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/wp29fdocstts.html

Regulation No 120 of the Economic Commission for Europe of the United Nations (UNECE) — Uniform provisions concerning the approval of internal combustion engines to be installed in agricultural and forestry tractors and in non-road mobile machinery, with regard to the measurement of the net power, net torque and specific fuel consumption [2015/1000]

Incorporating all valid text up to:

01 series of amendments to the Regulation — Date of entry into force: 26 July 2012

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1. SCOPE

1.1. This Regulation applies to the representation of the curves as a function of engine speed of the power, torque and specific fuel consumption at full load, indicated by the manufacturer for internal combustion engines to be used:

1.1.1. In category T vehicles ([1]),

1.1.2. In non-road mobile machinery ([1]), operated under variable or constant speed.

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

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

1.2.1. Reciprocating internal combustion engines (positive-ignition or compression-ignition), but excluding free piston engines;

1.2.2. Rotary piston engines (positive-ignition or compression-ignition).

2. DEFINITIONS

2.1. 'Approval of an engine' means the approval of an engine type with regard to its net power measured in accordance with the procedure specified in Annex 4 to this Regulation;

2.2. 'Approval of an engine family' means the approval of the members of an engine family with regard to their net power in accordance with the procedure specified in Annex 5 or 6 to this Regulation;

2.3. 'Engine type' means a category of engines which do not differ in such essential engine characteristics as defined in Annex 1 — Appendix 3 to this Regulation;

2.4. 'Engine family' means a manufacturer's grouping of engines which, through their design, fulfil the grouping criteria laid down in Annex 5 to this Regulation;

2.5. 'Parent engine' means an engine selected from an engine family in such a way that it complies with requirements set out in Annex 5 to this Regulation;

2.6. 'Net power' means the power obtained on a test bench at the end of the crankshaft or its equivalent at the corresponding engine speed with the auxiliaries and equipment listed in Table 1 of Annex 4 to this Regulation, determined under reference atmospheric conditions;

2.7. 'Rated net power' means engine net power as declared by the manufacturer at rated speed;

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

2.9. 'Rated speed' means the maximum full load speed allowed by the governor, as designed by the manufacturer, or, if such a governor is not present, the speed at which the maximum power is obtained from the engine, as specified by the manufacturer;

2.10. 'Maximum net power speed' means the engine speed at which the maximum net power is obtained, as specified by the manufacturer;

2.11. 'Maximum torque speed' means the engine speed at which the maximum torque is obtained, as specified by the manufacturer;

2.12. 'Maximum torque' means the maximum value of the net torque measured at full engine load.

3. APPLICATION FOR APPROVAL

3.1. The application for approval of an engine type or an engine family with regard to the measurement of the net power shall be submitted by the manufacturer or by his duly accredited representative.

3.2. It shall be accompanied by the following documents in triplicate: description of the engine type or engine family comprising all the relevant particulars referred to in Annex 1 to this Regulation.

3.3. An engine representative of the engine type to be approved, or the parent engine, in case of an engine family, fitted with the equipment prescribed in Annex 4 to this Regulation, shall be submitted to the technical service conducting the approval tests.

4. APPROVAL

4.1. If the power of the engine submitted for approval pursuant to this Regulation was measured according to the specifications of paragraph 5 below, approval of the engine type or family shall be granted.

4.2. An approval number shall be assigned to each engine type or family approved. Its first two digits (at present 01 for the Regulation in its 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 engine type or family.

4.3. Notice of approval or of extension or of refusal of approval of an engine type or an engine family 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 2 to this Regulation.

4.4. There shall be affixed, conspicuously and in a readily accessible place as specified on the approval form, to every engine conforming to an engine type or an engine family 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.

Alternatively, instead of affixing these approval marks and symbols to the engine, the manufacturer may decide that engine approved under this Regulation shall be accompanied by a document giving this information in order to enable the approval marks and symbol to be attached to the vehicle.

4.5. If the engine conforms to an approved type or family 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 additional numbers and 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 placed close to or on the data plate affixed by the manufacturer to the approved type.

4.7. Annex 3 to this Regulation gives examples of arrangements of approval arks.

4.8. Every engine conforming to an engine type or an engine family approved under this Regulation must bear, in addition to the approval mark:

4.8.1. The trademark or trade name of the manufacturer of the engine;

4.8.2. The manufacturer's engine code.

5. SPECIFICATIONS AND TESTS

5.1. General

The components liable to affect the power of the engine shall be so designed, constructed and assembled as to enable the engine 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 internal combustion engines

5.2.1. 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 of Annex 4 to this Regulation.

5.2.2. Measurements shall be taken at a sufficient number of engine speeds to define correctly the power, torque and specific fuel consumption curves between the lowest and the highest engine speeds recommended by the manufacturer. This range of speeds must include the rotational speeds at which the engine produces its rated net power, its maximum power and its maximum torque.

([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.3 —www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html

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 reference fuel specified in Annex 7.

5.2.3.2. For positive-ignition engines fuelled with LPG:

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 7;

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 7 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 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 references fuels specified in Annex 7;

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 the Wobbe Index at least 52,6 MJ/m³ (20 °C, 101,3 kPa). In case of dispute the fuel used shall be the reference fuel GR specified in Annex 7, 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 the Wobbe Index at least 52,6 MJ/m³ (20 °C, 101,3 kPa) if the engine is labelled for the H-range of gases, or at least 47,2 MJ/m³ (20 °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 GR specified in Annex 7 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 ([1])

5.2.3.3.4. 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.

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

5.2.3.4. For compression-ignition engines:

The fuel used shall be the reference fuel specified in Annex 7.

The choice of the test fuel shall be made based on the exhaust limit values that the engine type or the engine family is intended to comply with. Based on the power bands described in the Regulation setting uniform provisions concerning the approval of compression ignition (C.I.) engines to be installed in agricultural and forestry tractors and in non-road mobile machinery with regard to the emissions of pollutants by the engine, the reference fuel shall be selected as follows:

Annex 7 — Table 1 for power bands D to G

Annex 7 — Table 2 for power bands H to K

([1]) '*Wobbe Index (lower Wl; or upper Wu)*' means the ratio of the corresponding calorific value of a gas per unit volume and the square root of its relative density under the same reference conditions:

$$W = H_{gas} \times \sqrt{\rho_{air}/\rho_{gas}}$$

Annex 7 — Table 3 for power bands L to R.

Optionally, the reference fuel specified in Annex 7 — Table 1 may be used for power bands H to K.

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 determine the net power, as listed in the appendix to Annex 4 to this Regulation together with the characteristics of the engine, as listed in Annex 1 to this Regulation.

5.3. Interpretation of Results

5.3.1. Net power

The net power declared by the manufacturer for the type of engine (or parent engine) shall be accepted if it does not differ by more than the values indicated in the table below, from the corrected values measured by the technical service on the engine submitted for testing.

Engine Type	Rated net power [%]	Other measurement points on the curve [%]	Tolerance for engine speed [%]
General	± 2	± 4	± 1,5
Petrol fuelled spark ignited engines with governor	± 4	± 6	± 4
Petrol fuelled spark ignited engines without governor	± 4	± 10	± 4

5.3.2. Rated speed

The rated speed declared by the manufacturer shall not deviate by more than 100 min^{-1} from the value measured by the technical service on the engine submitted for testing. For spark ignited petrol fuelled engines, the rated speed declared by the manufacturer shall not deviate from the value measured by the technical service on the engine submitted for testing by more than 150 min^{-1} for engines provided with governor and for engines without governor 350 min^{-1} or 4 per cent, whichever is smaller.

5.3.3. Fuel consumption

The specific fuel consumption curve declared by the manufacturer for the type of engine (or parent engine) shall be accepted if it does not differ by more than ± 8 per cent at all measurement points from the values measured for the same points by the technical service on the engine submitted for testing.

5.3.4. Engine family

In case of compliance of the parent engine to the conditions in paragraphs 5.3.1 and 5.3.2, the acceptance is automatically extended to all the declared curves of the family members.

6. 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:

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 6 to this Regulation shall be complied with.

7. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

7.1. The approval granted in respect of an engine type or an engine family pursuant to this Regulation may be withdrawn if the requirements set forth in paragraph 6.1 above are not met or if an engine or an engine family 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 2 to this Regulation.

8. MODIFICATION AND EXTENSION OF APPROVAL OF AN ENGINE TYPE OR ENGINE FAMILY

8.1. Every modification of an engine type or an engine family with regard to the characteristics in Annex 1, shall be notified to the Type Approval Authority which approved the engine type or engine family. 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 engine 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 2 to this Regulation.

9. PRODUCTION DEFINITIVELY DISCONTINUED

If the holder of an approval completely ceases to manufacture an engine type or an engine family 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.

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.

ANNEX 1

Essential characteristics of the internal combustion engine and general information concerning the conduct of tests

Parent engine/engine type ([1]): .....

1. General

1.1. Make (name of undertaking): .....

1.2. Type and commercial description of the parent — and (if applicable) of the family engine(s) ([2]) .....

1.3. Manufacturer's type coding as marked on the engine(s) ([2]): .....

1.4. Specification of machinery to be propelled by the engine ([2]): .....

1.5. Name and address of manufacturer: .....

1.6. Name and address of manufacturer's authorised representative (if any): .....

1.7. Location, coding and method of affixing of the engine identification: .....

1.8. Location and method of affixing of the approval mark: .....

1.9. Address(es) of assembly plant(s): .....

2. Attachments

2.1. Essential characteristics of the parent engine(s) (see Appendix 1) .....

2.2. Essential characteristics of the engine family (see Appendix 2) .....

2.3. Essential characteristics of engine types within the family (see Appendix 3) .....

3. Characteristics of engine-related parts of the mobile machinery (if applicable) .....

4. Photographs of the parent engine .....

5. List of further attachments:

5.1. Appendix 1/Appendix 2/Appendix 3 ([1])

5.2. Declared power, torque and specific fuel consumption curves for engine/parent engine and engines within the family ([1])

5.3. Any further attachments, if any: .....

([1]) Strike out what does not apply.
([2]) List the types and models.

Appendix 1

ESSENTIAL CHARACTERISTICS OF THE ENGINE/PARENT ENGINE [1]

1. Description of engine

1.1. Manufacturer: .....

1.2. Manufacturer's engine code: .....

1.3. Working principle: positive-ignition/compression-ignition, four-stroke/two-stroke [1]

1.4. Bore [2]: ..... mm

1.5. Stroke [2]: ..... mm

1.6. Number, layout and firing order of cylinders: .....

1.7. Engine capacity [3]: ..... cm^3

1.8. Volumetric compression ratio [4]: .....

1.9. Combustion system description: .....

1.10. Drawing(s) of combustion chamber and piston crown: .....

1.11. Minimum cross-sectional area of inlet and outlet ports: .....

1.12. Cooling system: liquid/air [1]

1.12.1. Liquid

1.12.1.1. Nature of liquid: .....

1.12.1.2. Circulating pump(s): yes/no [1]

1.12.1.3. Characteristics or make(s) and type(s) (if applicable): .....

1.12.1.4. Drive ratio(s) (if applicable): .....

1.12.2. Air

1.12.2.1. Blower: yes/no [1]

1.12.2.2. Characteristics or make(s) and type(s) (if applicable): .....

1.12.2.3. Drive ratio(s) (if applicable): .....

1.13. Temperature permitted by the manufacturer

1.13.1. Liquid cooling: maximum temperature at outlet: ..... K

1.13.2. Air cooling: reference point: .....

1.13.3. Maximum temperature at reference point: ..... K

1.13.4. Maximum charge air outlet temperature at the inlet inter-cooler (if applicable): ..... K

1.13.5. Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): ..... K

1.13.6. Lubricant temperature: minimum: ..... K

maximum: ..... K

1.14. Pressure charger: yes/no [1]

1.14.1. Make: .....

1.14.2. Type: .....

1.14.3. Description of the system (e.g. max. charge pressure, waste-gate, if applicable):

1.14.4. Inter-cooler: yes/no [1]

1.15. Intake system: maximum allowable intake depression at rated engine speed and at 100 % load: ..... kPa

1.16. Exhaust system: maximum allowable exhaust back-pressure at rated engine speed and at 100 % load: .... kPa

2. Measures taken against air pollution

2.1. Device for recycling crankcase gases: yes/no [1]

2.2. Additional anti-pollution devices (if any, and if not covered by another heading)

2.2.1. Catalytic converter: yes/no [1]

2.2.1.1. Make(s): .....

2.2.1.2. Type(s): .....

2.2.1.3. Number of catalytic converters and elements .....

2.2.1.4. Dimensions — and volume of the catalytic converter(s): .....

2.2.1.5. Type of catalytic action: .....

2.2.1.6. Total charge of precious metals: .....

2.2.1.7. Relative concentration: .....

2.2.1.8. Substrate (structure and material): .....

2.2.1.9. Cell density: .....

2.2.1.10. Type of casing for the catalytic converter(s): .....

2.2.1.11. Location of the catalytic converter(s) (place(s) and maximum/minimum distance(s) from engine): .....

2.2.1.12. Normal operating range (K): .....

2.2.1.13. Consumable reagent (where appropriate): .....

2.2.1.13.1. Type and concentration of reagent needed for catalytic action: .....

2.2.1.13.2. Normal operational temperature range of reagent: .....

2.2.1.13.3. International standard (where appropriate): .....

2.2.1.14. NO_x sensor: yes/no [1]

2.2.2. Oxygen sensor: yes/no [1]

2.2.2.1. Make(s): .....

2.2.2.2. Type: .....

2.2.2.3. Location: .....

2.2.3. Air injection: yes/no [1]

2.2.3.1. Type (pulse air, air pump, etc.): .....

2.2.4. EGR: yes/no [1]

2.2.4.1. Characteristics (cooled/uncooled, high pressure/low pressure, etc.): .....

2.2.5. Particulate trap: yes/no [1]

2.2.5.1. Dimensions and capacity of the particulate trap: .....

2.2.5.2. Type and design of the particulate trap: .....

2.2.5.3. Location (place(s) and maximum/minimum distance(s) from engine): .....

2.2.5.4. Method or system of regeneration, description and/or drawing: .....

2.2.5.5. Normal operating temperature (K) and pressure (kPa) range: .....

2.2.6. Other systems: yes/no [1]

2.2.6.1. Description and operation: .....

3. Fuel feed for compression-ignition engines

3.1. Feed pump

3.1.1. Pressure or characteristic diagram [4]: ..... kPa

3.2. Injection system

3.2.1. Pump

3.2.1.1. Make(s): .....

3.2.1.2. Type(s): .....

3.2.1.3. Maximum fuel delivery: … mm^3 (1) (4) per stroke or cycle at full injection at pump speed of: … min^{-1} (rated) and … min^{-1} (maximum torque) respectively, or characteristic diagram: .....

3.2.1.3.1. Mention the method used: on engine/on pump bench (1)

3.2.1.4. Injection advance

3.2.1.4.1. Injection advance curve (4): .....

3.2.1.4.2. Timing (4): .....

3.2.2. Injection piping

3.2.2.1. Length: ..... mm

3.2.2.2. Internal diameter: ..... mm

3.2.3. Injector(s)

3.2.3.1. Make(s): .....

3.2.3.2. Type(s): .....

3.2.3.3. Opening pressure or characteristic diagram (1) (4): ..... kPa

3.2.4. Governor

3.2.4.1. Make(s): .....

3.2.4.2. Type(s): .....

3.2.4.3. Speed at which cut-off starts under full load (4): ..... min^{-1}

3.2.4.4. Maximum no-load speed (4): ..... min^{-1}

3.2.4.5. Idling speed (4): ..... min^{-1}

3.3. Cold start system

3.3.1. Make(s): .....

3.3.2. Type(s): .....

3.3.3. Description: .....

3.3.4 Electronic Engine Management Control Unit

3.3.4.1. Make(s): .....

3.3.4.2. Type: .....

3.3.4.3. Emission related adjustment possibilities: .....

3.3.4.4. Further documentation: .....

4. Fuel feed for positive-ignition engines

4.1. Carburettor

4.1.1. Make(s): .....

4.1.2. Type(s): .....

4.2. Port fuel injection: single-point or multi-point ([1])

4.2.1. Make(s): .....

4.2.2. Type(s): .....

4.3. Direct-injection

4.3.1. Make(s): .....

4.3.2. Type(s): .....

4.4. Fuel flow [g/h] and air/fuel ratio at rated speed and wide open throttle: .....

4.5 Electronic Engine Management Control Unit: .....

4.5.1. Make(s): .....

4.5.2. Type: .....

4.5.3. Emission related adjustment possibilities: .....

4.5.4. Further documentation: .....

5. Valve timing

5.1. Maximum lift and angles of opening and closing in relation to dead centres or equivalent data: .....

5.2. Reference and/or setting ranges ([1]): .....

5.3. Variable valve timing system (if applicable and where: intake and/or exhaust) ([1]):

5.3.1. Type: continuous or on/off ([1])

5.3.2. Cam phase shift angle: .....

6. Porting configuration

6.1. Position, size and number: .....

7. Ignition system

7.1. Ignition coil

7.1.1. Make(s): .....

7.1.2. Type(s): .....

7.1.3. Number: .....

7.2. Spark plug(s)

7.2.1. Make(s): .....

7.2.2. Type(s): .....

7.3. Magneto

7.3.1. Make(s): .....

7.3.2. Type(s): .....

7.4. Ignition timing

7.4.1. Static advance with respect to Top Dead Center [crank angle degrees] .....

7.4.2. Advance curve, if applicable .....

8. Engine performance (declared by the manufacturer)

Rated speed (min^{-1})	
Maximum power speed (min^{-1})	
Maximum torque speed (min^{-1})	
Rated net power (kW)	
Maximum net power (kW)	
Maximum net torque (Nm)	

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

Appendix 2

ESSENTIAL CHARACTERISTICS OF THE ENGINE FAMILY

1. Common parameters ([1])

1.1. Combustion cycle: .....

1.2. Cooling medium: .....

1.3. Method of air aspiration: .....

1.4. Combustion chamber type/design: .....

1.5. Valve and porting — configuration, size and number: .....

1.6. Fuel system: .....

1.7. Engine management systems

Proof of identity pursuant to drawing number(s): .....

1.7.1. Charge cooling system: .....

1.7.2. Exhaust gas recirculation ([2]): .....

1.7.3. Water injection/emulsion ([2]): .....

1.7.4. Air injection ([2]): .....

1.8. Proof of identical (or lowest for the parent engine) ratio: system capacity/fuel delivery per stroke, pursuant to diagram number(s) ([3]): .....

2. Engine family listing

2.1. Name of engine family: .....

2.2. Specification of engines within this family: .....

Specification	Engines of the family				Parent engine ([1])
Engine type					
No of cylinders					
Rated speed (min^{-1})					
Fuel delivery per stroke (mm^3) for compression-ignition engines, fuel flow (g/h) for positive-ignition engines					
Rated net power (kW)					
Maximum net power (kW)					
Maximum power speed (min^{-1})					

([1]) For full details see Annex 1 — Appendix 1.
([2]) Give all pertinent technical data.
([3]) See Annex 5, paragraph 3.10.

Specification	Engines of the family				Parent engine (1)
Maximum torque speed (min^{-1})					
Fuel delivery per stroke (mm^3)					
Maximum torque (Nm)					
Low idle speed (min^{-1})					
Cylinder displacement (in % of the largest one) (see Annex 5, para. 1.3)					

Appendix 3

ESSENTIAL CHARACTERISTICS OF ENGINE TYPE WITHIN THE FAMILY [1]

1. Description of the engine

1.1. Manufacturer: .....

1.2. Manufacturer's engine code: .....

1.3. Cycle: four-stroke/two-stroke [2]

1.4. Bore [3]: ..... mm

1.5. Stroke [3]: ..... mm

1.6. Number, layout and firing order of cylinders: .....

1.7. Engine capacity [4]: ..... cm^3

1.8. Rated speed: ..... min^{-1}

1.9. Maximum torque speed: ..... min^{-1}

1.10. Volumetric compression ratio [5]: .....

1.11. Combustion system description: .....

1.12. Drawing(s) of combustion chamber and piston crown: .....

1.13. Minimum cross-sectional area of inlet and outlet ports: .....

1.14. Cooling system: liquid/air [2]

1.14.1. Liquid

1.14.1.1. Nature of liquid: .....

1.14.1.2. Circulating pump(s): yes/no [2]

1.14.1.3. Characteristics or make(s) and type(s) (if applicable): .....

1.14.1.4. Drive ratio(s) (if applicable): .....

1.14.2. Air

1.14.2.1. Blower: yes/no [2]

1.14.2.2. Characteristics or make(s) and type(s) (if applicable): .....

1.14.2.3. Drive ratio(s) (if applicable): .....

1.15. Temperature permitted by the manufacturer

1.15.1. Liquid cooling: maximum temperature at outlet: ..... K

1.15.2. Air cooling: reference point: .....

maximum temperature at reference point: ..... K

1.15.3. Maximum charge air outlet temperature at the inlet intercooler (if applicable): ..... K

1.15.4. Maximum exhaust temperature at the point in the exhaust pipe(s) adjacent to the outer flange(s) of the exhaust manifold(s): ..... K

1.15.5. Lubricant temperature: minimum ..... K

maximum ..... K

1.16. Pressure charger: yes/no [2]

1.16.1. Make: .....

1.16.2. Type: .....

1.16.3. Description of the system (e.g. max charge pressure, waste-gate, if applicable): .....

1.16.4. Inter-cooler: yes/no [2]

1.17. Intake system: maximum allowable intake depression at rated engine speed and at 100 % load: ..... kPa

1.18. Exhaust system: maximum allowable exhaust back-pressure at rated engine speed and at 100 % load: .... kPa

2. Measures taken against air pollution

2.1 Device for recycling crankcase gases: yes/no [2] .....

2.2. Additional anti-pollution devices (if any, and if not covered under another heading)

2.2.1. Catalytic converter: yes/no [2]

2.2.1.1. Make(s): .....

2.2.1.2. Type(s): .....

2.2.1.3. Number of catalytic converters and elements .....

2.2.1.4. Dimensions and volume of the catalytic converter(s): .....

2.2.1.5. Type of catalytic action: .....

2.2.1.6. Total charge of precious metals: .....

2.2.1.7. Relative concentration: .....

2.2.1.8. Substrate (structure and material): .....

2.2.1.9. Cell density: .....

2.2.1.10. Type of casing for the catalytic converter(s): .....

2.2.1.11. Location of the catalytic converter(s) (place(s) and maximum/minimum distance(s) from engine): .....

2.2.1.12. Normal operating range (K): .....

2.2.1.13. Consumable reagent (where appropriate): .....

2.2.1.13.1. Type and concentration of reagent needed for catalytic action: .....

2.2.1.13.2. Normal operational temperature range of reagent: .....

2.2.1.13.3. International standard (where appropriate): .....

2.2.1.14. NO_x sensor: yes/no ([2])

2.2.2. Oxygen sensor: yes/no ([2])

2.2.2.1. Make(s): .....

2.2.2.2. Type: .....

2.2.2.3. Location: .....

2.2.3. Air injection: yes/no ([2])

2.2.3.1. Type (pulse air, air pump, etc.): .....

2.2.4. EGR: yes/no ([2])

2.2.4.1. Characteristics (cooled/uncooled, high pressure/low pressure, etc.): .....

2.2.5. Particulate trap: yes/no ([2])

2.2.5.1. Dimensions and capacity of the particulate trap: .....

2.2.5.2. Type and design of the particulate trap: .....

2.2.5.3. Location (place(s) and maximum/minimum distance(s) from engine): .....

2.2.5.4. Method or system of regeneration, description and/or drawing: .....

2.2.5.5. Normal operating temperature (K) and pressure (kPa) range: .....

2.2.6. Other systems: yes/no ([2])

2.2.6.1. Description and operation: .....

3. Fuel feed for compression-ignition engines

3.1. Feed pump

Pressure ([1]) or characteristic diagram: ..... kPa

3.2. Injection system

3.2.1. Pump

3.2.1.1. Make(s): .....

3.2.1.2. Type(s): .....

3.2.1.3. Maximum fuel delivery: … mm^3 (2) (5) per stroke or cycle at full injection at pump speed of: … min^{-1} (rated) and … min^{-1} (maximum torque) respectively, or characteristic diagram: .....

3.2.1.3.1. Mention the method used: on engine/on pump bench (2)

3.2.1.4. Injection advance

3.2.1.4.1. Injection advance curve (5): .....

3.2.1.4.2. Timing (5): .....

3.2.2. Injection piping

3.2.2.1. Length: ..... mm

3.2.2.2. Internal diameter: ..... mm

3.2.3. Injector(s)

3.2.3.1. Make(s): .....

3.2.3.2. Type(s): .....

3.2.3.3. Opening pressure or characteristic diagram (2) (5): ..... kPa

3.2.4. Governor

3.2.4.1. Make(s): .....

3.2.4.2. Type(s): .....

3.2.4.3. Speed at which cut-off starts under full load (5): ..... min^{-1}

3.2.4.4. Maximum no-load speed (5): ..... min^{-1}

3.2.4.5. Idling speed (5): ..... min^{-1}

3.3. Cold start system

3.3.1. Make(s): .....

3.3.2. Type(s): .....

3.3.3. Description: .....

3.4 Electronic Engine Management Control Unit:

3.4.1. Make(s): .....

3.4.2. Type: .....

3.4.3. Emission related adjustment possibilities: .....

3.4.4. Further documentation: .....

4. Fuel feed for positive-ignition engines

4.1. Carburettor

4.1.1. Make(s): .....

4.1.2. Type(s): .....

4.2. Port fuel injection: single-point or multi-point ([1])

4.2.1. Make(s): .....

4.2.2. Type(s): .....

4.3. Direct-injection

4.3.1. Make(s): .....

4.3.2. Type(s): .....

4.4. Fuel flow [g/h] and air/fuel ratio at rated speed and wide open throttle

4.5. Electronic engine management control unit

4.5.1. Make(s): .....

4.5.2. Type: .....

4.5.3. Emission related adjustment possibilities: .....

4.5.4. Further documentation: .....

5. Valve timing

5.1. Maximum lift and angles of opening and closing in relation to dead centres or equivalent data: .....

5.2. Reference and/or setting range ([1]): .....

5.3. Variable valve timing system (if applicable and where: intake and/or exhaust) ([1]): .....

5.3.1. Type: continuous or on/off ([1])

5.3.2. Cam phase shift angle: .....

6. Porting configuration

6.1. Position, size and number: .....

7. Ignition system

7.1. Ignition coil

7.1.1. Make(s): .....

7.1.2. Type(s): .....

7.1.3. Number

7.2. Spark plug(s)

7.2.1. Make(s): .....

7.2.2. Type(s): .....

7.3. Magneto

7.3.1. Make(s): .....

7.3.2. Type(s): .....

7.4. Ignition timing

7.4.1. Static advance with respect to Top Dead Center [crank angle degrees]: .....

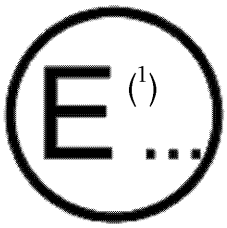
7.4.2. Advance curve, if applicable: .....

(1) For full details see Annex 1 — Appendix 1.
(2) Strike out what does not apply.
(3) This value shall be rounded-off to the nearest tenth of a millimetre.
(4) This value shall be calculated with π = 3,1416 and rounded-off to the nearest cm^3.
(5) Specify the tolerance.

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 definitively discontinued

of an engine or engine family pursuant to Regulation No 120

Approval No ..... Extension No .....

1. Trade name or mark of engine: .....
2. Manufacturer's designation of the parent and (if applicable) of the family engine(s) type(s) .....
3. Manufacturer's type coding as marked on the engine(s): .....
3.1. Location: .....
3.2. Method of affixing: .....
4. Name and address of manufacturer: .....
4.1. Name and address of manufacturer's authorised representative (if any): .....
5. Location, coding and method of affixing of the engine identification number: .....
6. Technical Service responsible for conducting approval tests: .....
7. Date of report issued by that service: .....
8. Number of report issued by that service: .....
9. Location and method of affixing of the ECE approval mark: .....
10. Reason(s) for extension of approval (if applicable): .....
11. Main specification of internal combustion engine
11.1. Approved data
11.1.1. Rated net power: ..... kW, at ..... min^{-1}
11.1.2. Maximum net power: ..... kW, at ..... min^{-1}
11.1.3. Maximum net torque: ..... Nm, at ..... min^{-1}
11.2. Essential characteristics of the engine type/parent engine type: .....

11.2.1. Operating principle:

11.2.1.1. Positive-ignition/compression-ignition ([2])

11.2.1.2. Four-stroke/two-stroke ([2])

11.2.2. Number, layout and firing order of cylinders: .....

11.2.3. Cylinder capacity: ..... cm^3

11.2.4. Fuel feed: carburettor/indirect injection/direct injection ([2])

11.2.5. Pressure-charger device: yes/no ([2])

11.2.6. Exhaust after-treatment device: yes/no ([2])

11.3. Engine fuel requirements: leaded petrol/unleaded petrol/diesel fuel/NG/LPG ([2])

11.4. Restriction of use:

11.4.1. Particular conditions to be respected in the installation of the engine(s) on the machinery

11.4.1.1. Maximum allowable intake depression: ..... kPa

11.4.1.2. Maximum allowable back-pressure: ..... kPa

11.4.2. Any other (if applicable): .....

12. Main family members specifications:

Specification	Engines of the family				Parent engine
Manufacturer's type coding					
No of cylinders					
Engine capacity (cm^3)					
Rated net power (kW)					
Rated speed (min^{-1})					
Maximum net power (kW)					
Max. net power speed (min^{-1})					
Max. net torque (Nm)					
Max. net torque speed (min^{-1})					
Low idle speed (min^{-1})					
Restrictions of use (yes/no) ([2])					

13. Approval granted/extended/refused/withdrawn ([2])

14. Place: .....

15. Date: .....

16. Signature: .....

17. The documents filed with the request for approval or extension may be obtained on request

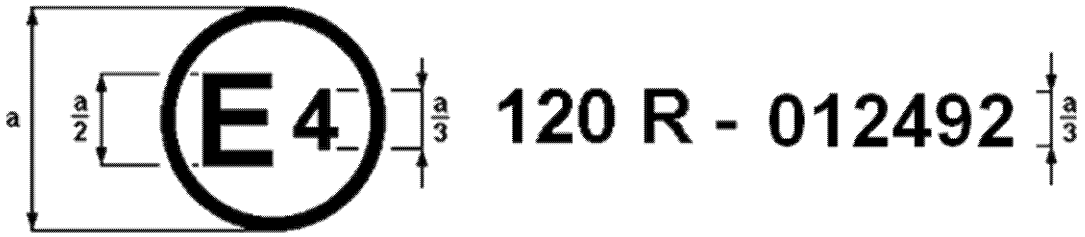
([1]) Distinguishing number of the country which has granted/extended/refused/withdrawn approval (see approval provisions in the Regulation).
([2]) Strike out which does not apply.

ANNEX 3

ARRANGEMENTS OF APPROVAL MARKS

MODEL A

(see paragraph 4.4 of this Regulation)

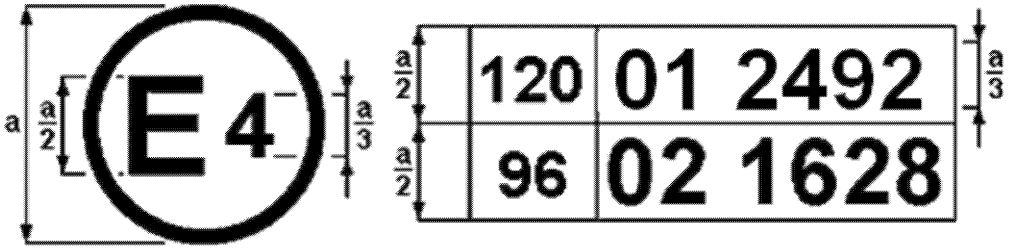


a = 8 mm min.

The above approval mark affixed to an engine shows that the engine type concerned has been approved in the Netherlands (E4) with regard to the measurement of the net power, pursuant to Regulation No 120 and under the approval number 012492. The approval number indicates that the approval was granted in accordance with the requirements of Regulation No 120 as amended by the 01 series of amendments.

MODEL B

(see paragraph 4.5 of this Regulation)



a = 8 mm min.

The above approval mark affixed to an engine shows that the engine type concerned has been approved in the Netherlands (E4) pursuant to Regulations No 120 and 96 ([1]). The first two digits of the approval numbers indicate that, at the dates when the respective approvals were granted, Regulation No 120 was amended by the 01 series of amendments, and Regulation No 96 already included the 02 series of amendments.

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

ANNEX 4

METHOD FOR MEASURING INTERNAL COMBUSTION ENGINE NET POWER

1. These provisions apply to the method for determining the power curve at full load of an internal combustion engine operated under intermittent speed as a function of engine speed and the rated speed and rated net power of an internal combustion engine under constant 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 gearbox mounted, the efficiency of the gearbox shall be taken into account.

2.3. Auxiliaries and equipment

2.3.1. Auxiliaries and equipment 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 and equipment to be removed

Certain auxiliaries whose definition is linked with the operation of the machine and which may be mounted on the engine shall be removed for the test. The following non-exhaustive list is given as a sample:

(i) Air compressor for brakes

(ii) Power steering compressor

(iii) Suspension compressor

(iv) Air-conditioning system

Where auxiliaries cannot be removed, the power they absorb in the unloaded condition may be determined and added to the measured engine power (see note h of Table 1). If this value is greater than 3 per cent of the maximum power at the test speed it may verified by the test authority.

Table 1

Equipment and auxiliaries to be installed for the test to determine engine power

Number	Equipment and auxiliaries	Fitted for emission test
1	Inlet system	
	Inlet manifold	Yes
	Crankcase emission control system	Yes
	Air flow meter	Yes
	Air filter	Yes ([a])
	Inlet silencer	Yes ([a])
	Induction-heating device of inlet manifold	Yes, standard production equipment. If possible to be set in the most favourable condition

Number	Equipment and auxiliaries	Fitted for emission test
2	Exhaust system	
	Exhaust aftertreatment	Yes, standard production equipment
	Exhaust manifold	Yes, standard production equipment
	Connecting pipes	Yes ([b])
	Silencer	Yes ([b])
	Tail pipe	Yes ([b])
	Exhaust brake	No ([c])
	Pressure charging device	Yes
3	Fuel supply pump	Yes ([d])
4	Carburation equipment	
	Carburettor	Yes
	Electronic control system, air flow meter, etc.	Yes
	Equipment for gas engines	
	Pressure reducer	Yes
	Evaporator	Yes
	Mixer	Yes
5	Fuel injection equipment (petrol and diesel)	
	Pre-filter	Yes
	Filter	Yes
	Pump	Yes
	High-pressure pipe	Yes
	Injector	Yes
	Electronic control system, sensors, etc.	Yes
	Governor/control system	Yes
	Automatic full-load stop for the control rack depending on atmospheric conditions	Yes
6	Liquid-cooling equipment	
	Radiator	No
	Fan	No
	Fan cowl	No
	Water pump	Yes ([e])
	Thermostat	Yes ([f])

Number	Equipment and auxiliaries	Fitted for emission test
7	Air cooling	
	Cowl	No (g)
	Fan or Blower	No (g)
	Temperature-regulating device	No
8	Electrical equipment	
	Generator	Yes (h)
	Spark distribution system	Yes
	Coil or coils	Yes
	Wiring	Yes
	Spark plugs	Yes
	Electronic control system including knock sensor/spark retard system	Yes
9	Pressure charging equipment	
	Compressor driven either directly by the engine and/or by the exhaust gases	Yes
	Charge air cooler	Yes (g) (i)
	Coolant pump or fan (engine-driven)	No (g)
	Coolant flow control device	Yes
10	Auxiliary test-bed fan	Yes, if necessary
11	Anti-pollution device	Yes, standard production equipment (j)
12	Starting equipment	Yes or test bed equipment (k)
13	Lubricating oil pump	Yes

(a) The complete inlet system shall be fitted as provided for the intended application:
(i) Where there is a risk of an appreciable effect on the engine power;
(ii) In the case of naturally aspirated spark ignition engines;
(iii) 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 upper limit specified by the manufacturer for a clean air filter.

(b) The compete exhaust system shall be fitted as provided for the intended application:
(i) Where there is a risk of an appreciable effect on the engine power;
(ii) In the case of naturally aspirated spark ignition engines;
(iii) When the manufacturer requests that this should be done.
In other cases, an equivalent system may be installed provided the pressure measured does not differ by more than 1 000 Pa from the upper limit specified by the manufacturer.

(c) If an exhaust brake is incorporated in the engine, the throttle valve shall be fixed in the fully open position.

(d) The fuel feed pressure may be adjusted, if necessary, to reproduce the pressure existing in the particular engine application (particularly when a 'fuel return' system is used).

(e) The cooling-liquid circulation shall be operated by the engine water pump only. Cooling of the liquid may be produced by an external circuit, such 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.

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

(g) When the cooling fan or blower is fitted for the test, the power absorbed shall be added to the results, except for engines where such auxiliaries are an integral part of the engine (i.e.: cooling fans of air cooled engines directly fitted on the crankshaft). The fan or blower power shall be determined at the speeds used for the test either by calculation from standard characteristics or by practical tests.

(h) Minimum power of the generator: the electrical power of the generator shall be limited to that necessary for operation of auxiliaries which are indispensable for engine operation. If the connection of a battery is necessary, a fully charged battery in good condition shall be used.

(i) Charge air-cooled engines shall be tested with charge air cooling, whether liquid- or air-cooled, but if the manufacturer prefers, a test bench system may replace the air cooler. In either case, the measurement of power at each speed shall be made with the maximum pressure drop and the minimum temperature drop of the engine air across the charge air cooler on the test bench system as those specified by the manufacturer.

(j) These may include, for example, exhaust-gas recirculation (EGR system), catalytic converter, thermal reactor, secondary air-supply system and fuel evaporation protecting system.

(k) The power for electrical or other starting systems shall be provided from the test bed.

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), evaporator/pressure regulator	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	
6. Boost Control	

3. DATA TO BE RECORDED

3.1. Data to be recorded are those indicated in paragraph 4 of the appendix to this annex. Performance data shall be obtained under stabilised 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 minimise the magnitude of the correction factor.

3.2. The temperature of the inlet air to the engine shall be measured within the inlet ductwork. The inlet depression measurement shall be made at the same point. The thermometer or thermocouple shall be shielded from fuel spray-back and radiant heat and located directly in the air stream. A sufficient number of locations shall be used to give a representative average of the inlet temperature.

3.3. The inlet depression shall be measured downstream of the entry ducts, air filter, inlet silencer or speed-limiting device (if fitted).

3.4. The absolute pressure at the entry to the engine downstream of the compressor and heat exchanger, if fitted, shall be measured in the inlet manifold and at any other point where pressure has to be measured to calculate correction factors.

3.5. The exhaust back pressure shall be measured at a point at least three pipe diameters downstream from the outlet flange(s) of the exhaust manifold(s) and downstream at the turbocharger(s), if fitted. The location shall be specified.

3.6. No data shall be taken until torque, speed and temperatures have been maintained substantially constant for at least one minute.

3.7. The engine speed during a run or reading shall not deviate from the selected speed by more than ± 1 per cent or ± 10 min, whichever is greater.

3.8. Observed brake load, fuel consumption and inlet air temperature data shall be taken simultaneously and shall be the average of two stabilised consecutive values which do not vary more than 2 per cent for the brake load.

3.9. 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 K ± 5 K. For air-cooled engines, the temperature at a point indicated by the manufacturer shall be kept within + 0/– 20 K of the maximum value specified by the manufacturer in the reference conditions.

3.10. For C.I. engines, the fuel temperature shall be measured at the inlet of the fuel injection pump and maintained within 306-316 K (33-43 °C) for positive-ignition engines the fuel temperature shall be measured as near as possible to the inlet of the carburettor or assembly of fuel injectors and maintained within 293-303 K (20-30 °C).

3.11. The temperature of the lubricating oil measured in the oil pump or at the outlet from the coil cooler, if fitted, shall be maintained within the limits established by the engine manufacturer.

3.12. An auxiliary regulating system may be used if necessary to maintain the temperatures within the limits specified in paragraphs 3.9, 3.10 and 3.11 above of this annex.

4. ACCURACY OF MEASUREMENTS

4.1. 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.

4.2. Engine speed: 0,5 per cent of measured speed.

4.3. Fuel consumption: ± 1 per cent of measured consumption.

4.4. Fuel temperature: ± 2 K.

4.5. Engine inlet air temperature: ± 2 K.

4.6. Barometric pressure: ± 100 Pa.

4.7. Depression in inlet system: ± 50 Pa.

4.8. Back-pressure in exhaust system: ± 200 Pa.

5. POWER CORRECTION FACTORS

5.1. Definition

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

$$P_o = \alpha P$$

where:

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

α is the correction factor (α_a or α_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

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: $288\ K \leq T \leq 308\ K$

For compression-ignition engines: $283\ K \leq T \leq 313\ K$

5.3.2. Pressure (p_s)

$$90\ kPa < p_s < 110\ kPa$$

5.4. Determination of correction factor α_a and α_d [1]

5.4.1. Naturally aspirated or pressure-charged positive-ignition engine

The correction factor α_a is obtained by applying the formula:

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

where:

p_s is the total dry atmospheric pressure in kilopascals (kPa); i.e. 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 must be such that

$$0,93 < \alpha_a < 1,07$$

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.

5.4.2. Compression-ignition engines — factor α_d

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

$$\alpha_d = (f_a)^{fm}$$

where:

f_a is the atmospheric factor

f_m the characteristic parameter for each type of engine and adjustment

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

5.4.2.1. 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 pressure charged engines

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

5.4.2.1.2. Turbocharged engines with or without charge air cooling

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

5.4.2.2. Engine factor f_m

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

$f_m = 0{,}036\ q_c - 1{,}14$

and

$q_c = q/r$

Where:

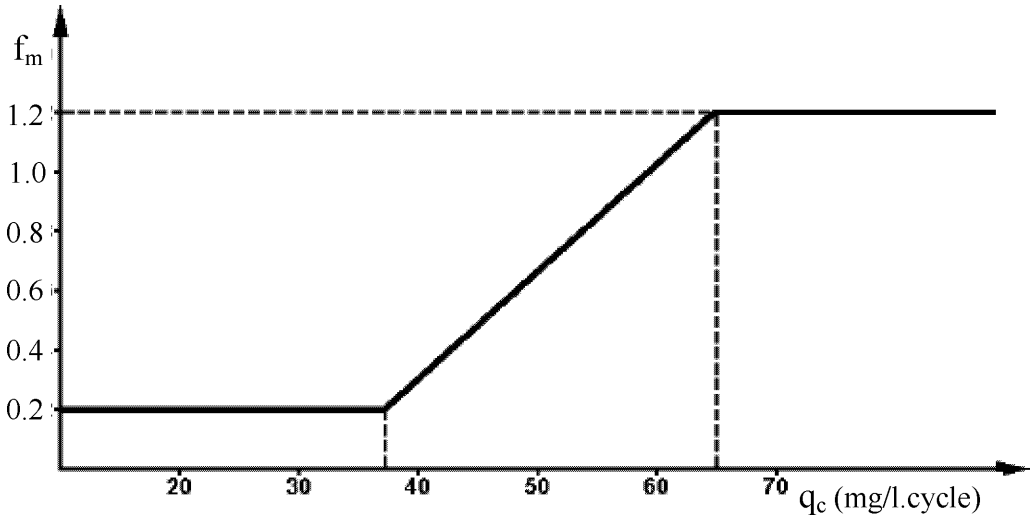
q is the fuel flow in milligram per cycle per litre of total swept volume (mg/(l.cycle))

r is the pressure ratio of compressor outlet and compressor inlet in case of multiple turbochargers r represents the total compression ratio (r = 1 for naturally aspirated engines)

This formula is valid for a value interval of q_c included between 37,2 mg/(l.cycle) and 65 mg/(l.cycle).

For q_c values lower than 37,2 mg/(l.cycle), a constant value of f_m equal to 0,2 (f_m = 0,2) 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 factors 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.

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. Location of exhaust back-pressure measuring point

1.2. Location of inlet depression measuring point

1.3. Characteristics of the dynamometer

1.3.1. Make: ..... Model: .....

1.3.2 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: .....

2.1.3.2. Content: ..... mg/l

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

2.1.4.1. Specify density: ..... g/cm^3 at 288 K

2.1.4.2. Lower calorific value: ..... kJ/kg

2.2. For positive-ignition engines operating on gaseous fuel

2.2.1. Make: .....

2.2.2. Specification: .....

2.2.3. Storage pressure: ..... bar

2.2.4. Utilisation 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 operating on liquid fuel

2.4.1. Make: .....

2.4.2. Specification of fuel used: .....

2.4.3. Cetane number (ASTM D 976-71): .....

2.4.4. Specify density: ..... g/cm^3 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 (*)

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 equipment and auxiliaries in excess of Table 1, kW Total, kW	No 1 No 2 No 3		
Power correction factor			
Corrected power, kW			
Corrected torque, Nm			
Corrected specific fuel consumption g/(kWh) (2)			
Cooling liquid temperature at outlet, K			
Lubricating oil temperature at measuring point, K			
Air temperature after pressure-charger, K (1)			
Fuel temperature at injection pump inlet, K			
Air temperature after charge air cooler, K (1)			
Pressure after pressure-charger, kPa			

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

Engine speed, min^{-1}		
Pressure after charge air cooler, kPa		
Inlet depression, Pa		
Exhaust back-pressure, Pa		
Fuel delivery, mm^3/stroke or cycle (1)		

(1) Strike out what does not apply.
(2) Calculated with the net power for compression-ignition and positive-ignition engines, in the latter case multiplied by the power correction factor.

ANNEX 5

ESSENTIAL CHARACTERISTICS OF THE ENGINE FAMILY

1. GENERAL

An engine family is characterised by design parameters. These shall be common to all engines within the family. The engine manufacturer may decide which engines belong to an engine family, as long as the membership criteria listed in paragraph 3.1 are respected. The engine family shall be approved by the Type Approval Authority. Since the choice of the engine family has significant implications on the engine exhaust emissions, paragraph 2.1 reports additional information (03 series of amendments to Regulation No 96), useful for the manufacturer and the Type Approval Authority when evaluating the engine family and choosing the parent engine.

2. SPECIAL CASES

2.1. Interactions between parameters

In some cases there may be interaction between parameters, which may cause emissions to change. This shall be taken into consideration to ensure that only engines with similar exhaust emission characteristics are included within the same engine family. These cases shall be identified by the manufacturer and notified to the Type Approval Authority. It shall then be taken into account as a criterion for creating a new engine family.

2.2. Devices or features having a strong influence on emissions

In case of devices or features, which are not listed in paragraph 3.1 and which have a strong influence on the level of emissions, this equipment shall be identified by the manufacturer using good engineering judgment, and shall be notified to the Type Approval Authority. It shall then be taken into account as a criterion for creating a new engine family.

2.3. Additional criteria

In addition to the parameters listed in paragraph 3.1, the manufacturer may introduce additional criteria allowing the definition of families of more restricted size. These parameters are not necessarily parameters that have an influence on the level of emissions.

3. PARAMETERS DEFINING THE ENGINE FAMILY

3.1. Combustion cycle:

(a) 2-stroke cycle;

(b) 4-stroke cycle;

(c) Rotary engine;

(d) Others.

3.2. Fuel type:

(a) Diesel;

(b) Petrol;

(c) Gaseous (NG or LPG).

3.3. Configuration of the cylinders

3.3.1. Position of the cylinders in the block:

(a) V;

(b) In-line;

(c) Radial;

(d) Others (F, W, etc.).

3.3.2. Relative position of the cylinders

Engines with the same block may belong to the same family as long as their bore centre-to-centre dimensions are the same.

3.4. Main cooling medium:

(a) Air;

(b) Water;

(c) Oil.

3.5. Individual cylinder displacement

Within 85 per cent and 100 per cent for engines with a unit cylinder displacement ≥ 0,75 dm^3 of the largest displacement within the engine family.

Within 70 per cent and 100 per cent for engines with a unit cylinder displacement < 0,75 dm^3 of the largest displacement within the engine family.

3.6. Method of air aspiration:

(a) Naturally aspirated;

(b) Pressure charged;

(c) Pressure charged with charge cooler.

3.7. Combustion chamber type/design:

(a) Open chamber;

(b) Divided chamber;

(c) Other types.

3.8. Valves and porting:

(a) Configuration;

(b) Number of valves per cylinder;

(c) Cylinder wall;

(d) Crankcase.

3.9. Fuel supply type

3.9.1. For compression ignition engines:

(a) Pump, (high pressure) line and injector;

(b) In-line pump or distributor pump;

(c) Unit injector;

(d) Common rail.

3.9.2. For positive ignition engines:

(a) Carburettor;

(b) Port fuel injection;

(c) Direct injection.

3.10. Miscellaneous devices:

(a) Exhaust gas recirculation (EGR);

(b) Water injection;

(c) Air injection;

(d) Others.

3.11. Electronic control strategy

The presence or absence of an Electronic Control Unit (ECU) on the engine is regarded as a basic parameter of the family.

In the case of electronically controlled engines, the manufacturer shall present the technical elements explaining the grouping of these engines in the same family, i.e. the reasons why these engines can be expected to satisfy the same emission requirements.

The electronic governing of speed does not need to be in a different family from those with mechanical governing. The need to separate electronic engines from mechanical engines should only apply to the fuel injection characteristics, such as timing, pressure, rate shape, etc.

3.12. Exhaust after-treatment systems

The function and combination of the following devices are regarded as membership criteria for an engine family:

(a) Oxidation catalyst;

(b) $DeNO_x$ system with selective reduction of NO_x (addition of reducing agent);

(c) Other $DeNO_x$ systems;

(d) Particulate trap with passive regeneration;

(e) Particulate trap with active regeneration;

(f) Other particulate traps;

(g) Other devices.

When an engine has been certified without an after-treatment system, whether as a parent engine or as a member of the family, then this engine, when equipped with an oxidation catalyst (not with particulate trap), may be included in the same engine family, if it does not require different fuel characteristics.

If it requires specific fuel characteristics (e.g. particulate traps requiring special fuel additives to ensure the regeneration process), the decision to include it in the same family shall be based on technical elements provided by the manufacturer. These elements shall indicate that the expected emission level of the equipped engine complies with the same limit value as the non-equipped engine.

When an engine has been certified with an after-treatment system, whether as a parent engine or as a member of a family, where the parent engine is equipped with the same after-treatment system, then this engine, when equipped without an after-treatment system, shall not be added to the same engine family.

ANNEX 6

CHECKS ON CONFORMITY OF PRODUCTION

1. GENERAL

These requirements are consistent with tests to be held to check conformity of production (COP), according to paragraph 6.2 of this Regulation.

2. TEST PROCEDURES

The methods of testing and measuring instruments shall be those described in Annex 4 to this Regulation.

3. COLLECTION OF SAMPLES

3.1. Case of an engine type

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

3.2. Case of a family of engines

In case of an approval granted to a family of engines the COP shall be run on one member of the family, which is not the parent engine. In case of failure of the COP test, the two more engines shall be of the same member type.

4. MEASUREMENT CRITERIA

4.1. Net power and specific fuel consumption of internal combustion engine

Measurements shall be taken at a sufficient number of engine speeds to define correctly the power, torque and specific fuel consumption curves between the lowest and the highest engine speeds recommended by the manufacturer as defined in paragraphs 2.9 and 2.11 of this Regulation.

The corrected values measured for the engine sampled shall not differ by more than the values indicated in the table below and ± 10 per cent for the specific fuel consumption.

Engine type	Rated net power (torque) [%]	Other measurement points on the curve [%]	Tolerance for engine speed [%]
General	± 5	± 10	± 5
Petrol fuelled spark ignited engines with governor	± 8	± 12	± 8
Petrol fuelled spark ignited engines without governor	± 8	± 20	± 8

5. EVALUATION OF RESULTS

If the net power and fuel consumption figures of the second and/or third engine of paragraph 3 do not fulfil the requirements of paragraph 4 above, the production shall be considered not to conform to the requirements of this Regulation and the provision of paragraph 7 of this Regulation shall be put into effect.

ANNEX 7

TECHNICAL DATA OF REFERENCE FUELS

1. Technical data of the LPG reference fuels

Parameter	Unit	Limits Fuel A		Limits Fuel B		Test Method
		Minimum	Maximum	Minimum	Maximum	
Motor octane number	1	92,5 (1)		92,5		EN 589 Annex B
Composition:						
C3 content	% vol	48	52	83	87	
C4 content	% vol	48	52	13	17	ISO 7941
Olefins	% vol		12		14	
Evaporation residue	mg/kg		50		50	NFM 41-015
Total sulphur content	ppm mass (1)		50		50	EN 24260
Hydrogen sulphide	—		None		None	ISO 8819
Copper strip corrosion	rating		Class 1		Class 1	ISO 6251 (2)
Water at 0 °C			Free		Free	Visual inspection

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

(2) 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

European market fuels are available in two ranges:

— The H range, whose extreme reference fuels are GR and G23;

— The L range, whose extreme reference fuels are G23 and G25.

The characteristics of GR, G23 and G25 reference fuels are summarised below:

Reference fuel GR					
Characteristics	Units	Basis	Limits		Test Method
			Minimum	Maximum	
Composition:					
Methane		87	84	89	
Ethane		13	11	15	
Balance (1)	%-mole	—	—	1	ISO 6974
Sulphur content	mg/m^3 (2)	—	—	10	ISO 6326-5

(1) Inerts $+C2_+$

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

Reference fuel G23					
Characteristics	Units	Basis	Limits		Test Method
			Minimum	Maximum	
Composition:					
Methane		92,5	91,5	93,5	
Balance (1)	%-mole	—	—	1	ISO 6974
N2		7,5	6,5	8,5	
Sulphur content	mg/m³ (2)	—	—	10	ISO 6326-5

(1) Inerts (different from N2) +C2/$C2_+$
(2) Value to be determined at standard conditions (293,2 K (20 °C) and 101,3 kPa).

Reference fuel G25					
Characteristics	Units	Basis	Limits		Test Method
			Minimum	Maximum	
Composition:					
Methane		86	84	88	
Balance (1)	%-mole	—	—	1	ISO 6974
N2		14	12	16	
Sulphur content	mg/m³ (2)	—	—	10	ISO 6326-5

(1) Inerts (different from N2) +C2 +$C2_+$
(2) Value to be determined at standard conditions (293,2 K (20 °C) and 101,3 kPa).

3. Reference fuel for positive-ignition engines

Parameter	Unit	Limits (1)		Test Method	Publication
		Minimum	Maximum		
Research octane number, RON		95,0	—	EN 25164	1993
Motor octane number, MON		85,0	—	EN 25163	1993
Density at 15 °C	kg/m³	748	775	ISO 3675	1995
Reid vapour pressure	kPa	56,0	95,0	EN 12	1993
Distillation:					
— initial boiling point	°C	24	40	EN-ISO 3405	1988

Parameter	Unit	Limits (1)		Test Method	Publication
		Minimum	Maximum		
— evaporated at 100 °C	per cent v/v	49,0	57,0	EN-ISO 3405	1988
— evaporated at 150 °C	per cent v/v	81,0	87,0	EN-ISO 3405	1988
— final boiling point	°C	190	215	EN-ISO 3405	1988
Residue	per cent	—	2	EN-ISO 3405	
Hydrocarbon analysis:					
— olefins	per cent v/v	—	10	ASTM D 1319	1995
— aromatics	per cent v/v	28,0	40,0	ASTM D 1319	1995
— benzene	per cent v/v	—	1,0	pr. EN 12177	1998
— saturates		—	Balance	ASTM D 1319	1995
Carbon/hydrogen ratio		Report	Report		
Oxidation stability (2)	mn.	480	—	EN-ISO 7536	1996
Oxygen content	per cent m/m	—	2,3	EN 1601	1997
Existent gum	mg/ml	—	0,04	EN-ISO 6246	1997
Sulphur content (3)	mg/kg	—	100	pr. EN-ISO 14596	1998
Copper corrosion at 50 °C		—	1	EN-ISO 2160	1995
Lead content	g/l	—	0,005	EN 237	1996
Phosphorus content	g/l	—	0,0013	ASTM D 3231	1994

(1) The values quoted in the specifications are 'true values'. In establishment of their limit values the terms of ISO 4259 Petroleum — products Determination and application of precision data in relation to methods of test have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility). Notwithstanding this measure, which is necessary for technical reasons, the manufacturer of fuels shall nevertheless aim at a zero value where the stipulated maximum value is 2R and at the mean value in the case of quotations of maximum and minimum limits. Should it be necessary to clarify whether a fuel meets the requirements of the specifications, the terms of ISO 4259 shall be applied.

(2) The fuel may contain oxidation inhibitors and metal deactivators normally used to stabilise refinery gasoline streams, but detergent/dispersive additives and solvent oils shall not be added.

(3) The actual sulphur content of the fuel used shall be reported.

4. Reference fuel for compression-ignition engines (1)

Table 1 (1) (11)

Agricultural and forestry tractors and non-road mobile machinery reference fuel for CI engines type approved to meet limit values of power bands D to G

	Limits and units (2)	Test method
Cetane number (4)	Minimum 45 (7) Maximum 50	ISO 5165

	Limits and units (2)	Test method
Density at 15 °C	Minimum 835 kg/m³ Maximum 845 kg/m³ (10)	ISO 3675, ASTM D 4052
Distillation (3) — 95 per cent point	Maximum 370 °C	ISO 3405
Viscosity at 40 °C	Minimum 2,5 mm²/s Maximum 3,5 mm²/s	ISO 3104
Sulphur content	Minimum 0,1 per cent mass (9) Maximum 0,2 per cent mass (8)	ISO 8754, EN 24260
Flash point	Minimum 55 °C	ISO 2719
CFPP	Minimum — Maximum +5 °C	EN 116
Copper corrosion	Maximum 1	ISO 2160
Conradson carbon residue (10 per cent DR)	Maximum 0,3 per cent mass	ISO 10370
Ash content	Maximum 0,01 per cent mass	ASTM D 482 (12)
Water content	Maximum 0,05 per cent mass	ASTM D 95, D 1744
Neutralisation (strong acid) number	Minimum 0,20 mg KOH/g	
Oxidation stability (5)	Maximum 2,5 mg/100 ml	ASTM D 2274
Additives (6)		

(1) If it is required to calculate thermal efficiency of an engine or vehicle, the calorific value of the fuel can be calculated from:
Specific energy (calorific value) (net) MJ/kg = (46,423 − 8,792 * d² + 3,17 * d) * (1 − (x + y + s)) + 9,42 * s − 2,499 * x
where:
d = is the density at 288 K (15 °C)
x = is the proportion by mass of water (%/100)
y = is the proportion by mass of ash (%/100)
s = is the proportion by mass of sulphur (%/100).

(2) The values quoted in the specification are 'true values'. In establishment of their limit values the terms of ISO 4259 'Defining a basis for petroleum produce quality disputes' have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility).
Notwithstanding this measure, which is necessary for statistical reasons, the manufacturer of fuel should nevertheless aim at a zero value where the stipulated maximum value is 2R and the mean value in the case of quotations of maximum and minimum limits. Should it be necessary to clarify the question as to whether a fuel meets the requirements of the specifications, the terms of ISO 4259 should be applied.

(3) The figures quoted show the evaporated quantities (percentage recovered + percentage loss).

(4) The range of cetane is not in accordance with the requirement of a minimum range of 4R. However, in cases of dispute between fuel supplier and fuel user, the terms in ISO 4259 can be used to resolve such disputes provided replicate measurements, of sufficient number to achieve the necessary precision, are made in preference to single determinations.

(5) Even though oxidation stability is controlled, it is likely that shelf life will be limited. Advice should be sought from the supplier as to storage conditions and life.

(6) This fuel should be based straight run and cracked hydrocarbon distillate components only; desulphurisation is allowed. It shall not contain any metallic additives or cetane improver additives.

(7) Lower values are permitted, in which case the cetane number of the reference fuel used is to be reported.

(8) Higher values are permitted, in which case the sulphur content of the reference fuel used is to be reported.

(9) To be kept under constant review in the light of trends in the markets. For the purpose of the initial approval of an engine with no exhaust gas after treatment on request of the applicant a 0,050 per cent mass sulphur minimum is permissible, in which case the measured particulate level shall be corrected upward to the average value that is nominally specified for fuel sulphur content (0,150 per cent mass) per the equation below:

$PT_{adj} = PT + [SFC * 0{,}0917 * (NSLF - FSF)]$

where:

PT_{adj} = adjusted PT value (g/kWh)

PT = measured weighted specific emission value for particulate emission (g/kWh)

SFC = weighted specific fuel consumption (g/kWh) calculated according to the formula as below

NSLF = average of the nominal specification of sulphur content mass fraction (i.e. 0,15 %/100)

FSF = fuel sulphur content mass fraction (%/100)

Equation for the calculation of the weighted specific fuel consumption:

$$SFC = \frac{\sum_{i=1}^{n} G_{FUEL,i} \times WF_i}{\sum_{i=1}^{n} P_i \times WF_i}$$

where:

$P_i = P_{m,i} + P_{AE,i}$

For the purpose of conformity of production assessments in accordance with paragraph 6 of this Regulation the requirements shall be met using reference fuel with a sulphur content which complies with the minimum/maximum level of 0,1/0,2 per cent mass.

(10) Higher values are permitted up to 855 kg/m³, in which case the density of the reference fuel used is to be reported. For the purpose of conformity of production assessments in accordance with paragraph 6 of this Regulation, the requirements shall be met using reference fuel which complies with the minimum/maximum level of 835/845 kg/m³.

(11) All fuel characteristics and limit values are to be kept under review in light of trends in the markets.

(12) To be replaced by EN/ISO 6245 with effect of the date of implementation.

Table 2

Agricultural and forestry tractors and non-road mobile machinery reference fuel for CI engines type approved to meet limit values of power bands H to K

Parameter	Unit	Limits (1)		Test Method
		Minimum	Maximum	
Cetane number (2)		52,0	54,0	EN-ISO 5165
Density at 15 °C	kg/m³	833	837	EN-ISO 3675
Distillation:				
50 per cent point	°C	245	—	EN-ISO 3405
95 per cent point	°C	345	350	EN-ISO 3405
Final boiling point	°C	—	370	EN-ISO 3405
Flash point	°C	55	—	EN 22719
CFPP	°C	—	– 5	EN 116
Viscosity at 40 °C	mm²/s	2,5	3,5	EN-ISO 3104
Polycyclic aromatic hydrocarbons	per cent m/m	3,0	6,0	IP 391
Sulphur content (3)	mg/kg	—	300	ASTM D 5453

Parameter	Unit	Limits (1)		Test Method
		Minimum	Maximum	
Copper corrosion		—	class 1	EN-ISO 2160
Conradson carbon residue (10 per cent DR)	per cent m/m	—	0,2	EN-ISO 10370
Ash content	per cent m/m	—	0,01	EN-ISO 6245
Water content	per cent m/m	—	0,05	EN-ISO 12937
Neutralisation (strong acid) number	mg KOH/g	—	0,02	ASTM D 974
Oxidation stability (4)	mg/ml	—	0,025	EN-ISO 12205

(1) The values quoted in the specifications are 'true values'. In establishment of their limit values the terms of ISO 4259 'Petroleum products — Determination and application of precision data in relation to methods of test' have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility).

Notwithstanding this measure, which is necessary for technical reasons, the manufacturer of fuels should nevertheless aim at a zero value where the stipulated maximum value is 2R and at the mean value in the case of quotations of maximum and minimum limits. Should it be necessary to clarify the questions as to whether a fuel meets the requirements of the specifications, the terms of ISO 4259 should be applied.

(2) The range for the cetane number is not in accordance with the requirements of a minimum range of 4R. However, in the case of a dispute between fuel supplier and fuel user, the terms of ISO 4259 may be used to resolve such disputes provided replicate measurements, of sufficient number to archive the necessary precision, are made in preference to single determinations.

(3) The actual sulphur content of the fuel used for the test shall be reported.

(4) Even though oxidation stability is controlled, it is likely that shelf life will be limited. Advice should be sought from the supplier on storage conditions and shelf life.

Table 3

Agricultural and forestry tractors and non-road mobile machinery reference fuel for CI engines type approved to meet limit values of power bands L to R

Parameter	Unit	Limits (1)		Test method
		Minimum	Maximum	
Cetane number (2)			54,0	EN-ISO 5165
Density at 15 °C	kg/m³	833	865	EN-ISO 3675
Distillation:				
50 per cent point	°C	245	—	EN-ISO 3405
95 per cent point	°C	345	350	EN-ISO 3405
Final boiling point	°C	—	370	EN-ISO 3405
Flash point	°C	55	—	EN 22719
CFPP	°C	—	– 5	EN 116

Parameter	Unit	Limits (1)		Test method
		Minimum	Maximum	
Viscosity at 40 °C	mm^2/s	2,3	3,3	EN-ISO 3104
Polycyclic aromatic hydrocarbons	per cent m/m	3,0	6,0	IP 391
Sulphur content (3)	mg/kg	—	10	ASTM D 5453
Copper corrosion		—	class 1	EN-ISO 2160
Conradson carbon residue (10 per cent DR)	per cent m/m	—	0,2	EN-ISO 10370
Ash content	per cent m/m	—	0,01	EN-ISO 6245
Water content	per cent m/m	—	0,02	EN-ISO 12937
Neutralisation (strong acid) number	mg KOH/g	—	0,02	ASTM D 974
Oxidation stability (4)	mg/ml	—	0,025	EN-ISO 12205
Lubricity (HFRR wear scar diameter at 60 °C)	µm	—	400	CEC F-06-A-96
FAME	prohibited			

(1) The values quoted in the specifications are 'true values'. In establishment of their limit values the terms of ISO 4259 'Petroleum products — Determination and application of precision data in relation to methods of test' have been applied and in fixing a minimum value, a minimum difference of 2R above zero has been taken into account; in fixing a maximum and minimum value, the minimum difference is 4R (R = reproducibility).

Notwithstanding this measure, which is necessary for technical reasons, the manufacturer of fuels should nevertheless aim at a zero value where the stipulated maximum value is 2R and at the mean value in the case of quotations of maximum and minimum limits. Should it be necessary to clarify the questions as to whether a fuel meets the requirements of the specifications, the terms of ISO 4259 should be applied.

(2) The range for cetane number is not in accordance with the requirements of a minimum range of 4R. However, in the case of a dispute between fuel supplier and fuel user, the terms of ISO 4259 may be used to resolve such disputes provided replicate measurements, of sufficient number to archive the necessary precision, are made in preference to single determinations.

(3) The actual sulphur content of the fuel used for the Type I test shall be reported.

(4) Even though oxidation stability is controlled, it is likely that shelf life will be limited. Advice should be sought from the supplier as to storage conditions and life.