

Transmitted by the expert from Italy

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(61st GRPE, 11-14 January 2011,
agenda item 5(c))

Proposal for draft 01 series of amendments to Regulation No. 120

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

Note: The aim of this proposal is to amend Regulation No. 120 in order to align the provisions of this Regulation with those of gtr No. 11 and Regulation No. 96.

I. Proposal

Paragraph 1.1.2., amend to read:

1.1.2. Non-road mobile machinery 1/, operated under ~~intermittent~~ **variable** or constant speed.

Paragraph 2.3., amend to read:

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**

Paragraph 2.9., replace with the following paragraph:

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;

Paragraph 5.3.1., amend to read:

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**, ~~± 2 per cent for rated net power and more than ± 4 per cent at the other measurement points on the curve with a tolerance of ± 1.5 per cent for engine speed,~~ from the 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
Small petrol fuelled spark ignited engines (≤ 19 kW) without governor	± 4	± 6	± 4
Small petrol fuelled spark ignited engines (≤ 19 kW) without governor	± 4	± 10	± 4

1/ As defined in the consolidated Resolution on the Construction of Vehicles (R.E: 3), Annex 7 ([ECE/TRANS/WP29/78/Rev.2] based on ECE/TRANS/WP29/2010/145 to be adopted by WP.29 in March 2011).

Paragraph 5.3.2., amend to read:

“5.3.2. The rated speed declared by the manufacturer shall not deviate by more than 100 min⁻¹ from the declared value measured by the technical service on the engine submitted for testing. For small (≤19 kW) 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%, whatever is smaller.”

Annex I Appendix 1 paragraph 2: amend to read:

“2. ~~ADDITIONAL ANTI-POLLUTION DEVICES~~ (if any, and if not covered by another heading)

MEASURES TAKEN AGAINST AIR POLLUTION

Description and/or diagram(s):

- 2.1. Device for recycling crankcase gases: yes/no
- 2.2. Additional anti-pollution devices (if any, and if not covered by another heading)
 - 2.2.1. Catalytic converter: yes/no1
 - 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. NOx sensor: yes/no1
- 2.2.2. Oxygen sensor: yes/no1
 - 2.2.2.1. Make(s):
 - 2.2.2.2. Type:
 - 2.2.2.3. Location:
- 2.2.3. Air injection: yes/no1
 - 2.2.3.1. Type (pulse air, air pump, etc.):
- 2.2.4. EGR: yes/no1
 - 2.2.4.1. Characteristics (cooled/uncooled, high pressure/low pressure, etc.):
- 2.2.5. Particulate trap: yes/no
 - 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/no1
 - 2.2.6.1. Description and operation:"

Annex 1, Appendix 3, Paragraph 2, amend to read:

~~“2. ADDITIONAL ANTI POLLUTION DEVICES (if any, and if not covered by another heading)~~

MEASURES TAKEN AGAINST AIR POLLUTION

Description and/or diagram(s):

- 2.1. Device for recycling crankcase gases: yes/no
- 2.2. Additional anti-pollution devices (if any, and if not covered by another heading)
 - 2.2.1. Catalytic converter: yes/no1
 - 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. NOx sensor: yes/no1
- 2.2.2. Oxygen sensor: yes/no1
 - 2.2.2.1. Make(s):
 - 2.2.2.2. Type:
 - 2.2.2.3. Location:
- 2.2.3. Air injection: yes/no1
 - 2.2.3.1. Type (pulse air, air pump, etc.):
- 2.2.4. EGR: yes/no1
 - 2.2.4.1. Characteristics (cooled/uncooled, high pressure/low pressure, etc.):
- 2.2.5. Particulate trap: yes/no
 - 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/no1

2.2.6.1. Description and operation:”

Annex 2 paragraph 11.1.4., Delete paragraph.

Annex 4, Paragraph 2.3.2., amend to read:

“2.3.2. Auxiliaries and equipment to be removed

Certain ~~accessories~~ **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 ~~accessories~~ **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.

Annex 4, Table 1., amend to read:

“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, standard production equipment.
	Crankcase emission control system	Yes, standard production equipment.
	Control devices for dual induction inlet manifold system	Yes, standard production equipment.
	Air flow meter	Yes, standard production equipment.
	Air inlet duct work	Yes. a/
	Air filter	Yes. a/
	Inlet silencer	Yes. a/
	Speed limiting device	Yes. a/

Number	Equipment and auxiliaries	Fitted for emission test
	Induction-heating device of inlet manifold	Yes, standard production equipment. If possible to be set in the most favourable condition
2	Induction heating device of inlet manifold	Yes, standard production equipment. If possible to be set in the most favourable condition.
3 2	Exhaust system Exhaust purifier - aftertreatment Exhaust manifold Connecting pipes Silencer Tail pipe Exhaust brake Pressure charging device	Yes, standard production equipment. Yes, standard production equipment. Yes. <u>b/</u> Yes. <u>b/</u> Yes. <u>b/</u> No. <u>c/</u> Yes, standard production equipment.
4 3	Fuel supply pump	Yes, standard production equipment. <u>d/</u>
5 4	Carburation equipment Carburettor Electronic control system, air flow meter, etc. Equipment for gas engines Pressure reducer Evaporator Mixer	Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment.
6 5	Fuel injection equipment (petrol and diesel) Pre-filter Filter Pump High-pressure pipe Injector Air inlet valve	Yes, standard production or test bed equipment. Yes, standard production or test bed equipment. Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment. <u>e/</u>

Number	Equipment and auxiliaries	Fitted for emission test
	Electronic control system, sensors, etc. Governor/control system Automatic full-load stop for the control rack depending on atmospheric conditions	Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment.
7 6	Liquid-cooling equipment Radiator Fan Fan cowl Water pump Thermostat	No. No. No. Yes, standard production equipment. f/ e/ Yes, standard production equipment. g/f/
8 9	Air cooling Cowl Fan or Blower Temperature-regulating device	No. h/ g/ No. h/ g/ No.
9 10	Electrical equipment Generator Spark distribution system Coil or coils Wiring Spark plugs Electronic control system including knock sensor/spark retard system	Yes, standard production equipment. i/ h/ Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment. Yes, standard production equipment.
10 11	Pressure charging equipment Compressor driven either directly by the engine and/or by the exhaust gases Charge air cooler Coolant pump or fan (engine-driven) Coolant flow control device	Yes, standard production equipment. Yes, standard production or test bed equipment. h/, k/ g/ i/ No. h/ g/ Yes, standard production equipment.

Number	Equipment and auxiliaries	Fitted for emission test
11 12	Auxiliary test-bed fan	Yes, if necessary.
12 13	Anti-pollution device	Yes, standard production equipment. h/ i/
13 14	Starting equipment	Yes or test bed equipment. m/ k/
14 15	Lubricating oil pump	Yes, standard production equipment.

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 complete 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 air intake valve is the control valve for the pneumatic governor of the injection pump. The governor or the fuel injection equipment may contain other devices which may affect the amount of injected fuel.~~

~~f/~~ 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.

~~g/~~ f/ The thermostat may be fixed in the fully open position.

~~h/~~ 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.

~~i/~~ h/ Minimum power of the generator: the electrical power of the generator shall be limited to that necessary for operation of ~~accessories~~ **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.

~~k/~~ 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.

~~l/~~ j/ These may include, for example, exhaust-gas recirculation (EGR system ^{*/}), catalytic converter, thermal reactor, secondary air-supply system and fuel evaporation protecting system.

~~m/~~ k/ The power for electrical or other starting systems shall be provided from the test bed.”

Annex 4, Paragraph 5.4.2.2., amend to read:

“5.4.2.2. Engine factor f_m

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

$$f_m = 0.036 q_c - 1.14$$

and

$$q_c = q/r$$

where:

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

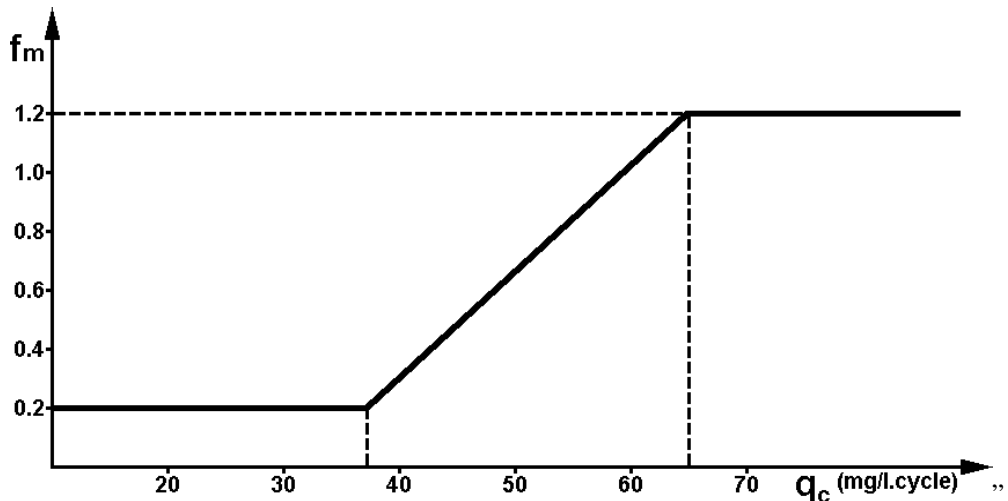
r is the pressure ratio of compressor outlet and compressor inlet **in case of multiple turbochargers r represents the total compression ratio** ($r = 1$ for naturally aspirated engines)

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):

^{*/} Exhaust gas recirculation.



Annex 5, Replace the whole annex with the following text:

“ESSENTIAL CHARACTERISTICS OF THE ENGINE FAMILY

1.1. General

An engine family is characterized 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 1.3. 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 1.2 reports additional information (Regulation N. 96-03), useful for the manufacturer and the type approval authority when evaluating the engine family and choosing the parent engine.

1.2. Special cases

1.2.1. 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.

1.2.2. Devices or features having a strong influence on emissions

In case of devices or features, which are not listed in paragraph 1.3. 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.

1.2.3. Additional criteria

In addition to the parameters listed in paragraph 1.3., 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.

1.3. Parameters defining the engine family

1.3.1. Combustion cycle

- (a) 2-stroke cycle;
- (b) 4-stroke cycle;
- (c) Rotary engine;
- (d) Others.

1.3.2. Fuel type

Diesel

Petrol

Gaseous (NG or LPG)

1.3.3. Configuration of the cylinders

1.3.3.1. Position of the cylinders in the block

- (a) V;
- (b) In-line;
- (c) Radial;
- (d) Others (F, W, etc.).

1.3.3.2. 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.

1.3.4. Main cooling medium

- (a) Air;
- (b) Water;
- (c) Oil.

1.3.5. Individual cylinder displacement

Within 85 per cent and 100 per cent for engines with a unit cylinder displacement ≥ 0.75 dm³ 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 dm³ of the largest displacement within the engine family.

- 1.3.6. Method of air aspiration**
 - (a) Naturally aspirated;**
 - (b) Pressure charged;**
 - (c) Pressure charged with charge cooler.**

- 1.3.7. Combustion chamber type/design**
 - (a) Open chamber;**
 - (b) Divided chamber;**
 - (c) Other types.**

- 1.3.8. Valves and porting**
 - (a) Configuration;**
 - (b) Number of valves per cylinder**
 - (c) Cylinder wall**
 - (d) Crankcase.**

- 1.3.9. Fuel supply type**
- 1.3.9.1 For compression ignition engines**
 - (a) Pump, (high pressure) line and injector;**
 - (b) In-line pump or distributor pump;**
 - (c) Unit injector;**
 - (d) Common rail.**

- 1.3.9.2 For positive ignition engines**
 - Carburettor**
 - Port fuel injection**
 - Direct injection**

- 1.3.10. Miscellaneous devices**
 - (a) Exhaust gas recirculation (EGR);**
 - (b) Water injection;**
 - (c) Air injection;**
 - (d) Others.**

1.3.11. 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.

1.3.12. 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 after-treatment system, whether as parent engine or as 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 additives in the fuel 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 after-treatment system, whether as parent engine or as member of a family, whose parent engine is equipped with the same after-treatment system, then this engine, when equipped without after-treatment system, shall not be added to the same engine family.”

II. Justification

1. The expert from Italy proposes amendments to Regulation No. 120 to align the requirements to those which are being prepared by the expert from the European Commission as an informal document to update Regulation No. 96, including the emission stages IIIB and IV (Directive 97/68/EC) and to align it with the provisions of global technical regulation (gtr) No. 11.
2. This update aims at maintaining the possibility offered by Regulation No. 120 to grant the engine power type approval at the same time and with the same test as the exhaust emissions type approval.
