

Low Volume Vehicle Technical Association Incorporated

Low Volume Vehicle Standard 195-00(00) (Suspension Systems)

*This Low Volume Vehicle Standard corresponds with:
Land Transport Rule: (32003) Vehicle Standards (Steering Systems); and
Transport (Vehicle Standard) Regulation 1990: (13) Brakes*

Original version

effective from: 1 December 2000

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 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.

Published by:

*The Low Volume Vehicle Technical Association (Inc.)
P O Box 75-790, Manurewa, Auckland, New Zealand.*

Contents

Purpose of this standard		Page	3
Section 1	Application		3
1.1	Scope of the standard		3
1.2	Category, class, and date of application		3
Section 2	Low volume vehicle general safety and technical requirements		4
2.1	Requirements for low volume vehicles with suspension systems		4
2.2	General safety requirements		4
2.3	Technical requirements for suspension systems		5
2.4	Road-testing requirements for suspension systems		10
Section 3	Exclusions		11
3.1	Motor-sporting exclusions		11
1.1.1 Section 4	Modification criteria		11
4.1	Modifications not requiring certification		11

The content of this document remains the property of the Low Volume Vehicle Technical Association (Inc.), and no part of it may be reproduced without the prior written consent of the copyright holder.

Suspension Systems

(195-00(00))

Purpose of this standard

The purpose of this standard is to specify requirements which motor vehicles must meet when safety-related suspension modifications are carried out in order to ensure satisfactory handling characteristics in all normal driving conditions.

Section 1 Application

1.1 Scope of the standard

This standard applies to all low volume vehicles of the classes specified in 1.2 which have suspension systems, except for those vehicles specified in *section 4* that are modified in such a way that certification to the *Low Volume Vehicle Code* is not required.

1.2 Category, class, and date of application

- 1.2(1) Low volume vehicles of Classes MA, MB, MC, MD1, MD2, NA, and L-group must comply with 2.1 and 2.2.
- 1.2(2) Modified production low volume vehicles of Class MA modified on or after 1 January 1992 in such a way as to directly or indirectly affect any suspension systems must, in addition to 1.2(1), comply with the low volume vehicle technical requirements specified in 2.3 and 2.4.
- 1.2(3) Modified production low volume vehicles of Classes MB, MC, and NA modified on or after 1 January 1993 in such a way as to directly or indirectly affect any suspension systems must, in addition to 1.2(1), comply with the low volume vehicle technical requirements specified in 2.3 and 2.4.
- 1.2(4) Modified production low volume vehicles of Classes MD1, MD2, and L-group modified on or after 1 March 1999 in such a way as to directly or indirectly affect any suspension systems must, in addition to 1.2(1), comply with the low volume vehicle technical requirements specified in 2.3 and 2.4.

- 1.2(5) Scratch-built low volume vehicles of Classes MA, MB, MC, MD1, MD2, NA, and L manufactured on or after 1 January 1992 must, in addition to 1.2(1), comply with the low volume vehicle technical requirements specified in 2.3 and 2.4.
- 1.2(6) Scratch-built low volume vehicles of Class L-group manufactured on or after 1 March 1999 must, in addition to 1.2(1), comply with the low volume vehicle technical requirements specified in 2.3 and 2.4.

Section 2 Low volume vehicle general safety and technical requirements

2.1 Requirements for all low volume vehicles

All low volume vehicles must be certified in accordance with the procedures specified in *Chapter 2* of the *Low Volume Vehicle Code* and other applicable requirements in this section.

2.2 General safety requirements

- 2.2(1) Low volume vehicles must be properly designed and constructed using materials and components that are fit for their purpose, and that comply with all legal requirements applicable to low volume vehicles that relate to the construction and equipment on a motor vehicle, and which make the vehicle safe to operate on roads.

NOTE: The requirement specified in 2.2(1) is the roadworthiness requirement from 2.1 of *Chapter 2* of the *Low Volume Vehicle Code* which is required as part of this low volume vehicle standard, and is reproduced here in the interest of convenience.

- 2.2(2) Low volume vehicles with suspension systems must comply with the following general safety requirements:
- (a) Steering mechanisms and their mountings, or any systems by which a driver controls the direction of a vehicle, must provide the vehicle with safe, efficient, convenient, and sensitive control.

NOTE: The requirements specified in 2.2(2) are the applicable general safety requirements from 2.2(1) of *Land Transport Rule 32003* which are required as part of this low volume vehicle standard, and are reproduced here in the interest of convenience.

2.3 Technical requirements for suspension systems

2.3(1) All low volume vehicles with suspension systems, except those specified in *section 3*, must comply with the applicable requirements in 2.3 and 2.4.

2.3(2) All low volume vehicles which are either scratch-built, or have suspension systems modified to such an extent that they are beyond the scope of this low volume vehicle standard, must, in addition to this standard, comply with the relevant suspension design and construction requirements specified in the applicable section of the *Low Volume Vehicle Technical Association Incorporated Member Association Technical Manual*.

Suspension travel

2.3(3) Suspension travel available within low volume vehicles must be such that:

- (a) no interference is likely to occur between the underside of the body and any drive-shafts or other drive-line components during full suspension movement; and
- (b) full suspension compression is unlikely to be reached during normal vehicle operation on smooth road surfaces when fully laden.

2.3(4) No components fitted to low volume vehicles other than chassis or sub-frame cross-members and non-structural body panels, may be positioned below a straight line which extends from the bottom of any wheel-rim to the opposite side tyre-to-ground contact point.

2.3(5) Tyres and wheel-rims fitted to low volume vehicles must be positioned in such a way that they can not contact any part of the vehicle to which they are fitted, other than the point of attachment, throughout the full range of steering and suspension movement during normal vehicle operation.

Bump-stops

2.3(6) All low volume vehicles must be fitted with purpose-designed bump-stops that:

- (a) are undamaged, and are not excessively worn; and
- (b) are positioned to provide sufficient clearance from any suspension components so as to allow suspension travel suitable for the safe operation of the vehicle when fully laden; and
- (c) function effectively to ensure that suspension or body components are cushioned from the transfer of excessive shock loading at the limit of suspension travel.

Geometry

2.3(7) Moving components and systems fitted to low volume vehicles which are affected by suspension travel, must not be detrimentally affected at extremes of suspension travel by exceeding the operating limits specified by the equipment manufacturer, including:

- (a) binding or excessive angularity of ball-joints, swivel-joints or constant velocity-joints; or
- (b) binding or excessive angularity of steering arms or tie rod ends; or
- (c) binding or shortening the normal working life of drive-shaft universals.

2.3(8) Low volume vehicles which have undergone significant changes to the suspension system must feature no abnormal suspension geometry, and be aligned so as to provide satisfactory handling characteristics, and ensure against excessively shortened tyre life.

2.3(9) Wheel-rims fitted to modified production low volume vehicles which retain the vehicle manufacturer's original wheel hub assemblies must not have the wheel-rim centre offset by any more than 20% of the total wheel-rim width.

Springs

2.3(10) Springs and shock-absorbers fitted to low volume vehicles must be:

- (a) of a size and rate which is appropriate for the weight and intended use of the vehicle to which they are fitted; and
- (b) in the case of coil springs, of a sufficient rate so as not to fully compress upon full suspension travel.

Heavy-duty and height-changing coil springs

2.3(11) Low volume vehicles fitted with coil springs must:

- (a) be fitted with shock absorbers which are able to satisfactorily control spring energy; and
- (b) where a substantial increase in spring rate occurs, be reinforced as necessary in the areas of the body or chassis or sub-frame structure on which the increased loads being transmitted are likely to cause fracturing or failure.

2.3(12) Coil springs fitted to low volume vehicles that reduce the suspension travel and, as a result, the ride height of the vehicle, must be proportionately increased in stiffness rate so as to ensure against contact between the underside of the vehicle and the road surface during normal vehicle operation when fully laden.

2.3(13) Coil springs fitted to low volume vehicles must be designed in such a way that the ends of the springs, whether of a plain, plain and ground, closed, or closed and ground configuration, are shaped to match the surfaces against which they seat, both top and bottom.

2.3(14) Progressive-rate coil springs must have the closely-wound section of the coil positioned either:

- (a) at the end nearest the body, chassis, or sub-frame structure; or
- (b) in accordance with the spring or vehicle manufacturer's specifications.

Coil spring containment

- 2.3(15) Coil springs fitted to low volume vehicles must be firmly contained within their locating seats in such a way that the springs can not rotate, move vertically, or become dislodged when the suspension travel reaches its maximum rebound, limited by either:
- (a) a shock absorber of a compatible stroke length; or
 - (b) properly fastened retaining clamps; or
 - (c) properly fastened wire-rope straps of the type used in motor-sport applications, provided that the suspension mounting points are sufficiently strong to withstand the increased loadings imposed by the straps reaching the end of their travel, particularly in the case of MacPherson-strut suspension systems.

Coil spring modifications

- 2.3(16) Coil springs fitted to low volume vehicles must not be modified for the purpose of changing the vehicle's ride height unless either:
- (a) the spring is modified by a recognised spring manufacturer, and the configuration of the modified spring ends match the end configuration of the original spring; or
 - (b) the spring:
 - (i) fitted to the vehicle in its original configuration had plain unground ends; and
 - (ii) no heat is used during the modification process.

Heavy-duty and height-changing leaf springs

- 2.3(17) Low volume vehicles fitted with leaf spring suspension systems, which use extended spring shackle pin sets to achieve an increase in suspension height, must be modified in accordance with the relevant specifications contained in the appropriate *Low Volume Vehicle Technical Association Incorporated Member Association Technical Manual*.

- 2.3(18) Spacer blocks which have been fitted to leaf spring suspension systems to raise or lower the ride height of the vehicle must be of a depth no greater than:
- (a) 50 mm if not supported by lift-bars or anti-tramp rods; or
 - (b) if supported by correctly fitted and adjusted lift-bars or anti-tramp rods, 80 mm.

Other requirements

- 2.3(19) Fasteners used within the suspension system of a low volume vehicle must:
- (a) be vibration-proof; and
 - (b) be of an appropriate size and type; and
 - (c) incorporate the correct length of shank, and
 - (d) be of an appropriate tensile strength, and
 - (e) not be electroplated if of a greater tensile strength than grade-10.9 metric.
- 2.3(20) A low volume vehicle required to comply with this standard must also comply with the requirements of the:
- (a) *LVVTA Low Volume Vehicle Standard 190-00 (Steering Systems)*; and
 - (b) *LVVTA Low Volume Vehicle Standard 35-00 (Braking)*; and
 - (c) *LVVTA Low Volume Vehicle Standard 35-40 (Hydraulic Brake Hoses)*; and
 - (d) *LVVTA Low Volume Vehicle Standard 125-00 (Lighting and Signalling)*.

Occupant weight simulation test

- 2.3(21) Any low volume vehicle with lowered suspension may be inspected and tested at the discretion of the low volume vehicle certifier in a condition of simulated occupant weight and load, on the following basis:
- (a) Class MA, MB, MC, MD1, and MD2 low volume vehicles carrying 80 kgs distributed in each seating position; and
 - (b) Class NA low volume vehicles carrying the difference between the tare weight of the vehicle and the manufacturer's gross vehicle mass rating at the forward-most section of the load floor.

2.4 Road-test requirements for suspension systems

- 2.4(1) All modified production low volume vehicles with modified suspension systems must perform in a manner which preserves at least the quality of steering control which could be reasonably expected when the vehicle was originally manufactured.
- 2.4(2) All scratch-built low volume vehicles must perform in a manner which gives a quality of steering control at least equal to that expected of production vehicles of similar purpose and performance.
- 2.4(3) All low volume vehicles must handle in a manner which allows good steering control in all normal driving conditions, including:
- (a) well controlled ride on uneven surfaces without excessive pitch movement, or direction change upon full suspension compression; and
 - (b) progressive and positive feel with no kick-back through the steering wheel during turn-in and turn-out; and
 - (c) no excessive under-steer or over-steer tendencies during constant radius cornering, including when encountering mid-corner bump disturbances; and
 - (d) directional stability with immediate self-centring after sharp minor steering inputs; and

- (e) immediate and easy controllability when encountering direction change as a result of road camber changes or surface irregularities; and
- (f) no tendency to climb the road camber toward the opposing lane.

Section 3 Exclusions

3.1 Motor-sporting exclusions

Low volume vehicles, which are primarily designed and used for LVVTA-recognised motor-sporting events, are not required to comply with 2.3(8).

Section 4 Modification criteria

4.1 Certification requirement exclusions

A vehicle is not required to be certified to the *Low Volume Vehicle Code* where a suspension modification is the sole modification, and the following criteria is met, provided that the safe performance of the vehicle is not compromised:

- (a) after-market shock absorbers including air adjustable units but not including those with height-adjustable platforms, may be used provided they are fitted to the vehicle manufacturer's mounting points; or
- (b) after-market road springs, including those that raise or lower the vehicle, may be substituted for the originals provided that:
 - (i) the springs are fitted correctly to the original vehicle manufacturer's mounts; and
 - (ii) there has been no heating or cutting of the springs subsequent to their original manufacturing process; and

- (iii) the springs remain in contact with their seats when the vehicle suspension is fully extended; and
 - (iv) the original vehicle manufacturer's method of retaining the springs at full extension is maintained without the addition of any supplementary devices such as wire ties or other non-standard methods of retaining the springs; and
 - (v) unless specified as an original condition by the original vehicle manufacturer, the road clearance of the unladen vehicle is not less than 100 mm measured at any part of the vehicle other than the wheel rim, brake backing plate and the outer knuckle of the suspension joint, or body kits such as front spoiler and side skirts of a lightweight construction; and
 - (vi) the normal relationship between the front and rear suspension height is not unduly affected; and
 - (vii) there is sufficient travel in the suspension to ensure that contact is not made with the vehicle manufacturer's unmodified bump-stops when the vehicle is fully loaded and operated under normal conditions; or
- (c) if blocks are used in leaf springs to adjust their ride height they must be securely fitted, have the same or more seating area than the original fitment, be no more than 50 mm high, be made of metal and be designed for the purpose; or
 - (d) after-market suspension bushes may be substituted for the originals, provided they are made from an appropriate material such as polyurethane and there has been no cutting or machining of the suspension arms to fit them; or
 - (e) after-market stabiliser bars may be fitted provided they use the original mounting points.