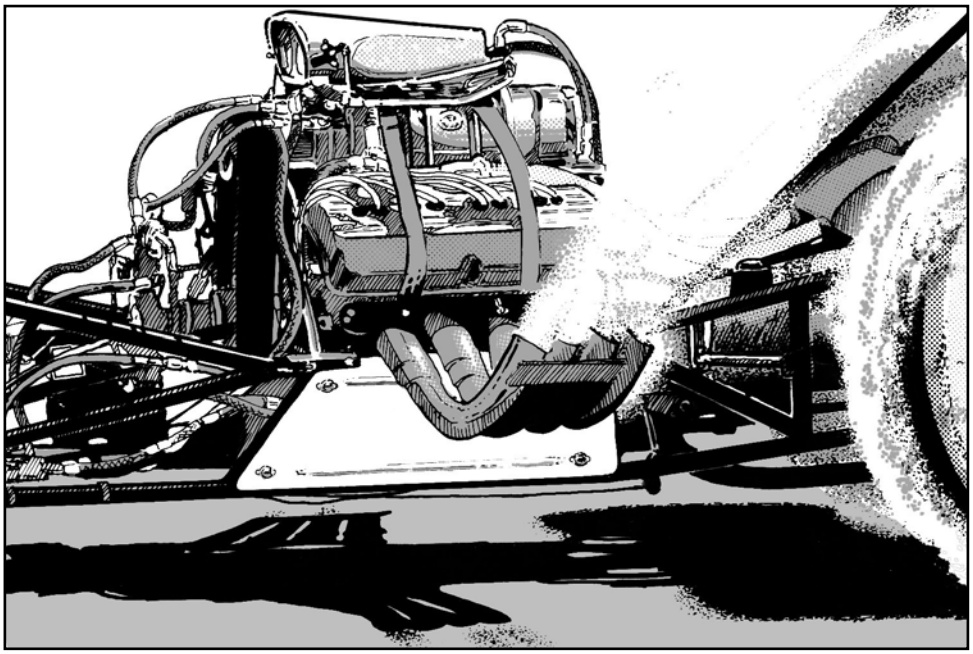
Low Volume Vehicle Technical Association Incorporated

Low Volume Vehicle Standard

90-10(00)

(Exhaust Gas Emissions)

This Low Volume Vehicle Standard corresponds with Land Transport Rule: Vehicle Exhaust Emissions 2007 (Rule 33001/2)



Original version - effective from: 1 May 2008

Signed in accordance with clause 1.5 of the Low Volume Vehicle Code, on ……..……..by:	
on behalf of the LTSA:	*on behalf on the LVVTA:*
……..……	……..……

Background

The Low Volume Vehicle Technical Association Incorporated (LVVTA) represents ten hobbyist and specialist groups who are dedicated to ensuring that their members' vehicles, when scratch-built or modified, meet the highest practicable safety standards. The information in these standards has stemmed from work undertaken by LVVTA founding member groups that commenced prior to 1990 and has been progressively developed as an integral part of NZ Government safety rules and regulations by agreement and in consultation with Land Transport New Zealand. As a result, the considerable experience in applied safety engineering built up by LVVTA members over the past fifteen years can be of benefit to members of the NZ public who also wish to build or modify light motor vehicles.

Availability of low volume vehicle standards

Low volume vehicle standards are developed by the LVVTA, in consultation with Land Transport New Zealand, and are printed and distributed by the LVVTA. Information on the availability of the low volume vehicle standards may be obtained by writing to the LVVTA at: Low Volume Vehicle Technical Association (Inc.), P O Box 202-104, Southgate, Auckland, New Zealand. The standards are also available to the public free of charge in PDF form, from the LVVTA website; www.lvvta.org.nz

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Purpose of this standard

The purpose of this low volume vehicle standard is to specify a set of technical and procedural requirements which will ensure that harmful exhaust gas emissions produced by modified and scratch-built low volume vehicles are minimized as much as practicably possible. This is achieved through the use of specified exhaust gas analysis equipment applied in controlled conditions, together with an associated assessment process, all of which will result in accurate, reliable, and repeatable outcomes in each case.

Section 1 Scope and application of this standard

1.1 Scope of this standard

1.1(1) This low volume vehicle standard applies to all light vehicles fitted with an internal combustion engine, other than those specified in *1.1(2)*, that either:

(a) are scratch-built in New Zealand on or after 1 May 2008; or

(b) are scratch-built outside New Zealand on or after 1 January 1990, and first registered in New Zealand on or after 1 May 2008; or

(c) have, after 1 May 2008, undergone an engine conversion.

1.1(2) This low volume vehicle standard does not apply to:

(a) powered bicycles of Class AB; or

(b) motorcycles of Class LA, LB, LC, LD, or LE; or

(c) those vehicles specified in *section 4*.

1.2 Application of this standard

1.2(1) A light vehicle that is modified or scratch-built as in *1.1(1)*, becomes a low volume vehicle, and must:

(a) be certified in accordance with the procedures specified in *chapter 2* of the *Low Volume Vehicle Code*; and

(b) comply with all applicable technical requirements contained in *section 2* of this low volume vehicle standard.

Section 2 Technical requirements of this standard

2.1 General safety requirements

2.1(1) A low volume vehicle must:

(a) be designed and constructed using materials and components that are fit for their purpose; and

(b) be safe to be operated on the road.

NOTE: The requirements specified in *2.1(1)* are selected from *2.2.1* of *Part 2* of the *Low Volume Vehicle Code*, reproduced here in the interest of convenience.

2.2 General engine condition requirements

General condition

2.2(1) An engine fitted to a low volume vehicle must:

(a) be in good operating condition with no obvious excessive compression blow-by; and

(b) run cleanly and efficiently, with all cylinders operating.

NOTE: An engine in a poor state of condition and tune, both petrol and diesel, can produce up to 28 times more harmful pollutants as that of an engine in good condition.

Visible smoke

2.2(2) An engine fitted to a low volume vehicle must not emit clearly visible smoke when the vehicle's engine is running at its normal operating temperature, under either of the following conditions:

(a) for a continuous period of 5 seconds when the engine is idling; or

(b) as the engine is being accelerated rapidly to approximately 2500 revolutions per minute or approximately half the maximum engine speed (whichever is lower).

NOTE 1: The requirements specified in *2.2(2)* are the (slightly amended for consolidation) relevant warrant of fitness inspection requirements as specified in the *Land Transport New Zealand Vehicle Inspection Requirements Manual*, reproduced here in the interest of convenience.

NOTE 2: *2.2(2)* means that a bit of smoke from initial start-up or over-run, due to typical valve stem seal or valve guide wear is acceptable, but any smoke due to excessive cylinder bore, piston, or piston ring wear or damage is not acceptable.

2.3 Positive crankcase ventilation systems

2.3(1) An engine that is fitted to a low volume vehicle, other than one specified in *2.3(2)* or *2.3(3)*, must be fitted with an operational positive crankcase ventilation system, which draws gases from the crankcase and directs them back into the engine.

2.3(2) An engine fitted to a low volume vehicle is not required to be fitted with a positive crankcase ventilation system if the engine was manufactured before 1975.

2.3(3) An engine fitted to a low volume vehicle is not required to be fitted with a positive crankcase ventilation system if the vehicle is designed and operated primarily for motor-sport activities, and:

(a) the vehicle owner is a member of a national motor-sporting regulatory body recognized by the Low Volume Vehicle Technical Association (Inc); and

(b) the vehicle owner holds a current and valid competition driving license issued by a national motor-sporting regulatory body recognized by the Low Volume Vehicle Technical Association (Inc); and

(c) a current and valid competition logbook has been issued for the vehicle by a national motor-sporting regulatory body recognized by the Low Volume Vehicle Technical Association (Inc).

NOTE: The engines in some legitimate motor-sport vehicles which are required by their sporting regulations to be road-registered are designed to draw crankcase gases from the engine and vent them to the atmosphere, in order to achieve optimum performance. Because of the operational nature of such vehicles, they are seldom used on public roads.

2.4 Electronic fuel injection system equipment

Required equipment

2.4(1) A low volume vehicle that is fitted with an engine which incorporates an electronic fuel injection system, and maintains the engine manufacturer's fuel injection system and computer, must, in order to run efficiently and emit the least possible amount of harmful exhaust gas emissions, continue to be fitted with any of the following items that were originally fitted to the engine by the original vehicle manufacturer:

(a) an air-flow sensor or MAP sensor; and

(b) a temperature sensor; and

(c) a detonation (knock) sensor; and

(d) a throttle position sensor; and

(e) one or more oxygen sensors; and

(f) an idle control valve; and

(g) a computer fault code warning light, or malfunction indicator light (MIL).

2.4(2) A low volume vehicle that is fitted with an engine which features an aftermarket electronic fuel injection system, must, in order to run efficiently and emit the least possible amount of harmful exhaust gas emissions, incorporate all sensors and systems specified by the manufacturer of the fuel injection system.

Removal of required original equipment

2.4(3) A low volume vehicle that, as a result of the installation of an aftermarket fuel injection system or an aftermarket programmable electronic control unit, has had any of the engine manufacturer's components specified in *2.4(1)* removed, must be provided with alternative equipment capable of achieving satisfactory air quality emissions over a range of operating loads and inlet air temperatures.

NOTE: In some cases, during the installation of an aftermarket ECU, the OE air-flow sensor may have been discarded. The requirement specified in *2.4(3)* may be complied with by the successful application of the air-fuel ratio testing specified in this standard.

2.5 Catalytic converters

Low volume vehicles required to be fitted with catalytic converters

2.5(1) A low volume vehicle that undergoes an engine conversion or is scratch-built after 1 May 2010, other than one specified in *2.5(2)* to *2.5(5)*, is required to have all of its exhaust gases directed through one or more catalytic converters, if the engine fitted to the low volume vehicle was originally manufactured in either:

(a) the United States of America on or after 1 January 1975; or

(b) Europe or the United Kingdom on or after 1990; or

(c) Japan on or after 1 January 1985; or

(d) Australia on or after 1 January 1986.

NOTE 1: The intention of *2.5(1)* is to say that if the engine being used in the scratch-built or engine-swapped low volume vehicle originally had catalytic converters, then 'cats' must be fitted to the vehicle being built or engine-swapped. Engines manufactured before the years specified in *2.5(1)* were generally not designed to meet any kind of emission standards, or to be operated with 'cats', particularly those engines fitted with carburettors.

NOTE 2: A new or re-manufactured engine that is based upon the same generic block and cylinder head design as a previously manufactured engine should be treated on the basis of the manufacture date of the original engine.

NOTE 3: The implementation date of 2010 specified in *2.5(1)* is to provide the industry with sufficient lead-time to arrange stocks of aftermarket catalytic converters that encompass the full range of sizes and performance applications that will need to become economically available before the requirement for 'cats' is mandated. The lead-time will also allow individuals with vehicles under construction to gain the information they need to enable them to retain all of the emission control equipment that they will need from the donor vehicle, and to reasonably allow those same people who have already committed financially to their engine of choice to proceed without unfair penalty.

Low volume vehicles which do not require catalytic converters

2.5(2) A modified production low volume vehicle that has undergone an engine conversion, is not required to be retro-fitted with one or more catalytic converters, if the vehicle was not originally fitted with catalytic converters by the vehicle manufacturer.

NOTE: Until (generally speaking) the 1980s, motor vehicle floor-pans were never built with the necessary under-body space (floor-pan height in particular) to provide sufficient room and air-space for catalytic converters. Therefore, if a production vehicle was not originally equipped with catalytic converters, it is most likely there will not be sufficient space in the floor-pan area to enable the retro-fitting of 'cats', whilst still maintaining a safe amount of airspace (necessary because of the heat generated by the 'cats') around them.

2.5(3) A scratch-built low volume vehicle of scratch-built sub-category 'Historic Replica', or scratch-built sub-category 'Reproduction' that is a replication or reproduction of a vehicle manufactured before 1 January 1975, is not required to be fitted with catalytic converters, provided that:

(a) the vehicle incorporates a floor-pan design that makes the fitting of the appropriate size and number of catalytic converters impractical; and

(b) the chassis incorporates a cross-member design that occupies substantially more space than that which was available when the vehicle was originally manufactured; and

(c) the retro-fitted engine block dimensions are greater than those of the engine fitted to the vehicle when originally manufactured.

NOTE: Some very small platforms upon which many scratch-built low volume vehicles are built, such as Lotus 7, Model-T, A, and B Ford, and MGTF, particularly when fitted with large capacity engines and a lot of additional cross-membering to improve the vehicle's torsional stiffness, physically do not end up with sufficient room to install the number of mufflers required to meet the 2008 noise emission limit, plus one or more catalytic converters.

2.5(4) A low volume vehicle which incorporates a side-pipe exhaust system as part of its design is not required to be fitted with one or more catalytic converters.

NOTE: Some low volume vehicles, such as those that replicate AC Cobras and early Chevrolet Corvettes, incorporate within their design a 'side-pipe' exhaust system, which, due to the design and size of the exhaust system, cannot practicably be fitted with catalytic converters.

2.5(5) A low volume vehicle is not required to be fitted with a catalytic converter if the vehicle is designed and operated primarily for motor-sport activities, and runs on leaded or racing fuel, and:

(a) the vehicle owner is a member of a national motor-sporting regulatory body recognized by the Low Volume Vehicle Technical Association (Inc); and

(b) the vehicle owner holds a current and valid competition driving license issued by a national motor-sporting regulatory body recognized by the Low Volume Vehicle Technical Association (Inc); and

(c) a current and valid competition logbook has been issued for the vehicle by a national motor-sporting regulatory body recognized by the Low Volume Vehicle Technical Association (Inc).

NOTE: The leaded or race fuels used by most motor-sport vehicles which are required by their sporting regulations to be road-registered will cause damage to a catalytic converter.

Types of catalytic converters

2.5(6) A catalytic converter fitted to a low volume vehicle must be of a size and flow-capacity appropriate for the engine, and can be either:

(a) a new or used original equipment item; or

(b) an after-market general purpose replacement, or performance item.

NOTE: If incorporating the engine's original used catalytic converters, or 'cats' from another vehicle that has been used, the vehicle owner should be satisfied that the donor vehicle has been maintained in a good state of tune throughout its life. If the engine in the donor vehicle has been run for a long time in a bad state of tune, the 'cats' may not work effectively. If however, an engine has been well-tuned throughout its life, 'cats' can last almost indefinitely – within the stringent testing regime that exists in California, it is not unusual for an OE catalytic converter fitted to a 20 year old 200,000 km vehicle to still operate efficiently and be capable of passing California's tough 5-gas testing regime.

Positioning, size, and shielding of catalytic converters

2.5(7) A catalytic converter fitted to a low volume vehicle must:

(a) be positioned as closely as practicable to the exhaust manifolds; and

(b) be oriented in the correct direction of flow.

NOTE: A catalytic converter is designed to work efficiently in one direction only. After-market catalytic converters usually have an arrow stamped into the body to show the correct direction of flow. The O_2 sensor, if fitted, should be installed ahead of the 'cat'.

2.5(8) The size of a catalytic converter fitted to a low volume vehicle must:

(a) have an inlet and an outlet that are of the same size as the diameter of the exhaust system to which it is fitted; and

(b) together with the exhaust system, not be substantially larger in diameter than what is required for the size and output of the engine to which the exhaust system is fitted.

2.5(9) A low volume vehicle must be fitted with suitable heat shielding between the catalytic converter and the floor of the vehicle adjacent to where the catalytic converter is positioned.

NOTE: Good heat-shielding is very important between a catalytic converter and the vehicle floor (from the point of view of occupant comfort) as a 'cat' generates substantially more heat than the rest of the exhaust system, or an exhaust system without a 'cat'.

2.6 Exhaust gas emissions test procedure

Exhaust gas analyser equipment

2.6(1) The exhaust gas emissions of a low volume vehicle certified to this standard must be assessed with an exhaust gas analyser that is specifically approved and issued for that purpose by the Low Volume Vehicle Technical Association (Inc), which consists of:

(a) a digital processor that controls a digital LCD display; and

(b) a heated wide-band oxygen sensor mounted in an exhaust tail-pipe installation kit.

NOTE: An oxygen (O_2) sensor is also called a 'lambda probe'. This system operates by a voltage being generated according to the amount of oxygen in the exhaust system. Higher amounts of exhaust oxygen indicate a lean mixture and produce a small output voltage, whereas a low amount of exhaust oxygen will indicate a rich mixture and produce a higher output voltage.

2.6(2) An exhaust gas analyser used in the testing of exhaust gas emissions of a low volume vehicle must:

(a) be maintained in good operating condition; and

(b) be recalibrated at a place and at intervals specified by the Low Volume Vehicle Technical Association (Inc).

NOTE 1: As a general rule, calibration intervals will be as specified by the exhaust gas analyser equipment manufacturer.

NOTE 2: The process of collection, re-calibration, and re-issue of the exhaust gas analyser equipment, as required by *2.6(2)(b)*, will be the responsibility of LVVTA.

Equipment attachment

2.6(3) A low volume vehicle certifier must, in preparation for conducting an exhaust gas emissions test:

(a) firmly secure the oxygen sensor to the vehicle's tail-pipe; and

(b) position the air-fuel ratio meter within the vehicle's passenger compartment where it can be easily viewed and read from the driving position; and

(c) connect the oxygen sensor and air-fuel ratio meter to a 12-volt power supply within the vehicle's passenger compartment, using either the vehicle's auxiliary 12-volt power supply or an independent 12-volt gel-cell battery; and

(d) ensure that the wiring harness to the oxygen sensor is taped to the vehicle in such a way that wiring 'slack' is minimized, and the wiring cannot flap or chaff, causing paint damage in doing so.

NOTE 1: Most modern vehicles have an auxiliary power supply for cell-phone chargers which will work, or alternatively, the power supply for a cigarette lighter will also provide a satisfactory power supply.

NOTE 2: The reason for the gel-cell battery referred to in *2.6(3)(c)*, if an independent power source is to be used, is so that in the event of an upset of the battery, acid cannot leak from the battery onto the vehicle floor coverings.

Test site requirements

2.6(4) A test site used in the application of the LVV exhaust gas emission test must:

(a) be an open road with a speed limit of 100 kph; and

(b) be relatively free of traffic; and

(c) be predominantly flat and straight for a distance of approximately 1 kilometre.

NOTE: The LVV exhaust gas emission test process relies heavily on a sustained steady throttle application for 10-15 seconds in duration, to allow for stabilisation of the meter, and to enable easy reading of the meter display.

Test preparation

2.6(5) A low volume vehicle certifier must, immediately prior to conducting an exhaust gas emissions test:

(a) drive the vehicle for a sufficient distance to bring the engine up to its normal operating temperature; and

(b) drive the vehicle for a sufficient period of time for the oxygen sensor heater to reach the temperature necessary to operate.

Test procedure

2.6(6) A low volume vehicle must be tested for compliance with the exhaust gas emission parameters specified in *2.6(9)*, under the following three separate conditions:

(a) at a steady and constant speed of between 90 kph and 100 kph, in the highest available forward gear, for a period of approximately 10 seconds; and

(b) under a loaded condition:

(i) in the case of a petrol engine, during moderate acceleration from approximately 70 kph to approximately 100 kph, using the highest available forward gear for the engine speed used during the acceleration period; or

(ii) in the case of a diesel engine, during heavy acceleration from approximately 70 kph to approximately 100 kph, using the gear ratio best suited to achieve maximum torque during the acceleration period;

and

(c) with the vehicle stationary and the engine at idle speed.

NOTE: Some low volume vehicles, such as those with especially high final drive ratios or those that operate in an unusually high rev range, may need to select a forward gear for the tests in *2.6(6)(a)* and *(b)* that is not the highest available forward gear as specified by the requirements, but rather, a gear that is better suited to the vehicle's engine speed at the specified test speeds, so as to enable a carburetted engine to be in the cruise system or an electronically fuel injected engine to be in the cruise mode.

2.6(7) In the case where a low volume vehicle certifier believes the road speeds specified in *2.6(6)(a)* or *(b)* are unreasonably high, taking into account the type and age of the engine, he may apply an engine speed for the purpose of the exhaust gas emission test at which he believes is appropriate for the engine, and at which the engine may be safely operated.

2.6(8) In the case of a low volume vehicle with two or more exhaust outlets, each outlet must be treated separately and tested in accordance with *2.6(7)*, with each outlet required to achieve a parameter 'pass', as set out in *2.6(8)*.

Test pass/fail parameters

2.6(9) A low volume vehicle, when tested in accordance with *2.6(6)*, must, in order to achieve a 'pass', indicate an air-fuel ratio of:

(a) during the steady-speed test specified in *2.6(6)(a)*:

(i) in the case of a carbureted engine or mechanically fuel-injected engine, between 12.8:1 and 14.9:1; or

(ii) in the case of an electronically fuel-injected engine, between 13.8:1 and 14.9:1; or

(iii) in the case of a diesel-injected engine, no richer than 18.9:1;

and

(b) during the loaded-condition test specified in *2.6(6)(b)*:

(i) in the case of a carbureted engine or mechanically-injected engine, between 12.0:1 and 14.9:1; or

(ii) in the case of an electronically fuel-injected engine, between 12.2:1 and 14.9:1; or

(iii) in the case of a diesel-injected engine, no richer than 13.8:1;

and

(c) during the idle-condition test specified in *2.6(6)(c)*:

(i) in the case of a carbureted engine or mechanically-injected engine, no richer than 12.8:1; or

(ii) in the case of an electronically fuel-injected engine, between 13.3:1 and 15.5:1.

NOTE 1: No idle-speed parameters are specified in *2.6(9)(c),* as an idle test is not part of the test procedure for a diesel engine.

NOTE 2: Many low volume vehicles, because of their performance-oriented nature, use camshafts that incorporate a lot of valve-overlap, which in turn creates a lean idle situation. The high duration of the valve-overlap allows exhaust gases to remain or re-enter the combustion chamber and thus lean out the incoming fuel mixture. For this reason, the test process does not require a 'lean limit' for carburetted engines because of their inherent and unavoidable poor emission performance in this area. This poor performance however, is balanced by the fact that such vehicles, because of that performance-oriented nature, are generally 'sunny Sunday cars', and not operated in built-up areas for prolonged periods at idle speed.

Section 3 Exclusions to this standard

No exclusions apply to this low volume vehicle standard.

Section 4 Vehicles that are not required to be certified to this standard

4.1 Vehicles that pre-date legal requirements

4.1(1) A low volume vehicle is not required to be certified to this standard, if the vehicle either:

(a) has undergone an engine conversion before 1 May 2008; or

(b) is scratch-built before 1 May 2008.

4.2 Vehicles of other motive power types

4.2(1) A low volume vehicle is not required to be certified to this standard if the vehicle operates on other than petrol, diesel, liquid petroleum gas (LPG), or compressed natural gas (CNG).

4.3 Two-stroke engines

4.3(1) A low volume vehicle is not required to be certified to this standard if the vehicle is powered by a two-stroke engine.

NOTE: Although a 2-stroke powered low volume vehicle is not required to be certified to this low volume vehicle standard at this time, if such a vehicle is certified to the Low Volume Vehicle Code for any other reason, the LVV Certifier must be satisfied that the engine is emitting no more oil smoke than should be reasonably expected of an engine of that type.

Section 5 Terms and definitions within this standard

Blow-by means gases that blow past the piston rings during a piston's power stroke. These products form acid and sludge in the crankcase and cause smoke.

Catalytic Converter means a reaction chamber typically containing a finely divided platinum-iridium catalyst into which exhaust gases from an automotive engine are passed together with excess air, so that carbon monoxide and hydrocarbon pollutants are oxidized to carbon dioxide and water.

Carbonaeceous particulate matter is unburned fuel particles that form smoke or soot (very fine particulates stick to lung tissues when inhaled); a chief component of exhaust emissions from heavy-duty diesel engines.

Carbon Dioxide, (CO_2) is the product of combustion of carbon containing fuel with oxygen in the air. These emissions are mostly benign, although carbon dioxide emissions are believed to contribute to global warming.

Carbon Monoxide, (CO) is a product of combustion of fuel into the air, and is an emission which hinders oxygen transport to the human body tissues.

Emissions in relation to motor vehicle exhaust emissions, mean potentially harmful emissions from internal combustion engines which include Carbon Monoxide (CO), Carbon Dioxide (CO_2), Oxides of Nitrogen (NOx), Benzene, and Carbonaeceous particulate matter. Emissions also include harmless products of combustion such as water (H_20) in the form of steam.

Engine conversion means, within the context of this standard, the substitution of a motor vehicle's factory-fitted engine with another engine of a different type, usually carried out for reasons of enhanced performance or improved fuel economy, in most cases involving the retro-fitment of a later-model engine.

Exhaust gas analyser means an item of equipment that analyses the content of an engine's exhaust gases. This usually refers to a multi-gas analyser, however for the purpose of this standard, the gas analysing equipment measures the oxygen content.

Hydrocarbons (HC) means a potentially harmful emission from an internal combustion engine, formed of partially or un-burnt fuel or oil.

O_2 sensor means an oxygen sensor, which is an electronic device that measures the proportion of oxygen in the exhaust gas being analyzed. The sensing element is usually made with a zirconium ceramic bulb coated on both sides with a thin layer of platinum and comes in both heated and unheated forms.

Oxides of Nitrogen (NOx) is a mixture of NO and NO_2 greenhouse gases produced as by-products in combustion engines and many industrial processes. NOx in the atmosphere can be converted to nitric acid (HNO_3) which falls as acid rain.

PCV is an abbreviation for positive crankcase ventilation.

Positive crankcase ventilation means a system which re-directs crankcase blow-by to the intake manifold and back to the engine, where it is re-burned in the cylinders as part of the fuel/air mixture. This cuts emission pollution and increases fuel economy because partially or un-burned fuel in the blow-by is consumed the second time around, in addition to keeping the blow-by and water vapour from fouling the oil in the crankcase, thus reducing the formation of engine sludge. Positive crankcase ventilation is also an essential aid against internal engine pressurisation and subsequent oil leaks - which is particularly handy if your engine was manufactured in England.

RPM is a measure of engine speed, and is an abbreviation for 'revolutions per minute', which means the number of times an engine's reciprocating assembly turns in one minute.

Scratch-built Historic Replica low volume vehicle means a vehicle which is an authentic replica of a specific make and model of production motor vehicle that was manufactured before 1960, which uses components, systems, materials, and engineering processes throughout its construction that are appropriate to the period in which the vehicle is styled, and either:

(a) is an accurate historical representation of a vehicle built from a period of motoring history before 1960; or

(b) is not readily distinguishable from an original example of the vehicle being replicated.

Scratch-built Reproduction low volume vehicle means a vehicle which is clearly recognisable as a reproduction of a specific make and model of production motor vehicle, and maintains an actual or approximate silhouette of the vehicle being reproduced, and uses an amalgamation of period and modern components, systems, materials, and engineering processes throughout its construction.

Stochiometric means the ratio of fuel and air which enables perfect combustion, and hence low production of the common harmful emissions from an internal combustion engine.

Two-stroke means, in relation to an internal combustion engine, an engine, that due to its unique design (which features no valves and fires once every revolution), completes the same four processes as a four-stroke engine (intake, compression, combustion, exhaust) in only two strokes of the piston rather than four.

