

Low Volume Vehicle Technical Association Incorporated

**Low Volume Vehicle Standard
85-40(00)
(Engine & Drive-train
Conversions)**

*This Low Volume Vehicle Standard corresponds with:
Land Transport Rule Light-vehicle Brakes, Rule 32014, and
Land Transport Rules Rule (32003) Vehicle Standards (Steering Systems)*

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Effective from: 1 September 2002**

Signed on behalf of:

LTSA:.....date:.....

LVVTA:.....date:.....

Page 1 of 23
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clause 1.5, LVV Code

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 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 the Land Transport Safety Authority.

As a result, the considerable experience in applied safety engineering built up by LVVTA members over the past ten 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 prepared by the Low Volume Vehicle Technical Association (Inc.) in consultation with the Ministry of Transport and the Land Transport Safety Authority of New Zealand.

Low volume vehicle standards are printed and distributed by the Low Volume Vehicle Technical Association (Inc.). Information on the availability of the low volume vehicle standards and their amendments may be obtained by writing to the Low Volume Vehicle Technical Association (Inc.) at the address shown below.

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Contents

Purpose of this standard		Page	3
Section 1	Scope and application of this standard		3
1.1	Application of this standard		3
Section 2	Technical requirements of this standard		4
2.1	General safety requirements		4
2.2	Engine conversion requirements		4
2.3	Engine equipment and system requirements		8
2.4	Gearbox conversion requirements		13
2.5	Drive-shaft and axle housing requirements		14
2.6	Other requirements		17
Section 3	Exclusions to this standard		18
3.1	LVVTA-approved authority card exclusions		18
Section 4	Vehicles that are not required to be certified to this standard		18
4.1	Vehicles that pre-date legal requirements		18
4.2	Engine modifications that do not require certification		19
4.3	Engine conversions that do not require certification		19
4.4	Gearbox conversions that do not require certification		19
4.5	Axle housing assembly conversions that do not require certification		20
Section 5	Terms and definitions within this standard		20

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Engine & Drive-train Conversions (85-40(00))

Purpose of this standard

The purpose of this low volume vehicle standard is to specify sound practical engineering principles and procedures relating to the conversion of engines and drive-trains to motor vehicles, to ensure that such conversions are as safe as practicable, having regard to their effect on inter-related vehicle components and systems, especially those relating to braking and steering control.

Section 1 Scope and application of this standard

1.1 Application of this standard

- 1.1(1) This low volume vehicle standard applies to all light vehicles, other than those specified in 1.1(2), that are:
- (a) modified on or after 1 January 1992 in such a way that any braking or steering systems may, directly or indirectly, be affected as a result of an engine or drive-train modification or conversion; or
 - (b) scratch-built on or after 1 January 1992.
- 1.1(2) This low volume vehicle standard does not apply to:
- (a) powered bicycles of Class AB or light trailers of Class TA or TB; or
 - (b) motorcycles of Class LA, LB, LC, LD, or LE; or
 - (c) those vehicles specified in *section 4*.
- 1.1(3) 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, other than those to which exclusions in *section 3* apply.

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 2.2(1) are selected from 2.2.1 of Part 2 of the *Low Volume Vehicle Code*, reproduced here in the interest of convenience.

2.1(2) A low volume vehicle must comply with the following general safety requirements:

- (a) the steering gear, associated mechanism, and all connections thereof shall be of ample strength, and their design and leverage shall give safe, convenient, and sensitive control; and
- (b) for the purpose of sub-clause (a) of this regulation, the steering gear, associated mechanism, and all connections thereof include linkages, couplings, power steering cylinders, wheels, bearings, and attachments of the steering axle to the chassis.

NOTE: The requirements specified in 2.1(2) are the applicable general safety requirements from regulation 33 of the Transport (Vehicle Standards) Regulations 1990, reproduced here in the interest of convenience.

2.2 Engine conversion requirements

Engine mount design and construction

2.2(1) An engine mount fitted to a low volume vehicle must be designed and constructed in such a way that:

- (a) it is able to withstand all fore and aft, rotational, and vertical loads and dynamic forces that may be imposed on it, taking into consideration engine weight and torque output; and
- (b) it's design will not impair the life of the flexible mount by stress.

- 2.2(2) Where solid-mounted front and rear engine plates are fitted to a low volume vehicle instead of conventional rubber mounts, the:
- (a) plates must be designed and constructed in such a way that they are able to withstand all fore and aft, rotational, and up/downward loads imposed on them; and
 - (b) gearbox, if attached to a gearbox cross-member or other part of the vehicle structure, must also be solid-mounted.
- 2.2(3) An engine mount fitted to a low volume vehicle must be designed and constructed in such a way that upon failure of either one or both of the engine mounts, the engine weight could not cause the steering system to become jammed or affected by engine weight, which may include either:
- (a) an engine mount chassis or sub-frame bracket designed to prevent the engine from dropping; or
 - (b) a safety-type engine mount that features a through-bolt that prevents detachment of the mount upon separation of the rubber from the backing plate; or
 - (c) an engine mount safety-strap.
- 2.2(4) An engine mount fitted to a low volume vehicle used to attach an engine positioned to the rear of the vehicle occupants, must be designed to minimize forward movement of the engine as much as practicable during a frontal crash.
- 2.2(5) Where a non-original or custom manufactured engine cross-member is installed on a low volume vehicle, the cross-member must be designed and constructed so as to withstand:
- (a) the weight of the engine and gearbox it supports; and
 - (b) any rotational or other dynamic loads it may be subjected to.
- 2.2(6) When engine mounting to a low volume vehicle necessitates bolting through a boxed, RHS, or tubular chassis or sub-frame section, bolts must pass through steel tubular reinforcing within the chassis or sub-frame section to prevent crushing.

Engine positioning

- 2.2(7) The engine in a low volume vehicle must be positioned in such a way that the crankshaft centre-line either:
- (a) in the case of a modified production vehicle, duplicates as closely as possible the original engine crankshaft centre-line, ensuring that the drive-shaft universal angles of the new drive-train match the original as closely as possible; or
 - (b) in the case of a scratch-built vehicle, is correctly aligned with the drive-shaft and differential.
- 2.2(8) The engine in a low volume vehicle must be mounted in such a way that when maximum engine torque is applied, it cannot come into contact with any part of the engine compartment, or items within the engine compartment.
- 2.2(9) A low volume vehicle which has the engine positioned above a beam-type axle assembly, must be positioned in such a way that adequate clearance is still available between the engine and the axle assembly, when the axle is under full suspension compression.

Engine attachment

- 2.2(10) A flexible mount used in an engine conversion or installation in a low volume vehicle must be of a type and size that will withstand all loads imposed on it.
- 2.2(11) Attachment of an engine mount to the engine, and an engine mount to the chassis or sub-frame section, of a low volume vehicle, must either:
- (a) in the case of a modified production vehicle, incorporate fasteners of a quantity, size, type, and grade of equal or greater specification than that used by the original engine manufacturer; or
 - (b) in the case of a scratch-built vehicle, incorporate fasteners of a quantity, size, type, and grade suitable for:
 - (i) the weight of the engine; and

- (ii) the rotational or other dynamic loads the engine is capable of applying.

2.2(12) A fastener used in the process of mounting an engine to a chassis or sub-frame of a low volume vehicle must be secured with a nyloc nut, spring washer, or other vibration-proof locking device, and must be in good condition.

Engine compartment and floor modifications

2.2(13) Any part of a firewall, floor, gearbox tunnel, or other structural section of a low volume vehicle that has been cut or removed to provide room for engine conversion clearance, must be adequately re-strengthened.

2.2(14) A low volume vehicle that is fitted with an engine-cooling fan that could easily be contacted, must be fitted with a shroud or protective cover to minimize the likelihood of contact.

2.2(15) All flexible hoses and wiring which extend from the body or chassis or sub-frame structure to the engine and gearbox of a low volume vehicle must incorporate sufficient slack to allow for full engine rotational movement on its mounts.

2.2(16) An opening between the engine compartment and the occupant cell of a low volume vehicle must be sealed to prevent exhaust gases, vapour, and liquids from entering the occupant cell.

Engine weight

2.2(17) A low volume vehicle fitted with an engine that is substantially heavier than the original engine, and is of a configuration never intended by the original vehicle manufacturer for fitment to the vehicle in question, must have:

- (a) a means of preventing the chassis or sub-frame rails from spreading apart as a result of the additional weight or torque loading of the new engine; and
- (b) the springs and shock absorbers up-rated as necessary to support the additional weight of the new engine; and
- (c) an engine cross-member beam, if fitted, that is either:

- (i) strong enough to withstand the additional weight or torque loading of the new engine; or
- (ii) be reinforced to provide the necessary additional strength;

and

- (d) the road wheel hub assembly's load capability increased by having either:
 - (i) the hub assembly replaced with one which has an increased number of studs, or pitch circle diameter; or
 - (ii) the original wheel studs replaced by studs of a diameter equivalent to a production vehicle that has a similar engine weight and number of wheel studs.

2.3 Engine equipment and system requirements

Superchargers & engine protrusions

- 2.3(1) An engine fitted to a low volume vehicle with a mechanical supercharger protruding above the line of the engine hood must have any exposed forward-facing moving components protected by the incorporation of a shield or cover to minimize the likelihood of contact.
- 2.3(2) An engine fitted to a low volume vehicle with protrusions extending beyond the line of the engine hood must comply with:
 - (a) the external projection requirements specified within *section 2.3* of the *LVVTA Low Volume Vehicle Standard 100-30 External Projections*; and
 - (b) the visibility requirements specified within *section 2.4* of the *LVVTA Low Volume Vehicle Standard 100-30 External Projections*.

Nitrous oxide systems

- 2.3(3) A nitrous oxide injection system fitted to an engine in a low volume vehicle must:
 - (a) incorporate hoses and fittings which are purpose-designed for automotive applications; and

- (b) have all hoses routed outside the occupant cell, and be installed in such a way that gas from a leaking hose or fitting can not escape into the passenger compartment; and
- (c) be fitted with a fail-safe arming switch to prevent unintentional activation of the system.

2.3(4) A bottle used within a nitrous oxide injection system fitted to a low volume vehicle must:

- (a) have a current test mark applied by the cylinder manufacturer or a Department of Labour-approved cylinder test station; and
- (b) be securely mounted, either:
 - (i) outside the occupant cell; or
 - (ii) if mounted inside the occupant cell, sealed and vented to the outside of the vehicle;

and

- (c) be specifically designed and manufactured:
 - (i) for the carriage of nitrous oxide; and
 - (ii) as a high pressure vessel, incorporating a high pressure safety blow-off valve.

Fuel systems

2.3(5) A low volume vehicle must comply with the relevant fuel system requirements specified in the applicable section of the appropriate *Low Volume Vehicle Technical Association Incorporated Member Association Technical Manual*.

2.3(6) A low volume vehicle fitted with an alternative fuel system, including liquid petroleum gas or compressed natural gas, must comply with the requirements of the approved New Zealand standard for alternative fuel systems.

Accelerator systems

- 2.3(7) An accelerator system on a low volume vehicle must:
- (a) be designed so as to ensure against being pulled or jammed in the open position in the event of an engine mount failure; and
 - (b) in the case of a low volume vehicle incorporating a modified or custom-built accelerator system, be fitted with a minimum of two return springs that work independently of each other; and
 - (c) have linkages that:
 - (i) move freely and give good return response without interference from any other part of the vehicle; and
 - (ii) are designed and positioned in such a way that they can not jam over-centre in the full-open position.
- 2.3(8) An accelerator system fitted to a low volume vehicle that is either hydraulically or electrically actuated, must be designed in such a way that the accelerator system, in the event of a loss of hydraulic pressure or electrical power, will fail to the fully closed position.

Exhaust Systems

- 2.3(9) An exhaust system fitted to a low volume vehicle must:
- (a) be of a good design using materials suitable for the purpose; and
 - (b) terminate in a position where the outer end of the exhaust pipe is not directly underneath the passenger compartment; and
 - (c) in the case of an external exhaust system which extends beyond the outer longitudinal extremity of the vehicle or the outer sidewall of the tyres, the exhaust system must:
 - (i) have a radius of no less than 3 mm on any sections facing toward the front of the vehicle; and
 - (ii) have any sections of exposed exhaust contactable from the front of the vehicle or adjacent to points of occupant entry and exit adequately heat-shielded.
-

NOTE: Exhaust noise output is an operational issue, not a safety one, however a low volume vehicle certifier should ensure that a vehicle undergoing low volume vehicle certification has an exhaust system that provides sufficient silencing so as to prevent the emission of exhaust noise levels that are likely to be alarming to pedestrians and other road users.

2.3(10) A fuel pipe, fuel hose, brake pipe, brake hose, or any rubber or fabric component within the steering system of a low volume vehicle must be protected from exhaust heat by:

- (a) the exhaust system being positioned at a safe distance away from the pipes and hoses; or
- (b) the inter-positioning of a suitably fabricated and mounted heat-shield.

Braking systems

2.3(11) A low volume vehicle that has undergone an engine conversion that results in braking system modifications, or that may affect the performance of the braking system, must comply with the applicable requirements contained in either:

- (a) the *LVVTA Low Volume Vehicle Standard 35-00 Braking Systems*; or
- (b) where the modifications are not provided for within *LVVTA Low Volume Vehicle Standard 35-00 Braking Systems*, the relevant braking design and construction requirements specified in the applicable section of the appropriate *Low Volume Vehicle Technical Association Incorporated Member Association Technical Manual*.

Vacuum systems

2.3(12) A low volume vehicle that has been fitted with an engine which draws its vacuum from an alternator-mounted pump must have an alternator and drive system that:

- (a) enables correct operation of the vacuum pump; and
- (b) has correctly aligned drive pulleys; and
- (c) incorporates fanbelts which are:
 - (i) in good condition; and

- (ii) correctly adjusted; and
- (iii) of the correct section type and width for the pulleys; and
- (iv) of a purpose-designed heat and oil-resistant automotive type.

Electrical systems

- 2.3(13) A battery fitted to a low volume vehicle must be secured or enclosed to prevent it from shifting during braking, cornering, acceleration, or impact.
- 2.3(14) An earth lead of a size suitable for the application must be fitted to a low volume vehicle:
- (a) in the case of a unitary construction vehicle, between the engine and body; and
 - (b) in the case of a vehicle with a separate body and chassis, between:
 - (i) the engine and chassis; and
 - (ii) the body and chassis.
- 2.3(15) Electrical wiring within the engine compartment of a low volume vehicle must:
- (a) be tidily clipped and securely attached to the body or chassis or sub-frame structure; and
 - (b) positioned at a safe distance away from moving parts and exhaust heat.

Steering system modifications

- 2.3(16) Where an engine conversion in a low volume vehicle results in the power steering system fitted to the vehicle being driven by a different means than that provided by the vehicle manufacturer, the pressure and supply delivery provided by the new engine must be sufficient to safely operate the power steering system.

- 2.3(17) A low volume vehicle that has undergone an engine conversion that results in steering system modifications other than that specified in 2.3(16), or that may affect the performance of the steering system, must comply with the applicable requirements contained in:
- (a) the *LVVTA Low Volume Vehicle Standard 190-00 Steering Systems*; or
 - (b) where the modifications are not provided for within *LVVTA Low Volume Vehicle Standard 190-00 Steering Systems*, the relevant steering design and construction requirements specified in the applicable section of the appropriate *Low Volume Vehicle Technical Association Incorporated Member Association Technical Manual*.

2.4 **Gearbox conversion requirements**

Gearbox mount design and construction

- 2.4(1) Where a non-original or custom manufactured gearbox mount or cross-member is installed into a low volume vehicle, the cross-member must be designed and constructed so as to withstand:
- (a) the weight of the gearbox it supports; and
 - (b) any rotational or other dynamic loads it may be subjected to.

- 2.4(2) When gearbox mounting to a low volume vehicle necessitates bolting through a boxed, RHS, or tubular chassis or sub-frame section, bolts must pass through steel tubular reinforcing within the chassis or sub-frame section to prevent crushing.

Gearbox attachment

- 2.4(3) A gearbox fitted to a low volume vehicle must use the same flexible-mounting or solid-mounting system that is used for the mounting of the engine.
- 2.4(4) A flexible mount used within a gearbox conversion or installation in a low volume vehicle must be of a type and size that will withstand all loads imposed on it.
- 2.4(5) Attachment of a gearbox to a gearbox mount, a gearbox mount to a gearbox cross-member, and a gearbox cross-member to the chassis or sub-frame section of a low volume vehicle, if bolted, must:

- (a) in the case of a modified production vehicle, incorporate fasteners of a quantity, size, type, and grade of equal or greater specification than that used by the original engine manufacturer; or
 - (b) in the case of a scratch-built vehicle, incorporate fasteners of a quantity, size, type, and grade suitable for:
 - (i) the weight of the gearbox; and
 - (ii) the rotational or other dynamic loads the engine is capable of applying.
- 2.4(6) A fastener used in the process of mounting an engine to a chassis or sub-frame of a low volume vehicle must be secured with a nyloc nut, spring washer, or other vibration-proof locking device, and must be in good condition.

Gearbox conversions

- 2.4(7) Any part of a unitary-constructed low volume vehicle that has had floor or gearbox tunnel material cut or removed for clearance or shifter installation, must be adequately re-strengthened.
- 2.4(8) A gear-shift mechanism in a low volume vehicle must:
- (a) operate easily, smoothly, correctly, and logically; and
 - (b) operate without any binding, or interference caused by the shift mechanism touching any other components or part of the vehicle structure; and
 - (c) in the case of an automatic transmission, provide to the driver an accurate indication of the selected gear.
- 2.4(9) A low volume vehicle fitted with an automatic transmission must feature an operative inhibitor switch, to enable engine starting only in neutral and park positions.

2.5 Drive-shaft and axle housing requirements

Drive-shaft modification and construction

- 2.5(1) A drive-shaft fitted to a low volume vehicle must be manufactured from:

- (a) tubing of a material specification appropriate for a drive-shaft; and
- (b) of a diameter and wall thickness appropriate for the power, torque, and weight of the vehicle.

2.5(2) A drive-shaft fitted to a low volume vehicle may be lengthened only if:

- (a) the complete original tube is replaced by a complete new single piece of tubing, without any spigots or joined sections; and
- (b) the main tubing material thickness is not reduced during any machining processes that are carried out; and
- (c) in the case of a substantial increase in drive-shaft length or engine power output, the diameter of the drive-shaft is increased proportionately with the drive-shaft length or engine power output; and
- (d) welded in accordance with the welding requirements for drive-shafts specified in 2.6(1).

2.5(3) A modified or manufactured drive-shaft fitted to a low volume vehicle must be visually inspected and dynamically balanced by a person professionally engaged in the drive-shaft manufacturing and balancing industry.

2.5(4) A drive-shaft fitted to a low volume vehicle must maintain the majority of its drive-shaft yoke coupling depth engaged into the gearbox output shaft throughout the full range of suspension travel.

Drive-shaft attachment

2.5(5) Attachment of a drive-shaft to a low volume vehicle must:

- (a) in the case of a modified production vehicle, incorporate fasteners of a quantity, size, type, and grade of equal or greater specification than that used by the original engine manufacturer; or
- (b) in the case of a scratch-built vehicle, incorporate fasteners of a quantity, size, type, and grade suitable for:
 - (i) the weight of the drive-shaft; and

- (ii) the loads the engine torque is capable of applying.

2.5(6) A fastener used in the process of attaching a drive-shaft to a low volume vehicle must be secured with a nyloc nut, spring washer, or other vibration-proof locking device, and must be in good condition.

Drive-shaft universals

2.5(7) A drive-shaft universal fitted to a low volume vehicle must:

- (a) not be able to bind throughout the full range of suspension travel; and
- (b) be aligned in such a way as to not induce premature wear or cause vibration; and
- (c) operate at angles that are within the universal manufacturer's specifications; and
- (d) if not original universals in the original application, operate at the a minimum of three degrees angle to prevent brinelling; and
- (e) be positioned so that all universal angles and phasing are in alignment, unless exact factory misalignment is duplicated.

Drive-shaft safety loops

2.5(8) A front-engine, rear-wheel drive low volume vehicle that has undergone an engine conversion, or has had its factory-fitted engine significantly modified, such that a significant increase in power or torque has resulted, must be fitted with an effective 360-degree front drive-shaft loop, mounted within 150 mm rearward of each front drive-shaft universal.

Axle housing and differential modification and attachment

2.5(9) Where an axle housing assembly conversion has taken place on a low volume vehicle, either:

- (a) the vehicle's original suspension geometry and suspension locating mounting points must be duplicated on the replacement axle housing assembly, and at the chassis or sub-frame attachment points; or

- (b) in the case of a changed suspension system configuration, the suspension must, in addition to this standard, comply with the relevant suspension design and construction requirements specified in the applicable section of the appropriate *Low Volume Vehicle Technical Association Incorporated Member Association Technical Manual*.
- 2.5(10) A differential fitted to a low volume vehicle must not be fitted with a permanently locked diff centre, spool, or mini-spool.
- 2.5(11) Attachment of a axle housing assembly to a low volume vehicle, must:
 - (a) in the case of a modified production vehicle, incorporate fasteners of a quantity, size, type, and grade of equal or greater specification than that used by the original differential manufacturer; or
 - (b) in the case of a scratch-built vehicle, incorporate fasteners of a quantity, size, type, and grade suitable for:
 - (i) the weight of the differential; and
 - (ii) the loads the engine torque is capable of applying.
- 2.5(12) A fastener used to attach a axle housing assembly to a low volume vehicle must be secured with a nyloc nut, spring washer, or other vibration-proof locking device, and must be in good condition.

2.6 Other requirements

Welding of drive-shafts

- 2.6(1) Welding of a modified or custom-manufactured drive-shaft fitted to a low volume vehicle may only be carried out by a person who:
 - (a) either:
 - (i) is a recognised industry specialist in the field of drive-shaft modification and manufacturing; or
 - (ii) holds a relevant current qualification or trade certification for the type of welding being undertaken; or
 - (iii) has demonstrated to a low volume vehicle certifier, a satisfactory level of competence in the method of welding being undertaken; and

- (b) documentation which verifies 2.6(1)(a)(i), (ii), or (iii) is supplied by the person who undertakes the welding.

Welding of other drive-train components

2.6(2) Welding of any engine or gearbox mounts or cross-members, or in relation to any differential housing modifications on a low volume vehicle, may only be carried out by a person who:

- (a) either:
 - (i) holds a relevant current qualification or trade certification for the type of welding being undertaken; or
 - (ii) has demonstrated to a low volume vehicle certifier, a satisfactory level of competence in the method of welding being undertaken; and
- (b) documentation which verifies 2.6(2)(a)(i) or (ii) is supplied by the person who undertakes the welding.

Section 3 Exclusions to this standard

3.1 LVVTA-approved authority card exclusions

A low volume vehicle, for which a valid *Low Volume Vehicle Authority Card* is issued by an LVVTA-approved organisation, that specifies 'competition differential' is issued, is not required to comply with 2.5(10).

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

4.1 Vehicles that pre-date legal requirements

A light vehicle is not required to be certified to this standard, if the vehicle was either:

- (a) modified before 1 January 1992 in such a way that any braking or steering systems may, directly or indirectly, be affected as a result of an engine or drive-train modification or conversion; or

- (b) scratch-built before 1 January 1992.

4.2 **Engine modifications that do not require certification**

A vehicle is not required to be certified to the *Low Volume Vehicle Code*, provided that the safe performance of the vehicle is not compromised, where the only modifications to the vehicle are those to the engine originally fitted to the vehicle by the vehicle manufacturer, that result in an increase of no more than 20% in engine power output from the original vehicle manufacturer's specifications.

4.3 **Engine conversions that do not require certification**

A vehicle is not required to be certified to the *Low Volume Vehicle Code*, provided that the safe performance of the vehicle is not compromised, where the only modification to the vehicle is the fitting of an engine other than that fitted by the vehicle manufacturer, and that the engine:

- (a) is of the same or less capacity or power output; and
- (b) is of the same configuration; and
- (c) the fuel type is not changed from petrol to diesel or vice-versa; and
- (d) has the same type of fuel induction system; and
- (e) has the same weight, location, and centre of gravity; and
- (f) is of the same design and casting family of cylinder block and cylinder head(s).

4.4 **Gearbox conversions that do not require certification**

A vehicle is not required to be certified to the *Low Volume Vehicle Code*, provided that the safe performance of the vehicle is not compromised, where the only modification to the vehicle is the fitting of a gearbox or automatic transmission other than that fitted by the vehicle manufacturer, and that:

- (a) the gearbox or automatic transmission has been fitted using the gearbox cross-member originally fitted to the vehicle; and

- (b) the gearbox or automatic transmission cross-member has not been either:
 - (i) modified by cutting, heating, bending, or welding; or
 - (ii) positioned or located to other than where originally installed by the vehicle manufacturer;

and

- (c) the drive-shaft has not been modified, or substituted for a drive-shaft of insufficient strength for the application.

4.5 **Axle housing assembly conversions that do not require certification**

A vehicle is not required to be certified to the *Low Volume Vehicle Code*, provided that the safe performance of the vehicle is not compromised, where the only modification to the vehicle is the fitting of an axle housing assembly other than that fitted by the original vehicle manufacturer, and that:

- (a) the braking system has not been changed or modified; or
- (b) the suspension attachment points have not been changed or modified; or
- (c) the drive-shaft has not been modified, or substituted for a drive-shaft of insufficient strength for the application.

Section 5 Terms and definitions within this standard

Alternator means a device mechanically driven by the engine that provides an electrical supply to maintain the battery's charge.

Automatic transmission means a type of gearbox, or transmission, that automatically varies the ratios between the input shaft and the output shaft to suit engine speeds automatically, without the driver having to physically select the gears.

Boxed	means to add a capping plate to covert a c-section or channel chassis rail or cross-member to a fully enclosed section like a RHS.
Brinelling	means premature wear of drive-shaft universal bearings due to a lack of rotary movement.
Chassis	means the supporting frame or platform of a motor vehicle to which the major mechanical components and body attach.
Cross-member	means a section of material positioned between or connecting the main chassis rails or sections to provide support to the chassis or body, or for the attachment of related components and systems.
Differential	means the mechanical assembly used for transferring the engine and gearbox power output to the driving wheels.
Drive-shaft	means the assembly which transfers the power output from the gearbox to the differential.
Drive-shaft safety loop	means a safety device designed to contain the drive-shaft in the event of a drive-shaft universal failure, to prevent the drive-shaft from contacting the vehicle floor or the road surface.
Drive-shaft universal	means the devices positioned at each end of the drive-shaft to enable the power transfer to take place from the rigidly mounted gearbox to the differential operating on an upward and downward plane whilst the suspension operates throughout its range of travel.
Engine mounts	means the devices that fasten the engine onto the chassis or sub-frame section.
Engine plates	means an alternative method of fastening the engine onto the chassis or sub-frame section through the use of a rigid plate system positioned vertically at the front and the rear of an engine, instead the more common flexible engine mounts.
Fan-belt	means flexible drive-belts, which operate the engine-cooling fan, water, pump, alternator, and other accessory motors from the engine crankshaft pulley.
Gearbox	means the mechanical assembly used to convert engine speed to road speed through the use of a number of different gear ratios.

Gear-shift	means the device by which the different gear ratios in the gearbox are selected.
Gearbox tunnel	means the floor of a motor vehicle surrounding the area where the gearbox is positioned.
Locked differential	means a differential that drives both left and right side axles simultaneously without the usual mechanical slippage designed into production motor vehicles to provide safe and comfortable cornering.
Nitrous oxide	means a liquid chemical composition of one part of nitrogen and two parts of oxygen, which when introduced with the fuel mixture entering an internal combustion engine, converts to a gas and may increase the oxygen content in the combustion chamber producing a momentary increase in power output.
Nyloc	means a type of vibration-proof locking nut that incorporates a nylon section, which enables the nut to lock itself against the corresponding bolt.
RHS	is an abbreviation for rectangular hollow section, which is a configuration of steel section commonly used in the manufacture of chassis and other motor vehicle component fabrication.
Spool	means a device which when fitted, has the effect of a locked differential.
Sub-frame	means a structural part of a unit-construction vehicle to which the major mechanical components attach.
Supercharged	means a mechanical device driven by the crankshaft pulley of an engine which forces an air/fuel mixture into the engine to provide increased levels of power output.
Torque	means rotating effort produced by applying a force to a lever arm about a pivot.
Unitary construction	means a type of vehicle construction that incorporates the vehicle body and chassis frame in one unit, as opposed to having a separate and removable chassis.