

ACTS ADOPTED BY BODIES CREATED BY INTERNATIONAL AGREEMENTS

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Regulation No 85 of the Economic Commission for Europe of the United Nations (UN/ECE) — Uniform provisions concerning the approval of internal combustion engines or electric drive trains intended for the propulsion of motor vehicles of categories M and N with regard to the measurement of net power and the maximum 30 minutes power of electric drive trains

Incorporating all valid text up to:

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1. SCOPE

1.1. This Regulation applies to the representation of the curve as a function of engine or motor speed of the power at full load indicated by the manufacturer for internal combustion engines or electric drive trains and the maximum 30 minutes power of electric drive trains intended for the propulsion of motor vehicles of categories M and N ⁽¹⁾.

1.2. The internal combustion engines belong to one of the following categories:

Reciprocating piston engines (positive-ignition or compression-ignition), but excluding free piston engines;

Rotary piston engines (positive-ignition or compression ignition);

Naturally aspirated or supercharged engines.

1.3. The electric drive trains are composed of controllers and motors and are used for propulsion of vehicles as the sole mode of propulsion.

2. DEFINITIONS

2.1. 'Approval of a drive train' means the approval of a drive train type with regard to its net power measured in accordance with the procedure specified in Annexes 5 or 6 to this Regulation;

2.2. 'Drive train type' means a category of an internal combustion engine or an electric drive train for installation in a motor vehicle which does not differ in such essential characteristics as those defined in Annexes 1 or 2 to this Regulation;

2.3. 'Net power' means the power obtained on a test bench at the end of the crankshaft or its equivalent at the corresponding engine or motor speed with the auxiliaries listed in Table 1 of Annex 5 or in Annex 6 to this Regulation, and determined under reference atmospheric condition;

2.4. 'Maximum net power' means the maximum value of the net power measured at full engine load;

⁽¹⁾ As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.2, paragraph 2 — www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

- 2.5. 'Maximum 30 minutes power' means the maximum net power of an electric drive train at DC voltage as defined in paragraph 5.3.1 of this Regulation, which a drive train can deliver over a period of 30 minutes as an average;
- 2.6. 'Hybrid vehicles (HV)':
- 2.6.1. 'Hybrid vehicle (HV)' means a vehicle with at least two different energy converters and two different energy storage systems (on vehicle) for the purpose of vehicle propulsion;
- 2.6.2. 'Hybrid electric vehicle (HEV)' means a vehicle 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, etc.);
- 2.6.3. For a hybrid electric vehicle the 'power train' comprises a combination of two different drive train types:
- An internal combustion engine; and
 - One (or several) electric drive train(s);
- 2.7. 'Standard-production equipment' means equipment provided by the manufacturer for a particular application;
- 2.8. 'Dual-fuel engine' means an engine system type approved according to Regulation No 49 or mounted on a vehicle type approved with regards to its emissions according to Regulation No 49 and that is designed to simultaneously operate with diesel fuel and a gaseous fuel, both fuels being metered separately, where the consumed amount of one of the fuels relative to the other one may vary depending on the operation;
- 2.9. 'Dual-fuel vehicle' means a vehicle that is powered by a dual-fuel engine and that supplies the fuels used by the engine from separate on-board storage systems;
- 2.10. 'Dual-fuel mode' means the normal operating mode of a dual-fuel engine during which the engine simultaneously uses diesel fuel and a gaseous fuel at some engine operating conditions;
- 2.11. 'Diesel mode' means the normal operating mode of a dual-fuel engine during which the engine does not use any gaseous fuel for any engine operating condition.
3. APPLICATION FOR APPROVAL
- 3.1. The application for approval of a drive train type with regard to the measurement of the net power and the maximum 30 minutes power of electric drive trains shall be submitted by the drive train manufacturer, the vehicle manufacturer, or by his duly accredited representative.

- 3.2. It shall be accompanied by the description, in triplicate, of the drive train comprising all the relevant particulars referred to:
- In Annex 1 for vehicles powered by an internal combustion engine only, or
 - In Annex 2 for pure electric vehicles, or
 - In Annexes 1 and 2 for hybrid electric vehicles.
- 3.3. For hybrid electric vehicles (HEV), the tests shall be carried out separately on the internal combustion engine (according to Annex 5) and on the electric drive train(s) (according to Annex 6).
- 3.4. A drive train (or set of drive trains), representative of the (set of) drive train type(s) to be approved, shall, with the equipment prescribed in Annexes 5 and 6 to this Regulation, be submitted to the technical service conducting the approval tests.
4. APPROVAL
- 4.1. If the power of the drive train submitted for approval pursuant to this Regulation has been measured according to the specifications of paragraph 5 below, approval of the drive train type shall be granted.
- 4.2. An approval number shall be assigned to each drive train type approved. Its first two digits [(at present 00 for the Regulation in its original 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 shall not assign the same number to another drive train type.
- 4.3. Notice of approval or of extension or of refusal of approval of a drive train type pursuant to this Regulation shall be communicated to the Parties to the 1958 Agreement applying this Regulation by means of a form conforming to the model in Annex 3a to this Regulation.
- 4.4. Notice of approval or of extension or of refusal of approval of vehicle type with regard to the drive train 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 3b to this Regulation.
- 4.5. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every drive train conforming to a drive train type approved under this Regulation an international approval mark consisting of:
- 4.5.1. A circle surrounding the letter 'E' followed by the distinguishing number of the country which has granted approval⁽¹⁾;
 - 4.5.2. 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 4.5.1.

⁽¹⁾ The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.2/Amend.3 — www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

- 4.5.3. Alternatively, instead of affixing these approval marks and symbols to the drive train, the manufacturer may decide that each drive train type approved under this Regulation shall be accompanied by a document giving this information so that the approval marks and symbol can be attached to the vehicle.
- 4.6. If the drive train conforms to a 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 4.5.1 above need not be repeated; in such a case, the Regulation and approval numbers 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 4.5.1.
- 4.7. The approval mark shall be clearly legible and be indelible.
- 4.8. The approval mark shall be placed close to the drive train identification figures provided by the manufacturer.
- 4.9. Annex 4 to this Regulation gives examples of the arrangements of the approval mark.

5. SPECIFICATIONS AND TESTS

5.1. General

The components liable to affect the power of the drive train shall be so designed, constructed and assembled as to enable the drive train in normal use, despite the vibration to which it may be subjected, to comply with the provisions of this Regulation.

5.2. Description of tests for internal combustion engines

5.2.1. The net power test shall consist of a run at full throttle for positive ignition engines and at full-load for compression ignition engines and dual-fuel engines, the engine being equipped as specified in Table 1 of Annex 5 to this Regulation.

5.2.1.1. In case of a dual-fuel engine that has a diesel mode, the test shall consist of a run on the dual-fuel mode and of a run on the diesel mode of that same engine.

5.2.2. Measurements shall be taken at a sufficient number of engine speeds to define correctly the power curve between the lowest and the highest engine speeds recommended by the manufacturer. This range of speeds shall include the speeds of revolution at which the engine produces its maximum power and its maximum torque. For each speed, the average of at least two stabilized measurements is to be determined.

5.2.3. The fuel used shall be the following:

5.2.3.1. For positive ignition engines fuelled with petrol:

The fuel used shall be the one available on the market. In any case of dispute, the fuel shall be one of the reference fuels defined by CEC ⁽¹⁾ for petrol fuelled engines, in CEC documents RF-01-A-84 and RF-01-A-85.

5.2.3.2. For positive ignition engines and dual-fuel engines fuelled with LPG:

⁽¹⁾ European Coordinating Council.

5.2.3.2.1. In the case of an engine with self-adaptive fuelling:

The fuel used shall be the one available on the market. In any case of dispute the fuel shall be one of the reference fuels specified in Annex 8;

5.2.3.2.2. In the case of an engine without self-adaptive fuelling:

The fuel used shall be the reference fuel specified in Annex 8 with the lowest C3-content, or

5.2.3.2.3. In the case of an engine labelled for one specific fuel composition:

The fuel used shall be the fuel for which the engine is labelled.

5.2.3.2.4. The fuel used shall be specified in the test report.

5.2.3.3. For positive ignition engines and dual-fuel engines fuelled with natural gas:

5.2.3.3.1. In the case of an engine with self-adaptive fuelling:

The fuel used shall be the one available on the market. In any case of dispute the fuel shall be one of the reference fuels specified in Annex 8;

5.2.3.3.2. In the case of an engine without self-adaptive fuelling:

The fuel used shall be the one available on the market with a Wobbe index at least $52,6 \text{ MJm}^{-3}$ (4 °C, 101,3 kPa). In case of dispute the fuel used shall be the reference fuel G20 specified in Annex 8, i.e. the fuel with the highest Wobbe Index, or

5.2.3.3.3. In the case of an engine labelled for a specific range of fuels:

The fuel used shall be the one available on the market with a Wobbe index at least $52,6 \text{ MJm}^{-3}$ (4 °C, 101,3 kPa) if the engine is labelled for the H-range of gases, or at least $47,2 \text{ MJm}^{-3}$ (4 °C, 101,3 kPa) if the engine is labelled for the L-range of gases. In case of dispute the fuel used shall be the reference fuel G20 specified in Annex 8 if the engine is labelled for the H-range of gases, or the reference fuel G23 if the engine is labelled for the L-range of gases, i.e. the fuel with the highest Wobbe Index for the relevant range, or

5.2.3.3.4. In the case of an engine labelled for one specific LNG fuel composition:

The fuel used shall be the fuel for which the engine is labelled or the reference fuel G20 specified in Annex 8 if the engine is labelled LNG20.

5.2.3.3.5. In the case of an engine labelled for one specific fuel composition:

The fuel used shall be the fuel for which the engine is labelled.

5.2.3.3.6. The fuel used shall be specified in the test report.

5.2.3.4. For compression ignition engines and dual-fuel engines:

The fuel used shall be the one available on the market. In any case of dispute, the fuel shall be the reference fuel defined by CEC for compression ignition engines, in CEC document RF-03-A-84.

5.2.3.5. Positive ignition engines of vehicles that can run either on petrol or on a gaseous fuel, are to be tested with both fuels, in accordance with the provisions in paragraphs 5.2.3.1 to 5.2.3.3. The vehicles that can be fuelled with both petrol and a gaseous fuel, but where the petrol system is fitted for emergency purposes or starting only and of which the petrol tank cannot contain more than 15 litres of petrol will be regarded for the test as vehicles that can only run a gaseous fuel.

5.2.3.6. Dual-fuel engines or vehicles that have a diesel mode are to be tested with the fuels appropriate to each mode, in accordance with the provisions set in paragraphs 5.2.3.1 to 5.2.3.5.

5.2.4. Measurements shall be carried out according to the provisions of Annex 5 to this Regulation.

5.2.5. The test report shall contain the results and all the calculations required to find the net power, as listed in the appendix to Annex 5 to this Regulation together with the characteristics of the engine listed in Annex 1 to this Regulation. In order to draw up this document, the competent authority may use the report prepared by an approved or recognized laboratory pursuant to the provisions of this Regulation.

5.3. Description of tests for measuring the net power and the maximum 30 minutes power of electric drive trains

The electric drive train shall be equipped as specified in Annex 6 to this Regulation. The electric drive train shall be supplied from a DC voltage source with a maximum voltage drop of 5 per cent depending on time and current (periods of less than 10 seconds excluded). The supply voltage of the test shall be given by the vehicle manufacturer.

Note: If the battery limits the maximum 30 minutes power, the maximum 30 minutes power of an electric vehicle can be less than the maximum 30 minutes power of the drive train of the vehicle according to this test.

5.3.1. Determination of the net power

5.3.1.1. The motor and its entire equipment assembly must be conditioned at a temperature of $25\text{ °C} \pm 5\text{ °C}$ for a minimum of two hours.

5.3.1.2. The net power test shall consist of a run at full setting of the power controller.

5.3.1.3. Just before beginning the test, the motor shall be run on the bench for three minutes delivering a power equal to 80 per cent of the maximum power at the speed recommended by the manufacturer.

5.3.1.4. Measurements shall be taken at a sufficient number of motor speeds to define correctly the power curve between zero and the highest motor speed recommended by the manufacturer. The whole test shall be completed within 5 minutes.

5.3.2. Determination of the maximum 30 minutes power

- 5.3.2.1. The motor and its entire equipment assembly must be conditioned at a temperature of $25\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for a minimum of four hours.
- 5.3.2.2. The electric drive train shall run at the bench at a power which is the best estimate of the manufacturer for the maximum 30 minutes power. The speed must be in a speed range, which the net power is greater than 90 per cent of the maximum power as measured in paragraph 5.3.1. This speed shall be recommended by the manufacturer.
- 5.3.2.3. Speed and power shall be recorded. The power must be in a range of ± 5 per cent of the power value at the start of the test. The maximum 30 minutes power is the average of the power within the 30 minutes period.

5.4. Interpretation of results

The net power and the maximum 30 minutes power for electric drive trains indicated by the manufacturer for the type of drive train shall be accepted if it does not differ by more than ± 2 per cent for maximum power and more than ± 4 per cent at the other measurement points on the curve with a tolerance of ± 2 per cent for engine or motor speed, or within the engine or motor speed range ($X1\text{ min}^{-1} + 2$ per cent) to ($X2\text{ min}^{-1} - 2$ per cent) ($X1 < X2$) from the values measured by the technical service on the drive train submitted for testing.

In case of a dual-fuel engine, the net power indicated by the manufacturer shall be the one measured on the dual-fuel mode of that engine.

6. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, Appendix 2 (E/CE/324 — E/CE/TRANS/505/Rev.2), with the following requirements:

- 6.1. Engines approved under this Regulation shall be so manufactured as to conform to the type approved.
- 6.2. The minimum requirements for conformity of production control procedures set forth in Annex 7 to this Regulation shall be complied with.

7. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

- 7.1. The approval granted in respect of a drive train type pursuant to this Regulation may be withdrawn if the requirements set forth above are not met or if a drive train bearing the approval mark does not conform to the type approved.
- 7.2. 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 3a or Annex 3b to this Regulation.

8. MODIFICATION AND EXTENSION OF APPROVAL OF DRIVE TRAIN TYPE

- 8.1. Every modification of a drive train within a drive train type with regard to the characteristics in Annex 1 or 2, shall be notified to the Type Approval Authority which approved the drive train type. The Type Approval Authority may then either:
 - 8.1.1. Consider that the modifications made are unlikely to have any appreciable adverse effect and that in any case the vehicle still complies with the requirements; or

- 8.1.2. Require a further test report from the Technical Service responsible for conducting the tests.
- 8.2. Confirmation or refusal of approval, specifying the alterations shall be communicated by the procedure specified in paragraph 4.3 above to the Parties to the Agreement applying this Regulation.
- 8.3. The Type Approval Authority issuing the extension of 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 3 a or Annex 3b to this Regulation.
9. PRODUCTION DEFINITELY DISCONTINUED
- If the holder of an approval completely ceases to manufacture a drive train approved in accordance with this Regulation, he shall so inform the Type Approval 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 3a or Annex 3b to this Regulation.
10. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF TYPE APPROVAL AUTHORITIES
- The Parties to the 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/or the Type Approval Authorities which grant approval, and to which forms certifying approval or extension or refusal of approval, issued in other countries, are to be sent.
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ANNEX 1

ESSENTIAL CHARACTERISTICS OF THE INTERNAL COMBUSTION ENGINE AND INFORMATION CONCERNING THE CONDUCT OF TESTS

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

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

0. General identification of the vehicle:
- 0.1. Make (trade name of manufacturer):
- 0.2. Type and general commercial description(s):
- 0.3. Means of identification of type, if marked on the vehicle:
- 0.3.1. Location of that marking:
- 0.4. Category of vehicle:
- 0.5. Name and address of manufacturer:
- 0.6. Address(es) of assembly plant(s):
1. General construction characteristics of the vehicle
- 1.1. Photographs and/or drawings of a representative vehicle:
- 1.2. Hand of drive: left/right ⁽¹⁾:
- 1.3. Dual-fuel vehicle: Yes/No ⁽¹⁾
- 1.3.1. Dual-fuel engine having a diesel mode: Yes/No ⁽¹⁾
- 2.0. Power plant
- 2.1. Manufacturer:
- 2.2. Manufacturer's engine code (as marked on the engine, or other means of identification):
- 2.3. Working principle: positive ignition/compression ignition, four stroke/two stroke ⁽¹⁾
- 2.4. Number and arrangement of cylinders:
- 2.5. Bore: mm
- 2.6. Stroke: mm
- 2.7. Firing order:
- 2.8. Engine capacity: cm³
- 2.9. Volumetric compression ratio:
- 2.10. Drawings of combustion chamber, piston crown and, in the case of positive ignition engines, piston rings: ...

- 2.11. Maximum net power: kW at min^{-1} (manufacturer's declared value)
- 2.12. Maximum permitted engine speed as prescribed by the manufacturer: min^{-1}
- 2.13. Maximum net torque ⁽¹⁾: Nm at min^{-1} (manufacturer's declared value)
- 3.0. Fuel: diesel oil/petrol/LPG/CNG/LNG ⁽¹⁾
- 3.0.1. When applicable, the additional character(s) in the approval marking required by Regulation No 49, the purpose of which is to distinguish the type of engine for which the approval has been granted (e.g. Hlt).
- 3.1. RON, leaded:
- 3.2. RON, unleaded:
- 3.3. Fuel feed
- 3.3.1. By carburettor(s): Yes/No ⁽¹⁾
- 3.3.1.1. Make(s):
- 3.3.1.2. Type(s):
- 3.3.1.3. Number fitted:
- 3.3.1.4. Adjustments
- 3.3.1.4.1. Jets:
- 3.3.1.4.2. Venturis:
- 3.3.1.4.3. Float-chamber level:
- 3.3.1.4.4. Mass of float:
- 3.3.1.4.5. Float needle:
- Or the curve of fuel delivery plotted against the air flow and settings required to keep to the curve
- 3.3.1.5. Cold start system: manual/automatic ⁽¹⁾
- 3.3.1.5.1. Operating principle(s):
- 3.3.1.5.2. Operating limits/settings ⁽¹⁾:
- 3.3.2. By fuel injection (compression ignition only): Yes/No ⁽¹⁾
- 3.3.2.1. System description:
- 3.3.2.2. Working principle: direct injection/pre-chamber/swirl chamber ⁽¹⁾
- 3.3.2.3. Injection pump
- 3.3.2.3.1. Make(s):
- 3.3.2.3.2. Type(s):

- 3.3.2.3.3. Maximum fuel delivery ⁽¹⁾: mm³/stroke or cycle at a pump speed of: min⁻¹ or, alternatively, a characteristic diagram:
- 3.3.2.3.4. Injection timing:
- 3.3.2.3.5. Injection advance curve:
- 3.3.2.3.6. Calibration procedure: test bench/engine ⁽¹⁾
- 3.3.2.4. Governor
- 3.3.2.4.1. Type:
- 3.3.2.4.2. Make:
- 3.3.2.4.3. Cut-off point
- 3.3.2.4.3.1. Cut-off point under load: min⁻¹
- 3.3.2.4.3.2. Cut-off point without load: min⁻¹
- 3.3.2.4.4. Maximum speed without load: min⁻¹
- 3.3.2.4.5. Idle speed:
- 3.3.2.5. Injection piping
- 3.3.2.5.1. Length: mm
- 3.3.2.5.2. Internal diameter: mm
- 3.3.2.6. Injector(s)
- 3.3.2.6.1. Make(s):
- 3.3.2.6.2. Type(s):
- 3.3.2.6.3. Opening pressure: kPa or characteristic diagram:
- 3.3.2.7. Cold start system
- 3.3.2.7.1. Make(s):
- 3.3.2.7.2. Type(s):
- 3.3.2.7.3. Description:
- 3.3.2.8. Electronic control unit
- 3.3.2.8.1. Make(s):
- 3.3.2.8.2. Description of the system:
- 3.3.3. By fuel injection (positive ignition only): Yes/No ⁽¹⁾
- 3.3.3.1. Working principle: intake manifold (single-/multi-point ⁽¹⁾) direct injection/other (specify) ⁽¹⁾:
- 3.3.3.2. Make(s):
- 3.3.3.3. Type(s):
- 3.3.3.4. System description
- 3.3.3.4.1. Type or number of the control unit:

- 3.3.3.4.2. Type of fuel regulator:
- 3.3.3.4.3. Type of air-flow sensor:
- 3.3.3.4.4. Type of fuel distributor:
- 3.3.3.4.5. Type of pressure regulator:
- 3.3.3.4.6. Type of throttle housing:
- In the case of systems other than continuous injection give equivalent details.
- 3.3.3.5. Injectors: opening pressure: kPa or characteristic diagram:
- 3.3.3.6. Injection timing:
- 3.3.3.7. Cold start system
- 3.3.3.7.1. Operating principle(s):
- 3.3.3.7.2. Operating limits/settings ⁽¹⁾:
- 3.4. Gas and dual-fuel engines
- 3.4.1. Self-adaptive fuelling: Yes/No ⁽¹⁾
- 3.4.2. In case of an engine without self-adaptive fuelling: specific gas composition/range of gases for which the engine is calibrated.
- 4.0. Feed pump
- 4.1. Pressure: kPa or characteristic diagram:
- 5.0. Electrical system
- 5.1. Rated voltage: V, positive/negative ground ⁽¹⁾
- 5.2. Generator
- 5.2.1. Type:
- 5.2.2. Nominal output: VA
- 6.0. Ignition
- 6.1. Make(s):
- 6.2. Type(s):
- 6.3. Working principle:
- 6.4. Ignition advance curve:
- 6.5. Static ignition timing: degrees before TDC
- 6.6. Contact-point gap: mm
- 6.7. Dwell-angle: degrees

- 7.0. Cooling system (liquid/air) ⁽¹⁾
- 7.1. Nominal setting of the engine temperature control mechanism:
- 7.2. Liquid
- 7.2.1. Nature of liquid:
- 7.2.2. Circulating pump(s): Yes/No ⁽¹⁾
- 7.2.3. Characteristics:
- 7.2.3.1. Make(s):
- 7.2.3.2. Type(s):
- 7.2.4. Drive ratio(s):
- 7.2.5. Description of the fan and its drive mechanism:
- 7.3. Air
- 7.3.1. Blower: Yes/No ⁽¹⁾
- 7.3.2. Characteristics:, or
- 7.3.2.1. Make(s):
- 7.3.2.2. Type(s):
- 7.3.3. Drive ratio(s):
- 8.0. Intake system
- 8.1. Pressure charger: Yes/No ⁽¹⁾
- 8.1.1. Make(s):
- 8.1.2. Type(s):
- 8.1.3. Description of the system (e.g. maximum charge pressure:
kPa, wastegate if applicable):
- 8.2. Intercooler: Yes/No ⁽¹⁾
- 8.3. Description and drawings of inlet pipes and their accessories (plenum chamber, heating device, additional air intakes, etc.):
- 8.3.1. Intake manifold description (include drawings and/or photos):
- 8.3.2. Air filter, drawings:, or
- 8.3.2.1. Make(s):
- 8.3.2.2. Type(s):

- 8.3.3. Intake silencer, drawings:, or
- 8.3.3.1. Make(s):
- 8.3.3.2. Type(s):
- 9.0. Exhaust system
- 9.1. Description and/or drawing of the exhaust manifold:
- 9.2. Description and/or drawing of the exhaust system:
- 9.3. Maximum allowable exhaust back pressure at rated engine speed and at 100 per cent load: kPa
- 10.0. Minimum cross-sectional areas of inlet and outlet ports:
- 11.0. Valve timing or equivalent data
- 11.1. Maximum lift of valves, angles of opening and closing, or timing details of alternative distribution systems, in relation to dead-centres:
- 11.2. Reference and/or setting ranges ⁽¹⁾:
- 12.0. Measures taken against air pollution
- 12.1. Additional anti-pollution devices (if any, and if not covered by another heading)
- 12.2. Catalytic converter: Yes/No ⁽¹⁾
- 12.2.1. Number of catalytic converters and elements:
- 12.2.2. Dimensions, shape and volume of the catalytic converter(s):
- 12.3. Oxygen sensor: Yes/No ⁽¹⁾
- 12.4. Air injection: Yes/No ⁽¹⁾
- 12.5. Exhaust gas recirculation: Yes/No ⁽¹⁾
- 12.6. Particulate trap: Yes/No ⁽¹⁾
- 12.6.1. Dimensions, shape and capacity of the particulate trap:
- 12.7. Other systems (description and operation):
- 13.0. LPG fuelling system: Yes/No ⁽¹⁾
- 13.1. Approval number according Regulation No 67:
- 13.2. Electronic engine management control unit for LPG fuelling:
- 13.2.1. Make(s):
- 13.2.2. Type(s):
- 13.2.3. Emission-related adjustment possibilities:

- 13.3. Further documentation:
- 13.3.1. Description of the safeguarding of the catalyst at switch-over from petrol to LPG or back:
- 13.3.2. System lay-out (electrical connections, vacuum connections compensation hoses, etc.):
- 13.3.3. Drawing of the symbol:
- 14.0. NG fuelling system: Yes/No ⁽¹⁾
- 14.1. Approval number according to Regulation No 110:
- 14.2. Electronic engine management control unit for NG fuelling:
- 14.2.1. Make(s):
- 14.2.2. Type(s):
- 14.2.3. Emission-related adjustment possibilities:
- 14.3. Further documentations:
- 14.3.1. Description of the safeguarding of the catalyst at switch-over from petrol to NG or back:
- 14.3.2. System lay-out (electrical connections, vacuum connections compensation hoses, etc.):
- 14.3.3. Drawing of the symbol:
- 15.0. Temperatures permitted by the manufacturer
- 15.1. Cooling system
- 15.1.1. Liquid cooling
- Maximum temperature at outlet: °C
- 15.1.2. Air cooling
- 15.1.2.1. Reference point:
- 15.1.2.2. Maximum temperature at reference point: °C
- 15.2. Maximum outlet temperature of the inlet intercooler: °C
- 15.3. Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold: °C
- 15.4. Fuel temperature
- Minimum: °C
- Maximum: °C
- 15.5. Lubricant temperature
- Minimum: °C
- Maximum: °C

- 16.0. Lubrication system
- 16.1. Description of the system
 - 16.1.1. Position of the lubricant reservoir:
 - 16.1.2. Feed system (by pump/injection into intake/mixing with fuel, etc.) ⁽¹⁾:
- 16.2. Lubricating pump
 - 16.2.1. Make(s):
 - 16.2.2. Type(s):
- 16.3. Mixture with fuel
 - 16.3.1. Percentage:
- 16.4. Oil cooler: Yes/No ⁽¹⁾
 - 16.4.1. Drawing(s):, or
 - 16.4.1.1. Make(s):
 - 16.4.1.2. Type(s):
- Other auxiliary equipment driven by the engine (as per item 2.3.2 of Annex 5) (list and brief description if necessary):
- 17.0. Additional information on test conditions (for positive ignition and dual-fuel engines only)
- 17.1. Spark plugs
 - 17.1.1. Make:
 - 17.1.2. Type:
 - 17.1.3. Spark-gap setting:
- 17.2. Ignition coil
 - 17.2.1. Make:
 - 17.2.2. Type:
- 17.3. Ignition condenser
 - 17.3.1. Make:
 - 17.3.2. Type:
- 17.4. Radio interference suppression equipment
 - 17.4.1. Make:
 - 17.4.2. Type:
- 17.5. Gas fuel used for the test: Reference fuel ⁽²⁾/other ⁽¹⁾
 - 17.5.1. If the gas fuel used for the test is a reference fuel, label of that gas:
 - 17.5.2. If the gas fuel used for the test is not a reference fuel, composition of that gas:
(Date, file)

⁽¹⁾ Delete where not applicable.

⁽²⁾ As specified in Annex 8 of this Regulation.

ANNEX 2

ESSENTIAL CHARACTERISTICS OF THE ELECTRIC DRIVE TRAIN AND INFORMATION CONCERNING THE CONDUCT OF TESTS

1. General

- 1.1. Make:
- 1.2. Type:
- 1.3. Drive ⁽¹⁾: Monomotor/multimotors/(number)
- 1.4. Transmission arrangement: parallel/transaxial/others, to precise:
- 1.5. Test voltage: V
- 1.6. Basic motor rotation: min⁻¹
- 1.7. Motor crankshaft maximum speed: min⁻¹
(or by default): reducer/gearbox outlet shaft ⁽²⁾ min⁻¹
- 1.8. Maximum power speed ⁽³⁾ (specified by the manufacturer): min⁻¹
- 1.9. Maximum power (specified by the manufacturer): kW
- 1.10. Maximum 30 minutes power (specified by the manufacturer): kW
- 1.11. Flexible range (where $P \geq 90$ per cent of max. power):
Speed at beginning of the range: min⁻¹
Speed at the end of the range: min⁻¹

2. Motor

2.1. Working principle

- 2.1.1. Direct current (DC)/alternative current (AC) ⁽¹⁾ number of phases:
- 2.1.2. Excitation/separate/series/compound ⁽¹⁾
- 2.1.3. Synchron/asynchron ⁽¹⁾
- 2.1.4. Rotor coiled/with permanent magnets/with housing ⁽¹⁾
- 2.1.5. Number of poles of the motor:

2.2. Inertia mass:

3. Power controller

- 3.1. Make:
- 3.2. Type:
- 3.3. Control principle: vectorial/open loop/closed/other, to be specified:
- 3.4. Maximum effective current supplied to the motor ⁽³⁾: A
during seconds
- 3.5. Voltage range use: V to V

4. Cooling system:
 - Motor liquid/air ⁽¹⁾
 - Controller liquid/air ⁽¹⁾
- 4.1. Liquid-cooling equipment characteristics
 - 4.1.1. Nature of the liquid circulating pumps: Yes/No ⁽¹⁾
 - 4.1.2. Characteristics or make(s) and type(s) of the pump:
 - 4.1.3. Thermostat: setting:
 - 4.1.4. Radiator: drawing(s) or make(s) and type(s):
 - 4.1.5. Relief valve: pressure setting:
 - 4.1.6. Fan: characteristics or make(s) and type(s):
 - 4.1.7. Fan duct:
- 4.2. Air-cooling equipment characteristics
 - 4.2.1. Blower: characteristics or make(s) and type(s):
 - 4.2.2. Standard air ducting:
 - 4.2.3. Temperature regulating system: Yes/No ⁽¹⁾
 - 4.2.4. Brief description:
 - 4.2.5. Air filter make(s) type(s)
- 4.3. Temperatures admitted by the manufacturer
 - 4.3.1. Motor outlet: (max.) °C
 - 4.3.2. Controller inlet: (max) °C
 - 4.3.3. At motor reference point(s): (max.) °C
 - 4.3.4. At controller reference point(s): (max.) °C
5. Insulating category:
6. International protection (IP)-code:
7. Lubrication system principle ⁽¹⁾
 - Bearings: friction/ball
 - Lubricant: grease/oil
 - Seal: Yes/No
 - Circulation: with/without

⁽¹⁾ Strike out what does not apply.

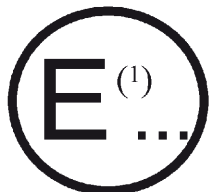
⁽²⁾ Gear engaged.

⁽³⁾ Specify tolerances.

ANNEX 3A

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration

.....

.....

.....

Concerning ⁽²⁾: Approval granted,
 Approval extended,
 Approval refused,
 Approval withdrawn,
 Production definitively discontinued

of a drive train pursuant to Regulation No 85.

Approval No Extension No

1. Trade name or mark of drive train or set of drive trains:
2. Internal combustion engine:
 - 2.1. Make:
 - 2.2. Type:
 - 2.3. Manufacturer's name and address:
3. Electric drive train(s):
 - 3.1. Make:
 - 3.2. Type:
 - 3.3. Manufacturer's name and address:
4. Drive train or set of drive trains submitted for approval on:
5. Technical Service responsible for conducting approval tests:
6. Date of report issued by that Service:
7. Number of report issued by that Service:
8. Location of the approval mark:
9. Reason(s) for extension of approval (if applicable):
10. Internal combustion engine
 - 10.1. Declared figures
 - 10.1.1. Maximum net power: kW, at min⁻¹

- 10.1.2. Maximum net torque: Nm, at min⁻¹
- 10.2. Essential characteristics of the engine type:
Operating principle: four stroke/two stroke ⁽²⁾
Number and layout of cylinders:
Cylinder capacity: cm³
Fuel feed: carburettor/indirect injection/direct injection ⁽²⁾
Pressure-charger device: Yes/No ⁽²⁾
Exhaust gas cleaning device: Yes/No ⁽²⁾
Dual-fuel engine: Yes with a diesel mode/Yes without a diesel mode/No ⁽²⁾
- 10.3. Engine fuel requirements: leaded petrol/unleaded petrol/diesel fuel/CNG/LNG/LPG ⁽²⁾:
11. Electric drive train(s):
- 11.1. Declared figures
- 11.1.1. Maximum net power: kW, at min⁻¹
- 11.1.2. Maximum net torque: Nm, at min⁻¹
- 11.1.3. Maximum net torque at zero speed: Nm
- 11.1.4. Maximum 30 minutes power: kW
- 11.2. Essential characteristics of the electric drive train
- 11.2.1. Test DC voltage: V
- 11.2.2. Working principle:
- 11.2.3. Cooling system:
Motor: liquid/air ⁽²⁾
Variator: liquid/air ⁽²⁾
12. Approval granted/extended/refused/withdrawn ⁽²⁾
13. Place:
14. Date:
15. Signature:
16. The documents filed with the request for approval or extension may be obtained on request.
-

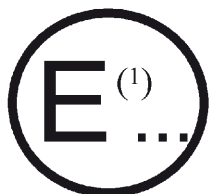
⁽¹⁾ Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).

⁽²⁾ Strike out what does not apply.

ANNEX 3B

COMMUNICATION

(maximum format: A4 (210 × 297 mm))



issued by: Name of administration

.....

.....

.....

Concerning ⁽²⁾: Approval granted,
 Approval extended,
 Approval refused,
 Approval withdrawn,
 Production definitively discontinued,

of a vehicle type with regard to the drive train pursuant to Regulation No 85.

Approval No Extension No

1. Vehicle make and type:
2. Manufacturer's name and address:
3. If applicable, name and address of manufacturer's representatives:
4. Trade name or mark of drive train or set of drive trains:
5. Internal combustion engine:
 - 5.1. Make:
 - 5.2. Type:
 - 5.3. Manufacturer's name and address:
6. Electric drive train(s):
 - 6.1. Make:
 - 6.2. Type:
 - 6.3. Manufacturer's name and address:
7. Drive train or set of drive trains submitted for approval on:
8. Technical Service responsible for conducting approval tests:
9. Date of report issued by that Service:
10. Number of report issued by that Service:
11. Location of the approval mark:
12. Reason(s) for extension of approval (if applicable):
13. Internal combustion engine
 - 13.1. Declared figures

- 13.1.1. Maximum net power: kW, at min⁻¹
- 13.1.2. Maximum net torque: Nm, at min⁻¹
- 13.2. Essential characteristics of the engine type:
- Operating principle: four stroke/two stroke ⁽²⁾
- Number and layout of cylinders:
- Cylinder capacity: cm³
- Fuel feed: carburettor/indirect injection/direct injection ⁽²⁾
- Pressure-charger device: Yes/No ⁽²⁾
- Exhaust gas cleaning device: Yes/No ⁽²⁾
- Dual-fuel engine: Yes with a diesel mode/Yes without a diesel mode/No ⁽²⁾
- 13.3. Engine fuel requirements: leaded petrol/unleaded petrol/diesel fuel/CNG/LNG/LPG ⁽²⁾:
14. Electric drive train(s):
- 15.1. Declared figures
- 15.1.1. Maximum net power: kW, at min⁻¹
- 15.1.2. Maximum net torque: Nm, at min⁻¹
- 15.1.3. Maximum net torque at zero speed: Nm
- 15.1.4. Maximum 30 minutes power: kW
- 15.2. Essential characteristics of the electric drive train
- 15.2.1. Test DC voltage: V
- 15.2.2. Working principle:
- 15.2.3. Cooling system:
- Motor: liquid/air ⁽²⁾
- Variator: liquid/air ⁽²⁾
16. Approval granted/extended/refused/withdrawn ⁽²⁾
17. Place:
18. Date:
19. Signature:
20. The documents filed with the request for approval or extension may be obtained on request.

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

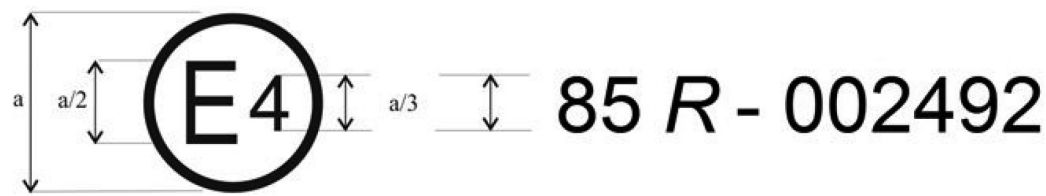
⁽²⁾ Strike out what does not apply.

ANNEX 4

ARRANGEMENTS OF APPROVAL MARKS

Model A

(see paragraph 4.4 of this Regulation)

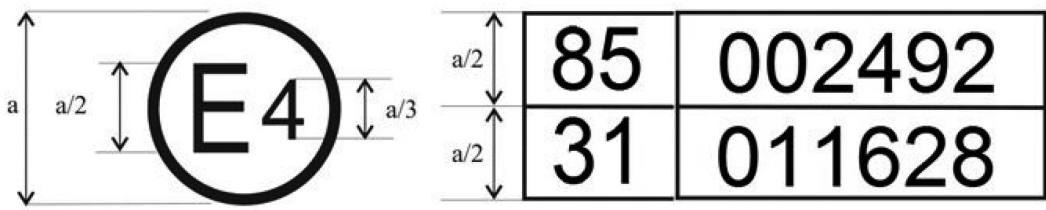


a = 8 mm min.

The above approval mark affixed to a drive train shows that the drive train type concerned has been approved in the Netherlands (E 4) with regard to the measurement of the net power, pursuant to Regulation No 85 and under the approval number 002492. The approval number indicates that the approval was granted in accordance with the requirements of Regulation No 85 in its original form.

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 (E 4) pursuant to Regulations Nos 85 and 31 ⁽¹⁾. The first two digits of the approval numbers indicate that, at the dates when the respective approvals were granted, Regulation No 85 had not been modified, and Regulation No 31 already included the 01 series of amendments.

⁽¹⁾ The second number is given merely as an example.

ANNEX 5

METHOD FOR MEASURING INTERNAL COMBUSTION ENGINE NET POWER

1. THESE PROVISIONS APPLY TO THE METHOD FOR REPRESENTING THE POWER CURVE AT FULL LOAD OF AN INTERNAL COMBUSTION ENGINE AS A FUNCTION OF ENGINE SPEED
2. TEST CONDITIONS
 - 2.1. The engine shall have been run-in according to the manufacturer's recommendations.
 - 2.2. If the power measurement can be carried out only on an engine with the gear-box mounted, the efficiency of the gear-box shall be taken into account.
 - 2.3. Auxiliaries
 - 2.3.1. Auxiliaries to be fitted
During the test, the auxiliaries necessary for the engine operation in the intended application (as listed in Table 1) shall be installed on the test bench as far as possible in the same position as in the intended application.
 - 2.3.2. Auxiliaries to be removed
Certain vehicle accessories necessary only for operation of the vehicle and which may be mounted on the engine shall be removed for the test. The following non-exhaustive list is given as a sample:

Air compressor for brakes power steering compressor suspension compressor

Air-conditioning system

Where accessories cannot be removed, the power they absorb in the unloaded condition may be determined and added to the measured engine power.

Table 1

Auxiliaries to be fitted for the test to determine net power of engine

('Standard production equipment' means equipment provided by the manufacturer for a particular application)

No	Auxiliaries	Fitted for net power test
1	Intake system Intake manifold Crankcase emission control system Air filter Intake silencer Speed limiting device	Yes, standard production equipment Yes, standard production equipment ^(1a)
2	Induction heating device of intake manifold	Yes, standard production equipment. If possible, to be set in the most favourable position.
3	Exhaust system Exhaust purifier Exhaust manifold Supercharging device Connecting pipes ^(1b) Silencer ^(1b) Tail pipe ^(1b) Exhaust brake ⁽²⁾	Yes, standard production equipment
4	Fuel supply pump ⁽³⁾	Yes, standard production equipment

No	Auxiliaries	Fitted for net power test
5	Carburettor Electronic control system, air flow meter, etc. (if fitted) Pressure reducer Evaporator Mixer	Yes, standard production equipment Equipment for gas engines
6	Fuel injection equipment (petrol and diesel) Prefilter Filter Pump High pressure pipe Injector Air intake valve ⁽⁴⁾ , if fitted Electronic control system, air flow meter, etc., if fitted Governor/control system. Automatic full-load stop for the control rack depending on atmospheric conditions	Yes, standard production equipment
7	Liquid cooling equipment Engine bonnet Bonnet air outlet Radiator Fan ⁽⁵⁾ ⁽⁶⁾ Fan cowl Water pump Thermostat ⁽⁷⁾	No Yes ⁽⁵⁾ , standard production equipment
8	Air cooling Cowl Blower ⁽⁵⁾ ⁽⁶⁾ Temperature regulating device	Yes, standard production equipment Yes, standard production equipment
9	Electrical equipment	Yes ⁽⁸⁾ , standard production equipment
10	Supercharging equipment (if fitted) Compressor driven either directly by the engine, and/or by the exhaust gases Charge air cooler ⁽⁹⁾ Coolant pump or fan (engine driven) Coolant flow control devices (if fitted)	Yes, standard production equipment
11	Auxiliary test bench fan	Yes, if necessary
12	Anti-pollution devices ⁽¹⁰⁾	Yes, standard production equipment

^(1a) The complete intake system shall be fitted as provided for the intended application:

Where there is a risk of an appreciable effect on the engine power;

In the case of two-stroke and positive-ignition engines;

When the manufacturer requests that this should be done.

In other cases, an equivalent system may be used and a check should be made to ascertain that the intake pressure does not differ by more than 100 Pa from the limit specified by the manufacturer for a clean air filter.

^(1b) The complete exhaust system shall be fitted as provided for the intended application:

Where there is a risk of an appreciable effect on the engine power;

In the case of two-stroke and positive-ignition engines;

When the manufacturer requests that this should be done.

In other cases, an equivalent system may be installed provided the pressure measured at the exit of the engine exhaust system does not differ by more than 1000 Pa from that specified by the manufacturer.

The exit from the engine exhaust system is defined as a point 150 mm downstream from the termination of the part of the exhaust system mounted on the engine.

- (²) If an exhaust brake is incorporated in the engine, the throttle valve must be fixed in a fully open position.
- (³) The fuel feed pressure may be adjusted, if necessary, to reproduce the pressures existing in the particular engine application (particularly when a 'fuel return' system is used).
- (⁴) The air intake valve is the control valve for the pneumatic governor of the injection pump. The governor of the fuel injection equipment may contain other devices which may affect the amount of injected fuel.
- (⁵) The radiator, the fan, the fan cowl, the water pump and the thermostat shall be located on the test bench in the same relative positions as on the vehicle. The cooling liquid circulation shall be operated by the engine water pump only. Cooling of the liquid may be produced either by the engine radiator or by an external circuit, provided that the pressure loss of this circuit and the pressure at the pump inlet remain substantially the same as those of the engine cooling system. The radiator shutter, if incorporated, shall be in the open position.
- Where the fan, radiator and cowl system cannot conveniently be fitted to the engine, the power absorbed by the fan when separately mounted in its correct position in relation to the radiator and cowl (if used), must be determined at the speeds corresponding to the engine speeds used for measurement of the engine power either by calculation from standard characteristics or by practical tests. This power, corrected to the standard atmospheric conditions (293,2 K (20 °C) and 101,3 kPa), should be deducted from the corrected power.
- (⁶) Where a disconnectable or progressive fan or blower is incorporated, the test shall be made with the disconnectable fan (or blower) disconnected or with the progressive fan or blower running at maximum slip.
- (⁷) The thermostat may be fixed in the fully open position.
- (⁸) Minimum power of the generator: the power of the generator shall be limited to that necessary for the operation of accessories which are indispensable for the operation of the engine. If the connection of a battery is necessary, a fully charged battery in good order must be used.
- (⁹) Charge air cooled engines shall be tested with charge air cooling, whether liquid or air cooled, but if the engine manufacturer prefers, a test bench system may replace the air cooled cooler. In either case, the measurement of power at each speed shall be made with the same pressure drop and temperature drop of the engine air across the charge air cooler on the test bench system as those specified by the manufacturer for the system on the complete vehicle.
- (¹⁰) They may include, for example, EGR (Exhaust gas recirculation) system, catalytic convertor, thermal reactor, secondary air supply system and fuel evaporation protecting system.

2.3.3. Compression-ignition engine starting auxiliaries

For the auxiliaries used in starting compression-ignition engines, the two following cases shall be considered:

- (a) Electric starting. A generator is fitted and supplies, where necessary, the auxiliaries essential for engine operation;
- (b) Starting other than by electrical means. If there are any electrically operated accessories essential for engine operation for which a generator is fitted. Otherwise, it is removed.

In either case, the system for producing and storing the energy necessary for starting is fitted and operates in the unloaded condition.

2.4. Setting conditions

The setting conditions for the test to determine the net power are indicated in Table 2.

Table 2

Setting conditions

1. Setting of carburettor(s)	In accordance with the manufacturer's production specifications and used without further alteration for the particular application
2. Setting of injection pump delivery system	
3. Ignition or injection timing (timing curve)	
4. Governor setting	
5. Emission control devices	

3. DATA TO BE RECORDED

- 3.1. The net power test shall consist of a run at full throttle for positive-ignition engines and at fixed full load fuel-injection-pump setting for compression-ignition engines, the engine being equipped as specified in Table 1.

- 3.2. Data to be recorded are those indicated in paragraph 4 of the appendix to this annex. Performance data shall be obtained under stabilized operating conditions with an adequate fresh air supply to the engine. Combustion chambers may contain deposits, but in limited quantity. Test conditions, such as inlet air temperature, shall be selected as near to reference conditions (see paragraph 5.2 of this annex) as possible in order to minimize the magnitude of the correction factor.
- 3.3. The temperature of the inlet air to the engine (ambient air) shall be measured within 0,15 m upstream of the point of entry to the air cleaner, or, if no air cleaner is used, within 0,15 m of the air inlet horn. The thermometer or thermocouple shall be shielded from radiant heat and placed directly in the air stream. It shall also be shielded from fuel spray-back. A sufficient number of locations shall be used to give a representative average inlet temperature.
- 3.4. No data shall be taken until torque, speed and temperatures have been maintained substantially constant for at least one minute.
- 3.5. The engine speed during a run or reading shall not deviate from the selected speed by more than ± 1 per cent or $\pm 10 \text{ min}^{-1}$, whichever is greater.
- 3.6. Observed brake load, fuel consumption and inlet air temperature data shall be taken simultaneously and shall be the average of two stabilized consecutive values which do not vary more than 2 per cent for the brake load and fuel consumption.
- 3.7. The temperature of the coolant at the outlet from the engine shall be kept at the value specified by the manufacturer. If no temperature is specified by the manufacturer, the temperature shall be $353 \text{ K} \pm 5 \text{ K}$. For air-cooled engines, the temperature at a point indicated by the manufacturer shall be kept within $\pm \frac{0}{20} \text{ K}$ of the maximum value specified by the manufacturer in the reference conditions.
- 3.8. The fuel temperature shall be measured at the inlet to the carburettor or at the fuel injection system and maintained within the limits established by the engine manufacturer.
- 3.9. The temperature of the lubricating oil measured in the oil pump or within the oil sump or at the outlet from the oil cooler, if fitted shall be maintained within the limits established by the engine manufacturer.
- 3.10. An auxiliary regulating system may be used if necessary to maintain the temperature within the limits specified in paragraphs 3.7, 3.8 and 3.9 of this annex.
4. ACCURACY OF MEASUREMENTS
- 4.1. Torque: ± 11 per cent of measured torque.
- The torque measuring system shall be calibrated to take friction losses into account. The accuracy in the lower half of the measuring range of the dynamometer bench may be ± 2 per cent of measured torque.
- 4.2. 'Engine speed': The measurement shall be accurate to within $\pm 0,5$ per cent. Engine speed shall be measured preferably with an automatically synchronized revolution counter and chronometer (or counter-timer).
- 4.3. Fuel consumption: ± 1 per cent of measured consumption.
- 4.4. Fuel temperature: $\pm 2 \text{ K}$.
- 4.5. Engine inlet air temperature: $\pm 1 \text{ K}$.
- 4.6. Barometric pressure: $\pm 100 \text{ Pa}$.
- 4.7. Pressure in intake-duct: $\pm 50 \text{ Pa}$.
- 4.8. Pressure in exhaust duct: $\pm 200 \text{ Pa}$.

5. POWER CORRECTION FACTORS

5.1. Definition

The power correction factor is the coefficient L determine the engine power under the reference atmospheric conditions specified in paragraph 5.2 below.

Where

$$P_o = L \cdot P$$

P_o is the corrected power (i.e. power under reference atmospheric conditions)

L is the correction factor (L_a or L_d)

P is the measured power (test power)

5.2. Reference atmospheric conditions

5.2.1. Temperature (T_o): 298 K (25 °C)5.2.2. Dry pressure (P_{so}): 99 kPa

Note: The dry pressure is based on a total pressure of 100 kPa and a water vapour pressure of 1 kPa.

5.3. Test atmospheric conditions

The atmospheric conditions during the test shall be the following:

5.3.1. Temperature (T)

For positive-ignition engines $288 \text{ K} \leq T \leq 308 \text{ K}$

For diesel engines $283 \text{ K} \leq T \leq 313 \text{ K}$

5.3.2. Pressure (P_s)

$80 \text{ kPa} \leq P_s \leq 110 \text{ kPa}$

5.4. Determination of correction factor α_a and α_d ⁽¹⁾5.4.1. Naturally aspirated or pressure-charged positive-ignition engine factor α_a

The correction factor α_a is obtained by applying the formula:

$$\alpha_a = \left(\frac{99}{P_s} \right)^{1,2} \cdot \left(\frac{T}{298} \right)^{0,6} \quad (2)$$

Where

P_s is the total dry atmospheric pressure in kilopascals (kPa); that is to say, the total barometric pressure minus water vapour pressure

T is the absolute temperature in kelvins (K) of the air drawn in by the engine.

Conditions to be complied with in the laboratory

For a test to be valid, the correction factor α_a must be such that $0,93 \leq \alpha_a \leq 1,07$

If these limits are exceeded, the corrected value obtained shall be given and the test conditions (temperature and pressure) precisely stated in the test report.

⁽¹⁾ The tests may be carried out in air-conditioned test rooms where the atmospheric conditions may be controlled.

⁽²⁾ In the case of engines fitted with automatic air temperature control, if the device is such that at full load at 25 °C no heated air is added, the test shall be carried out with the device fully closed. If the device is still operating at 25 °C then the test is made with the device operating normally and the exponent of the temperature term in the correction factor shall be taken as zero (no temperature correction).

5.4.2. Diesel engines — Factor α_d

The power correction factor (α_d) for diesel engines at constant fuel rate is obtained by applying the formula:

Where $\alpha_d = (f_a) f_m$

f_a is the atmospheric factor

f_m is the characteristic parameter for each type of engine and adjustment

5.4.2.1. Atmospheric factor f_a

This factor indicates the effects of environmental conditions (pressure, temperature and humidity) on the air drawn in by the engine. The atmospheric factor formula differs according to the type of engine.

5.4.2.1.1. Naturally aspirated and mechanically supercharged engines

$$f_a = \left(\frac{99}{P_s} \right) \cdot \left(\frac{T}{298} \right)^{0,7}$$

5.4.2.1.2. Turbocharged engines with or without cooling of inlet air

$$f_a = \left(\frac{99}{P_s} \right)^{0,7} \cdot \left(\frac{T}{298} \right)^{1,5}$$

5.4.2.2. Engine factor f_m

f_m is a function of q_c (fuel flow corrected) as follows:

$$f_m = 0,036 q_c - 1,14$$

Where: $q_c = q/r$

Where:

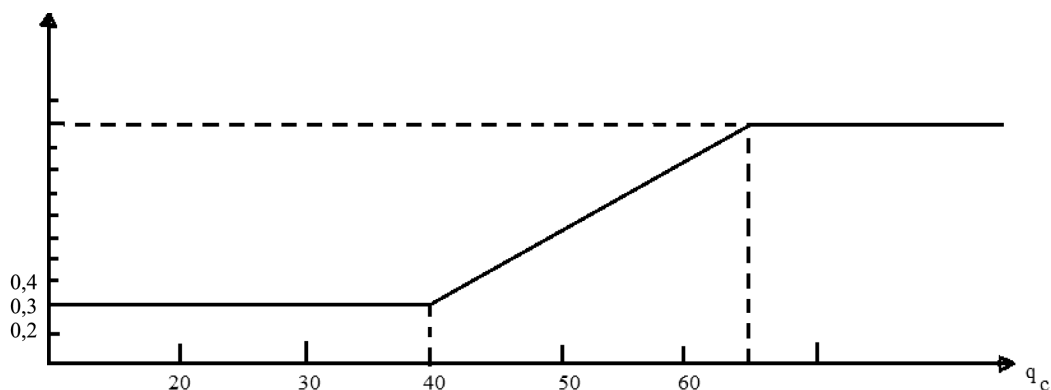
q is the fuel flow in milligram per cycle per litre of total swept volume (mg/(l.cycle))

r is the pressure ratio of compressor outlet and compressor inlet ($r = 1$ for naturally aspirated engines)

This formula is valid for a value interval of q_c included between 40 mg/(l.cycle) and 65 mg/(l.cycle.)

For q_c values lower than 40 mg/(l.cycle), a constant value of f_m equal to 0,3 ($f_m = 0,3$) will be taken.

For q_c values higher than 65 mg/(l.cycle), a constant value of f_m equal to 1,2 ($f_m = 1,2$) will be taken (see figure):



5.4.2.3. Conditions to be complied with in the laboratory

For a test to be valid; the correction factor α_d must be such that $0,9 \leq \alpha_d \leq 1,1$

If these limits are exceeded, the corrected value obtained shall be given and the test conditions (temperature and pressure) precisely stated in the test report.

Appendix

Results of tests for measuring net engine power

This form shall be completed by the laboratory performing the test.

1. Test conditions
 - 1.1. Pressures measured at maximum power
 - 1.1.1. Total barometric pressure: Pa
 - 1.1.2. Water vapour pressure: Pa
 - 1.1.3. Exhaust pressure: Pa
 - 1.2. Temperatures measured at maximum power
 - 1.2.1. Of the intake air: K
 - 1.2.2. At the outlet of the engine intercooler: K
 - 1.2.3. Of the cooling fluid
 - 1.2.3.1. At the engine cooling fluid outlet: K ⁽¹⁾
 - 1.2.3.2. At the reference point in the case of air cooling: K ⁽¹⁾
 - 1.2.4. Of the lubricating oil: K (indicate point of measurement)
 - 1.2.5. Of the fuel
 - 1.2.5.1. At the fuel pump inlet: K
 - 1.2.5.2. In the fuel consumption measuring device: K
 - 1.2.6. Of the exhaust measured at the point adjacent to the outlet flange(s) of the exhaust manifold(s): °C
 - 1.3. Engine speed when idling: min⁻¹
 - 1.4. Characteristics of the dynamometer
 - 1.4.1. Make: Model:
 - 1.4.2. Type:
 - 1.5. Characteristics of the opacimeter
 - 1.5.1. Make:
 - 1.5.2. Type:
2. Fuel
 - 2.1. For positive-ignition engines operating on liquid fuel
 - 2.1.1. Make:
 - 2.1.2. Specification:
 - 2.1.3. Anti-knock additive (lead etc.):
 - 2.1.3.1. Type:

⁽¹⁾ Delete as appropriate.

2.1.3.2. Content: mg/l

2.1.4. Octane number RON: (ASTM D 26 99-70)

2.1.4.1. MON No:

2.1.4.2. Specific density: g/cm³ at 288 K

2.1.4.3. Lower calorific value: kJ/kg

	Engine speed (min ⁻¹)	Nominal flow G (litres/second)	Limit absorption values (m ⁻¹)	Measured absorption values (m ⁻¹)
1				
2				
3				
4				
5				
6				

Maximum net power: kW at min⁻¹

Maximum net torque: Nm at min⁻¹

2.2. For positive-ignition engines and dual-fuel engines operating on gaseous fuel

2.2.1. Make:

2.2.2. Specification:

2.2.3. Storage pressure: bar

2.2.4. Utilization pressure: bar

2.2.5. Lower calorific value: kJ/kg

2.3. For compression-ignition engines operating on gaseous fuels

2.3.1. Feed system: gas

2.3.2. Specification of gas used:

2.3.3. Fuel oil/gas proportion:

2.3.4. Lower calorific value:

2.4. For compression-ignition engines and dual-fuel engines operating on diesel fuel

2.4.1. Make:

2.4.2. Specification of fuel used:

2.4.3. Cetane number (ASTM D 976-71)

2.4.4. Specific density: g/cm³ at 288 K

2.4.5. Lower calorific value: kJ/kg

3. Lubricant

3.1. Make:

- 3.2. Specification:
- 3.3. SAE viscosity:
4. Detailed results of Measurements ⁽²⁾

Engine speed, min ⁻¹		
Measured torque, Nm		
Measured power, kW		
Measured fuel flow, g/h		
Barometric pressure, kPa		
Water vapour pressure, kPa		
Inlet air temperature, K		
Power to be added for No 1 auxiliaries in excess No 2 of table above, kW No 3		
Power correction factor		
Corrected brake power, kW (with/without ⁽¹⁾ fan)		
Power of fan, kW (to be subtracted if fan not fitted)		
Net power, kW		
Net torque, Nm		
Corrected specific fuel consumption g/(kWh) ⁽²⁾		
Cooling liquid temperature at outlet, K		
Lubricating oil temperature t measuring point, K		
Air temperature after pressure-charger, K ⁽³⁾		
Fuel temperature at injection pump inlet, K		
Air temperature after charge air cooler, K ⁽³⁾		
Pressure after pressure-charger, kPa ⁽³⁾		
Pressure after charge air cooler, kPa		

Notes:

⁽¹⁾ Delete as appropriate.

⁽²⁾ Calculated with the net power for compression-ignition and positive-ignition engines, in the latter case multiplied by the power correction factor.

⁽³⁾ Delete where inapplicable.

⁽²⁾ The characteristic curves of the net power and the net torque shall be drawn as a function of the engine speed.

ANNEX 6

METHOD FOR MEASURING NET POWER AND THE MAXIMUM 30 MINUTES POWER OF ELECTRIC DRIVE TRAINS

1. THESE REQUIREMENTS APPLY FOR MEASURING THE MAXIMUM NET POWER AND THE MAXIMUM 30 MINUTES POWER OF ELECTRIC DRIVE TRAINS USED FOR PROPELLING PURE ELECTRIC ROAD VEHICLES.

2. TEST CONDITIONS

2.1. The drive train shall have been run-in according to the manufacturer's recommendations.

2.2. Kann die Leistungsmessung nur mit eingebautem Getriebe oder Vorgelege durchgeführt werden, so ist dessen Wirkungsgrad zu berücksichtigen.

2.3. Auxiliaries

2.3.1. Auxiliaries to be fitted

During the test, the auxiliaries necessary for the drive train operation in the intended application (as listed in table 1 of this annex) shall be installed in the same position as in the vehicle.

2.3.2. Auxiliaries to be removed

The auxiliaries necessary for the proper operation of the vehicle, and which may be mounted on the motor shall be removed when performing the test. The following non-exhaustive list is given as an example:

Air compressor for brakes; Power steering compressor; Suspension system compressor; Air conditioner system, etc.

Where accessories cannot be removed, the power they absorb in the unloaded condition may be determined and added to the measured power.

Table 1

Auxiliaries to be fitted for the test to determine net power and the maximum 30 minutes power of electric drive trains

('Standard-production equipment' means equipment provided by the manufacturer for a particular application).

No	Auxiliaries	Fitted for net power and the maximum 30 minutes power test
1	DC voltage source	Voltage drop during test less than 5 %
2	Speed variator and control device	Yes: Standard-production equipment
3	Liquid-cooling Motor bonnet Bonnet outlet Radiator ⁽¹⁾ ⁽²⁾ Fan Fan cowl Pump Thermostat ⁽³⁾	No Yes: Standard production equipment

No	Auxiliaries	Fitted for net power and the maximum 30 minutes power test
	Air cooling Air filter Cowl Blower Temperature adjustment system	Yes: Standard production equipment
4	Electric equipment	Yes: Standard production equipment
5	Bench test auxiliary fan	Yes, if necessary

(¹) The radiator, the fan, the fan cowl, the water pump and the thermostat shall be located on the test bench in the same relative position as on the vehicle. The cooling-liquid circulation shall be activated by the drive train water pump only.

Cooling of the liquid may be produced either by the drive train radiator, or by an external circuit, provided that the pressure loss of this circuit and the pressure at the pump inlet remain substantially the same as those of the drive train cooling system. The radiator shutter, if any, shall be in the open position.

Where the fan, radiator and fan cowl cannot conveniently be fitted for the bench test, the power absorbed by the fan when separately mounted in its correct position in relation to the radiator and cowl (if used), shall be determined at the speed corresponding to the motor speeds used for measurement of the motor power either by calculation from standard characteristics or by practical tests. This power, corrected to the standard atmospheric conditions should be deducted from the correct power.

(²) Where a disconnectable or progressive fan or blower is incorporated, the test should be carried out with the disconnectable fan (or blower) disconnected or at maximum slip condition.

(³) The thermostat may be fixed in the fully open position.

2.4. Setting conditions

The setting conditions shall conform to the manufacturer's specifications for the production motor and be used without further alteration for the particular application.

2.5. Data to be recorded

2.5.1. The test for determining the net power shall be carried out with the accelerator control set at the maximum position.

2.5.2. The motor must have been run-in in accordance with the recommendations of the applicant for the approval.

2.5.3. Torque and speed data shall be recorded simultaneously.

2.5.4. If needed, the cooling liquid temperature recorded at the motor outlet must be maintained at ± 5 K of the thermostat temperature setting specified by the manufacturer.

For air cooling drive trains, the temperature at a point indicated by the manufacturer shall be kept within $+ 0/- 20$ K of the maximum value specified by the manufacturer.

2.5.5. The temperature of the lubricating oil measured in the oil sump or at the outlet from the oil temperature exchanger (if any) shall be maintained within the limits prescribed by the manufacturer.

2.5.6. An auxiliary regulating system may be used, if necessary, to maintain the temperature within the limits specified in paragraphs 2.5.4 and 2.5.5 above.

3. ACCURACY OF MEASUREMENTS

3.1. Torque: ± 1 per cent of measured torque.

The torque measuring system shall be calibrated to take friction losses into account. The accuracy in the lower half of the measuring range of the dynamometer bench may be ± 2 per cent of measured torque.

3.2. Motor speed: 0,5 per cent of measured speed.

3.3. Motor inlet air temperature: ± 2 K.

ANNEX 7

CHECKS ON CONFORMITY OF PRODUCTION**1. GENERAL**

These requirements are consistent with tests to be held to check conformity of production, according to paragraph 6 and its subparagraphs.

2. TEST PROCEDURES

The methods of testing and measuring instruments shall be those described in Annexes 5 or 6 to this Regulation.

3. COLLECTION OF SAMPLES

One drive train has to be chosen. If after the test of paragraph 5.1 below, the drive train is not considered as conforming to the requirements of this Regulation, two more drive trains have to be tested.

4. MEASUREMENT CRITERIA**4.1. Net power of internal combustion engine**

During the tests to verify conformity of production, the power shall be measured at two engine speeds S1 and S2, corresponding respectively to the measurement points of maximum power and maximum torque accepted for type approval. At these two engine speeds, which are subject to a tolerance of ± 5 per cent, the net power measured at least one point within the ranges $S1 \pm 5$ per cent and $S2 \pm 5$ per cent shall not differ by more than ± 5 per cent from the approval figure.

4.2. Net power and maximum 30 minutes power of electric drive trains

During the tests to verify conformity of production the power shall be measured at motor speed S1 corresponding to the measurement point of maximum power accepted for type approval. At this speed, the net power shall not differ by more than ± 5 per cent from the approval figure.

5. EVALUATION OF RESULTS

5.1. If the net power and the maximum 30 minutes power of the drive train tested pursuant to paragraph 2 above fulfils the requirement of paragraph 4 above, the production is considered to conform to the type approval.

5.2. If the requirements of paragraph 4 above are not fulfilled, two more drive trains are tested in the same way.

5.3. If the net power figure or the maximum 30 minutes power of the second and/or third drive train of paragraph 5.2 above does not fulfil the requirements of paragraph 4 above, the production shall be considered not to conform to the requirements of this Regulation and the provisions of paragraph 7.1 of this Regulation shall be put into effect.

ANNEX 8

REFERENCE FUELS

1. Technical data of the LPG reference fuels

		Fuel A	Fuel B	Test method
Composition:				ISO 7941
C3	% vol.	30 ± 2	85 ± 2	
C4	% vol.	balance	balance	
< C3, > C4	% vol.	max. 2 %	max. 2 %	
Olefines	% vol.	9 ± 3	12 ± 3	
Evaporative residue	ppm	max. 50	max. 50	NFM 41-015
Water content		none	none	visual inspection
Sulphur content	ppm mass (*)	max. 50	max. 50	EN 24260
Hydrogen sulphide		none	none	
Copper corrosion	rating	class 1	class 1	ISO 625 1 (**)
Odour		Characteristic	Characteristic	
MON		min. 89	min. 89	EN 589 Annex B

(*) Value to be determined at standard conditions (293,2 K (20 °C) and 101,3 kPa).

(**) This method may not accurately determine the presence of corrosive materials if the sample contains corrosion inhibitors or other chemicals which diminish the corrosivity of the sample to the copper strip. Therefore, the addition of such compounds for the sole purpose of biasing the test method is prohibited.

2. Technical data of NG reference fuels

		G20	G23	G25
Composition:				
CH ₄	% vol.	100	92,5	86
N ₂	% vol.	0	7,5	14
Wobbe Index (*)	MJ/m ³	$53,6 \pm 2 \%$	$48,2 \pm 2 \%$	$43,9 \pm 2 \%$

(*) Based on the gross calorific value and calculated for 0 °C.

The constituting gases of the mixtures shall have at least the following purities:

N₂: 99 %

CH₄: 95 % with a total content of hydrogen, carbon monoxide and oxygen below 1 per cent and a total content of nitrogen and carbon dioxide below 2 per cent.

The Wobbe Index is the ratio of the calorific value of a gas per unit volume and the square root of its relative density under the same reference conditions:

$$\text{Wobbe Index} = H_{\text{gas}} \frac{\sqrt{\rho_{\text{air}}}}{\sqrt{\rho_{\text{gas}}}}$$

with

H_{gas} = calorific value of the fuel in MJ/m³

ρ_{air} = density of air at 0 °C

ρ_{gas} = density of fuel at 0 °C at 0 °C

The Wobbe Index is said to be gross or net according to whether the calorific value uses is the gross or net calorific value.
