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II

(Acts adopted under the EC Treaty/Euratom Treaty whose publication is not obligatory)

ACTS ADOPTED BY BODIES CREATED BY INTERNATIONAL AGREEMENTS

Only the original UN/ECE texts have legal effect under international public law. The status and date of entry into force of this Regulation should be checked in the latest version of the UN/ECE status document TRANS/WP.29/343/, available at:
<http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29fdocsts.html>.

Regulation No 89 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform prescriptions for approval of:

- I. **Vehicles with regard to limitation of their maximum speed or their adjustable speed limitation function;**
- II. **Vehicles with regard to the installation of a speed limitation device (SLD) or adjustable speed limitation device (ASLD) of an approved type;**
- III. **Speed limitation device (SLD) and adjustable speed limitation device (ASLD)**

Addendum 88: Regulation No 89**Incorporates all valid text up to:**

Supplement 1 to the original version of the Regulation — Date of entry into force: 12 August 2002

1. SCOPE
- 1.1. This Regulation applies to:
 - 1.1.1. Part I: Vehicles of categories ⁽¹⁾ M₃, N₂ and N₃ ⁽²⁾ equipped with an SLD and to vehicles of categories M and N equipped with an adjustable speed limitation device ASLD which have not been separately approved according to Part III of this Regulation, or so designed and/or equipped that its component parts can be regarded as totally or partially fulfilling the function of an SLD or ASLD, as appropriate.
 - 1.1.2. Part II: The installation on vehicles of categories M₃, N₂ and N₃ of SLDs and installation on vehicles of categories M and N of ASLD which have been type approved to Part III of this Regulation.

⁽¹⁾ As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3) (TRANS/WP29/78/Rev. 1/Amend.2).

⁽²⁾ It is recommended to apply this Regulation with respect to SLDs to vehicles over 10 tonnes for which the limitation speed is less than the general speed limitation.

- 1.1.3. Part III: SLDs which are intended to be fitted to vehicles of categories M₃, N₂ and N₃ and ASLD which are intended to be fitted to vehicles of categories M and N.

1.2. **Purpose**

The purpose of this Regulation is to limit the road speed of vehicles by means of a vehicle system which has the primary function of controlling the fuel feed to the engine or via the engine management.

- 1.2.1. Vehicles of categories M₃, N₂ and N₃ shall be limited to a maximum speed achieved by a speed limitation device (SLD) or function (SLF).
- 1.2.2. Vehicles of categories M₁, N₁ and M₂ shall be limited to a speed voluntarily set by the driver by means of an adjustable speed limitation device (ASLD) or function (ASLF), when it is activated.
- 1.2.3. Vehicles of categories M₃, N₂ and N₃ may in addition be equipped with an ASLD or an ASLF.

2. DEFINITIONS

2.1. For the purpose of this Regulation:

- 2.1.1. 'Limitation speed V' means the maximum speed of the vehicle such that its design or equipment does not permit a response after a positive action on the accelerator control;
- 2.1.2. 'Set speed V_{set}' means the intended mean vehicle speed when operating in a stabilised condition;
- 2.1.3. 'Stabilised speed V_{stab}' means the mean vehicle speed when operating in the condition specified in paragraph 1.1.4.2.3 of Annex 5 to this Regulation;
- 2.1.4. 'Maximum speed V_{max}' is the maximum speed reached by the vehicle in the first half period of the response curve as defined in the figure of Annex 5 (para. 1.1.4.2.4);
- 2.1.5. 'Adjustable limit speed V_{adj}' means the speed voluntarily set by the driver;
- 2.1.6. 'Adjustable speed limitation function ASLF' means a function which allows the driver to set a vehicle speed V_{adj} and when activated limits the vehicle automatically to that speed;
- 2.1.7. 'Speed limitation function', means a function to control the fuel feed of the vehicle or engine management in order to limit the vehicle speed to a fixed maximum value.

2.2. For the purpose of Part I of this Regulation:

- 2.2.1. 'Approval of a vehicle' means the approval of a vehicle type with regard to speed limitation.

2.3. For the purpose of Part II of this Regulation:

- 2.3.1. 'Approval of a vehicle' means the approval of a vehicle type with regard to the installation of an SLD of a type approved in accordance with Part III of this Regulation.

- 2.4. For the purpose of Part I and Part II of this Regulation:
- 2.4.1. 'Vehicle type' means vehicles which do not differ in such essential respects as:
- 2.4.1.1. The make and type of the SLD, if any,
- 2.4.1.2. The range of speeds at which the limitation may be set within the range established for the tested vehicle;
- 2.4.1.3. The ratio of maximum engine power/unladen mass, less than or equal to that of the tested vehicle; and
- 2.4.1.4. The highest ratio of engine speed/vehicle speed in top gear, less than or equal to that of the tested vehicle.
- 2.5. 'Unladen mass' means the mass of the vehicle in running order without crew, passengers or load, but with the fuel tank full and the usual set of tools and spare wheel on board, where applicable.
- 2.6. For the purpose of Part III of this Regulation:
- 2.6.1. 'Speed limitation device (SLD)' means a device whose primary function is to control the fuel feed to the engine in order to limit the vehicle speed to the specified value;
- 2.6.2. 'Approval of an SLD' means the approval of a type of SLD with respect to the requirements laid down in paragraph 21 below;
- 2.6.3. 'Type of an SLD' means SLDs which do not differ with respect to the essential characteristics such as:
- The make and type of the device,
- The range of speed values at which the SLD may be set,
- The method used to control the fuel feed of the engine.

PART I

APPROVAL OF VEHICLES WITH REGARD TO LIMITATION OF THEIR MAXIMUM SPEED

3. APPLICATION FOR APPROVAL
- 3.1. The application for approval of a vehicle type with regard to speed limitation shall be submitted by the vehicle manufacturer or by his duly accredited representative.
- 3.2. It shall be accompanied by the under-mentioned documents in triplicate and by the following particulars:
- 3.2.1. A detailed description of the vehicle type and of vehicle parts related to the speed limitation, comprising the particulars and documents referred to in Annex 1 to this Regulation;
- 3.2.2. A vehicle representative of the type to be approved shall be submitted to the technical service responsible for conducting the approval tests;
- 3.2.3. A vehicle not comprising all the components proper to the type may be accepted for test provided that it can be shown by the applicant to the satisfaction of the competent authority that the absence of the components omitted has no effect on the results of the verifications, so far as the requirements of this Regulation are concerned.

- 3.3. The competent authority shall verify the existence of satisfactory arrangements for ensuring effective checks on conformity of production before type approval is granted.
4. APPROVAL
- 4.1. If the vehicle submitted for approval pursuant to this Regulation meets the requirements of paragraph 5 below, approval of that vehicle type shall be granted.
- 4.2. An approval number shall be assigned to each type approved. Its first two digits (00 for the Regulation in its present form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another vehicle type.
- 4.3. Notice of approval or of extension or refusal or withdrawal of approval or production definitely discontinued of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 to this Regulation.
- 4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:
- 4.4.1. A circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval ⁽¹⁾;
- 4.4.2. The number of this Regulation, followed by the letter 'R', a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1;
- 4.4.3. The following additional symbol: a rectangle surrounding a figure (or number of figures) expressing the set speed (or range of set speeds) in km/h (and mile/h if requested by the applicant).
- 4.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1 need not be repeated; in such a case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.
- 4.6. The approval mark shall be clearly legible and indelible.
- 4.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.
- 4.8. Models B and C of Annex 4 to this Regulation give examples of arrangements of approval marks.

⁽¹⁾ 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, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for The Former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa and 48 for New Zealand. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

- 4.9. In addition to the marking requirements of paragraph 4.4 above, Contracting Parties to this Regulation may require the vehicle to be equipped with a plate which is in a conspicuous and readily accessible position within the driving compartment and which shows clearly and indelibly:
 - 4.9.1. The words 'SPEED LIMITER FITTED' (or other words to similar effect),
 - 4.9.2. The name or trade mark of the SLD calibrator (if applicable),
 - 4.9.3. A circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval and the number of this Regulation, followed by the letter 'R', and
 - 4.9.4. The set speed in km/h (and mile/h if requested) at which the vehicle is calibrated.

5. REQUIREMENTS

5.1. Requirements for vehicles of categories M₃, N₂ and N₃ equipped with SLF

- 5.1.1. The speed limitation must be such that the vehicle in normal use, despite the vibrations to which it may be subjected, complies with the provisions of Part I of this Regulation.
- 5.1.2. In particular, the vehicle's SLD must be so designed, constructed and assembled as to resist corrosion and ageing phenomena to which it may be exposed and to resist tempering in accordance with paragraph 5.1.6 below.
 - 5.1.2.1. The limitation threshold must not, in any case, be capable of being increased or removed temporarily or permanently on vehicles in use. The inviolability shall be demonstrated to the technical service with documentation analysing the failure mode in which the system will be globally examined. The analysis shall show, taking into account the different states taken by the system, the consequences of a modification of the input or output states on the functioning, the possibilities to obtain these modifications by failures or by voluntary violation and the possibility of their occurrence. The analysis level will be always to the first failure.
 - 5.1.2.2. The speed limitation function and the connections necessary for its operation, except those essential for the running of the vehicle, shall be capable of being protected from any unauthorised adjustments or the interruption of its energy supply by the attachment of sealing devices and/or the need to use special tools.
- 5.1.3. The speed limitation function shall not actuate the vehicle's service braking system. A permanent brake (e.g. retarder) may be incorporated only if it operates after the speed limitation function has restricted the fuel feed to the minimum fuel position.
- 5.1.4. The speed limitation function must be such that it does not affect the vehicle's road speed if a positive action on the accelerator is applied when the vehicle is running at its set speed.
- 5.1.5. The speed limitation function may allow normal accelerator control for the purposes of gear changing.
- 5.1.6. No malfunction or unauthorised interference shall result in an increase in engine power above that demanded by the position of the driver's accelerator.
- 5.1.7. The speed limitation function shall be obtained regardless of the accelerator control used if there is more than one such control which may be reached from the driver's seating position.

- 5.1.8. The speed limitation function shall operate satisfactorily in its electromagnetic environment without unacceptable electromagnetic disturbance for anything in this environment.
- 5.1.9. The applicant for approval shall provide documentation describing checking and calibration procedures. It shall be possible to check the functioning of the speed limitation function whilst the vehicle is stationary (e.g. for conformity of production or periodic inspection).
- 5.1.10. All components necessary for the full function of the speed limitation function shall be energised whenever the vehicle is being driven.
- 5.2. **Requirements for vehicles equipped with ASLF**
- 5.2.1. The ASLF must be such that the vehicle in normal use, despite the vibrations to which it may be subjected, complies with the provisions of Part I of this Regulation.
- 5.2.1.1. In particular, the device and all components supporting the ASLF must be so designed, constructed and assembled as to resist corrosion and ageing phenomena to which it may be exposed.
- 5.2.2. The ASLF shall operate satisfactorily in its electromagnetic environment and conform to the technical prescriptions of Regulation No 10 to the latest level of amendments in force at the time of type approval.
- 5.2.3. No malfunction or unauthorised interference with the system shall result in an increase in engine power above that demanded by the position of the driver's accelerator.
- 5.2.4. The V_{adj} value shall be permanently indicated to the driver and visible from the driver seat. This does not preclude temporary interruption of the indication for safety reasons or driver's demand.
- 5.2.5. The ASLF must satisfy the following requirements:
- 5.2.5.1. The ASLF shall not actuate the vehicle's service braking system except for vehicles of categories M_1 and N_1 , where the vehicle's service braking system may be actuated.
- 5.2.5.2. The ASLF must be effective whichever the engine type or transmission is used.
- 5.2.5.3. The vehicle speed shall be limited to V_{adj} .
- 5.2.5.4. It shall still be possible to exceed V_{adj} when tested in accordance with paragraph 5.3.
- 5.2.5.4.1. To exceed V_{adj} a positive action will be required (*).
- 5.2.5.4.2. Whenever the vehicle speed is exceeding V_{adj} the driver must be informed by means of a suitable or warning signal other than the speedometer.
- 5.2.5.4.3. Compliance with paragraph 5.2.5.4.2 shall be demonstrated by conducting the tests according to paragraph 5.3.
- 5.2.6. Setting of V_{adj} :
- 5.2.6.1. It shall be possible to set V_{adj} value by steps not greater than 10 km/h between 30 km/h and the maximum design speed of the vehicle.

(*) e.g. kickdown.

- 5.2.6.2. In the case of vehicles manufactured for sale in any country where imperial units are used, it shall be possible to set V_{adj} value by steps not greater than 5 mph between 20 mph and the maximum design speed of the vehicle.
- 5.2.6.3. This shall be achieved by a control device operated directly by the driver.
- 5.2.7. Activation/de-activation:
- 5.2.7.1. The ASLF must be capable of being activated/de-activated at any time.
- 5.2.7.2. The ASLF must be de-activated each time the engine is stopped by a deliberate action of the driver.
- 5.2.7.3. When the ASLF is activated the initial setting of V_{adj} shall not be less than the current vehicle speed.
- 5.3. **Tests**
- 5.3.1. The speed limitation tests to which the vehicle presented for approval is submitted as well as the limitation performances required, are described in Annex 5 of this Regulation. At the request of the manufacturer and with the agreement of the type approval authority, vehicles whose theoretical limitation speed V does not exceed the set speed V_{set} defined for those vehicles may be exempt from the testing of Annex 5 providing the requirements of this Regulation are met.
- 5.3.2. The adjustable speed limitation tests to which the vehicle presented for approval are submitted are described in Annex 6 of this Regulation.
- 5.3.2.1. Three different speeds will be chosen for the tests at the discretion of the technical service
6. MODIFICATIONS OF VEHICLE TYPE AND EXTENSION OF APPROVAL
- 6.1. Every modification of the vehicle type shall be notified to the administrative department which approved the vehicle type. The department may then either:
- 6.1.1. Consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the vehicle still complies with the requirements, or
- 6.1.2. Require a further test report from the technical service responsible for conducting the tests.
- 6.2. Confirmation or refusal of approval, specifying the alteration, shall be communicated by the procedure specified in paragraph 4.3 above to the Parties to the 1958 Agreement which apply this Regulation.
- 6.3. The competent authority issuing an extension of approval shall assign a series number to each communication form drawn up for such an extension and inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.
7. CONFORMITY OF PRODUCTION
- 7.1. Every vehicle approved under this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements set out in paragraph 5 above.
- 7.2. In order to verify that the requirements of paragraph 7.1 are met, suitable checks of the production shall be carried out.

- 7.3. The holder of the approval shall, in particular:
- 7.3.1. Ensure existence of procedures for effective quality control of the vehicle;
- 7.3.2. Have access to the testing equipment necessary for checking conformity to each approved type;
- 7.3.3. Ensure that test result data are recorded and that the annexed documents remain available for a period to be determined in agreement with the administrative department;
- 7.3.4. Analyse the results of each type of test, in order to verify and ensure the consistency of characteristics of the vehicle, making allowance for permissible variations in industrial production;
- 7.3.5. Ensure that for each type of vehicle sufficient checks and tests are carried out in accordance with the procedures approved with the competent authority;
- 7.3.6. Ensure that any set of samples or test components giving evidence of non-conformity in the type of test in question shall give rise to a further sampling and test. All necessary steps shall be taken to restore conformity of the corresponding production.
- 7.4. The competent authority which has granted type approval may at anytime verify the conformity control methods applied in each production unit.
- 7.4.1. At every inspection, the test records and production records shall be presented to the visiting inspector.
- 7.4.2. The inspector may select samples at random to be tested in the manufacturer's laboratory. The minimum number of samples may be determined according to the results of the manufacturer's own checks.
- 7.4.3. Where the quality level appears unsatisfactory or it seems necessary to verify the validity of the tests carried out in application of paragraph 7.4.2, the inspector shall select samples to be sent to the technical service which conducted the type approval tests.
- 7.4.4. The competent authority may carry out any test prescribed in this Regulation. The normal frequency of inspections authorised by the competent authority shall be one every two years. In cases where unsatisfactory results are found during one of these inspections, the competent authority shall ensure that all necessary steps are taken to restore conformity of production as rapidly as possible.
8. PENALTIES FOR NON-CONFORMITY OF PRODUCTION
- 8.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 5 above are not complied with.
- 8.2. If a Contracting Party to the 1958 Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 1 to this Regulation.
9. PRODUCTION DEFINITELY DISCONTINUED
- 9.1. If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

10. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS AND OF ADMINISTRATIVE DEPARTMENTS

- 10.1. The Contracting Parties to the 1958 Agreement applying this Regulation shall communicate to the United Nations secretariat the names and addresses of the technical services responsible for conducting approval tests and of the administrative departments which grant approval and to which forms certifying approval or extension, or refusal or withdrawal of approval or production definitely discontinued, issued in other countries, are to be sent.

PART II

APPROVAL OF VEHICLES WITH REGARD TO THE INSTALLATION OF A SPEED LIMITATION DEVICE (SLD) OF AN APPROVED TYPE

11. APPLICATION FOR APPROVAL

- 11.1. The application for approval of a vehicle type with regard to the installation of an SLD of an approved type shall be submitted by the vehicle manufacturer or by his duly accredited representative.
- 11.2. It shall be accompanied by the under-mentioned documents in triplicate and by the following particulars:
- 11.2.1. A detailed description of the vehicle type and of vehicle parts related to the speed limitation, comprising the particulars and documentation referred to in Annex 2 to this Regulation.
- 11.2.2. At the request of the competent authority the type approval communication form (i.e. Annex 3 of this Regulation) of each type of SLD shall also be supplied.
- 11.2.3. A vehicle representative of the type to be approved and fitted with a type approved SLD shall be submitted to the technical service,
- 11.2.3.1. A vehicle not comprising all the components proper to the type may be accepted provided that it can be shown by the applicant to the satisfaction of the competent authority that the absence of the components omitted has no effect on the results of the verifications, so far as the requirements of this Regulation are concerned.
- 11.3. The competent authority shall verify the existence of satisfactory arrangements for ensuring effective checks on conformity of production before type approval is granted.

12. APPROVAL

- 12.1. If the vehicle submitted for approval pursuant to this Regulation is provided with an approved SLD and meets the requirements of paragraph 13 below, approval of that vehicle type shall be granted.
- 12.2. An approval number shall be assigned to each type approved. Its first two digits (00 for the Regulation in its present form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another vehicle type.
- 12.3. Notice of approval or of extension or refusal or withdrawal of approval or production definitely discontinued of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 2 to this Regulation.

- 12.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:
- 12.4.1. A circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval ⁽¹⁾;
- 12.4.2. The number of this Regulation, followed by the letter 'R', a dash and the approval number to the right of the circle prescribed in paragraph 12.4.1.
- 12.4.3. The following additional symbol: a rectangle surrounding a number of figures corresponding to the range of vehicle speeds for which the SLD may be set, expressed in km/h (and mile/h if requested by the applicant).
- 12.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 12.4.1 need not be repeated; in such a case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 12.4.1.
- 12.6. The approval mark shall be clearly legible and indelible.
- 12.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.
- 12.8. Models B and C of Annex 4 to this Regulation give examples of arrangements of approval marks.
- 12.9. In addition to the marking requirements of paragraph 12.4 above, Contracting Parties to this Regulation may require the vehicle to be equipped with a plate which is in a conspicuous and readily accessible position within the driving compartment and which shows clearly and indelibly:
- 12.9.1. The words 'SPEED LIMITER FITTED' (or other words to similar effect),
- 12.9.2. The name or trade mark of the SLD calibrator (if applicable),
- 12.9.3. A circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval and the number of this regulation, followed by the letter 'R', and
- 12.9.4. The set speed in km/h (and mile/h if requested) at which the vehicle is calibrated.

⁽¹⁾ 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, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for The Former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa and 48 for New Zealand. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

13. REQUIREMENTS

13.1. **Requirements concerning the installation of an approved SLD**

- 13.1.1. The SLD shall be so installed as to enable the vehicle in normal use, despite the vibrations to which it may be subjected, to comply with the provisions of Part II of this Regulation.
- 13.1.2. The information document shall indicate how inviolability of the SLD is assured. The analysis level will be always to the first failure.
- 13.1.3. The speed limitation function shall be obtained regardless of the accelerator control used if there is more than one such control which may be reached from the driver's seating position.
- 13.1.4. The applicant for approval shall provide documentation describing checking and calibration procedures. It shall be possible to check the functioning of the speed limitation function whilst the vehicle is stationary (e.g. for conformity of production or periodic inspection).
- 13.1.5. All components necessary for the full function of the SLD shall be energised whenever the vehicle is being driven.
- 13.1.6. The speed limitation function shall not actuate the vehicle's service braking system. A permanent brake (e.g. retarder) may be incorporated only if it operates after the speed limitation function has restricted the fuel feed to the minimum fuel position.

13.2. **Requirements concerning the installation of an approved ASLD**

- 13.2.1. The vehicle on which the approved ASLD has been installed shall meet all requirements of paragraphs 5.2.2, 5.2.4, 5.2.5.4, 5.2.6 and 5.2.7.

14. MODIFICATIONS OF VEHICLE TYPE AND EXTENSION OF APPROVAL

- 14.1. Every modification of the vehicle type shall be notified to the administrative department which approved the vehicle type. The department may then either:
- 14.1.1. Consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the vehicle still complies with the requirements, or
- 14.1.2. Require a further report from the technical service.
- 14.2. Confirmation or refusal of approval, specifying the alteration, shall be communicated by the procedure specified in paragraph 12.3 above to the Parties to the 1958 Agreement which apply this Regulation.
- 14.3. The competent authority issuing the extension of approval shall assign a series number to each communication form drawn up for such an extension and inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

15. CONFORMITY OF PRODUCTION

- 15.1. Every vehicle approved pursuant to this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements set out in paragraph 13.
- 15.2. In order to verify that the requirements of paragraph 15.1 are met, appropriate checks on production shall be carried out.

- 15.3. The holder of the approval shall in particular:
- 15.3.1. Ensure existence of procedures for effective quality control of the vehicles as regards all aspects relevant to compliance with the requirements set out in paragraph 13 above;
- 15.3.2. Ensure that for every approved vehicle sufficient checks are carried out regarding the installation of a type approved SLD, in such a way that all vehicles in production comply with the specifications of the vehicles submitted for type approval;
- 15.3.3. Ensure that, if the checks carried out pursuant to paragraph 15.3.2 above give evidence of non-conformity of one or more vehicles with the requirements set out in paragraph 13 above, all necessary steps are taken to restore conformity of the corresponding production.
- 15.4. The competent authority which granted type approval may at any time verify the conformity control methods applied for each production unit. The authority may also carry out random checks on serially manufactured vehicles in respect to the requirements set out in paragraph 13 above.
- 15.5. Where unsatisfactory results are found during verifications and checks pursuant to paragraph 15.4 above, the competent authority shall ensure that all necessary steps are taken to restore conformity of production as rapidly as possible.
- 15.6. The normal frequency of inspections authorised by the competent authority shall be one every two years. In cases where unsatisfactory results are found during one of these inspections, the competent authority shall ensure that all necessary steps are taken to restore conformity of production as rapidly as possible.
16. PENALTIES FOR NON-CONFORMITY OF PRODUCTION
- 16.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 13 above are not complied with.
- 16.2. If a Contracting Party to the 1958 Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 2 to this Regulation.
17. PRODUCTION DEFINITELY DISCONTINUED
- 17.1. If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.
18. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS AND OF ADMINISTRATIVE DEPARTMENTS
- 18.1. The Contracting Parties to the 1958 Agreement applying this Regulation shall communicate to the United Nations secretariat the names and addresses of the technical services responsible for conducting approval tests and of the administrative departments which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval or production definitely discontinued issued in other countries, are to be sent.

PART III

APPROVAL OF SPEED LIMITATION DEVICES (SLD)

19. APPLICATION FOR APPROVAL OF AN SLD

- 19.1. The application for approval of an SLD must be submitted by the manufacturer of the SLD or by his duly accredited representative.
- 19.2. For each type of SLD the application must be accompanied by:
- 19.2.1. Documentation in triplicate giving a description of the technical characteristics of the SLD and the method of its installation on each make and type of vehicle for which the SLD is intended to be installed;
- 19.2.2. Five samples of the type of SLD: the samples must be clearly and indelibly marked with the applicant's trade name or mark and the type designation;
- 19.2.3. A vehicle or an engine (in the case of testing on an engine bench) fitted with the SLD to be type approved, chosen by the applicant in agreement with the technical service responsible for conducting approval tests.
- 19.3. The competent authority shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production before type approval is granted.

20. APPROVAL

- 20.1. If the SLD submitted for approval pursuant to this Regulation meets the requirements of paragraph 21 below, approval of that type of SLD shall be granted.
- 20.2. An approval number shall be assigned to each type approved. Its first two digits (00 for the Regulation in its present form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another type of SLD.
- 20.3. Notice of approval, or of extension or refusal or withdrawal of approval or production definitely discontinued, of a type of SLD pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 3 to this Regulation.
- 20.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every SLD conforming to a type of SLD approved under this Regulation an international approval mark consisting of:

- 20.4.1. A circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval ⁽¹⁾;
- 20.4.2. The number of this Regulation, followed by the letter 'R', a dash and the approval number to the right of the circle prescribed in paragraph 20.4.1.
- 20.5. The approval mark shall be clearly legible and indelible.
- 20.6. Model A of Annex 4 to this Regulation gives examples of arrangements of approval marks.
21. REQUIREMENTS
- 21.1. **General**
- 21.1.1. The SLD shall be so designed, constructed and assembled as to enable the vehicle in normal use, fitted with the SLD, to comply with the provisions of Part III of this Regulation.
- 21.1.2. In particular, the SLD must be so designed, constructed and assembled as to resist corrosion and ageing phenomena to which it may be exposed and to resist tampering in accordance with paragraph 21.1.6.
- 21.1.2.1. The set speed V_{set} must not, in any case, be capable of being increased or removed temporarily or permanently on vehicles in use. The inviolability shall be demonstrated to the technical service with documentation analysing the failure mode in which the system will be globally examined. The analysis shall show, taking into account the different states taken by the system, the consequences of a modification of the input or output states on the functioning, the possibilities to obtain these modifications by failures or by voluntary violation and the possibility of their occurrence. The analysis level will be always to the first failure.
- 21.1.2.2. The SLD and the connections necessary for its operation, except those essential for the running of the vehicle, shall be capable of being protected from any unauthorised adjustments or the interruption of its energy supply by the attachment of seals and/or the need to use special tools.
- 21.1.3. The SLD shall not actuate the vehicle's service braking system. A permanent brake (e.g. retarder) may be actuated only if it operates after the speed limitation device has restricted the fuel feed to the minimum fuel position.
- 21.1.4. The SLD must be such that it does not affect the vehicle's road speed if a positive action on the accelerator is applied when the vehicle is running at its set speed.
- 21.1.5. The SLD may allow normal accelerator control for the purposes of gear changing.

⁽¹⁾ 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, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for The Former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa and 48 for New Zealand. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

21.1.6. No malfunction or unauthorised interference shall result in an increase in engine power above that demanded by the position of the driver's accelerator.

21.1.7. The SLD shall operate satisfactorily in its electromagnetic environment without unacceptable electromagnetic disturbance for anything in this environment.

21.2. Requirements for ASLDs

21.2.1. The adjustable speed limitation device ASLD must be such that the vehicle in normal use, despite the vibrations to which it may be subjected, complies with the provisions of Part III of this Regulation.

21.2.1.1. In particular, the ASLD must be so designed, constructed and assembled as to resist corrosion and ageing phenomena to which it may be exposed.

21.2.2. The speed limitation function shall operate satisfactorily in its electromagnetic environment, in accordance with prescriptions of Regulation No 10 to the latest level of amendments in force at the time of type approval.

21.2.3. No malfunction or unauthorised interference shall result in an increase in engine power above that demanded by the position of the driver's accelerator.

21.2.4. The V_{adj} value shall be permanently indicated to the driver by a visual display. This does not preclude temporary interruption of the display for safety reasons.

21.2.5. The ASLD must respect the following requirements:

21.2.5.1. The adjustable speed limitation device shall not actuate the vehicle's braking system except for vehicles of categories M_1 and N_1 , where the vehicle's service braking system may be actuated.

21.2.5.2. The method used to limit speed when reaching V_{adj} must be possible whichever transmission type (automatic or manual) of the vehicle.

21.2.5.3. The vehicle speed shall be limited to V_{adj} .

21.2.5.4. It shall still be possible to exceed speed V_{adj} .

21.2.5.4.1. To exceed V_{adj} a positive action will be required (*).

21.2.5.4.2. Whenever the vehicle speed exceeds V_{adj} the driver must be informed by means of a suitable or warning signal other than the speedometer.

21.2.5.4.3. Compliance with paragraph 21.2.5.4.2 shall be demonstrated with paragraph 21.3.

21.2.5.5. The speed limitation function shall permit a normal use of the accelerator control for gear selection.

21.2.6. Setting of V_{adj} :

21.2.6.1. It shall be possible to set V_{adj} value by steps no greater than 10 km/h (5 mph) between 30 km/h (20 mph) and the maximum design max speed of the vehicle.

21.2.6.2. In the case of vehicles manufactured for sale in any country where imperial units are used, it shall be possible to set V_{adj} value by steps not greater than 5 mph between 20 mph and the maximum design speed of the vehicle.

(*) e.g. kickdown.

- 21.2.6.3. This shall be achieved by a control device operated by the driver.
- 21.2.7. Activation/de-activation
 - 21.2.7.1. When V_{adj} is set by the driver it shall not be capable of being modified by any means other than the designated control device.
 - 21.2.7.2. The ASLD must be capable to be activated/de-activated at any time.
 - 21.2.7.3. The ASLD must be de-activated at each engine stop and the key removed.
- 21.3. **Tests**
 - 21.3.1. The speed limitation tests to which the SLD presented for approval is submitted as well as the performances required are described in Annex 5 to this Regulation.
 - 21.3.2. The adjustable speed limitation tests to which the ASLD presented for approval are submitted are described in Annex 6 of this Regulation.
 - 21.3.2.1. Three different speeds will be chosen for the tests at the discretion of the technical service.
- 22. MODIFICATION OF THE SLD TYPE AND EXTENSION OF APPROVAL
 - 22.1. Every modification of the SLD type shall be notified to the administrative department which approved this type of SLD. The department may then either:
 - 22.1.1. Consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the SLD still complies with the requirements, or
 - 22.1.2. Require a further test report for some or all the tests described in Annex 5 to this Regulation from the technical service responsible for conducting the tests.
 - 22.2. Confirmation or refusal of approval, specifying the alteration, shall be communicated by the procedure specified in paragraph 20.3 above to the Parties to the 1958 Agreement which apply this Regulation.
 - 22.3. The competent authority issuing the extension of approval shall assign a series number to each communication form drawn up for such an extension and inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 3 to this Regulation.
- 23. CONFORMITY OF PRODUCTION
 - 23.1. Every SLD approved under this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements set out in paragraph 21.
 - 23.2. In order to verify that the requirements of paragraph 23.1 are met, suitable checks of the production shall be carried out.
 - 23.3. The holder of the approval shall, in particular:
 - 23.3.1. Ensure existence of procedures for effective quality control of the SLD;

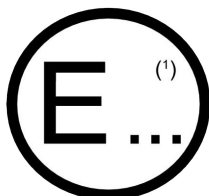
- 23.3.2. Have access to the testing equipment necessary for checking conformity of each approved type;
- 23.3.3. Ensure that test result data are recorded and that the annexed documents remain available for a period to be determined in agreement with the administrative service;
- 23.3.4. Analyse the results of each type of test, in order to verify and ensure the consistency of the SLD characteristics, making allowance for permissible variations in industrial production;
- 23.3.5. Ensure that for each type of SLD at least the constituent materials and the method of assembly correspond to the SLD approved. If necessary the tests prescribed in paragraph 1 of Annex 5 to this Regulation shall be carried out;
- 23.3.6. Ensure that any set of samples or test components giving evidence of non-conformity in the type of test in question shall give rise to a further sampling and test. All necessary steps shall be taken to restore conformity of the corresponding production.
- 23.4. The competent authority which has granted type approval may at any time verify the conformity control methods applied in each production unit.
 - 23.4.1. At every inspection, the test records and production records shall be presented to the visiting inspector.
 - 23.4.2. The inspector may select samples at random to be tested in the manufacturer's laboratory. The minimum number of samples may be determined according to the results of the manufacturer's own checks.
 - 23.4.3. Where the quality level appears unsatisfactory or it seems necessary to verify the validity of the tests carried out in application of paragraph 23.4.2 the inspector shall select samples to be sent to the technical service which conducted the type-approval tests.
 - 23.4.4. The competent authority may carry out any test prescribed in this Regulation. The normal frequency of inspections authorised by the competent authority shall be one every two years. In cases where unsatisfactory results are found during one of these inspections, the competent authority shall ensure that all necessary steps are taken to restore conformity of production as rapidly as possible.
- 24. PENALTIES FOR NON-CONFORMITY OF PRODUCTION
 - 24.1. The approval granted in respect of a type of SLD pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 21 above are not complied with.
 - 24.2. If a Contracting Party to the 1958 Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 3 to this Regulation.
- 25. PRODUCTION DEFINITELY DISCONTINUED
 - 25.1. If the holder of the approval completely ceases to manufacture a type of SLD approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 3 to this Regulation.

26. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS AND OF ADMINISTRATIVE DEPARTMENTS
- 26.1. The Contracting Parties to the 1958 Agreement applying this Regulation shall communicate to the United Nations secretariat the names and addresses of the technical services responsible for conducting approval tests and of the administrative departments which grant approval and to which forms certifying approval Br extension or refusal or withdrawal of approval or production definitely discontinued issued in other countries, are to be sent.
-

ANNEX 1

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration:

.....

.....

.....

concerning ⁽²⁾:

APPROVAL GRANTED

APPROVAL EXTENDED

APPROVAL REFUSED

APPROVAL WITHDRAWN

PRODUCTION DEFINITELY DISCONTINUED

of a vehicle type with regard to the maximum speed limitation by the vehicle's speed limiting function/adjustable speed limitation function pursuant to Part I of Regulation No 89.

Approval No: Extension No:

1. Trade name or mark of the vehicle:
2. Vehicle type:
3. Manufacturer's name and address:
4. If applicable name and address of manufacturer's representative:
5. Brief description of the speed limiting function/adjustable speed limitation function of the vehicle:
6. Speed or range of speeds at which the limitation may be set:
V = km/h
7. Ratio of maximum engine power/unladen mass of the vehicle type:
8. Highest ratio of engine speed/vehicle speed in top gear of the vehicle type:
9. Vehicle submitted for approval on:
10. Technical service responsible for conducting the approval tests:
11. Date of report issued by that service:
12. Number of report issued by that service:
13. Approval granted/extended/refused/withdrawn ⁽²⁾

14. Position of approval mark on the vehicle:
15. Place:
16. Date:
17. Signature:
18. The list of documents filed with the administrative service which has granted approval and available on request is annexed to this communication.

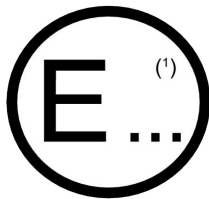
(¹) Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in this Regulation).

(²) Strike out what does not apply.

ANNEX 2

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration:

.....

.....

.....

concerning ⁽²⁾:

APPROVAL GRANTED

APPROVAL EXTENDED

APPROVAL REFUSED

APPROVAL WITHDRAWN

PRODUCTION DEFINITELY DISCONTINUED

of a vehicle type with regard to the installation of a speed limitation device/adjustable speed limitation device (SLD/ASLD)
of an approved type pursuant to Part II of Regulation No 89.

Approval No: Extension No:

1. Trade name or mark of the vehicle
2. Vehicle
3. Manufacturer's name and address
4. If applicable name and address of manufacturer's representative
5. Brief description of the vehicle type as regards its speed limitation device/adjustable speed limitation device (SLD/ASLD)
6. Trade name or mark of the SLD/ASLD(s) and its/their approval number(s)
7. Speed or range of speeds at which the limitation may be set
8. Ratio of maximum engine power/unladen mass of the vehicle type
9. Highest ratio of engine speed/vehicle speed in top gear of the vehicle type
10. Vehicle submitted for approval on
11. Technical service responsible for conducting approval
12. Date of report issued by that service
13. Number of report issued by that service

14. Approval granted/refused/extended/withdrawn ⁽²⁾
15. Position of approval mark on the vehicle
16. Place
17. Date
18. Signature
19. The list of documents filed with the administration service which has granted approval and available on request is annexed to this communication.

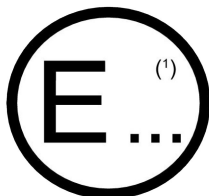
(¹) Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in this Regulation).

(²) Strike out what does not apply.

ANNEX 3

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration:

.....

.....

.....

concerning ⁽²⁾:

APPROVAL GRANTED

APPROVAL EXTENDED

APPROVAL REFUSED

APPROVAL WITHDRAWN

PRODUCTION DEFINITELY DISCONTINUED

with regard to a type of speed limitation device/adjustable speed limitation device (SLD/ASLD) pursuant to Part III of Regulation No 89.

Approval No:..... Extension No:

1. Trade name or mark of the SLD/ASLD
2. Type of device
3. Name and address of manufacturer
4. If applicable name and address of manufacturer's representative
5. Brief description of the SLD/ASLD
6. Type of vehicle on which the SLD/ASLD has been tested
7. Speed or range of speeds at which the SLD/ASLD may be set within the range established for the test vehicle
8. Ratio of maximum engine power/unladen mass of the test vehicle
9. Highest ratio of engine speed/vehicle speed in top gear of the test vehicle
10. Type(s) of vehicle(s) on which the device may be installed
11. Speed or range of speeds at which the limiter may be set within the range established for the vehicle(s) on which the device may be installed
12. Ratio of maximum engine power/unladen mass of the vehicle type(s) on which the device may be installed
13. Highest ratio of engine speed/vehicle speed in top gear of the vehicle type(s) on which the device may be installed

14. Device submitted for approval on
15. Technical service responsible for conducting approval tests
16. Date of report issued by that service
17. Number of report issued by that service
18. Approval has been granted/refused/extended/withdrawn in respect of the SLD/ASLD ⁽²⁾
19. Position of approval mark on device
20. Place
21. Date
22. Signature
23. The list of documents filed with the administrative service which has granted approval and available on request is annexed to this communication.

⁽¹⁾ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in this Regulation).

⁽²⁾ Strike out what does not apply.

ANNEX 4

EXAMPLES OF ARRANGEMENTS OF APPROVAL MARKS

MODEL A



a = 8 mm min

The above approval mark affixed to an SLD/ASLD shows that the SLD/ASLD has been approved in the Netherlands (E4), pursuant to Regulation No 89 under approval number 002439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No 89 in its original form.

MODEL B

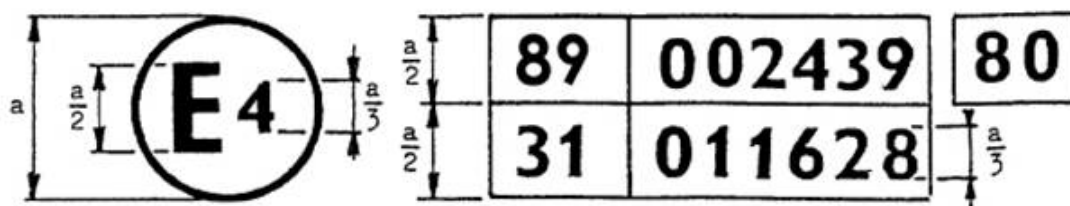


a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle has been approved in the Netherlands (E4), pursuant to Regulation No 89 under approval number 002439. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No 89 in its original form. The figure and range of figures, expressed in km/h, surrounded by a rectangle, show the set speed to which the vehicle is limited ⁽¹⁾, and the range of set speeds within which the vehicle may be limited.

⁽¹⁾ This figure may be inserted after application of the rest of the mark, when it is known where the individual vehicle will be registered. Variations of this part of the mark shall not be considered as changes in the vehicle type.

MODEL C



a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle has been approved in the Netherlands (E4), pursuant to Regulations Nos 89 and 31 ⁽¹⁾. The first two digits of the approval number indicate that, at the dates when the respective approvals were given. Regulation No 31 already included the 01 series of amendments, and Regulation No 89 was in its original form. The figure and range of figures, expressed in km/h, surrounded by a rectangle, show the set speed to which the vehicle is limited and the range of set speeds within which the vehicle may be limited.

⁽¹⁾ The latter number is given as an example only.

ANNEX 5

TESTS AND PERFORMANCE REQUIREMENTS

1. TESTS OF SPEED LIMITATION

At the request of the applicant for approval, tests shall be made in accordance with either paragraphs 1.1, 1.2 or 1.3 below.

1.1. MEASUREMENT ON TEST TRACK

1.1.1. **Preparation of the vehicle**

1.1.1.1. A vehicle representative of the vehicle type to be approved or an SLD/ASLD representative of the type of SLD/ASLD, as appropriate, shall be submitted to the technical service;

1.1.1.2. The settings of the engine of the test vehicle, particularly the fuel feed (carburetor or injection system), shall conform to the specifications of the vehicle manufacturer;

1.1.1.3. The tyres shall be bedded and the pressure shall be as specified by the manufacturer for the vehicle;

1.1.1.4. The vehicle mass shall be the unladen mass as declared by the manufacturer.

1.1.2. **Characteristics of the test track**

1.1.2.1. The test surface shall be suitable to enable stabilised speed to be maintained and shall be free from uneven patches. Gradients shall not exceed 2 % and shall not vary by more than 1 % excluding camber effects.

1.1.2.2. The test surface shall be free from standing water, snow or ice.

1.1.3. **Ambient weather conditions**

1.1.3.1. The mean wind speed measured at a height at least 1m above the ground shall be less than 6 m/s with gusts not exceeding 10 m/s.

1.1.4. **Acceleration test method:** (see the figure below)

1.1.4.1. The vehicle running at a speed which is 10 km/h below the set speed shall be accelerated as much as possible using a fully positive action on the accelerator control. This action shall be maintained at least 30 seconds after the vehicle speed has been stabilised. The instantaneous vehicle speed shall be recorded during the test in order to establish the curve of the speed versus the time and during the operation of the speed limiting function/adjustable speed limitation function or of the SLD/ASLD as appropriate. The accuracy of the speed measurement shall be ± 1 %. The accuracy of the time measurement shall be less than 0,1 s.

1.1.4.2. The test shall be considered satisfactory if the following conditions are met:

1.1.4.2.1. The stabilised speed reached by the vehicle shall not exceed the set speed ($V_{\text{stab}} \leq V_{\text{set}}$). However, a tolerance of 5 % of the V_{set} value, or 5 km/h, whichever is the greater, is acceptable;

1.1.4.2.2. After the stabilised speed is reached for the first time:

1.1.4.2.2.1. $V_{\max}$ shall not exceed V_{stab} by more than 5 %;

1.1.4.2.2.2. the rate of change of speed shall not exceed $0,5 \text{ m/s}^2$ when measured on a period greater than 0,1 s;

1.1.4.2.2.3. the stabilised speed conditions specified in 1.1.4.2.3 shall be attained within 10 s of first reaching V_{stab} ;

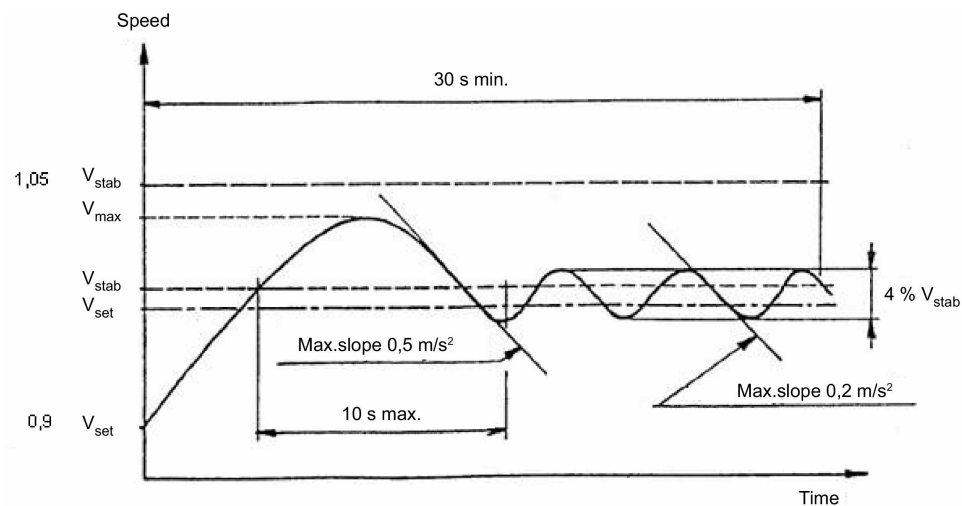
1.1.4.2.3. When stable speed control has been achieved:

1.1.4.2.3.1. speed shall not vary by more than 4 % of V_{stab} or 2 km/h whichever is greater;

1.1.4.2.3.2. the rate of change of speed shall not exceed $0,2 \text{ m/s}^2$ when measured on a period greater than 0,1 s;

1.1.4.2.3.3. V_{stab} is the average speed calculated for a minimum time interval of 20 seconds beginning 10 seconds after first reaching V_{stab} ;

1.1.4.2.4. Tests in acceleration shall be carried out and the acceptance criteria verified for each gear ratio allowing in theory the set speed to be exceeded.



$V_{\max}$ is the maximum speed reached by the vehicle in the first half period of the response curve.

1.1.5. Test method at steady speed

1.1.5.1. The vehicle shall be driven at full acceleration up to the steady speed, then shall be maintained at this speed without any modification on the test basis of at least 400 metres. The vehicle's average speed shall be measured on this test basis. The average speed measurement shall then be repeated on the same test basis, but run in the opposite direction, and under the same procedures. The stabilisation speed for the whole test previously considered is the mean of the two average speeds measured for both test runs. The whole test including the calculation of the stabilisation speed shall be carried out five times. The speed measurements shall be carried out with an accuracy of $\pm 1 \%$, the time measurements with an accuracy of 0,1 s.

- 1.1.5.2. The tests shall be considered satisfactory if the following conditions are met:
- 1.1.5.2.1. On each test run V_{stab} shall not exceed V_{set} . However, a tolerance of 5 % of the V_{set} value, or 5 km/h, whichever is the greater, is acceptable;
- 1.1.5.2.2. The difference between the stabilisation speeds obtained during each test run shall be equal to or less than 3 km/h;
- 1.1.5.2.3. Tests in steady speed shall be carried out and the acceptance criteria verified for each gear ratio allowing in theory the set speed to be exceeded.

1.2. TESTS ON CHASSIS DYNAMOMETER

1.2.1. Characteristics of the chassis dynamometer

The equivalent inertia of the vehicle mass shall be reproduced on the chassis dynamometer with an accuracy of $\pm 10\%$. The speed of the vehicle shall be measured with an accuracy of $\pm 1\%$. The time shall be measured with an accuracy of 0,1 s.

1.2.2. Acceleration test method

- 1.2.2.1. The power absorbed by the brake during the test shall be set to correspond with the vehicle's resistance to progress at the tested speed(s). This power may be established by calculation and shall be set to an accuracy of $\pm 10\%$. At the request of the applicant, and with the agreement of the competent authority, the power absorbed may alternatively be set at $0,4 P_{max}$ (P_{max} is the maximum power of the engine). The vehicle running at a speed which is 10 km/h below the set speed V_{set} shall be accelerated at the maximum possibilities of the engine by using a fully positive action on the acceleration control. This action shall be maintained at least 20 seconds after the vehicle speed has been stabilised. The instantaneous vehicle speed shall be recorded during the test in order to draw the curve of the speed versus time during the operation of the speed limiting function/adjustable speed limitation function or of the SLD/ASLD as appropriate.

- 1.2.2.2. The test shall be considered satisfactory if the provisions of the preceding paragraph 1.1.4.2 and its subparagraphs are satisfied.

1.2.3. Test method for steady speed test

- 1.2.3.1. The vehicle shall be installed on the chassis dynamometer. The following acceptance criteria should be met for power absorbed by the chassis dynamometer varying progressively from the maximum power P_{max} to a value equal to $0,2 P_{max}$. The speed of the vehicle shall be recorded in the full range of power defined above. The maximum speed of the vehicle shall be determined on this range. Test and record defined above should be made five times.
- 1.2.3.2. The tests shall be considered satisfactory if the provisions of the preceding paragraph 1.1.5.2 and its subparagraphs are satisfied.

1.3. TEST ON ENGINE TEST BENCH

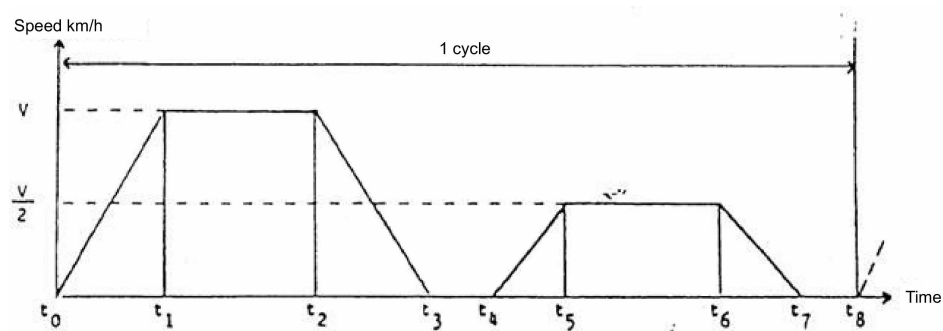
This test procedure can be used only when the applicant can demonstrate to the satisfaction of the technical services that this method is equivalent to the measurement on a test track.

2. TEST OF ENDURANCE

The speed limiting function/adjustable speed limitation function or the SLD/ASLD, as appropriate, shall be submitted to the durability test prescribed below. However, this may be omitted if the applicant demonstrates resistance to those effects.

- 2.1. The device is cycled on a bench simulating the attitude and the movement which the SLD/ASLD would experience on the vehicle.

2.2. A functioning cycle is maintained by means of a control system supplied by the manufacturer. The diagram of the cycle is given below:



$t_0 - t_1$, $t_2 - t_3$, $t_4 - t_5$, $t_6 - t_7$: the time taken to do this operation
 $t_1 - t_2 = 2$ seconds
 $t_3 - t_4 = 1$ second
 $t_5 - t_6 = 2$ seconds
 $t_7 - t_8 = 1$ second

Five conditionings are defined hereafter. The SLD/ASLD samples of the type presented for approval shall be submitted to the conditionings according to the table below:

	First SLD/ASLD	Second SLD/ASLD	Third SLD/ASLD	Fourth SLD/ASLD
Conditioning 1	X			
Conditioning 2		X		
Conditioning 3		X		
Conditioning 4			X	
Conditioning 5				X

2.2.1. Conditioning 1: tests at ambient temperature ($20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$)

Number of cycles: 50 000

2.2.2. Conditioning 2: tests at high temperatures

2.2.2.1. Electronic components

The components shall be cycled in a climatic chamber. A temperature of $65\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ is maintained during the whole functioning.

Number of cycles: 12 500.

2.2.2.2. Mechanical components

The components shall be cycled in a climatic chamber. A temperature of $100\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ is maintained during the whole functioning.

Number of cycles: 12 500.

2.2.3. Conditioning 3: tests at low temperatures

In the climatic chamber used for conditioning 2, a temperature of $-20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ is maintained during the whole functioning.

Number of cycles: 12 500.

2.2.4. Conditioning 4: tests in a salted atmosphere. (Only for components exposed to the ambient road environment.)

The device shall be cycled in a salted atmosphere chamber. The concentration of sodium chloride is of 5 % and internal temperature of the climatic chamber is of $35\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

Number of cycles: 12 500.

- 2.2.5. Conditioning 5: vibration test
 - 2.2.5.1. The SLD/ASLD is mounted in a similar way to its mounting on the vehicle.
 - 2.2.5.2. Sinusoidal vibrations shall be applied in all three planes. Logarithmic sweep shall be 1 octave per minute;
 - 2.2.5.2.1. First test: frequency range 10–24 Hz, amplitude ± 2 mm;
 - 2.2.5.2.2. Second test: frequency range 24–1 000 Hz for chassis and cab-mounted components, input 2,5 g. For engine-mounted components, input 5 g.
 - 2.3. ACCEPTANCE CRITERIA OF THE ENDURANCE TESTS
 - 2.3.1. At the end of the endurance tests, no modification of the device's performances shall be observed regarding the set speed;
 - 2.3.2. However, if any breaking down of the device occurs during one of the endurance tests, a second device can be submitted to the considered endurance tests at the manufacturer's request.
-

ANNEX 6

TESTS AND PERFORMANCE REQUIREMENTS FOR ASLD**1. TESTS OF ADJUSTABLE SPEED LIMITATION SYSTEM****1.1. Preparation of the vehicle**

1.1.1. A vehicle representative of the vehicle type to be approved or an ASLD representative of the type of ASLD, as appropriate, shall be submitted to the technical service.

1.1.1.1. Where an ASLD is to be approved it shall be fitted by the manufacturer to a vehicle which is representative of the type for which the device is intended.

1.1.2. The settings of the engine of the test vehicle, particularly the fuel feed (carburettor or injection system), shall conform to the specifications of the vehicle manufacturer.

1.1.3. The tyres shall be bedded and the pressure shall be as specified by the manufacturer for the vehicle.

1.1.4. The vehicle mass shall be the minimum kerb weight declared by the manufacturer.

1.2. Characteristics of the test track

1.2.1. The test surface shall be suitable for enabling stabilised speed to be maintained and shall be free from uneven patches. Gradients shall not exceed 2 %.

1.2.2. The test surface shall be free from standing water, snow or ice.

1.3. Ambient weather conditions

1.3.1. The mean wind speed measured at a height of at least 1 m above the ground shall be less than 6 m/s with gusts not exceeding 10 m/s.

1.4. Test for the driver being informed that V_{adj} is being exceeded

1.4.1. The positive action (as referred to in paragraphs 5.2.5.4.1 and 21.2.5.4.1) required to enable V_{adj} to be exceeded shall be applied when the vehicle is running at a speed 10 km/h below V_{adj} .

1.4.2. The vehicle shall be accelerated up to a speed at least 10 km/h greater than V_{adj} .

1.4.3. This speed shall be maintained for at least 30 seconds.

1.4.4. Instantaneous vehicle speed shall be recorded during the test and measured with an accuracy of ± 1 %.

1.4.5. The test shall be considered satisfactory if the following conditions are met:

1.4.5.1. The driver is informed by a warning signal when the actual speed of the vehicle is exceeding V_{adj} by more than 3 km/h.

1.4.5.2. The driver continues to be informed for the duration of the time that V_{adj} is exceeded by more than 3 km/h.

- 1.5. **Test of the adjustable speed limitation function/device.**
- 1.5.1. With the ASLF/D deactivated, for each gear ratio selected for the chosen test speed V_{adj} , the technical service shall measure the forces required on the accelerator control to maintain V_{adj} and a speed (V_{adj*}), which is 20 per cent or 20 km/h (whichever is the greater) faster than V_{adj} .
- 1.5.2. With the ASLF/D activated and set at V_{adj} , the vehicle shall be run at a speed of 10 km/h below V_{adj} . The vehicle shall then be accelerated by increasing the force on the accelerator control over a period of $1 \pm 0,2$ s to that required to attain V_{adj*} . This force shall then be maintained for a period of at least 30 seconds, after the vehicle speed has stabilised.
- 1.5.3. The instantaneous vehicle speed shall be recorded during the test in order to establish the curve of the speed versus the time and during the operation of the ASLF/D as appropriate. The accuracy of the speed measurement shall be ± 1 %. The accuracy of the time measurement shall be less than 0,1 s.
- 1.5.4. The test shall be considered satisfactory if the following conditions are met:
- 1.5.4.1. The stabilised speed (V_{stab}) reached by the vehicle shall not exceed V_{adj} by more than 3 km/h
- 1.5.4.1.1. After V_{stab} is reached for the first time:
- 1.5.4.1.1.1. V_{max} shall not exceed V_{stab} by more than 5 %;
- 1.5.4.1.1.2. the rate of change of speed shall not exceed $0,5 \text{ m/s}^2$ when measured over a period greater than 0,1 s;
- 1.5.4.1.1.3. the stabilised speed conditions specified in 1.5.4.1.1 shall be attained within 10 s of first reaching V_{stab} ;
- 1.5.4.1.2. When stable speed control has been achieved:
- 1.5.4.1.2.1. speed shall not vary by more than 3 km/h of V_{adj} ;
- 1.5.4.1.2.2. the rate of change of speed shall not exceed $0,2 \text{ m/s}^2$ when measured over a period greater than 0,1 s;
- 1.5.4.1.2.3. V_{stab} is the average speed calculated for a minimum time interval of 20 seconds beginning 10 seconds after first reaching V_{stab} ;
- 1.5.4.1.3. Tests in acceleration shall be carried out and the acceptance criteria verified for each gear ratio allowing in theory V_{adj*} to be achieved.
-

Only the original UN/ECE texts have legal effect under international public law. The status and date of entry into force of this Regulation should be checked in the latest version of the UN/ECE status document TRANS/WP.29/343/, available at: <http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29docstts.html>.

Regulation No 101 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of passenger cars powered by an internal combustion engine only, or powered by a hybrid electric power train with regard to the measurement of the emission of carbon dioxide and fuel consumption and/or the measurement of electric energy consumption and electric range, and of categories M₁ and N₁ vehicles powered by an electric power train only with regard to the measurement of electric energy consumption and electric range

Addendum 100: Regulation No 101

Revision 2

Incorporating all valid text up to:

Supplement 6 to the original version of the Regulation — Date of entry into force: 4 April 2005

1. SCOPE

This Regulation applies to the measurement of the emission of carbon dioxide (CO₂) and fuel consumption, and/or to the measurement of electric energy consumption and electric range of category M₁ vehicles powered by an internal combustion engine only or by a hybrid electric power train, and to the measurement of electric energy consumption and electric range of categories M₁ and N₁ vehicles powered by an electric power train only ⁽¹⁾.

2. DEFINITIONS

For the purposes of this Regulation,

- 2.1. 'Approval of a vehicle' means the approval of a vehicle type with regard to the measurement of energy consumption (fuel or electric energy);
- 2.2. 'Vehicle type' means a category of power driven vehicles which do not differ in such essential respects as body, power train, transmission, traction battery (if applicable), tyres and unladen mass;
- 2.3. 'Unladen mass' means the mass of the vehicle in running order without crew, passengers or load, but with the fuel tank full (if any), cooling liquid, service and traction batteries, oils, onboard charger, portable charger, tools and spare wheel, whatever is appropriate for the vehicle considered and if provided by the manufacturer of the vehicle;
- 2.4. 'Reference mass' means the unladen mass of the vehicle increased by a uniform figure of 100 kg;
- 2.5. 'Maximum mass' means the technically permissible maximum mass declared by the manufacturer (this mass may be greater than the maximum mass authorised by the national administration);
- 2.6. 'Test mass' for the pure electric vehicles, means the 'reference mass' for the category M₁ vehicles and the unladen mass plus half the full load for the category N₁ vehicles;
- 2.7. 'Cold start device' means a device which enriches the air/fuel mixture of the engine temporarily, to assist starting;

⁽¹⁾ As defined in Annex 7 to the Consolidated Resolution on the Construction of Vehicles (R.E.3) (TRANS/WP.29/78/Rev.1/Amend.2).

- 2.8. 'Starting aid' means a device which assists engine starting without enrichment of the air/fuel mixture, e.g. glow plug, changed injection timing, etc.;
- 2.9. 'Power train' means the system of energy storage device(s), energy converter(s) and transmission(s) that converts stored energy to mechanical energy delivered at the wheels for propulsion of the vehicle;
- 2.10. 'Internal combustion engine vehicle' means vehicle powered by an internal combustion engine only;
- 2.11. 'Electric power train' means a system consisting of one or more electric energy storage devices (e.g. a battery, electromechanical flywheel or super capacitor), one or more electric power conditioning devices and one or more electric machines that convert stored electric energy to mechanical energy delivered at the wheels for propulsion of the vehicle;
- 2.12. 'Pure electric vehicle' means vehicle powered by an electric power train only;
- 2.13. 'Hybrid power train' means a power train with at least two different energy converters and two different energy storage systems (on-board the vehicle) for the purpose of vehicle propulsion;
- 2.13.1. 'Hybrid electric power train' means a power train that, for the purpose of mechanical propulsion, draws energy from both of the following on-vehicle sources of stored energy/power:
- a consumable fuel
 - an electrical energy/power storage device (e.g.: battery, capacitor, flywheel/generator ...)
- 2.14. 'Hybrid vehicle (HV)' means a vehicle powered by a hybrid power train;
- 2.14.1. 'Hybrid electric vehicle (HEV)' means a vehicle powered by a hybrid electric power train;
- 2.15. 'Electric range', for vehicles powered by an electric power train only or by a hybrid electric power train with off-vehicle charging, means distance that can be driven electrically on one fully charged battery (or other electric energy storage device) as measured according to the procedure described in Annex 9.
- 2.16. 'Periodically regenerating system' means an anti-pollution device (e.g. catalytic converter, particulate trap) that requires a periodical regeneration process in less than 4 000 km of normal vehicle operation. If a regeneration of an anti-pollution device occurs at least once per Type I test and that has already regenerated at least once during the vehicle preparation cycle, it will be considered as a continuously regenerating system, which does not require a special test procedure. Annex 10 does not apply to continuously regenerating systems.

At the request of the manufacturer, the test procedure specific to periodically regenerating systems will not apply to a regenerative device if the manufacturer provides data to the type approval authority that, during cycles where regeneration occurs, emission of CO₂ does not exceed the declared value by more than 4 % after agreement of the technical service.

3. APPLICATION FOR APPROVAL

- 3.1. The application for approval of a vehicle type with regard to the measurement of the emission of carbon dioxide and fuel consumption and/or to the measurement of electric energy consumption and electric range shall be submitted by the vehicle manufacturer or by his duly accredited representative.
- 3.2. It shall be accompanied by the under-mentioned documents in triplicate and the following particulars:

- 3.2.1. A description of the essential characteristics of the vehicle comprising all the particulars referred to in Annex 1, Annex 2 or Annex 3, depending on the power train type. At the request of the technical service in charge of the tests or the manufacturer, complementary technical information could be considered for specific vehicles which are particularly fuel efficient.
- 3.2.2. Description of the basic features of the vehicle, including those used in drafting Annex 4.
- 3.3. A vehicle, representative of the vehicle type to be approved, shall be submitted to the technical services responsible for conducting approval tests. During the test, the technical service will check that this vehicle, if powered by an internal combustion engine only or by a hybrid electric power train, conforms to the limit values applicable to that type, as described in Regulation No 83.
- 3.4. The competent authority shall verify the existence of satisfactory provisions to ensure an effective check of conformity of production before approval of the vehicle type is granted.
4. APPROVAL
- 4.1. If the emissions of CO₂ and fuel consumption and/or the electric energy consumption and electric range of the vehicle type submitted for approval pursuant to this Regulation have been measured according to the conditions specified in paragraph 5. below, approval of that vehicle type shall be granted.
- 4.2. An approval number shall be assigned to each type approved. Its first two digits (at present 00, corresponding to the original version of the Regulation) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another vehicle type.
- 4.3. Notice of approval or of extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Contracting Parties to the 1958 Agreement applying this Regulation by means of a form conforming to the model in Annex 4 to this Regulation.
- 4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:
- 4.4.1. A circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval ⁽¹⁾.
- 4.4.2. The number of this Regulation, followed by the letter 'R', a dash and the approval number to the right of the circle prescribed in paragraph 4.4.1.

⁽¹⁾ 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, 10 for Serbia and Montenegro, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35 (vacant), 36 for Lithuania, 37 for Turkey, 38 (vacant), 39 for Azerbaijan, 40 for The Former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol), 43 for Japan, 44 (vacant), 45 for Australia, 46 for Ukraine, 47 for South Africa, 48 for New Zealand, 49 for Cyprus, 50 for Malta and 51 for the Republic of Korea. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

- 4.5. If the vehicle conforms to a vehicle type approved under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.4.1. need not be repeated; in such a case, the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.
- 4.6. The approval mark shall be clearly legible and be indelible.
- 4.7. The approval mark shall be placed close to or on the vehicle data plate.
- 4.8. Annex 5 to this Regulation gives examples of arrangements of the approval mark.

5. SPECIFICATIONS AND TESTS

5.1. **General**

The components liable to affect the emissions of CO₂ and fuel consumption or the electric energy consumption shall be so designed, constructed and assembled as to enable the vehicle, in normal use, despite the vibrations to which it may be subjected, to comply with the provisions of this Regulation.

5.2. **Description of tests for vehicles powered by an internal combustion engine only**

- 5.2.1. The emissions of CO₂ and fuel consumption shall be measured according to the test procedure described in Annex 6.
- 5.2.2. For CO₂ emissions the results of the test must be expressed in grams per kilometre (g/km) rounded to the nearest whole number.
- 5.2.3. Fuel consumption values must be expressed in litres per 100 km (in the case of petrol, LPG or diesel) or in m³ per 100 km (in the case of NG), and are calculated according to paragraph 1.4.3 of Annex 6 by the carbon balance method using the measured emissions of CO₂ and the other carbon related emissions (CO and HC). The results will be rounded to the first decimal place.
- 5.2.4. For the purpose of the calculation mentioned in paragraph 5.2.3, the fuel consumption shall be expressed in appropriate units and the following fuel characteristics shall be used:
- (1) density: measured on the test fuel according to ISO 3675 or an equivalent method. For petrol and diesel fuel the density measured at 15 °C will be used; for LPG and natural gas a reference density will be used, as follows:

0,538 kg/litre for LPG

0,654 kg/m³ for NG ⁽¹⁾

- (2) hydrogen-carbon ratio: fixed values will be used which are:

1,85 for petrol

1,86 for diesel fuel

2,525 for LPG

4,00 for NG

5.3. **Description of tests for vehicles powered by an electric power train only**

- 5.3.1. The technical service in charge of the tests conducts the measurement of the electric energy consumption according to the method and test cycle described in Annex 7 to this Regulation.

⁽¹⁾ Mean value of G20 and G23 reference fuels at 15 °C.

- 5.3.2. The technical service in charge of the tests conducts the measurement of the electric range of the vehicle according to the method described in Annex 9.

The electric range measured by this method is the only one which may be included in sales promotional material.

- 5.3.3. The result of the electric energy consumption must be expressed in Watt hours per kilometre (Wh/km) and the range in km, both rounded to the nearest whole number.

5.4. **Description of tests for vehicles powered by a hybrid electric power train**

- 5.4.1. The technical service in charge of the tests conducts the measurement of the emissions of CO₂ and of the electric energy consumption according to the test procedure described in Annex 8.

- 5.4.2. The results of the test for CO₂ emissions must be expressed in grams per kilometre (g/km) rounded to the nearest whole number.

- 5.4.3. Fuel consumption values must be expressed in litres per 100 km (in the case of petrol, LPG or diesel) or in m³ per 100 km (in the case of NG), and are calculated according to paragraph 1.4.3 of Annex 6 by the carbon balance method using the measured emissions of CO₂ and the other carbon related emissions (CO and HC). The results will be rounded to the first decimal place.

- 5.4.4. For the purpose of the calculation mentioned in paragraph 5.4.3., the prescriptions and values of paragraph 5.2.4. shall apply.

- 5.4.5. If applicable, the result of the electric energy consumption must be expressed in Watt hours per kilometre (Wh/km), rounded to the nearest whole number.

- 5.4.6. The technical service in charge of the tests conducts the measurement of the electric range of the vehicle according to the method described in Annex 9 to this Regulation. The result shall be expressed in km, rounded to the nearest whole number.

The electric range measured by this method is the only one which may be included in sales promotional material and which may be used for the calculations of Annex 8.

5.5. **Interpretation of results**

- 5.5.1. The CO₂ value or the value of electric energy consumption adopted as the type approval value shall be the value declared by the manufacturer if the value measured by the technical service does not exceed the declared value by more than 4 %. The measured value can be lower without any limitations.

In the case of vehicles powered by an internal combustion engine only which are equipped with periodically regenerating systems as defined in paragraph 2.16., the results are multiplied by the factor K_i obtained from Annex 10 before being compared to the declared value.

- 5.5.2. If the measured value of CO₂ or electric energy consumption exceeds the manufacturer's declared CO₂ or electric energy consumption value by more than 4 %, then another test is run on the same vehicle.

When the average of the two test results does not exceed the manufacturer's declared value by more than 4 %, then the value declared by the manufacturer is taken as the type approval value.

- 5.5.3. If the average still exceeds the declared value by more than 4 %, a final test is run on the same vehicle. The average of the three test results is taken as the type approval value.

6. **MODIFICATION AND EXTENSION OF APPROVAL OF THE APPROVED TYPE**

- 6.1. Every modification of the approved type shall be notified to the administrative department which approved the type. The department may then either:

- 6.1.1. Consider that the modifications made are unlikely to have an appreciable adverse effect on the values of CO₂ and fuel consumption or electric energy consumption and that, in this case, the original approval will be valid for the modified vehicle type; or
- 6.1.2. Require a further test report from the technical service responsible for conducting the tests according to conditions in paragraph 7 of this Regulation.
- 6.2. Confirmation or extension of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 4.3 to the Parties to the 1958 Agreement applying this Regulation.
- 6.3. The competent authority which grants the extension of the approval shall assign a series number for such an extension and inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 4 to this Regulation.

7. CONDITIONS OF EXTENSION OF THE TYPE APPROVAL FOR VEHICLE TYPE

7.1. **Vehicles powered by an internal combustion engine only, except vehicles equipped with a periodically regenerating emission control system**

The type approval can be extended to vehicles from the same type or from a different type differing with regard to the following characteristics of Annex 4 if the CO₂ emissions measured by the technical service do not exceed by more than 4 per cent the type approved value:

- 7.1.1. Mass.
- 7.1.2. Maximum authorised mass.
- 7.1.3. Type of bodywork: saloon, estate, coupé.
- 7.1.4. Overall gear ratios.
- 7.1.5. Engine equipment and accessories.

7.2. **Vehicles powered by an internal combustion engine only and equipped with a periodically regenerating emission control system**

The type approval can be extended to vehicles from the same type or from a different type, differing with regard to the characteristics of Annex 4, given in paragraphs 7.1.1 to 7.1.5 above, but not exceeding the family characteristics of Annex 10, if the CO₂ emissions measured by the technical service do not exceed by more than 4 % the type approved value, and where the same K_i factor is applicable.

The type approval can be extended also to vehicles from the same type, but with a different K_i factor, if the corrected CO₂ value measured by the technical service does not exceed by more than 4 per cent the type approved value.

7.3. **Vehicles powered by an electric power train only**

Extensions may be granted after agreement with the technical service responsible for conducting the tests.

7.4. **Vehicles powered by a hybrid electric power train**

The type approval can be extended to vehicles from the same type or from a different type differing with regard to the following characteristics of Annex 4 if the CO₂ emissions and the electric energy consumption measured by the technical service do not exceed by more than 4 per cent the type approved value:

- 7.4.1. Mass.
- 7.4.2. Maximum authorised mass.

7.4.3. Type of bodywork: saloon, estate, coupé.

7.4.4. With respect to a change in any other characteristic extensions may be granted after agreement with the technical service responsible for conducting the tests.

8. SPECIAL PROVISIONS

In the future, vehicles with special energy efficient technologies may be offered which could be submitted to complementary testing programmes. These would be specified at a later stage which can be claimed by the manufacturer in order to demonstrate the advantages of the solution.

9. CONFORMITY OF PRODUCTION

9.1. Vehicles approved to this Regulation shall be so manufactured as to conform to the type approved vehicle.

9.2. So as to verify that the conditions set out in paragraph 9.1 are complied with, appropriate production checks shall be carried out.

9.3. **Vehicles powered by an internal combustion engine only**

9.3.1. As a general rule, measures to ensure the conformity of production with regard to CO₂ emissions from vehicles are checked on the basis of the description in the type approval certificate conforming to the model in Annex 4 of this Regulation.

The control of production conformity is based on an assessment made by the competent authority of the manufacturer's auditing procedure in order to ensure conformity of the vehicle type with respect to the emission of CO₂.

If the authority is not satisfied with the standard of the manufacturer's auditing procedure, they may require that verification tests be carried out on vehicles in production.

9.3.1.1. If a measurement of the emissions of CO₂ must be carried out on a vehicle type that has had one or several extensions, the tests will be carried out on the vehicle(s) available at the time of the test (vehicle(s) described in the first document or in subsequent extensions).

9.3.1.1.1. Conformity of the vehicle for the CO₂ test.

9.3.1.1.1.1. Three vehicles are randomly taken in the series and are tested according to the procedure as described in Annex 6.

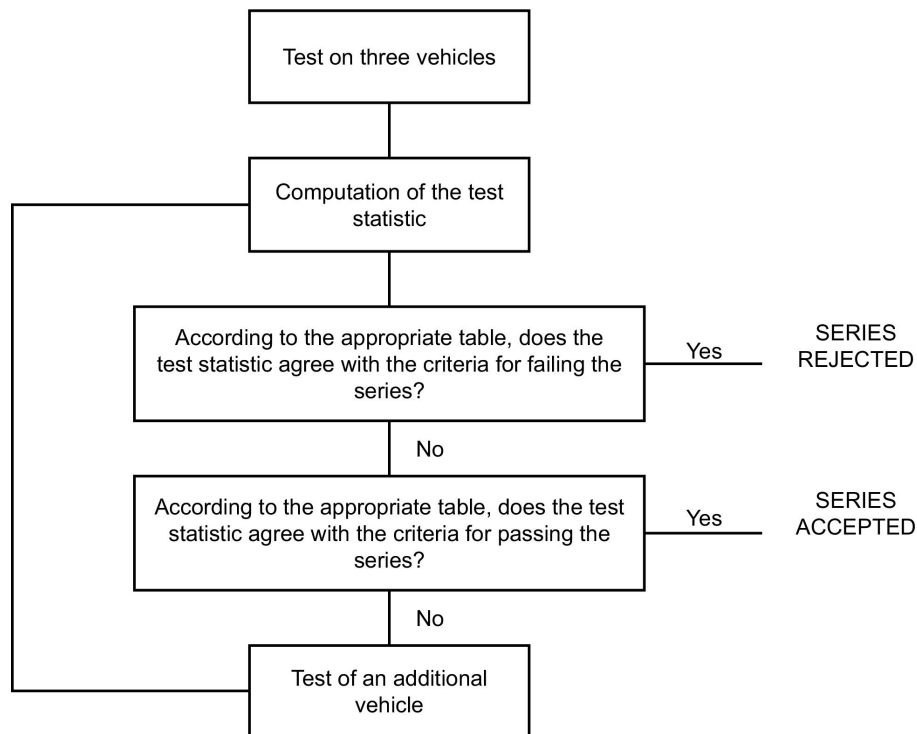
9.3.1.1.1.2. If the authority is satisfied with the production standard deviation given by the manufacturer, the tests are carried out according to paragraph 9.3.2.

If the authority is not satisfied with the production standard deviation given by the manufacturer, the tests are carried out according to paragraph 9.3.3.

9.3.1.1.1.3. The production of a series is regarded as conforming or non-conforming, on the basis of tests on the three sampled vehicles, once a pass or fail decision is reached for CO₂, according to the test criteria applied in the appropriate table.

If no pass or fail decision is reached for CO₂, a test is carried out on an additional vehicle (see figure 1).

Figure 1



- 9.3.1.1.1.4. In the case of periodically regenerating systems as defined in paragraph 2.16, the results shall be multiplied by the factor K_r obtained by the procedure specified in Annex 10 at the time when type approval was granted.

At the request of the manufacturer, testing may be carried out immediately after a regeneration has been completed.

- 9.3.1.1.2. Notwithstanding the requirements of Annex 6, the tests will be carried out on vehicles which have not travelled any distance.
- 9.3.1.1.2.1. However, at the request of the manufacturer, the tests will be carried out on vehicles which have been run-in a maximum of 15 000 km.

In this case, the running-in procedure will be conducted by the manufacturer who shall undertake not to make any adjustments to those vehicles.

- 9.3.1.1.2.2. If the manufacturer asks to conduct a running-in procedure ('x' km, where $x \leq 15\,000$ km), it may be carried out as follows:

The emissions of CO_2 will be measured at zero and at 'x' km on the first tested vehicle (which can be the type approval vehicle);

The evolution coefficient (EC) of the emissions between zero and 'x' km will be calculated as follows:

$$\text{EC} = \frac{\text{Emissions at x km}}{\text{Emissions at zero km}}$$

The value of EC may be less than 1.

The following vehicles will not be subjected to the running-in procedure, but their zero km emissions will be modified by the evolution coefficient, EC.

In this case, the values to be taken will be:

The value at 'x' km for the first vehicle;

The values at zero km multiplied by the evolution coefficient for the following vehicles.

9.3.1.1.2.3. As an alternative to this procedure, the car manufacturer can use a fixed evolution coefficient, EC, of 0,92 and multiply all values of CO₂ measured at zero km by this factor.

9.3.1.1.2.4. The reference fuels described in Annex 9 of Regulation No 83 shall be used for this test.

9.3.2. Conformity of production when manufacturer's statistical data is available.

9.3.2.1. The following sections describe the procedure to be used to verify the CO₂ conformity of production requirements when the manufacturer's production standard deviation is satisfactory.

9.3.2.2. With a minimum sample size of three the sampling procedure is set so that the probability of a lot passing a test with 40 % of the production defective is 0,95 (producer's risk = 5 %) while the probability of a lot being accepted with 65 % of the production defective is 0,1 (consumer's risk = 10 %).

9.3.2.3. The following procedure is used (see figure 1):

Let L be the natural logarithm of the CO₂ type approval value:

x_i = the natural logarithm of the measurement for the i-th vehicle of the sample;

s = an estimate of the production standard deviation (after taking the natural logarithm of the measurements);

n = the current sample number.

9.3.2.4. Compute for the sample, the test statistic quantifying the sum of the standardised deviations to the limit and defined as:

$$\frac{1}{s} \sum_{i=1}^n (L - x_i)$$

9.3.2.5. Then:

9.3.2.5.1. if the test statistic is greater than the pass decision number for the sample given in Table 1, a pass decision is reached;

9.3.2.5.2. if the test statistic is less than the fail decision number for the sample size given in Table 1, a fail decision is reached;

9.3.2.5.3. otherwise, an additional vehicle is tested according to Annex 6 and the procedure is applied to the sample with one unit more.

Table 1

Sample size (cumulative number of vehicles tested)	Pass Decision No	Fail Decision No
(a)	(b)	(c)
3	3,327	– 4,724
4	3,261	– 4,790
5	3,195	– 4,856
6	3,129	– 4,922
7	3,063	– 4,988
8	2,997	– 5,054
9	2,931	– 5,120
10	2,865	– 5,185
11	2,799	– 5,251
12	2,733	– 5,317
13	2,667	– 5,383
14	2,601	– 5,449
15	2,535	– 5,515
16	2,469	– 5,581
17	2,403	– 5,647
18	2,337	– 5,713
19	2,271	– 5,779
20	2,205	– 5,845
21	2,139	– 5,911
22	2,073	– 5,977
23	2,007	– 6,043
24	1,941	– 6,109
25	1,875	– 6,175
26	1,809	– 6,241
27	1,743	– 6,307
28	1,677	– 6,373
29	1,611	– 6,439
30	1,545	– 6,505
31	1,479	– 6,571
32	– 2,112	– 2,112

9.3.3. Conformity of production when manufacturer's statistical data is unsatisfactory or unavailable.

9.3.3.1. The following sections describe the procedure to be used to verify the CO₂ conformity of production requirements when the manufacturer's evidence of production standard deviation is either unsatisfactory or unavailable.

9.3.3.2. With a minimum sample size of three the sampling procedure is set so that the probability of a lot passing a test with 40 % of the production defective is 0,95 (producer's risk = 5 %) while the probability of a lot being accepted with 65 % of the production defective is 0,1 (consumer's risk = 10 %).

9.3.3.3. The measurement of CO₂ is considered to be log normally distributed and should first be transformed by taking the natural logarithms. Let m_o and m denote the minimum and maximum sample sizes respectively (m_o = 3 and m = 32) and let n denote the current sample number.

9.3.3.4. If the natural logarithms of the measurements in the series are x₁, x₂, ..., x_j and L is the natural logarithm of the CO₂ type approval value, then define:

$$d_j = x_j - L$$

$$\bar{d}_n = \frac{1}{n} \sum_{j=1}^n d_j$$

$$v_n^2 = \frac{1}{n} \sum_{j=1}^n (d_j - \bar{d}_n)^2$$

9.3.3.5. Table 2 shows values of the pass (A_n) and fail (B_n) decision numbers against current sample number. The test statistic is the ratio $\bar{d}_n/v_n$ and shall be used to determine whether the series has passed or failed as follows:

for m_o ≤ n ≤ m:

9.3.3.5.1. pass the series if $\bar{d}_n/v_n \leq A_n$;

9.3.3.5.2. fail the series if $\bar{d}_n/v_n \geq B_n$;

9.3.3.5.3. take another measurement if $A_n < \bar{d}_n/v_n < B_n$.

Table 2

Sample size (cumulative number of vehicles tested) n	Pass Decision No A _n	Fail Decision No B _n
(a)	(b)	(c)
3	- 0,80380	16,64743
4	- 0,76339	7,68627
5	- 0,72982	4,67136
6	- 0,69962	3,25573
7	- 0,67129	2,45431
8	- 0,64406	1,94369
9	- 0,61750	1,59105
10	- 0,59135	1,33295
11	- 0,56542	1,13566
12	- 0,53960	0,97970
13	- 0,51379	0,85307
14	- 0,48791	0,74801
15	- 0,46191	0,65928
16	- 0,43573	0,58321
17	- 0,40933	0,51718
18	- 0,38266	0,45922
19	- 0,35570	0,40788

(a)	(b)	(c)
20	– 0,32840	0,36203
21	– 0,30072	0,32078
22	– 0,27263	0,28343
23	– 0,24410	0,24943
24	– 0,21509	0,21831
25	– 0,18557	0,18970
26	– 0,15550	0,16328
27	– 0,12483	0,13880
28	– 0,09354	0,11603
29	– 0,06159	0,09480
30	– 0,02892	0,07493
31	0,00449	0,05629
32	0,03876	0,03876

9.3.3.6. Remarks

The following recursive formulae are useful for computing successive values of the test statistic:

$$\bar{d}_n = \left(1 - \frac{1}{n}\right)\bar{d}_{n-1} + \frac{1}{n}d_n$$

$$v_n^2 = \left(1 - \frac{1}{n}\right)v_{n-1}^2 + \frac{(\bar{d}_n - d_n)^2}{n-1}$$

$$(n = 2, 3, \dots; \bar{d}_1 = d_1; v_1 = 0)$$

9.4. Vehicles powered by an electric power train only

As a general rule, measures to ensure the conformity of production with regard to electric energy consumption is checked on the basis of the description in the type approval certificate set out in Annex 4 to this Regulation.

9.4.1. The holder of the approval shall, in particular:

9.4.1.1. Ensure the existence of procedures for the effective control of production quality;

9.4.1.2. Have access to the equipment necessary for checking conformity with each approved type;

9.4.1.3. Ensure that the data concerning the test result are recorded and that the annexed documents are available during a period to be agreed with the administrative service;

9.4.1.4. Analyse the results of each type of test so as to monitor and ensure the consistency of the characteristics of the product, taking into account the variations admissible in industrial manufacture;

9.4.1.5. Make sure that for each type of vehicle tests prescribed in Annex 7 to this Regulation are carried out; notwithstanding the requirements of paragraph 2.3.1.6 of Annex 7, at the request of the manufacturer, the tests will be carried out on vehicles which have not travelled any distance;

- 9.4.1.6. Make sure that any collections of samples or test pieces demonstrating non-conformity with the type test under consideration is followed by a subsequent sampling and a further test. All necessary steps shall be taken to re-establish the conformity of production.
- 9.4.2. The competent authorities issuing the approval may verify at any time the methods applied in each production unit.
 - 9.4.2.1. In every inspection, the records of tests and production monitoring shall be communicated to the visiting inspector.
 - 9.4.2.2. The inspector may select at random the samples to be tested in the manufacturer's laboratory. The minimum number of samples may be determined on the basis of the results of the manufacturer's own checks.
 - 9.4.2.3. When the quality standard does not seem satisfactory or when it seems necessary to verify the validity of the tests conducted under paragraph 9.4.2.2, the inspector shall collect samples to be sent to the technical service which carried out the approval tests.
 - 9.4.2.4. The competent authorities may carry out all the tests prescribed in this Regulation.

9.5. **Vehicles powered by a hybrid electric power train**

As a general rule, measures to ensure the conformity of production with regard to CO₂ emissions and electric energy consumption from hybrid electric vehicles is checked on the basis of the description in the type approval certificate conforming to the model in Annex 4 of this Regulation.

The control of production conformity is based on an assessment made by the competent authority of the manufacturer's auditing procedure in order to ensure conformity of the vehicle type with respect to the emission of CO₂ and the electric energy consumption.

If the authority is not satisfied with the standard of the manufacturer's auditing procedure, they may require that verification tests be carried out on vehicles in production.

Conformity for CO₂ emissions is checked using the statistical procedures described in paragraphs 9.3.1 to 9.3.3. Vehicles are tested according to the procedure described in Annex 8 to this Regulation.

9.6. **Actions to be taken in case of non-conformity of production**

If, during inspections, non-conformity is observed, the competent authority shall ensure that all necessary steps are taken to re-establish conformity of production as soon as possible.

10. **PENALTIES FOR NON-CONFORMITY OF PRODUCTION**

- 10.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 9.1 are not complied with.
- 10.2. If a Contracting Party to the 1958 Agreement which applies this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 4 of this Regulation.

11. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 4 to this Regulation.

12. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS AND OF ADMINISTRATIVE DEPARTMENTS

The Parties to the 1958 Agreement which apply this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests and the administrative departments which grant approval and to which, forms certifying approval or refusal or extension or withdrawal of approval, issued in other countries, are to be sent.

ANNEX 1

ESSENTIAL CHARACTERISTICS OF THE VEHICLE POWERED BY AN INTERNAL COMBUSTION ENGINE ONLY AND INFORMATION CONCERNING THE CONDUCT OF TESTS

The following information, when applicable, shall be supplied in triplicate and shall include a summary.

If there are drawings, they shall be to an appropriate scale and show sufficient detail. They shall be presented in A4 format or folded to that format. In the case of microprocessor controlled functions, appropriate operating information shall be supplied.

1. GENERAL
 - 1.1. Make (name of manufacturer):
 - 1.2. Type and commercial description (mention any variants):
 - 1.3. Means of identification of type, if marked on the vehicle:
 - 1.3.1. Location of that mark:
 - 1.4. Category of vehicle:
 - 1.5. Name and address of manufacturer:
 - 1.6. Name and address of manufacturer's authorised representative where appropriate:

2. GENERAL CONSTRUCTION CHARACTERISTICS OF THE VEHICLE
 - 2.1. Photographs and/or drawings of a representative vehicle:
 - 2.2. Powered axles (number, position, interconnection):

3. MASSES (kilograms) (refer to drawing where applicable)
 - 3.1. Mass of the vehicle with bodywork in running order, or mass of the chassis with cab if the manufacturer does not fit the bodywork (including coolant, oils, fuel, tools, spare wheel and driver):
 - 3.2. Technically permissible maximum laden mass as stated by the manufacturer:

4. DESCRIPTION OF POWER TRAIN AND POWER TRAIN COMPONENTS
 - 4.1. **Internal combustion engine**
 - 4.1.1. Engine manufacturer:
 - 4.1.2. Manufacturer's engine code (as marked on the engine, or other means of identification):
 - 4.1.2.1. Working principle: positive-ignition/compression-ignition, four-stroke/two-stroke ⁽¹⁾
 - 4.1.2.2. Number, arrangement and firing order of cylinders:
 - 4.1.2.2.1. Bore ⁽²⁾: mm
 - 4.1.2.2.2. Stroke ⁽²⁾: mm
 - 4.1.2.3. Engine capacity ⁽³⁾: cm³
 - 4.1.2.4. Volumetric compression ratio ⁽⁴⁾:
 - 4.1.2.5. Drawings of combustion chamber and piston crown:
 - 4.1.2.6. Idle speed ⁽⁴⁾:
 - 4.1.2.7. Carbon monoxide content by volume in the exhaust gas with the engine idling: %
(according to the manufacturer's specifications) ⁽⁴⁾
 - 4.1.2.8. Maximum net power: kW at min⁻¹
 - 4.1.3. Fuel: petrol/unleaded petrol/diesel oil/LPG/NG ⁽¹⁾
 - 4.1.3.1. Research octane number (RON):
 - 4.1.4. Fuel feed
 - 4.1.4.1. By carburettor(s): yes/no ⁽¹⁾
 - 4.1.4.1.1. Make(s):
 - 4.1.4.1.2. Type(s):
 - 4.1.4.1.3. Number fitted:
 - 4.1.4.1.4. Adjustments ⁽⁴⁾:
 - 4.1.4.1.4.1. Jets:
 - 4.1.4.1.4.2. Venturis:
 - 4.1.4.1.4.3. Float-chamber level:
 - 4.1.4.1.4.4. Mass of float:
 - 4.1.4.1.4.5. Float needle:

4.1.4.1.5.	Cold start system: manual/automatic ⁽¹⁾
4.1.4.1.5.1.	Operating principle:
4.1.4.1.5.2.	Operating limits/settings ⁽¹⁾ ⁽⁴⁾ :
4.1.4.2.	By fuel injection (compression-ignition only): yes/no ⁽¹⁾
4.1.4.2.1.	System description:
4.1.4.2.2.	Working principle: direct-injection/pre-chamber/swirl chamber ⁽¹⁾
4.1.4.2.3.	Injection pump
4.1.4.2.3.1.	Make(s):
4.1.4.2.3.2.	Type(s):
4.1.4.2.3.3.	Maximum fuel delivery ⁽¹⁾ ⁽⁴⁾ : mm ³ /stroke or cycle at a pump speed of ⁽¹⁾ ⁽⁴⁾ : min ⁻¹ or characteristic diagram:
4.1.4.2.3.4.	Injection timing ⁽⁴⁾ :
4.1.4.2.3.5.	Injection advance curve ⁽⁴⁾ :
4.1.4.2.3.6.	Calibration procedure: test bench/engine ⁽¹⁾
4.1.4.2.4.	Governor
4.1.4.2.4.1.	Type:
4.1.4.2.4.2.	Cut-off point:
4.1.4.2.4.2.1.	Cut-off point under load: min ⁻¹
4.1.4.2.4.2.2.	Cut-off point without load: min ⁻¹
4.1.4.2.4.3.	Idling speed: min ⁻¹
4.1.4.2.5.	Injector(s):
4.1.4.2.5.1.	Make(s):
4.1.4.2.5.2.	Type(s):
4.1.4.2.5.3.	Opening pressure ⁽⁴⁾ : kPa or characteristic diagram:
4.1.4.2.6.	Cold start system
4.1.4.2.6.1.	Make(s):
4.1.4.2.6.2.	Type(s):
4.1.4.2.6.3.	Description:
4.1.4.2.7.	Auxiliary starting aid
4.1.4.2.7.1.	Make(s):
4.1.4.2.7.2.	Type(s):
4.1.4.2.7.3.	Description:
4.1.4.3.	By fuel injection (positive-ignition only): yes/no ⁽¹⁾
4.1.4.3.1.	System description:
4.1.4.3.2.	Working principle ⁽¹⁾ : intake manifold (single/multi-point)/direct injection/other (specify)
	Control unit – type (or No):)
	Fuel regulator – type:)
	Air-flow sensor – type:)
	Fuel distributor – type:)
	Pressure regulator – type:)
	Micro-switch – type:)
	Idle adjusting screw – type:)
	Throttle housing – type:)
	Water temperature sensor – type:)
	Air temperature sensor – type:)
	Air temperature switch – type:)
	Electromagnetic interference protection:
	Description and/or drawing:
4.1.4.3.3.	Make(s):
4.1.4.3.4.	Type(s):
4.1.4.3.5.	Injectors: Opening pressure ⁽⁴⁾ : kPa or characteristic diagram ⁽⁴⁾ :
4.1.4.3.6.	Injection timing:
4.1.4.3.7.	Cold start system:
4.1.4.3.7.1.	Operating principle(s):
4.1.4.3.7.2.	Operating limits/settings ⁽¹⁾ ⁽⁴⁾ :

information to be given in the case of continuous injection; in the case of other systems, equivalent details

- 4.1.4.4. Feed pump
- 4.1.4.4.1. Pressure ⁽⁴⁾: kPa or characteristic diagram:
- 4.1.4.5. By LPG fuelling system: yes/no ⁽¹⁾
- 4.1.4.5.1. Approval number according to Regulation No 67 and documentation:
- 4.1.4.5.2. Electronic Engine Management Control Unit for LPG-fuelling:
 - 4.1.4.5.2.1. Make(s):
 - 4.1.4.5.2.2. Type:
 - 4.1.4.5.2.3. Emission related adjustment possibilities:
- 4.1.4.5.3. Further documentation:
 - 4.1.4.5.3.1. Description of the safeguarding of the catalyst at switch-over from petrol to LPG or back:
 - 4.1.4.5.3.2. System lay-out (electrical connections, vacuum connections compensation hoses, etc):
 - 4.1.4.5.3.3. Drawing of the symbol:
- 4.1.4.6. By NG fuelling system: yes/no ⁽¹⁾
- 4.1.4.6.1. Approval number according to Regulation No 67:
- 4.1.4.6.2. Electronic Engine Management Control Unit for NG-fuelling:
 - 4.1.4.6.2.1. Make(s):
 - 4.1.4.6.2.2. Type:
 - 4.1.4.6.2.3. Emission related adjustment possibilities:
- 4.1.4.6.3. Further documentation:
 - 4.1.4.6.3.1. Description of the safeguarding of the catalyst at switch-over from petrol to NG or back:
 - 4.1.4.6.3.2. System lay-out (electrical connections, vacuum connections compensation hoses, etc.):
 - 4.1.4.6.3.3. Drawing of the symbol:
- 4.1.5. Ignition
 - 4.1.5.1. Make(s):
 - 4.1.5.2. Type(s):
 - 4.1.5.3. Working principle:
 - 4.1.5.4. Ignition advance curve ⁽⁴⁾:
 - 4.1.5.5. Static ignition timing ⁽⁴⁾: degrees before TDC
 - 4.1.5.6. Contact-point gap ⁽⁴⁾:
 - 4.1.5.7. Dwell-angle ⁽⁴⁾:
 - 4.1.5.8. Spark plugs
 - 4.1.5.8.1. Make:
 - 4.1.5.8.2. Type:
 - 4.1.5.8.3. Spark plug gap setting: mm
 - 4.1.5.9. Ignition coil
 - 4.1.5.9.1. Make:
 - 4.1.5.9.2. Type:
 - 4.1.5.10. Ignition condenser
 - 4.1.5.10.1. Make:
 - 4.1.5.10.2. Type:
- 4.1.6. Cooling system: liquid/air ⁽¹⁾
- 4.1.7. Intake system:
 - 4.1.7.1. Pressure charger: yes/no ⁽¹⁾
 - 4.1.7.1.1. Make(s):
 - 4.1.7.1.2. Type(s):
 - 4.1.7.1.3. Description of the system (maximum charge pressure: kPa, waste-gate)
 - 4.1.7.2. Inter-cooler: yes/no ⁽¹⁾
 - 4.1.7.3. Description and drawings of inlet pipes and their accessories (plenum chamber, heating device, additional air intakes, etc.):
 - 4.1.7.3.1. Intake manifold description (drawings and/or photographs):
 - 4.1.7.3.2. Air filter, drawings:, or
 - 4.1.7.3.2.1. Make(s):
 - 4.1.7.3.2.2. Type(s):
 - 4.1.7.3.3. Intake silencer, drawings:, or
 - 4.1.7.3.3.1. Make(s):
 - 4.1.7.3.3.2. Type(s):
- 4.1.8. Exhaust system
 - 4.1.8.1. Description and drawings of the exhaust system:
- 4.1.9. Valve timing or equivalent data:
 - 4.1.9.1. Maximum lift of valves, angles of opening and closing, or timing details of alternative distribution systems, in relation to dead centres:

- 4.1.9.2. Reference and/or setting ranges ⁽¹⁾:
- 4.1.10. Lubricant used:
- 4.1.10.1. Make:
- 4.1.10.2. Type:
- 4.1.11. Measures taken against air pollution:
- 4.1.11.1. Device for recycling crankcase gases (description and drawings):
- 4.1.11.2. Additional pollution control devices (if any, and if not covered by another heading:
- 4.1.11.2.1. Catalytic converter: yes/no ⁽¹⁾
- 4.1.11.2.1.1. Number of catalytic converters and elements:
- 4.1.11.2.1.2. Dimensions and shape of the catalytic converter(s) (volume,):
- 4.1.11.2.1.3. Type of catalytic action:
- 4.1.11.2.1.4. Total charge of precious metal:
- 4.1.11.2.1.5. Relative concentration:
- 4.1.11.2.1.6. Substrate (structure and material):
- 4.1.11.2.1.7. Cell density:
- 4.1.11.2.1.8. Type of casing for catalytic converter(s):
- 4.1.11.2.1.9. Positioning of the catalytic converter(s) (place and reference distances in the exhaust system):
- 4.1.11.2.1.10. Regeneration systems/method of exhaust after-treatment systems, description:
- 4.1.11.2.1.10.1. The number of Type I operating cycles, or equivalent engine test bench cycles, between two cycles where regenerative phases occur under the conditions equivalent to Type I test (Distance 'D' in figure 10/1 in Annex 10):
- 4.1.11.2.1.10.2. Description of method employed to determine the number of cycles between two cycles where regenerative phases occur:
- 4.1.11.2.1.10.3. Parameters to determine the level of loading required before regeneration occurs (i.e. temperature, pressure etc.):
- 4.1.11.2.1.10.4. Description of method used to load system in the test procedure described in paragraph 3.1. of Annex 10:
- 4.1.11.2.1.11. Oxygen sensor: type
- 4.1.11.2.1.11.1. Location of oxygen sensor:
- 4.1.11.2.1.11.2. Control range of oxygen sensor:
- 4.1.11.2.2. Air injection: yes/no ⁽¹⁾
- 4.1.11.2.2.1. Type (pulse air, air pump,):
- 4.1.11.2.3. Exhaust gas recirculation (EGR): yes/no ⁽¹⁾
- 4.1.11.2.3.1. Characteristics (flow,):
- 4.1.11.2.4. Evaporative emission control system.
- Complete detailed description of the devices and their state of tune:
- Drawing of the evaporative control system:
- Drawing of the carbon canister:
- Drawing of the fuel tank with indication of capacity and material:
- 4.1.11.2.5. Particulate trap: yes/no ⁽¹⁾
- 4.1.11.2.5.1. Dimensions and shape of the particulate trap (capacity):
- 4.1.11.2.5.2. Type of particulate trap and design:
- 4.1.11.2.5.3. Location of the particulate trap (reference distances in the exhaust system):
- 4.1.11.2.5.4. Regeneration system/method. Description and drawing:
- 4.1.11.2.5.4.1. The number of Type I operating cycles, or equivalent engine test bench cycle, between two cycles where regeneration phases occur under the conditions equivalent to Type I test (Distance 'D' in figure 10/1 in Annex 10):
- 4.1.11.2.5.4.2. Description of method employed to determine the number of cycles between two cycles where regenerative phases occur:
- 4.1.11.2.5.4.3. Parameters to determine the level of loading required before regeneration occurs (i.e. temperature, pressure, etc.):
- 4.1.11.2.5.4.4. Description of method used to load system in the test procedure described in paragraph 3.1. of Annex 10:
- 4.1.11.2.6. Other systems (description and working principle):
- 4.2. **Power train control unit**
- 4.2.1. Make:
- 4.2.2. Type:
- 4.2.3. Identification number:

- 4.3. **Transmission**
- 4.3.1. Clutch (type):
- 4.3.1.1. Maximum torque conversion:
- 4.3.2. Gearbox:
- 4.3.2.1. Type:
- 4.3.2.2. Location relative to the engine:
- 4.3.2.3. Method of control:
- 4.3.3. Gear ratios:

	Gearbox ratios	Final drive ratios	Total ratios
Maximum for CVT (*)			
1			
2			
3			
4, 5, others			
Minimum for CVT (*)			
Reverse			

(*) CVT — Continuously variable transmission

5. **SUSPENSION**
- 5.1. **Tyres and wheels**
- 5.1.1. Tyre/wheel combination(s) (for tyres indicate size designation, minimum load-capacity index, minimum speed category symbol; for wheels, indicate rim size(s) and off-set(s):
- 5.1.1.1. Axles
- 5.1.1.1.1. Axle 1:
- 5.1.1.1.2. Axle 2:
- 5.1.1.1.3. Axle 3:
- 5.1.1.1.4. Axle 4: etc.
- 5.1.2. Upper and lower limit of rolling circumference:
- 5.1.2.1. Axles
- 5.1.2.1.1. Axle 1:
- 5.1.2.1.2. Axle 2:
- 5.1.2.1.3. Axle 3:
- 5.1.2.1.4. Axle 4: etc.
- 5.1.3. Tyre pressure(s) as recommended by the manufacturer: kPa

6. **BODYWORK**
- 6.1. Seats:
- 6.1.1. Number of seats:

(1) Strike out what does not apply.

(2) This value must be rounded to the nearest tenth of a millimetre.

(3) This value must be calculated with $\pi = 3,1416$ and rounded to the nearest cm^3 .

(4) Specify the tolerance.

ANNEX 2

**ESSENTIAL CHARACTERISTICS OF THE VEHICLE POWERED BY AN ELECTRIC POWER TRAIN ONLY
AND INFORMATION CONCERNING THE CONDUCT OF TESTS ⁽¹⁾**

The following information, when applicable, shall be supplied in triplicate and shall include a summary.

If there are drawings, they shall be to an appropriate scale and show sufficient detail. They shall be presented in A4 format or folded to that format. In the case of microprocessor controlled functions, appropriate operating information shall be supplied.

1. GENERAL
 - 1.1. Make (name of manufacturer):
 - 1.2. Type and commercial description (mention any variants):
 - 1.3. Means of identification of type, if marked on the vehicle:
 - 1.3.1. Location of that mark:
 - 1.4. Category of vehicle:
 - 1.5. Name and address of manufacturer:
 - 1.6. Name and address of manufacturer's authorised representative where appropriate:

2. GENERAL CONSTRUCTION CHARACTERISTICS OF THE VEHICLE
 - 2.1. Photographs and/or drawings of a representative vehicle:
 - 2.2. Powered axles (number, position, interconnection):

3. MASSES (kilograms) (refer to drawing where applicable)
 - 3.1. Mass of the vehicle with bodywork in running order, or mass of the chassis with cab if the manufacturer does not fit the bodywork (including coolant, oils, fuel, tools, spare wheel and driver):
 - 3.2. Technically permissible maximum laden mass as stated by the manufacturer:

4. DESCRIPTION OF THE POWER TRAIN AND POWER TRAIN COMPONENTS
 - 4.1. **General description of electric power train**
 - 4.1.1. Make:
 - 4.1.2. Type:
 - 4.1.3. Use ⁽²⁾: Monomotor/multimotors (number):
 - 4.1.4. Transmission arrangement: parallel/transaxial/others, to precise:
.....
 - 4.1.5. Test voltage: V
 - 4.1.6. Motor nominal speed: min⁻¹
 - 4.1.7. Motor maximum speed: min⁻¹
or by default:
reducer outlet shaft/gear box speed (specify gear engaged): min⁻¹
 - 4.1.8. Maximum power speed ⁽³⁾: min⁻¹
 - 4.1.9. Maximum power: kW
 - 4.1.10. Maximum thirty minutes power: kW
 - 4.1.11. Flexible range (where P ≥ 90 % of maximum power):
speed at the beginning of range: min⁻¹
speed at the end of range: min⁻¹
 - 4.2. **Traction battery**
 - 4.2.1. Trade name and mark of the battery:
 - 4.2.2. Kind of electro-chemical couple:
 - 4.2.3. Nominal voltage: V
 - 4.2.4. Battery maximum thirty minutes power (constant power discharge): kW

- 4.2.5. Battery performance in 2 h discharge (constant power or constant current) ⁽²⁾:
- 4.2.5.1. Battery energy: kWh
- 4.2.5.2. Battery capacity: Ah in 2 h
- 4.2.5.3. End of discharge voltage value:
- 4.2.6. Indication of the end of the discharge that leads to a compulsory stop of the vehicle ⁽⁴⁾:
- 4.2.7. Battery mass: kg
- 4.3. **Electric Motor**
- 4.3.1. Working principle:
- 4.3.1.1. direct current/alternating current ⁽²⁾/number of phases:
- 4.3.1.2. separate excitation/series/compound ⁽²⁾
- 4.3.1.3. synchronous/asynchronous ⁽²⁾
- 4.3.1.4. coiled rotor/with permanent magnets/with housing ⁽²⁾
- 4.3.1.5. number of poles of the motor:
- 4.3.2. Inertia mass:
- 4.4. **Power controller**
- 4.4.1. Make:
- 4.4.2. Type:
- 4.4.3. Control principle: vectorial/open loop/closed/other (to be specified) ⁽²⁾:
- 4.4.4. Maximum effective current supplied to the motor ⁽³⁾: A during seconds
- 4.4.5. Voltage range use: V to V
- 4.5. **Cooling system**
- motor: liquid/air ⁽²⁾
- controller: liquid/air ⁽²⁾
- 4.5.1. Liquid-cooling equipment characteristics:
- 4.5.1.1. Nature of the liquid circulating pumps: yes/no ⁽²⁾
- 4.5.1.2. Characteristics or make(s) and type(s) of the pump:
- 4.5.1.3. Thermostat: setting:
- 4.5.1.4. Radiator: drawing(s) or make(s) and type(s):
- 4.5.1.5. Relief valve: pressure setting:
- 4.5.1.6. Fan: characteristics or make(s) and type(s):
- 4.5.1.7. Fan duct:
- 4.5.2. Air-cooling equipment characteristics
- 4.5.2.1. Blower: characteristics or make(s) and type(s):
- 4.5.2.2. Standard air ducting:
- 4.5.2.3. Temperature regulating system: yes/no ⁽²⁾
- 4.5.2.4. Brief description:
- 4.5.2.5. Air filter: make(s): type(s):
- 4.5.3. Temperatures admitted by the manufacturer maximum temperature
- 4.5.3.1. Motor outlet: °C
- 4.5.3.2. controller inlet: °C
- 4.5.3.3. at motor reference point(s): °C
- 4.5.3.4. at controller reference point(s): °C
- 4.6. Insulating category:
- 4.7. International protection (IP)-code:
- 4.8. Lubrication system principle ⁽²⁾:
- | | |
|--------------|---------------|
| Bearings: | friction/ball |
| Lubricant: | grease/oil |
| Seal: | yes/no |
| Circulation: | with/without |

4.9. **Description of the transmission**4.9.1. Drive wheels: front/rear/4 × 4 ⁽²⁾4.9.2. Type of transmission: manual/automatic ⁽²⁾

4.9.3. Number of gear ratios:

4.9.3.1.

Gear	Wheel speed	Gear ratio	Motor speed
1			
2			
3			
4			
5			
Reverse			

minimum CVT (continuous variable transmission):

maximum CVT:

4.9.4. *Recommendations for changing the gears*

1 → 2: 2 → 1:

2 → 3: 3 → 2:

3 → 4: 4 → 3:

4 → 5: 5 → 4:

overdrive in: overdrive out:

5. **CHARGER**5.1. Charger: on board/external ⁽²⁾

In case of an external unit, define the charger (trademark, model):

.....

5.2. Description of the normal profile of charge:

5.3. Specification of mains:

5.3.1. Type of mains: single phase/three phase ⁽²⁾

5.3.2. Voltage:

5.4. Rest period recommended between the end of the discharge and the start of the charge:

5.5. Theoretical duration of a complete charge:

6. **SUSPENSION**6.1. **Tyres and wheels**

6.1.1. Tyre/wheel combination(s) (for tyres indicate size designation, minimum load-capacity index, minimum speed category symbol; for wheels, indicate rim size(s) and off-set(s):

6.1.1.1. Axles

6.1.1.1.1. Axle 1:

6.1.1.1.2. Axle 2:

6.1.1.1.3. Axle 3:

6.1.1.1.4. Axle 4: etc.

6.1.2. Upper and lower limit of rolling circumference:

6.1.2.1. Axles

6.1.2.1.1. Axle 1:

6.1.2.1.2. Axle 2:

6.1.2.1.3. Axle 3:

6.1.2.1.4. Axle 4: etc.

6.1.3. Tyre pressure(s) as recommended by the manufacturer: kPa

7. BODYWORK
7.1. Seats:
7.1.1. Number of seats:

8. INERTIA MASS
8.1. Equivalent inertia mass of complete front axle:
8.2. Equivalent inertia mass of complete rear axle:

(¹) For non-conventional motors or systems, the manufacturer will supply data equivalent to those requested hereafter.

(²) Strike out what does not apply.

(³) Specify tolerances.

(⁴) If applicable.

ANNEX 3

ESSENTIAL CHARACTERISTICS OF THE VEHICLE POWERED BY A HYBRID ELECTRIC POWER TRAIN AND INFORMATION CONCERNING THE CONDUCT OF TESTS

The following information, when applicable, shall be supplied in triplicate and shall include a summary.

If there are drawings, they shall be to an appropriate scale and show sufficient detail. They shall be presented in A4 format or folded to that format. In the case of microprocessor controlled functions, appropriate operating information shall be supplied.

1. GENERAL
 - 1.1. Make (name of manufacturer):
 - 1.2. Type and commercial description (mention any variants):
 - 1.3. Means of identification of type, if marked on the vehicle:
 - 1.3.1. Location of that mark:
 - 1.4. Category of vehicle:
 - 1.5. Name and address of manufacturer:
 - 1.6. Name and address of manufacturer's authorised representative where appropriate:

2. GENERAL CONSTRUCTION CHARACTERISTICS OF THE VEHICLE
 - 2.1. Photographs and/or drawings of a representative vehicle:
 - 2.2. Powered axles (number, position, interconnection):

3. MASSES (kilograms) (refer to drawing where applicable)
 - 3.1. Mass of the vehicle with bodywork in running order, or mass of the chassis with cab if the manufacturer does not fit the bodywork (including coolant, oils, fuel, tools, spare wheel and driver):
 - 3.2. Technically permissible maximum laden mass as stated by the manufacturer:

4. DESCRIPTION OF POWER TRAIN AND POWER TRAIN COMPONENTS
 - 4.1. **Description of the hybrid electric vehicle**
 - 4.1.1. Category of hybrid electric vehicle: off vehicle charging/not off vehicle charging ⁽¹⁾
 - 4.1.2. Operating mode switch: with/without ⁽¹⁾
 - 4.1.2.1. Selectable modes:
 - 4.1.2.1.1. Pure electric: yes/no ⁽¹⁾
 - 4.1.2.1.2. Pure fuel consuming: yes/no ⁽¹⁾
 - 4.1.2.1.3. Hybrid modes: yes/no ⁽¹⁾ (if yes, short description)
 - 4.1.3. General description of hybrid electric power train
 - 4.1.3.1. Drawing of the hybrid power train system layout (engine/motor/transmission combination ⁽¹⁾):
 - 4.1.3.2. Description of the general hybrid power train working principle:
 - 4.1.4. Vehicle electric range (according Annex 9): km
 - 4.1.5. Manufacturer's recommendation for preconditioning:
 - 4.2. **Internal combustion engine**
 - 4.2.1. Engine manufacturer:
 - 4.2.2. Manufacturer's engine code (as marked on the engine, or other means of identification):
 - 4.2.2.1. Working principle: positive-ignition/compression-ignition, four-stroke/two-stroke ⁽¹⁾
 - 4.2.2.2. Number, arrangement and firing order of cylinders:
 - 4.2.2.2.1. Bore ⁽²⁾: mm
 - 4.2.2.2.2. Stroke ⁽²⁾: mm
 - 4.2.2.3. Engine capacity ⁽³⁾: cm³
 - 4.2.2.4. Volumetric compression ratio ⁽⁴⁾:

4.2.2.5.	Drawings of combustion chamber and piston crown:
4.2.2.6.	Idle speed ⁽⁴⁾ :
4.2.2.7.	Carbon monoxide content by volume in the exhaust gas with the engine idling: . per cent (according to the manufacturer's specifications) ⁽⁴⁾
4.2.2.8.	Maximum net power: kW at min ⁻¹
4.2.3.	Fuel: petrol/unleaded petrol/diesel oil/LPG/NG ⁽¹⁾
4.2.3.1.	Research octane number (RON):
4.2.4.	Fuel feed
4.2.4.1.	By carburettor(s): yes/no ⁽¹⁾
4.2.4.1.1.	Make(s):
4.2.4.1.2.	Type(s):
4.2.4.1.3.	Number fitted:
4.2.4.1.4.	Adjustments ⁽⁴⁾
4.2.4.1.4.1.	Jets:
4.2.4.1.4.2.	Venturis:
4.2.4.1.4.3.	Float-chamber level:
4.2.4.1.4.4.	Mass of float:
4.2.4.1.4.5.	Float needle:
4.2.4.1.5.	Cold start system: manual/automatic ⁽¹⁾
4.2.4.1.5.1.	Operating principle:
4.2.4.1.5.2.	Operating limits/settings ⁽¹⁾ ⁽⁴⁾ :
4.2.4.2.	By fuel injection (compression-ignition only): yes/no ⁽¹⁾
4.2.4.2.1.	System description:
4.2.4.2.2.	Working principle: direct-injection/pre-chamber/swirl chamber ⁽¹⁾
4.2.4.2.3.	Injection pump
4.2.4.2.3.1.	Make(s):
4.2.4.2.3.2.	Type(s):
4.2.4.2.3.3.	Maximum fuel delivery ⁽¹⁾ ⁽⁴⁾ : mm ³ /stroke or cycle at a pump speed of ⁽¹⁾ ⁽⁴⁾ : min ⁻¹ or characteristic diagram:
4.2.4.2.3.4.	Injection timing ⁽⁴⁾ :
4.2.4.2.3.5.	Injection advance curve ⁽⁴⁾ :
4.2.4.2.3.6.	Calibration procedure: test bench/engine ⁽¹⁾
4.2.4.2.4.	Governor
4.2.4.2.4.1.	Type:
4.2.4.2.4.2.	Cut-off point
4.2.4.2.4.2.1.	Cut-off point under load: min ⁻¹
4.2.4.2.4.2.2.	Cut-off point without load: min ⁻¹
4.2.4.2.4.3.	Idling speed: min ⁻¹
4.2.4.2.5.	Injector(s)
4.2.4.2.5.1.	Make(s):
4.2.4.2.5.2.	Type(s):
4.2.4.2.5.3.	Opening pressure ⁽⁴⁾ : kPa or characteristic diagram:
4.2.4.2.6.	Cold start system
4.2.4.2.6.1.	Make(s):
4.2.4.2.6.2.	Type(s):
4.2.4.2.6.3.	Description:
4.2.4.2.7.	Auxiliary starting aid
4.2.4.2.7.1.	Make(s):
4.2.4.2.7.2.	Type(s):
4.2.4.2.7.3.	Description:
4.2.4.3.	By fuel injection (positive-ignition only): yes/no ⁽¹⁾
4.2.4.3.1.	System description:

- 4.2.4.3.2. Working principle ⁽¹⁾: intake manifold (single/multi-point)/direct injection/other (specify)
- Control unit – type (or No):
 Fuel regulator – type:
 Air-flow sensor – type:
 Fuel distributor – type:
 Pressure regulator – type:
 Micro-switch – type:
 Idle adjusting screw – type:
 Throttle housing – type:
 Water temperature sensor – type:
 Air temperature sensor – type:
 Air temperature switch – type:
 Electromagnetic interference protection:
 Description and/or drawing:
- 4.2.4.3.3. Make(s):
 4.2.4.3.4. Type(s):
 4.2.4.3.5. Injectors: opening pressure ⁽⁴⁾: kPa or characteristic diagram ⁽⁴⁾:
 4.2.4.3.6. Injection timing:
 4.2.4.3.7. Cold start system:
 4.2.4.3.7.1. Operating principle(s):
 4.2.4.3.7.2. Operating limits/settings ⁽¹⁾ ⁽⁴⁾:
 4.2.4.4. Feed pump
 4.2.4.4.1. Pressure ⁽⁴⁾: kPa or characteristic diagram:
 4.2.5. Ignition
 4.2.5.1. Make(s):
 4.2.5.2. Type(s):
 4.2.5.3. Working principle:
 4.2.5.4. Ignition advance curve ⁽⁴⁾:
 4.2.5.5. Static ignition timing ⁽⁴⁾: degrees before TDC
 4.2.5.6. Contact-point gap ⁽⁴⁾:
 4.2.5.7. Dwell-angle ⁽⁴⁾:
 4.2.5.8. Spark plugs
 4.2.5.8.1. Make:
 4.2.5.8.2. Type:
 4.2.5.8.3. Spark plug gap setting: mm
 4.2.5.9. Ignition coil
 4.2.5.9.1. Make:
 4.2.5.9.2. Type:
 4.2.5.10. Ignition condenser
 4.2.5.10.1. Make:
 4.2.5.10.2. Type:
 4.2.6. Cooling system: liquid/air ⁽¹⁾
 4.2.7. Intake system:
 4.2.7.1. Pressure charger: yes/no ⁽¹⁾
 4.2.7.1.1. Make(s):
 4.2.7.1.2. Type(s):
 4.2.7.1.3. Description of the system (maximum charge pressure: kPa, waste-gate)
 4.2.7.2. Inter-cooler: yes/no ⁽¹⁾
 4.2.7.3. Description and drawings of inlet pipes and their accessories (plenum chamber, heating device, additional air intakes, etc.):
 4.2.7.3.1. Intake manifold description (drawings and/or photographs):
 4.2.7.3.2. Air filter, drawings: , or
 4.2.7.3.2.1. Make(s):
 4.2.7.3.2.2. Type(s):
 4.2.7.3.3. Intake silencer, drawings: , or
 4.2.7.3.3.1. Make(s):
 4.2.7.3.3.2. Type(s):

- 4.2.8. Exhaust system
- 4.2.8.1. Description and drawings of the exhaust system:
- 4.2.9. Valve timing or equivalent data:
- 4.2.9.1. Maximum lift of valves, angles of opening and closing, or timing details of alternative distribution systems, in relation to dead centres:
- 4.2.9.2. Reference and/or setting ranges ⁽¹⁾:
- 4.2.10. Lubricant used
- 4.2.10.1. Make:
- 4.2.10.2. Type:
- 4.2.11. Measures taken against air pollution
- 4.2.11.1. Device for recycling crankcase gases (description and drawings):
- 4.2.11.2. Additional pollution control devices (if any, and if not covered by another heading:
- 4.2.11.2.1. Catalytic converter: yes/no ⁽¹⁾
- 4.2.11.2.1.1. Number of catalytic converters and elements:
- 4.2.11.2.1.2. Dimensions and shape of the catalytic converter(s) (volume,):
- 4.2.11.2.1.3. Type of catalytic action:
- 4.2.11.2.1.4. Total charge of precious metal:
- 4.2.11.2.1.5. Relative concentration:
- 4.2.11.2.1.6. Substrate (structure and material):
- 4.2.11.2.1.7. Cell density:
- 4.2.11.2.1.8. Type of casing for catalytic converter(s):
- 4.2.11.2.1.9. Positioning of the catalytic converter(s) (place and reference distances in the exhaust system):
- 4.2.11.2.1.10. Oxygen sensor: type
- 4.2.11.2.1.10.1. Location of oxygen sensor:
- 4.2.11.2.1.10.2. Control range of oxygen sensor:
- 4.2.11.2.2. Air injection: yes/no ⁽¹⁾
- 4.2.11.2.2.1. Type (pulse air, air pump,):
- 4.2.11.2.3. Exhaust gas recirculation (EGR): yes/no ⁽¹⁾
- 4.2.11.2.3.1. Characteristics (flow,):
- 4.2.11.2.4. Evaporative emission control system.
- Complete detailed description of the devices and their state of tune:
- Drawing of the evaporative control system:
- Drawing of the carbon canister:
- Drawing of the fuel tank with indication of capacity and material:
- 4.2.11.2.5. Particulate trap: yes/no ⁽¹⁾
- 4.2.11.2.5.1. Dimensions and shape of the particulate trap (capacity):
- 4.2.11.2.5.2. Type of particulate trap and design:
- 4.2.11.2.5.3. Location of the particulate trap (reference distances in the exhaust system):
- 4.2.11.2.6. Other systems (description and working principle):
- 4.3. **Traction battery/energy storage device**
- 4.3.1. Description of the energy storage device: (battery, capacitor, flywheel/generator):
- 4.3.1.1. Make:
- 4.3.1.2. Type:
- 4.3.1.3. Identification number:
- 4.3.1.4. Kind of electrochemical couple:
- 4.3.1.5. Energy: (for battery: voltage and capacity Ah in 2 h, for capacitor: J,)
- 4.3.1.6. Charger: on board/external/without ⁽¹⁾
- 4.4. **Electric machines (describe each type of electric machine separately)**
- 4.4.1. Make:
- 4.4.2. Type:
- 4.4.3. Primary use: traction motor/generator ⁽¹⁾
- 4.4.3.1. When used as traction motor: monomotor/multimotors ⁽¹⁾ (number):
- 4.4.4. Maximum power: kW
- 4.4.5. Working principle:
- 4.4.5.1. Direct current/alternating current/number of phases ⁽¹⁾:

- 4.4.5.2. separate excitation/series/compound (*)
 4.4.5.3. synchronous/asynchronous (*)

4.5. **Power train control unit**

- 4.5.1. Make:
 4.5.2. Type:
 4.5.3. Identification number:

4.6. **Power controller**

- 4.6.1. Make:
 4.6.2. Type:
 4.6.3. Identification number:

4.7. **Transmission**

- 4.7.1. Clutch (type):
 4.7.1.1. Maximum torque conversion:
 4.7.2. Gearbox:
 4.7.2.1. Type:
 4.7.2.2. Location relative to the engine:
 4.7.2.3. Method of control:
 4.7.3. Gear ratios:

	Gearbox ratios	Final drive ratios	Total ratios
Maximum for CVT (*)			
1			
2			
3			
4, 5, others			
Minimum for CVT (*)			
Reverse			

(*) CVT — Continuously variable transmission.

5. **SUSPENSION**

5.1. **Tyres and wheels**

- 5.1.1. Tyre/wheel combination(s) (for tyres indicate size designation, minimum load-capacity index, minimum speed category symbol; for wheels, indicate rim size(s) and off-set(s):
 5.1.1.1. Axles
 5.1.1.1.1. Axle 1:
 5.1.1.1.2. Axle 2:
 5.1.1.1.3. Axle 3:
 5.1.1.1.4. Axle 4: etc
 5.1.2. Upper and lower limit of rolling circumference:
 5.1.2.1. Axles
 5.1.2.1.1. Axle 1:
 5.1.2.1.2. Axle 2:
 5.1.2.1.3. Axle 3:
 5.1.2.1.4. Axle 4: etc
 5.1.3. Tyre pressure(s) as recommended by the manufacturer: kPa

6. **BODYWORK**

- 6.1. Seats:
 6.1.1. Number of seats:

7. INERTIA MASS

7.1. Equivalent inertia mass of complete front axle:

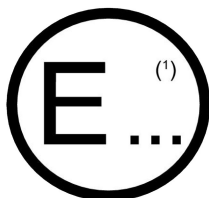
7.2. Equivalent inertia mass of complete rear axle:

⁽¹⁾ Strike out what does not apply.⁽²⁾ This value must be rounded to the nearest tenth of a millimetre.⁽³⁾ This value must be calculated with $\pi = 3,1416$ and rounded to the nearest cm^3 .⁽⁴⁾ Specify the tolerance.

ANNEX 4

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration:

.....

.....

.....

concerning ⁽²⁾:

APPROVAL GRANTED

APPROVAL EXTENDED

APPROVAL REFUSED

APPROVAL WITHDRAWN

PRODUCTION DEFINITELY DISCONTINUED

of a vehicle type pursuant to Regulation No 101.

Approval No: Extension No:

1. Trade name or mark of the vehicle:
2. Vehicle type:
3. Vehicle category:
4. Manufacturer's name and address:
5. If applicable, name and address of manufacturer's representative:
6. Description of the vehicle:
- 6.1. Mass of the vehicle in running order:
- 6.2. Maximum permitted mass:
- 6.3. Type of body: saloon/estate/coupé ⁽²⁾
- 6.4. Drive: front-wheel/rear-wheel/four-wheel ⁽²⁾
- 6.5. Pure electric vehicle: yes/no ⁽²⁾
- 6.6. Hybrid electric vehicle: yes/no ⁽²⁾
- 6.6.1. Category of hybrid electric vehicle: off vehicle charging/not off vehicle charging ⁽²⁾
- 6.6.2. Operating mode switch: with/without ⁽²⁾
- 6.7. **Internal combustion engine.**
- 6.7.1. Cylinder capacity:
- 6.7.2. Fuel feed: carburettor/injection ⁽²⁾

- 6.7.3. Fuel recommended by the manufacturer:
- 6.7.4. In the case of LPG/NG ⁽²⁾ the reference fuel used for the test (e.g. G20, G25):
- 6.7.5. Maximum engine power: kW at: min⁻¹
- 6.7.6. Super-charger: yes/no ⁽²⁾
- 6.7.7. Ignition: compression ignition/positive ignition (mechanical or electronic) ⁽²⁾
- 6.8. **Power train** (for pure electric vehicle or hybrid electric vehicle) ⁽²⁾
- 6.8.1. Maximum net power: kW, at: to min⁻¹
- 6.8.2. Maximum thirty minutes power: kW
- 6.8.3. Working principle:
- 6.9. **Traction battery** (for pure electric vehicle or hybrid electric vehicle)
- 6.9.1. Nominal voltage: V
- 6.9.2. Capacity (2 h rate): Ah
- 6.9.3. Battery maximum thirty minutes power: kW
- 6.9.4. Charger: on board/external ⁽²⁾
- 6.10. **Transmission**
- 6.10.1. Type of gearbox: manual/automatic/variable transmission ⁽²⁾
- 6.10.2. Number of gears:
- 6.10.3. Overall gear ratios (including tyre tread circumference under load): road speeds (km/h) per 1 000 engine speed (min⁻¹):
- First gear:
- Second gear:
- Third gear:
- Fourth gear:
- Fifth gear:
- Overdrive:
- 6.10.4. Final drive ratio:
- 6.11. **Tyres**
- Type:
- Dimensions:
- Rolling circumference under load:

7. TEST RESULTS

7.1. **Internal combustion engine vehicle and not externally chargeable (NOVC) hybrid electric vehicle ⁽²⁾**7.1.1. CO₂ mass emissions

7.1.1.1. Urban conditions: g/km

7.1.1.2. Extra-urban conditions: g/km

7.1.1.3. Combined: g/km

7.1.2. Fuel consumption ⁽³⁾ ⁽⁴⁾

7.1.2.1. Fuel consumption (urban conditions): l/100 km

7.1.2.2. Fuel consumption (extra-urban conditions): l/100 km

7.1.2.3. Fuel consumption (combined): l/100 km

7.1.3. For vehicles powered by an internal combustion engine only which are equipped with periodically regenerating systems as defined in paragraph 2.16 of this Regulation, the test results must be multiplied by the factor K_i obtained from Annex 10.7.2. **Pure electric vehicles ⁽²⁾**

7.2.1. Measurement of electric energy consumption.

7.2.1.1. Electric energy consumption: Wh/km

7.2.1.2. Total time out of tolerance for the conduct of the cycle: sec

7.2.2. Measurement of range:

7.2.2.1. Range: km

7.2.2.2. Total time out of tolerance for the conduct of the cycle: sec

7.3. **Externally chargeable (OVC) hybrid electric vehicle**7.3.1. CO₂ mass emission (Condition A, combined ⁽⁵⁾): g/km7.3.2. CO₂ mass emission (Condition B, combined ⁽⁵⁾): g/km7.3.3. CO₂ mass emission (weighted, combined ⁽⁵⁾): g/km7.3.4. Fuel consumption (Condition A, combined ⁽⁵⁾): l/100 km7.3.5. Fuel consumption (Condition B, combined ⁽⁵⁾): l/100 km7.3.6. Fuel consumption (weighted, combined ⁽⁵⁾): l/100 km7.3.7. Electric energy consumption (Condition A, combined ⁽⁵⁾): Wh/km7.3.8. Electric energy consumption (Condition B, combined ⁽⁵⁾): Wh/km7.3.9. Electric energy consumption (weighted and combined ⁽⁵⁾): Wh/km

7.3.10. Electric range: km

8. Vehicle submitted for approval on:
9. Technical service responsible for conducting approval tests:
10. Number of report issued by that service:
11. Date of report issued by that service:
12. Approval granted/extended/refused/withdrawn ⁽²⁾
13. Reasons for extension (if applicable):
14. Remarks:
15. Positioning of approval mark on the vehicle:
16. Place:
17. Date:
18. Signature:

⁽¹⁾ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in this Regulation).

⁽²⁾ Strike out what does not apply.

⁽³⁾ Repeat for petrol and gaseous fuel in the case of a vehicle that can run either on petrol or on a gaseous fuel.

⁽⁴⁾ For vehicles fuelled with NG the unit l/100 km is replaced by m³/km.

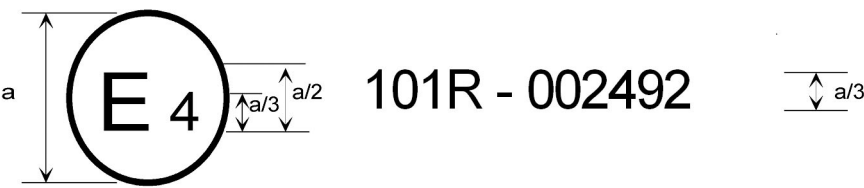
⁽⁵⁾ Measured over the combined cycle, i.e. Part One (urban) and Part Two (extra-urban) together.

ANNEX 5

ARRANGEMENTS OF APPROVAL MARKS

MODEL A

(See paragraph 4.4. of this Regulation)

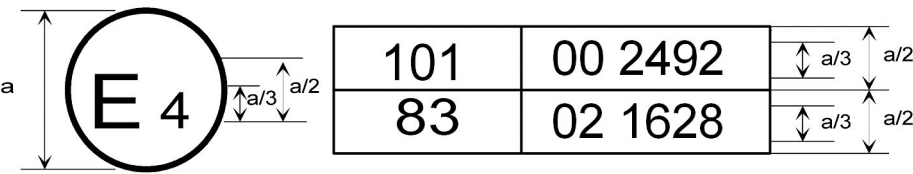


a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E4) with regard to the measurement of emissions of CO₂ and fuel consumption or to the measurement of electric energy consumption and electric range pursuant to Regulation No 101 and under approval number 002492. The first two digits of the approval number indicate that the approval was granted according to the requirements of Regulation No 101 as amended by in its original version.

MODEL B

(See paragraph 4.5 of this Regulation)



a = 8 mm min

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E4) pursuant to Regulations Nos 101 and 83 (*). The first two digits of the approval numbers indicate that, at the dates when the respective approvals were given, Regulation No 101 in its original version and Regulation No 83 already included the 02 series of amendments.

(*) The second number is given merely as an example.

ANNEX 6

**METHOD OF MEASURING EMISSIONS OF CARBON DIOXIDE AND FUEL CONSUMPTION OF VEHICLES
POWERED BY AN INTERNAL COMBUSTION ENGINE ONLY**

1. SPECIFICATION OF THE TEST

- 1.1. Emissions of carbon dioxide (CO₂) and fuel consumption of vehicles powered by an internal combustion engine only shall be determined according to the procedure for the Type I test as defined in Annex 4 of Regulation No 83 in force at the time of the approval of the vehicle.
- 1.2. Emissions of carbon dioxide (CO₂) and fuel consumption shall be determined separately for the Part One (urban driving) and the Part Two (extra-urban driving) of the specified driving cycle.
- 1.3. In addition to the conditions specified in Annex 4 of Regulation No 83 in force at the time of the approval of the vehicle, the following conditions apply:
- 1.3.1. Only the equipment necessary for the operation of the vehicle during the test shall be in use. If there is a manually controlled device for the engine intake air temperature, it shall be in the position prescribed by the manufacturer for the ambient temperature at which the test is performed. In general, the auxiliary devices required for the normal operation of the vehicle shall be in use.
- 1.3.2. If the radiator fan is temperature controlled, it shall be in the condition of normal operation on the vehicle. The passenger compartment heating system shall be switched off, as shall any air conditioning system, but such systems compressor shall be functioning normally.
- 1.3.3. If a super-charger is fitted, it shall be in the normal operating condition for the test conditions.
- 1.3.4. All the lubricants shall be those recommended by the manufacturer of the vehicle and shall be specified in the test report.
- 1.3.5. The tyres shall be of a type specified as original equipment by the vehicle manufacturer inflated to the pressure recommended for the test load and speeds. The pressures shall be indicated in the test report.

1.4. Calculation of CO₂ and fuel consumption values

- 1.4.1. The mass emission of CO₂, expressed in g/km, shall be calculated from the measurement results using the provisions defined in Appendix 8 to Annex 4 of Regulation No 83 in force at the time of the approval of the vehicle.
- 1.4.1.1. For this calculation the density of CO₂ shall be Q_{CO₂} = 1,964 g/litre.
- 1.4.2. The fuel consumption values shall be calculated from the emissions of hydrocarbons, carbon monoxide, and carbon dioxide determined from the measurement results using the provisions defined in Appendix 8 to Annex 4 of Regulation No 83 in force at the time of the approval of the vehicle.
- 1.4.3. The fuel consumption, expressed in litres per 100 km (in the case of petrol, LPG or diesel) or in m³ per 100 km (in the case of NG) is calculated by means of the following formulae:

- (a) for vehicles with a positive ignition engine fuelled with petrol:

$$FC = (0,1154 / D) \cdot [(0,866 \cdot HC) + (0,429 \cdot CO) + (0,273 \cdot CO_2)]$$

- (b) for vehicles with a positive ignition engine fuelled with LPG:

$$FC_{\text{norm}} = (0,1212 / 0,538) \cdot [(0,825 \cdot HC) + (0,429 \cdot CO) + (0,273 \cdot CO_2)]$$

If the composition of the fuel used for the test differs from the composition that is assumed for the calculation of the normalised consumption, on the manufacturer's request a correction factor cf may be applied, as follows:

$$FC_{\text{norm}} = (0,1212 / 0,538) \cdot (cf) \cdot [(0,825 \cdot \text{HC}) + (0,429 \cdot \text{CO}) + (0,273 \cdot \text{CO}_2)]$$

The correction factor cf , which may be applied, is determined as follows:

$$cf = 0,825 + 0,0693 \cdot n_{\text{actual}}$$

where:

n_{actual} = the actual H/C ratio of the fuel used

- (c) for vehicles with a positive ignition engine fuelled with NG:

$$FC_{\text{norm}} = (0,1336 / 0,654) \cdot [(0,749 \cdot \text{HC}) + (0,429 \cdot \text{CO}) + (0,273 \cdot \text{CO}_2)]$$

- (d) for vehicles with a compression ignition engine:

$$FC = (0,1155 / D) \cdot [(0,866 \cdot \text{HC}) + (0,429 \cdot \text{CO}) + (0,273 \cdot \text{CO}_2)]$$

In these formulae:

FC = the fuel consumption in litre per 100 km (in the case of petrol, LPG or diesel) or in m³ per 100 km (in the case of natural gas)

HC = the measured emission of hydrocarbons in g/km

CO = the measured emission of carbon monoxide in g/km

CO₂ = the measured emission of carbon dioxide in g/km

D = the density of the test fuel.

In the case of gaseous fuels this is the density at 15 °C.

ANNEX 7

METHOD OF MEASURING THE ELECTRIC ENERGY CONSUMPTION OF VEHICLES POWERED BY AN ELECTRIC POWER TRAIN ONLY

1. TEST SEQUENCE

1.1. Composition

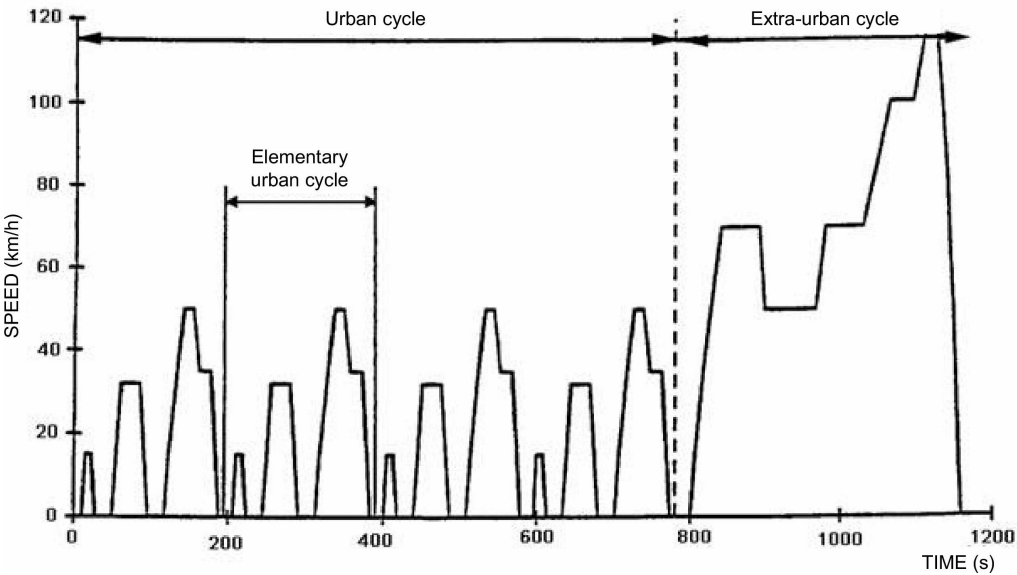
The test sequence is composed of two parts (see Figure 1):

- (a) an urban cycle made of four elementary urban cycles;
- (b) an extra-urban cycle.

In case of a manual gear box with several gears, the operator changes the gear according to the manufacturer's specifications.

If the vehicle has several driving modes, which may be selected by the driver, the operator shall select the one to best match the target curve.

Figure 1
Test sequence — M₁ and N₁ categories of vehicles



Theoretical distance = 11 022 m
Average speed = 33,6 km/h

1.2. Urban cycle

The urban cycle is composed of four elementary cycles of 195 seconds each and lasts 780 seconds in total.

Description of the elementary urban cycle is given in Figure 2 and Table 1.

Figure 2

Elementary urban cycle (195 seconds)

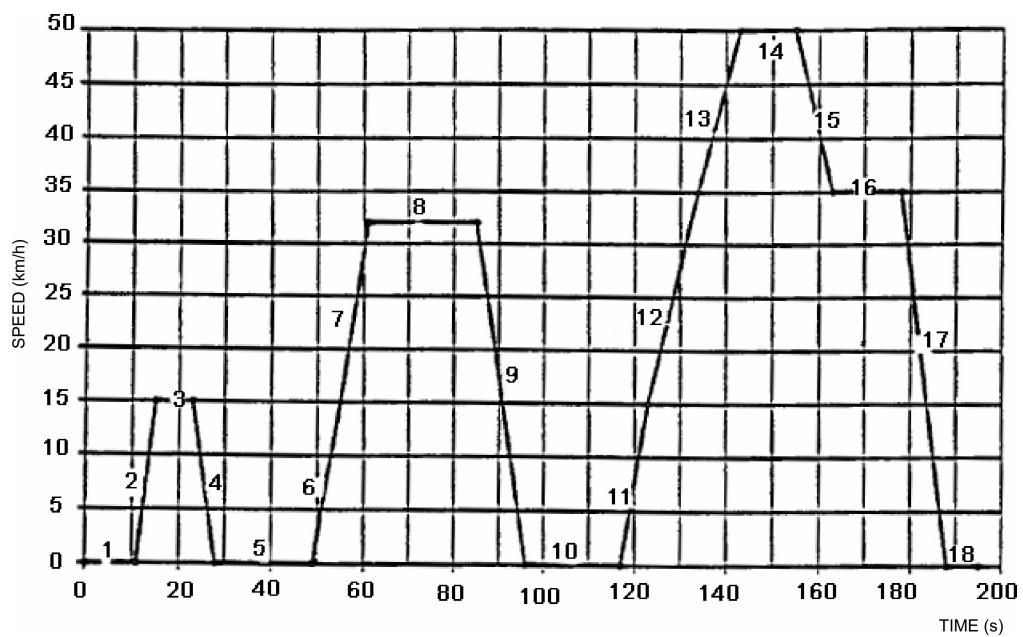


Table 1

Elementary urban cycle

Operation No	Operation type	Mode No	Acceleration (m/s ²)	Speed (km/h)	Operation duration (s)	Mode duration (s)	Total time (s)
1	Stop	1	0,00	0	11	11	11
2	Acceleration	2	1,04	0–15	4	4	15
3	Constant speed	3	0,00	15	8	8	23
4	Deceleration	4	– 0,83	15–0	5	5	28
5	Stop	5	0,00	0	21	21	49
6	Acceleration	6	0,69	0–15	6	12	55
7	Acceleration		0,79	15–32	6		61
8	Constant speed	7	0,00	32	24	24	85
9	Deceleration	8	– 0,81	32–0	11	11	96
10	Stop	9	0,00	0	21	21	117
11	Acceleration	10	0,69	0–15	6	26	123
12	Acceleration		0,51	15–35	11		134
13	Acceleration		0,46	35–50	9		143
14	Constant speed	11	0,00	50	12	12	155
15	Deceleration	12	– 0,52	50–35	8	8	163
16	Constant speed	13	0,00	35	15	15	178
17	Deceleration	14	– 0,97	35–0	10	10	188
18	Stop	15	0,00	0	7	7	195

Generalities	in time (s)	in percentage
Stop	60	30,77
Acceleration	42	21,54
Constant speed	59	30,26
Deceleration	34	17,44
Total	195	100,00

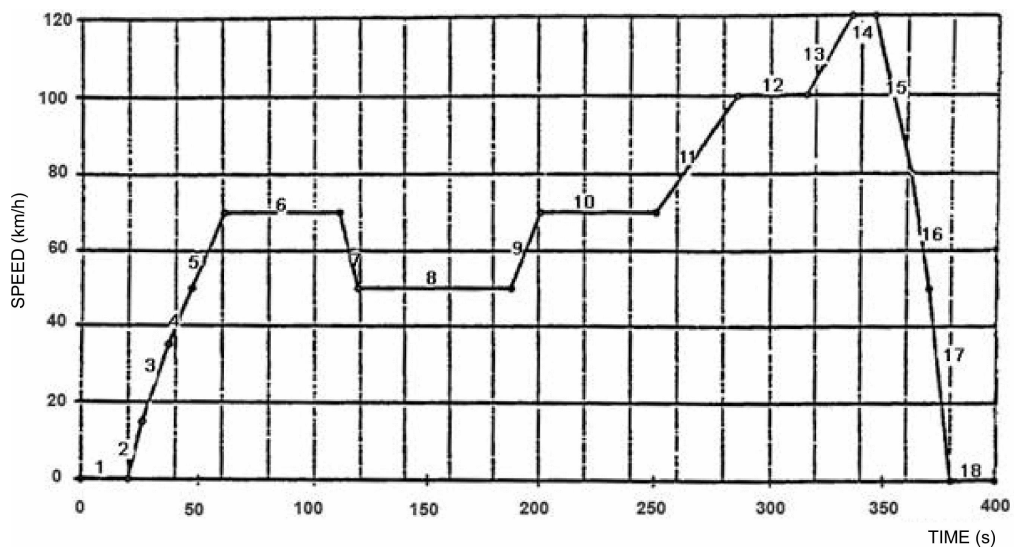
Average speed (km/h)	18,77
Working time (s)	195
Theoretical distance by elementary urban cycle (m)	1 017
Theoretical distance for four elementary urban cycles (m)	4 067

1.3. Extra-urban cycle

The description of the extra-urban cycle is given in Figure 3 and Table 2.

Figure 3

Extra-urban cycle (400 seconds)



Note: The procedure to be adopted when the vehicle failed to meet the speed requirements of this curve is detailed in item 1.4.

Table 2

Extra-urban cycle

Operation No	Operation type	Mode No	Acceleration (m/s ²)	Speed (km/h)	Operation duration (s)	Mode duration (s)	Total time (s)
1	Stop	1	0,00	0	20	20	20
2	Acceleration	2	0,69	0–15	6	41	26
3	Acceleration		0,51	15–35	11		37
4	Acceleration		0,42	35–50	10		47
5	Acceleration		0,40	50–70	14		61
6	Constant speed	3	0,00	70	50	50	111
7	Deceleration	4	– 0,69	70–50	8	8	119
8	Constant speed	5	0,00	50	69	69	188
9	Acceleration	6	0,43	50–70	13	13	201
10	Constant speed	7	0,00	70	50	50	251
11	Acceleration	8	0,24	70–100	35	35	286
12	Constant speed	9	0,00	100	30	30	316
13	Acceleration	10	0,28	100–120	20	20	336
14	Constant speed	11	0,00	120	10	10	346
15	Deceleration	12	– 0,69	120–80	16	34	362
16	Deceleration		– 1,04	80–50	8		370
17	Deceleration		– 1,39	50–0	10		380
18	Stop	13	0,00	0	20	20	400

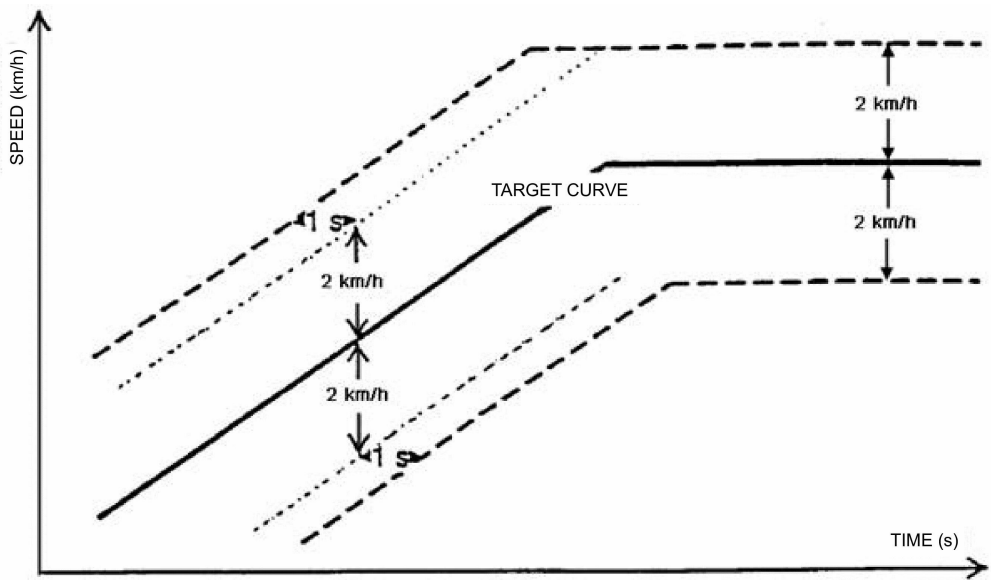
Generalities	in time (s)	in percentage
Stop	40	10,00
Acceleration	109	27,25
Constant speed	209	52,25
Deceleration	42	10,50
Total	400	100,00

Average speed (km/h)	62,60
Working time (s)	400
Theoretical distance (m)	6 956

1.4. Tolerance

Tolerances are given in Figure 4.

Figure 4
Speed tolerance



Tolerances on speed (± 2 km/h) and on time (± 1 s) are geometrically combined at each point as represented in Figure 4.

Below 50 km/h, deviations beyond this tolerance are permitted as follows:

- (a) at gear changes for a duration less than 5 seconds;
- (b) and up to five times per hour at other times, for a duration less than 5 seconds each.

The total time out of tolerance has to be mentioned in the test report.

Over 50 km/h, it is accepted to go beyond tolerances provided the accelerator pedal is fully depressed.

2. TEST METHOD

2.1. Principle

The test method described hereafter allows the electric energy consumption, expressed in Wh/km, to be measured:

2.2. Parameters, units and accuracy of measurements

Parameter	Units	Accuracy	Resolution
Time	s	$\pm 0,1$ s	0,1 s
Distance	m	$\pm 0,1$ per cent	1 m
Temperature	$^{\circ}\text{C}$	± 1 $^{\circ}\text{C}$	1 $^{\circ}\text{C}$
Speed	km/h	± 1 per cent	0,2 km/h
Mass	kg	$\pm 0,5$ per cent	1 kg
Energy	Wh	$\pm 0,2$ per cent	Class 0,2 s according to IEC 687

IEC = International Electrotechnical Commission.

2.3. Vehicle**2.3.1. Condition of the vehicle**

- 2.3.1.1. The vehicle tyres shall be inflated to the pressure specified by the vehicle manufacturer when the tyres are at the ambient temperature.
- 2.3.1.2. The viscosity of the oils for the mechanical moving parts shall conform to the specification of the vehicle manufacturer.
- 2.3.1.3. The lighting and light-signalling and auxiliary devices shall be off, except those required for testing and usual day-time operation of the vehicle.
- 2.3.1.4. All energy storage systems available for other than traction purposes (electric, hydraulic, pneumatic, etc.) shall be charged up to their maximum level specified by the manufacturer.
- 2.3.1.5. If the batteries are operated above the ambient temperature, the operator shall follow the procedure recommended by the car manufacturer in order to keep the temperature of the battery in the normal operating range.
- The manufacturer's agent shall be in a position to attest that the thermal management system of the battery is neither disabled nor reduced.
- 2.3.1.6. The vehicle must have undergone at least 300 km during the seven days before the test with those batteries that are installed in the test vehicle.

2.4. Operation mode

All the tests are conducted at a temperature of between 20 °C and 30 °C.

The test method includes the four following steps:

- (a) Initial charge of the battery;
- (b) Application twice of the cycle made of four elementary urban cycles and an extra-urban cycle;
- (c) Charging the battery;
- (d) Calculation of the electric energy consumption.

Between the steps, if the vehicle shall move, it is pushed to the following test area (without regenerative recharging).

2.4.1. Initial charge of the battery

Charging the battery consists of the following procedures:

2.4.1.1. Discharge of the battery

The procedure starts with the discharge of the battery of the vehicle while driving (on the test track, on a chassis dynamometer, etc.) at a steady speed of 70 % $\pm$ 5 % from the maximum 30 minutes speed of the vehicle.

Stopping the discharge occurs:

- (a) when the vehicle is not able to run at 65 % of the maximum thirty minutes speed;
- (b) or when an indication to stop the vehicle is given to the driver by the standard on-board instrumentation,
- or
- (c) after covering the distance of 100 km.

2.4.1.2. Application of a normal overnight charge

The battery shall be charged according to the following procedure.

2.4.1.2.1. Normal overnight charge procedure

The charge is carried out:

- (a) with the on-board charger if fitted,
- (b) with an external charger recommended by the manufacturer, using the charging pattern prescribed for normal charging,
- (c) in an ambient temperature comprised between 20 °C and 30 °C.

This procedure excludes all types of special charges that could be automatically or manually initiated like, for instance, the equalisation charges or the servicing charges.

The car manufacturer shall declare that during the test, a special charge procedure has not occurred.

2.4.1.2.2. End of charge criteria

The end of charge criteria corresponds to a charging time of 12 hours except if a clear indication is given to the driver by the standard instrumentation that the battery is not yet fully charged.

In this case,

the maximum time is =
$$\frac{3 \cdot \text{claimed battery capacity (Wh)}}{\text{mains power supply (W)}}$$

2.4.1.2.3. Fully charged battery

Battery having been charged according to overnight charge procedure until the end of charge criteria.

2.4.2. Application of the cycle and measurement of the distance

The end of charging time t_0 (plug off) is reported.

The chassis dynamometer shall be set with the method described in the Appendix to this annex.

Starting within 4 hours from t_0 , the cycle made of four elementary urban cycles and an extra-urban cycle is run twice on a chassis dynamometer (test distance: 22 km, test duration: 40 minutes).

At the end, the measure D_{test} of the covered distance in km is recorded.

2.4.3. Charge of the battery

The vehicle shall be connected to the mains within the 30 minutes after the conclusion of the cycle made of four elementary urban cycles and an extra-urban cycle, carried out twice.

The vehicle shall be charged according to normal overnight charge procedure (see paragraph 2.4.1.2 to this Annex).

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy E delivered from the mains, as well as its duration.

Charging is stopped after 24 hours from the previous end of charging time (t_0).

Note:

In case of a mains power cut, the 24 hours period will be extended accordingly to the cut duration. Validity of the charge will be discussed between the technical services of the approval laboratory and the vehicle's manufacturer.

2.4.4. *Electric energy consumption calculation*

Energy E in Wh and charging time measurements are recorded in the test report.

The electric energy consumption c is defined by the formula:

$$c = \frac{E}{D_{\text{test}}} \text{ (expressed in Wh/km and rounded to the nearest whole number)}$$

where D_{test} is the distance covered during the test (km).

Appendix to Annex 7

Determination of the total road load power of a vehicle powered by an electric power train only, and calibration of the dynamometer

1. INTRODUCTION

The purpose of this appendix is to define the method of measuring the total road load power of a vehicle with a statistical accuracy of ± 4 per cent at a constant speed and to reproduce this measured road load power on a dynamometer with an accuracy of ± 5 %.

2. CHARACTERISTICS OF THE TRACK

The test road layout shall be level, straight and free of obstacles or wind barriers which adversely affect the variability of road load measurement.

The test road longitudinal slope shall not exceed ± 2 %. This slope is defined as the ratio of the difference in elevation between both ends of the test road and its overall length. In addition, the local inclination between any two points 3 m apart shall not deviate by more than $\pm 0,5$ % from this longitudinal slope.

The maximum cross-sectional camber of the test road shall be 1,5 % or less.

3. ATMOSPHERIC CONDITIONS

3.1. **Wind**

Testing shall be performed at wind speeds averaging less than 3 m/s with peak speeds less than 5 m/s. In addition, the vector component of the wind speed across the test track must be less than 2 m/s. Wind velocity shall be measured at 0,7 m above the track surface.

3.2. **Humidity**

The track shall be dry.

3.3. **Reference conditions**

Barometric pressure	$H_0 = 100 \text{ kPa}$
Temperature	$T_0 = 293 \text{ K (20 °C)}$
Air density	$d_0 = 1,189 \text{ kg/m}^3$

3.3.1. *Air density*

3.3.1.1. The air density during the test, calculated as described in paragraph 3.3.1.2 below, shall not differ by more than 7,5 % from the air density under the reference conditions.

3.3.1.2. The air density shall be calculated by the formula:

$$d_T = d_0 \cdot \frac{H_T}{H_0} \cdot \frac{T_0}{T_T}$$

where:

d_T is the air density during the test (kg/m^3)

d_0 is the air density at reference conditions (kg/m^3)

H_T is the total barometric pressure during the test (kPa)

T_T is absolute temperature during the test (K).

3.3.2. Ambient conditions

- 3.3.2.1. The ambient temperature shall be between 5 °C (278 K) and 35 °C (308 K) and the barometric pressure between 91 kPa and 104 kPa. The relative humidity shall be less than 95 %.
- 3.3.2.2. However, with the manufacturer's agreement, the tests may be made at lower ambient temperatures down to 1 °C. In this case the correction factor calculated for 5 °C should be used.

4. PREPARATION OF THE VEHICLE

4.1. Running-in

The vehicle shall be in normal running order and adjustment after having been run in for at least 300 km. The tyres shall be run in at the same time as the vehicle or shall have a tread depth within 90 and 50 % of the initial tread depth.

4.2. Checks

The following checks shall be made in accordance with the manufacturer's specifications for the use considered: wheels, wheel rims, tyres (make, type, pressure), front axle geometry, brake adjustment (elimination of parasitic drag), lubrication of front and rear axles, adjustment of the suspension and vehicle ground clearance, etc. Check that during freewheeling, there is no electrical braking.

4.3. Preparation for the test

- 4.3.1. The vehicle shall be loaded to its test mass including driver and measurement equipments, spread in a uniform way in the loading areas.
- 4.3.2. The windows of the vehicle shall be closed. Any covers for air conditioning systems, headlamps, etc. shall be closed.
- 4.3.3. The vehicle shall be clean.
- 4.3.4. Immediately before the test, the vehicle shall be brought to the normal running temperature in an appropriate manner.

5. SPECIFIED SPEED V

The specified speed is required for determining the running resistance at the reference speed from the running resistance curve. To determine the running resistance as a function of vehicle speed in the vicinity of the reference speed V_0 , running resistances shall be measured at the specified speed V . At least four to five points indicating the specified speeds, along with the reference speeds, are desired to be measured.

Table 1 shows the specified speeds in accordance with the category of the vehicle. The asterisk (*) indicates the reference speed in the table.

Table 1

Category $V_{\max}$	Specified speeds (km/h)					
> 130	120 (**)	100	80 (*)	60	40	20
130 – 100	90	80 (*)	60	40	20	—
100 – 70	60	50 (*)	40	30	20	—
< 70	50 (**)	40 (*)	30	20	—	—

(*) Reference speed.

(**) If it could be reached by the vehicle.

6. ENERGY VARIATION DURING COAST-DOWN

6.1. **Total road load power determination**6.1.1. *Measurement equipment and accuracy*

The margin of measurement error shall be less than 0,1 second for time and less than $\pm 0,5$ km/h for speed.

6.1.2. *Test procedure*

6.1.2.1. Accelerate the vehicle to a speed of 5 km/h greater than the speed at which test measurement begins.

6.1.2.2. Put the gearbox to neutral, or disconnect the power supply.

6.1.2.3. Measure the time t_1 taken by the vehicle to decelerate from:

$$V_2 = V + \Delta V \text{ km/h to } V_1 = V - \Delta V \text{ km/h}$$

where:

$$\Delta V \leq 5 \text{ km/h for nominal speed} \leq 50 \text{ km/h}$$

$$\Delta V \leq 10 \text{ km/h for nominal speed} > 50 \text{ km/h}$$

6.1.2.4. Carry out the same test in the opposite direction, measuring time t_2 .

6.1.2.5. Take the average T_1 of the two times t_1 and t_2 .

6.1.2.6. Repeat these tests until the statistical accuracy (p) of the average

$$T = \frac{1}{n} \sum_{i=1}^n T_i$$

is equal to or less than 4 per cent ($p \leq 4$ per cent).

The statistical accuracy (p) is defined by:

$$p = \frac{t \cdot s}{\sqrt{n}} \cdot \frac{100}{T}$$

where:

t is the coefficient given by the table below;

s is the standard deviation: $s = \sqrt{\frac{\sum_{i=1}^n (T_i - T)^2}{n - 1}}$

n is the number of tests

n	4	5	6	7	8	9	10
t	3,2	2,8	2,6	2,5	2,4	2,3	2,3
$t/\sqrt{n}$	1,6	1,25	1,06	0,94	0,85	0,77	0,73

6.1.2.7. Calculation of the running resistance force

The running resistance force F at the specified speed V is calculated as follows:

$$F = (M_{HP} + M_r) \cdot \frac{2\Delta V}{\Delta T} \cdot \frac{1}{3,6} \text{ [N]}$$

where:

M_{HP} is the test mass,

M_r is the equivalent inertia mass of all the wheels and vehicle portions rotating with the wheels during coast down on the road. M_r should be measured or calculated by an appropriate manner.

6.1.2.8. The running resistance determined on the track shall be corrected to the reference ambient conditions as follows:

$$F_{\text{corrected}} = k \cdot F_{\text{measured}}$$

$$k = \frac{R_R}{R_T} [1 + K_R(t - t_0)] + \frac{R_{AERO} d_0}{R_T d_t}$$

where:

R_R is the rolling resistance at speed V

R_{AERO} is the aerodynamic drag at speed V

R_T is the total road load = $R_R + R_{AERO}$

K_R is the temperature correction factor of rolling resistance, taken to be equal to: $3,6 \times 10^{-3} \text{ } ^\circ\text{C}$

t is the road test ambient temperature in $^\circ\text{C}$

t_0 is the reference ambient temperature = $20 \text{ } ^\circ\text{C}$

d_t is the air density at the test conditions

d_0 is the air density at the reference conditions ($20 \text{ } ^\circ\text{C}$, 100 kPa) = $1,189 \text{ kg/m}^3$.

The ratios R_R/R_T and R_{AERO}/R_T shall be specified by the vehicle manufacturer on the basis of the data normally available to the company.

If these values are not available, subject to the agreement of the manufacturer and the technical service concerned, the figures for the rolling/total resistance ratio given by the following formula may be used:

$$\frac{R_R}{R_T} = aM_{HP} + b$$

where:

M_{HP} is the test mass

and for each speed the coefficients a and b are as shown in the following table:

$V \text{ (km/h)}$	a	b
20	$7,24 \cdot 10^{-5}$	0,82
40	$1,59 \cdot 10^{-4}$	0,54
60	$1,96 \cdot 10^{-4}$	0,33
80	$1,85 \cdot 10^{-4}$	0,23
100	$1,63 \cdot 10^{-4}$	0,18
120	$1,57 \cdot 10^{-4}$	0,14

6.2. Setting of the dynamometer

The purpose of this procedure is to simulate on the dynamometer the total road load power at a given speed.

6.2.1. Measurement equipment and accuracy

The measuring equipment shall be similar to that used on the track.

6.2.2. Test procedure

6.2.2.1. Install the vehicle on the dynamometer.

6.2.2.2. Adjust the tyre pressure (cold) of the driving wheels as required for the chassis dynamometer.

6.2.2.3. Adjust the equivalent inertia mass of the chassis dynamometer, according to Table 2.

Table 2

Test mass M_{HP} (kg)	Equivalent inertia I (kg)
$M_{HP} \leq 480$	455
$480 < M_{HP} \leq 540$	510
$540 < M_{HP} \leq 595$	570
$595 < M_{HP} \leq 650$	625
$650 < M_{HP} \leq 710$	680
$710 < M_{HP} \leq 765$	740
$765 < M_{HP} \leq 850$	800
$850 < M_{HP} \leq 965$	910
$965 < M_{HP} \leq 1\,080$	1 020
$1\,080 < M_{HP} \leq 1\,190$	1 130
$1\,190 < M_{HP} \leq 1\,305$	1 250
$1\,305 < M_{HP} \leq 1\,420$	1 360
$1\,420 < M_{HP} \leq 1\,530$	1 470
$1\,530 < M_{HP} \leq 1\,640$	1 590
$1\,640 < M_{HP} \leq 1\,760$	1 700
$1\,760 < M_{HP} \leq 1\,870$	1 810
$1\,870 < M_{HP} \leq 1\,980$	1 930
$1\,980 < M_{HP} \leq 2\,100$	2 040
$2\,100 < M_{HP} \leq 2\,210$	2 150
$2\,210 < M_{HP} \leq 2\,380$	2 270
$2\,380 < M_{HP} \leq 2\,610$	2 270
$2\,610 < M_{HP}$	2 270

6.2.2.4. Bring the vehicle and the chassis dynamometer to the stabilized operating temperature, in order to approximate the road conditions.

6.2.2.5. Carry out the operations specified in paragraph 6.1.2 to this annex with the exception of paragraphs 6.1.2.4 and 6.1.2.5, replacing M_{HP} by I and M_r by M_{rm} in the formula given in paragraph 6.1.2.7.6.2.2.6. Adjust the brake to reproduce the corrected running resistance half payload (paragraph 6.1.2.8 to this annex) and to take into account the difference between the vehicle mass on the track and the equivalent inertia test mass (I) to be used. This may be done by calculating the mean corrected road coast down time from V_2 to V_1 and reproducing the same time on the dynamometer by the following relationship:

$$T_{\text{corrected}} = (I + M_{rm}) \frac{2\Delta V}{F_{\text{corrected}}} \cdot \frac{1}{3,6}$$

where:

 I is the flywheel equivalent inertia mass of chassis dynamometer. M_{rm} is the equivalent inertia mass of the powered wheels and vehicle portions rotating with the wheels during coast down. M_{rm} shall be measured or calculated by an appropriate manner.6.2.2.7. The power P_a to be absorbed by the bench should be determined in order to enable the same total road load power to be reproduced for the same vehicle on different days or on different chassis dynamometers of the same type.

ANNEX 8

**METHOD OF MEASURING THE EMISSIONS OF CARBON DIOXIDE, FUEL CONSUMPTION AND THE
ELECTRIC ENERGY CONSUMPTION OF VEHICLES POWERED BY A HYBRID ELECTRIC POWER TRAIN**

1. INTRODUCTION

- 1.1. This Annex defines the specific provisions regarding type-approval of a hybrid electric vehicle (HEV) as defined in paragraph 2.12.2 ⁽¹⁾ of this Regulation.
- 1.2. As a general principle for the tests, hybrid electric vehicles shall be tested according to the principles applied to vehicles powered by an internal combustion engine only (Annex 6), unless modified by this Annex.
- 1.3. OVC vehicles (as categorised in paragraph 2 to this Annex) shall be tested according to condition A and to condition B.

The test results under both conditions A and B and the weighted average shall be reported in the communication form described in Annex 4.

1.4. Driving cycles and gear shifting points

- 1.4.1. For vehicles with a manual transmission the driving cycle described in Appendix 1 of Annex 4 to Regulation No 83 in force at the time of approval of the vehicle shall be used, including the prescribed gear shifting points.
- 1.4.2. For vehicles with a special gear shifting strategy the gear shifting points prescribed in Appendix 1 of Annex 4 to Regulation No 83 are not applied. For these vehicles the driving cycle specified in paragraph 2.3.3 of Annex 4 to Regulation No 83 in force at the time of approval of the vehicle shall be used. Concerning gear shifting points, these vehicles shall be driven according to the manufacturer's instructions, as incorporated in the drivers' handbook of production vehicles and indicated by a technical gear shift instrument (for drivers information).
- 1.4.3. For vehicles with an automatic transmission the driving cycle specified in paragraph 2.3.3 of Annex 4 to Regulation No 83 in force at the time of approval of the vehicle shall be used.
- 1.4.4. For vehicle conditioning a combination of the Part One and/or Part Two cycles of the applicable driving cycle shall be used as prescribed in this Annex.

2. CATEGORIES OF HYBRID ELECTRIC VEHICLES

Vehicle charging	Off-vehicle charging ^(a) (OVC)		Not Off-vehicle charging ^(b) (NOVC)	
	Without	With	Without	With

^(a) Also known as 'externally chargeable'.

^(b) Also known as 'not externally chargeable'.

3. EXTERNALLY CHARGEABLE (OVC HEV) WITHOUT AN OPERATING MODE SWITCH

- 3.1. Two tests shall be performed under the following conditions:

Condition A: test shall be carried out with a fully charged electrical energy/power storage device.

Condition B: test shall be carried out with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity).

The profile of the state of charge (SOC) of the electrical energy/power storage device during different stages of the Type I test is given in Appendix 1.

⁽¹⁾ Correction to the initial UN/ECE document: erroneous reference in source text. Reference should refer to paragraph 2.14.1 instead of paragraph 2.12.2.

3.2. Condition A

3.2.1. The procedure shall start with the discharge of the electrical energy/power storage device as described in paragraph 3.2.1.1 below:

3.2.1.1. Discharge of the electrical energy/power storage device

The electrical energy/power storage device of the vehicle is discharged while driving (on the test track, on a chassis dynamometer, etc.):

- at a steady speed of 50 km/h until the fuel consuming engine of the HEV starts up,
or
- if a vehicle can not reach a steady speed of 50 km/h without starting up the fuel consuming engine, the speed shall be reduced until the vehicle can run a lower steady speed where the fuel consuming engine just does not start up for a defined time/distance (to be specified between technical service and manufacturer),
or
- with manufacturer's recommendation.

The fuel consuming engine shall be stopped within 10 seconds of it being automatically started.

3.2.2. Conditioning of the vehicle

3.2.2.1. For conditioning compression-ignition engines the Part Two cycle of the applicable driving cycle shall be used in combination with the applicable gear shifting prescriptions as defined in paragraph 1.4 of this Annex. Three consecutive cycles shall be driven.

3.2.2.2. Vehicles fitted with positive-ignition engines shall be preconditioned with one Part One and two Part Two cycles of the applicable driving cycle in combination with the applicable gear shifting prescriptions as defined in paragraph 1.4 of this Annex.

3.2.2.3. After this preconditioning, and before testing, the vehicle shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 °C and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within ± 2 K of the temperature of the room, and the electrical energy/power storage device is fully charged as a result of the charging prescribed in paragraph 3.2.2.4 below.

3.2.2.4. During soak, the electrical energy/power storage device shall be charged, using the normal overnight charging procedure as defined in paragraph 3.2.2.5 below.

3.2.2.5. Application of a normal overnight charge

The electrical energy/power storage device shall be charged according to the following procedure.

3.2.2.5.1. Normal overnight charge procedure

The charging is carried out:

- (a) with the on board charger if fitted,
or
- (b) with an external charger recommended by the manufacturer using the charging pattern prescribed for normal charging;
- (c) in an ambient temperature comprised between 20 °C and 30 °C.

This procedure excludes all types of special charges that could be automatically or manually initiated like, for instance, the equalisation charges or the servicing charges. The manufacturer shall declare that during the test, a special charge procedure has not occurred.

3.2.2.5.2. End of charge criteria

The end of charge criteria corresponds to a charging time of 12 hours, except if a clear indication is given to the driver by the standard instrumentation that the electrical energy/power storage device is not yet fully charged.

In this case,

$$\text{the maximum time is} = \frac{3 \cdot \text{claimed battery capacity (Wh)}}{\text{mains power supply (W)}}$$

3.2.3. *Test procedure*

3.2.3.1. The vehicle shall be started up by the means provided for normal use to the driver. The first cycle starts on the initiation of the vehicle start-up procedure.

3.2.3.2. Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and end on conclusion of the final idling period in the extra-urban cycle (Part Two, end of sampling (ES)).

3.2.3.3. The vehicle shall be driven using the applicable driving cycle and gear shifting prescriptions as defined in paragraph 1.4 to this Annex.

3.2.3.4. The exhaust gases shall be analysed according to Annex 4 of Regulation No 83 in force at the time of approval of the vehicle.

3.2.3.5. The test results on the combined cycle (CO₂ and fuel consumption) for Condition A shall be recorded (respectively m₁ [g] and c₁ [l]).

3.2.4. Within the 30 minutes after the conclusion of the cycle, the electrical energy/power storage device shall be charged according to paragraph 3.2.2.5 of this Annex.

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy e₁ [Wh] delivered from the mains.

3.2.5. The electric energy consumption for condition A is e₁ [Wh].

3.3. **Condition B**3.3.1. *Conditioning of the vehicle*

3.3.1.1. The electrical energy/power storage device of the vehicle shall be discharged according to paragraph 3.2.1.1. of this Annex.

At the manufacturer's request, a conditioning according to paragraph 3.2.2.1. or 3.2.2.2. of this Annex may be carried out before electrical energy/power storage discharge.

3.3.1.2. Before testing, the vehicle shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 °C and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within ± 2 K of the temperature of the room.

3.3.2. *Test procedure*

3.3.2.1. The vehicle shall be started up by the means provided for normal use to the driver. The first cycle starts on the initiation of the vehicle start-up procedure.

3.3.2.2. Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and end on conclusion of the final idling period in the extra-urban cycle (Part Two, end of sampling (ES)).

3.3.2.3. The vehicle shall be driven using the applicable driving cycle and gear shifting prescriptions as defined in paragraph 1.4 of this Annex.

3.3.2.4. The exhaust gases shall be analysed according to Annex 4 of Regulation No 83 in force at the time of approval of the vehicle.

3.3.2.5. The test results on the combined cycle (CO₂ and fuel consumption) for Condition B shall be recorded (respectively m₂ [g] and c₂ [l]).

- 3.3.3. Within the 30 minutes after the conclusion of the cycle, the electrical energy/power storage device shall be charged according to paragraph 3.2.2.5 of this Annex.

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy e_2 [Wh] delivered from the mains.

- 3.3.4. The electrical energy/power storage device of the vehicle shall be discharged according to paragraph 3.2.1.1 of this Annex.

- 3.3.5. Within 30 minutes after the discharge, the electrical energy/power storage device shall be charged according to paragraph 3.2.2.5 of this Annex.

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy e_3 [Wh] delivered from the mains.

- 3.3.6. The electric energy consumption e_4 [Wh] for condition B is: $e_4 = e_2 - e_3$

3.4. Test results

- 3.4.1. The values of CO_2 shall be $M_1 = m_1/D_{\text{test1}}$ and $M_2 = m_2/D_{\text{test2}}$ [g/km] with D_{test1} and D_{test2} the actual driven distances in the tests performed under conditions A (paragraph 3.2 of this Annex) and B (paragraph 3.3. of this Annex) respectively, and m_1 and m_2 determined in paragraphs 3.2.3.5 and 3.3.2.5 of this Annex respectively.

- 3.4.2. The weighted values of CO_2 shall be calculated as below:

$$M = (D_e \cdot M_1 + D_{av} \cdot M_2) / (D_e + D_{av})$$

where:

M = mass emission of CO_2 in grams per kilometre

M_1 = mass emission of CO_2 in grams per kilometre with a fully charged electrical energy/power storage device

M_2 = mass emission of CO_2 in grams per kilometre with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity)

D_e = vehicle's electric range, according to the procedure described in Annex 9, where the manufacturer must provide the means for performing the measurement with the vehicle running in pure electric operating state

D_{av} = 25 km (assumed average distance between two battery recharges)

- 3.4.3. The values of fuel consumption shall be

$$C_1 = 100 \cdot c_1/D_{\text{test1}} \text{ and } C_2 = 100 \cdot c_2/D_{\text{test2}} \text{ [l/100 km]}$$

with D_{test1} and D_{test2} the actual driven distances in the tests performed under conditions A (paragraph 3.2 of this Annex) and B (paragraph 3.3 of this Annex) respectively, and c_1 and c_2 determined in paragraphs 3.2.3.5 and 3.3.2.5 of this Annex respectively.

- 3.4.4. The weighted values of fuel consumption shall be calculated as below:

$$C = (D_e \cdot C_1 + D_{av} \cdot C_2) / (D_e + D_{av})$$

where:

C = fuel consumption in l/100 km.

C_1 = fuel consumption in l/100 km with a fully charged electrical energy/power storage device

C_2 = fuel consumption in l/100 km with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity)

D_e = vehicle's electric range, according to the procedure described in Annex 9, where the manufacturer must provide the means for performing the measurement with the vehicle running in pure electric operating state.

D_{av} = 25 km (assumed average distance between two battery recharges)

- 3.4.5. The values of electric energy consumption shall be

$E_1 = e_1/D_{\text{test1}}$ and $E_4 = e_4/D_{\text{test2}}$ [Wh/km] with D_{test1} and D_{test2} the actual driven distances in the tests performed under conditions A (paragraph 3.2 of this Annex) and B (paragraph 3.3 of this Annex) respectively, and e_1 and e_4 determined in paragraphs 3.2.5 and 3.3.7 of this Annex respectively.

- 3.4.6. The weighted values of electric energy consumption shall be calculated as below:

$$E = (D_e \cdot E_1 + D_{av} \cdot E_4) / (D_e + D_{av})$$

where:

E = electric consumption Wh/km

E₁ = electric consumption Wh/km with a fully charged electrical energy/power storage device calculated

E₄ = electric consumption Wh/km with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity)

D_e = vehicle's electric range, according to the procedure described in Annex 9, where the manufacturer must provide the means for performing the measurement with the vehicle running in pure electric operating state

D_{av} = 25 km (assumed average distance between two battery recharges)

4. EXTERNALLY CHARGEABLE (OVC HEV) WITH AN OPERATING MODE SWITCH

- 4.1. Two tests shall be performed under the following conditions:

- 4.1.1. Condition A: test shall be carried out with a fully charged electrical energy/power storage device.

- 4.1.2. Condition B: test shall be carried out with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity)

- 4.1.3. The operating mode switch shall be positioned according to the table below:

Hybrid-modes Battery state of charge	— Pure electric — Hybrid	— Pure fuel consuming — Hybrid	— Pure electric — Pure fuel consuming — Hybrid	— Hybrid mode n (*) — ... — Hybrid mode m (*)
	Switch in position	Switch in position	Switch in position	Switch in position
Condition A Fully charged	Hybrid	Hybrid	Hybrid	Most electric hybrid mode (**)
Condition B Min. state of charge	Hybrid	Fuel consuming	Fuel consuming	Most fuel consuming mode (***)

(*) For instance: sport, economic, urban, extra-urban position ...

(**) Most electric hybrid mode:

The hybrid mode which can be proven to have the highest electricity consumption of all selectable hybrid modes when tested in accordance with condition A, to be established based on information provided by the manufacturer and in agreement with the technical service.

(***) Most fuel consuming mode:

The hybrid mode which can be proven to have the highest fuel consumption of all selectable hybrid modes when tested in accordance with condition B, to be established based on information provided by the manufacturer and in agreement with the technical service.

4.2. Condition A

- 4.2.1. If the electric range of the vehicle, as measured in accordance with Annex 9 to this Regulation, is higher than 1 complete cycle, on the request of the manufacturer, the type I test for electric energy measurement may be carried out in pure electric mode, after agreement of the technical service. In this case, the values of M₁ and C₁ in paragraph 4.4 are equal to 0.

- 4.2.2. The procedure shall start with the discharge of the electrical energy/power storage device of the vehicle as described in paragraph 4.2.2.1 below.

- 4.2.2.1. The electrical energy/power storage device of the vehicle is discharged while driving with the switch in pure electric position (on the test track, on a chassis dynamometer, etc.) at a steady speed of 70 % ± 5 % of the maximum speed of the vehicle in pure electric mode, which is to be determined according to the test procedure for electric vehicles defined in Regulation No 68.

Stopping the discharge occurs:

- when the vehicle is not able to run at 65 % of the maximum thirty minutes speed,
- or
- when an indication to stop the vehicle is given to the driver by the standard on-board instrumentation,
- or
- after covering a distance of 100 km.

If the vehicle is not equipped with a pure electric mode, the electrical energy/power storage device discharge shall be achieved by driving the vehicle (on the test track, on a chassis dynamometer, etc.):

- at a steady speed of 50 km/h until the fuel consuming engine of the HEV starts up,
- or
- if a vehicle can not reach a steady speed of 50 km/h without starting up the fuel consuming engine, the speed shall be reduced until the vehicle can run a lower steady speed where the fuel consuming engine just does not start up for a defined time/distance (to be specified between technical service and manufacturer),
- or
- with manufacturer's recommendation.

The fuel-consuming engine shall be stopped within 10 seconds of it being automatically started.

4.2.3. *Conditioning of the vehicle*

- 4.2.3.1. For conditioning compression-ignition engined vehicles the Part Two cycle of the applicable driving cycle shall be used in combination with the applicable gear shifting prescriptions as defined in paragraph 1.4 of this Annex. Three consecutive cycles shall be driven.
- 4.2.3.2. Vehicles fitted with positive-ignition engines shall be preconditioned with one Part One and two Part Two cycles of the applicable driving cycle in combination with the applicable gear shifting prescriptions as defined in paragraph 1.4 of this Annex.
- 4.2.3.3. After this preconditioning, and before testing, the vehicle shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 °C and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within ± 2 K of the temperature of the room, and the electrical energy/power storage device is fully charged as a result of the charging prescribed in paragraph 4.2.3.4 below.
- 4.2.3.4. During soak, the electrical energy/power storage device shall be charged, using the normal overnight charging procedure as defined in paragraph 3.2.2.5 of this Annex.

4.2.4. *Test procedure*

- 4.2.4.1. The vehicle shall be started up by the means provided for normal use to the driver. The first cycle starts on the initiation of the vehicle start-up procedure.
- 4.2.4.2. Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and end on conclusion of the final idling period in the extra-urban cycle (Part Two, end of sampling (ES)).
- 4.2.4.3. The vehicle shall be driven using the applicable driving cycle and gear shifting prescriptions as defined in paragraph 1.4 to this Annex.
- 4.2.4.4. The exhaust gases shall be analysed according to Annex 4 of Regulation No 83 in force at the time of approval of the vehicle.
- 4.2.4.5. The test results on the combined cycle (CO₂ and fuel consumption) for Condition A shall be recorded (respectively m_1 [g] and c_1 [l]).

- 4.2.5. Within the 30 minutes after the conclusion of the cycle, the electrical energy/power storage device shall be charged according to paragraph 3.2.2.5. of this Annex).

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy e_1 [Wh] delivered from the mains.

- 4.2.6. The electric energy consumption for condition A is e_1 [Wh].

4.3. **Condition B**

4.3.1. *Conditioning of the vehicle*

- 4.3.1.1. The electrical energy/power storage device of the vehicle shall be discharged according to paragraph 4.2.2.1. of this Annex.

At the manufacturer's request, a conditioning according to paragraph 4.2.3.1. or 4.2.3.2. of this Annex may be carried out before electrical energy/power storage discharge.

- 4.3.1.2. Before testing, the vehicle shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within ± 2 K of the temperature of the room.

4.3.2. *Test procedure*

- 4.3.2.1. The vehicle shall be started up by the means provided for normal use to the driver. The first cycle starts on the initiation of the vehicle start-up procedure.

- 4.3.2.2. Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and end on conclusion of the final idling period in the extra-urban cycle (Part Two, end of sampling (ES)).

- 4.3.2.3. The vehicle shall be driven using the applicable driving cycle and gear shifting prescriptions as defined in paragraph 1.4 to this Annex.

- 4.3.2.4. The exhaust gases shall be analysed according Annex 4 of Regulation No 83 in force at the time of approval of the vehicle.

- 4.3.2.5. The test results on the combined cycle (CO_2 and fuel consumption) for Condition B shall be recorded (respectively m_2 [g] and c_2 [l]).

- 4.3.3. Within the 30 minutes after the conclusion of the cycle, the electrical energy/power storage device shall be charged according to paragraph 3.2.2.5 of this Annex.

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy e_2 [Wh] delivered from the mains.

- 4.3.4. The electrical energy/power storage device of the vehicle shall be discharged in accordance with paragraph 4.2.2.1 of this Annex.

- 4.3.5. Within 30 minutes after the discharge, the electrical energy/power storage device shall be charged according to paragraph 3.2.2.5 of this Annex.

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy e_3 [Wh] delivered from the mains.

- 4.3.6. The electric energy consumption e_4 [Wh] for condition B is: $e_4 = e_2 - e_3$

4.4. **Test results**

- 4.4.1. The values of CO_2 shall be:

$$M_1 = m_1/D_{\text{test1}} \text{ and } M_2 = m_2/D_{\text{test2}} \text{ [g/km]}$$

with D_{test1} and D_{test2} the actual driven distances in the tests performed under conditions A (paragraph 4.2 of this Annex) and B (paragraph 4.3 of this Annex) respectively, and m_1 and m_2 determined in paragraphs 4.2.4.5 and 4.3.2.5 of this Annex respectively.

4.4.2. The weighted values of CO₂ shall be calculated as below:

$$M = (D_e \cdot M_1 + D_{av} \cdot M_2) / (D_e + D_{av})$$

where:

M = mass emission of CO₂ in grams per kilometre.

M₁ = mass emission of CO₂ in grams per kilometre with a fully charged electrical energy/power storage device.

M₂ = mass emission of CO₂ in grams per kilometre with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity).

D_e = vehicle's electric range, according to the procedure described in Annex 9, where the manufacturer must provide the means for performing the measurement with the vehicle running in pure electric operating state.

D_{av} = 25 km (assumed average distance between two battery recharges).

4.4.3. The values of fuel consumption shall be

$$C_1 = 100 \cdot c_1 / D_{\text{test1}} \text{ and } C_2 = 100 \cdot c_2 / D_{\text{test2}} \text{ [l/100 km]}$$

with D_{test1} and D_{test2} the actual driven distances in the tests performed under conditions A (paragraph 4.2 of this Annex) and B (paragraph 4.3 of this Annex) respectively, and c₁ and c₂ determined in paragraphs 4.2.4.5 and 4.3.2.5 of this Annex respectively.

4.4.4. The weighted values of fuel consumption shall be calculated as below:

$$C = (D_e \cdot C_1 + D_{av} \cdot C_2) / (D_e + D_{av})$$

where:

C = fuel consumption in l/100 km.

C₁ = fuel consumption in l/100 km with a fully charged electrical energy/power storage device.

C₂ = fuel consumption in l/100 km with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity).

D_e = vehicle's electric range, according to the procedure described in Annex 9, where the manufacturer must provide the means for performing the measurement with the vehicle running in pure electric operating state.

D_{av} = 25 km (assumed average distance between two battery recharges).

4.4.5. The values of electric energy consumption shall be:

$$E_1 = e_1 / D_{\text{test1}} \text{ and } E_4 = e_4 / D_{\text{test2}} \text{ [Wh/km]}$$

with D_{test1} and D_{test2} the actual driven distances in the tests performed under conditions A (paragraph 4.2 of this Annex) and B (paragraph 4.3 of this Annex) respectively, and e₁ and e₄ determined in paragraphs 4.2.6 and 4.3.6 of this Annex respectively.

4.4.6. The weighted values of electric energy consumption shall be calculated as below:

$$E = (D_e \cdot E_1 + D_{av} \cdot E_4) / (D_e + D_{av})$$

where:

E = electric consumption Wh/km.

E₁ = electric consumption Wh/km with a fully charged electrical energy/power storage device calculated.

E₄ = electric consumption Wh/km with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity).

D_e = vehicle's electric range, according to the procedure described in Annex 9, where the manufacturer must provide the means for performing the measurement with the vehicle running in pure electric operating state.

D_{av} = 25 km (assumed average distance between two battery recharges)

5. NOT EXTERNALLY CHARGEABLE (NOVC HEV) WITHOUT AN OPERATING MODE SWITCH
- 5.1. These vehicles shall be tested according to Annex 6, using the applicable driving cycle and gear shifting prescriptions as defined in paragraph 1.4. of this Annex.
- 5.1.1. Emissions of carbon dioxide (CO₂) and fuel consumption shall be determined separately for the Part One (urban driving) and the Part Two (extra-urban driving) of the specified driving cycle.
- 5.2. For preconditioning, at least two consecutive complete driving cycles (one Part One and one Part two) are carried out without intermediate soak, using the applicable driving cycle and gear shifting prescriptions as defined in paragraph 1.4. of this Annex.

5.3. Test results

- 5.3.1. The test results (fuel consumption C [l/100 km] and CO₂-emission M [g/km]) of this test are corrected in function of the energy balance ΔE_{batt} of the vehicle's battery.

The corrected values (C_0 [l/100 km] and M_0 [g/km]) should correspond to a zero energy balance ($\Delta E_{\text{batt}} = 0$), and are calculated using a correction coefficient determined by the manufacturer as defined below.

In case of other storage systems than an electric battery, ΔE_{batt} is representing $\Delta E_{\text{storage}}$, the energy balance of the electric energy storage device.

- 5.3.1.1. The electricity balance Q [Ah], measured using the procedure specified in appendix 2 to this Annex, is used as a measure of the difference in the vehicle battery's energy content at the end of the cycle compared to the beginning of the cycle. The electricity balance is to be determined separately for the Part One cycle and the Part Two cycle.

- 5.3.2. Under the conditions below, it is allowed to take the uncorrected measured values C and M as the test results:

- (1) in case the manufacturer can prove that there is no relation between the energy balance and fuel consumption,
- (2) in case that ΔE_{batt} always corresponds to a battery charging,
- (3) in case that ΔE_{batt} always corresponds to a battery discharging and ΔE_{batt} is within 1 % of the energy content of the consumed fuel (consumed fuel meaning the total fuel consumption over 1 cycle).

The change in battery energy content ΔE_{batt} can be calculated from the measured electricity balance Q as follows:

$$\Delta E_{\text{batt}} = \Delta \text{SOC}(\%) \cdot E_{\text{TEbatt}} \approx 0,0036 \cdot |\Delta \text{Ah}| \cdot V_{\text{batt}} = 0,0036 \cdot Q \cdot V_{\text{batt}} \text{ (MJ)}$$

with E_{TEbatt} [MJ] the total energy storage capacity of the battery and V_{batt} [V] the nominal battery voltage.

- 5.3.3. Fuel consumption correction coefficient (K_{fuel}) defined by the manufacturer

- 5.3.3.1. The fuel consumption correction coefficient (K_{fuel}) shall be determined from a set of n measurements performed by the manufacturer. This set should contain at least one measurement with $Q_i < 0$ and at least one with $Q_i > 0$.

If the latter condition can not be realised on the driving cycle (Part One or Part Two) used in this test, then it is up to the Technical Service to judge the statistical significance of the extrapolation necessary to determine the fuel consumption value at $\Delta E_{\text{batt}} = 0$.

- 5.3.3.2. The fuel consumption correction coefficient (K_{fuel}) is defined as:

$$K_{\text{fuel}} = (n \cdot \Sigma Q_i C_i - \Sigma Q_i \cdot \Sigma C_i) / (n \cdot \Sigma Q_i^2 - (\Sigma Q_i)^2) \text{ (l/100 km/Ah)}$$

where:

C_i = fuel consumption measured during i-th manufacturer's test (l/100 km)

Q_i = electricity balance measured during i-th manufacturer's test (Ah)

n = number of data.

The fuel consumption correction coefficient shall be rounded to four significant figures (e.g. 0,xxxx or xx,xx). The statistical significance of the fuel consumption correction coefficient is to be judged by the Technical Service.

- 5.3.3.3. Separate fuel consumption correction coefficients shall be determined for the fuel consumption values measured over the Part One cycle and the Part Two cycle respectively.

- 5.3.4. *Fuel consumption at zero battery energy balance (C_0)*

- 5.3.4.1. The fuel consumption C_0 at $\Delta E_{\text{batt}} = 0$ is determined by the following equation:

$$C_0 = C - K_{\text{fuel}} \cdot Q \text{ (l/100 km)}$$

where:

C = fuel consumption measured during test (l/100 km)

Q = electricity balance measured during test (Ah)

- 5.3.4.2. Fuel consumption at zero battery energy balance shall be determined separately for the fuel consumption values measured over the Part One cycle and the Part Two cycle respectively.

- 5.3.5. *CO₂-emission correction coefficient (K_{CO_2}) defined by the manufacturer*

- 5.3.5.1. The CO₂-emission correction coefficient (K_{CO_2}) shall be determined as follows from a set of n measurements performed by the manufacturer. This set should contain at least one measurement with $Q_i < 0$ and at least one with $Q_j > 0$.

If the latter condition can not be realised on the driving cycle (Part One or Part Two) used in this test, then it is up to the Technical Service to judge the statistical significance of the extrapolation necessary to determine the CO₂-emission value at $\Delta E_{\text{batt}} = 0$.

- 5.3.5.2. The CO₂-emission correction coefficient (K_{CO_2}) is defined as:

$$K_{\text{CO}_2} = (n \cdot \sum Q_i M_i - \sum Q_i \cdot \sum M_i) / (n \cdot \sum Q_i^2 - (\sum Q_i)^2) \text{ (g/km/Ah)}$$

where:

M_i = CO₂-emission measured during i -th manufacturer's test (g/km)

Q_i = electricity balance during i -th manufacturer's test (Ah)

n = number of data

The CO₂-emission correction coefficient shall be rounded to four significant figures (e.g. 0,xxxx or xx,xx). The statistical significance of the CO₂-emission correction coefficient is to be judged by the Technical Service.

- 5.3.5.3. Separate CO₂-emission correction coefficients shall be determined for the fuel consumption values measured over the Part One cycle and the Part Two cycle respectively.

- 5.3.6. *CO₂-emission at zero battery energy balance (M_0)*

- 5.3.6.1. The CO₂-emission M_0 at $\Delta E_{\text{batt}} = 0$ is determined by the following equation:

$$M_0 = M - K_{\text{CO}_2} \cdot Q \text{ (g/km)}$$

where:

M = CO₂-emission measured during test (g/km)

Q = electricity balance measured during test (Ah)

- 5.3.6.2. CO₂-emission at zero battery energy balance shall be determined separately for the CO₂-emission values measured over the Part One cycle and the Part Two cycle respectively.

6. NOT EXTERNALLY CHARGEABLE (NOT OVC HEV) WITH AN OPERATING MODE SWITCH

- 6.1. These vehicles shall be tested in hybrid mode according to Annex 6, using the applicable driving cycle and gear shifting prescriptions as defined in paragraph 1.4 of this Annex. If several hybrid modes are available, the test shall be carried out in the mode that is automatically set after turn on of the ignition key (normal mode).

- 6.1.1. Emissions of carbon dioxide (CO₂) and fuel consumption shall be determined separately for the Part One (urban driving) and the Part Two (extra-urban driving) of the specified driving cycle.

- 6.2. For preconditioning, at least two consecutive complete driving cycles (one Part One and one Part Two) are carried out without intermediate soak, using the applicable driving cycle and gear shifting prescriptions as defined in paragraph 1.4. of this Annex.

6.3. Test results

- 6.3.1. The test results (fuel consumption C [l/100 km] and CO_2 -emission M [g/km]) of this test are corrected in function of the energy balance ΔE_{batt} of the vehicle's battery.

The corrected values (C_0 [l/100 km] and M_0 [g/km]) should correspond to a zero energy balance ($\Delta E_{\text{batt}} = 0$), and are calculated using a correction coefficient determined by the manufacturer as defined below.

In case of other storage systems than an electric battery, ΔE_{batt} is representing $\Delta E_{\text{storage}}$, the energy balance of the electric energy storage device.

- 6.3.1.1. The electricity balance Q [Ah], measured using the procedure specified in appendix 2 to this Annex, is used as a measure of the difference in the vehicle battery's energy content at the end of the cycle compared to the beginning of the cycle. The electricity balance is to be determined separately for the Part One cycle and the Part Two cycle.

- 6.3.2. Under the conditions below, it is allowed to take the uncorrected measured values C and M as the test results:

- (1) in case the manufacturer can prove that there is no relation between the energy balance and fuel consumption,
- (2) in case that ΔE_{batt} always corresponds to a battery charging
- (3) in case that ΔE_{batt} always corresponds to a battery discharging and ΔE_{batt} is within 1 % of the energy content of the consumed fuel (consumed fuel meaning the total fuel consumption over one cycle)

The change in battery energy content ΔE_{batt} can be calculated from the measured electricity balance Q as follows:

$$\Delta E_{\text{batt}} = \Delta \text{SOC}(\%) \cdot E_{\text{TEbatt}} \approx 0,0036 \cdot |\Delta \text{Ah}| \cdot V_{\text{batt}} = 0,0036 \cdot Q \cdot V_{\text{batt}} \text{ (MJ)}$$

with E_{TEbatt} [MJ] the total energy storage capacity of the battery and V_{batt} [V] the nominal battery voltage.

- 6.3.3. Fuel consumption correction coefficient (K_{fuel}) defined by the manufacturer

- 6.3.3.1. The fuel consumption correction coefficient (K_{fuel}) shall be determined from a set of n measurements performed by the manufacturer. This set should contain at least one measurement with $Q_i < 0$ and at least one with $Q_i > 0$.

If the latter condition can not be realised on the driving cycle (Part One or Part Two) used in this test, then it is up to the Technical Service to judge the statistical significance of the extrapolation necessary to determine the fuel consumption value at $\Delta E_{\text{batt}} = 0$.

- 6.3.3.2. The fuel consumption correction coefficient (K_{fuel}) is defined as:

$$K_{\text{fuel}} = (n \cdot \sum Q_i C_i - \sum Q_i \cdot \sum C_i) / (n \cdot \sum Q_i^2 - (\sum Q_i)^2) \text{ (l/100 km/Ah)}$$

where:

C_i = fuel consumption measured during i -th manufacturer's test (l/100 km)

Q_i = electricity balance measured during i -th manufacturer's test (Ah)

n = number of data

The fuel consumption correction coefficient shall be rounded to four significant figures (e.g. 0,xxxx or xx,xx). The statistical significance of the fuel consumption correction coefficient is to be judged by the Technical Service.

- 6.3.3.3. Separate fuel consumption correction coefficients shall be determined for the fuel consumption values measured over the Part One cycle and the Part Two cycle respectively.

6.3.4. *Fuel consumption at zero battery energy balance (C_0)*

6.3.4.1. The fuel consumption C_0 at $\Delta E_{\text{batt}} = 0$ is determined by the following equation:

$$C_0 = C - K_{\text{fuel}} \cdot Q \text{ (l/100 km)}$$

where:

C = fuel consumption measured during test (l/100 km)

Q = electricity balance measured during test (Ah)

6.3.4.2. Fuel consumption at zero battery energy balance shall be determined separately for the fuel consumption values measured over the Part One cycle and the Part Two cycle respectively.

6.3.5. *CO₂-emission correction coefficient (K_{CO_2}) defined by the manufacturer*

6.3.5.1. The CO₂-emission correction coefficient (K_{CO_2}) shall be determined as follows from a set of n measurements performed by the manufacturer. This set should contain at least one measurement with $Q_i < 0$ and at least one with $Q_i > 0$.

If the latter condition can not be realised on the driving cycle (Part One or Part Two) used in this test, then it is up to the Technical Service to judge the statistical significance of the extrapolation necessary to determine the CO₂-emission value at $\Delta E_{\text{batt}} = 0$.

6.3.5.2. The CO₂-emission correction coefficient (K_{CO_2}) is defined as:

$$K_{\text{CO}_2} = (n \cdot \sum Q_i M_i - \sum Q_i \cdot \sum M_i) / (n \cdot \sum Q_i^2 - (\sum Q_i)^2) \text{ (g/km/Ah)}$$

where:

M_i = CO₂-emission measured during i -th manufacturer's test (g/km)

Q_i = electricity balance during i -th manufacturer's test (Ah)

n = number of data

The CO₂-emission correction coefficient shall be rounded to four significant figures (e.g. 0,xxxx or xx,xx). The statistical significance of the CO₂-emission correction coefficient is to be judged by the Technical Service.

6.3.5.3. Separate CO₂-emission correction coefficients shall be determined for the fuel consumption values measured over the Part One cycle and the Part Two cycle respectively.

6.3.6. *CO₂-emission at zero battery energy balance (M_0)*

6.3.6.1. The CO₂-emission M_0 at $\Delta E_{\text{batt}} = 0$ is determined by the following equation:

$$M_0 = M - K_{\text{CO}_2} \cdot Q \text{ (g/km)}$$

where:

M = CO₂-emission measured during test (g/km)

Q = electricity balance measured during test (Ah)

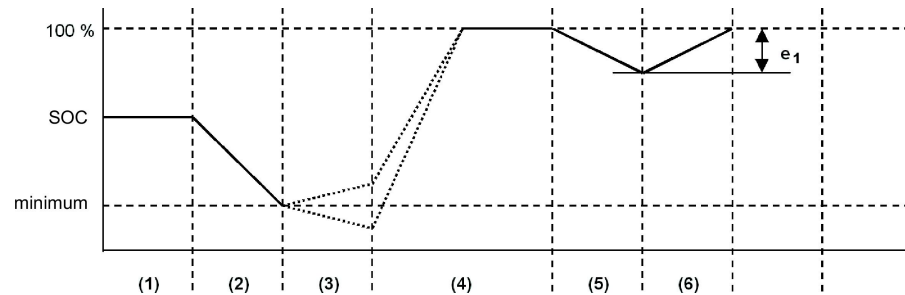
6.3.6.2. CO₂-emission at zero battery energy balance shall be determined separately for the CO₂-emission values measured over the Part One cycle and the Part Two cycle respectively.

Appendix 1 to Annex 8

Electrical energy/power storage device state of charge (SOC) profile for OVC HEVs

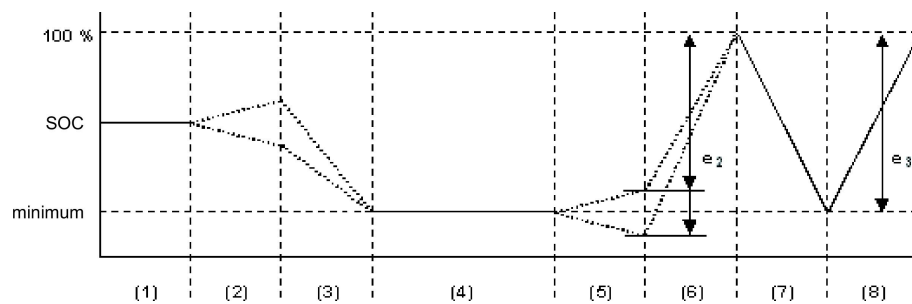
The SOC profiles for OVC-HEVs tested under conditions A and B are:

Condition A:



- (1) Initial state of charge of the electrical energy/power storage device.
- (2) Discharge according to paragraph 3.2.1 or 4.2.2 of this Annex.
- (3) Vehicle conditioning according to paragraph 3.2.2.1/3.2.2.2 or 4.2.3.1/4.2.3.2 of this Annex.
- (4) Charge during soak according to paragraph 3.2.2.3 and 3.2.2.4 or 4.2.3.3 and 4.2.3.4 of this Annex.
- (5) Test according to paragraph 3.2.3 or 4.2.4 of this Annex.
- (6) Charging according to paragraph 3.2.4 or 4.2.5 of this Annex.

Condition B:



- (1) Initial state of charge.
- (2) Vehicle conditioning according to paragraph 3.3.1.1 or 4.3.1.1 (optional) of this Annex.
- (3) Discharge according to paragraph 3.3.1.1 or 4.3.1.1 of this Annex.
- (4) Soak according to paragraph 3.3.1.2 or 4.3.1.2 of this Annex.
- (5) Test according to paragraph 3.3.2 or 4.3.2 of this Annex.
- (6) Charging according to paragraph 3.3.3 or 4.3.3 of this Annex.
- (7) Discharging according to paragraph 3.3.4 or 4.3.4 of this Annex.
- (8) Charging according to paragraph 3.3.5 or 4.3.5 of this Annex.

*Appendix 2 to Annex 8***Method for measuring the electricity balance of the battery of a NOVC HEV****1. INTRODUCTION**

- 1.1. The purpose of this appendix is to define the method and required instrumentation for measuring the electricity balance of not off vehicle charging hybrid electric vehicles (NOVC HEVs). Measurement of the electricity balance is necessary to correct the measured fuel consumption and CO₂-emissions for the change in battery energy content occurring during the test, using the method defined in paragraphs 5 and 6 of this Annex.
- 1.2. The method described in this Annex shall be used by the manufacturer for the measurements that are performed to determine the correction factors K_{fuel} and K_{CO_2} , as defined in paragraphs 5.3.3.2, 5.3.5.2, 6.3.3.2, and 6.3.5.2 of this Annex.

The Technical Service shall check whether these measurements have been performed in accordance with the procedure described in this Annex.

- 1.3. The method described in this Annex shall be used by the Technical Service for the measurement of the electricity balance Q , as defined in paragraphs 5.3.4.1, 5.3.6.1, 6.3.4.1, and 6.3.6.1 of this Annex.

2. MEASUREMENT EQUIPMENT AND INSTRUMENTATION

- 2.1. During the tests as described in paragraphs 5 and 6 of this Annex, the battery current shall be measured using a current transducer of the clamp-on type or the closed type. The current transducer (i.e. the current sensor without data acquisition equipment) shall have a minimum accuracy of 0,5 per cent of the measured value or 0,1 per cent of the maximum value of the scale.

OEM diagnostic testers are not to be used for the purpose of this test.

- 2.1.1. The current transducer shall be fitted on one of the wires directly connected to the battery. In order to easily measure battery current using external measuring equipment, manufacturers should preferably integrate appropriate, safe and accessible connection points in the vehicle. If that is not feasible, the manufacturer is obliged to support the Technical Service by providing the means to connect a current transducer to the wires connected to the battery in the above described manner.
- 2.1.2. The output of the current transducer shall be sampled with a minimum sample frequency of 5 Hz. The measured current shall be integrated over time, yielding the measured value of Q , expressed in Ampere hours (Ah).
- 2.1.3. The temperature at the location of the sensor shall be measured and sampled with the same sample frequency as the current, so that this value can be used for possible compensation of the drift of current transducers and, if applicable, the voltage transducer used to convert the output of the current transducer.
- 2.2. A list of the instrumentation (manufacturer, model No, serial No) used by the manufacturer for determining the correction factors K_{fuel} and K_{CO_2} (as defined in paragraphs 5.3.3.2, 5.3.5.2, 6.3.3.2, and 6.3.5.2 of this Annex) and the last calibration dates of the instruments (where applicable) should be provided to the Technical Service.

3. MEASUREMENT PROCEDURE

- 3.1. Measurement of the battery current shall start at the same time as the test starts and shall end immediately after the vehicle has driven the complete driving cycle.
 - 3.2. Separate values of Q shall be logged over the Part One and Part Two of the cycle.
-

ANNEX 9

METHOD OF MEASURING THE ELECTRIC RANGE OF VEHICLES POWERED BY AN ELECTRIC POWER TRAIN ONLY OR BY A HYBRID ELECTRIC POWER TRAIN

1. MEASUREMENT OF THE ELECTRIC RANGE

The test method described hereafter permits to measure the electric range, expressed in km, of vehicles powered by an electric power train only or of vehicles powered by a hybrid electric power train with off-vehicle charging (OVC-HEV as defined in paragraph 2 of Annex 8).

2. PARAMETERS, UNITS AND ACCURACY OF MEASUREMENTS

Parameters, units and accuracy of measurements shall be as follows:

Parameters, units and accuracy of measurements

Parameter	Unit	Accuracy	Resolution
Time	s	$\pm 0,1$ s	0,1 s
Distance	m	$\pm 0,1$ %	1 m
Temperature	°C	± 1 °C	1 °C
Speed	km/h	± 1 %	0,2 km/h
Mass	kg	$\pm 0,5$ %	1 kg

3. TEST CONDITIONS

3.1. **Condition of the vehicle**

3.1.1. The vehicle tyres shall be inflated to the pressure specified by the vehicle manufacturer when the tyres are at the ambient temperature.

3.1.2. The viscosity of the oils for the mechanical moving parts shall conform to the specifications of the vehicle manufacturer.

3.1.3. The lighting and light-signalling and auxiliary devices shall be off, except those required for testing and usual daytime operation of the vehicle.

3.1.4. All energy storage systems available for other than traction purposes (electric, hydraulic, pneumatic, etc.) shall be charged up to their maximum level specified by the manufacturer.

3.1.5. If the batteries are operated above the ambient temperature, the operator shall follow the procedure recommended by the vehicle manufacturer in order to keep the temperature of the battery in the normal operating range.

The manufacturer's agent shall be in a position to attest that the thermal management system of the battery is neither disabled nor reduced.

3.1.6. The vehicle must have undergone at least 300 km during the seven days before the test with those batteries that are installed in the test vehicle.

3.2. **Climatic conditions**

For testing performed outdoors, the ambient temperature shall be between 5 °C and 32 °C.

The indoors testing shall be performed at a temperature between 20 °C and 30 °C.

4. OPERATION MODES

The test method includes the following steps:

- (a) Initial charge of the battery.
- (b) Application of the cycle and measurement of the electric range.

Between the steps, if the vehicle shall move, it is pushed to the following test area (without regenerative recharging).

4.1. Initial charge of the battery

Charging the battery consists of the following procedures:

Note: 'Initial charge of the battery' applies to the first charge of the battery, at the reception of the vehicle. In case of several combined tests or measurements, carried out consecutively, the first charge carried out shall be an 'initial charge of the battery' and the following may be done in accordance with the 'normal overnight charge' procedure.

4.1.1. Discharge of the battery

4.1.1.1. For pure electric vehicles:

4.1.1.1.1. The procedure starts with the discharge of the battery of the vehicle while driving (on the test track, on a chassis dynamometer, etc.) at a steady speed of $70 \% \pm 5 \%$ from the maximum 30 minutes speed of the vehicle.

4.1.1.1.2. Stopping the discharge occurs:

- (a) when the vehicle is not able to run at 65 per cent of the maximum thirty minutes speed;
- (b) or when an indication to stop the vehicle is given to the driver by the standard on-board instrumentation;
- or
- (c) after covering the distance of 100 km.

4.1.1.2. For externally chargeable hybrid electric vehicle (OVC HEV) without an operating mode switch as defined in Annex 8:

4.1.1.2.1. The manufacturer shall provide the means for performing the measurement with the vehicle running in pure electric operating state.

4.1.1.2.2. The procedure shall start with the discharge of the electrical energy/power storage device of the vehicle while driving (on the test track, on a chassis dynamometer, etc.):

- at a steady speed of 50 km/h until the fuel consuming engine of the HEV starts up,
- or
- if a vehicle can not reach a steady speed of 50 km/h without starting up the fuel consuming engine, the speed shall be reduced until the vehicle can run at a lower steady speed where the fuel consuming engine just does not start up for a defined time/distance (to be specified between technical service and manufacturer),
- or
- with manufacturer's recommendation.

The fuel consuming engine shall be stopped within 10 seconds of it being automatically started.

4.1.1.3. For externally chargeable hybrid electric vehicle (OVC HEV) with an operating mode switch as defined in Annex 8:

4.1.1.3.1. If there is not a pure electric position, the manufacturer shall provide the means for performing the measurement with the vehicle running in pure electric operating state.

4.1.1.3.2. The procedure shall start with the discharge of the electrical energy/power storage device of the vehicle while driving with the switch in pure electric position (on the test track, on a chassis dynamometer, etc.) at a steady speed of $70 \% \pm 5 \%$ of the maximum thirty minutes speed of the vehicle.

4.1.1.3.3. Stopping the discharge occurs:

- when the vehicle is not able to run at 65 % of the maximum thirty minutes speed,
or
- when an indication to stop the vehicle is given to the driver by the standard on-board instrumentation,
or
- after covering the distance of 100 km.

4.1.1.3.4. If the vehicle is not equipped with a pure electric operating state, the electrical energy/power storage device discharge shall be achieved by driving the vehicle (on the test track, on a chassis dynamometer, etc.):

- at a steady speed of 50 km/h until the fuel consuming engine of the HEV starts up,
or
- if a vehicle can not reach a steady speed of 50 km/h without starting up the fuel consuming engine, the speed shall be reduced until the vehicle can run a lower steady speed where the fuel consuming engine just does not start up for a defined time/distance (to be specified between technical service and manufacturer),
or
- with manufacturer's recommendation.

The fuel consuming engine shall be stopped within 10 seconds of it being automatically started.

4.1.2. *Application of a normal overnight charge*

For a pure electric vehicle, the battery shall be charged according to the normal overnight charge procedure, as defined in paragraph 2.4.1.2 of Annex 7, for a period not exceeding 12 hours.

For an OVC HEV, the battery shall be charged according to the normal overnight charge procedure as described in paragraph 3.2.2.5 of Annex 8.

4.2. **Application of the cycle and measurement of the range**

4.2.1. *For pure electric vehicle:*

4.2.1.1. The test sequence as defined in paragraph 1.1 of Annex 7 is applied on a chassis dynamometer adjusted as described in appendix 1 of Annex 7, until the end of the test criteria is reached.

4.2.1.2. The end of the test criteria is reached when the vehicle is not able to meet the target curve up to 50 km/h, or when an indication from the standard on-board instrumentation is given to the driver to stop the vehicle.

Then the vehicle shall be slowed down to 5 km/h by releasing the accelerator pedal, without touching the brake pedal and then stopped by braking.

- 4.2.1.3. At a speed over 50 km/h, when the vehicle does not reach the required acceleration or speed of the test cycle, the accelerator pedal shall remain fully depressed until the reference curve has been reached again.
- 4.2.1.4. To respect human needs, up to three interruptions are permitted between test sequences, of no more than 15 minutes in total.
- 4.2.1.5. At the end, the measure D_e of the covered distance in km is the electric range of the electric vehicle. It shall be rounded to the nearest whole number
- 4.2.2. *For hybrid electric vehicle:*
- 4.2.2.1. The applicable test sequence and accompanying gear shift prescription, as defined in paragraph 1.4 of Annex 8, is applied on a chassis dynamometer adjusted as described in Appendix 2, 3, and 4 of Annex 4 of Regulation No 83, until the end of the test criteria is reached.
- 4.2.2.2. The end of the test criteria is reached when the vehicle is not able to meet the target curve up to 50 km/h, or when an indication from the standard on-board instrumentation is given to the driver to stop the vehicle or when the fuel consuming engine starts up. Then the vehicle shall be slowed down to 5 km/h by releasing the accelerator pedal, without touching the brake pedal and then stopped by braking.
- 4.2.2.3. At a speed over 50 km/h, when the vehicle does not reach the required acceleration or speed of the test cycle, the accelerator pedal shall remain fully depressed until the reference curve has been reached again.
- 4.2.2.4. To respect human needs, up to three interruptions are permitted between test sequences, of no more than 15 minutes in total.
- 4.2.2.5. At the end, the measure D_e of the covered distance in km is the electric range of the hybrid electric vehicle. It shall be rounded to the nearest whole number.
-

ANNEX 10

EMISSIONS TEST PROCEDURE FOR A VEHICLE EQUIPPED WITH A PERIODICALLY REGENERATING SYSTEM**1. INTRODUCTION**

- 1.1. This Annex defines the specific provisions regarding type-approval of a vehicle equipped with a periodically regenerating system as defined in paragraph 2.16. of this Regulation.

2. SCOPE AND EXTENSION OF THE TYPE APPROVAL**2.1. Vehicle family groups equipped with periodically regenerating system**

The procedure applies to vehicles equipped with a periodically regenerating system as defined in paragraph 2.16 of this Regulation. For the purpose of this annex vehicle family groups may be established. Accordingly, those vehicle types with regenerative systems, whose parameters described below are identical, or within the stated tolerances, shall be considered to belong to the same family with respect to measurements specific to the defined periodically regenerating systems.

2.1.1. Identical parameters are:

Engine:

- (a) number of cylinders
- (b) engine capacity ($\pm 15\%$)
- (c) number of valves
- (d) fuel system
- (e) combustion process (two stroke, four stroke, rotary).

Periodically regenerating system (i.e. catalyst, particulate trap):

- (a) construction (i.e. type of enclosure, type of precious metal, type of substrate, cell density)
- (b) type and working principle
- (c) dosage and additive system
- (d) volume ($\pm 10\%$)
- (e) location (temperature $\pm 50\text{ }^{\circ}\text{C}$ at 120 km/h or 5 % difference of maximum temperature/pressure).

2.2. Vehicle types of different reference masses

The K_i factor developed by the procedures in this Annex for type approval of a vehicle type with a periodically regenerating system as defined in paragraph 2.16 of this Regulation, may be extended to other vehicles in the family group with a reference mass within the next two higher equivalent inertia classes or any lower equivalent inertia.

- 2.3. Instead of carrying out the test procedures defined in the following section, a fixed K_i value of 1,05 may be used, if the technical service sees no reason that this value could be exceeded.

3. TEST PROCEDURE

The vehicle may be equipped with a switch capable of preventing or permitting the regeneration process provided that this operation has no effect on original engine calibration. This switch shall be permitted only for the purpose of preventing regeneration during loading of the regeneration system and during the pre-conditioning cycles. However, it shall not be used during the measurement of emissions during the regeneration phase; rather the emission test shall be carried out with the unchanged Original Equipment Manufacturer's (OEM) control unit.

3.1. Measurement of carbon dioxide emission and fuel consumption between two cycles where regenerative phases occur

- 3.1.1. Average of carbon dioxide emission and fuel consumption between regeneration phases and during loading of the regenerative device shall be determined from the arithmetic mean of several approximately equidistant (if more than two) Type I operating cycles or equivalent engine test bench cycles. As an alternative, the manufacturer may provide data to show that the carbon dioxide emission and fuel consumption remain constant $\pm 4\%$ between regeneration phases. In this case, the carbon dioxide emission and fuel consumption measured during the regular Type I test may be used. In any other case emissions measurement for at least two Type I operating cycles or equivalent engine test bench cycles must be completed: one immediately after regeneration (before new loading) and one as close as possible prior to a regeneration phase. All emissions measurements and calculations shall be carried out according to Annex 6.
- 3.1.2. The loading process and K_i determination shall be made during the Type I operating cycle, on a chassis dynamometer or on an engine test bench using an equivalent test cycle. These cycles may be run continuously (i.e. without the need to switch the engine off between cycles). After any number of completed cycles, the vehicle may be removed from the chassis dynamometer, and the test continued at a later time.
- 3.1.3. The number of cycles (D) between two cycles where regeneration phases occur, the number of cycles over which emissions measurements are made (n), and each emissions measurement (M'_{sij}) shall be reported in Annex 1, items 4.1.11.2.1.10.1 to 4.1.11.2.1.10.4 or 4.1.11.2.5.4.1 to 4.1.11.2.5.4.4 as applicable.

3.2. Measurement of carbon dioxide emission and fuel consumption during regeneration

- 3.2.1. Preparation of the vehicle, if required, for the emissions test during a regeneration phase, may be completed using the preparation cycles in paragraph 5.3 of Annex 4 to Regulation No 83 or equivalent engine test bench cycles, depending on the loading procedure chosen in paragraph 3.1.2 above.
- 3.2.2. The test and vehicle conditions for the test described in Annex 6 apply before the first valid emission test is carried out.
- 3.2.3. Regeneration must not occur during the preparation of the vehicle. This may be ensured by one of the following methods:
- 3.2.3.1. A 'dummy' regenerating system or partial system may be fitted for the pre-conditioning cycles.
- 3.2.3.2. Any other method agreed between the manufacturer and the type approval authority.
- 3.2.4. A cold-start exhaust emission test including a regeneration process shall be performed according to the Type I operating cycle, or equivalent engine test bench cycle. If the emissions tests between two cycles where regeneration phases occur are carried out on an engine test bench, the emissions test including a regeneration phase shall also be carried out on an engine test bench.
- 3.2.5. If the regeneration process requires more than one operating cycle, subsequent test cycle(s) shall be driven immediately, without switching the engine off, until complete regeneration has been achieved (each cycle shall be completed). The time necessary to set up a new test should be as short as possible (e.g. particular matter filter change). The engine must be switched off during this period.
- 3.2.6. The carbon dioxide emission and fuel consumption values during regeneration (M_{ri}) shall be calculated according to Annex 6. The number of operating cycles (d) measured for complete regeneration shall be recorded.

3.3. Calculation of the combined carbon dioxide emission and fuel consumption

$$M_{si} = \frac{\sum_{j=1}^n M'_{sij}}{n} \quad n \geq 2; \quad M_{ri} = \frac{\sum_{j=1}^d M'_{rij}}{d}$$

$$M_{pi} = \left\{ \frac{M_{si} \cdot D + M_{ri} \cdot d}{D + d} \right\}$$

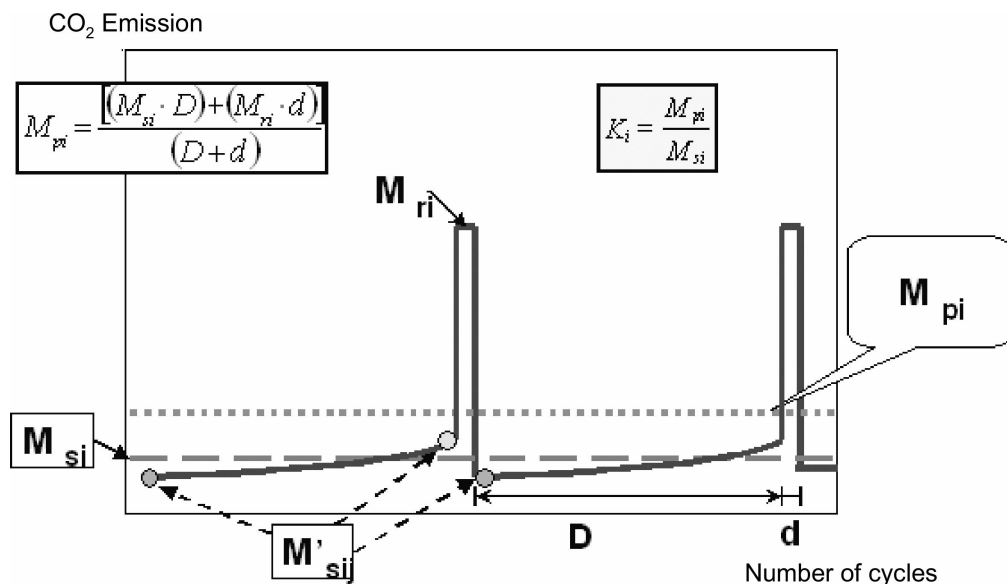
where for each carbon dioxide emission and fuel consumption considered:

- M'_{sij} = mass emissions of CO₂ in g/km and fuel consumption in l/100 km over one part (i) of the operating cycle (or equivalent engine test bench cycle) without regeneration
- M'_{rij} = mass emissions of CO₂ in g/km and fuel consumption in l/100 km over one part (i) of the operating cycle (or equivalent engine test bench cycle) during regeneration. (when $n > 1$, the first Type I test is run cold, and subsequent cycles are hot)
- M_{si} = mean mass emissions of CO₂ in g/km and fuel consumption in l/100 km over one part (i) of the operating cycle without regeneration
- M_{ri} = mean mass emissions of CO₂ in g/km and fuel consumption in l/100 km over one part (i) of the operating cycle during regeneration
- M_{pi} = mean mass emission of CO₂ in g/km and fuel consumption in l/100 km
- N = number of test points at which emissions measurements (Type I operating cycles or equivalent engine test bench cycles) are made between two cycles where regenerative phases occur, ≥ 2
- d = number of operating cycles required for regeneration
- D = number of operating cycles between two cycles where regenerative phases occur

For exemplary illustration of measurement parameters see Figure 10/1.

Figure 10/1

Parameters measured during carbon dioxide emission and fuel consumption test during and between cycles where regeneration occurs (schematic example, the emissions during 'D' may increase or decrease)



3.4. **Calculation of the regeneration factor K for each carbon dioxide emission and fuel consumption (i) considered**

$$K_i = M_{pi} / M_{si}$$

M_{si} , M_{pi} and K_i results shall be recorded in the test report delivered by the Technical Service.

K_i may be determined following the completion of a single sequence.

Only the original UN/ECE texts have legal effect under international public law. The status and date of entry into force of this Regulation should be checked in the latest version of the UN/ECE status document TRANS/WP.29/343/, available at:
<http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29fdocsts.html>.

**Regulation No 103 of the Economic Commission for Europe of the United Nations (UN/ECE) —
Uniform provisions concerning the approval of replacement catalytic converters for power-driven
vehicles**

Addendum 102: Regulation No 103

Incorporating all valid text up to:

Amendment 1 — Date of entry into force: 6 July 2000

Amendment 2 — Date of entry into force: 4 April 2005

1. SCOPE

This Regulation applies to the type-approval, as separate technical units, of catalytic converters to be fitted in one or more types of motor vehicles of categories M₁ and N₁ as replacement parts.

2. DEFINITIONS

For the purpose of this Regulation:

- 2.1. 'Original equipment catalytic converter' means a catalytic converter or an assembly of catalytic converters covered by the type approval delivered for the vehicle and whose types are indicated in the documents related to Annex 2 to Regulation No 83.
- 2.2. 'Replacement catalytic converter' means a catalytic converter or an assembly of catalytic converters for which approval can be obtained according to this Regulation, other than those defined in paragraph 2.1 above.
- 2.3. 'Original replacement catalytic converter' means a catalytic converter or an assembly of catalytic converters whose types are indicated in the documents related to Annex 2 to Regulation No 83, but are offered in the market as separate technical units by the holder of the vehicle type-approval.
- 2.4. 'Type of catalytic converter' means catalytic converters which do not differ in such essential aspects as:
 - (i) number of coated substrates, structure and material
 - (ii) type of catalytic activity (oxidising, three-way, ...)
 - (iii) volume, ratio of frontal area and substrate length
 - (iv) catalyst material content
 - (v) catalyst material ratio
 - (vi) cell density
 - (vii) dimensions and shape
 - (viii) thermal protection
- 2.5. 'Vehicle type'

See paragraph 2.3 of Regulation No 83.

- 2.6. 'Approval of a replacement catalytic converter' means the approval of a converter intended to be fitted as a replacement part on one or more specific types of vehicles with regard to the limitation of pollutant emissions, noise level and effect on vehicle performance and, where applicable, on the on-board diagnostic (OBD).
- 2.7. 'Deteriorated replacement catalytic converter' means a converter that has been aged or artificially deteriorated to such an extent that it fulfils the requirements laid out in paragraph 1 of Appendix 1 to Annex 11 to Regulation No 83.

3. APPLICATION FOR APPROVAL

- 3.1. The application for approval of a type of replacement catalytic converter shall be submitted by its manufacturer or by his authorised representative.
- 3.2. For each type of replacement catalytic converter for which type approval is requested, the application for approval shall be accompanied by the following documents in triplicate.
- 3.2.1. Drawings of the replacement catalytic converter identifying in particular all the characteristics referred to in paragraph 2.4 of this Regulation.
- 3.2.2. Description of the vehicle type or types for which the replacement catalytic converter is intended. The number and/or symbols characterizing the engine and vehicle type(s) shall be indicated.
- 3.2.3. Description and drawings showing the position of the replacement converter relative to the engine exhaust manifold(s).
- 3.2.4. Drawings indicating the intended location of the approval mark.
- 3.2.5. Indication if the replacement catalytic converter is intended to be compatible with OBD requirements.
- 3.2.6. A model for the information document is given in Appendix 1.
- 3.3. The applicant for approval shall provide the technical service responsible for approval tests with:
- 3.3.1. Vehicle(s) of a type approved in accordance with Regulation No 83 equipped with a new original catalytic converter. This (these) vehicle(s) shall be selected by the applicant with the agreement of the technical service. It (they) shall comply with the requirements of paragraph 3 of Annex 4 to Regulation No 83.
- The test vehicle(s) shall have no emission control system defects; any excessively worn out or malfunctioning emission related original part shall be repaired or replaced. The test vehicle(s) shall be tuned properly and set to the manufacturer's specification prior to emission testing.
- 3.3.2. One sample of the type of the replacement catalytic converter. This sample shall be clearly and indelibly marked with the applicant's trade name or mark and its commercial designation.
- 3.3.3. An additional sample of the type of the replacement catalytic converter, in the case of a replacement catalytic converter intended to be fitted to a vehicle equipped with an OBD system. This sample shall be clearly and indelibly marked with the applicant's trade name or mark and its commercial designation. It must have been deteriorated as defined in paragraph 2.7 above.

4. APPROVAL

4.1. If the replacement catalytic converter submitted for approval pursuant to this Regulation meets the requirements of paragraph 5 below, approval of that type of replacement catalytic converter shall be granted.

4.2. Original replacement catalytic converters, which are of a type covered by paragraph 18. of Annex 2 to Regulation No 83 and are intended for fitment to a vehicle to which the relevant type-approval document refers, do not need to be approved according to this Regulation provided they fulfil the requirements of paragraphs 4.2.1 and 4.2.2.

4.2.1. Marking

Original replacement catalytic converters shall bear at least the following identifications:

4.2.1.1. The vehicle manufacturer's name or trademark.

4.2.1.2. The make and identifying part number of the original replacement catalytic converter as recorded in the information mentioned in paragraph 4.2.3.

4.2.2. Documentation

Original replacement catalytic converters shall be accompanied by the following information:

4.2.2.1. The vehicle manufacturer's name or trade mark.

4.2.2.2. Make and identifying part number of the original replacement catalytic converter as recorded in the information mentioned in paragraph 4.2.3.

4.2.2.3. The vehicles for which the original replacement catalytic converter is of a type covered by item 18 of Annex 2 of Regulation No 83, including, where applicable, a marking to identify if the original replacement catalytic converter is suitable for fitting to a vehicle that is equipped with an on-board diagnostic (OBD) system.

4.2.2.4. Installation instructions, where necessary.

4.2.2.5. This information shall be provided either:

- as a leaflet accompanying the original replacement catalytic converter,
- or
- on the packaging in which the original replacement catalytic converter is sold,
- or
- by any other applicable means.

In any case, the information must be available in the product catalogue distributed to points of sale by the vehicle manufacturer.

4.2.3. The vehicle manufacturer shall provide to the technical service and/or approval authority the necessary information in electronic format which makes the link between the relevant part numbers and the type approval documentation.

This information shall contain:

- (i) make(s) and type(s) of vehicle.
- (ii) make(s) and type(s) of original replacement catalytic converter.
- (iii) part number(s) of original replacement catalytic converter.
- (iv) type-approval number of the relevant vehicle type(s).

- 4.3. An approval number shall be assigned to each replacement catalytic converter type approved. Its first two digits (00 for the Regulation in its present form) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party may not assign the same number to another type of replacement catalytic converter. The same approval number may cover the use of that replacement catalytic converter type on a number of different vehicle types.
- 4.4. When the applicant for type-approval can demonstrate to the type-approval authority or technical service that the replacement catalytic convert is of a type indicated in item 18 of Annex 2 to the 05 series of amendments to Regulation No 83, the granting of a type approval certificate shall not be dependent on the requirements specified in paragraph 5 having to be verified.
- 4.5. Notice of approval or of extension or of refusal of approval of a type of replacement catalytic converter pursuant to this Regulation shall be communicated to the Contracting Parties to the Agreement applying this Regulation by means of a form conforming to the model in Annex 1 to this Regulation.
- 4.6. There shall be affixed, conspicuously and in a place specified on the approval form, to the replacement catalytic converter conforming to a type of replacement catalytic converter approved under this Regulation, an international approval mark consisting of:
- 4.6.1. A circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval ⁽¹⁾;
- 4.6.2. The number of this Regulation, followed by the letter 'R', a dash and the approval number in the vicinity of the circle prescribed in paragraph 4.6.1.
- 4.7. If the replacement catalytic converter conforms to a catalytic converter type approved under one or more other Regulations annexed to the Agreement in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.6.1 need not be repeated; in such a case, the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.6.1.
- 4.8. The approval mark shall be indelible and clearly legible when the replacement catalytic converter is mounted under the vehicle.
- 4.9. Annex 2 to this Regulation gives examples of arrangements of approval marks.
5. REQUIREMENTS
- 5.1. **General requirements**
- 5.1.1. The replacement catalytic converter shall be designed, constructed and capable of being mounted so as to enable the vehicle to comply with the provisions of those Regulations which it was originally in compliance with and that pollutant emissions are effectively limited throughout the normal life of the vehicle under normal conditions of use.

⁽¹⁾ 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, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 (vacant), 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland, 21 for Portugal, 22 for the Russian Federation, 23 for Greece, 24 for Ireland, 25 for Croatia, 26 for Slovenia, 27 for Slovakia, 28 for Belarus, 29 for Estonia, 30 (vacant), 31 for Bosnia and Herzegovina, 32 for Latvia, 33 (vacant), 34 for Bulgaria, 35-36 (vacant), 37 for Turkey, 38-39 (vacant), 40 for The Former Yugoslav Republic of Macedonia, 41 (vacant), 42 for the European Community (Approvals are granted by its Member States using their respective ECE symbol, 43 for Japan, 44 (vacant), 45 for Australia and 46 for Ukraine. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the basis of these prescriptions, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

- 5.1.2. The installation of the replacement catalytic converter shall be at the exact position of the original equipment catalytic converter, and the position on the exhaust line of the oxygen probe(s) and other sensors, if applicable, shall not be modified.
- 5.1.3. If the original equipment catalytic converter includes thermal protections, the replacement catalytic converter shall include equivalent protections.
- 5.1.4. The replacement catalytic converter shall be durable, that is designed, constructed and capable of being mounted so that reasonable resistance to the corrosion and oxidation phenomena to which it is exposed is obtained, having regard to the conditions of use of the vehicle.

5.2. **Requirements regarding emissions**

The vehicle(s) indicated in paragraph 3.3.1 of this Regulation, equipped with a replacement converter of the type for which approval is requested, shall be subjected to a type I test under the conditions described in the corresponding annexes to Regulation No 83 in order to compare its performance with the original catalytic converter according to the procedure described below.

5.2.1. *Determination of the basis for comparison*

The vehicle(s) shall be fitted with a new original catalytic converter (see paragraph 3.3.1) which shall be run in with 12 extra urban cycles (test type I part 2).

After this preconditioning, the vehicle(s) shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within ± 2 K of the temperature of the room. Subsequently three exhaust gas tests type I shall be made.

5.2.2. *Exhaust gas test with replacement catalytic converter*

The original catalytic converter of the test vehicle(s) shall be replaced by the replacement catalytic converter (see paragraph 3.3.2.) which shall be run in with 12 extra urban cycles (test type I part 2). After this preconditioning, the vehicle(s) shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within ± 2 K of the temperature of the room. Subsequently three exhaust gas tests type I shall be made.

5.2.3. *Evaluation of the emission of pollutants of vehicles equipped with replacement catalytic converters*

The test vehicle(s) with the original catalytic converter shall comply with the limit values according to the type approval of the vehicle(s) including — if applicable — the deterioration factors applied during the type approval of the vehicle(s).

The requirements regarding emissions of the vehicle(s) equipped with the replacement catalytic converter shall be deemed to be fulfilled if the results meet for each regulated pollutant (CO, HC, NO_x and particulates) the following conditions:

(1) $M \leq 0,85S + 0,4G$

(2) $M \leq G$

where:

- M: mean value of the emissions of one pollutant (CO, HC, NO_x and particulates) or the sum of two pollutants (HC + NO_x) obtained from the three type I tests with the replacement catalytic converter.
- S: mean value of the emissions of one pollutant (CO, HC, NO_x and particulates) or the sum of two pollutants (HC + NO_x) obtained from the three type I tests with the original catalytic converter.
- G: limit value of the emissions of one pollutant (CO, HC, NO_x and particulates) or the sum of two pollutants (HC + NO_x) according to the type approval of the vehicle(s) divided by — if applicable — the deterioration factors determined in accordance with paragraph 5.4. below.

Where approval is applied for different types of vehicles from the same car manufacturer, and provided that these different types of vehicles are fitted with the same type of original equipment catalytic converter, the type I testing may be limited to at least two vehicles selected after agreement with the technical service responsible for approval.

5.3. Requirements regarding noise and vehicle performance

The replacement catalytic converter shall satisfy the technical requirements of Regulation No 59. As an alternative to the measurement of back-pressure as specified in Regulation No 59, the verification of the vehicle performance can be performed by measuring on a chassis dynamometer the maximum absorbed power at a speed corresponding to the engine maximum power. The value determined under reference atmospheric conditions as specified in Regulation No 85 with the replacement catalytic converter shall not be lower by more than 5 % than that determined with the original equipment catalytic converter.

5.4. Requirements regarding durability

The replacement catalytic converter shall comply with the requirements of paragraph 5.3.5. of Regulation No 83, i.e. type V test or deterioration factors from the following table for the results of the type I tests.

Engine category	Deterioration factors				
	CO	HC ⁽¹⁾	NO _x ⁽¹⁾	HC + NO _x	Particulates
Positive-ignition	1,2	1,2	1,2	1,2 ⁽²⁾	—
Compression ignition	1,1	—	1,0	1,0	1,2

⁽¹⁾ Applicable only to vehicles approved according to the 05 series of amendments to Regulation No 83.

⁽²⁾ Applicable only to positive-ignition engines approved according to earlier than 05 series of amendments to Regulation No 83.

- 5.5. Requirements regarding OBD compatibility (applicable only to replacement catalytic converters intended to be fitted to vehicles equipped with an OBD system).

OBD compatibility demonstration is required only when the original catalyst was monitored in the original configuration.

- 5.5.1. The compatibility of the replacement catalytic converter with the OBD system shall be demonstrated by using the procedures described in the 05 series of amendments to Regulation No 83, Annex 11, Appendix 1.
- 5.5.2. The provisions in the 05 series of amendments to Regulation No 83, Annex 11, Appendix 1 applicable to components other than the catalytic converter shall not be applied.

- 5.5.3. The aftermarket manufacturer may use the same preconditioning and test procedure as used during the original type approval. In this case, the administrative departments shall provide, on request and on a non-discriminatory basis, Appendix 1 to the type approval communication which contains the number and type of preconditioning cycles and the type of test cycle used by the original equipment manufacturer for OBD testing of the catalytic converter.
- 5.5.4. In order to verify the correct installation and functioning of all other components monitored by the OBD system, the OBD system shall indicate no malfunction and have no stored fault codes prior to the installation of any of the replacement catalytic converters. An evaluation of the status of the OBD system at the end of the tests described in paragraph 5.2.1 may be used for this purpose.
- 5.5.5. The malfunction indicator (MI: see reference paragraph 2.5 of Annex 11 to the 05 series of amendments to Regulation No 83) must not activate during vehicle operation required by paragraph 5.2.2.

6. MODIFICATION OF THE REPLACEMENT CATALYTIC CONVERTER TYPE AND EXTENSION OF APPROVAL

Every modification of the replacement catalytic converter type shall be notified to the administrative department which approved this type of replacement catalytic converter.

The department may then either:

- (i) consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the replacement catalytic converter still complies with the requirements,
- or
- (ii) require a further test report for some or all the tests described in paragraph 5 of this Regulation from the technical service responsible for conducting the tests.

Confirmation or refusal of approval, specifying the alteration, shall be communicated by the procedure specified in paragraph 4.5 above to the Parties to the Agreement applying this Regulation.

The competent authority issuing the extension of approval shall assign a serial number to each communication form drawn up for such an extension.

7. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, Appendix 2 (E/ECE/324-E/ECE/TRANS/505/Rev.2), with the following requirements.

- 7.1. The replacement catalytic converters approved under this Regulation shall be so manufactured as to conform to the type approved in the characteristics as defined under paragraph 2.4 of this Regulation. They shall meet the requirements set forth in paragraph 5 and, where applicable, fulfil the requirements of the tests specified in this Regulation.
- 7.2. The approval authority may carry out any check or test prescribed in this Regulation. In particular, the tests described in paragraph 5.2 of this Regulation (requirements regarding emissions) may be carried out. In this case, the holder of the approval may ask, as an alternative, to use as a basis for comparison not the original equipment converter, but the replacement catalytic converter which was used during the type approval tests (or another sample that has been proven to conform to the approved type). Emissions' values measured with the sample under verification shall then on average not exceed by more than 15 % the mean values measured with the sample used for reference.

8. PENALTIES FOR NONCONFORMITY OF PRODUCTION

- 8.1. The approval granted in respect of a type of replacement catalytic converter pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 7 above are not complied with.
- 8.2. If a Party to the Agreement which applies this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a form conforming to the model in Annex 1 to this Regulation.

9. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of replacement catalytic converter approved in accordance with this Regulation, he shall so inform the authority which granted the approval.

Upon receiving the relevant communication, that authority shall inform thereof the other Parties to the Agreement applying this Regulation by means of a form conforming to the model in annex 1 to this Regulation.

10. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF ADMINISTRATIVE DEPARTMENTS

The Contracting Parties to the Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests and of the administrative departments which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval issued in other countries are to be sent.

11. DOCUMENTATION

11.1. Each new replacement catalytic converter shall be accompanied by the following information:

- 11.1.1. The catalyst manufacturer's name or trade mark.
- 11.1.2. The vehicles (including year of manufacture) for which the replacement catalytic converter is approved, including, where applicable, a marking to identify if the replacement catalytic converter is suitable for fitting to a vehicle that is equipped with an on-board diagnostic (OBD) system.
- 11.1.3. Installation instructions, where necessary.
- 11.2. This information shall be provided either:

- (i) as a leaflet accompanying the replacement catalytic converter;
- or
- (ii) on the packaging in which the replacement catalytic converter is sold;
- or
- (iii) by any other applicable means.

In any case, the information must be available in the product catalogue distributed to points of sale by the manufacturer of replacement catalytic converters.

*Appendix*INFORMATION DOCUMENT No... RELATING TO THE TYPE APPROVAL OF REPLACEMENT
CATALYTIC CONVERTERS

Any drawings must be supplied in appropriate scale and sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, must show sufficient detail.

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

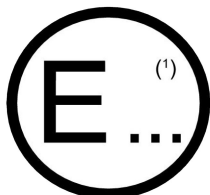
1. GENERAL
 - 1.1. Make (trade name of manufacturer):
 - 1.2. Type:
 - 1.5. Name and address of manufacturer:
 - 1.7. In the case of components and separate technical units, location and method of affixing of the ECE approval mark:
 - 1.8. Address(es) of assembly plant(s):

 2. DESCRIPTION OF THE DEVICE
 - 2.1. Make and type of the replacement catalytic converter:
 - 2.2. Drawings of the replacement catalytic converter, identifying in particular all the characteristics referred to in items 2.3 to 2.3.2 of this appendix:
 - 2.3. Description of the vehicle type or types for which the replacement catalytic converter is intended:
 - 2.3.1. Number(s) and/or symbol(s) characterising the engine and vehicle type(s):
 - 2.3.2. Is the replacement catalytic converter intended to be compatible with OBD requirements: Yes/No (Strike out what does not apply).
 - 2.4. Description and drawings showing the position of the replacement catalytic converter relative to the engine exhaust manifold(s):
-

ANNEX 1

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration:

.....

.....

.....

concerning ⁽²⁾:

APPROVAL GRANTED

APPROVAL EXTENDED

APPROVAL REFUSED

APPROVAL WITHDRAWN

PRODUCTION DEFINITELY DISCONTINUED

of a replacement catalytic converter pursuant to Regulation No 103.

Approval No: Extension No:

Reason for extension:

1. Applicant's name and address:
2. Manufacturer's name and address:
3. Manufacturer's trade name or mark:
4. Type and commercial designation of the replacement catalytic converter:
5. Means of identification of type, if marked:
 - 5.1. Location of that marking:
6. Vehicles type(s) for which the catalytic converter type qualifies as replacement catalytic converter:
7. Type(s) of vehicle(s) on which the replacement catalytic converter has been tested:
 - 7.1. Has the replacement catalytic converter demonstrated compatibility with OBD requirements: Yes/No ⁽²⁾
8. Location and method of affixing of the approval mark:
9. Submitted for approval on:
10. Technical service responsible for approval tests:
 - 10.1. Date of test report:
 - 10.2. Number of test report:

11. Approval granted/extended/refused/withdrawn ^(?)
12. Place:
13. Date:
14. Signature:
15. Annexed to this communication is a list of documents in the approval file deposited at the administrative services having delivered the approval and which can be obtained upon request.

⁽¹⁾ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in this Regulation).

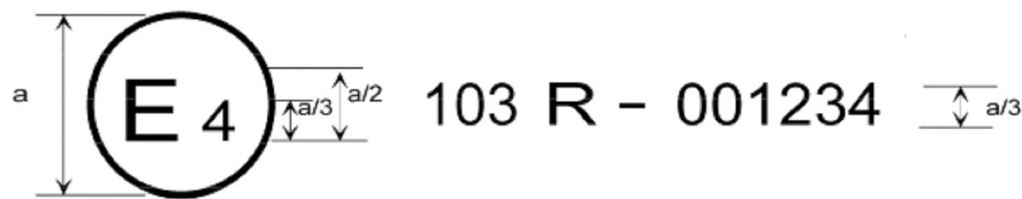
⁽²⁾ Strike out what does not apply.

ANNEX 2

EXAMPLES OF ARRANGEMENTS OF APPROVAL MARKS

MODEL A

(See paragraph 4.4. of this Regulation)

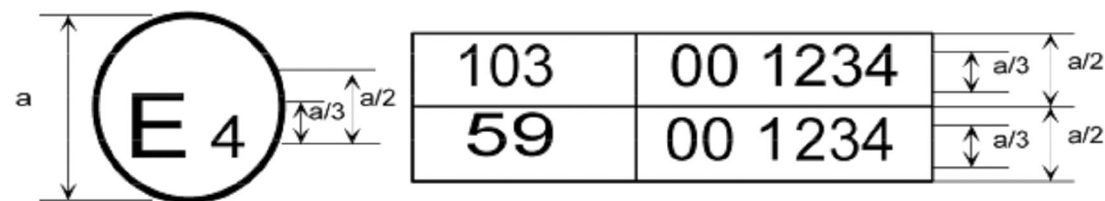


a = 8 mm min

The above approval mark affixed to a component of a replacement catalytic converter shows that the type concerned has been approved in the Netherlands (E 4), pursuant to Regulation No 103 under approval No 001234. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No 103 in its original form.

MODEL B

(See paragraph 4.5 of this Regulation)



a = 8 mm min

The above approval mark affixed to a component of replacement catalytic converter shows that the type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos 103 and 59 ⁽¹⁾.

The first two digits of the approval numbers indicate that, on the date on which these approvals were granted, Regulations Nos 103 and 59 were in their original form.

⁽¹⁾ The second number is given merely as an example.