

## Low Volume Vehicle Technical Association Incorporated

# Low Volume Vehicle Standard 155-20(01) (Door Retention Systems)

*This Low Volume Vehicle Standard corresponds with:  
Land Transport Rule: Door Retention Systems 2001 (Rule 32001/1)*

## 1<sup>st</sup> amendment

### Effective from: 1 September 2002

Signed  
on behalf of:  
LTSA.....LVVTA.....

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as per 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**

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*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.*

### **Published by:**

*The Low Volume Vehicle Technical Association (Inc.)  
P O Box 82-150, Highland Park, Auckland, New Zealand.*

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# Door Retention Systems

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**(155-20(01))**

## Purpose of this standard

The purpose of this low volume vehicle standard is to specify requirements for door retention systems in light vehicles, in order to minimise the possibility of inadvertent door opening, and to maximise the likelihood of the door being able to be opened following a collision.

## Section 1 Scope and application of this standard

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### 1.1 Application of this standard

- 1.1(1) This low volume vehicle standard applies to all light vehicles fitted with doors that are used for the entry and exit of occupants, other than those specified in 1.1(2), that are:
- (a) modified on or after 1 January 1992 in such a way that any door retention systems may, directly or indirectly, be affected; 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) unless *section 3* applies, comply with all applicable technical requirements contained in *section 2* of this standard.

NOTE 1: Where a light vehicle is required to be certified to the *Low Volume Vehicle Code*, but the modification or construction date precedes the dates specified in 1.1(1), a low volume vehicle certifier must ensure that the vehicle meets the general safety requirements contained in 2.2 of this standard.

NOTE 2: A light vehicle that is to be operated as a Passenger Service Vehicle (PSV) must also comply with any applicable requirements of the *Land Transport Rule: Passenger Service Vehicles 1999 (Rule 31001)*.

## 1.2 Methods of compliance with this standard

1.2(1) A low volume vehicle must comply with the technical requirements of this standard by meeting the requirements in either 1.2(2), or 1.2(3), or 1.2(4).

### **Designs specified by this standard**

1.2(2) The technical requirements of this standard may be complied with by meeting all applicable requirements specified in 2.2 to 2.6.

### **Alternative systems proven by practical testing**

1.2(3) The technical requirements of this standard may be complied with, where a specific design solution is required as an alternative to 1.2(2), by:

- (a) meeting all applicable requirements specified in *section 2*, other than those in 2.3 and 2.4; and
- (b) instead of complying with 2.3 and 2.4, completion of a practical test process of the alternative door latch and striker plate assembly or door hinge assembly, to demonstrate that either:
  - (i) the applicable specific loading requirements in 2.1 have been achieved; or
  - (ii) results directly equivalent to those required by one of the approved standards specified in 2.3(2) of the *Land Transport Rule: Door Retention Systems 2001(Rule 32001/1)*, have been achieved;

and

- (c) provision of a report of the test process to the low volume vehicle certifier to confirm that the test results required by 1.2(3)(b) have been achieved.

### Alternative systems proven by calculation

- 1.2(4) The technical requirements of this standard may be complied with, where a specific design solution is required as an alternative to 1.2(2), by:
- (a) meeting all applicable requirements specified in *section 2*, other than 2.3 and 2.4; and
  - (b) instead of complying with 2.3 and 2.4, completion of engineering calculations of the alternative door latch and striker plate assembly or door hinge assembly, to confirm that the applicable specific loading requirements contained in 2.1 can be achieved; and
  - (c) provision of a report of the engineering calculation process to the low volume vehicle certifier to confirm that the calculation process required by 1.2(4)(b) has been carried out.

## Section 2 Technical requirements of this standard

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### 2.1 Loading requirements for door retention systems

#### Specific loading requirements

- 2.1(1) In the case of an alternative door latch and striker plate assembly being proven by practical testing or calculation as in 1.2(3) or 1.2(4), a door latch and striker plate assembly in a low volume vehicle must be designed to withstand a force that may deform the components, but not result in ultimate failure or its inability to function as intended, of:
- (a) in the primary latching position, applied individually:
    - (i) 11 kN applied in the longitudinal direction; and
    - (ii) 8.9 kN applied in the lateral direction;
- and
- (b) in the secondary latching position, applied individually, 4.4 kN applied in both the longitudinal and lateral directions.

- 2.1(2) In the case of an alternative door hinge assembly being proven by practical testing or calculation as in 1.2(3) or 1.2(4), a door hinge assembly in a low volume vehicle must be designed to withstand a force that may deform the components, but not result in ultimate failure or its inability to function as intended, of 11 kN, applied individually, in both the longitudinal and lateral directions.

## **2.2 General safety requirements**

- 2.2(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.

- 2.2(2) A low volume vehicle must comply with the following general safety requirements:
- (a) door retention systems and their mountings must be safe, structurally sound, and in good working order; and
  - (b) doors must open and close easily; and
  - (c) doors must remain secure in a closed position during operation of the motor vehicle; and
  - (d) doors must be operable at all times by any occupant seated by the door, from inside the vehicle.

NOTE: The requirements specified in 2.2(2) are the applicable general safety requirements from 2.2 of *Land Transport Rule: Door Retention Systems 2001(Rule 32001/1)*, reproduced here in the interest of convenience.

## **2.3 Door latch and striker plate assembly requirements**

### **Latch and striker assembly design**

- 2.3(1) A door latch and striker plate assembly fitted to a low volume vehicle must be of a burst-proof design.

- 2.3(2) A door latch and striker plate assembly fitted to a low volume vehicle must incorporate two latching positions, comprising a primary latching position and a secondary latching position.

#### **Latch and striker assemblies from production vehicles**

- 2.3(3) A door latch and striker plate assembly sourced from a production motor vehicle may be fitted to a low volume vehicle, provided that the vehicle to which the assembly was originally fitted was manufactured in either:

- (a) the United States of America on or after 1 January 1968; or
- (b) Europe or the United Kingdom on or after 1 January 1970; or
- (c) Japan on or after 1 January 1983; or
- (d) Australia on or after 1 January 1988.

#### **Latch and striker assemblies from other sources**

- 2.3(4) If it is not practicable to apply 2.3(3) due to the door latch and striker plate assembly type, or vehicle constructional features, the door latch and striker plate assembly must meet the appropriate best practice solutions for special applications contained within the applicable *Low Volume Vehicle Technical Association Incorporated Inc (LVVTA) Member Association Technical Manual*.

## **2.4 Door hinge assembly requirements**

#### **Hinge assemblies from production vehicles**

- 2.4(1) A door hinge assembly sourced from a production motor vehicle may be fitted to a low volume vehicle, provided that:
- (a) the door to which the hinge assembly is fitted is of similar or lower mass than that of the door to which the hinge assembly was originally fitted; and
  - (b) the hinge assembly is positioned such that the loads to which it is subjected are no greater than in the original application of the hinge assembly; and
  - (c) the vehicle to which the assembly was originally fitted was manufactured in either:

- (i) the United States of America on or after 1 January 1968; or
- (ii) Europe or the United Kingdom on or after 1 January 1970; or
- (iii) Japan on or after 1 January 1983; or
- (iv) Australia on or after 1 January 1988.

### **Hinge assemblies from other sources**

- 2.4(2) If it is not practicable to apply 2.4(1) due to the hinge assembly type, or vehicle constructional features, the hinge assembly must meet the appropriate best practice solutions for special applications contained within the applicable *Low Volume Vehicle Technical Association Incorporated Inc (LVVTA) Member Association Technical Manual*.

## **2.5 Body and door structure strength requirements**

- 2.5(1) The door structure to which a latch and striker plate assembly, and hinge assembly is fitted must be of such a design, or be suitably reinforced, to ensure that the door is sufficiently strong to withstand the same loads required of the latch, striker, and hinge assemblies specified in 2.1.
- 2.5(2) The body structure to which each end of a door is attached by the latch, striker, and hinge assembly must be of such a design, or be suitably reinforced, to ensure that the body pillars and surrounding structure are sufficiently strong to withstand the same loads required of the latch, striker, and hinge assemblies specified in 2.1.

## **2.6 Door opening requirements**

### **From inside the vehicle**

- 2.6(1) A door fitted to a low volume vehicle must be fitted with a mechanically operated interior handle or other mechanically-operated opening device, which can be easily accessed and operated at all times from inside the vehicle.

### **From outside the vehicle**

- 2.6(2) A door fitted to a low volume vehicle is not required to be able to be opened from outside the vehicle.

- 2.6(3) An exterior door handle or other opening device may be positioned in a hidden location on a low volume vehicle, provided that either:
- (a) the location is such that the handle or opening device is shielded or protected to prevent unintentional activation by contact from road debris; or
  - (b) the handle or opening device is positioned in such a way so as not to be able to be unintentionally activated.
- 2.6(4) A door fitted to a low volume vehicle may be opened from outside the vehicle, if fitted with:
- (a) a fixed electrically-operated unlatching device; or
  - (b) a remotely operated and electrically operated unlatching device, provided that a fail-safe inter-lock system is incorporated to prevent unlatching of the doors unless:
    - (i) the ignition system is switched off; and
    - (ii) a gearbox inhibitor switch operating only in neutral and park, is engaged.

NOTE: In the case of a low volume vehicle which is designed in such a way as to possibly make entry and exit difficult, a low volume vehicle certifier may require, at his or her discretion, proof by way of a physical demonstration that an occupant can exit the vehicle, from being seated in a restrained position with the door closed, to standing outside the vehicle, within a maximum time of seven seconds.

## Section 3 Exclusions to this standard

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### 3.1 General safety requirement exclusions

A low volume vehicle that is not a passenger service vehicle, is not required to comply with 2.2(2)(d), and may incorporate on a door to the rear of the driver's seat a safety device that can be temporarily engaged to prevent the door from being opened from inside the vehicle, provided that:

- (a) the device is designed as a 'kiddie-lock'; and
- (b) there is some means for a rear seat occupant to exit the vehicle in the event of an emergency.

NOTE: In the case of a low volume vehicle that is a Passenger Service Vehicle, a 'kiddie-lock' can be fitted, provided that the vehicle to which the kiddie-lock is fitted has been issued with an exemption from the Land Transport Safety Authority.

### **3.2 Motor vehicles for people with disabilities**

A low volume vehicle with an electrically operated door opening and closing system principally designed to enable wheelchair access for a person with a disability, is not required to comply with 2.6(4), provided that the affected doors are not adjacent to any occupant seating positions.

### **3.3 Motor caravan exclusions**

A door that is not adjacent to any occupant seating position, and is fitted to a low volume vehicle that is designed and operated solely as a motor caravan, is not required to comply with 2.3 to 2.6.

### **3.4 Original equipment exclusions**

#### **Where space constraints exist**

- 3.4(1) A modified production low volume vehicle manufactured before 1 January 1992, other than one that has had the hinging system relocated to the rear of the door, is not required to comply with 2.3, 2.4, or 2.5 if the design and dimensions of the original vehicle structure makes it impractical to fit a burst-proof door retention system.

#### **Where doors are non-structural**

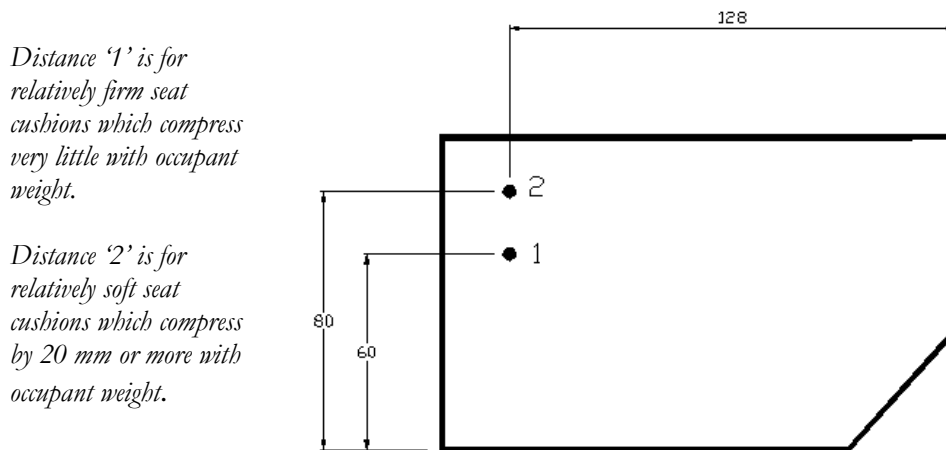
- 3.4(2) A modified production low volume vehicle is not required to comply with 2.3, 2.4, or 2.5 if the vehicle was designed by the manufacturer to operate safely with readily removable lightweight flexible doors functioning as weather protection.

### **3.5 Design criteria exclusions**

A scratch-built low volume vehicle that does not have a permanent roof structure is not required to comply with 2.3, 2.4, or 2.5 if the vehicle:

- (a) can be operated safely without doors fitted; and

- (b) is fitted with a web-clamp retractor lap-and-diagonal seatbelt, or another type of seatbelt that exceeds the performance requirements of a web-clamp retractor lap-and-diagonal seatbelt, in the driver and outboard occupant seating positions; and
- (c) has high-sided sills (between the occupant and outer side of the vehicle) which extend to a point no lower than the H-point, determined by either:
  - (i) an LVVTA body frame; or
  - (ii) measured from an LVVTA H-point template, as shown in diagram 3.5.



*Diagram 3.5 LVVTA H-point template*

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

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### 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; or
- (b) scratch-built before 1 January 1992.

## Section 5 Terms and definitions within this standard

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<b>Burst-proof</b>	means, in relation to a latch and striker assembly, a system that remains engaged when a load, less than that specified in this standard, is applied to either part of the assembly in any direction, including longitudinally, laterally, or vertically.
<b>Cap-screws</b>	means a fastener with a circular outer head, and an inner cavity usually of a hexagonal shape, which is used for tightening and loosening.
<b>Construction</b>	in relation to any vehicle, means the manufacture, assembly, re-assembly, or modification of the vehicle; and includes all activities related or incidental to the construction of a vehicle.
<b>Door</b>	means those doors designed by the vehicle manufacturer for the normal entry and exit of vehicle occupants.
<b>Door latch</b>	means the moving part of the latching assembly designed to hold the door in a closed position, that clasps the striker pin.
<b>Door retention system</b>	means any system, contrivance or mechanism that connects the doors of a motor vehicle to those doorways that are used for the entry and exit of vehicle occupants.
<b>Double-shear</b>	means, in relation to the attachment of a hinge assembly, that the hinge is secured on both the bottom and top sides.
<b>Dowell-pins</b>	means, a pin manufactured from a round solid section of material.
<b>Hinge</b>	means the system by which the door pivots throughout its arc, as it opens and closes.
<b>kN</b>	is an abbreviation for kilo-Newtons, which is the force applied by gravity at sea level to a mass of 100 kilograms.
<b>LVVTA Body frame</b>	means a frame designed and manufactured by the Low Volume Vehicle Technical Association Incorporated to identify certain critical measurements and positions for safety-related components and systems.
<b>Primary latch</b>	means the part of the door latch assembly that fully secures the door against the body structure.

**Retro-fitted** means the fitting of a component or system that was not originally installed during the construction of the vehicle by the manufacturer of the vehicle.

**Secondary latch** means the part of the door latch assembly that provides a back-up method of securing the door in the event of the primary latch becoming disengaged.

**Single-shear** means, in relation to the attachment of a hinge assembly, that the hinge is secured on either the bottom or the top side.

**Striker plate assembly** means the fixed part of the door retention system used to hold the door in a closed position that the door latch assembly clasps.

NOTE: The terms and definitions found in section 5 are limited to those terms and definitions that are unique to this low volume vehicle standard, and are not contained within the terms and definitions section of the *Low Volume Vehicle Code*.

**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)*

**Original version  
Effective from: 1 September 2002**

Signed on behalf of:

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

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

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clause 1.5, LVV Code

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

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## 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**

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### 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**

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### **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**

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### **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**

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**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.

<b>Boxed</b>	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.
<b>Brinelling</b>	means premature wear of drive-shaft universal bearings due to a lack of rotary movement.
<b>Chassis</b>	means the supporting frame or platform of a motor vehicle to which the major mechanical components and body attach.
<b>Cross-member</b>	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.
<b>Differential</b>	means the mechanical assembly used for transferring the engine and gearbox power output to the driving wheels.
<b>Drive-shaft</b>	means the assembly which transfers the power output from the gearbox to the differential.
<b>Drive-shaft safety loop</b>	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.
<b>Drive-shaft universal</b>	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.
<b>Engine mounts</b>	means the devices that fasten the engine onto the chassis or sub-frame section.
<b>Engine plates</b>	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.
<b>Fan-belt</b>	means flexible drive-belts, which operate the engine-cooling fan, water, pump, alternator, and other accessory motors from the engine crankshaft pulley.
<b>Gearbox</b>	means the mechanical assembly used to convert engine speed to road speed through the use of a number of different gear ratios.

<b>Gear-shift</b>	means the device by which the different gear ratios in the gearbox are selected.
<b>Gearbox tunnel</b>	means the floor of a motor vehicle surrounding the area where the gearbox is positioned.
<b>Locked differential</b>	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.
<b>Nitrous oxide</b>	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.
<b>Nyloc</b>	means a type of vibration-proof locking nut that incorporates a nylon section, which enables the nut to lock itself against the corresponding bolt.
<b>RHS</b>	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.
<b>Spool</b>	means a device which when fitted, has the effect of a locked differential.
<b>Sub-frame</b>	means a structural part of a unit-construction vehicle to which the major mechanical components attach.
<b>Supercharged</b>	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.
<b>Torque</b>	means rotating effort produced by applying a force to a lever arm about a pivot.
<b>Unitary construction</b>	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.