Queensland Code of Practice: Vehicle Modifications (QCOP)

Code LS9: High Lift - Up to 150mm (Design Certification)

November 2022

Queensland Government

CODE LS9

High Lift - Up to 150 mm (Design Certification)

Code LS9 applies to vehicles of ADR category MC, NA and NB1.

1.0 Introduction

LS9 code provides modification standards for lifting vehicle ride height by changes to suspension, tyres or body blocks on light vehicles of categories MC (Off Road Passenger Vehicle), NA (Light Goods Vehicle with GVM up to 3,500 kg) and NB1 (Medium Goods Vehicle with GVM up to 4,500 kg). Modifications that result in change to ride height of these categories of vehicles are classified into four types.

Minor Modifications- Change in ride height due to fitting of alternate tyre and rim combination that is permitted by the original vehicle manufacturer or otherwise permitted in the relevant Code of Practice without certification is deemed as a Minor Modification and does not require certification under LS9. For more details refer to LS Section of NCoP VSB-14 and the Vehicle Standards Instruction “Minor Modifications”.

Basic Modifications- A modification that is not a Minor Modification and results in increase in ride height of (a) up to 50 mm due to modified suspension or (b) up to 25 mm due to larger tyres or (c) up to 75 mm due to combination of (a) and (b) is a Basic Modification and **does not** require certification under LS9, provided the modification is carried out according to the guidelines in LS9.

Complex Modification- A modification that is neither a Minor Modification nor a Basic Modification and results increase to ride height of (a) up to 100 mm due to modified suspension or (b) up to 25 mm due to larger tyre or (c) up to 50 mm due to body blocks or (d) up to 150 mm due to any combination of (a), (b) and (c) is a Complex Modification and requires certification under LS9 and LS10.

Specific Modification- A modification that results in change to ride height that is not covered by Minor Modification or Basic Modification, or Complex Modification is a Specific Modification. Specific Modifications to ride height change are outside the scope of LS9 and LS10. For Specific Modifications, an application may be made to TMR Vehicle Standards unit.

The above classification covers both vehicles with and without an Electronic Stability Control (ESC) system.

2.0 Scope

This code provides guidance for Basic Modifications and covers requirements for design of Complex Modifications to increase in ride height up to 150 mm on vehicles of MC, NA and NB1 categories.

Modifications to vehicles with or without an ESC system resulting in a vehicle lift up to 75 mm above the original manufacturer's specifications do not require certification under LS9, provided the lift is within the limits of the Basic Modifications as explained above. A person performing this type of modification is encouraged to use the relevant technical requirements contained within this code as guidance; however, no formal certification is required.

The LS9 code requires that the increase in ride height from suspension, tyres and body blocks must not exceed 100 mm, 25 mm and 50 mm (or 25 mm when increase due to suspension exceeds 75 mm) respectively. The code also requires that the combined increase in ride height must not exceed 150 mm. Table LS9-1 further clarifies the above scope.

Table LS9-1 Lift Guide for Vehicles with and without ESC

Certification	Lift from Suspension	Lift from Tyres	Lift from Body blocks	Total lift
Not required	1 to 50 mm	1 to 25 mm	--	up to 75 mm
Required	51 to 100 mm	--	1 to 50 mm	up to 150 mm

LS9 code provides for certification of designs that can be used as guide to modify a vehicle and to certify a modified vehicle. Code LS10 provides for certification of physical modifications to a vehicle when carried out as specified in the relevant LS9 certification.

Lift modifications that are outside the scope of LS9 as explained above, require specific approval from the Department of Transport and Main Roads (TMR).

2.1 Designs permitted under Code LS9

The following is a summary of the designs allowed to be certified under Code LS9:

- Increase in ride height of vehicles of categories MC, NA and NB1;
- Design that results in the total vehicle height being raised by no more than 150 mm;
- Design that results in the total vehicle height being raised by no more than 100 mm by modified suspension;
- Design that results in the total vehicle height being raised by no more than 25 mm by larger tyres;
- Design that results in the total vehicle height being raised by no more than 50 mm by body blocks (reduced to 25 mm if combined with lift from modified suspension that exceeds 75 mm);
- Design of front suspension modifications using different struts or uprights;
- Design of independent rear suspension modifications using different struts, trailing arms or uprights;
- Design of a conversion using a complete suspension assembly from a different vehicle model;
- Design of a complete rear suspension assembly using components from different vehicle model(s); and
- Alternative wheel and tyre specifications for vehicles with modified axles or suspension.

2.2 Designs not permitted under Code LS9

The following is a summary of the designs NOT allowed to be certified under Code LS9:

- If a vehicle is fitted with electronic stability control (ESC) system and (a) either the lift has not been approved by the vehicle manufacturer or (b) ESC is not proven through testing after modification;
- Certification of the actual physical modification on a particular vehicle (this is covered by code LS10);
- Design of modifications that increase the ride height by (a) more than 100 mm from suspension or (b) more than 25 mm from tyres or (c) more than 50 mm (or more than 25 mm if the increase in ride height due to suspension exceeds 75 mm) from body blocks or (d) more than 150 mm combined from the original manufactured height; and
- Design for modifications that raise the vehicle ride height more than 50mm from the original as-manufactured height on vehicles that have had the wheel track reduced from the as-manufactured width.

2.3 Designs not requiring certification

Note that vehicle lift designs that do not exceed 75 mm above the original manufacturer's specifications and are achieved only from a lift from modified suspension (lift up to 50 mm) and/or lift from larger tyres and rims (lift up to 25 mm) do not require certification.

3.0 General requirements

All work must also comply with the requirements contained in sub-section 2.0 General Requirements of *Section LS Tyres, Rims, Suspension and Steering* of the *National Code of Practice for Light Vehicle Construction and Modification (NCoP)*. Specific requirements in this code take precedence over any general instructions in Queensland Code of Practice (QCoP).

Specific modifications to a vehicle may affect the warranty provided by the Original Vehicle Manufacturer (OVM). It is the responsibility of the certifying Approved Person (AP) to consider such effect on warranty. Consideration of the effect this modification may have on product warranty is outside the scope of this code. The certifying AP must clarify this point to the modifier and the vehicle operator.

For audit purposes, sufficient documentary and photographic evidence of the modification must be retained by the certifying AP.

3.1 Compliance with applicable vehicle standards

3.1.1 The modified vehicle must continue to comply with the applicable Australian Design Rules (ADRs).

3.1.2 If different or additional ADRs apply to the modified vehicle due to the modifications, the vehicle must comply with those ADRs that apply to it after modification.

3.1.3 A modified vehicle must also comply with the applicable in-service requirements of the *Transport Operations (Road Use Management – Vehicle Standards and Safety) Regulation 2021* (the VSS regulation).

3.1.4 A pre-ADR modified vehicle must continue to comply with the VSS regulation.

3.1.5 Specific requirements, if listed in Section 4.0 of this code, take precedence over the general requirements in Section 3.0. For example, see Section 4.7, if the vehicle as supplied to market is fitted with ESC system.

3.1.6 Outlined in table LS9-2 are areas of the vehicle that may be affected by the modifications and may require re-certification, testing and/or data to show compliance of the modified vehicle.

Table LS9-2 Summary of items that, if modified, may detrimentally affect compliance with applicable ADRs

DETAIL	REQUIREMENTS
Installation of Lighting	ADR 13/00
Braking System	ADR 7, 7/.., 31, 31/.., 35x, 35/.., 42/..
Speedometer	ADR 18x, 18/..
Tyre Speed Rating	ADR 24x, 24/.., 42/..
Ground Clearance	ADR 43/..

Note: This is not an exhaustive list and compliance to other ADRs may also be affected.

The ADR applicability is according to the vehicle's category and date of manufacture. It is the responsibility of the certifying AP to verify compliance to the applicable ADRs. The certification must include the vehicle date of manufacture in addition to the date of modification.

4.0 Specific Requirements

4.1 Vehicle lifts up to 150mm

The following requirements must be met for all vehicle lift modifications that do not exceed 150mm and require certification. Where a modification involves a change to the suspension system *design*, the basic functional requirements for suspension modifications/conversions are provided as a guide to suitably qualified and experienced AP when designing or certifying such modifications or conversions.

The design should also comply with the general guidelines contained in sub-section 2 *General Requirements*, *Specific Requirements* in Code LS3 *Front Suspension and Steering Conversion – Design and Specific Requirements* in Code LS5 *Rear Suspension Modification – Design,* in the NCoP.

Each design should be fully documented, with drawings, calculations, procedural details, test results, wheel alignment specifications and any other data necessary to fully describe the vehicle modifications and should have a unique design number. The design document should contain:

- Details of all drawings needed to fully describe the full extent of the modification;
- Details of any special modification techniques, procedures or adjustments; and
- Details of any testing of components and performance (e.g., bump steer plots) with related acceptance criteria.

4.2 Suspension Modifications

The available suspension travel in either direction must remain at least equivalent to two thirds of that originally available prior to modifying the system.

The available suspension rebound following the addition of increased length coil springs and longer travel shock absorbers must be at least equivalent to two thirds of the original rebound travel.

The rebound must be limited by either the shock absorber maximum travel (providing the component is designed for this type of loading), the technique used by the original manufacturer's design or by the addition of adequately sized straps.

At full rebound the coil springs must still be securely attached to the vehicle by not having reached their free length.

All linkages and brake lines etc. must be adequately designed for the increased movement.

The increase in vehicle ride height due to suspension modifications must not exceed 100 mm.

4.3 Body Blocks

Body blocks between the vehicle body and the chassis must comply with the following:

- The material must be of similar strength and durability as the original components;
- All assemblies and piping that span between the body and the chassis must be suitable for the increased distance; and

- The increase in vehicle ride height due to body blocks must not exceed 50 mm (or 25 mm if the increase in ride height due to suspension exceeds 75 mm).

4.4 Wheels and Tyres

The overall tyre diameter can be increased up to 50mm for vehicles of category MC, NA and NB1. This will increase the ride height up to 25 mm.

Tyres fitted to such vehicles (category MC, NA, NB1) must not be more than 50% wider than the vehicle manufacturer's widest optional tyre.

The rim width must match the recommendations for the tyre fitted.

The tables of original tyres with the maximum allowable tyre and rim sizes in Clause 4.2 *Non-Standard Tyres and Rims* in the NCOP are applicable.

The wheel track of MC, NA, NB1 category vehicles must not be increased by more than 50mm beyond the maximum specified by the vehicle manufacturer for the particular model.

The wheels must be contained within the bodywork or mudguards (including flares) when the wheels are in the straight-ahead position. Adequate clearance must be available between the tyres and the vehicle bodywork.

Speedometer accuracy must be maintained for the selected tyre and rim combination to as specified in the applicable ADR 18/…

4.5 Brakes

Modifications to any of the brake circuitry should meet the requirements of Section LG *Brakes* in the NCoP.

The braking performance of the vehicle should also meet the requirements of Section LG *Brakes* in the NCoP.

4.6 Vehicle Dynamics

These modifications, where the height of the centre of mass (centre of gravity) of a vehicle is increased, can have a complex influence on the handling/rollover characteristics of the modified vehicle. The height to which a particular vehicle can be safely raised is limited by the ability of that vehicle to safely negotiate conditions encountered in normal highway driving and under emergency situations. Vehicles certified under LS9 must fully comply with the *Lane Change Test* as outlined in Section LT *Test Procedures* (Code LT2) in the NCoP.

While Code LS9 allows for an overall vehicle height increase of 150 mm maximum, it is conditional upon the vehicle's ability to safely negotiate the lane change test as mentioned above.

4.7 Electronic Stability Control (ESC) System Testing

In case of vehicles fitted with an ESC system either as a mandatory requirement or as an optional safety feature, the ESC system must continue to perform as intended. The vehicle must continue to comply with the ESC related standards after modification. Appropriate evidence of such continued compliance must be obtained and retained by the AP. Apart from the ADR testing for ESC compliance by a test facility that is approved by the National Association of Testing Authorities (NATA) or similar, the following other forms of alternative evidence may be accepted:

- Vehicle manufacturer's approval letter, or
- Recalibration of the ESC system by the original vehicle/system manufacturer (or authorised representative), or
- Combination of computer simulation and diagnostic testing by a recognised test authority, or
- Traceable physical testing by an approved test facility to one of the following standards:
    - ADR 31/… or ADR 35/… as appropriate;
    - ADR 88/00;
    - UN ECE R 13H;
    - Global Technical Standard GTR-08;
    - US FMVSS-126; or
- Any other form of evidence approved by the department.

4.8 Vehicle Lighting

The headlights must comply with the ADR requirements with respect to position and illumination pattern. For vehicles complying with ADR 13/00 the top of the headlamp lens must not be greater than 1200mm from the ground when measured on a level surface.

4.9 Wheel guards (Mudguards)

After all modifications are completed the wheel guards (mudguards) must continue to comply with the requirements of applicable ADR 42/…

5.0 Components

Both general and specific requirements specified in any codes of the LS section of the NCOP that are applicable to individual steering and suspension components continue to apply. Important items such as spline engagement, operating angles of drive shaft joints and in the case of CV joints, the range of axial movement, must remain within design limits for the full range of suspension travel. Also, other components such as gear levers, brake hoses etc. may need to be extended depending on the nature of the lift.

Steering linkages must continue to operate efficiently, and sufficient spline contact surface must be retained for the full range of suspension travel to ensure the safe operation of the vehicle. Otherwise, an appropriate steering shaft extension must be used.

Wheel alignment must be checked to ensure that wheels are aligned within the specification.

Following the completion of modifications the vehicle attitude must remain as per original specifications – i.e., the original relationship between the front and rear suspension heights must not be changed and therefore the front and rear suspensions must be both raised by a proportionate amount.

Checklist LS9

CODE LS9: High Lift – Up to 150 mm (Design Certification)

Form No: LS9

Provide an answer to each of the following (N/A=Not Applicable, Y=Yes, N=No)

Modification Certificate Number:		
1	**Suspension Modifications** Will the lift due to suspension be no more than 100 mm Y/ N/ N/A	
1.1	**Front Suspension and Steering**	
	Do the front suspension system modifications comply with all the relevant requirements of Code LS3 in the NCOP?	☐ Y ☐ N ☐ N/A
1.2	**Rear Suspension**	
	Do the rear suspension system modifications comply with all the relevant requirements of Code LS5 in the NCOP?	☐ Y ☐ N ☐ N/A
1.3	**Suspension travel**	
	Is the designed suspension travel at least two thirds of the original in all directions?	☐ Y ☐ N ☐ N/A
	Has adequate rebound limiting been provided?	☐ Y ☐ N ☐ N/A
	At full rebound, do the coil springs remain securely attached to the vehicle by not having reached their free length?	☐ Y ☐ N ☐ N/A
	Have all linkages and brake lines been designed to accommodate the increased suspension travel?	☐ Y ☐ N ☐ N/A

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2	**Body Blocks**	
2.1	**Mounting**	
	Are the replacement body blocks suitably designed to carry the load as per the vehicle's GVM?	☐ Y ☐ N ☐ N/A
	When fitted, will the blocks lift the body no more than 50 mm or 25 mm as applicable?	☐ Y ☐ N ☐ N/A
2.2	**Design**	
	Is the material of the body blocks similar in strength and durability as the original components?	☐ Y ☐ N ☐ N/A
	Are all assemblies spanning the body and chassis suitably designed to allow for the increased distance?	☐ Y ☐ N ☐ N/A
	Are the body lift blocks suitably braced to the chassis or bodywork so as to prevent excess bending loads being placed on components?	☐ Y ☐ N ☐ N/A
3	**Wheels and Tyres** Will the lift due to tyres be no more than 25 mm	Y/ N/ N/A
3.1	**Tyres and Rims**	
	Are all selected tyres and rims in accordance with Section LS of the NCOP?	☐ Y ☐ N ☐ N/A
	Is the increase in overall tyre diameter less than 50mm for MC, NA and NB1 category vehicles?	☐ Y ☐ N ☐ N/A
3.2	**Speedometer**	
	Has the speedometer calibration been considered and adjusted to comply with ADR 18/…?	☐ Y ☐ N ☐ N/A

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4	**Vehicle Dynamics**	
4.1	**Lane Change Test**	
	Has a vehicle undergone and passed a Lane Change Test as required by Code LT2 in the NCoP?	☐ Y ☐ N ☐ N/A
	Was the driver satisfied that the vehicle was safe to drive?	☐ Y ☐ N ☐ N/A
5	**ESC Testing**	
5.1	If the vehicle is fitted with an ESC system before modification, is the modified vehicle assessed for continued compliance with ESC performance?	☐ Y ☐ N ☐ N/A
5.2	Is the appropriate evidence of the continued compliance of the ESC system obtained and retained?	☐ Y ☐ N ☐ N/A
6	**High Lift**	
6.1	**Maximum Increase in Vehicle Height**	
	Is the design total increase in vehicle height less than 150 mm?	☐ Y ☐ N
	Is the top of the dipped beam headlight height less than 1200 mm?	☐ Y ☐ N
	Does the dipped beam headlight pattern and position comply?	☐ Y ☐ N
6.2	Do the wheel guards (mudguards) continue to comply with the applicable ADR 42/…?	☐ Y ☐ N
7	**Brakes**	
7.1	Do the brake modifications comply with Section LG in the NCoP?	☐ Y ☐ N ☐ N/A

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7.2	Do the brakes meet the Section LG performance requirements in the NCOP?	☐ Y ☐ N ☐ N/A
8	**Fasteners**	
8.1	Are high tensile bolts specified for all new critical mountings?	☐ Y ☐ N
8.2	Are self-locking nuts specified for all new critical mountings?	☐ Y ☐ N
8.3	Do all fasteners specified comply with the applicable requirements of *Section LZ Appendices - Appendix A Fasteners* in the NCoP?	☐ Y ☐ N
9	**Design**	
9.1	Does the design of the modification comply with all the requirements outlined in Code LS9?	☐ Y ☐ N
9.2	Has all work, including welding, that has been specified in the certification of the LS9 design, been determined in accordance with recognised engineering standards and the relevant Appendices of Section LZ *Appendices* of NCoP?	☐ Y ☐ N
9.3	Have all components affected by the lift such as gear levers, brake hoses etc. been modified to comply with Code LS9?	☐ Y ☐ N ☐ N/A
9.4	Have all items affected by the lift such as drive shaft joint operating angles, spline engagement and axial movement of CV joints been checked or designed to be within design limits over the entire suspension travel?	☐ Y ☐ N ☐ N/A
9.5	Has a detailed Design Approval Package (with unique identifier) been provided for use by the modifier and the LS10 certifier to carry out the physical modifications, tests and checks?	☐ Y ☐ N

Note: If the answer to any question is **N (No),** the design cannot be certified under Code LS9.

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CERTIFICATION DETAILS																		
Make						**Model**						**Year of Manufacture**						
VIN																		
Chassis Number (If applicable)																		
Brief Description of Modification/s																		
Vehicle Modified By																		
Certificate Number (If applicable)																		
Vehicle Certified By (*Print*)																		
Signatory's Employer (If applicable)																		
Signatory's Signature											**Date**							