient vehicles of 28.04.2010<sup>2</sup> announced that the European Commission will present a proposal in 2011 to amend the respective legislation to reduce the noise emissions of vehicles. This proposal will introduce a new test method for measuring the noise emissions and change the limit values for the type-approval of motor vehicles. It will also address for the first time the issue of the minimum noise level of electric or hybrid electric vehicles.

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<sup>1</sup>

Future Noise Policy – European Commission Green Paper, 4.11.1996, COM(96) 540 final.

<sup>2</sup>

Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee - A European strategy on clean and energy efficient vehicles, COM(2010)186 final.

- **Existing provisions in the area of the proposal**

Noise emissions of four-wheel motor vehicles are addressed by Council Directive 70/157/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to the permissible sound level and the exhaust system of motor vehicles<sup>3</sup>, as modified by Directives 73/350/EEC, 77/212/EEC, 81/334/EEC, 84/372/EEC, 84/424/EEC, 87/354/EEC, 89/491/EEC, 92/97/EEC, 96/20/EC, 99/101/EC, 2006/96/EC, 2007/34/EC - and by the equivalent UNECE Regulation No 51 on noise emissions.

The draft proposal will repeal Directive 70/157/EEC and its subsequent amendments. Compared to the existing act, the draft proposal will lay down new requirements: new test protocol, new limit values, additional sound emission provisions and minimum noise for electric and electric-hybrid vehicles.

- New test protocol:

The noise limits have been reduced several times, the most recent being in 1995. This last reduction did not have the expected effects and subsequent studies showed that the measurement method does not reflect real world driving behaviour anymore. It was therefore decided that, before reducing the limits once again, it is first of all necessary to develop a new test cycle and bring the driving conditions for the noise test closer in line with real life driving operation.

The UNECE Working Group on Noise has elaborated a new test method which was published in 2007. During a period of three years this new method has been used on a provisional basis in parallel with the existing test method in order to get practical experience with the application of this new method, to evaluate its qualities and to establish a database with measurement results. During the monitoring periods the type-approval authorities were obliged to execute the noise emission tests according to both methods and to submit the results of both tests to the European Commission. By this procedure a database of parallel test results had been collected that offered a good opportunity to investigate the qualities of the new method and to quantify the differences between the results of the two methods. The test results of the new method are depending on the vehicle category, up to 2 dB(A) less than those obtained under the old method.

- New limit values:

On the basis of the results of the monitoring data an impact assessment has been prepared with different policy options for the noise test method and corresponding limit values. According to the most preferable option the limit values for light and medium size vehicles will be lowered in two steps of each 2 dB(A) and for heavy vehicles in a first step of 1 and a second step of 2 dB(A). This will result in a reduction of the noise impact of about 3 dB(A) for free flowing traffic and up to 4 dB(A) for intermittent traffic. The reduction of the number of highly annoyed people will be 25 %. The cost-benefit ratio for this measure is estimated to be around 20 times in favour of the noise reduction compared to no action taken.

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<sup>3</sup>

OJ L 42, 23.2.1970, p. 16.

- Additional sound emissions provisions:

The representativeness of the new test method for the noise emission during normal traffic conditions is considered good, but it is less representative for noise emissions under worst case conditions. Therefore it was necessary to implement Additional Sound Emission Provisions. They are preventive requirements intended to cover driving conditions of the vehicle in real traffic outside the type-approval driving cycle. These driving conditions are environmentally relevant and it needs to be ensured that the sound emission of a vehicle under street driving conditions does not differ significantly from what can be expected from the type approval test result for this specific vehicle.

- Minimum noise of electric and electric-hybrid vehicles:

The increase of hybrid and electric vehicles on European roads is welcomed because it is serving to significantly reduce air pollution and traffic noise. But these positive environmental benefits have produced the unintended consequence of removing a source of audible signal that is in particular used by blind and low vision people to inform them of the approach, presence, direction or departure of road vehicles. A working group on minimum sound levels for silent vehicles has been set up by UNECE. Taking into account the discussions and the information provided in this group it is proposed to amend the noise legislation with an Annex harmonising the performance of 'Approaching Vehicle Audible Systems' if they are fitted to a vehicle. The fitting of such systems however shall be voluntary and remain an option under the discretion of the vehicle manufacturers.

- **Consistency with the other policies and objectives of the Union**

The proposal is consistent with the EU objective to provide for a high level of road and occupational safety and environmental protection.

## **2. CONSULTATION OF INTERESTED PARTIES AND IMPACT ASSESSMENT**

- **Consultation of interested parties**

In developing the proposal the European Commission has consulted stakeholders. There was a general consultation in the framework of CARS 21 gathering Member States, manufacturers (European and national representatives and individual companies), component manufacturers, transport organisations and user representatives. The working group number 4 of CARS 21 in charge of "Internal Market, emissions and CO<sub>2</sub> policies" discussed all aspects of the proposal. The proposed measures received overall support. The new test protocol for measuring vehicle noise emissions has been evaluated positively and should be used for type-approval, together with provisions for off-cycle noise emissions.

- **Impact assessment**

The European Commission had an impact assessment carried out by TNO – Venoliva – Vehicle Noise Limit Values – Comparison of two noise emission test methods –

2011.

Different options were considered for the proposal which covered environmental, social and economic aspects:

1. No change. In this option the current limit values together with the allowances will remain valid, as well as the old measurement method.
2. New method – old limit values. In this option, the new measurement method will be combined with the current set of limit values.
3. New method – new limit values equivalent to old ones. This option aims at the use of the new test method in combination with limit values, such that they do not lead to more severe requirements than incorporated in the current test method and application limit values. This option foresees new limit values that will not modify the level of stringency compared to the old system.
4. New method – new limit values with noise reduction potential. This option proposes new limit values in combination with the new test method in such a way that a reduction of the authorised noise emissions per motor vehicle may be expected. The proposed reduction of the vehicle noise limit values by 3 dB(A) for light vehicles and 2 dB(A) for heavy duty vehicles might take effect two years after the date of publication of the present proposal.
5. New method – new limit values with noise reductions potential in a two step approach. In comparison with option 4, in policy option 5, a more ambitious final target for noise reduction is pursued. This would be achieved in two stages. The first step is a reduction of 2 dB(A) for light vehicles and 1 dB(A) for heavy vehicles and can be introduced two years after the date of publication of the present proposal. The second step is a reduction of 2 dB(A) for light vehicles and 2 dB(A) for heavy vehicles. It will require more development effort and a more drastic set of technical measures: according to the contractor, this step could be introduced two years after the first step. The total reduction would be 4 dB(A) for light vehicles and 3 dB(A) for heavy vehicles.

The conclusion is that policy option 5 is to be chosen.

### **3. LEGAL ELEMENTS OF THE PROPOSAL**

- **Summary of the proposed action**

The proposal updates the requirements for the type-approval system as regards the sound level of motor vehicles and of their exhaust systems. In particular, it introduces a new test method for noise emissions measurement, lowers noise limit values and introduces additional sound emission provisions in the EU type-approval procedure. Furthermore, it takes into account technological changes by laying down new requirements regarding the minimum noise for electric and electric-hybrid vehicles.

- **Legal basis**

The legal basis of the proposal is Article 114 of the Treaty on the Functioning of the

European Union.

- **Subsidiarity principle**

As noise emission limits and the type-approval procedure for motor vehicles are already harmonised any modifications to the Motor Vehicle Noise Directive 70/157/EEC can only be done at EU level. This does not only prevent fragmentation of the Internal Market, but also ensures equal health, safety and environmental standards across the EU. It also offers advantages of economies of scale: products can be made for the whole European market, instead of being customised to obtain national type-approval for every single Member State.

Given the current levels of environmental noise and affected citizens and the fact that EU noise limits have not changed in the last decade despite increasing traffic levels, a change in limits to remedy this situation is considered proportional.

Union action will better achieve the objectives of the proposal because it will avoid fragmentation of the Internal Market which would otherwise arise and will enhance the safety and environmental performance of vehicles. This is clearly the case for vehicle noise limits, due to the international nature of road traffic, vehicle exports and the potential for national regulations which would otherwise occur.

The proposal therefore complies with the subsidiarity principle.

- **Proportionality principle**

The proposal complies with the proportionality principle for the following reasons.

As shown in the impact assessment, the proposal complies with the proportionality principle because it does not go beyond what is necessary in order to achieve the objectives of ensuring the proper functioning of the Internal Market while at the same time providing for a high level of public safety and environmental protection.

Given the current levels of environmental noise and affected citizens, and the fact that EU noise limits have not changed in the last decade despite increasing traffic levels, a change in limits to help remedy this situation is considered proportional. Many other local instruments are also applied to reduce traffic noise, but need to be matched by noise reduction at the source, which is far more effective both technically and economically.

- **Choice of instruments**

Proposed instruments: Regulation.

Other means would not be adequate for the following reasons.

The use of a Regulation is considered to be appropriate in providing the required assurance for compliance whilst not requiring the transposition into EU Member States' legislation.

#### **4. BUDGETARY IMPLICATION**

The proposal has no implication for the Union budget.

## 5. ADDITIONAL INFORMATION

- **Simulation, pilot phase and transitory period**

There is a general transitory period in the proposal in order to allow sufficient lead time for vehicle and component manufacturers and administrations. A two step approach is proposed with a delay of two years before the application of the first phase (i.e. two years after the entry into force of the Regulation) and a second phase with more stringent requirements with a further delay of two years (i.e. four years after the entry into force of the Regulation). The timeframe of together four years recommended by the contractor (impact assessment) can be supported for the first step which will not require substantial changes to the vehicle. However, as a result of the consultation process within CARS 21, it did not appear to be fully appropriate as regards the second step which will require major modifications to the vehicle engineering. Hence, it is proposed to have three years instead for the second step (timeframe of together five years).

- **Simplification**

The proposal provides for simplification of legislation as Directive 70/157/EEC and its subsequent amendments will be repealed.

- **Repeal of existing legislation**

The adoption of the proposal will lead to the repeal of existing legislation (Directive 70/157/EEC and subsequent amendments).

- **European Economic Area**

The proposed act concerns an EEA matter and should therefore extend to the European Economic Area.

Proposal for a

**REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL  
on the sound level of motor vehicles**

**(Text with EEA relevance)**

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 114 thereof,

Having regard to the proposal from the European Commission,

Having regard to the opinion of the European Economic and Social Committee<sup>4</sup>,

After transmission of the proposal to the national Parliaments,

Acting in accordance with the ordinary legislative procedure,

Whereas:

- (1) The internal market comprises an area without internal frontiers in which the free movement of goods, persons, services and capital must be ensured. To that end a comprehensive Union type-approval system for motor vehicles is in place. The technical requirements for the type-approval of motor vehicles and their exhaust systems with regard to permissible sound levels should be harmonised to avoid the adoption of requirements that differ from one Member State to another and to ensure the proper functioning of the internal market while, at the same time, providing for a high level of environmental protection and public safety.
- (2) Council Directive 70/157/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to the permissible sound level and the exhaust system of motor vehicles<sup>5</sup> harmonised the different technical requirements of Member States relating to the permissible sound level of motor vehicles and of their exhaust systems for the purpose of the establishment and operation of the internal market. For the purposes of the good functioning of the internal market and in order to ensure a uniform and consistent

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<sup>4</sup>

OJ C..., ..., p. .

<sup>5</sup>

OJ L 42, 23.2.1970, p. 16.

application throughout the Union, it is appropriate to replace that Directive by a Regulation.

- (3) This Regulation is a separate Regulation in the context of the type-approval procedure under Directive 2007/46 of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (Framework Directive).<sup>6</sup>
- (4) Directive 70/157/EEC refers to Regulation No 51<sup>7</sup> of the United Nations Economic Commission for Europe (UNECE) on noise emissions, to which the Union is a Contracting Party, which specifies the test method for noise emissions.
- (5) Since its adoption, Directive 70/157/EEC has been substantially amended several times. The most recent reduction of noise limits for motor vehicles, introduced in 1995, did not have the expected effects. Studies showed that the test method used under the Directive no longer reflected real life driving behaviour in urban traffic. In particular, as pointed out in the Green paper concerning the Future Noise Policy of 1996,<sup>8</sup> the contribution of tyre rolling noise to the total noise emission was underestimated in the test method.
- (6) This Regulation should therefore introduce a different method in relation to the compulsory one of Directive 70/157/EEC. That method should be based on the method published by the UNECE Working Party on Noise (GRB) in 2007 which incorporated a 2007 version of the standard ISO 362.<sup>9</sup> The results of monitoring of both the old and the new test methods were submitted to the Commission.
- (7) The representativeness of the new test method for the noise emission during normal traffic conditions is considered good, but it is less representative for noise emissions under worst case conditions. Therefore, it is necessary to implement in this Regulation additional sound emission provisions. Those provisions establish preventive requirements intended to cover driving conditions of the vehicle in real traffic outside the type-approval driving cycle. Those driving conditions are environmentally relevant and it needs to be ensured that the sound emission of a vehicle under street driving conditions does not differ significantly from what can be expected from the type-approval test result for the specific vehicle.
- (8) This Regulation should also further reduce noise limits. It should take account of Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor,<sup>10</sup>

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<sup>6</sup> OJ L 263, 9.10.2007, p. 1.

<sup>7</sup> OJ L 137, 30.5.2007, p. 68.

<sup>8</sup> COM(96) 540 final.

<sup>9</sup> ISO 362-1, Measurement of noise emitted by accelerating road vehicles - Engineering method – Part 1: M and N categories, ISO, Geneva, Switzerland, 2007.

<sup>10</sup> OJ L 200, 31.7.2009, p. 1.

which introduced new stricter noise requirements for motor vehicle tyres. Studies highlighting the annoyance and health effects from road traffic noise,<sup>11</sup> <sup>12</sup> and the associated costs and benefits should also be heeded.<sup>13</sup>

- (9) The overall limit values should be reduced with regards to all noise sources of motor vehicles including the air intake over the power train and the exhaust taking into account of the tyre contribution to noise reduction addressed in Regulation (EC) No 661/2009.
- (10) The environmental benefits expected from hybrid electric and pure electric road transport vehicles have resulted in a substantial reduction of the noise emitted by such vehicles. This has resulted in the removal of an important source of audible signal that is used by blind and low vision pedestrians and cyclists, amongst other road users, to become aware of the approach, presence or departure of these vehicles. For that purpose, industry is developing acoustic systems to compensate for this lack of audible signal in electric and hybrid electric vehicles. The performance of approaching vehicle audible systems fitted to vehicles should be harmonised. The fitting of such systems should however, remain an option at the discretion of vehicle manufacturers.
- (11) In order to simplify the type-approval legislation of the Union, in line with the 2007 recommendations of the CARS 21 Report<sup>14</sup>, it is appropriate to base this Regulation on UNECE Regulations No 51 on noise emissions with regards to the test method and No 59 on silencing systems<sup>15</sup> with regard to replacement exhaust silencing systems.
- (12) In order to enable the Commission to replace the technical requirements of this Regulation with a direct reference to UNECE Regulations No 51 and No 59 once the limit values relating to the new test method are laid down in those Regulations, or to adapt those requirements to technical and scientific developments, the power to adopt acts in accordance with Article 290 of the Treaty on the Functioning of the European Union should be delegated to the Commission in respect of the amendment of the provisions in Annexes to this Regulation related to the test methods and sound levels. It is of particular importance that the Commission carry out appropriate consultations during its preparatory work. The Commission, when preparing and drawing up delegated acts, should ensure a

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<sup>11</sup> Knol, A.B., Staatsen, B.A.M., Trends in the environmental burden of disease in the Netherlands 1980 – 2020, RIVM report 500029001, Bilthoven, The Netherlands, 2005; <http://www.rivm.nl/bibliotheek/rapporten/500029001.html>.

<sup>12</sup> WHO-JRC study on the burden of disease from environmental noise, quantification of healthy life years lost in Europe; [http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/noise/publications/2011/burden-of-disease-from-environmental-noise.-quantification-of-healthy-life-years-lost-in-europe\\_](http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/noise/publications/2011/burden-of-disease-from-environmental-noise.-quantification-of-healthy-life-years-lost-in-europe_)

<sup>13</sup> Valuation of Noise - Position Paper of the Working Group on Health and Socio-Economic Aspects, European Commission, Environment Directorate-General, Brussels, 4 December 2003; [www.ec.europa.eu/environment/noise/pdf/valuatio\\_final\\_12\\_2003.pdf](http://www.ec.europa.eu/environment/noise/pdf/valuatio_final_12_2003.pdf)

<sup>14</sup> CARS 21: A Competitive Automotive Regulatory System for the 21<sup>st</sup> Century, 2006; [http://ec.europa.eu/enterprise/sectors/automotive/files/pagesbackground/competitiveness/cars21finalreport\\_en.pdf](http://ec.europa.eu/enterprise/sectors/automotive/files/pagesbackground/competitiveness/cars21finalreport_en.pdf)

<sup>15</sup> OJ L 326, 24.11.2006, p. 43.

simultaneous, timely and appropriate transmission of relevant documents to the European Parliament and to the Council.

- (13) As a consequence of the application of a new regulatory framework by this Regulation, Directive 70/157/EEC should be repealed,

HAVE ADOPTED THIS REGULATION:

*Article 1*  
*Subject matter*

This Regulation establishes the administrative and technical requirements for the EU type-approval of all new vehicles referred to in Article 2 with regard to their sound level and their exhaust systems and for the sale and entry into service of parts and equipments intended for those vehicles.

*Article 2*  
*Scope*

This Regulation shall apply to vehicles of categories M<sub>1</sub>, M<sub>2</sub>, M<sub>3</sub>, N<sub>1</sub>, N<sub>2</sub> and N<sub>3</sub>, as defined in Annex II to Directive 2007/46/EC and to the systems, components and separate technical units designed and constructed for such vehicles.

*Article 3*  
*Definitions*

For the purposes of this Regulation, the following definitions shall apply:

- (1) "approval of a vehicle" means the approval of a vehicle type with regard to noise;
- (2) "vehicle type" means a set of vehicles as defined in Annex II Part B to Directive 2007/46/EC.
- (3) "maximum mass" means the technically permissible maximum mass declared by the vehicle manufacturer;

By way of derogation from point (3), the maximum mass may be greater than the maximum mass authorized by the administration of the Member States.

- (4) "rated engine power" means the engine power expressed in kW (UNECE) and measured by the UNECE method pursuant to UNECE Regulation No 85<sup>16</sup>;

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<sup>16</sup> OJ L 326, 24.11.2006, p. 55.

(5) "standard equipment" means the basic configuration of a vehicle including all features that are fitted without giving rise to any further specifications on configuration or equipment level but equipped with all the features required under the regulatory acts mentioned in Annex IV or Annex XI to Directive 2007/46/EC;

(6) "mass of the driver" means a mass rated at 75 kg located at the driver's seating reference point;

(7) "mass of a vehicle in running order" ( $m_{ro}$ ) means the mass of the vehicle including the mass of the driver, of the fuel and liquids, fitted with the standard equipment in accordance with the manufacturer's specifications.

When fitted, the mass of the bodywork, the cabin, the coupling and the spare wheel(s) as well as the tools shall be included.

The fuel tank(s) shall be filled to at least 90 % of its or their capacity/ies;

(8) "rated engine speed" (S) means the declared engine speed in  $\text{min}^{-1}$  (rpm) at which the engine develops its rated maximum net power pursuant to UNECE Regulation No 85 or, where the rated maximum net power is reached at several engine speeds, the highest one of those speeds ;

(9) "power to mass ratio index" (PMR) means a numerical quantity calculated in accordance with the formula set out in point 4.1.2.1.1. of Annex II;

(10) "reference point" means one of the following points:

(a) in the case of vehicles of categories M<sub>1</sub>, N<sub>1</sub>:

- (i) for front engine vehicles, the front end of the vehicle;
- (ii) for mid engine vehicles, the centre of the vehicle;
- (iii) for rear engine vehicles, the rear end of the vehicle.

(b) in the case of vehicles of categories M<sub>2</sub>, M<sub>3</sub>, N<sub>2</sub>, N<sub>3</sub> the border of the engine closest to the front of the vehicle.

(11) "target acceleration" means acceleration at a partial throttle condition in urban traffic as derived from statistical investigations;

(12) "reference acceleration" means the required acceleration during the acceleration test on the test track;

(13) "gear ratio weighting factor" (k) means a dimensionless numerical quantity used to combine the test results of two gear ratios for the acceleration test and the constant speed test;

- (14) "partial power factor" ( $k_p$ ) means a numerical quantity with no dimension used for the weighted combination of the test results of the acceleration test and the constant speed test for vehicles;
- (15) "pre-acceleration" means application of acceleration control device prior to AA' for the purpose of achieving stable acceleration between AA' and BB' as referred to in figure 1 to Appendix 1 to Annex II;
- (16) "locked gear ratios" means the control of transmission such that the transmission gear cannot change during a test;
- (17) "design family of silencing system or silencing system components" means a group of silencing systems or components thereof in which all of the following characteristics are the same:
  - (a) the presence of net gas flow of the exhaust gases through the absorbing fibrous material when in contact with that material;
  - (b) the type of the fibres;
  - (c) where applicable, binder material specifications;
  - (d) average fibre dimensions;
  - (e) minimum bulk material packing density in kg/m<sup>3</sup>;
  - (f) maximum contact surface between the gas flow and the absorbing material;
- (18) "silencing system" means a complete set of components necessary for limiting the noise produced by an engine and its exhaust;
- (19) "silencing system of different types" means silencing systems which significantly differ in respect of at least one of the following:
  - (a) trade names or trademarks of their components;
  - (b) the characteristics of the materials constituting their components, except for the coating of those components;
  - (c) the shape or size of their components;
  - (d) the operating principles of at least one of their components;
  - (e) the assembly of their components;
  - (f) the number of exhaust silencing systems or components;

- (20) "replacement silencing system or components of said system" means any part of the silencing system defined in point (17) intended for use on a vehicle, other than a part of the type fitted to this vehicle when submitted for type-approval pursuant to this Regulation;
- (21) "Acoustic Vehicle Alerting System" (AVAS) are systems for hybrid electric and electric road transport vehicles which provide vehicle operation information to pedestrians and vulnerable road users.

*Article 4*  
*General obligations of Member States*

- 1. Member States may not, on grounds relating to the permissible sound level and the exhaust system, refuse to grant EU or national type-approval in respect of a type of motor vehicle or type of exhaust system or component of such a system regarded as a separate technical unit where the following conditions are fulfilled:
  - (a) the vehicle satisfies the requirements of Annex I,
  - (b) the exhaust system or any component thereof, considered as a separate technical unit within the meaning of point (25) of Article 3 of Directive 2007/46/EC satisfies the requirements of Annex X to this Regulation.
- 2. Member States may not, on grounds relating to the permissible sound level and the exhaust system, refuse or prohibit the sale, registration, entry into service or use of any vehicle in which the sound level and the exhaust system satisfy the requirements of Annex I.
- 3. Member States may not, on grounds relating to the permissible sound level and the exhaust system, prohibit the placing on the market of an exhaust system or any component thereof considered as a separate technical unit within the meaning of point (25) of Article 3 of Directive 2007/46/EC if it conforms to a type in respect of which a type-approval has been granted in accordance with this Regulation.

*Article 5*  
*General obligations of manufacturers*

- 1. Manufacturers shall ensure that the vehicle, its engine and its noise reduction system is designed, constructed and assembled so as to enable the vehicle in normal use to comply with the provisions of this Regulation, despite the vibration to which it is inherently subjected.
- 2. Manufacturers shall ensure that the noise reduction system is designed, constructed and assembled so as to be able to reasonably resist the corrosive phenomena to which it is exposed having regard to the conditions of use of the vehicle.

3. The manufacturer shall be responsible to the approval authority for all aspects of the approval process and for ensuring conformity of production, whether or not the manufacturer is directly involved in all stages of the construction of a vehicle, system, component or separate technical unit.

*Article 6*  
*Limits values*

The sound level measured in accordance with the provisions of Annex II shall not exceed the limits set out in Annex III.

*Article 7*  
*Revision clause*

Within three years following the date referred to in Annex III, third column, phase 1, to this Regulation, the Commission shall carry out a detailed study to ascertain whether the noise limits prove to be appropriate. On the basis of the conclusions of the study, the Commission may, where appropriate, present proposals for amendment to this Regulation.

*Article 8*  
*Additional sound emission provisions (ASEP)*

1. Paragraph 2 to 6 and the second subparagraph of this paragraph shall apply to vehicles of categories M<sub>1</sub> and N<sub>1</sub> equipped with an internal combustion engine.

Vehicles shall be deemed to fulfil the requirements of Annex X, if the vehicle manufacturer provides technical documents to the type-approval authority showing that the difference between maximum and minimum engine speed of the vehicles at BB<sup>17</sup>, for any test condition inside the ASEP control range defined in point 3.3. of Annex VIII, with respect to conditions set out in Annex II, does not exceed 0,15 x S.

2. The sound emission of the vehicle under typical on-road driving conditions, which are different from those under which the type-approval test set out in Annex II was carried out, shall not deviate from the test result in an unreasonable manner.
3. The vehicle manufacturer shall not intentionally alter, adjust, or introduce any mechanical, electrical, thermal, or other device or procedure solely for the purpose of fulfilling the noise emission requirements under this Regulation which is not operational during typical on-road operation under conditions applicable to ASEP.
4. The vehicle shall meet the requirements of Annex VIII to this Regulation.

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As referred to in Figure 1 to Appendix 1 to Annex II to this Regulation.

5. In the application for type-approval, the manufacturer shall provide a statement, established in accordance with the model set out in Appendix 1 of Annex VIII, that the vehicle type to be approved complies with the requirements of Article 8(1) and 8(2).

*Article 9*  
*Acoustic Vehicle Alerting System (AVAS)*

Where manufacturers choose to install an AVAS in vehicles, the requirements of Annex X shall be fulfilled.

*Article 10*  
*Amendment of the Annexes*

1. The Commission shall be empowered to adopt delegated acts to amend Annexes I to XI.
2. When the limit values relating to the test method are laid down in UNECE Regulation No 51, the Commission shall consider replacing the technical requirements laid down in Annex III with a direct reference to the corresponding requirements of UNECE Regulations No 51 and No 59.

*Article 11*  
*Exercise of the Delegation*

1. The powers to adopt delegated acts are conferred on the Commission subject to the conditions laid down in this Article.
2. The power to adopt delegated acts referred to in Article 10(1) shall be conferred on the Commission for an indeterminate period of time from the date of adoption of this Regulation.
3. The delegation of power referred to in Article 10(1) may be revoked at any time by the European Parliament or by the Council. A decision to revoke shall put an end to the delegation of the power specified in that decision. It shall take effect the day following the publication of the decision in the Official Journal or at a later date specified therein. It shall not affect the validity of any delegated acts already in force.
4. As soon as it adopts a delegated act, the Commission shall notify it simultaneously to the European Parliament and to the Council.
5. A delegated act adopted pursuant to Article 10(1) shall enter into force only if no objection has been expressed either by the European Parliament or the Council within a period of two months of notification of that act to the European Parliament and the Council or if, before the expiry of that period, the European Parliament and the Council have both informed the Commission that they will not object. That period shall be extended by one month at the initiative of the European Parliament or of the Council.

*Article 12*  
*Objections to delegated acts*

1. The European Parliament and the Council may object to the delegated act within a period of two months from the date of notification. At the initiative of the European Parliament or the Council this period shall be extended by one month.
2. If, on expiry of that period, neither the European Parliament nor the Council has objected to the delegated act, or if, before that date, the European Parliament and the Council have both informed the European Commission that they have decided not to raise objections, the delegated act shall enter into force at the date stated in its provisions.
3. If the European Parliament or the Council objects to the adopted delegated act, it shall not enter into force. The institution which objects shall state the reasons for objecting to the delegated act.

*Article 13*  
*Urgency procedure*

1. Delegated acts adopted under Article 10(1) shall enter into force without delay and shall apply as long as no objection is expressed in accordance with paragraph 2. The notification of a delegated act to the European Parliament and to the Council shall state the reasons for the use of the urgency procedure.
2. Either the European Parliament or the Council may object to a delegated act in accordance with the procedure referred to in Article 11(5). In such a case, the Commission shall repeal the act without delay following the notification of the decision to object by the European Parliament or the Council.

*Article 14*  
*Transitional provisions*

1. This Regulation shall not invalidate any EU type-approval granted to vehicles or to systems, components or separate technical units before the date laid down in Article 16.
2. Approval authorities shall continue to grant extension of approvals to those vehicles, systems, components or separate technical units under the terms of Directive 70/157/EEC.
3. Until [DATE: *For the first five years after the entry into force of this Regulation*], vehicles with a serial hybrid drive train, which have an additional combustion engine with no mechanical coupling to the power train, shall be excluded from the requirements of this Article 8.

*Article 15  
Repeal*

1. Directive 70/157/EEC is repealed.
2. References to the repealed Directive shall be construed as references to this Regulation and shall be read in accordance with the correlation table set out in Annex XII.

*Article 16  
Entry into force*

1. This Regulation shall enter into force on the twentieth day following that of its publication in the Official Journal of the European Union.
2. It shall apply from [*two years after its date of adoption*].

This Regulation shall be binding in its entirety and directly applicable in all Member States.

Done at Brussels,

*For the European Parliament  
The President  
[...]*

*For the Council  
The President  
[...]*

## **LIST OF ANNEXES**

- Annex I EU type-approval in respect of the sound level of a vehicle type
- Appendix 1: Information document
  - Appendix 2: Model EU Type-Approval Certificate
  - Appendix 3: Vehicle and test data
- Annex II Methods and instruments for measuring the noise made by motor vehicles
- Appendix 1: Figures
- Annex III Limit Values
- Annex IV Silencing Systems Containing Acoustically Absorbing Fibrous Materials
- Appendix 1: Figure – test Apparatus For Conditioning by Pulsation
- Annex V Compressed Air Noise
- Appendix 1: Figure - Microphone positions for measurement of compressed air noise
- Annex VI Checks on Conformity of Production for Vehicles
- Annex VII Specifications for the test site
- Annex VIII Measuring method to evaluate compliance with the additional sound emission provisions
- Appendix 1: Statement of compliance with the Additional Sound Emission Provisions
- Annex IX Measures ensuring the audibility of hybrid and electric vehicles
- Annex X EU type-approval in respect of the sound level of exhaust systems as separate technical units (replacement exhaust systems)
- Appendix 1: Information document
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  - Appendix 3: Model for the EU type-approval mark
  - Appendix 4: Test apparatus

**Appendix 5:** Measuring points- Back pressure

**Annex XI** Checks on conformity of production for exhaust system as a separate technical unit

**Annex XII** Correlation table

## **Annex I**

### **EU type-approval in respect of the sound level of a vehicle type**

1. APPLICATION FOR EU TYPE-APPROVAL OF A VEHICLE TYPE
  - 1.1. The application for EU type-approval pursuant to Article 7(1) and (2) of Directive 2007/46/EC of a vehicle type with regard to its sound level shall be submitted by the vehicle manufacturer.
  - 1.2. A model for the information document is given in Appendix 1.
  - 1.3. A vehicle representative of the type in respect of which type-approval is sought must be submitted to the technical service responsible for the tests by the vehicle manufacturer.
  - 1.4. At the request of the technical service, a specimen of the exhaust system and an engine of at least the same cylinder capacity and rated maximum power as that fitted to the vehicle in respect of which type-approval is sought must also be submitted.
2. MARKINGS
  - 2.1. The exhaust and intake system components, excluding fixing hardware and pipes, must bear:
    - 2.1.1. the trade mark or name of the manufacturer of the systems and their components;
    - 2.1.2. the manufacturer's trade description.
  - 2.2. These markings must be clearly legible and indelible, even when the system is fitted to the vehicle.
3. GRANTING OF EU TYPE-APPROVAL OF A VEHICLE TYPE
  - 3.1. If the relevant requirements are satisfied, EU type-approval pursuant to Article 9(3) and, if applicable 10(4) of Directive 2007/46/EC shall be granted.
  - 3.2. A model for the EU type-approval certificate is given in Appendix 2.
  - 3.3. An approval number in accordance with Annex VII to Directive 2007/46/EC shall be assigned to each vehicle type approved. The same Member State shall not assign the same number to another vehicle type.
4. AMENDMENTS TO TYPE-APPROVALS

In the case of changes of the type approved pursuant to this Regulation, the provisions of Articles 13, 14, 15, 16 and 17(4) of Directive 2007/46/EC shall apply

## 5. CONFORMITY OF PRODUCTION ARRANGEMENTS

5.1. Measures to ensure the conformity of production arrangements shall be taken in accordance with the requirements laid down in Article 12 of Directive 2007/46/EC.

5.2. Special provisions:

5.2.1. The tests laid down in Annex VI of this Regulation correspond to those referred to in point 2.3.5 of Annex X to Directive 2007/46/EC

5.2.2. The frequency of inspections referred to in point 3 of Annex X to Directive 2007/46/EC shall normally be once every two years.

## Appendix 1

### **Information document No ... pursuant to Annex I of Directive 2007/46/EC<sup>18</sup> relating to EU type-approval of a vehicle with respect to the permissible sound level and the exhaust system**

The following information, if applicable, must be supplied in triplicate and include a list of contents. Any drawings must be supplied in appropriate scale and in sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, must show sufficient detail.

If the systems, components or separate technical units have electronic controls, information concerning their performance must be supplied.

#### **0. General**

- 0.1. Make (trade name of manufacturer):
- 0.2. Type and general commercial description(s):
- 0.3. Means of identification of type, if marked on the vehicle (<sup>b</sup>):
  - 0.3.1. Location of that marking.
- 0.4. Category of vehicle (<sup>c</sup>):
- 0.5. Name and address of manufacturer:
- 0.8. Address(es) of assembly plant(s):

#### **1. General construction characteristics of the vehicle**

- 1.1. Photographs and/or drawings of a representative vehicle:
- 1.3.3. Powered axles (number, position, interconnection):
- 1.6. Position and arrangement of the engine:

#### **2. Masses and dimensions (<sup>e</sup>) (in kg and mm) (Refer to drawing where applicable)**

- 2.4. Range of vehicle dimensions (overall)
  - 2.4.1. For chassis without bodywork

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<sup>18</sup> The item numbers and footnotes used in this information document correspond to those set out in Annex I to Directive 2007/46/EC. Items not relevant for the purpose of this Regulation are omitted.

2.4.1.1. Length (<sup>j</sup>):

2.4.1.2. Width (<sup>k</sup>):

2.4.2. For chassis with bodywork

2.4.2.1. Length (<sup>j</sup>):

2.4.2.2. Width (<sup>k</sup>):

2.6. Mass of the vehicle with bodywork in running order, or mass of the chassis with cab if the manufacturer does not fit the bodywork (with standard equipment, including coolant, oils, fuel, tools, spare wheel and driver) (<sup>o</sup>) (maximum and minimum):

### **3. Power plant (<sup>q</sup>)**

3.1. Manufacturer:

3.1.1. Manufacturer's engine code: (As marked on the engine, or other means of identification)

3.2. Internal combustion engine

3.2.1.1. Working principle: positive ignition/compression ignition, four stroke/two stroke<sup>19</sup>

3.2.1.2. Number and arrangement of cylinders:

3.2.1.2.3. Firing order:

3.2.1.3. Engine capacity (<sup>s</sup>): cm<sup>3</sup>

3.2.1.8. Maximum net power (<sup>t</sup>): kW at min<sup>-1</sup> (manufacturer's declared value)

3.2.4. Fuel feed

3.2.4.1. By carburettor(s): yes/no<sup>20</sup>

3.2.4.1.2. Type(s):

3.2.4.1.3. Number fitted:

3.2.4.2. By fuel injection (compression ignition only): yes/no<sup>21</sup>

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<sup>19</sup> Delete as applicable.

<sup>20</sup> Delete as applicable.

<sup>21</sup> Delete as applicable.

3.2.4.2.2. Working principle: Direct injection/pre-chamber/swirl chamber<sup>22</sup>

3.2.4.2.4. Governor

3.2.4.2.4.1. Type:

3.2.4.2.4.2.1. Cut-off point under load: min<sup>-1</sup>

3.2.4.3. By fuel injection (positive ignition only): yes/no<sup>23</sup>

3.2.4.3.1. Working principle: Intake manifold (single-/multi-point<sup>24</sup>)/direct injection/other (specify)<sup>25</sup>

3.2.8. Intake system

3.2.8.4.2. Air filter, drawings; or

3.2.8.4.2.1. Make(s):

3.2.8.4.2.2. Type(s):

3.2.8.4.3. Intake silencer, drawings; or

3.2.8.4.3.1. Make(s):

3.2.8.4.3.2. Type(s):

3.2.9. Exhaust system

3.2.9.2. Description and/or drawing of the exhaust system:

3.2.9.4. Exhaust silencer(s):

For front, centre, rear silencer: construction, type, marking, where relevant for exterior noise: reducing measures in the engine compartment and on the engine:

3.2.9.5. Location of the exhaust outlet:

3.2.9.6. Exhaust silencer containing fibrous materials:

3.2.12.2.1. Catalytic convertor: yes/no<sup>26</sup>

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<sup>22</sup> Delete as applicable.

<sup>23</sup> Delete as applicable.

<sup>24</sup> Delete as applicable.

<sup>25</sup> Delete as applicable.

3.2.12.2.1.1. Number of catalytic convertors and elements:

3.3. Electric motor

3.3.1. Type (winding, excitation):

3.3.1.1. Maximum hourly output: kW

3.3.1.2. Operating voltage: V

3.4. Other engines or motors or combinations thereof (particulars regarding the parts of such engines or motors):

#### 4. Transmission (v)

4.2. Type (mechanical, hydraulic, electric, etc.):

4.6. Gear ratios

Gear	Internal gearbox ratios (ratios of engine to gearbox output shaft revolutions)	Final drive ratio(s) (ratio of gearbox output shaft to driven wheel revolutions)	Total gear ratios
Maximum for CVT <sup>27</sup>			
1			
2			
3			
...			
Minimum for CVT <sup>28</sup>			
Reverse			

4.7. Maximum vehicle speed (and gear in which this is achieved) (in km/h) (^w):

#### 6. Suspension

<sup>26</sup> Delete as applicable.

<sup>27</sup> Continuously variable transmission.

<sup>28</sup> Continuously variable transmission.

- 6.6. Tyres and wheels
  - 6.6.2. Upper and lower limits of rolling radii
    - 6.6.2.1. Axle 1:
    - 6.6.2.2. Axle 2:
    - 6.6.2.3. Axle 3:
    - 6.6.2.4. Axle 4:
  - etc.

## **9. Bodywork (not applicable for vehicles of category M<sub>1</sub>)**

- 9.1. Type of bodywork:
- 9.2. Materials used and method of construction

## **12. Miscellaneous**

- 12.5. Details of any non-engine devices designed to reduce noise (if not covered by other items):

Additional information in the case of off-road vehicles:

- 1.3. Number of axles and wheels:
  - 2.4.1. For chassis without bodywork
    - 2.4.1.4.1. Approach angle (<sup>na</sup>): ... degrees
    - 2.4.1.5.1. Departure angle (<sup>nb</sup>): ... degrees
    - 2.4.1.6. Ground clearance (as defined in point 4.5 of section A of Annex II to Directive 2007/46/EC)
      - 2.4.1.6.1. Between the axles:
      - 2.4.1.6.2. Under the front axle(s):
      - 2.4.1.6.3. Under the rear axle(s):
    - 2.4.1.7. Ramp angle (<sup>nc</sup>): ... degrees
  - 2.4.2. For chassis with bodywork
    - 2.4.2.4.1. Approach angle (<sup>na</sup>): ... degrees

2.4.2.5.1. Departure angle (<sup>nb</sup>): ... degrees

2.4.2.6. Ground clearance (as defined in point 4.5 of section A of Annex II to Directive 2007/46/EC)

2.4.2.6.1. Between the axles:

2.4.2.6.2. Under the front axle(s):

2.4.2.6.3. Under the rear axle(s):

2.4.2.7. Ramp angle (<sup>nc</sup>): ... degrees

2.15. Hill-starting ability (solo vehicle): ... %

4.9. Differential lock: yes/no/optional<sup>29</sup>

Date,

File

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<sup>29</sup>

Delete as applicable.

## **Appendix 2**

### **Model EU type-approval certificate**

(Maximum Format: A4 (210 × 297 mm))

*Stamp of administration*

Communication concerning the

- type-approval<sup>30</sup>
- extension of type-approval<sup>31</sup>
- refusal of type-approval<sup>32</sup>
- withdrawal of type-approval<sup>33</sup>

of a type of a vehicle/component/separate technical unit<sup>34</sup> with regard to Directive .../.../EU, as last amended by Directive .../.../EU.

Type-approval number:

Reason for extension:

#### ***SECTION I***

0.1. Make (trade name of manufacturer):

0.2. Type and general commercial description(s):

0.3. Means of identification of type if marked on the vehicle/component/separate technical unit<sup>35</sup><sup>36</sup>

0.3.1. Location of that marking.

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<sup>30</sup> Delete as applicable.

<sup>31</sup> Delete as applicable.

<sup>32</sup> Delete as applicable.

<sup>33</sup> Delete as applicable.

<sup>34</sup> Delete as applicable.

<sup>35</sup> Delete as applicable.

<sup>36</sup> If the means of identification of type contains characters not relevant to describe the vehicle, component or separate technical unit types covered by the type-approval certificate such characters shall be represented in the documentation by the symbol: ‘?’ (e.g. ABC??123??).

- 0.4. Category of vehicle<sup>37</sup>:
- 0.5. Name and address of manufacturer:
- 0.7. In the case of components and separate technical units, location and method of affixing of the EU approval mark:
- 0.8. Address(es) of assembly plant(s)

## *SECTION II*

1. Additional information (where applicable): See Appendix 3
2. Technical service responsible for carrying out the tests:
3. Date of test report:
4. Number of test report:
5. Remarks (if any): See Appendix 3
6. Place:
7. Date:
8. Signature:
9. The index to the information package lodged with the approval authority, which may be obtained on request, is attached.

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<sup>37</sup>

As defined in Annex IIA to Directive 2007/46/EC.

### Appendix 3

#### **Vehicle and test data<sup>38</sup>**

1.	Trade name or mark of the vehicle
2.	Vehicle type
2.1.	Maximum mass including semi-trailer (where applicable)
3.	Manufacturer's name and address
4.	If applicable, name and address of manufacturer's representative
5.	Engine:
5.1.	Manufacturer:
5.2.	Type:
5.3.	Model:
5.4.	Rated maximum power (ECE): ..... kW at ..... min <sup>-1</sup> (rpm).
5.5.	Kind of engine: e.g. positive-ignition, compression ignition, etc. <sup>1/</sup>
5.6.	Cycles: two stroke or four-stroke (if applicable)
5.7.	Cylinder capacity (if applicable)
6.	Transmission: non-automatic gearbox/automatic gearbox <sup>2/</sup>
6.1.	Number of gears
7.	Equipment:
7.1.	Exhaust silencer:
7.1.1.	Manufacturer or authorized representative (if any)
7.1.2.	Model:

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<sup>38</sup> Information reported in Appendix 1 to Annex I need not be repeated.

7.1.3.	Type: ..... in accordance with drawing No.: .....
7.2.	Intake silencer:
7.2.1.	Manufacturer or authorized representative (if any)
7.2.2.	Model:
7.2.3.	Type: ..... in accordance with drawing No.: .....
7.3.	Elements of capsulation
7.3.1.	Elements of noise encapsulation as defined by the vehicle manufacturer
7.3.2.	Manufacturer or authorized representative (if any)
7.4.	Tyres
7.4.1.	Tyre size(s) (by axle):
8.	Measurements:
8.1.	Length of the vehicle ( $l_{veh}$ ): ..... mm
8.2.	Point of accelerator depression: ..... m before line AA'
8.2.1.	Engine speed in gear i at: AA' / PP' 1/ ..... $\text{min}^{-1}$ (rpm) BB' ..... $\text{min}^{-1}$ (rpm)
8.2.2.	Engine speed in gear (i+1) at: AA' / PP' 1/ ..... $\text{min}^{-1}$ (rpm) BB' ..... $\text{min}^{-1}$ (rpm)
8.3.	Type-approval number of tyre(s) :
	if not available, the following information shall be provided:
8.3.1.	Tyre manufacturer
8.3.2.	Commercial description(s) of the type of tyre (by axle), (e.g. trade name, speed index, load index):.....
8.3.3.	Tyre size (by axle):.....

8.3.4.	Type-approval number (if available):.....
8.4.	Noise level of moving vehicle:
	Test result ( $L_{urban}$ ):..... dB(A)
	Test result ( $L_{wot}$ ):..... dB(A)
	Test result ( $L_{cruise}$ ):..... dB(A)
	$k_p$ – factor: .....
8.5.	Noise level of stationary vehicle:
	Position and orientation of microphone (according to figure 2 in Appendix 1 of Annex II)
	Test result for stationary test:... dB(A)
8.6.	Noise level of compressed air sound:
	Test result for
	-service brake: ..... dB(A)
	-parking brake: ..... dB(A)
	-during the pressure regulator actuation: ..... dB(A)
9.	Vehicle submitted for approval on:
10.	Technical service responsible for type-approval tests:
11.	Date of test report issued by that service:
12.	Number of test report issued by that service:
13.	Position of approval mark on the vehicle
14.	Place
15.	Date
16.	Signature

17.	The following documents, bearing the approval number shown above, are annexed to this document: .....
	.....
	drawings and/or photographs, diagrams and plans of the engine and of the noise reduction system;
	list of components, duly identified constituting the noise reduction system.
18.	Reason for extension of approval :
19.	Remarks

<sup>1/</sup> If a non-conventional engine is used, this should be stated.

<sup>2/</sup> Strike out what does not apply.

## **Annex II**

### **Methods and instruments for measuring the noise made by motor vehicles**

#### **1. METHODS OF MEASUREMENT**

1.1. The noise made by the vehicle type submitted for approval shall be measured by the two methods described in this Annex for the vehicle in motion and for the vehicle when stationary<sup>43</sup>. In the case of a vehicle where an internal combustion engine does not operate when the vehicle is stationary, the emitted noise shall only be measured in motion.

Vehicles having a maximum permissible mass exceeding 2800 kg shall be subjected to an additional measurement of the compressed air noise with the vehicle stationary in accordance with the specifications of Annex V, if the corresponding brake equipment is part of the vehicle.

1.2. The two values measured in accordance with the tests set out in point 1.1 shall be entered in the test report and on a form conforming to the model laid down in Appendix 3 to Annex I.

#### **2. MEASURING INSTRUMENTS**

##### **2.1. Acoustic measurements**

The apparatus used for measuring the noise level must be a precision sound-level meter or equivalent measurement system meeting the requirements of class 1 instruments (inclusive of the recommended windscreens, if used). These requirements are described in "IEC 61672-1:2002: Precision sound level meters", second edition, of the International Electrotechnical Commission (IEC).

Measurements shall be carried out using the "fast" response of the acoustic measurement instrument and the "A" weighting curve also described in "IEC 61672-1:2002". When using a system that includes a periodic monitoring of the A-weighted sound pressure level, a reading should be made at a time interval not greater than 30 ms (milliseconds).

The instruments shall be maintained and calibrated in accordance with the instructions of the instrument manufacturer.

<sup>43</sup>

A test is made on a stationary vehicle in order to provide a reference value for administrations which use this method to check vehicles in use.

## 2.2. Compliance with requirements

Compliance of the acoustic measurement instrumentation shall be verified by the existence of a valid certificate of compliance. Those certificates shall be deemed to be valid if certification of compliance with the standards was conducted within the previous 12-month period for the sound calibration device and within the previous 24-month period for the instrumentation system. All compliance testing must be conducted by a laboratory, which is authorized to perform calibrations traceable to the appropriate standards.

## 2.3. Calibration of the entire Acoustic Measurement System for Measurement Session

At the beginning and at the end of every measurement session, the entire acoustic measurement system shall be checked by means of a sound calibrator that fulfils the requirements for sound calibrators of precision class 1 according to IEC 60942: 2003. Without any further adjustment the difference between the readings shall be less than or equal to 0,5 dB. If this value is exceeded, the results of the measurements obtained after the previous satisfactory check shall be discarded.

## 2.4. Instrumentation for speed measurements

The engine speed shall be measured with instrumentation having an accuracy of  $\pm 2$  per cent or better at the engine speeds required for the measurements being performed.

The road speed of the vehicle shall be measured with instrumentation having an accuracy of at least  $\pm 0,5$  km/h, when using continuous measurement devices.

If testing uses independent measurements of speed, this instrumentation must meet specification limits of at least  $\pm 0,2$  km/h.

## 2.5. Meteorological instrumentation

The meteorological instrumentation used to monitor the environmental conditions during the test shall include the following devices, which meet at least the accuracies listed below:

- temperature measuring device,  $\pm 1$  °C;
- wind speed-measuring device,  $\pm 1.0$  m/s;
- barometric pressure measuring device,  $\pm 5$  hPa;
- a relative humidity measuring device,  $\pm 5$  per cent.

### 3. CONDITIONS OF MEASUREMENT

#### 3.1. Test Site <sup>1/</sup> and ambient conditions

The test site shall be substantially level. The surface of the test track shall be dry. The test site shall be such that when a small omni-directional noise source is placed on its surface at the central point (intersection of the microphone line PP<sup>39</sup> and the centre line of the vehicle lane CC<sup>40</sup>), deviations from hemispherical acoustic divergence shall not exceed  $\pm 1$  dB

This condition is deemed to be satisfied if the following requirements are met:

- (a) Within a radius of 50 m from the centre of the track the space is free of large reflecting objects such as fences, rocks, bridges or buildings;
- (b) The test track and the surface of the site are dry and free from absorbing materials such as powdery snow, or loose debris;
- (c) In the vicinity of the microphone, there is no obstacle that could influence the acoustical field and no person is positioned between the microphone and the noise source. The meter observer is positioned so as not to influence the meter reading.

Measurements shall not be made under adverse weather conditions. It must be ensured that the results are not affected by gusts of wind.

The meteorological instrumentation should be positioned adjacent to the test area at a height of  $1.2 \text{ m} \pm 0.02 \text{ m}$ . The measurements shall be made when the ambient air temperature is between  $+5^\circ\text{C}$  and  $+40^\circ\text{C}$ .

The tests shall not be carried out if the wind speed, including gusts, at microphone height exceeds 5 m/s, during the noise measurement interval.

A value representative of temperature, wind speed and direction, relative humidity, and barometric pressure shall be recorded during the noise measurement interval.

Any noise peak which appears to be unrelated to the characteristics of the general noise level of the vehicle shall be ignored in taking the readings.

The background noise shall be measured for a duration of 10 seconds immediately before and after a series of vehicle tests. The measurements shall be made with the

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<sup>39</sup> As referred to in Figure 1 to Appendix 1 to Annex II to this Regulation.

<sup>40</sup> As referred to in Figure 1 to Appendix 1 to Annex II to this Regulation.

same microphones and microphone locations used during the test. The A-weighted maximum noise pressure level shall be reported.

The background noise (including any wind noise) shall be at least 10 dB below the A-weighted noise pressure level produced by the vehicle under test. If the difference between the ambient noise and the measured noise is between 10 and 15 dB(A), the appropriate correction must be subtracted from the readings on the noise-level meter in order to calculate the test results, as in the following table:

In conformity with Annex VII to this Regulation.

Difference between ambient noise and noise to be measured dB(A)	10	11	12	13	14	15
Correction dB(A)	0.5	0.4	0.3	0.2	0.1	0.0

### 3.2. Vehicle

3.2.1. The vehicle tested shall be selected in a way so that all vehicles of the same type which are put on the market fulfil the requirements of this Regulation. Measurements shall be made without any trailer, except in the case of non-separable vehicles. Measurements shall be made on vehicles at the test mass  $m_t$  specified according to the following table:

Vehicle category	Vehicle test mass ( $m_t$ )
$M_1$	$m_t = m_{ro}$
$N_1$	$m_t = m_{ro}$

	$m_t = 50 \text{ kg per kW rated engine power}$
N <sub>2</sub> , N <sub>3</sub>	<p>Extra loading to reach the test mass of the vehicle shall be placed above the driven rear axle(s). The extra loading is limited to 75 per cent of the maximum mass allowed for the rear axle. The test mass must be achieved with a tolerance of <math>\pm 5</math> per cent.</p> <p>If the centre of gravity of the extra loading cannot be aligned with the centre of the rear axle, the test mass of the vehicle shall not exceed the sum of the front axle and the rear axle load in un-laden condition plus the extra loading.</p> <p>The test mass for vehicles with more than two axles shall be the same as for a two-axle vehicle.</p>
M <sub>2</sub> , M <sub>3</sub>	$m_t = m_{ro} - \text{mass of the crew member (if applicable)}$

3.2.2. Tyre rolling sound emissions are laid down in Regulation (EC) No 661/2009 on the general safety of motor vehicles. The tyres to be used for the test shall be representative for the vehicle and shall be selected by the vehicle manufacturer and recorded in Appendix 3 to Annex I of this Regulation. They shall correspond to one of the tyre sizes designated for the vehicle as original equipment. The tyre is or will be commercially available on the market at the same time as the vehicle.<sup>2/</sup> The tyres shall be inflated to the pressure recommended by the vehicle manufacturer for the test mass of the vehicle. The tyres shall have at least legal tread depth.

3.2.3. Before the measurements are started, the engine shall be brought to its normal operating conditions.

3.2.4. If the vehicle is fitted with more than two-wheel drive, it shall be tested in the drive which is intended for normal road use.

3.2.5. If the vehicle is fitted with one or more fans having an automatic actuating mechanism, this system shall not be interfered with during the measurements.

3.2.6. If the vehicle is equipped with an exhaust system containing fibrous materials, the exhaust system is to be conditioned before the test in accordance with Annex IV.

<sup>2/</sup> Given that the tyre contribution for overall sound emission is significant, regard must be had for existing regulatory provisions concerning tyre/road sound emissions. Traction tyres, snow tyres and special-use tyres shall be excluded during type-approval- and conformity of production measurements at the request of the manufacturer in accordance with UNECE

## 4. METHODS OF TESTING

### 4.1. Measurement of noise of vehicles in motion

#### 4.1.1. General test conditions

Two lines, AA' and BB', parallel to line PP' and situated respectively 10 m forward and 10 m rearward of line PP' shall be marked out on the test runway.

At least four measurements shall be made on each side of the vehicle and for each gear. Preliminary measurements may be made for adjustment purposes, but shall be disregarded.

The microphone shall be located at a distance of  $7.5 \text{ m} \pm 0.05 \text{ m}$  from the reference line CC' of the track and  $1.2 \text{ m} \pm 0.02 \text{ m}$  above the ground.

The reference axis for free field conditions (see IEC 61672-1:2002) shall be horizontal and directed perpendicularly towards the path of the vehicle line CC'.

#### 4.1.2. Specific test conditions for vehicles

##### 4.1.2.1. Vehicles of category M<sub>1</sub>, M<sub>2</sub> ≤ 3500 kg, N<sub>1</sub>

The path of the centreline of the vehicle shall follow line CC' as closely as possible throughout the entire test, from the approach to line AA' until the rear of the vehicle passes line BB'. If the vehicle is fitted with more than two-wheel drive, test it in the drive selection which is intended for normal road use.

If the vehicle is fitted with an auxiliary manual transmission or a multi-gear axle, the position used for normal urban driving shall be used. In all cases, the gear ratios for slow movements, parking or braking shall be excluded.

The test mass of the vehicle shall be that set out in the Table in point 3.2.1

The test speed v<sub>test</sub> is  $50 \text{ km/h} \pm 1 \text{ km/h}$ . The test speed must be reached, when the reference point is at line PP'.

##### 4.1.2.1.1. Power to mass ratio index (PMR)

PMR is defined as follows:

$$\text{PMR} = (P_n / m_t) \times 1000 \text{ in [kW/1000kg]}$$

The power to mass ratio index (PMR) is used for the calculation of acceleration.

#### 4.1.2.1.2. Calculation of acceleration

Acceleration calculations are applicable to M<sub>1</sub>, N<sub>1</sub> and M<sub>2</sub> ≤ 3500 kg categories only.

All accelerations are calculated using different speeds of the vehicle on the test track<sup>3/</sup>. The formulae given are used for the calculation of a<sub>wot i</sub>, a<sub>wot i+1</sub> and a<sub>wot test</sub>. The speed either at AA' or PP' is defined as the vehicle speed when the reference point passes AA' (v<sub>AA'</sub>) or PP' (v<sub>PP'</sub>). The speed at BB' is defined when the rear of the vehicle passes BB' (v<sub>BB'</sub>). The method used for determination of the acceleration shall be indicated in the test report.

Due to the definition of the reference point for the vehicle the length of the vehicle (l<sub>veh</sub>) is considered differently in the formula below. If the reference point is in the front of the vehicle, then l = l<sub>veh</sub>, mid: l = ½ l<sub>veh</sub> and rear: l = 0.

3/

See figure 1 in Annex VII

##### 4.1.2.1.2.1 The calculation procedure for vehicles with manual transmission, automatic transmission, adaptive transmissions and transmissions with variable gear ratios (CVTs<sup>41</sup>) tested with locked gear ratios is as follows:

$$a_{wot \text{ test}} = ((v_{BB'}/3.6)^2 - (v_{AA'}/3.6)^2) / (2*(20+l))$$

a<sub>wot test</sub> used in the determination of gear selection shall be the average of the four a<sub>wot test, i</sub> during each valid measurement run.

Pre-acceleration may be used. The point of depressing the accelerator before line AA' shall be reported in the vehicle and test data (see Appendix 3 to Annex I).

##### 4.1.2.1.2.2. The calculation procedure for vehicles with automatic transmissions, adaptive transmissions and continuous variable transmissions (CVTs) tested with non-locked gear ratios is as follows:

a<sub>wot test</sub> used in the determination of gear selection shall be the average of the four a<sub>wot test, i</sub> during each valid measurement run.

Where devices or measures described in point 4.1.2.1.4.2. can be used to control transmission operation for the purpose of achieving test requirements, calculate a<sub>wot test</sub> using the equation:

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<sup>41</sup>

Continuously variable transmissions.

$$a_{wot\ test} = ((v_{BB}/3.6)^2 - (v_{AA}/3.6)^2) / (2*(20+l))$$

Pre-acceleration may be used.

Where devices or measures described in point 4.1.2.1.4.2. are not used, calculate  $a_{wot}$  test using the equation:

$$a_{wot\_testPP-BB} = ((v_{BB}/3.6)^2 - (v_{PP}/3.6)^2) / (2*(10+l))$$

Pre-acceleration shall not be used.

The location of depressing the accelerator shall be where the reference point of the vehicle passes line AA'.

#### 4.1.2.1.2.3 Target acceleration

The target acceleration  $a_{urban}$  defines the typical acceleration in urban traffic and is derived from statistical investigations. It is a function depending on the PMR of a vehicle.

The target acceleration  $a_{urban}$  is defined by:

$$a_{urban} = 0,63 * \log_{10} (\text{PMR}) - 0,09$$

#### 4.1.2.1.2.4 Reference acceleration

The reference acceleration  $a_{wot\ ref}$  defines the required acceleration during the accelerated test on the test track. It is a function depending on the power-to-mass ratio of a vehicle. That function is different for specific vehicle categories.

The reference acceleration  $a_{wot\ ref}$  is defined by:

$$a_{wot\ ref} = 1.59 * \log_{10} (\text{PMR}) - 1.41 \quad \text{for } \text{PMR} \geq 25$$

$$a_{wot\ ref} = a_{urban} = 0,63 * \log_{10} (\text{PMR}) - 0,09 \quad \text{for } \text{PMR} < 25$$

#### 4.1.2.1.3 Partial power factor $k_p$

The partial power factor  $k_p$  (see point 4.1.3.1.) is used for the weighted combination of the test results of the acceleration test and the constant speed test for vehicles of category M<sub>1</sub> and N<sub>1</sub>.

In cases other than a single gear test,  $a_{wot\ ref}$  has to be used instead of  $a_{wot\ test}$  (see point 3.1.3.1.).

#### 4.1.2.1.4. Gear ratio selection

The selection of gear ratios for the test depends on their specific acceleration potential  $a_{wot}$  under full throttle condition, according to the reference acceleration  $a_{wot\ ref}$  required for the full throttle acceleration test.

Some vehicles may have different software programs or modes for the transmission (e.g. sporty, winter, adaptive). Where the vehicle has different modes leading to valid accelerations, the vehicle manufacturer shall prove to the satisfaction of the technical service, that the vehicle is tested in the mode which achieves an acceleration closest to  $a_{wot\ ref}$ .

##### 4.1.2.1.4.1. Vehicles with manual transmissions, automatic transmissions, adaptive transmissions or CVTs tested with locked gear ratios

The following conditions for selection of gear ratios are possible:

- (a) If one specific gear ratio gives an acceleration in a tolerance band of  $\pm 5\%$  of the reference acceleration  $a_{wot\ ref}$ , not exceeding  $3,0\text{ m/s}^2$ , test with that gear ratio.
- (b) If none of the gear ratios give the required acceleration, then choose a gear ratio  $i$ , with an acceleration higher and a gear ratio  $i + 1$ , with an acceleration lower than the reference acceleration. If the acceleration value in gear ratio  $i$  does not exceed  $3,0\text{ m/s}^2$ , use both gear ratios for the test. The weighting ratio in relation to the reference acceleration  $a_{wot\ ref}$  is calculated by:

$$k = (a_{wot\ ref} - a_{wot(i+1)}) / (a_{wot(i)} - a_{wot(i+1)})$$

- (c) if the acceleration value of gear ratio  $i$  exceeds  $3,0\text{ m/s}^2$ , the first gear ratio shall be used that gives an acceleration below  $3,0\text{ m/s}^2$  unless gear ratio  $i + 1$  provides acceleration less than  $a_{urban}$ . In this case, two gears,  $i$  and  $i + 1$  shall be used, including the gear  $i$  with acceleration exceeding  $3,0\text{ m/s}^2$ . In other cases, no other gear shall be used. The achieved acceleration  $a_{wot\ test}$  during the test shall be used for the calculation of the part power factor  $k_p$  instead of  $a_{wot\ ref}$ .
- (d) If the vehicle has a transmission in which there is only one selection for the gear ratio the acceleration test is carried out in this vehicle gear selection. The achieved acceleration is then used for the calculation of the part power factor  $k_p$  instead of  $a_{wot\ ref}$ .
- (e) If rated engine speed is exceeded in a gear ratio before the vehicle passes BB' the next higher gear shall be used.

4.1.2.1.4.2. Vehicles with automatic transmission, adaptive transmissions and CVTs tested with non-locked gear ratios:

The gear selector position for full automatic operation shall be used.

The acceleration value  $a_{wot}$  test shall be calculated as defined in point 4.1.2.1.2.2.

The test may then include a gear 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 shifting to a gear ratio which is not used in urban traffic shall be avoided.

Therefore, it is permitted to establish and use electronic or mechanical devices, including alternate gear selector positions, to prevent a downshift to a gear ratio which is typically not used at the specified test condition in urban traffic.

The achieved acceleration  $a_{wot}$  test shall be greater or equal to  $a_{urban}$ .

If possible, the manufacturer shall take measures to avoid an acceleration value  $a_{wot}$  test greater than  $2.0 \text{ m/s}^2$ .

The achieved acceleration  $a_{wot}$  is then used for the calculation of the partial power factor  $k_p$  (see point 4.1.2.1.3.) instead  $a_{wot}$  ref.

#### 4.1.2.1.5. Acceleration test

The manufacturer shall define the position of the reference point in front of line AA' of fully depressing the accelerator. The accelerator shall be fully depressed (as rapidly as is practicable) when the reference point of the vehicle reaches the defined point. The accelerator shall be kept in this depressed condition until the rear of the vehicle reaches line BB'. The accelerator shall then be released as rapidly as possible. The point of fully depressing the accelerator shall be reported in the vehicle and test data in accordance with Appendix 3 to Annex II. The technical service shall have the possibility of pretesting.

In the case of articulated vehicles consisting of two non-separable units regarded as a single vehicle, the semi-trailer shall be disregarded in determining when line BB' is crossed.

#### 4.1.2.1.6. Constant speed test

The constant speed test shall be carried out with the same gear(s) specified for the acceleration test and a constant speed of 50 km/h with a tolerance of  $\pm 1 \text{ km/h}$  between AA' and BB'. During the constant speed test the acceleration control shall be positioned to maintain a constant speed between AA' and BB' as specified. If the gear is locked for the acceleration test, the same gear shall be locked for the

constant speed test.

The constant speed test is not required for vehicles with a PMR < 25.

#### 4.1.2.2. Vehicles of categories M<sub>2</sub> > 3500 kg, M<sub>3</sub>, N<sub>2</sub>, N<sub>3</sub>

The path of the centreline of the vehicle shall follow line CC' as closely as possible throughout the entire test, from the approach to line AA' until the rear of the vehicle passes line BB'. The test shall be conducted without a trailer or semi-trailer. If a trailer is not readily separable from the towing vehicle, the trailer shall not be taken into consideration when assessing the crossing of line BB'. If the vehicle incorporates equipment such as a concrete mixer, a compressor, etc, this equipment shall not be in operation during the test. The test mass of the vehicle shall be according to the table set out in point 3.2.1.

Target conditions of category M<sub>2</sub> > 3500 kg, N<sub>2</sub>

When the reference point passes line BB', the engine speed n<sub>BB'</sub> shall be between 70 per cent and 74 per cent of speed S, at which the engine develops its rated maximum power, and the vehicle speed shall be 35 km/h ± 5 km/h. Between line AA' and line BB' a stable acceleration condition shall be ensured.

Target conditions of category M<sub>3</sub>, N<sub>3</sub>:

When the reference point passes line BB', the engine speed n<sub>BB'</sub> shall be between 85 per cent and 89 per cent of speed S, at which the engine develops its rated maximum power, and the vehicle speed shall be 35 km/h ± 5 km/h. Between line AA' and line BB' a stable acceleration condition shall be ensured.

##### 4.1.2.2.1. Gear ratio selection

###### 4.1.2.2.1.1. Vehicles with manual transmissions

Stable acceleration condition shall be ensured. The gear choice is determined by the target conditions. If the difference in speed exceeds the given tolerance, then two gears should be tested, one above and one below the target speed.

If more than one gear fulfils the target conditions, select that gear which is closest to 35 km/h. If no gear fulfils the target condition for v<sub>test</sub>, two gears shall be tested, one above and one below v<sub>test</sub>. The target engine speed shall be reached under any condition.

A stable acceleration condition shall be ensured. If a stable acceleration cannot be ensured in a gear, this gear has to be disregarded.

#### 4.1.2.2.1.2. Vehicles with automatic transmissions, adaptive transmissions and transmissions with variable gear ratio (CVTs)

The gear selector position for full automatic operation shall be used. The test may then include a gear change to a lower range and a higher acceleration. A gear change to a higher range and a lower acceleration shall not be permitted. A gear shifting to a gear ratio which is not used in urban traffic, at the specified test condition, shall be avoided. Therefore, it shall be permitted to establish and use electronic or mechanical devices to prevent a downshift to a gear ratio which is typically not used at the specified test condition in urban traffic.

If the vehicle includes a transmission design, which provides only a single gear selection (drive), which limits engine speed during the test, the vehicle shall be tested using only a target vehicle speed. If the vehicle uses an engine and transmission combination that does not fulfil the requirements set out in point 4.1.2.2.1.1., the vehicle shall be tested using only the target vehicle speed. The target vehicle speed ( $v_{BB'}$ ) for the test is =  $35 \text{ km/h} \pm 5\text{km/h}$ . A gear change to a higher range and a lower acceleration is allowed after the reference point of the vehicle passes line PP'. Two tests shall be performed, one with the end speed of  $v_{test} = v_{BB'} + 5 \text{ km/h}$ , and one with the end speed of  $v_{test} = v_{BB'} - 5 \text{ km/h}$ . The reported noise level is that result which is related to the test with the highest engine speed obtained during the test from AA' to BB'.

#### 4.1.2.2.2. Acceleration test

When the reference point of the vehicle reaches the line AA' the accelerator control shall be fully depressed (without operating the automatic downshift to a lower range than normally used in urban driving) and held fully depressed until the rear of the vehicle passes BB', but the reference point shall be at least 5 m behind BB'. The accelerator control shall then be released.

In the case of articulated vehicles consisting of two non-separable units regarded as a single vehicle, the semi-trailer shall be disregarded in determining when line BB' is crossed.

#### 4.1.3. Interpretation of results

The maximum A-weighted sound pressure level indicated during each passage of the vehicle between the two lines AA' and BB' shall be noted. If a noise peak obviously out of character with the general sound pressure level is observed, the measurement shall be discarded. At least four measurements for each test condition shall be made on each side of the vehicle and for each gear ratio. Left and right side may be measured simultaneously or sequentially. The first four valid consecutive measurement results, within 2 dB(A), allowing for the deletion of non valid results

(see point 3.1.), shall be used for the calculation of the final result for the given side of the vehicle. The results of each side shall be averaged separately. The intermediate result is the higher value of the two averages mathematically rounded to the first decimal place.

The speed measurements at AA', BB', and PP' shall be noted and used in calculations to the first significant digit after the decimal place.

The calculated acceleration  $a_{wot\ test}$  shall be noted to the second digit after the decimal place.

#### 4.1.3.1. Vehicles of categories M<sub>1</sub>, N<sub>1</sub> and M<sub>2</sub> ≤ 3500 kg

The calculated values for the acceleration test and the constant speed test are given by:

$$L_{wot\ rep} = L_{wot(i+1)} + k * (L_{wot(i)} - L_{wot(i+1)})$$

$$L_{crs\ rep} = L_{crs(i+1)} + k * (L_{crs(i)} - L_{crs(i+1)})$$

$$\text{Where } k = (a_{wot\ ref} - a_{wot(i+1)}) / (a_{wot(i)} - a_{wot(i+1)})$$

In the case of a single gear ratio test the values are the test result of each test.

The final result is calculated by combining  $L_{wot\ rep}$  and  $L_{crs\ rep}$ . The equation is:

$$L_{urban} = L_{wot\ rep} - k_p * (L_{wot\ rep} - L_{crs\ rep})$$

The weighting factor  $k_p$  gives the partial power factor for urban driving. In cases other than a single gear test  $k_p$  is calculated by:

$$k_p = 1 - (a_{urban} / a_{wot\ ref})$$

If only one gear was specified for the test  $k_p$  is given by:

$$k_p = 1 - (a_{urban} / a_{wot\ test})$$

In cases where  $a_{wot\ test}$  is less than  $a_{urban}$ :

$$k_p = 0$$

#### 4.1.3.2. Vehicles of categories M<sub>2</sub> > 3500 kg, M<sub>3</sub>, N<sub>2</sub>, N<sub>3</sub>

When one gear is tested the final result is equal to the intermediate result. When two gears are tested the arithmetic mean of the intermediate results shall be calculated.

4.2. Measurement of noise emitted by stationary vehicles

4.2.1. Sound level in the vicinity of vehicles

The measurement results shall be entered into the test report referred to in Appendix 3 to Annex I.

4.2.2. Acoustic measurements

A precision sound level meter, or equivalent measuring system, as defined in point 2.1. shall be used for the measurements

4.2.3. Test site - local conditions as referred to in figure 1 to Appendix 2 to Annex II

4.2.3.1. In the vicinity of the microphone, there shall be no obstacle that could influence the acoustical field and no person shall remain between the microphone and the noise source. The meter observer shall be positioned so as not to influence the meter reading.

4.2.4. Disturbance sound and wind interference

Readings on the measuring instruments produced by ambient noise and wind shall be at least 10 dB(A) below the sound level to be measured. A suitable windscreen may be fitted to the microphone provided that account is taken of its effect on the sensitivity of the microphone (see point 2.1.).

4.2.5. Measuring method

4.2.5.1. Nature and number of measurements

The maximum sound level expressed in A-weighted decibels (dB(A)) shall be measured during the operating period referred to in point 4.2.5.3.2.1.

At least three measurements shall be taken at each measuring point.

4.2.5.2. Positioning and preparation of the vehicle

The vehicle shall be located in the centre part of the test area with the gear selector in the neutral position and the clutch engaged. If the design of the vehicle does not allow this, the vehicle shall be tested in conformity with the manufacturer's prescriptions for stationary engine testing. Before each series of measurements, the engine must be brought to its normal operating condition, as specified by the manufacturer.

If the vehicle is fitted with a fan or fans having an automatic actuating mechanism,

this system shall not be interfered with during the sound level measurements.

The engine hood or compartment cover, if so fitted, shall be closed.

4.2.5.3. Measuring of noise in proximity to the exhaust as referred to in Figure 1 to Appendix 2 to Annex II.

4.2.5.3.1. Positions of the microphone

4.2.5.3.1.1. The microphone shall be located at a distance of  $0,5\text{ m} \pm 0,01\text{ m}$  from the reference point of the exhaust pipe defined in Figure 1, and at an angle of  $45^\circ(\pm 5^\circ)$  to the flow axis of the pipe termination. The microphone shall be at the height of the reference point, but not less than  $0,2\text{ m}$  from the ground surface. The reference axis of the microphone shall lie in a plane parallel to the ground surface and shall be directed toward the reference point on the exhaust outlet. If two microphone positions are possible, the location farthest laterally from the vehicle longitudinal centreline shall be used. If the flow axis of the exhaust outlet pipe is at  $90^\circ$  to the vehicle longitudinal centreline, the microphone shall be located at the point, which is farthest from the engine.

4.2.5.3.1.2. For vehicles having an exhaust provided with outlets spaced more than  $0,3\text{ m}$  apart, measurements shall be made for each outlet. The highest level shall be recorded.

4.2.5.3.1.3. In the case of an exhaust provided with two or more outlets spaced less than  $0,3\text{ m}$  apart and which are connected to the same silencer, only one measurement shall be made; the microphone position is related to the outlet nearest to one extreme edge of the vehicle or, when such outlet does not exist, to the outlet which is the highest above the ground.

4.2.5.3.1.4. For vehicles with a vertical exhaust (e.g. commercial vehicles) the microphone shall be placed at the height of the exhaust outlet. Its axis shall be vertical and oriented upwards. It shall be placed at a distance of  $0,5\text{ m} \pm 0,01\text{ m}$  from the exhaust pipe reference point, but never less than  $0,2\text{ m}$  from the side of the vehicle nearest to the exhaust.

4.2.5.3.1.5. For exhaust outlets located under the vehicle body, the microphone shall be located a minimum of  $0,2\text{ m}$  from the nearest part of the vehicle, at a point closest to, but never less than  $0,5\text{ m}$  from the exhaust pipe reference point, and at a height of  $0,2\text{ m}$  above the ground, and not in line with the exhaust flow. The angularity requirement in point 4.2.5.3.1.1. may not be met in some cases.

4.2.5.3.2. Operating conditions of the engine

4.2.5.3.2.1. Target engine speed

The target engine speed is defined as:

- 75 per cent of the engine speed S for vehicles with a rated engine speed  $\leq 5000 \text{ min}^{-1}$
- $3750 \text{ min}^{-1}$  for vehicles with a rated engine speed above  $5000 \text{ min}^{-1}$  and below  $7500 \text{ min}^{-1}$
- 50 per cent of the engine speed S for vehicles with a rated engine speed  $\geq 7500 \text{ min}^{-1}$ .

If the vehicle cannot reach such engine speed , the target engine speed shall be 5 per cent below the maximum possible engine speed for that stationary test.

#### 4.2.5.3.2.2. Test procedure

The engine speed shall be gradually increased from idle to the target engine speed, not exceeding a tolerance band of  $\pm 3$  per cent of the target engine speed, and held constant. Then the throttle control shall be rapidly released and the engine speed shall return to idle. The noise level shall be measured during a period of operation consisting of a maintenance of constant engine speed of 1 second and throughout the entire deceleration period, the maximum sound level meter reading, mathematically rounded to the first decimal place, is taken as the test value.

#### 4.2.5.3.2.3. Test validation

The measurement shall be regarded as valid if the test engine speed does not deviate from the target engine speed by more than  $\pm 3$  per cent for at least 1 second.

### 4.2.6. Results

At least three measurements for each test position shall be made. The maximum A-weighted sound pressure level indicated during each of the three measurements shall be recorded. The first three valid consecutive measurement results, within 2 dB(A), allowing for the deletion of non valid results (taking into account the specifications of the test site as referred to in point 3.1.), shall be used for the determination of the final result for the given measurement position. The maximum sound level, for all measurement positions, and of the three measurement results, shall constitute the final result.

## Appendix 1

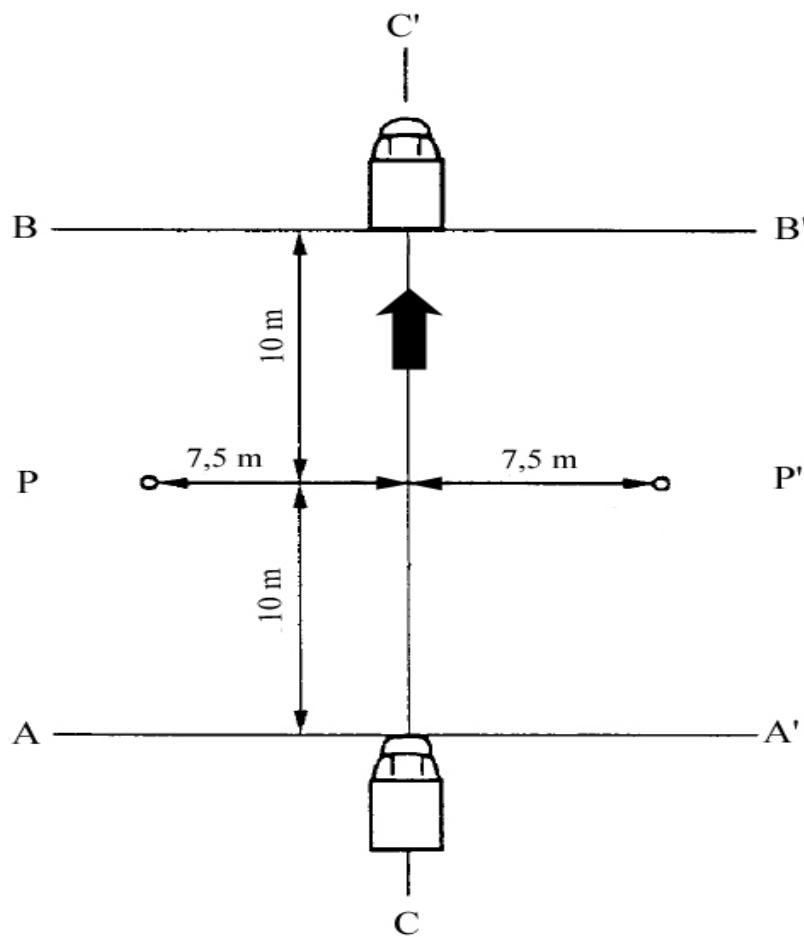
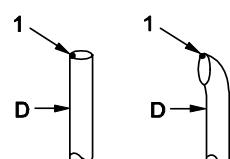
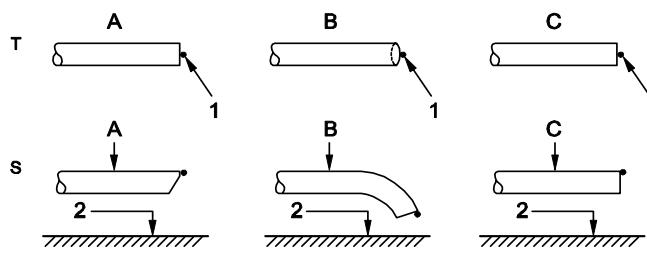


Figure 1: Measuring positions for vehicles in motion



T = top view  
 S = side view  
 A = metered pipe  
 B = bent down pipe  
 C = straight pipe  
 D = vertical pipe  
 1 = reference point  
 2 = road surface

Figure 2: Reference point

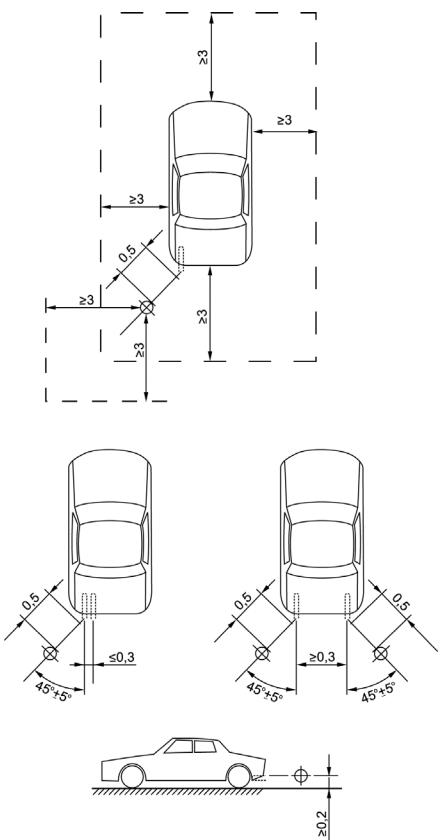


Figure 3a

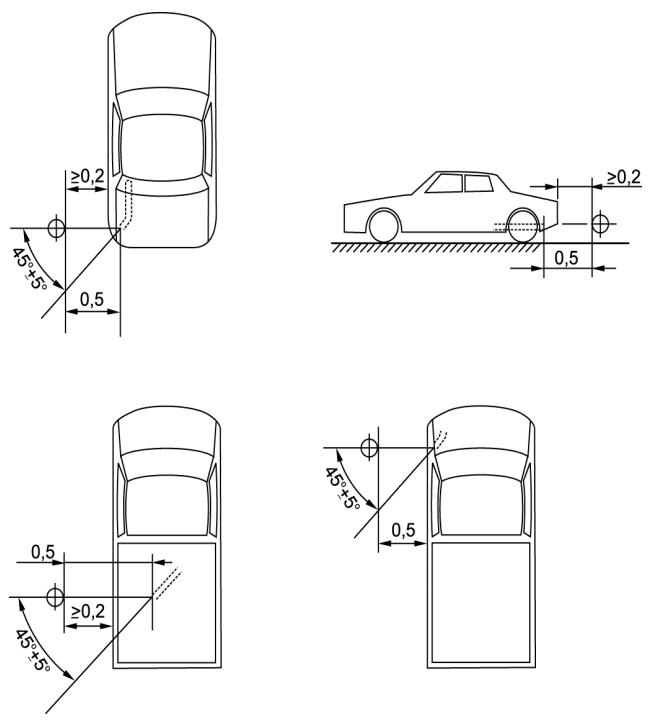


Figure 3b

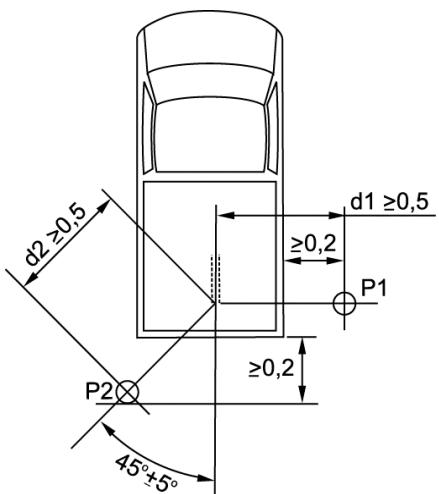


Figure 3c

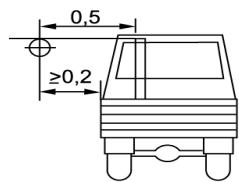


Figure 3d

Figures 3 a - d: Examples of the position of the microphone, depending on the location of the exhaust pipe

### Annex III

#### Limit values

The sound level measured in accordance with the provisions of Annex II shall not exceed the following limits:

Vehicle category	Description of vehicle category	Limit values expressed in dB(A) [decibels(A)]					
		Limit values for Type-approval of new vehicle types		Limit values for Type-approval of new vehicle types		Limit values for registration, sale and entry into service of new vehicles	
		Phase 1 valid from [2 years after publication]		Phase 2 valid from [5 years after publication]		Phase 3 valid from [7 years after publication]	
		General	Off-road *	General	Off-road *	General	Off-road *
<b>M</b>	<b>Vehicles used for the carriage of passengers</b>						
M <sub>1</sub>	no of seats ≤ 9	70	71**	68	69**	68	69**
M <sub>1</sub>	no of seats ≤ 9; power to mass ratio > 150 kW/ton	71	71	69	69	69	69
M <sub>2</sub>	no of seats > 9; mass ≤ 2 tons	72	72	70	70	70	70
M <sub>2</sub>	no of seats > 9; 2 tons < mass ≤ 3.5 tons	73	74	71	72	71	72
M <sub>2</sub>	no of seats > 9; 3.5 tons < mass ≤ 5 tons; rated engine power < 150 kW	74	75	72	73	72	73
M <sub>2</sub>	no of seats > 9; 3.5 tons < mass ≤ 5 tons; rated engine power ≥ 150 kW	76	78	74	76	74	76
M <sub>3</sub>	no of seats > 9; mass > 5 tons; rated engine power < 150 kW	75	76	73	74	73	74
M <sub>3</sub>	no of seats > 9; mass > 5 tons; rated engine power ≥ 150 kW	77	79	75	77	75	77
<b>N</b>	<b>Vehicles used for the carriage of goods</b>						
N <sub>1</sub>	mass ≤ 2 tons	71	71	69	69	69	69
N <sub>1</sub>	2 tons < mass ≤ 3.5 tons	72	73	70	71	70	71
N <sub>2</sub>	3.5 tons < mass ≤ 12 tons; rated engine power	74	75	72	73	72	73

	< 75 kW						
N <sub>2</sub>	3.5 tons < mass ≤ 12 tons; 75 ≤ rated engine power < 150 kW	75	76	73	74	73	74
N <sub>2</sub>	3.5 tons < mass ≤ 12 tons; rated engine power ≥ 150 kW	77	79	75	77	75	77
N <sub>3</sub>	mass > 12 tons; 75 ≤ rated engine power < 150 kW	77	78	75	76	75	76
N <sub>3</sub>	mass > 12 tons; rated engine power ≥ 150 kW	80	82	78	80	78	80

- \* Increased limit values shall only be valid if the vehicle complies with the relevant definition for off-road vehicles set out in point 4 of Section A of Annex II to EU Directive 2007/46/EC.
  - \*\* For M<sub>1</sub> vehicles the increased limit values for off-road vehicles are only valid if the maximum authorised mass > 2 tonnes.
-

## **Annex IV**

### **Silencing Systems Containing Acoustically Absorbing Fibrous Materials**

#### 1. General

Sound absorbing fibrous materials may be used in silencing systems or components thereof where any of the following conditions are fulfilled;

- (a) the exhaust gas is not in contact with the fibrous materials;
- (b) the silencing system or components thereof are of the same design family as systems or components for which it has been proven, in the course of type approval process in accordance with the requirements of this Regulation for another vehicle-type, that they are not subject to deterioration.

Where none of these conditions is fulfilled, the complete silencing system or components thereof shall be submitted to a conventional conditioning using one of three installations and procedures described below.

#### 1.1. Continuous road operation for 10000 km.

1.1.1.  $50 \pm 20$  per cent of this operation shall consist of urban driving and the remaining operation shall be long-distance runs at high speed; continuous road operation may be replaced by a corresponding test-track programme.

1.1.2. The two speed regimes should be alternated at least twice.

1.1.3. The complete test programme shall include a minimum of 10 breaks of at least three hours duration in order to reproduce the effects of cooling and any condensation which may occur.

#### 1.2. Conditioning on a test bench

1.2.1. Using standard parts and observing the vehicle manufacturer's instructions, the exhaust system or components thereof must be fitted to the vehicle referred to in point 1.3. of Annex I or the engine referred to in point 1.4. of Annex I. In the case of the vehicle referred to in point 1.3 of Annex I, the vehicle must be mounted on a roller dynamometer. In the case of an engine referred to in point 1.4 of Annex I, the engine must be coupled to a dynamometer.

1.2.2. The test shall be conducted in six six-hour periods with a break of at least 12 hours between each period in order to reproduce the effects of cooling and any condensation which may occur.

1.2.3. During each six-hour period, the engine shall be run, under the following conditions in turn:

- (a) Five minutes at idling speed;
- (b) One-hour sequence under 1/4 load at 3/4 of rated maximum speed (S);

- (c) One-hour sequence under 1/2 load at 3/4 of rated maximum speed (S);
- (d) 10 - minute sequence under full load at 3/4 of rated maximum speed (S);
- (e) 15 - minute sequence under 1/2 load at rated maximum speed (S);
- (f) 30 - minute sequence under 1/4 load at rated maximum speed (S).

Total duration of the six sequences: three hours.

Each period shall comprise two sequenced sets of those conditions in consecutive order from (a) to (f).

1.2.4. During the test, the silencing system or components thereof shall not be cooled by a forced draught simulating normal airflow around the vehicle. Nevertheless, at the request of the manufacturer, the silencing system or components thereof may be cooled in order not to exceed the temperature recorded at its inlet when the vehicle is running at maximum speed.

### 1.3. Conditioning by pulsation

1.3.1. The silencing system or components thereof shall be fitted to the vehicle referred to in point 1.3. of Annex I or the engine referred to in point 1.4. of Annex I. In the former case the vehicle shall be mounted on a roller dynamometer.

In the second case, the engine shall be mounted on a dynamometer. The test apparatus, a detailed diagram of which is shown in Figure 1 of the Appendix to this Annex shall be fitted at the outlet of the silencing system. Any other apparatus providing equivalent results shall be acceptable.

1.3.2. The test apparatus shall be adjusted in such a way that the exhaust-gas flow is alternatively interrupted and re-established by the quick-action valve for 2500 cycles.

1.3.3. The valve shall open when the exhaust-gas back pressure, measured at least 100 mm downstream of the intake flange, reaches a value of between 0,35 and 0,40 kPa. It shall close when this pressure does not differ by more than 10 per cent from its stabilized value with the valve open.

1.3.4. The time-delay switch shall be set for the duration of gas exhaust resulting from the provisions laid down in point 1.3.3.

1.3.5. Engine speed shall be 75 % of the speed (S) at which the engine develops maximum power.

1.3.6. The power indicated by the dynamometer shall be 50 % of the full-throttle power measured at 75 % of engine speed (S).

1.3.7. Any drain holes shall be closed off during the test.

1.3.8. The entire test shall be completed within 48 hours.

If necessary, one cooling period shall be observed after each hour.

## Appendix 1

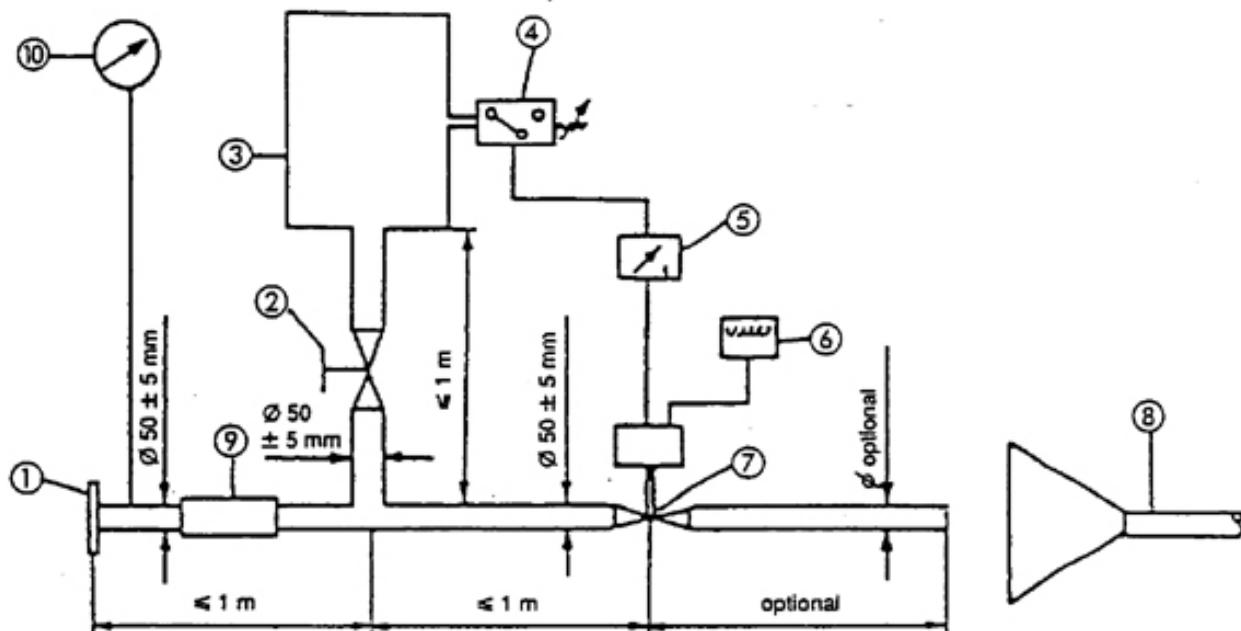


Figure 1  
Test apparatus for conditioning by pulsation

1. Inlet flange or sleeve for connection to the rear of the test exhaust system.
2. Hand-operated regulating valve.
3. Compensating reservoir with a maximum capacity of 40 l and a filling time of not less than one second.
4. Pressure switch with an operating range of 0,05 to 2,5 bar.
5. Time delay switch
6. Pulse counter
7. Quick-acting valve, such as exhaust brake valve 60 mm in diameter, operated by a pneumatic cylinder with an output of 120 N at 4 bar. The response time, both when opening and closing, must not exceed 0,5 second.
8. Exhaust gas evacuation.
9. Flexible pipe.
10. Pressure gauge.

## **Annex V**

### **Compressed air noise**

#### **1. Method of measurement**

The measurement is performed at microphone positions 2 and 6 according to Figure 1, with the vehicle stationary. The highest A-weighted noise level shall be registered during venting the pressure regulator and during ventilating after the use of both the service and parking brakes.

The noise during venting the pressure regulator is measured with the engine at idling speed. The ventilating noise is registered while operating the service and parking brakes; before each measurement, the air-compressor unit has to be brought up to the highest permissible operating pressure, and then the engine switched off.

#### **2. Evaluation of the results**

For all microphone positions two measurements are taken. In order to compensate for inaccuracies of the measuring equipment, the metre reading is reduced by 1 dB(A), and the reduced value is taken as the result of measurement. The results are taken as valid if the difference between the measurements at one microphone position does not exceed 2 dB(A). The highest value measured is taken as the result. If this value exceeds the noise limit by 1 dB(A), two additional measurements are to be taken at the corresponding microphone position. In this case, three out of the four results of measurement obtained at this position have to comply with the noise limit.

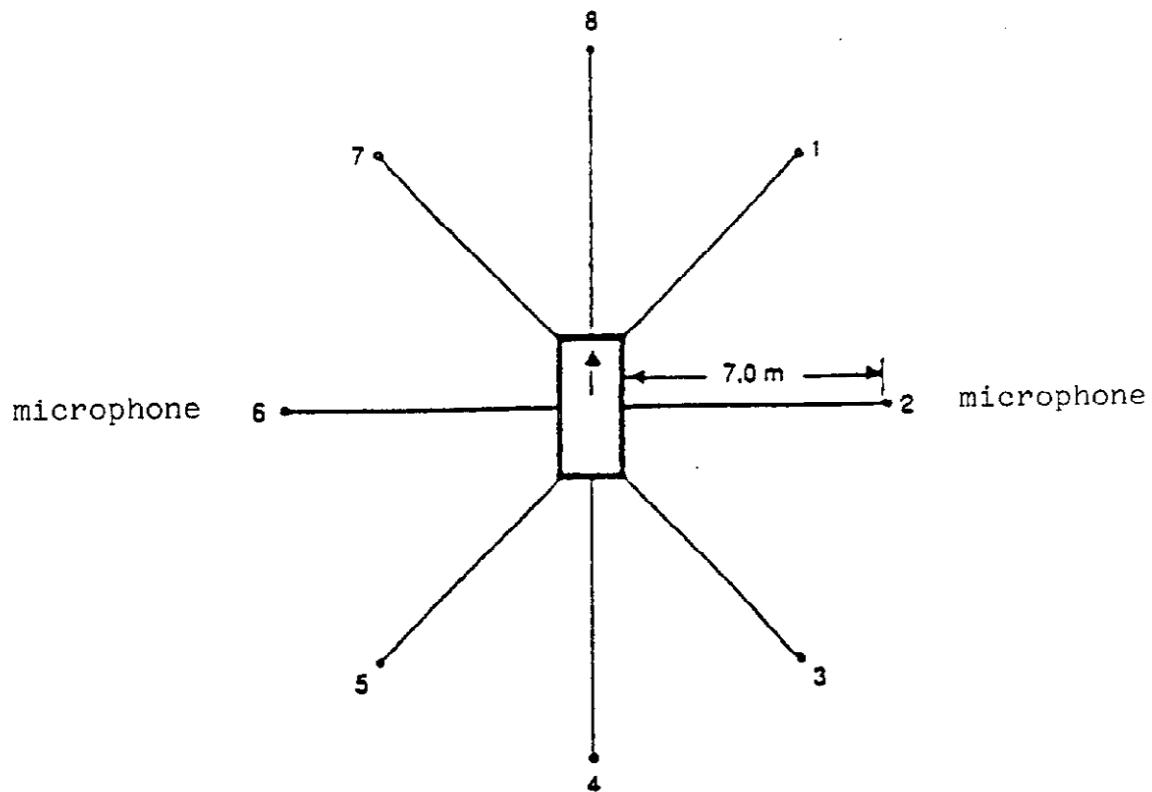
#### **3. Limiting value**

The sound level shall not exceed the limit of 72 dB(A).

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## Appendix 1

Figure 1: Microphone positions for measurement of compressed air noise



The measurement is performed at the stationary vehicle according to Figure 1, using two microphone positions at a distance of 7 m from the contour of the vehicles, and at 1,2 m above ground.

## **Annex VI**

### **Checks on conformity of production for vehicles**

#### **1. General**

These requirements are consistent with the test to be held to check conformity of production (COP) in accordance with point 5 of Annex I.

#### **2. Testing procedure**

The test site and measuring instruments shall be those described in Annex II.

##### **2.1. The vehicle(s) under test shall be subjected to the test for measurement of sound of vehicle in motion set out in point 4.1. of Annex II.**

##### **2.2. Compressed air sound**

Vehicles having maximum mass exceeding 2800 kg and equipped with compressed air systems must be subjected to the additional test for measurement of the compressed air sound set out in point 1 of Annex V.

##### **2.3. Additional sound emission provisions**

The vehicle manufacturer shall assess the compliance with ASEP by an appropriate evaluation or may perform the test described in Annex VIII.

#### **3. Sampling and evaluation of the results**

One vehicle has to be chosen and subjected to the tests set out in point 2. If the test results fulfil the COP requirements of Annex X of Directive 2007/46/EC, the vehicle shall be considered to be in compliance with the COP provisions.

If one of the test results does not fulfil the COP requirements of Annex X of Directive 2007/46/EC, two more vehicles of the same type shall be tested pursuant to point 2 of this Annex.

If the test results for the second and the third vehicle fulfil the COP requirements of Annex X of Directive 2007/46/EC, the vehicle is considered in compliance with the COP.

If one of the test results of the second or third vehicle does not fulfil the COP requirements of Annex X of Directive 2007/46/EC, the vehicle type shall be considered not to conform to the requirements of this Regulation and the manufacturer shall take the necessary measures to re-establish the conformity

## **Annex VII**

### **Specifications for the test site**

#### **1. Introduction**

This Annex describes the specifications relating to the physical characteristics and the laying of the test track. These specifications based on a special standard 1/ describe the required physical characteristics as well as the test methods for these characteristics.

#### **2. Required characteristics of the surface**

A surface is considered to conform to this standard provided that the texture and voids content or sound absorption coefficient have been measured and found to fulfil all the requirements of points 2.1. to 2.4. and provided that the design requirements set out in point 3.2. have been met.

##### **2.1. Residual voids content**

The residual voids content,  $V_C$ , of the test track paving mixture shall not exceed 8 %. For the measurement procedure, see point 4.1.

##### **2.2. Sound absorption coefficient**

If the surface fails to comply with the residual voids content requirement, the surface shall be acceptable only if its sound absorption coefficient,  $\alpha \leq 0,10$ . For the measurement procedure, see point 4.2. The requirements of point 2.1. and of this point shall be deemed to be met also if only sound absorption has been measured and found to be  $\alpha \leq 0,10$ .

It is to be noted that the most relevant characteristic is the sound absorption, although the residual voids content is more familiar among road constructors. However, sound absorption needs to be measured only if the surface fails to comply with the voids requirement. This is motivated because the latter is connected with relatively large uncertainties in terms of both measurements and relevance and some surfaces therefore erroneously may be rejected when based only on the voids measurement.

##### **2.3. Texture depth**

The texture depth (TD) measured according to the volumetric method (see point 4.3. below) shall be:

$$TD \geq 0,4 \text{ mm}$$

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1/ ISO10844:1994.

## 2.4.

### Homogeneity of the surface

Every practical effort shall be taken to ensure that the surface is made to be as homogeneous as possible within the test area. This includes the texture and voids content, but it should also be observed that if the rolling process results in more effective rolling at some places than others, the texture may be different and unevenness causing bumps may also occur.

## 2.5.

### Period of testing

In order to check whether the surface continues to conform to the texture and voids content or sound absorption requirements stipulated in this standard, periodic testing of the surface shall be done at the following intervals:

- (a) For residual voids content or sound absorption:

when the surface is new;

if the surface meets the requirements when new, no further periodical testing is required. If it does not meet the requirement when it is new, it may do later because surfaces tend to become clogged and compacted with time.

- (b) For texture depth (TD):

when the surface is new;

when the noise testing starts (NB: not before four weeks after laying);

then every twelve months.

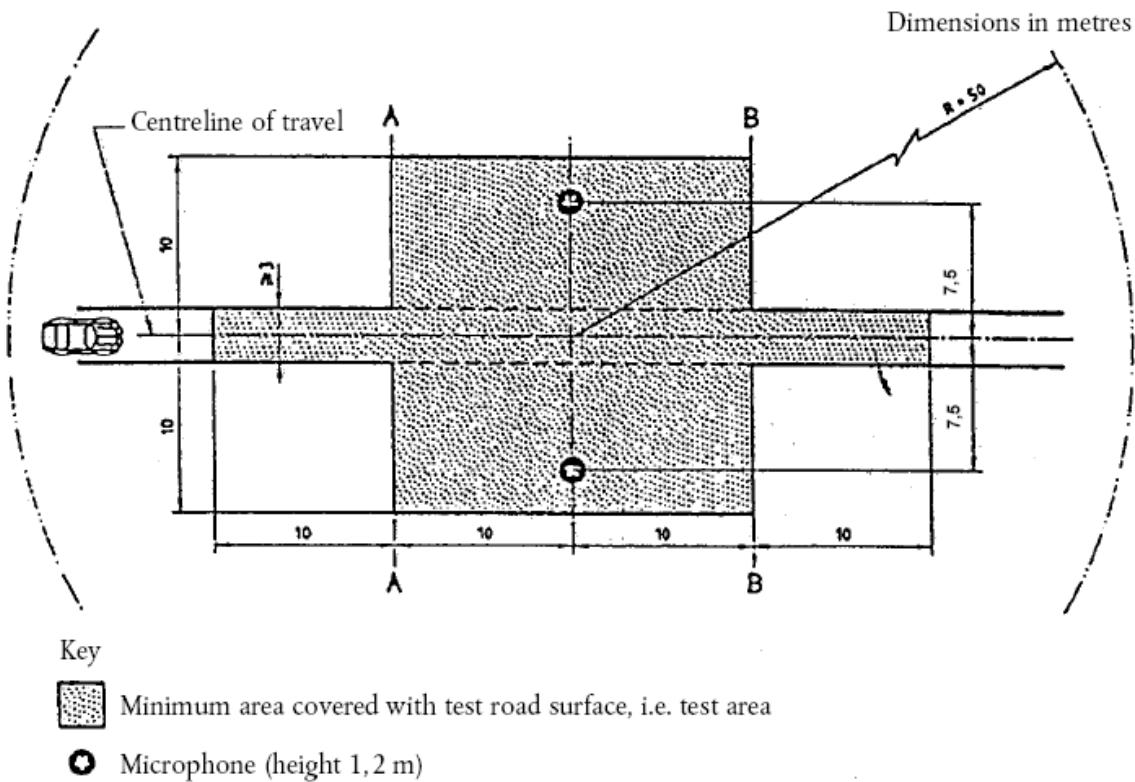
## 3.

### Test surface design

#### 3.1.

##### Area

When designing the test track layout it is important to ensure that, as a minimum requirement, the area traversed by the vehicles running through the test strip is covered with the specified test material with suitable margins for safe and practical driving. This shall require that the width of the track is at least 3 m and the length of the track extends beyond lines AA and BB by at least 10 m at either end. Figure 1 shows a plan of a suitable test site and indicates the minimum area which shall be machine laid and machine compacted with the specified test surface material. According to point 4.1.1. of Annex II, measurements have to be made on each side of the vehicle. This can be made either by measuring with two microphone locations (one on each side of the track) and driving in one direction, or measuring with a microphone only on one side of the track but driving the vehicle in two directions. If the latter method is used, then there are no surface requirements on that side of the track where there is no microphone.



NOTE – There shall be no large acoustically reflective objects within this radius.

**Figure 1:** Minimum requirement for test surface area. The shaded part is called "Test Area".

### 3.2. Design and preparation of the surface

#### 3.2.1. Basic design requirements

The test surface shall meet four design requirements.

3.2.1.1. It shall be a dense asphaltic concrete.

3.2.1.2. The maximum chipping size shall be 8 mm (tolerances allow from 6,3 to 10 mm).

3.2.1.3. The thickness of the wearing course shall be  $\geq 30$  mm.

3.2.1.4. The binder shall be a straight penetration grade bitumen without modification.

#### 3.2.2. Design guidelines

As a guide to the surface constructor, an aggregate grading curve which will give desired characteristics is shown in Figure 2. In addition, Table 1 gives some guidelines in order to obtain the desired texture and durability. The grading curve fits the following formula:

$$P (\% \text{ passing}) = 100 \cdot (d/d_{\max})^{1/2}$$

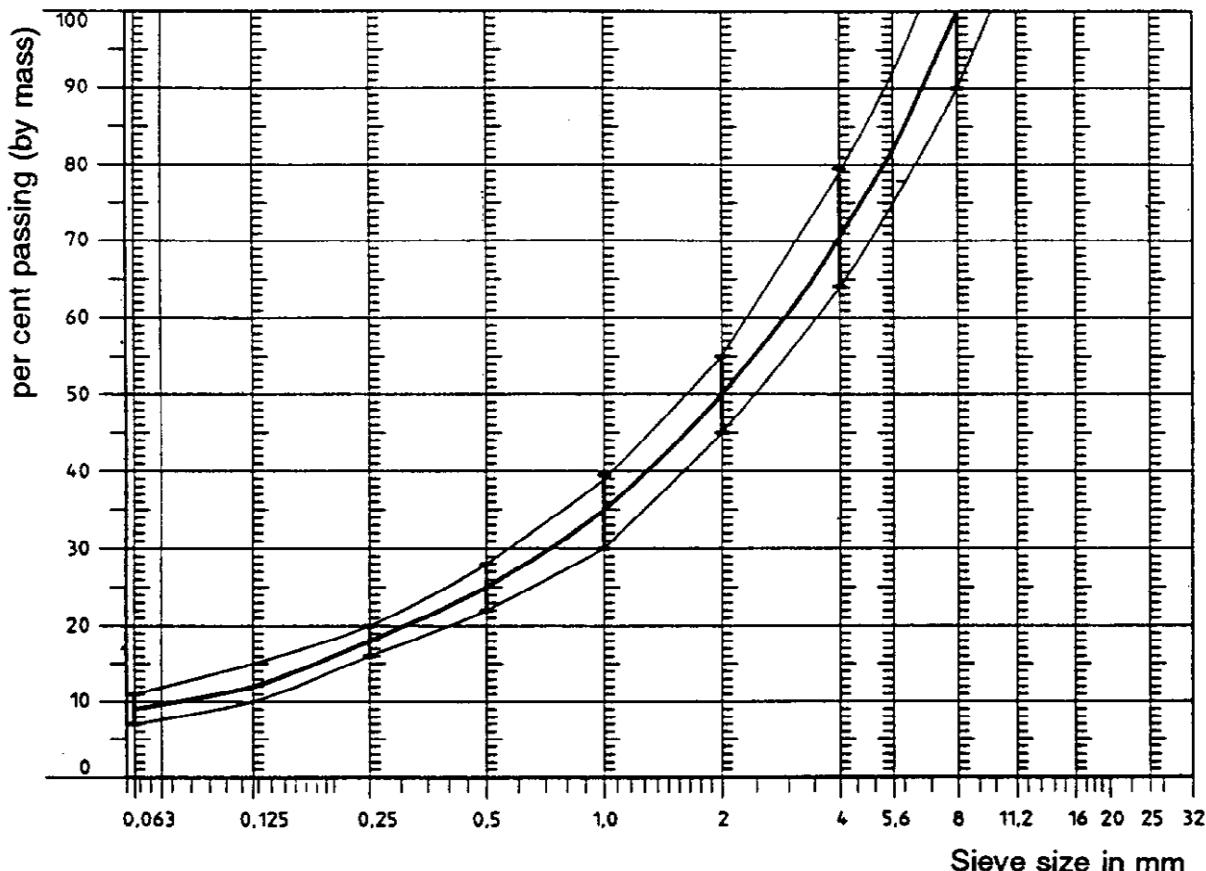
where:

$d$  = square mesh sieve size, in mm

$d_{max} = 8$  mm for the mean curve

$d_{max} = 10$  mm for the lower tolerance curve

$d_{max} = 6,3$  mm for the upper tolerance curve



**Figure 2 :** Grading curve of the aggregate in the asphaltic mix with tolerances.

In addition to the requirements set out under points 1 to 3.2.2, the following requirements shall be fulfilled:

- (a) The sand fraction ( $0,063 \text{ mm} < \text{square mesh sieve size} < 2 \text{ mm}$ ) shall include no more than 55 % natural sand and at least 45 % crushed sand;
- (b) The base and sub-base shall ensure a good stability and evenness, according to best road construction practice;
- (c) The chippings shall be crushed (100 % crushed faces) and of a material with a high resistance to crushing;
- (d) The chippings used in the mix shall be washed;
- (e) No extra chippings shall be added onto the surface;

- (f) The binder hardness expressed as PEN value shall be 40-60, 60-80 or even 80-100 depending on the climatic conditions of the country. As hard a binder as possible shall be used, provided this is consistent with common practice;
- (g) The temperature of the mix before rolling shall be chosen so as to achieve by subsequent rolling the required voids content. In order to increase the probability of satisfying the specifications of points 2.1. to 2.4., the compactness shall be studied not only by an appropriate choice of mixing temperature, but also by an appropriate number of passings and by the choice of compacting vehicle.

Table 1: Design guidelines

	<u>Target values</u>		<u>Tolerances</u>
	By total mass of mix	By mass of the aggregate	
Mass of stones, square mesh sieve (SM) > 2 mm	47.6 %	50.5 %	± 5
Mass of sand 0,063 < SM < 2 mm	38.0 %	40.2 %	± 5
Mass of filler SM < 0,063 mm	8.8 %	9.3 %	± 2
Mass of binder (bitumen)	5.8 %	N.A.	± 0,5
Max. chipping size		8 mm	6.3 - 10
Binder hardness		(see point 3.2.2. (f) )	
Polished stone value (PSV)		> 50	
Compactness, relative to Marshall compactness		98 %	

#### 4. Test method

##### 4.1. Measurement of the residual voids content

For the purpose of this measurement, cores have to be taken from the track in at least four different positions which are equally distributed in the test area between lines AA and BB (see Figure 1). In order to avoid inhomogeneity and unevenness in the wheel tracks, cores should not be taken in wheel tracks themselves, but close to them. Two cores (minimum) should be taken close to the wheel tracks and one core (minimum) should be taken approximately midway between the wheel tracks and each microphone location.

If there is a suspicion that the condition of homogeneity is not met (see point 2.4.), cores shall be taken from more locations within the test area.

The residual voids content shall be determined for each core, then the average value from all cores shall be calculated and compared with the requirement of point 2.1. In addition, no single core shall have a voids value which is higher than 10 %. The test surface constructor is reminded of the problem which may arise when the test area is heated by pipes or electrical wires and cores must be taken from this area. Such installations must be carefully planned with respect to future core drilling locations. It is recommended to leave a few locations of size approximately 200 x 300 mm where there are no wires/pipes or where the latter are located deep enough

in order not to be damaged by cores taken from the surface layer.

#### 4.2.

##### Sound absorption coefficient

The sound absorption coefficient (normal incidence) shall be measured by the impedance tube method using the procedure specified in ISO 10534-1: "Acoustics - Determination of sound absorption coefficient and impedance by a tube method."<sup>42</sup>

Regarding test specimens, the same requirements shall be followed as regarding the residual voids content (see point 4.1.). The sound absorption shall be measured in the range between 400 Hz and 800 Hz and in the range between 800 Hz and 1600 Hz (at least at the centre frequencies of third octave bands) and the maximum values shall be identified for both of these frequency ranges. Then these values, for all test cores, shall be averaged to constitute the final result.

#### 4.3.

##### Volumetric macrotexture measurement

For the purpose of this standard, texture depth measurements shall be made on at least 10 positions evenly spaced along the wheel tracks of the test strip and the average value taken to compare with the specified minimum texture depth. See ISO 10844:1994 for the description of the procedure.

#### 5.

##### Stability in time and maintenance

###### 5.1.

###### Age influence

In common with any other surfaces, it is expected that the tyre/road noise level measured on the test surface may increase slightly during the first 6-12 months after construction.

The surface will achieve its required characteristics not earlier than four weeks after construction. The influence of age on the noise from trucks is generally less than that from cars.

The stability over time is determined mainly by the polishing and compaction by vehicles driving on the surface. It shall be checked according to the Period of testing referred to in point 2.5.

###### 5.2.

###### Maintenance of the surface

Loose debris or dust which could significantly reduce the effective texture depth must be removed from the surface. In countries with winter climates, salt is sometimes used for de-icing. Salt may alter the surface temporarily or even permanently in such a way as to increase noise and is therefore not recommended.

###### 5.3.

###### Repaving the test area

If it is necessary to repave the test track, it is usually unnecessary to repave more than the test strip (of 3 m width in Figure 1) where vehicles are driving, provided the test area outside the strip met the requirement of residual voids content or sound

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<sup>42</sup>

To be published.

absorption when it was measured.

6. Documentation of the test surface and of tests performed on it

6.1. Documentation of the test surface

The following data shall be given in a document describing the test surface

6.1.1. The location of the test track.

6.1.2. Type of binder, binder hardness, type of aggregate, maximum theoretical density of the concrete ( $D_R$ ), thickness of the wearing course and grading curve determined from cores from the test track.

6.1.3. Method of compaction (e.g. type of roller, roller mass, number of passes).

6.1.4. Temperature of the mix, temperature of the ambient air and wind speed during laying of the surface.

6.1.5. Date when the surface was laid and contractor.

6.1.6. All or at least the latest test result, including:

6.1.6.1. The residual voids content of each core.

6.1.6.2. The locations in the test area from where the cores for voids measurements have been taken.

6.1.6.3. The sound absorption coefficient of each core (if measured). Specify the results both for each core and each frequency range as well as the overall average.

6.1.6.4. The locations in the test area from where the cores for absorption measurement have been taken.

6.1.6.5. Texture depth, including the number of tests and standard deviation.

6.1.6.6. The institution responsible for tests according to points 6.1.6.1. and 6.1.6.2. and the type of equipment used.

6.1.6.7. Date of the test(s) and date when the cores were taken from the test track.

6.2. Documentation of vehicle noise tests conducted on the surface

In the document describing the vehicle noise test(s) it shall be stated whether all the requirements of this standard were fulfilled or not. Reference shall be given to a document according to point 6.1. describing the results which verify this.

## **Annex VIII**

### **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 8.

It is not mandatory to perform actual tests when applying for type-approval. The manufacturer shall sign the declaration of compliance set out in Appendix 1 to this Annex. The type-approval authority may ask for additional information about the declaration of compliance and carry out the tests described below.

The analysis of Annex VIII requires the performance of a test according to 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 in this Annex 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  $V_{AA\ ASEP}$ :  $v_{AA} \geq 20\ km/h$

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

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

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

Vehicle speed  $V_{BB\ ASEP}$ :

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

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

gears                     $k \leq \text{gear ratio } i \text{ as determined in Annex II}$

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<sup>43</sup> 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.

#### 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 according to point 2.3.

The other two test points are defined by the following formula:

Test Point  $P_j$ :  $v_{BB\_j} = v_{BB\_1} + ((j - 1) / 3) * (v_{BB\_4} - v_{BB\_1})$     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  $v_{BB\_j}$ :  $\pm 3 \text{ km/h}$

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

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<sup>43</sup>

Continuously variable transmissions.

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.

$$L_{\text{anchor},i} = L_{woti, \text{Annex II}}$$

$$n_{\text{anchor},i} = n_{BB,woti,\text{Annex II}}$$

$$v_{\text{anchor},i} = v_{BB,woti,\text{Annex II}}$$

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.

$$L_{\text{anchor},i+1} = L_{woti+1, \text{Annex II}}$$

$$n_{\text{anchor},i+1} = n_{BB,woti+1,\text{Annex II}}$$

$$v_{\text{anchor},i+1} = v_{BB,woti+1,\text{Annex II}}$$

#### 3.2. Slope of the regression line for each gear

The sound measurements shall be evaluated as function of engine speed according to 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.

$$Slope_k = \frac{\sum_{j=1}^5 (n_j - \bar{n})(L_i - \bar{L})}{\sum_{j=1}^5 (n_j - \bar{n})^2} \text{ (in dB/1000 min}^{-1}\text{)}$$

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

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

### 3.2.2.

Slope of the regression line for each gear

The Slope<sub>k</sub> 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/1000 min<sup>-1</sup>.

### 3.3.

Calculation of the linear noise level increase expected for each measurement

The sound level L<sub>ASEP,k,j</sub> 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  $n_{BB\_k,j} \leq n_{anchor,k}$ :

$$L_{ASEP\_k,j} = L_{anchor\_k} + (Slope_k - Y) * (n_{BB\_k,j} - n_{anchor,k}) / 1000$$

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

$$L_{ASEP\_k,j} = L_{anchor\_k} + (Slope_k + Y) * (n_{BB\_k,j} - n_{anchor,k}) / 1000$$

Where Y= 1

### 3.4.

Samples

On request of the type-approval authority two additional runs within the boundary conditions according to point 2.3. of this Annex 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:

$x = 3 \text{ dB(A)}$  for vehicle with a non-lockable automatic transmission or non-lockable CVT

$x = 2 \text{ dB(A)} + \text{limit value } L_{\text{urban}}$  of Annex II for all other vehicles

If the measured noise 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 $n_{\text{ref},k}$

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

### 5.3. Calculation of $L_{\text{ref}}$

$$L_{\text{ref}} = L_{\text{anchor},k} + \text{Slope}_k * (n_{\text{ref},k} - n_{\text{anchor},k}) / 1000$$

$L_{\text{ref}}$  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 maximum power greater than 140 kW (UNECE) and having a maximum-power/maximum-mass ratio greater than 75 kW/t,  $L_{\text{ref}}$  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 maximum power greater than 140 kW (UNECE) and having a maximum-power/maximum-mass ratio greater than 75 kW/t,  $L_{\text{ref}}$  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 vehicle manufacturer to the procedure described in point 3 of this Annex and is applicable for all vehicle technologies. It is the responsibility of the vehicle manufacturer to determine the correct manner of testing. Unless otherwise specified, all testing and calculation shall be as specified in Annex II to this Regulation.

### 6.2 Calculation of L<sub>urban</sub> ASEP

From any L<sub>wot ASEP</sub> as measured according to this annex, L<sub>urban ASEP</sub> shall be calculated as follows:

- (a) Calculate a<sub>wot test ASEP</sub> using acceleration calculation from point 4.1.2.1.2.1. or point 4.1.2.1.2.2. of Annex II to this Regulation, as applicable;
- (b) Determine the vehicle speed (V<sub>BB ASEP</sub>) at BB during the L<sub>wot ASEP</sub> test;
- (c) Calculate k<sub>P ASEP</sub> as follows:

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

Test results where a<sub>wot test ASEP</sub> are less than a<sub>urban</sub> shall be disregarded.

- (d) Calculate L<sub>urban measured ASEP</sub> as follows:

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

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

For further calculation, use the L<sub>urban</sub> from Annex II to this Regulation without rounding, including the digit after the decimal (xx.x).

- (e) Calculate L<sub>urban normalized</sub> as follows:

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

- (f) Calculate L<sub>urban ASEP</sub> as follows:

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

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

- (g) Compliance with limits:

L<sub>urban ASEP</sub> shall be less than or equal to 3.0 dB.

## **Appendix 1**

### **Statement of compliance with the Additional Sound Emission Provisions**

(Maximum format: A4 (210 x 297 mm))

(Name of manufacturer) attests that vehicles of this type (type with regard to its noise emission pursuant to EU Regulation No. ) comply with the requirements of Article 8 of Regulation No. .

(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:

## **Annex IX**

### **Measures ensuring the audibility of hybrid and electric vehicles**

This Annex addresses Acoustic Vehicle Alerting System (AVAS) for hybrid electric and pure electric road transport vehicles (HEV and EV).

#### A      Acoustic Vehicle Alerting System

##### 1.      Definition

Acoustic Vehicle Alerting System (AVAS) is a sound generating device designed to inform pedestrians and vulnerable road users.

##### 2.      System performance

If AVAS is installed on a vehicle, it shall fulfil the requirements referred to below.

##### 3.      Operation conditions

###### (a)      Sound generation method

The AVAS shall automatically generate a sound in the minimum range of vehicle speed from start up to approximately 20 km/h and during reversing if applicable for that vehicle category. Where the vehicle is equipped with an internal combustion engine that is in operation within the vehicle speed range defined above, the AVAS may not need to generate a sound.

For vehicles having a reversing sound warning device, it is not necessary for the AVAS to generate a sound during backup.

###### (b)      Pause switch

The AVAS may have a switch to stop its operation temporarily ("pause switch").

If a pause switch is introduced, however, the vehicle should also be equipped with a device for indicating the pause state of the vehicle-approach informing device to the driver in the driver's seat.

The AVAS should remain capable of re-operating after stopped by a pause switch.

If fitted in the vehicle, a pause switch should be located in such a position that the driver will find and manipulate it with ease.

###### (c)      Attenuation

The AVAS sound level may be attenuated during periods of vehicle operation.

##### 4.      Sound type and volume

###### (a)      The sound to be generated by the AVAS should be a continuous sound that provides information to the pedestrians and vulnerable road users of a vehicle in

operation.

However, the following and similar types of sounds are not acceptable:

- (i) Siren, horn, chime, bell and emergency vehicle sounds
- (ii) Alarm sounds e.g. fire, theft, smoke alarms
- (iii) Intermittent sound

The following and similar types of sounds should be avoided:

- (iv) Melodious sounds, animal and insect sounds
- (v) Sounds that confuse the identification of a vehicle and/or its operation (e.g. acceleration, deceleration etc.)

(b) The sound to be generated by the AVAS should 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 to be generated by the AVAS should not exceed the approximate sound level of a similar vehicle of the same category equipped with an internal combustion engine and operating under the same conditions.

Environmental consideration:

The development of the AVAS shall give consideration to the overall community noise impact.

## **Annex X**

### **EU type-approval in respect of the sound level of exhaust systems as separate technical units (replacement exhaust systems)**

1. **APPLICATION FOR EU TYPE-APPROVAL**
  - 1.1. The application of EU type-approval pursuant to Article 7(1) and (2) of Directive 2007/46/EC in respect of a replacement exhaust system or component thereof as a separate technical unit shall be submitted by the vehicle manufacturer or the manufacturer of the separate technical unit in question.
  - 1.2. A model for the information document is given in Appendix 1.
  - 1.3. At the request of the technical service concerned, the applicant must submit:
    - 1.3.1 two examples of the system in respect of which application for EU type-approval has been made,
    - 1.3.2. an exhaust system of the type originally fitted to the vehicle when EU type-approval was granted,
    - 1.3.3. a vehicle representative of the type to which the system is to be fitted, which meets the requirements of point 2.1 of Annex VI to this Regulation.
    - 1.3.4. a separate engine corresponding to the type of vehicle described.
2. **MARKINGS**
  - 2.4.1. The replacement exhaust system or its components, excluding fixing hardware and pipes must bear:
    - 2.4.1.1. the trademark or trade name of the manufacturer of the replacement system and its components,
    - 2.4.1.2. the manufacturer's trade description,
  - 2.4.2. These marks must be clearly legible and indelible, even when the system is fitted to the vehicle.
3. **GRANTING OF EU TYPE-APPROVAL**
  - 3.1. If the relevant requirements are satisfied, EU type-approval pursuant to Article 9(3) and, if applicable, Article 10(4) of Directive 2007/46/EC shall be granted.
  - 3.2. A model for the EU type-approval certificate is given in Appendix 2.
  - 3.3. A type-approval number in accordance with Annex VII to Directive 2007/46/EC shall be assigned to each type of replacement exhaust system or component thereof approved as a separate technical unit; section 3 of the type-approval number shall indicate the number of the amending Directive which was applicable at the time of the vehicle type-approval. The same Member State shall not assign the same number to another type of replacement exhaust system or component thereof.

4. EU TYPE-APPROVAL MARK

4.1. Every replacement exhaust system or component thereof, excluding fixing hardware and pipes, conforming to a type approved under this Regulation shall bear an EU type-approval mark.

4.2. The EU type-approval mark shall consist of a rectangle surrounding the lower case letter ‘e’ followed by the distinguishing letter(s) or number of the Member State which has granted the approval:

‘1’ for Germany

‘2’ for France

‘3’ for Italy

‘4’ for the Netherlands

‘5’ for Sweden

‘6’ for Belgium

‘7’ for Hungary

‘8’ for the Czech Republic

‘9’ for Spain

‘11’ for the United Kingdom

‘12’ for Austria

‘13’ for Luxembourg

‘17’ for Finland

‘18’ for Denmark

‘19’ for Romania

‘20’ for Poland

‘21’ for Portugal

‘23’ for Greece

‘24’ for Ireland

‘26’ for Slovenia

‘27’ for Slovakia

‘29’ for Estonia

‘32’ for Latvia

‘34’ for Bulgaria

‘36’ for Lithuania

‘49’ for Cyprus

‘50’ for Malta

It must also include in the vicinity of the rectangle the ‘base approval number’ contained in section 4 of the type-approval number referred to in Annex VII to Directive 2007/46/EC, preceded by the two figures indicating the sequence number assigned to the most recent major technical amendment to this regulation which was applicable at the time of the vehicle type-approval.

4.3. The mark must be clearly legible and indelible even when the replacement exhaust system or component thereof is fitted to the vehicle.

4.4. An example of the EU type-approval mark is shown in Appendix 3.

## 5. SPECIFICATIONS

### 5.1. General specifications

5.1.1. The replacement exhaust system or components thereof shall be designed, constructed and capable of being mounted so as to ensure that the vehicle complies with the provisions of this Regulation under normal conditions of use, notwithstanding any vibrations to which it may be subject.

5.1.2. The silencing system or components thereof shall be designed, constructed and capable of being mounted so that reasonable resistance to the corrosion phenomenon to which it is exposed is obtained having regard to the conditions of use of the vehicle.

5.1.3. Additional prescriptions related to tamperability and manually adjustable multi-mode exhaust or silencing systems

5.1.3.1. All exhaust or silencing systems shall be constructed in a way that does not easily permit removal of baffles, exit-cones and other parts whose primary function is as part of the silencing/expansion chambers. Where incorporation of such a part is unavoidable, its method of attachment shall be such that removal is not facilitated easily (e.g. with conventional threaded fixings) and should also be attached such that removal causes permanent/irrecoverable damage to the assembly.

5.1.3.2. Exhaust or silencing systems with multiple, manually adjustable operating modes shall meet all requirements in all operating modes. The reported noise levels shall be those resulting from the mode with the highest noise levels.

### 5.2. Specifications regarding noise levels

## 5.2.1. Conditions of measurement

### 5.2.1.1.

The noise test of the silencing system and the replacement silencing system has to be executed with the same "normal" tyres (as defined in paragraph 2.8. of UNECE Regulation No 117 (OJ L231, 29.8.2008 p. 19). The tests are not allowed to be done with "special use" tyres or "snow" tyres as defined in paragraphs 2.9. and 2.10. of UNECE Regulation No 117. Such tyres could increase the noise level of the vehicle or would have a masking effect on the noise reduction performance comparison. The tyres may be of used condition but shall satisfy legal requirements for in-traffic use.

### 5.2.2.

The noise reduction performance of the replacement silencing system or components of said system shall be verified by means of the methods described in Articles 7 and 8 and point 1 of Annex II. In particular, for the application of this point, reference shall be made to the amendment level of this Regulation which was in force at the time of type-approval of the new vehicle.

#### (a) Measurement with running vehicle

When the replacement silencing system or components thereof is mounted on the vehicle described in point 1.3.3., the noise levels obtained shall satisfy one of the following conditions:

- (i) The value measured (rounded to the nearest integer) shall not exceed by more than 1 dB(A) the type-approval value obtained under this Regulation with the type of vehicle concerned.
- (ii) The value measured (before any rounding to the nearest integer) shall not exceed by more than 1 dB(A) the noise value measured (before any rounding to the nearest integer) on the vehicle referred to in point 1.3.3., when this is fitted with a silencing system corresponding to the type fitted to the vehicle when submitted for type-approval under this Regulation.

Where back-to-back comparison of the replacement system with the original system is chosen, for the application of point 4.1.2.1.4.2. and/or point 4.1.2.2.1.2. of Annex II of this Regulation, it is allowed to have a gear change to higher accelerations and the use of electronic or mechanical devices to prevent this downshift is not mandatory. If under these conditions the noise level of the test vehicle becomes higher than the conformity of production (COP) values, the technical service will decide on the representativeness of the test vehicle.

#### (b) Measurement with stationary vehicle

When the replacement silencing system or components thereof is mounted on the vehicle described in point 1.3.3., the noise levels obtained shall satisfy one of the following conditions:

- (i) The value measured (rounded to the nearest integer) shall not exceed by more than 2 dB(A) the type-approval value obtained under this Regulation with the type of vehicle concerned.

- (ii) The value measured (before any rounding to the nearest integer) shall not exceed by more than 2 dB(A) the noise value measured (before any rounding to the nearest integer) on the vehicle referred to in point 1.3.3., when this is fitted with a silencing system corresponding to the type fitted to the vehicle when submitted for type-approval under this Regulation.

5.2.3. Further to the requirements of Annex II, any replacement silencing system or component has to fulfil the applicable specifications of Annex VIII in this Regulation. For vehicles type approved before the coming into force of this Regulation and in particular the requirements of Annex VIII (ASEP) the specifications of points 5.2.3.1. to 5.2.3.3. of this Annex do not apply.

5.2.3.1. Where the replacement silencing system or component is a system or component with variable geometry, in the application for type-approval the manufacturer shall provide a statement (in conformity with Appendix 1 to Annex VIII) that the silencing system type to be approved complies with the requirements of point 5.2.3. of this Annex. The type-approval authority may require any relevant test to verify the compliance of the silencing system type to the additional sound emission provisions.

5.2.3.2. Where the replacement silencing system or component is not a system with variable geometry, it is sufficient in the application for type-approval that the manufacturer provides a statement (in conformity with Appendix 1 of Annex VIII) that the silencing system type to be approved complies with the requirements of point 5.2.3. of this Annex.

5.2.3.3. The compliance statement shall read as follows: "(Name of the manufacturer) attests that the silencing system of this type complies with the requirements of point 5.2.3. of Annex X of Regulation (EU) No ... [this Regulation]. (Name of the manufacturer) makes this statement in good faith, after having performed an appropriate engineering evaluation of the sound emission performance over the applicable range of operating conditions.

### 5.3. Measurement of the vehicle performances

5.3.1. The replacement silencing system or components thereof shall be such as to ensure that vehicle performance is comparable with that achieved with the original equipment silencing system or component thereof.

5.3.2. The replacement silencing system or, depending on the manufacturer's choice, the components of said system shall be compared with an original silencing system or components, which are also in new condition, successively mounted on the vehicle mentioned in point 1.3.3.

5.3.3. The verification shall be carried out by measuring the back pressure pursuant to point 5.3.4.

The value measured with the replacement silencing system shall not exceed the value measured with the original silencing system by more than 25 % under the conditions mentioned below

### 5.3.4. Test method

#### 5.3.4.1. Test method with engine

The measurements shall be conducted on the engine referred to in point 1.3.4. coupled to a dynamometer. With the throttle completely open, the bench shall be adjusted so as to obtain the engine speed ( $S$ ) corresponding to the rated maximum power of the engine.

For the measurement of back pressure, the distance at which the pressure tap shall be placed from the exhaust manifold is indicated in Appendix 5.

#### 5.3.4.2. Test method with vehicle

The measurements shall be carried out on the vehicle referred to point 1.3.3. The test shall be conducted either on the road or on a roller dynamometer.

With the throttle completely open, the engine shall be loaded so as to obtain the engine speed corresponding to the rated maximum power of the engine (engine speed  $S$ ).

For the measurement of back pressure, the distance at which the pressure tap shall be placed from the exhaust manifold is indicated in Appendix 5..

### 5.4. Additional specifications regarding replacement silencing systems or components containing acoustically absorbing fibrous materials

#### 5.4.1. General

Sound absorbing fibrous materials may only be used in silencing systems or components thereof where any of the following conditions are fulfilled:

- (a) The exhaust gas is not in contact with the fibrous materials;
- (b) The silencing system or the components thereof are of the same design family as systems or components for which it has been proven, in the course of the type-approval process in accordance with the requirements of this Regulation, that they are not subject to deterioration.

Unless one of these conditions is fulfilled, the complete silencing system or component thereof shall be submitted to conventional conditioning using one of the three installations and procedures described below.

#### 5.4.1.1. Continuous road operation for 10000 km

##### 5.4.1.1.1. $50 \pm 20\%$ of this operation shall consist of urban driving and the remaining operation shall be long-distance runs at high speed; continuous road operation may be replaced by a corresponding test-track programme.

The two speed regimes shall be alternated at least twice.

The complete test program shall include a minimum of 10 breaks of at least three-hour duration in order to reproduce the effects of cooling and any condensation which may occur.

- 5.4.1.2. Conditioning on a test bench
- 5.4.1.2.1. Using standard parts and observing the vehicle manufacturer's instructions, the silencing system or components thereof shall be fitted to the vehicle referred to in point 1.3.3. or the engine referred to in point 1.3.4.. In the former case the vehicle shall be mounted on a roller dynamometer. In the second case, the engine shall be coupled to a dynamometer.
- 5.4.1.2.2. The test shall be conducted in six six-hour periods with a break of at least 12 hours between each period in order to reproduce the effects of cooling and any condensation which may occur.
- 5.4.1.2.3. During each six-hour period, the engine shall be run under the following conditions in turn:
- (a) Five minutes at idling speed;
  - (b) One-hour sequence under 1/4 load at 3/4 of rated maximum speed (S);
  - (c) One-hour sequence under 1/2 load at 3/4 of rated maximum speed (S);
  - (d) 10-minute sequence under full load at 3/4 of rated maximum speed (S);
  - (e) 15-minute sequence under 1/2 load at rated maximum speed (S);
  - (f) 30-minute sequence under 1/4 load at rated maximum speed (S).
- Each period shall comprise two sequenced sets of those conditions in consecutive order from (a) to (f).
- 5.4.1.2.4. During the test, the silencing system or components thereof shall not be cooled by a forced draught simulation normal airflow around the vehicle.
- Nevertheless, at the request of the manufacturer, the silencing system or components thereof may be cooled in order not to exceed the temperature recorded at its inlet when the vehicle is running at maximum speed.
- 5.4.1.3. Conditioning by pulsation
- 5.4.1.3.1. The silencing system or components thereof shall be fitted to the vehicle referred to in point 1.3.3. or to the engine referred to in point 1.3.4. In the former case, the vehicle shall be mounted on a roller dynamometer, and, in the second case, the engine shall be mounted on a dynamometer.
- 5.4.1.3.2. The test apparatus, a detailed diagram of which is shown in Figure 1 of the Appendix 1 to Annex IV shall be fitted at the outlet of the silencing system. Any other apparatus providing equivalent results is acceptable.
- 5.4.1.3.3. The test apparatus shall be adjusted in such a way that the exhaust gas flow is alternately interrupted and re-established by the quick action valve for 2500 cycles.
- 5.4.1.3.4. The valve shall open when the exhaust gas back pressure, measured at least 100 mm downstream of the intake flange, reaches a value of between 35 and 40 kPa. It

shall close when this pressure does not differ by more than 10 % from its stabilized value with the valve opened.

- 5.4.1.3.5. The time-delay switch shall be set for the duration of gas exhaust resulting from the provisions laid down in point 5.4.1.3.4.
- 5.4.1.3.6. Engine speed shall be 75 % of the speed (S) at which the engine develops maximum power.
- 5.4.1.3.7. The power indicated by the dynamometer shall be 50 % of the full-throttle power measured at 75 % of engine speed (S).
- 5.4.1.3.8. Any drain holes shall be closed off during the test.
- 5.4.1.3.9. The entire test shall be completed within 48 hours. If necessary, one cooling period will be observed after each hour.
- 5.4.1.3.10. After conditioning, the noise level is checked pursuant to point 5.2.

#### 6. Extension of approval

The silencing system manufacturer or his duly accredited representative may ask the administrative department which has granted the approval of the silencing system for one or several types of vehicles, for an extension of the approval to other types of vehicles.

The procedure is that described in point 1. Notice of the extension of approval (or refusal of extension) shall be communicated to the Member States in accordance with the procedure specified in Directive 2007/46/EC.

#### 7. Modification of the type of silencing system

In the case of modifications of the type approved pursuant to this Regulation, Articles 13 - 16 and Article 17(4) of Directive 2007/46/EC shall apply.

#### 8. Conformity of production

##### 8.1. Measures to ensure the conformity of production shall be taken in accordance with the requirements laid down in Article 12 of Directive 2007/46/EC.

##### 8.2. Special provisions:

8.2.1. The tests referred to point 2.3.5 of Annex X to Directive 2007/46/EC are those prescribed in Annex VI to this Regulation.

8.2.2. The frequency of inspections referred to in point 3 of Annex X to Directive 2007/46/EC is normally once every two years.

## **Appendix 1**

### **Information Document No ... relating to EU type-approval as separate technical unit of exhaust systems for motor vehicles (Regulation ...)**

The following information, if applicable, must be supplied in triplicate and include a list of contents. Any drawings must be supplied in appropriate scale and in sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, must show sufficient detail.

If the systems, components or separate technical units have electronic controls, information concerning their performance must be supplied.

- 0. General
- 0.1. Make (trade name of manufacturer):
- 0.2. Type and general commercial description(s):
- 0.5. Name and address of manufacturer
- 0.7. In the case of components and separate technical units, location and method of affixing of the EU approval mark:
- 0.8. Address(es) of assembly plant(s):
  - 1. Description of the vehicle for which the device is intended (if the device is intended to be fitted to more than one vehicle type the information requested under this point shall be supplied for each type concerned)
    - 1.1. Make (trade name of manufacturer):
    - 1.2. Type and general commercial description(s):
    - 1.3. Means of identification of type, if marked on the vehicle:
    - 1.4. Category of vehicle:
    - 1.5. EU type-approval number with regard to sound level:
    - 1.6. All the information mentioned in points 1.1 to 1.4 of the type-approval certificate concerning the vehicle (Annex I, Appendix 2 to this Regulation):
      - 1. Additional information
      - 1.1. Composition of the separate technical unit:
      - 1.2. Trademark or trade name of the type(s) of motor vehicle to which the silencer is to be fitted <sup>(1)</sup>
      - 1.3. Type(s) of vehicle and its/their type-approval number(s):
      - 1.4. Engine

- 1.4.1. Type (positive ignition, diesel):
- 1.4.2. Cycles: two-stroke, four-stroke:
- 1.4.3. Total cylinder capacity:
- 1.4.4. Rated maximum engine power ... kW at ... min<sup>-1</sup>
- 1.5. Number of gear ratios:
- 1.6. Gear ratios employed:
- 1.7. Drive-axle ratios(s):
- 1.8. Sound-level values:
  - moving vehicle: ..... dB(A), speed stabilised before acceleration
  - at ..... km/h;
  - stationary vehicle dB(A), at ... min<sup>-1</sup>
- 1.9. Value of the back pressure:
- 1.10. Any restrictions in respect of use and mounting requirements:
- 2. Remarks:
- 3. Description of the device
  - 3.1. A description of the replacement exhaust system indicating the relative position of each system component, together with mounting instructions:
  - 3.2. Detailed drawings of each component, so that they can be easily located and identified, and reference to the materials used. These drawings must indicate the place provided for the compulsory affixing of the EU type-approval mark

Date, File

## **Appendix 2**

MODEL

### **EU TYPE-APPROVAL CERTIFICATE**

(Maximum Format: A4 (210 × 297 mm))

Stamp of administration

Communication concerning the

- type-approval (¹)
- extension of type-approval (¹)
- refusal of type-approval (¹)
- withdrawal of type-approval (¹)

of a type of a vehicle/component/separate technical unit (¹) with regard to Regulation No. .

Type-approval number:

Reason for extension:

### **SECTION 1**

- 0.1. Make (trade name of manufacturer):
- 0.2. Type and general commercial description(s):
- 0.3. Means of identification of type if marked on the vehicle/component/separate technical unit (1) (2):
  - 0.3.1. Location of that marking:
  - 0.4. Category of vehicle (3):
  - 0.5. Name and address of manufacturer:
- 0.7. In the case of components and separate technical units, location and method of affixing of the EU type-approval mark:
- 0.8. Address(es) of assembly plant(s):

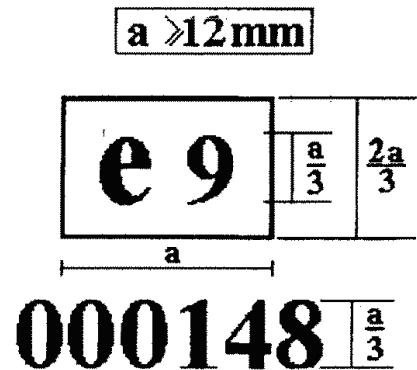
### **SECTION II**

1. Additional information (where applicable): See Addendum

2. Technical service responsible for carrying out the tests:
  3. Date of test report:
  4. Number of test report:
  5. Remarks (if any): See Addendum
  6. Place:
  7. Date:
  8. Signature:
  9. The index to the information package lodged with the approval authority, which may be obtained on request, is attached
- (<sup>1</sup>) Delete as applicable.
- (<sup>2</sup>) If the means of identification of type contains characters not relevant to describe the vehicle, component or separate technical unit types covered by the type-approval certificate such characters shall be represented in the documentation by the symbol: '?' (e.g. ABC??123??).
- (<sup>3</sup>) As defined in point A of Annex IIA to Directive 2007/46/EC.

### Appendix 3

#### Model for the EU type-approval mark

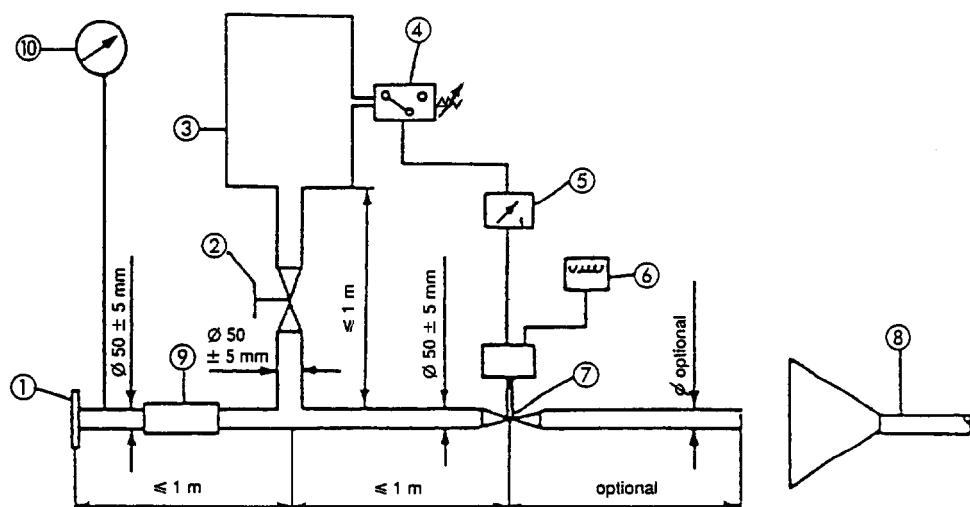


The exhaust system or component thereof bearing the above EU type-approval mark is a device which has been approved in Spain (e 9) pursuant to Regulation No.. under the base approval number 0148.

The figures used are only indicative.

## Appendix 4

### Test apparatus



- 1 Inlet flange or sleeve – connection to the rear of complete silencing system to be tested.
- 2 Regulation valve (hand operated).
- 3 Compensating reservoir from 35 to 40 l.
- 4 Pressure switch 5 kPa to 250 kPa – to open item 7.
- 5 Time delay switch – to close item 7.
- 6 Counter of impulses.
- 7 Quick response valve – such as the valve of an exhaust brake system of 60 mm in diameter, operated by a pneumatic cylinder with an output of 120 N at 400 kPa. The response time, both when opening and closing, shall not exceed 0,5 s.
- 8 Exhaust gas evacuation.
- 9 Flexible pipe.
- 10 Pressure gauge.

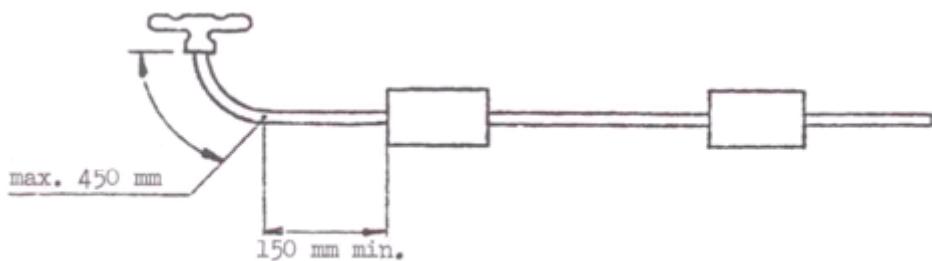
## Appendix 5

### Measuring points – Back pressure

Examples of possible measuring points for loss-of-pressure tests. The exact measuring point shall be specified in the test report. It shall be in an area where gas flow is regular.

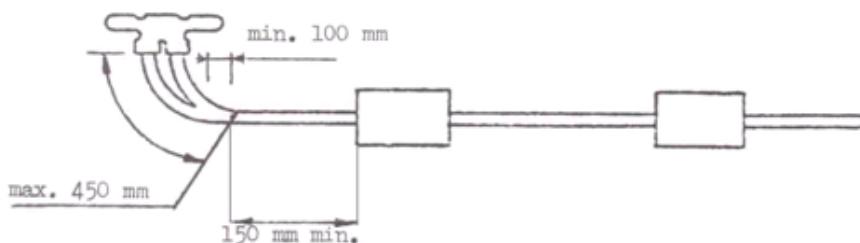
#### 1. FIGURE 1

**Single pipe**



#### 2. FIGURE 2

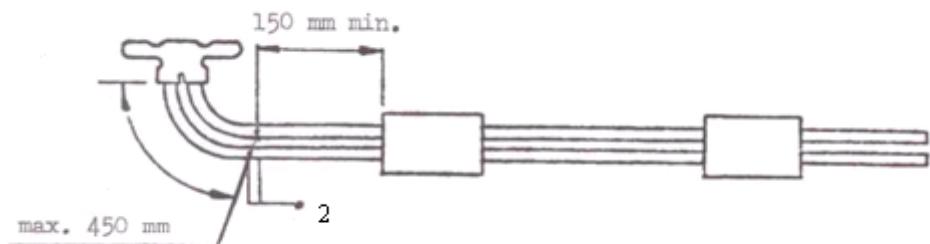
**Partly twin pipe<sup>1</sup>**



<sup>1</sup> If not possible, refer to figure 3.

#### 3. FIGURE 3

**Twin pipe**



- <sup>2</sup> Two measuring points, one reading.

## **Annex XI**

### **Checks on conformity of production for exhaust system as a separate technical unit**

#### **1. General**

These requirements are consistent with the test to be held to check conformity of production (COP) according to point 1 of Annex I to this Regulation.

#### **2. Testing and procedures**

The methods of testing, measuring instruments and interpretation of results shall be those described in point 5 of Annex X. The exhaust system or component under test shall be subjected to the test as described in points 5.2., 5.3. and 5.4. of Annex X.

#### **3. Sampling and evaluation of the results**

**3.1.** One silencing system or component has to be chosen and subjected to the tests of point 2. If the test results fulfil the conformity of production requirements of point 8.1. of Annex X, the type of silencing system or component is considered to be in compliance with COP.

**3.2.** If one of the test results does not fulfil the conformity of production requirements of point 8.1. of Annex X, two more silencing systems or components of the same type shall be tested pursuant to point 2

**3.3.** If the test results for the second and the third silencing system or component fulfil the conformity of production requirements of point 8.1 of Annex X, the type of silencing system or component is considered to be in compliance with the conformity of production.

**3.4.** If one of the test results of the second or third silencing system or component does not fulfil the conformity of production requirements of point 8.1. of Annex X, the type of silencing system or component shall be considered not to conform to the requirements of this Regulation and the manufacturer shall take the necessary measures to re-establish the conformity.

## **Annex XII**

### **Correlation table**

(Referred to in Article 15.2)

Directive 70/157/EEC	This Regulation
-	Article 1
-	Article 2
-	Article 3
Article 2	Article 4(1)
Article 2a	Article 4(2) and (3)
-	Article 5
-	Article 6
-	Article 7
-	Article 8
-	Article 9
-	Articles 10, 11, 12 and 13
-	Article 14
-	Article 15
	Article 16
Annex I, point 1	Annex I, point 1
Annex I, point 3	Annex I, point 2
Annex I, point 4	Annex I, point 3
Annex I, point 5	Annex I, point 4
Annex I, point 6	Annex I, point 5
Annex I, Appendix 1	Annex I, Appendix 1
Annex I, Appendix 2 (without Addendum)	Annex I, Appendix 2
-	Annex I, Appendix 3

-	Annex II
Annex I, point 2	Annex III
-	Annex IV
-	Annex V
-	Annex VI
-	Annex VII
-	Annex VIII
	Annex IX
Annex II, points 1, 2, 3 and 4	Annex X, points 1, 2, 3 and 4
-	Annex X, points 5 and 6
Annex II, points 5 and 6	Annex X, points 7 and 8
Annex II, Appendix 1	Annex X, Appendix 1 (+ additional info)
Annex II, Appendix 2 (without Addendum)	Annex X, Appendix 2
Annex II, Appendix 3	Annex X, Appendix 3
-	Annex X, Appendixes 4 and 5
	Annex XI
-	Annex XII
Annex III, point 1	-
Annex III, point 2	-