

Gaseous Fuelled Vehicles emission related definitions

Overview of the UNECE and EU Legislation for LDVs and HDVs

This document intends to give an overview of the existing emission definitions applicable to Light Duty and heavy duty Vehicles in EU and UNECE legislation. It has been decided to also include certain definitions that are currently (February 2012) under discussion. The objective has been to find possible existing inconsistencies between the definitions found. The next two pages analyse definitions duplicated in different legislative acts, while the Annex refers to all the definitions found.

- 'Pressure' definition included in Pressure Equipment Directive (97/23/EC) and ECE R 110. No inconsistencies found.
- 'Gaseous pollutants' definition included in Regulations 715/2007, 692/2008, 595/2009 and ECE R 49 rev.6 and R 83. No inconsistencies found.
- 'Mono-fuel vehicle' and 'mono-fuel gas vehicle' definitions included in Regulation 692/2008 and ECE R 83. **Some variations can be found in the mono-fuel gas vehicle definition, but those are not considered to pose problems for the industry. Nevertheless, full alignment would be welcome. We'd advocate for taking the ECE R 83 definition as reference. Same suggestion for 'bi-fuel vehicle' and 'bi-fuel gas vehicle' definitions.**

692/2008

'mono fuel vehicle' means a vehicle that is designed to run primarily on one type of fuel;

'mono fuel gas vehicle' means a mono fuel vehicle that primarily runs on LPG, NG/biomethane, or hydrogen but may also have a petrol system for emergency purposes or starting only, where the petrol tank does not contain more than 15 litres of petrol;

ECE R 83

'Mono-fuel vehicle' means a vehicle that is designed to run primarily on one type of fuel;

'Mono-fuel gas vehicle' means a vehicle that is designed primarily for permanent running on LPG or NG/biomethane or hydrogen, but may also have a petrol system for emergency purposes or starting only, where the petrol tank does not contain more than 15 litres of petrol.

Note: GFV has submitted to the GRPE an informal document ([see GRPE-63-05](#)) in which slight modifications of these definitions can be found.

The definitions is proposed to be modified as follows:

'Mono-fuel gas vehicle' means a vehicle that is designed primarily for permanent running on LPG or NG/biomethane or hydrogen, but may also have a petrol system for emergency purposes or starting only, where the **capacity of the** petrol tank does not **exceed** ~~contain more than~~ 15 litres of petrol.

- 'Bi-fuel vehicle' and 'bi-fuel gas vehicle' definitions included in Regulation (EC) 692/2008 and ECE R 83. No inconsistencies found.

Note: GFV has submitted to the GRPE an informal document in order to permit the simultaneous use of petrol and gas in gas mode, with a limit in duration and amount (see GRPE-63-05). This is stated in the definitions themselves and is accordingly subject to specific emission-related provisions. These modifications are needed primarily for the approval of some bi-fuel vehicles equipped with petrol direct injection systems, where, in order to safeguard the petrol injectors, a certain amount of petrol may need to be injected also in gas mode, especially when particular temperature conditions are reached.

The two definitions are proposed to be modified as follows:

'Bi-fuel vehicle' means a vehicle with two separate fuel storage systems that ~~can run part-time on two different fuels and~~ is designed to run on only one fuel at a time. **The simultaneous use of both fuels is limited in amount or duration.**

'Bi-fuel gas vehicle' means a bi fuel vehicle that can run on petrol (**petrol mode**) and also on either LPG, NG/biomethane or hydrogen (**gas mode**).

- Dual-fuel related definitions are currently under final approval within the WP29/GRPE process. They concern Heavy-Duty vehicles and engines. They were prepared by the GFV group under a Heavy-Duty Dual-Fuel Task Force and will be presented in a working document to the June 2012 GRPE session. These definitions will be part of rev.6 of R49 and possibly of an implementing Regulation to Regulation (EC) 595/2009, but are not yet covered by any existing legislative act in the EU and UNECE frameworks. The proposed definitions are as follows:

'Dual-fuel engine' means an engine system that is designed to simultaneously operate with diesel fuel and a gaseous fuel, both fuels being metered separately, where the consumed amount of one of the fuels relative to the other one may vary depending on the operation.

'Dual-fuel vehicle' means a vehicle that is powered by a dual-fuel engine and that supplies the fuels used by the engine from separate on-board storage systems.

'Dual-fuel mode' means the operating mode of a dual-fuel engine during which the engine simultaneously uses diesel fuel and a gaseous fuel at some engine operating conditions.

'Diesel mode' means the operating mode of a dual-fuel engine during which the engine does not use any gaseous fuel at any engine operating condition.

'Service mode' means a special mode of a dual-fuel engine that is activated for the purpose of repairing, or of moving the vehicle from the traffic when operation in the dual-fuel mode is not possible.

- 'Member of the family' definition included in Regulation (EC) 692/2008 and ECE R 83. No inconsistencies found.
- 'Flex-fuel vehicle' definition included in Regulation (EC) 692/2008 and ECE R 83. No inconsistencies found.
- 'Biofuels' definition included in Regulation (EC) 715/2007, Directive 2009/28/EC and ECE R 83. No inconsistencies found.
- 'Alternative fuel vehicle' definition included in Regulations (EC) 715/2007, (EC) 595/2009, ECE R 83, and ECE R49 rev.6. No inconsistencies found.

Directive 70/156/EEC – Type Approval of motor vehicles and their trailers
Consolidated Text Available [here](#)

Directive 2007/46/EC – Type Approval Framework Directive
Consolidated Text Available [here](#)
(light duty only)

'Gaseous pollutants' means the exhaust gas emissions of carbon monoxide, oxides of nitrogen, expressed in nitrogen dioxide (NO₂) equivalent, and hydrocarbons assuming ratio of:

- C₁H_{1.85} for petrol,
- C₁H_{1.86} for diesel,
- C₁H_{2.525} for LPG,
- CH₄ for NG.

'a vehicle fuelled by LPG or NG' means a vehicle fitted with specific equipment for the use of LPG or NG in its propulsion system. Such an LPG or NG vehicle can be designed and constructed as a mono-fuel vehicle or a bi-fuel vehicle;

'a mono-fuel vehicle' means a vehicle that is designed primarily for permanent running on LPG or NG but may also have a petrol system for emergency purposes or starting only, where the petrol tank does not contain more than 15 litres of petrol;

'a bi-fuel vehicle' means a vehicle that can run part-time on petrol and also part-time on either LPG or NG.

'Fuel requirement by the engine' means the type of fuel normally used by the engine:

- petrol,
- LPG (liquefied petroleum gas),
- NG (natural gas),
- both petrol and LPG,
- both petrol and NG,
- diesel fuel.

A 'member of the family' means a vehicle that shares the following essential characteristics with its parent:

- a) It is produced by the same vehicle manufacturer;
- b) It is subject to the same emission limits;
- c) If the gas fuelling system has a central metering for the whole engine, it has a certified power output between 0,7 and 1,15 times that of the engine of the parent vehicle;
- d) If the gas fuelling system has an individual metering per cylinder, it has a certified power output per cylinder between 0,7 and 1,15 times that of the engine of the parent vehicle;
- e) If fitted with a catalyst system, it has the same type of catalyst i.e. three-way, oxidation, de NO_x ;

- f) It has a gas fuelling system (including the pressure regulator) from the same system manufacturer and of the same type: induction, vapour injection (single point, multipoint), liquid injection (single point, multipoint);
- g) This gas fuelling system is controlled by an ECU of the same type and technical specification, containing the same software principles and control strategy. The vehicle may have a second ECU compared to the parent vehicle, provided that the ECU is only used to control the injectors, additional shut-off valves and the data acquisition from additional sensors.

Regulation (EC) 692/2008 - implementing and Amending Regulation 715/2007 on Type Approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and Euro 6) and on access to vehicle repair and maintenance information:

Consolidated Text Available [here](#)

'gaseous pollutants' means the exhaust gas emissions of carbon monoxide, oxides of nitrogen, expressed in nitrogen dioxide (NO₂) equivalent, and hydrocarbons with the following ratio:

- (a) $C_1H_{1,89}O_{0,016}$ for petrol (E5);
- (b) $C_1H_{1,86}O_{0,005}$ for diesel (B5);
- (c) $C_1H_{2,525}$ for liquefied petroleum gas (LPG);
- (d) CH_4 for natural gas (NG) and biomethane;
- (e) $C_1H_{2,74}O_{0,385}$ for ethanol (E85);

'mono fuel vehicle' means a vehicle that is designed to run primarily on one type of fuel;

'mono fuel gas vehicle' means a mono fuel vehicle that primarily runs on LPG, NG/biomethane, or hydrogen but may also have a petrol system for emergency purposes or starting only, where the petrol tank does not contain more than 15 litres of petrol;

'bi fuel vehicle' means a vehicle with two separate fuel storage systems that can run part-time on two different fuels and is designed to run on only one fuel at a time;

'bi fuel gas vehicle' means a bi fuel vehicle that can run on petrol and also on either LPG, NG/biomethane or hydrogen;

'flex fuel vehicle' means a vehicle with one fuel storage system that can run on different mixtures of two or more fuels;

Additional requirements for granting of EC type-approval

1.1. Additional requirements for mono fuel gas vehicles and bi fuel gas vehicles

1.1.1.1. A 'member of the family' means a vehicle that shares the following essential characteristics with its parent:

- a) It is produced by the same vehicle manufacturer;
- b) It is subject to the same emission limits;
- c) If the gas fuelling system has a central metering for the whole engine, it has a certified power output between 0,7 and 1,15 times that of the engine of the parent vehicle;
- d) If the gas fuelling system has an individual metering per cylinder, it has a certified power output per cylinder between 0,7 and 1,15 times that of the engine of the parent vehicle;

- e) If fitted with a catalyst system, it has the same type of catalyst i.e. three-way, oxidation, de NOx ;
- f) It has a gas fuelling system (including the pressure regulator) from the same system manufacturer and of the same type: induction, vapour injection (single point, multipoint), liquid injection (single point, multipoint);
- g) This gas fuelling system is controlled by an ECU of the same type and technical specification, containing the same software principles and control strategy. The vehicle may have a second ECU compared to the parent vehicle, provided that the ECU is only used to control the injectors, additional shut-off valves and the data acquisition from additional sensors.

Regulation (EC) 715/2007 – Type Approval (amended by Regulation 692/2008)
Consolidated Text Available [here](#)

‘gaseous pollutants’ means the exhaust gas emissions of carbon monoxide, oxides of nitrogen, expressed in nitrogen dioxide (NO₂) equivalent, and hydrocarbons;

‘biofuels’ means liquid or gaseous fuels for transport, produced from biomass;

‘alternative fuel vehicle’ means a vehicle designed to be capable of running on at least one type of fuel that is either gaseous at atmospheric temperature and pressure, or substantially non-mineral oil derived.

Regulation (EC) 443/2009 – CO₂ emission performance for passenger cars
Text Available [here](#)

Regulation (EU) 1014/2010 – Monitoring and reporting of data on the registration of new passenger cars according to Regulation 443/2009
Text Available [here](#)

‘bi-fuel gas vehicle’ and ‘flex-fuel ethanol vehicle’ are as defined in Article 2 of Commission Regulation (EC) No 692/2008 (3).

Regulation (EU) 510/2011 – CO₂ emission performance for light commercial vehicles
Text Available [here](#)

Communication (2010) 657 final – on the monitoring and reporting of passenger car registrations
Text Available [here](#)

Directive 2009/28/EC – on the promotion of the use of energy from renewable sources
Text Available [here](#)

‘energy from renewable sources’ means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases;

‘biomass’ means the biodegradable fraction of products, waste and residues from biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste;

'biofuels' means liquid or gaseous fuel for transport produced from biomass;

UNECE Regulation 83 Rev 4 – Emission of pollutants according to engine fuel requirements
Text Available [here](#)

'Gaseous pollutants' means the exhaust gas emissions of carbon monoxide, oxides of nitrogen expressed in nitrogen dioxide (NO₂) equivalent and hydrocarbons assuming ratio of:

- a) C₁H_{2.525} for liquefied petroleum gas (LPG)
- b) C₁H₄ for natural gas (NG) and biomethane
- c) C₁H_{1.89}O_{0.016} for petrol (E5)
- d) C₁H_{1.86}O_{0.005} for diesel (B5)
- e) C₁H_{2.74}O_{0.385} for ethanol (E85)

'Fuel requirement by the engine' means the type of fuel normally used by the engine:

- a) Petrol E5);
- b) LPG (liquefied petroleum gas);
- c) NG/biomethane (natural gas);
- d) Either petrol (E5) or LPG;
- e) Either petrol (E5) or NG/biomethane;
- f) Diesel fuel B5);
- g) Mixture of ethanol (E85) and petrol (E5) (Flex fuel)
- h) Mixture of biodiesel and diesel (B5) (Flex fuel)
- i) Hydrogen
- j) Either petrol (E5) or Hydrogen (Bi-fuel)

'Exhaust emissions' means:

- For positive-ignition (P.I.) engines, emissions of gaseous and particulate pollutants;
- For compression-ignition (C.I.) engines, emissions of gaseous pollutants, particulate pollutants and particle numbers;

'Biofuel' means liquid or gaseous fuel for transport, produced from biomass.

'Mono-fuel vehicle' means a vehicle that is designed to run primarily on one type of fuel;

'Mono-fuel gas vehicle' means a vehicle that is designed primarily for permanent running on LPG or NG/biomethane or hydrogen, but may also have a petrol system for emergency purposes or starting only, where the petrol tank does not contain more than 15 litres of petrol.

'Bi-fuel vehicle' means a vehicle with two separate fuel storage systems that can run part-time on two different fuels and is designed to run on only one fuel at a time.

'Bi-fuel gas vehicle' means a bi fuel vehicle that can run on petrol and also on either LPG, NG/biomethane or hydrogen.

'Alternative fuel vehicle' means a vehicle designed to be capable of running on at least one type of fuel that is either gaseous at atmospheric temperature and pressure, or substantially non-mineral oil derived.

'Flex fuel vehicle' means a vehicle with one fuel storage system that can run on different mixtures of two or more fuels.

A 'member of the family' is a vehicle that shares the following essential characteristics with its parent(s):

- a) It is produced by the same manufacturer;
- b) It is subject to the same emission limits;
- c) If the gas fuelling system has a central metering for the whole engine:
It has a certified power output between 0.7 and 1.15 times that of the parent vehicle.
If the gas fuelling system has an individual metering per cylinder:
It has a certified power output per cylinder between 0.7 and 1.15 times that of the parent vehicle.
- d) If fitted with a catalyst, it has the same type of catalyst i.e. three way, oxidation, de-NOx.
- e) It has a gas fuelling system (including the pressure regulator) from the same system manufacturer and of the same type: induction, vapour injection (single point, multipoint), liquid injection (single point, multipoint).
- f) This gas fuelling system is controlled by an ECU of the same type and technical specification, containing the same software principles and control strategy. The vehicle may have a second ECU compared to the parent vehicle, provided that the ECU is only used to control the injectors, additional shut-off valves and the data acquisition from additional sensors.

UNECE Regulation 101 Rev 2 – Emissions of carbon dioxide and fuel consumption
Text Available [here](#)

Not in the definitions: 5.2.4. For the purpose of the calculation mentioned in paragraph 5.2.3., the fuel consumption shall be expressed in appropriate units and the following fuel characteristics shall be used:

(1) density: measured on the test fuel according to ISO 3675 or an equivalent method. For petrol and diesel fuel the density measured at 15 °C will be used; for LPG and natural gas a reference density will be used, as follows:

- 0.538 kg/litre for LPG
- 0.654 kg/m³ for NG (mean value of G₂₀ and G₂₃ reference fuels at 15°C)

UNECE Regulation 85 – Measurement of Net Power
Text Available [here](#)