Low Volume Vehicle Technical Association Incorporated

Low Volume Vehicle Standard

195-00(02)

(Suspension Systems)

This Low Volume Vehicle Standard corresponds with: Land Transport Rules Steering Systems 2001 (Rule 32003/1) and Light Vehicle Brakes 2002 (Rule 32014)

2nd Amendment – effective from: 25 October 2016

Signed in accordance with clause 1.5 of the Low Volume Vehicle Code, on……by:	
on behalf of the New Zealand Transport Agency: ……	*on behalf on the Low Volume Vehicle Technical Association(Inc):* ……

LVV Standard 195-00 Amendment Record:

No:	Detail of amendments:	Version:	Issue date:	Effect date:
1	Initial issue – original version	195-00(00)	1 December 2000	1 December 2000
2	1st Amendment	195-00(01)	1 August 2016	1 August 2016
3	2nd Amendment	195-00(02)	25 October 2016	25 October 2016
4				
5				

Note that highlighted text shows amendments that have been made subsequent to the document's previous issue, and a grey vertical stroke to the left of the text denotes information that is of a technical (rather than a formatting) nature.

Overview

Background

The Low Volume Vehicle Technical Association Incorporated (LVVTA) represents ten specialist automotive groups who are dedicated to ensuring that vehicles, when scratch-built or modified, meet the highest practicable safety standards. The information in these standards has stemmed from work undertaken by LVVTA founding member organisations 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 New Zealand Transport Agency. As a result, the considerable experience in applied safety engineering built up by LVVTA and the specialist automotive groups over the past twenty years can be of benefit to members of the NZ public who also wish to build or modify light motor vehicles.

Availability of low volume vehicle standards

Low volume vehicle standards are developed by the LVVTA, in consultation with the New Zealand Transport Agency, and are printed and distributed by the LVVTA. The standards are available to the public free of charge from the LVVTA website; www.lvvta.org.nz

Further information on the availability of the low volume vehicle standards may be obtained by contacting the LVVTA at info@lvvta.org.nz.

Copyright

Associated information

Other associated information relevant to the subject matter contained in this low volume vehicle standard, which in the interest of comprehensiveness, should be read in conjunction with this standard, includes:

Document	Page #/Section/Chapter
• LVVTA News June-September 2013 Issue 47	Page 2 Aftermarket Cast I-beam Axle Update
• LVVTA News June-September 2013 Issue 47	Page 3 Bump-steer Bum-steer
• LVVTA News June-September 2013 Issue 47	Page 4 Chinese Bearings in American Stub Axles
• LVVTA News June-September 2013 Issue 47	Page 6 Aftermarket Mustang II-based Custom IFS 'Dog-bone' Mounting System
• LVVTA News June-September 2013 Issue 47	Page 7 'Heidts'-brand Suspension Arm Issue
• LVVTA News June-September 2013 Issue 47	Page 9 Update of LVVTA-recognised IFS Manufacturers
• LVVTA News October-December 2013 Issue 48	Page 1-4 Raising the Hard Questions (raised vehicles)
• LVVTA News October-December 2013 Issue 48	Page 9 Faulty Threads on Aftermarket Suspension Arms

• LVVTA News October-December 2013 Issue 48	Page 11 Inspecting Modified Vehicles with 'Airbag' and 'Hydraulic' Suspension Systems
• LVVTA News January-July 2014 Issue 49	Page 12 Lowered Suspension LVV Inspection Basics
• LVVTA News August-December 2014 Issue 50	Page 2 Suspension 'Johnny Joints'
• LVVTA News August-December 2014 Issue 50	Page 4 Check for Drilling of I-beam Axles
• LVVTA News August-December 2014 Issue 50	Page 8 Custom Suspension Arms Info-sheet # 01-2012 Reminder
• LVVTA News May-July 2015 Issue 52	Page 6 Lock Washers on Adjustable Camber Plates
• LVVTA News May-July 2015 Issue 52	Page 6 Dome-style Rubber Cushions as Bump-stops
• LVVTA News May-July 2015 Issue 52	Page 9 Recognised IFS Manufacturers (covers IRS & welded brake calipers)
• LVVTA News May-July 2015 Issue 52	Page 9 Custom Bushed Rod Ends
• LVV Information Sheet # 05-2004	Upper Suspension Ball-joints in Early Ford Falcons and Fairlanes
• LVV Information Sheet # 05-2008	Air Cylinder Suspension Systems
• LVV Information Sheet # 08-2008	I-beam Axles and Split Radius Rods
• LVV Information Sheet # 02-2009	Spring and Hub-carrier Adjustable Suspension
• LVV Information Sheet # 04-2010	Bump-steer Measurement Background Information
• LVV Information Sheet # 05-2010	Bump-steer Swing-check Procedure
• LVV Information Sheet # 05-2011	Rear Suspension Radius Rod Geometry
• LVV Information Sheet # 08-2011	Jaguar Independent Rear Suspension Installation Guide
• LVV Information Sheet # 01-2012	Custom Suspension Arm Inspection and Approval
• LVV Information Sheet # 04-2012	Suspension Camber Angle Guide
• LVV Information Sheet # 05-2012	Welded Forged Aftermarket Suspension Struts
• LVV Information Sheet # 06-2012	'Magnum'-brand I-beam Axle Safety Warning
• NZ Car Construction Manual	Chapter 6 Suspension Systems
• NZ Car Construction Manual	Chapter 7 Steering Systems

Note that all documents referred to in this table, with the exception of the NZ Car Construction Manual, can be accessed from www.lvvta.org.nz free of charge. For information on obtaining the NZ Car Construction Manual, contact info@lvvta.org.nz

Note also that paper copies of documents can become out of date and as such should not be relied upon, therefore LVVTA advises users of this standard to check to ensure that the Associated Information listed here is current, by going to www.lvvta.org.nz/standards.html

Contents

Suspension Systems (195-00[02])

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 that satisfactory handling characteristics are present in all normal driving conditions.

Section 1 Scope and application of this standard

1.1 Scope of this standard

1.1(1) This low volume vehicle standard applies to all light vehicles other than those specified in *1.1(2)*, that are:

(a) modified on or after 1 January 1992 in such a way that any suspension 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

(b) light trailers of Class TA or TB; or

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

1.2 Application of this standard

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

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

(b) unless *section 3* applies, comply with all applicable technical requirements contained in *section 2* of this standard.

NOTE: Where a light vehicle is required to be certified to the *Low Volume Vehicle Code*, but the modification date precedes the date upon which this standard takes effect (1 December 2000), an LVV Certifier must ensure that the vehicle meets the general safety requirements contained in *2.1* of this standard, and should use the applicable technical requirements of *section 2* of this standard as a guideline upon which to base his judgements on the safety of the vehicle.

Section 2 Technical requirements of this standard

2.1 General safety requirements

2.1(1) A low volume vehicle must:

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

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

NOTE: The requirements specified in *2.1(1)* are selected from *2.3* of *Part 2* of the *Low Volume Vehicle Code*, reproduced here in the interest of convenience, and are over-riding requirements which make it clear that, regardless of what technical requirements are or are not in place, every vehicle certified to the *Low Volume Vehicle Code* must be fit for its purpose, and must be safe.

2.1(2) A steering system on a motor vehicle, and associated systems and components that could directly or indirectly affect the directional control of the vehicle, must:

(a) provide the vehicle with safe, efficient, convenient, and sensitive control; and

(b) be strong, durable, and fit for its purpose, taking into account whether adverse effects have resulted from a loss of integrity of any protective system used by a relevant component.

NOTE: The requirements specified in *2.1(2)* are the applicable general safety requirements from *2.2(1)* and *2.2(2)* of *Land Transport Rule 32003: Steering Systems 2001* which are required as part of this low volume vehicle standard, and are reproduced here in the interest of convenience.

2.2 Technical requirements for suspension systems

2.2(1) All low volume vehicles, except those specified in *section 3*, must comply with the applicable requirements in 2.2 and 2.3.

2.2(2) A low volume vehicle that is either scratch-built, or has had its suspension system modified to such an extent that the modifications 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 *Chapter 6 Suspension Systems* of the *New Zealand Car Construction Manual*.

Suspension travel

2.2(3) Suspension travel available within a low volume vehicle 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; and

(c) the minimum distance that the suspension extends from static ride height is either:

(i) 40 mm; or

(ii) one third of the vehicle's total suspension travel; or

(iii) in the case of an unusual vehicle or suspension configuration, a figure that may be determined by the LVV Certifier to be acceptable.

NOTE: An unusual vehicle as referred to in *2.2(3)(c)(iii)* may be one with an unusually small amount of suspension travel such as a scratch-built Lotus 7 replica.

2.2(4) No components fitted to a low volume vehicle 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.

2.2(5) Tyres and wheel-rims fitted to a low volume vehicle must be positioned in such a way that they cannot 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.

2.2(6) A suspension system incorporated within a low volume vehicle may be modified to raise or lower the ride-height of a vehicle, provided that:

(a) any lever-actuated brake bias control, if fitted, is repositioned if necessary in order to maintain correct operation; and

(b) bump-steer geometry is not increased beyond that which would be expected within the original range of suspension operation; and

(c) sufficient drive-shaft yoke engagement remains throughout all extremes of suspension travel.

Bump-stops

2.2(7) A low volume vehicle 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; and

(d) limit the suspension travel before the ball-joints have reached the end of their effective travel; and

(e) prevent contact between the underside of the vehicle and the road surface during vehicle operation when fully laden.

NOTE 1: The purpose of a bump-stop is to avoid shock-load damage upon bottoming out under full suspension compression. A rubber donut-type buffer-stop is acceptable, and can be incorporated into coil-over shock absorbers that do not have one already fitted.

NOTE 2: A short dome-style rubber cushion meant as a full-droop stop on a suspension arm is not acceptable for use as a suspension bump-stop.

Geometry

2.2(8) Moving components and systems fitted to a low volume vehicle 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; or

(d) drive-shaft universal angularity exceeding the maximum operating angles specified by the drive-shaft universal manufacturer.

2.2(9) A low volume vehicle, except in the case of a vehicle for which a current and valid LVV Authority Card has been issued, which has 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.

NOTE 1: An 'LVV Authority Card' as referred to in *2.2(10)* is an authority card issued by Motorsport New Zealand for authorised competition licence-holders.

NOTE 2: Proof of compliance with the requirement specified in *2.2(9)* is a full four-wheel alignment report.

2.2(10) A front or rear suspension system in a low volume vehicle, except in the case of a vehicle which is primarily designed and used for LVVTA-recognised motor sport events, and for which a current and valid LVV Authority Card has been issued, must incorporate no more than either:

(a) 1.5 degrees of negative camber; or

(b) one half of a degree of negative camber more than the maximum figure specified by the vehicle manufacturer, including any manufacturer-specified tolerance.

NOTE 1: Where negative camber does not exceed 1.5 degrees when measured by the LVV certifier, the requirement for a wheel alignment report is not mandatory, unless specifically required by the LVV Certifier.

NOTE 2: An 'LVV Authority Card' as referred to in *2.2(10)* is an authority card issued by Motorsport New Zealand for authorised competition licence-holders.

2.2(11) A wheel-rim fitted to a modified production low volume vehicle which retains the vehicle manufacturer's original wheel hub assembly must not have the wheel-rim centre offset by any more than 35% of the total wheel-rim width.

Shock absorbers

2.2(12) A low volume vehicle must have a method of effectively dampening road shock for each wheel, which is able to satisfactorily control suspension spring energy.

2.2(13) A shock-absorber fitted to a low volume vehicle must be:

(a) compatible in stroke and rate to the spring with which it operates; and

(b) of a size and rate which is appropriate for the weight and intended use of the vehicle to which it is fitted.

Springs (including coil and leaf)

2.2(14) A spring fitted to a low volume vehicle must:

(a) be of a size and rate that is appropriate for the weight and intended use of the vehicle to which it is fitted; and

(b) in the case of a spring that reduces the suspension travel and, as a result, reduces the ride height of the vehicle, be proportionately increased in stiffness rate so as to ensure against premature bottoming-out during normal vehicle operation when the vehicle is fully laden.

Coil springs (including heavy-duty and height-changing)

2.2(15) A low volume vehicle fitted with coil springs must:

(a) incorporate springs that have sufficient coil spacing to ensure that coil bind does not occur at full suspension travel; 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.

2.2(16) Coil springs fitted to a low volume vehicle 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.

2.2(17) 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

2.2(18) Coil springs fitted to a low volume vehicle must be firmly contained within their locating seats in such a way that the springs cannot 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

2.2(19) Coil springs fitted to a low volume vehicle 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 heating was used during the modification process.

2.2(20) A coil spring fitted to a low volume vehicle may only be electro-plated if the electro-plating is carried out in accordance with the relevant specifications in *Chapter 6 Suspension Systems* of the *New Zealand Car Construction Manual*.

Leaf springs (including heavy-duty and height-changing)

2.2(21) With the exception of the removal or refitting of one or more leaves within a leaf spring, a leaf spring fitted to a low volume vehicle may only be manufactured or modified by a recognised industry expert who is professionally engaged in the manufacturing and modification of springs.

NOTE 1: A leaf spring may be heated and reset in order to reduce the ride-height of a low volume vehicle, provided that the work is carried out by a person referred to in *2.2(21)*.

NOTE 2: The spring eyes of a leaf spring fitted to a low volume vehicle may be reversed provided that the work is carried out by a person referred to in *2.2(21)*.

NOTE 3: In the case of a leaf being removed from a spring pack, an LVV Certifier must ensure that the requirement for suitable spring stiffness in *2.2(14)* remains.

2.2(22) A low volume vehicle must not be lowered by the fitting of leaf springs mounted in the upside-down position.

2.2(23) A low volume vehicle fitted with a leaf spring suspension system, which uses extended spring shackle pin sets to achieve an increase in suspension height, must have shackle pin sets that, if longer than 150 mm between shackle pin centres, are reinforced to prevent bending under cornering loadings.

2.2(24) 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.

2.2(25) A spacer block fitted to a leaf spring suspension system to raise or lower the ride-height of a low volume vehicle must be:

(a) positively located at the top and the bottom of the block; and

(b) securely fitted; and

(c) firmly seated over not less than the original seat area; and

(d) constructed from metal; and

(e) designed for the purpose.

2.2(26) Over-ride airbags, when fitted to assist the springs on a low volume vehicle when the vehicle is heavily laden, must:

(a) where fitted in place of a bump stop, incorporate an effective bump stop; and

(b) mount to a suitable part of the vehicle structure.

NOTE: The over-ride airbag manufacturer's installation instructions may be used as a guide for correct mounting, provided that all technical requirements contained within this standard are met.

Adjustable height and adjustable geometry suspension

2.2(27) A suspension strut that is adjustable to raise and lower the vehicle ride height must:

(a) attach to the original suspension mounting points; and

(b) in the case of a threaded height adjustment mechanism, have a suitable mechanical locking device to prevent loosening.

NOTE: A second locking ring is a 'suitable mechanical locking device' as referred to in *2.2(27)(b)*. A thread-lock adhesive is not acceptable.

2.2(28) A non-adjustable strut modified by removing most of the strut tube down to the stub axle and sliding over a replacement threaded strut tube for the attachment of an adjustable spring platform, must:

(a) not incorporate any modification of, or welding to, any cast or forged component, in particular the stub axle assembly; and

(b) have the threaded strut tube press-fitted over the original remaining strut tube with no less overlap than the length of one diameter of the tube; and

(c) have the threaded strut tube fully welded to the original remaining strut tube, around the circumference of the lower end, with plug welds above; and

(d) meet the requirements specified in *section 18.9* of *Chapter 18* of the *New Zealand Car Construction Manual* for critical function welding.

NOTE 1: A weld referred to in *2.2(28)(c)* is considered to perform a critical function, and as such must meet the requirement for critical welds, including TIG welding, with an associated non-destructive test.

NOTE 2: Any welding of the strut tube should be no closer than 10 mm to any casting or forging.

NOTE 3: The plug welds referred to in *2.2(28)(c)* should consist of not less than two 10 mm plug welds, or four 8 mm plug welds.

2.2(29) A non-adjustable strut modified by replacing the fixed OE spring platform with a threaded sleeve and adjustable spring platform that is fitted to a low volume vehicle must either:

(a) have the threaded sleeve fully-welded to the strut tube around the top and bottom circumferences, and meet the requirements specified in *section 18.7* of *Chapter 18* of the *New Zealand Car Construction Manual* for general welding; or

(b) where the strut tube has been shortened by cutting and re-welding, have the threaded sleeve positioned across the joint and be fully-welded to the strut tube around the top and bottom circumferences, and meet the requirements specified in *section 18.9* of *Chapter 18* of the *New Zealand Car Construction Manual* for critical function welding.

NOTE 1: A weld referred to in *2.2(29)(a)* is not considered to perform a critical function, and as such does not need to meet the requirement for critical function welds in *section 18.9* of the *NZ Car Construction Manual*, however an LVV Certifier may require, at his discretion, a non-destructive test (NDT) following a visual inspection.

NOTE 2: In the case of where *2.2(29)(a)* applies, to prove the tube has not been cut and welded, a modifier should have the strut inspected by an LVV Certifier before the strut is reassembled.

2.2(30) An aftermarket suspension strut fitted to a low volume vehicle that incorporates adjustment on the upper platform mount to adjust geometry, must use the same number of fasteners as supplied by the upper platform mount manufacturer.

NOTE: In the case where upper platform mounts are incorporated within aftermarket McPherson-style struts (which usually incorporate 4 or 6 fasteners), additional anti-vibration devices (as required by *Chapter 18 Attachment Systems* of the *NZ Car Construction Manual*) are not required in this specific situation, provided that the upper platform mount is installed in accordance with the manufacturer's instructions and the fastening equipment is that which is provided by the upper platform mount manufacturer.

Aftermarket suspension arms

2.2(31) A suspension arm that is fitted to a low volume vehicle which is a volume-produced aftermarket bolt-in type, and which is mounted directly to the vehicle's unmodified original suspension attachment points therefore maintaining all original suspension geometry, other than to allow additional adjustability, must:

(a) follow sound time-proven designs, and be consistent with the common time-proven makes; and

(b) be in good condition, with no evident deterioration or cracking, particularly around welded attachment points; and

(c) be of an appropriate size for use with the weight and performance characteristics of the vehicle to which it is fitted; and

(d) in the case of a suspension arm which supports the weight of the vehicle:

(i) the arm must be an identifiable reputable aftermarket brand; and

(ii) the arm must be accompanied by documented brand verification that confirms that the manufacturer is as purported to be; and

(iii) in the case that no such documented evidence is available, the arm meets the requirements specified in *2.2(32)*.

NOTE: 'Documented brand verification' as referred to in *2.2(31)(d)(ii)* means some form of documented verification that the arm is in fact a known and recognised brand of volume aftermarket manufacturer, and can be an invoice (preferred) or advertising material that clearly shows the listed parts being identical to those being assessed.

2.2(32) In the case of a suspension arm fitted to a low volume vehicle that supports the weight of the vehicle which is produced by an unrecognised or unidentified aftermarket suspension component manufacturer, the arm must:

(a) meet or exceed the material specifications for aftermarket and custom suspension arms provided in *Chapter 6 Suspension Systems* of the *New Zealand Car Construction Manual*; and

(b) be non-destructively tested in accordance with the non-destructive test requirements for critical components specified in *18.9* of *Chapter 18 Attachment Systems* of the *New Zealand Car Construction Manual*.

NOTE 1:	For requirements relating to other types of suspension arm modifications, including custom or one-off arms that are outside of the scope of this standard, and for guidance on appropriate sizing, *Chapter 6 Suspension Systems* of the *NZ Car Construction Manual* should be referred to.
NOTE 2:	Where any doubt exists in relation to any aspect of an aftermarket suspension arm during the LVV certification assessment process, an LVV Certifier should use *Chapter 6 Suspension Systems* of the *NZ Car Construction Manual* as a source document for guidance, and as part of that assessment process may elect to refer the component to the LVVTA Technical Advisory Committee for approval.

Suspension joints

2.2(33) An automotive suspension ball-joint fitted to a low volume vehicle must:

(a) either:

(i) be original equipment for the vehicle to which it is fitted; or

(ii) be suitable for the weight of the vehicle to which it is fitted, and be designed to operate correctly in its new configuration, particularly in the case of a vertically-loaded suspension joint in which case it must be a purpose-designed load-bearing automotive ball-joint designed to support the corner weight of the vehicle;

and

(b) be connected to the suspension arm with sufficient strength, taking into consideration the applied load-paths through the ball-joint, and the forces to which the connection will be subjected.

2.2(34) A spherical bearing rod-end joint fitted to a low volume vehicle must:

(a) be of premium quality, having a radial load-rating appropriate to the rod end size; and

(b) be positioned in such a way that binding of the end cannot occur throughout the full range of suspension travel; and

(c) incorporate sufficient thread engagement to ensure that the rod end is securely held in position; and

(d) be injected with a high-quality flexible lining material such as Teflon or Kevlar; and

(e) incorporate a retaining washer to prevent pull-out if the end becomes worn; and

(f) incorporate a suitable shank and bolt size; and

(g) where the joint is a screw-in ball-type, have thread engagement of at least one-and-a-half times the thread diameter; and

(h) where the joint is a screw in/out custom spherical bearing rod-end, only be loaded in compression or tension through its longitudinal axis.

NOTE 1: A spherical bearing rod-end joint is also commonly referred to within the automotive hobby and industry as a 'rose-joint' or 'heim-joint'.

NOTE 2: 'Radial load-rating' (appropriate to rod-end size) as specified in *2.2(34)(a)* is to be assessed by referring to *Table 6.3* in *Chapter 6 Suspension Systems* of the *NZ Car Construction Manual*.

2.2(35) A bushed rod-end joint fitted to a low volume vehicle must:

(a) incorporate a purpose-designed rubber or urethane bushing; and

(b) incorporate a steel inner sleeve; and

(c) in the case of a single-shear attachment of the rod-end, a purpose-designed pull-out prevention retaining washer; and

(d) where the rod-end joint is a screw in/out bushed rod-end, only be loaded in compression or tension through its longitudinal axis.

Stub axles

2.2(36) A stub axle fitted to a low volume vehicle may be replaced, provided that:

(a) the replacement stub axle is a common 'bolt-on' aftermarket or original equipment-style of stub axle, and:

(i) if aftermarket, is an identifiable aftermarket brand, accompanied by documented verification that it is from a reputable aftermarket stub axle manufacturer; and

(ii) if aftermarket, is a volume-produced aftermarket catalogued part for that make and model of vehicle; and

(iii) if manufactured via a casting process, is made from either cast steel or cast ductile iron; and

(iv) is unmodified; and

(v) in the case of an aftermarket stub axle manufactured via a casting process, incorporates a separate spindle pin machined from solid bar-stock; and

(vi) is comparable to or greater in size than the original stub axle being replaced;

and

(b) the steering arm is either:

(i) an unmodified original bolt-on steering arm that is in an identical position relative to the position of the original steering arm; or

(ii) an integral part of the stub axle and enables correct steering geometry to be retained.

NOTE 1:	A 'stub axle' is also commonly referred to within the automotive hobby and industry as an 'upright'.
NOTE 2:	The common 'bolt-on original equipment-style of stub axle' referred to in *2.2(36)(a)* includes an OEM-type 4-stud to 5 stud stub axle conversion or an OEM conversion from drum to disk brake that includes stub axle replacement.
NOTE 3:	A stub axle that does not meet the above criteria, such as a custom made part or one that cannot be identified as being from a reputable manufacturer, is outside the scope of this standard and must be evaluated using the *NZ Car Construction Manual*.
NOTE 4:	An LVV Certifier may require an aftermarket stub axle to undergo a nodularity test if he has reason to believe that the axle may not have sufficient ductility to be fit for its intended purpose.

Other requirements

2.2(37) All welding incorporated in suspension system attachment, modification, or adaptation within a low volume vehicle, must meet all applicable welding requirements specified in *Chapter 18 Attachment Systems* of the *New Zealand Car Construction Manual*.

2.2(38) All fasteners incorporated in suspension system attachment, modification, or adaptation within a low volume vehicle, must meet all applicable fastening requirements specified in *Chapter 18 Attachment Systems* of the *New Zealand Car Construction Manual*.

2.2(39) A low volume vehicle required to comply with this standard must also comply with the relevant requirements of:

(a) *Low Volume Vehicle Standard 35-00 (Braking Systems)*; and

(b) *Low Volume Vehicle Standard 125-00 (Lighting Equipment)*; and

(c) *Chapter 6 Suspension Systems* of the *New Zealand Car Construction Manual; and*

(d) *Chapter 7 Steering Systems* of the *New Zealand Car Construction Manual.*

NOTE: The reference *to LVV Standard 125-00 (Lighting Equipment)* in *2.2(39)(b)* is because the raising or lowering of a vehicle could, in extreme cases, cause lighting equipment to fall outside of permitted areas.

2.3 Road-test requirements for suspension systems

Vehicle operation

2.3(1) A modified production low volume vehicle 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 manufactured.

2.3(2) A scratch-built low volume vehicle 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.

2.3(3) A low volume vehicle 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.

2.3(4) Shock absorbers with adjustable damping rate fitted to a low volume vehicle must achieve acceptable ride and handling when tested in the firmest available setting, except in the case of a vehicle which is primarily designed and used for LVVTA-recognised motor sport events, and for which a current and valid LVV Authority Card has been issued.

NOTE: An 'LVV Authority Card' as referred to in *2.3(4)* is an authority card issued by Motorsport New Zealand for authorised competition licence-holders.

Occupant weight simulation test

2.3(5) Any low volume vehicle with lowered suspension may be inspected and tested, where considered necessary at the discretion of the LVV Certifier, in a condition of simulated occupant weight and load, on the following basis:

(a) a Class MA, MB, MC, MD1, and MD2 low volume vehicle carrying 80 kg distributed in each seating position; and

(b) a Class NA low volume vehicle 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.

Recording of suspension height

2.3(6) The suspension height of a low volume vehicle must be measured and recorded, as an average figure of the front wheel heights and of the rear wheel heights, by the LVV Certifier at the time of LVV certification inspection:

(a) from the centre of each wheel up to the underside of the guard directly above, as shown in *Diagram 2.3(6)*; and

(b) with the vehicle on a flat surface, with the vehicle unladen and no occupants; and

(c) where a vehicle with guards that extend lower than the centre of the wheel, from the centre of each wheel down to the bottom edge of the guard, with a negative figure recorded.

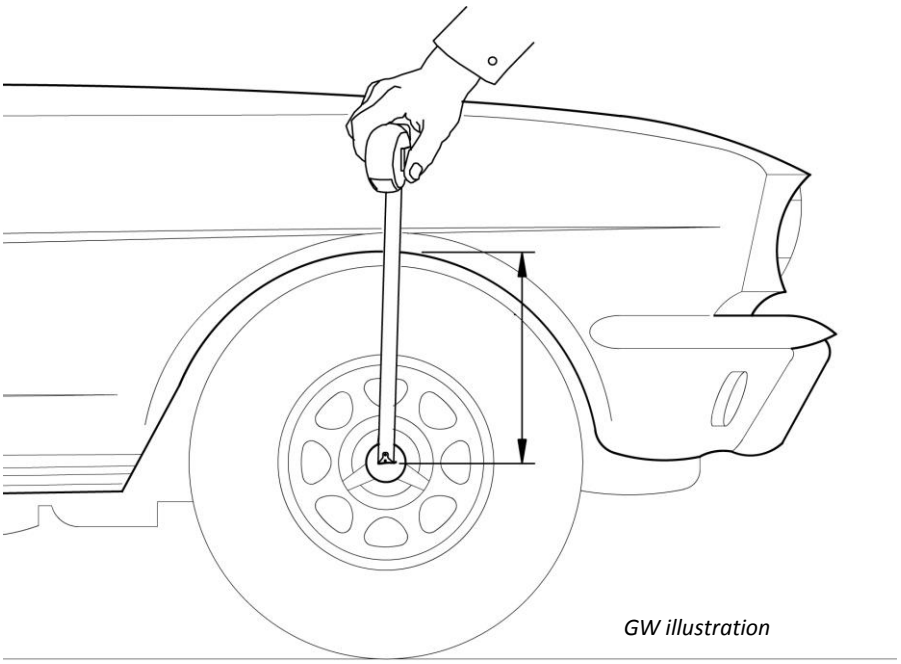

Diagram 2.3(6) Suspension height recording

Section 3 Exclusions to this standard

3.1 Motor sport vehicle exclusions

Geometry exclusion

3.1(1) A low volume vehicle which is primarily designed and used for LVVTA-recognised motor sport events, and for which a valid and current LVV Authority Card is issued, is not required to comply with the requirements specified in *2.2(9)* and *2.2(10)*.

Shock absorber setting exclusion

3.1(2) A low volume vehicle which is primarily designed and used for LVVTA-recognised motor sport events, and for which a valid and current LVV Authority Card is issued, is not required to comply with the road-test shock absorber setting requirement specified in *2.3(4)*.

NOTE: An 'LVV Authority Card' as referred to in *3.1(1)* and *3.1(2)* is an authority card issued by Motorsport New Zealand for their association members who are authorised competition licence-holders.

Section 4 Vehicles not required to be certified to this standard

4.1 Vehicles not covered by this standard

4.1(1) A light vehicle is not required to be certified to this low volume vehicle standard, if the vehicle is modified for the purposes of law enforcement or the provision of emergency services.

4.1(2) A light vehicle is not required to be certified to this low volume vehicle standard, if the vehicle is identified as having been modified by a second-stage vehicle manufacturer, and complies with an approved overseas standard that is listed in *Annex 6* of the *Low Volume Vehicle Code*.

4.2 Vehicles that pre-date legal requirements

Modified production low volume vehicles

4.2(1) A modified production low volume vehicle is not required to be certified to this low volume vehicle standard, if the vehicle was:

(a) modified before 1 January 1992 in such a way that any suspension system may, directly or indirectly, be affected; and

(b) the suspension system fitted to the vehicle is the same as that which was fitted at the time of the vehicle's modification.

Scratch-built low volume vehicles

4.2(2) A scratch-built low volume vehicle is not required to be certified to this low volume vehicle standard, if the vehicle was:

(a) built before 1 January 1992; and

(b) the suspension system fitted to the vehicle is the same as that which was fitted at the time of the vehicle's construction.

4.3 Modifications that do not require certification

4.3(1) 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 are met, provided that the safe performance of the vehicle is not compromised:

market shock absorbers including air adjustable units but not with height-adjustable platforms, may be used provided mountings; or

hat raise or lower the vehicle, the springs or shock

(ii) rep

(iii) replacement springs a extension, without the use of no ties, straps, or external spring locators; an

(iv) springs and spring seats are not height adjustable by any me (unless original equipment); and

(v) a minimum of 100mm ground clearance (un-laden and without driver) exists below any part of the vehicle structure, or any steering, braking or suspension component, but does not include such items as exhaust pipes and exterior body panels that do not contribute to the structural strength of the vehicle; and

(vi) the normal relationship between the front and rear suspension height is not unduly affected; and

(vii) suspension components maintain sufficient clearance from unmodified bump-stops when fully laden; and

(viii) the suspension maintains sufficient travel for safe operation when fully laden;

height (up or down) the blocks

(ii)

(iii) not more than 50 mm

(iv) constructed from metal; and

(v) positively located top and bottom; and

(vi) designed for the purpose;

or

(d) after-market suspension bushes may be substituted for the originals, provided that:

(i) they are made from an appropriate material such as polyurethane; and

(ii) there has been no cutting or machining of the suspension arms to fit them;

or

(e) after-market anti-sway bars may be fitted provided the bar is attached to unmodified OE mounting points; or

...ay bars may occur provided no cutting, heating or ...ture or suspension components is involved in ...

...vided there are ...

...pro...

(i) designed as a me... and

(ii) are a catalogued aftermarket item for that m... vehicle.

Section 5 Terms and definitions within this standard

mm	is an abbreviation for millimeters.
Bump-stop	means a resilient block, usually rubber, that is contacted by the suspension at the extreme limits of travel.
NDT	is an abbreviation for non-destructive testing, usually used to check that a weld does not have any flaws, cracks or features of the design that may weaken the joint.
Offset	means the distance between the vertical centreline of the wheel, and the hub flange to which the wheel attaches.

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 necessarily contained within the terms and definitions section of the *Low Volume Vehicle Code*.