

# **Vehicle Standards Bulletin 14**

**NATIONAL CODE OF PRACTICE  
for  
LIGHT VEHICLE CONSTRUCTION  
and  
MODIFICATION**

**SECTION LH  
BODY & CHASSIS**

**1<sup>st</sup> February 2006**

## National Code of Practice for Light Vehicle Construction and Modification (NCOP)

### **WARNING TO USERS**

*Users of the NCOP need to be aware that this document needs to be used in conjunction with the appropriate administrative requirements of the jurisdiction in which they wish to either register a vehicle or to obtain approval for a modification for an already registered vehicle. "Administrative requirements" include, amongst other things, processes for- vehicle registration, obtaining exemptions, obtaining modification approvals, vehicle inspections, preparation and submission of reports and the payment of appropriate fees and charges.*

*If unsure of any of these requirements, or if more information is needed for any other issues or processes, users should contact their relevant registration authority prior to commencing any work.*

*Whilst the NCOP provides assistance with respect to the construction of ICVs and the execution of modifications, it is not to be taken to be a design manual. Determination of component strength, performance, suitability and functionality must be either calculated or determined on a case by case basis by suitably qualified personnel experienced in each matter under consideration.*

*Users of the NCOP also need to ensure that they refer to the most recent version of the relevant Section/s when working on a job or project. The version is identified by the date on the face page of each Section. On the website, each Section has the version date contained in the Section file name for easy identification.*

*It is prudent to check for new versions if a job or project is taking a long time to complete.*

*If they have not already done so, users must also download the Preface and Introduction.*

*These two Sections provide the necessary background information to assist users in understanding how the NCOP is administered by registration authorities across Australia, on how it is structured, and the meaning of the types of modification codes specified in the NCOP.*

*Understanding these requirements is important to ensure that the correct processes are followed thereby reducing the likelihood of having work rejected by authorities.*

*Many of the Sections refer to other Sections for further information or additional requirements. Users must download all relevant Sections. Lack of information due to insufficient downloads will not be accepted as an excuse by authorities.*

*If in doubt about any issue concerning or contained in the NCOP, users should seek clarification from the appropriate state or territory registration authority.*

***Please do not contact the Department of Transport and Regional Services (DOTARS) about the NCOP. DOTARS provides the central NCOP website as a service only.***

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# 1 SCOPE

This Section outlines the minimum design, construction, installation and performance requirements for the following body and chassis modifications for light vehicles:

## 1.1 MODIFICATIONS NOT REQUIRING CERTIFICATION

Note that whilst these modifications do not require certification under the LH approval codes, this only applies if the modifications are carried out in accordance with the requirements specified in Section 4 *Modifications Without Certification*.

- Bonnet scoops and projections
- Bonnet pins and mascots
- Customised and replacement panels
- Inner mudguard modifications
- Glass and surface films

## 1.2 MODIFICATIONS AND CONSTRUCTION REQUIRING CERTIFICATION UNDER LH APPROVAL CODES

- Conversion of a vehicle by removing or modifying the roof, e.g. convertible conversion.
- Conversion of a vehicle by extending or reducing the wheelbase e.g. stretched limousine.
- Construction of a vehicle using at least the chassis or body from a production vehicle e.g. Holden station wagon body on a Landcruiser chassis.
- Construction of up to three vehicles per year with newly constructed bodies and chassis (Individually Constructed Vehicle - ICV), e.g. Cobra replica.
- Conversion of a vehicle to a different model variant, e.g. station wagon to utility conversion.
- Tilt fronts

**NOTE:** The main design and construction requirements are contained in the relevant part of sub-sections 4 or 5. However, these sub-sections must be read in conjunction with the contents of sub-section 2 *General Requirements* that apply to all vehicles.

## 2 GENERAL REQUIREMENTS

This sub-section applies to all light vehicles and should be read in conjunction with the other sub-sections of the LH Code and the specific Approval Code for the modification, conversion or construction.

### 2.1 OCCUPANT PROTECTION

#### SEAT BELTS

Seat belts must be fitted to all seating positions where required by an Australian Design Rule applicable to the vehicle because of its category and date of original manufacture. (Refer to Section LK for more information).

#### ADDITIONAL SEATS

Where additional seats have been fitted, calculations or results of testing must be presented that demonstrate that all additional seats, seat anchorages and seat-belt anchorages comply with either the relevant ADRs, the National Code of Practice - *Commercial Manufacture and Installation of Additional Seats* - VSB5A, or the National Guidelines - *Construction and Installation of Additional Seats by Individuals* - VSB5B. (Refer to Section LK for more information).

#### GLASS PARTITIONS

If the vehicle is fitted with a glass partition between the first and second row of seats, a head restraint complying with ADR 22 must be fitted to all front seating positions if there is insufficient occupant protection space between the rear of the front seat and the glass partition. This is necessary to ensure that the driver's and the front passengers' heads cannot strike the glass partition when the seat is in its most rearward setting.

#### HEAD RESTRAINTS

Fitting head restraints of a removable type (i.e. not built in to the seat) is acceptable provided they are not likely to collapse or separate from the seat in a vehicle collision. Clip-on type head restraints are not acceptable.

#### DANGEROUS PROJECTIONS

Any dangerous or sharp projections must be removed. These include edges that are exposed as a result of cutting and removal of body sections. All edges that vehicle occupants may contact must have a radius of not less than 5mm and a minimum thickness of 5mm of high density energy absorbing foam or similar material bonded to the surface and suitably trimmed.

### 2.2 MECHANICAL

#### COMPONENT STRENGTH

Suspension, braking, axle and steering components and tyres shall not be over loaded due to increased vehicle mass as a result of any vehicle modifications such as extensions to the wheelbase, additional seating etc. Where standard components are not designed to handle the increased loading due to a modified vehicle's increased GVM, the standard components shall be upgraded or replaced with components of a higher rating as appropriate.

#### VEHICLE WEIGHT

Where a conversion has resulted in an increase in tare mass, the modified vehicle shall be weighed at a weighbridge. Individual axle masses and total mass shall be recorded separately. Where the original GVM of the vehicle is no longer applicable due to the modifications performed, a new GVM must be determined. For light trucks and commercials, refer to VSB 6 Section S Codes.

## **TYRE LOAD CAPACITY**

Tyre load ratings must be adequate for any resultant increase in individual axle loadings or GVM following the modification. If the tyre ratings listed on the original tyre placard are no longer suitable, a new tyre placard must be fitted to the vehicle that specifies the appropriate size, load capacity and speed rating of the tyres and the suitable width and diameter of rims. The placard must be clearly legible and manufactured from a durable material.

## **2.3 GLAZING**

### **WINDOWS AND WINDSCREENS**

Any new, additional or replacement glazing must comply with ADR 8/.....

### **WINDOW TINTING**

Any window tinting by means of an applied surface film must meet the following requirements.

The windscreen of a motor vehicle must have a luminous transmittance of at least—

- (a) for a motor vehicle built after 1971 – 75%; or
- (b) for another motor vehicle – 70%

except for the area above the highest point swept by the windscreen wipers or the upper 10% of the windscreen.

If the windows of a motor vehicle are coated to reduce light transmittance, the following requirements apply:-

- Visible light transmittance must not be less than 35% when measured through glass and film together.
- Reflectance in the visible light range must not exceed 10%.
- The coating must not be wrinkled, blistered, bubbled or discoloured such that visibility through the glass and film is impaired.
- The windscreen may be coated only above the highest point swept by the windscreen wipers or the upper 10% of the windscreen.

**Note: South Australian Regulations require a light transmittance of not less than 70% for the driver and front passenger windows.**

## **2.4 DRIVEABILITY**

### **TURNING CIRCLE**

The vehicle shall have a turning circle in each direction, as determined by reference to the extreme outer edge of the tyre track at ground level, not exceeding 25m in diameter.

### **GROUND CLEARANCE**

The vehicle shall have sufficient ground clearance to meet the requirements of ADR 43/..... All other dimensional requirements addressed in this ADR shall be met.

### **FIELD OF VIEW**

Where the visibility (field of view) requirements for the internal rear vision mirror can no longer be met, an external mirror shall be fitted on the passenger side.

## **ROADHOLDING AND HANDLING**

The roadholding and handling qualities of a modified vehicle shall not exhibit any undesirable handling or braking characteristics. Similarly, a newly constructed vehicle shall have roadholding and handling qualities appropriate to its purpose and overall design, for example its engine power, size, mass and suspension.

## **VIBRATION**

The vehicle shall not exhibit any excessive vibration.

## **2.5 BRAKES**

Vehicles originally manufactured to comply with ADR 31/.. must continue to do so following modifications. A modified or newly constructed vehicle shall exhibit stable and effective braking across the full range of application of the brakes and meet the requirements of Code LG.

## **2.6 FABRICATION**

All work must be performed in accordance with recognised engineering standards.

## **WELDING**

Welding of components, except where expressly specified to a higher standard, must be performed in accordance with recognised general engineering practices taking into account the function of the welded joint. This typically involves, for each task in question:

- choosing the appropriate welding method together with the most suitable welding materials
- ensuring appropriate job preparation is performed
- ensuring all subject joints and heat affected areas are effectively prepared and sealed in accordance with current trade techniques to minimise the onset of corrosion.

In addition, welds, particularly on structural members, should not be ground back to such an extent that the strength of the joint would be affected.

Where a higher or alternative weld standard is specified, the requirements of that standard must be satisfied.

Guidance on good welding techniques can be found in AS/NZS 1554.1:2004 *Structural steel welding - Welding of steel structures*.

## **FASTENERS**

Unless supported by specific engineering design, all fasteners on transmission mountings or in highly stressed locations must be high tensile ISO Grade 8.8 (mm sizes), SAE Grade 5 (inch sizes) or equivalent, as a minimum specification. All other fasteners are to be at least of similar strength and number to those in the original installation. Self-locking nuts should be used in preference to spring washers.

## 2.7 FIBREGLASS

### STRENGTH AND THICKNESS

The minimum thickness (with gel coat removed) of non-intrusion panels, e.g. bonnets and guards, should be 3.5 mm.

The strength and thickness of structural components such as floor pans and bodies that incorporate seat belts anchorages, door hinges and latches etc., must be certified by a professional engineer.

The fixings for replacement fibreglass panels should have the same positions and strength as the fixings used for the original panels. A combination of steel and neoprene washers of a minimum 20mm diameter should be used with all fixings.

### TESTING

All fibreglass used in structural components must comply with and be tested in accordance with the requirements of British Standard 2782 Part III, methods 320E and 335A. The test panels must reach minimum acceptance levels of 85 MPa in tension and 152 MPa in flexure. The Barcol hardness value must be greater than 25 and the fibre to weight ratio must be at least 0.29.

Fibreglass panels presented for testing should be laid up under supervision in order to verify the consistency of lay up when referenced to the vehicle components being constructed. These test panels should measure approximately 600mm x 600mm and be free of gel coat. Flat (planar) test panels are needed to comply with test procedures.

Testing must be carried out by a NATA certified testing laboratory.

Where the modifier has quality management processes in place, testing of the components need only be done once to prove the general design.

## 3 AUSTRALIAN DESIGN RULES

### 3.1 ADR REQUIREMENTS

A modified vehicle must continue to comply with the Australian Design Rules, to which it was originally constructed, except as allowed for in the Australian Vehicle Standards Rules.

A newly constructed *Individually Constructed Vehicle* (ICV), or Street Rod may not be required to fully comply with the Australian Design Rules. However, in its design and construction, it may be required to meet the intent of nominated Australian Design Rules.

### 3.2 CERTIFICATION

Certification of compliance of vehicles with the Australian Design Rules (ADRs) is required where specifically stated in the relevant Approval Code in sub-section 5.

### 3.3 IDENTIFICATION PLATES (Previously Known as Compliance Plates)

An Identification Plate authorised by the Australian Motor Vehicle Certification Board or the Department of Transport and Regional Services (DOTARS) is required for vehicle registration in all Australian States or Territories. This requirement is dependent on the vehicle's date of original manufacture and the date varies according to the applicable State or Territory regulations. Vehicles may also be registered in some jurisdictions if they have been issued with a permit exempting them from the installation of an Identification Plate.

Low Volume Identification Plates authorised by the DOTARS are required for construction or conversion of more than three vehicles per year.

### 3.4 APPLICABILITY

All Australian Design Rules may be applicable to some sections of this Code, however the following generic ADRs are applicable to most sections:

ADR	Title
3	Seat and Seat Anchorages
4	Seatbelts
5	Anchorages for Seatbelts and Child Restraints
8	Safety Glazing Material
11	Internal Sunvisors
22	Head Restraints
29	Side Door Strength
31	Hydraulic Brake Systems for Passenger Cars
34	Child Restraint Anchorages and Child Restraint Anchor fittings
42	General Safety Requirements
43	Vehicle Configuration & Dimensions
60	Centre High-mounted Stop Light
69	Full Frontal Impact Occupant Protection
72	Dynamic Side Impact Occupant Protection
73	Offset Frontal Impact Occupant Protection

**NOTE:** To determine the ADRs that apply to the vehicle in question, refer to the Applicability Tables in Section LO. Vehicles manufactured after 1 January 1969 and prior to 1 July 1988 need to comply with the Second Edition ADRs whilst vehicles manufactured after this date need to comply with the Third Edition ADRs. Section LO has separate applicability tables for each edition.

The ADRs apply according to the vehicle's category and date of manufacture. It is the responsibility of the signatory to refer to the appropriate ADR applicable to the vehicle.

## 4 MODIFICATIONS WITHOUT CERTIFICATION

The following modifications may be carried out without obtaining approval under an LH Approval Code, provided that the vehicle continues to comply with relevant Australian Design Rules and Australian Vehicle Standards Rules and provided that the vehicle meets the following general safety requirements.

### 4.1 BONNET SCOOPS AND PROJECTIONS

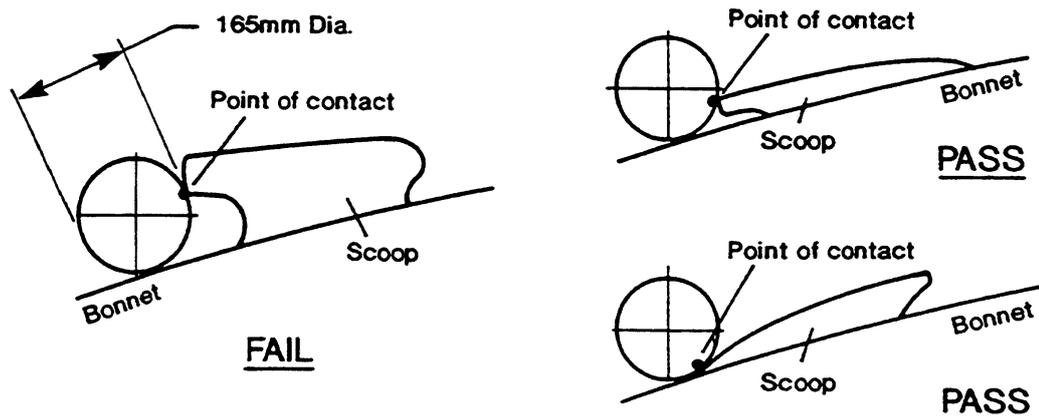
Modifications to the surface of the bonnet of a vehicle should take into account the possibility that the body of a pedestrian or cyclist might strike parts of the scoop (or bonnet projection) in a collision. Parts of a scoop likely to be struck are the front, sides and top. The top surface of a scoop should not be more rigid than the original bonnet in the case when a force is applied to the scoop perpendicular to the surface of the bonnet.

For vehicles manufactured prior to July 1988, there are no specific design rule requirements relating to bonnet scoops, however any fixture that is a dangerous protrusion, is not acceptable. For vehicles manufactured on or after July 1988, ADR 42/-- specifically prohibits external or internal protrusions, which are not technically essential and that protrude from any part of the vehicle and are likely to increase the risk of bodily injury to any person.

Rigid engine-mounted components that are likely to increase injuries to a pedestrian in a collision must not project through and above the bonnet profile, unless protected with a cover mounted to the bonnet.

Bonnet-mounted scoops must meet the following requirements:

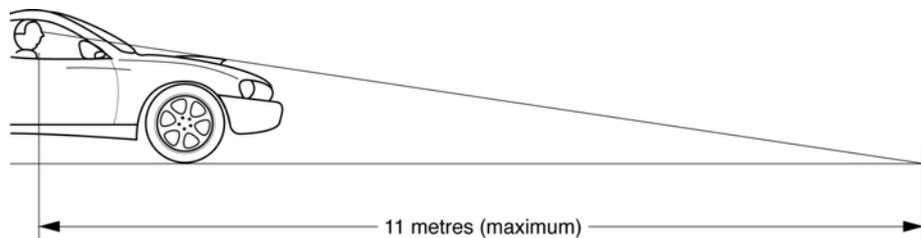
- When a 165mm diameter sphere is placed on the bonnet in front of the scoop (or bonnet projection) and rolled rearwards until it touches the scoop, no point of contact between the sphere and the scoop shall lie above a horizontal plane passing through the centre of the sphere.



LV001-NSW-BONNET SCOOP.BMP

Figure LH 1: Requirements for bonnet mounted scoops

- There is no maximum height specified for a bonnet scoop, however it is unacceptable if it restricts the field of view of the driver under normal operating conditions. The field of view requirements are determined as follows:
  - ♦ When sitting in the driver's seat with the seat located at its rearmost position, it shall be possible to see either the surface of the road, 11 metres in front of the driver's eye or the front edge of the original body when looking across the top of the bonnet scoop.
  - ♦ For the purposes of this requirement, the *driver's eye position* shall lie at the bottom of the 95<sup>th</sup> percentile eye ellipse (Reference: ADR 15/01 clause 15.1.5.1). Alternatively, the eye position can be taken as being a point 730mm above and 270mm forward of the junction of the seat cushion and squab (back) with the seat in its lowest and rearmost position.



**Figure LH 2: Requirements for bonnet mounted scoops**

- The edges at the front of a scoop likely to contact a pedestrian in a collision shall be well rounded with a minimum of 10mm radius.
- The scoop must not have reflective surfaces that will cause glare towards the driver.
- A bonnet scoop manufactured from a plastic or fibreglass material may be fitted, providing that the hole in the original bonnet does not substantially reduce the strength or impact resistance of the bonnet and no rigid component, such as an air cleaner or carburettor protrudes beyond the original bonnet profile.
- Holes may be cut in the bonnet and the protrusion of an air cleaner or carburettor above the bonnet line, but below the bonnet scoop providing that the bonnet scoop or raised bonnet section is manufactured from equivalent gauge mild steel, compared with that of the original bonnet.
- If any bonnet reinforcing braces are cut or modified, the design of the modified bonnet must be of equal strength to the original bonnet and any sharp edges created must be suitably treated.
- All edges and corners shall have a radius of not less than 5mm and of general design and construction to reduce to a minimum the risk of bodily injury to any person.

## 4.2 BONNET PINS & MASCOTS

### GENERAL

For vehicles manufactured prior to July 1988 there are no specific requirements with respect to bonnet pins and mascots, however fixtures that are deemed a dangerous protrusion are not permitted. For vehicles manufactured on or after July 1988 ADR 42/-- specifically prohibits external or internal protrusions, which are not technically essential and that protrude from any part of the vehicle and is likely to increase the risk of bodily injury to any person.

### BONNET PINS

Bonnet pins that protrude through the bonnet are **not** acceptable. The use of bonnet securing devices that are flush with the contours of the bonnet may be used.

### MASCOTS

Mascots provided as original equipment by the vehicle manufacturer for a particular make and model of vehicle or mascots that do not protrude outside the contours of the body are acceptable.

## 4.3 CUSTOMISED AND REPLACEMENT PANELS

### CUSTOMISED METAL PANELS

Body panels may be customised (for example to fit alternative lights), provided that the structural integrity of the body is not adversely affected and the vehicle continues to comply with all relevant ADRs.

### FIBREGLASS AND OTHER COMPOSITE REPLACEMENT PANELS

Original bolt-on metal bonnets and mudguards may be replaced with fibreglass or other composite panels that comply with Section 2.7 on pre 1971 (ADR 10) vehicles.

### MUDGUARD FLARES

Flared extensions may be added to original mudguards. There is no restriction on their design or size, however, the new section must be securely fixed, the ends tapered back to follow the body line of the vehicle and the exposed edges must have a radius of at least 5mm. The shape of flared mudguards must ensure that there is no likelihood of contact with tyres under all operating conditions.

#### 4.4 TILT FRONTS ON PRE-1971 VEHICLES

*Tilt fronts* are forward pivoting integral bonnet, grille and front mudguard assemblies for front-engine vehicles. Examples of production vehicles fitted with this type of engine access are the Jaguar 'E' Type and the Triumph Herald.

The fitting of tilt-fronts may affect vehicle lighting, field of view, seat belts, seat belt & child restraint anchorages and collapsibility of steering columns. However, if the modifications do not increase the rigidity of the front structure of the vehicle, any adverse effects on seat belts, seat belt & child restraint anchorages and collapsibility of steering columns would be minimal.

If a tilt front is fitted to a vehicle manufactured on or after 1 January 1971, the modification must be approved under Approval Codes LH5 and LH6.

The fitting of a tilt-front to a pre1971 (ADR 10) vehicle will be acceptable provided that:

New body sections are designed and constructed with no dangerous or sharp projections so that in the event of a collision the risk of injury to pedestrians and cyclists is minimised;

- New body sections do not obstruct the visibility of lamps fitted to the front of the vehicle and in particular the direction indicator lamps or headlamps.
- New body sections do not obstruct the field of view of the driver when seated in the normal driving position. The modification is unacceptable if it restricts the field of view of the driver under normal operating conditions.
- ♦ The field of view requirement is acceptable if, with the driver's seat in the rearmost position, it shall be possible to see, unobstructed for the full width of the vehicle, a line drawn on the roadway 11 m ahead of the *driver's eye position* when looking over the bonnet.
- ♦ For the purpose of this requirement the *driver's eye position* shall lie at the bottom of the of the 95<sup>th</sup> percentile eye ellipse (reference ADR 15/01 clause 15.1.5.1). Alternatively the *driver's eye position* can be taken as a point 730mm above and 270mm forward of the junction of the seat cushion and seat squab (back) with the seat in the lowest and rearmost position.
- Anchoring, hinge and latching mechanisms are durable and are at least equal in strength to the hinge and latching mechanisms of the original vehicle.
- The catches and/or the design of the tilt-front shall prevent the unit from being propelled rearwards through the windscreen into the cabin area in the event of a frontal collision.
- All lights and direction indicators incorporated in the tilt-front shall comply with the requirements of the relevant Acts and Regulations.
- Any wiring running to lights incorporated in the tilt-front shall be adequately supported and protected against chafing on surrounding components.
- A collapsible steering column is fitted as part of the modifications.

#### 4.5 INNER MUDGUARD MODIFICATION

Inner mudguards may be extended to form *wheel tubs* to accommodate larger wheels and tyres provided that:

- the vehicle structure is not weakened;
- seat anchorages or seat belt anchorages are not weakened;
- body modifications are not undertaken within 200mm of any seat anchorage or seat belt anchorage;
- the wheels or tyres do not protrude beyond the bodywork of the vehicle when viewed from above;
- the wheels or tyres do not contact any part of the vehicle's suspension, brake lines or bodywork for the full range of suspension movement;
- the maximum allowable rim and tyre sizes are not exceeded;
- the maximum and minimum allowable track is not exceeded; and
- there are no sharp or dangerous projections.

Any replacement mudguard panels should use material of at least the same thickness as the surrounding body panels and should preferably be fully welded to the body on one side of the panel and stitch welded on the other. All joints must be sealed against the entry of exhaust fumes into the cabin and to prevent moisture getting between any over-lapping panels.

Wheel tubs that require modifications to coil spring and shock absorber mounts are discouraged.

Where the installation requires modification or relocation of seat mountings, seat belt mountings, structural sub-frames or chassis rails, the vehicle must be approved under Approval Codes LH5 and LH6.

## 4.6 GLASS AND SURFACE FILMS

Vehicle glazing particularly, the windscreen, provides protection to vehicle occupants and permits the driver to maintain a clear view. The clarity of vision through the windscreen will deteriorate over time. This becomes more apparent when driving towards the sun near sunset. Windscreens that are cracked or otherwise deteriorated should be replaced. Some vehicle manufacturers incorporate the windscreen and rear window into the structural design of the vehicle and if improperly secured may reduce the crash-worthiness of the vehicle.

Vehicle glazing must comply with the following requirements:

- Any replacement glass fitted to any windscreen or window or interior partition must be safety glass marked as complying with at least one of the following standards: AS 2080, ECE R43/00, BS AU178, JIS R3211, ANSI Z26.1 or NZS 5443.
- The glass must carry the indelible mark or marks of the relevant standards, visible when the glass is fitted in the vehicle. The mark must identify the type of glass and the relevant standard to which the glass conforms.
- For any windscreen glass having a zone of modified heat treatment, the marking must indicate the position of the zone.
- All replacement transparent material must be of a type that will not shatter.
- The section of the windscreen directly in front of the driver (primary vision area) must be free of scratches or chips.

### SURFACE FILMS (WINDOW TINTING)

Surface films reduce light transmission through windscreens and windows. This can significantly reduce a driver's vision, particularly at night and during periods of low visibility.

The windscreen of a motor vehicle must have a luminous transmittance of at least:

- (a) for a motor vehicle built after 1971 – 75%; or
- (b) for another motor vehicle – 70%

except for the area above the highest point swept by the windscreen wipers or the upper 10% of the windscreen.

If the windows of a motor vehicle are coated to reduce light transmittance, the following requirements apply:

- Visible light transmittance must not be less than 35% when measured through glass and film together.
- Reflectance in the visible light range must not exceed 10%.
- The coating must not be wrinkled, blistered, bubbled or discoloured such that visibility through the glass and film is impaired.
- The windscreen may be coated only above the highest point swept by the windscreen wipers or the upper 10% of the windscreen.

**Note: South Australian Regulations require a light transmittance of not less than 70% for the driver and front passenger windows.**

Vehicles fitted with surface film must be equipped with an external rear vision mirror on both sides of the vehicle.

## 5 CERTIFIED MODIFICATIONS (LH CODES)

This section specifies particular requirements and covers limitations on approvals carried out under individual LH Approval Codes.

Each Code is supplemented with a checklist.

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## ROOF CONVERSION (DESIGN)

### CODE LH1

#### SCOPE

The following is a summary of the modifications that may be approved under Code LH1 - *Roof Conversion (Design)*.

Design approvals that are **allowed** under this Code include:

- Conversion of vehicles of monocoque construction to convertibles or cabriolets.
- Conversion of vehicles with separate chassis to convertibles or cabriolets.
- Conversions of vehicles to lower (chop top) or otherwise re-configure the roof.
- Installation of a sunroof.

Design approvals that are **not allowed** under this Code include:

- Design of a complete new body on an existing chassis.
- The actual physical modification of vehicle (this is covered by Code LH2).

Code LH1 does not apply to L-group vehicles (e.g. motorcycles).

#### COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS

The modified vehicle must continue to comply with all applicable ADRs, VSR's, VSB's, Acts and Regulations.

Outlined below are areas of the vehicle that may be affected by the modifications and that may require re-certification, testing and/or data to show compliance for the modified vehicle.

DETAIL	REQUIREMENTS
Installation of Seats and Seat Anchorages	ADR 3, 3A, 3/00, 3/01, VSB5A, VSB5B
Installation of Seatbelts and Seatbelt Anchorages	ADR 4, 4A, 4B, 4C, 4D, 4/00, 4/01, 4/02, 4/03, ADR 5A, 5B, 5/00, 5/01, 5/02, VSB5A, VSB5B
Child Restraint Anchorages	ADR 5/00, 5/01, 5/02, ADR 34, 34A, 34/00, 34/01, VSB5A, VSB5B
Safety Glazing Material	ADR 8, 8/00, 8/01
Internal Sunvisors	ADR 11, 11/00
Rear Vision Mirrors	ADR 14, 14/00

**NOTE:** To determine the ADRs that apply to the vehicle in question, refer to the Applicability Tables in Section LO. Vehicles manufactured after 1 January 1969 and prior to 1 July 1988 need to comply with the Second Edition ADRs whilst vehicles manufactured after this date need to comply with the Third Edition ADRs. Section LO has separate applicability tables for each edition.

The ADRs apply according to the vehicle's category and date of manufacture. It is the responsibility of the signatory to refer to the appropriate ADR applicable to the vehicle.

## **SPECIFIC REQUIREMENTS**

The following are specific requirements for the approval of Roof Conversion designs under Code LH1.

The conversions must also comply with the general guidelines contained in sub-section 2 - *General Requirements*.

### **1. STRENGTH AND SAFETY**

Modification to a vehicle's roof structure that involves removal of the roof, roof support beams and cant rails can drastically reduce the strength and the safety of the vehicle. Most modern motor vehicles are constructed without a separate chassis and the majority of body panels and some glass panels are stressed to achieve the vehicle's required strength and stiffness.

### **2. BODY FLEXING**

If the modifications significantly reduce the stiffness of the body or chassis, it is highly likely that the vehicle's durability and driveability will suffer. The body will flex more and eventually crack. The vehicle will not handle as well and it will be unpleasant to drive, with increased shaking of the windscreen, dashboard and steering wheel. Road shocks will be absorbed more in the flexing of the body and less in the suspension.

### **3. CONVERTIBLE VARIANTS OF SEDANS & COUPES**

Many convertibles produced by manufacturers, that may be superficially similar to their sedan or coupe variants, have very different body structures. It is generally impractical for a modifier to exactly duplicate the body structure of a convertible by modifying the variant. Conversions using all manufacturer's standard components can be approved under Approval Code LH7.

### **4. CONVERTING FROM FOUR DOOR TO TWO DOOR**

Converting a four-door vehicle to a two door generally involves major reconstruction of the vehicle. Adequate passenger access must be provided to rear seating positions. To achieve this, vehicles must be modified to incorporate the features of vehicles originally manufactured in two-door configuration. This normally requires the front doors to be extended in length; the "B" pillars moved rearwards and the front seats to tilt forward. The front seat tilt mechanism must be able to be easily activated by rear seat passengers.

## 5. ROOF LOWERING (CHOP TOP)

When lowering a roof structure, the minimum head space specification for front and rear seat occupants as specified in Section LK *Occupant Protection*, must be incorporated in the design.

Driver vision must not be impaired by the modification and thus the windscreen wiper swept area must not be adversely affected. External rear vision mirrors to ADR 14/-- must be fitted, if the field of view as specified in ADR 14 cannot be met for the internal mirror.

Compliance with ADR 2/--, ADR 5/--, ADR 8/--, ADR 11/--, ADR 14/--, and ADR 29/-- must be maintained where applicable.

## 6. REINFORCING

To produce a safe, durable vehicle, reinforcing must be compatible with the vehicle's existing structure. Strengthening should consist of material of similar thickness to that of the vehicle's original structure. In no case should the reinforcing material exceed twice the original thickness. The ends of reinforcing should be tapered to eliminate abrupt changes in section that produce stress concentrations, as this may promote cracking.

A convertible or cabriolet with a separate chassis, such as an early model Toyota Crown, normally requires strengthening of the body only.

A convertible or cabriolet with a separate floorpan structure, such as a Type 1 Volkswagen, normally requires strengthening of the body and floorpan structure.

A convertible and cabriolet of monocoque construction normally requires extensive strengthening, with the addition of extra structural members and gussets (refer Figure LH 3).

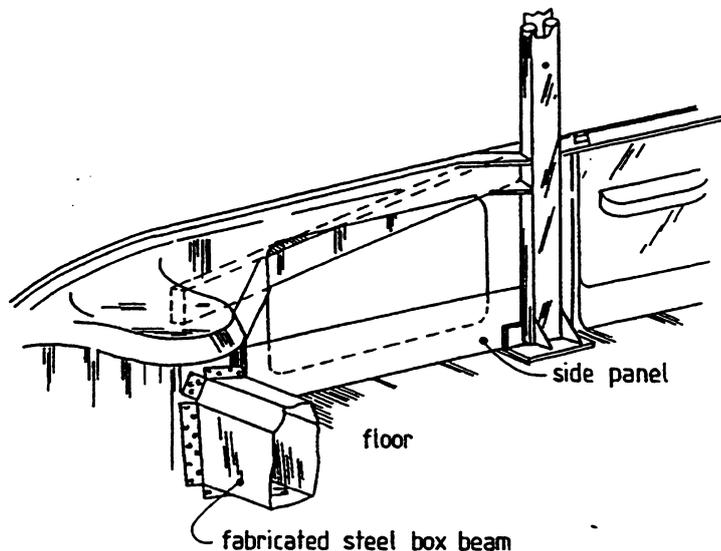


Figure LH 3 Convertible Structure

The following Figure LH 4 illustrates three possible methods of reinforcing sill sections, an exterior skirt (A), an internal member (B) or an interior sill section (C). The reinforcing section should be attached to the original sill along the full length of the sill.

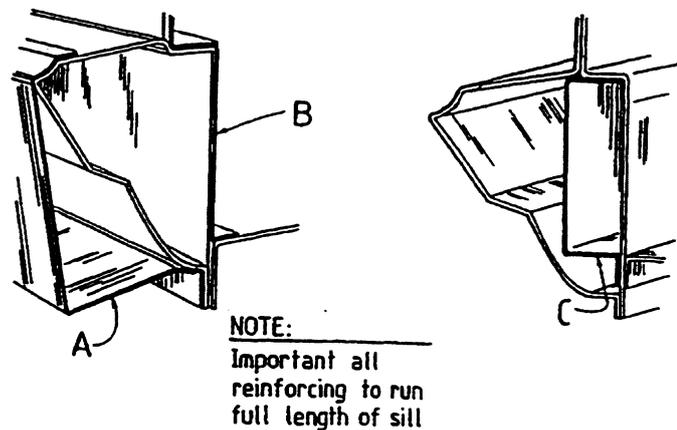


Figure LH 4 Alternative Sill Details

Consideration should be given to increasing the strength of the windscreen pillars of convertibles. Modifications may also be required to ensure the correct operation of the windows in the doors if the upper support frame is removed. The windscreen header should be reinforced and closed to form a rigid section (refer Figure LH 5). The inside of the header should be padded with 10mm minimum thickness high-density foam.

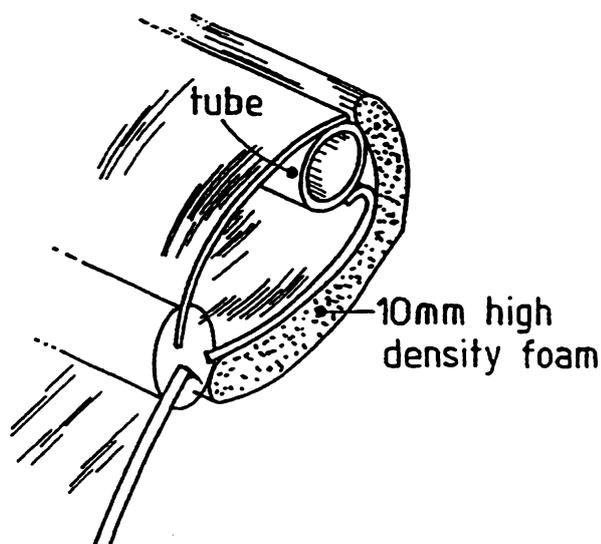


Figure LH 5 Windscreen Header

The cant rails should be reinforced and closed to form a rigid section when incorporating a sunroof frame (refer Figure LH 6). The sunroof frame should have large corner radii to reduce stress concentrations.

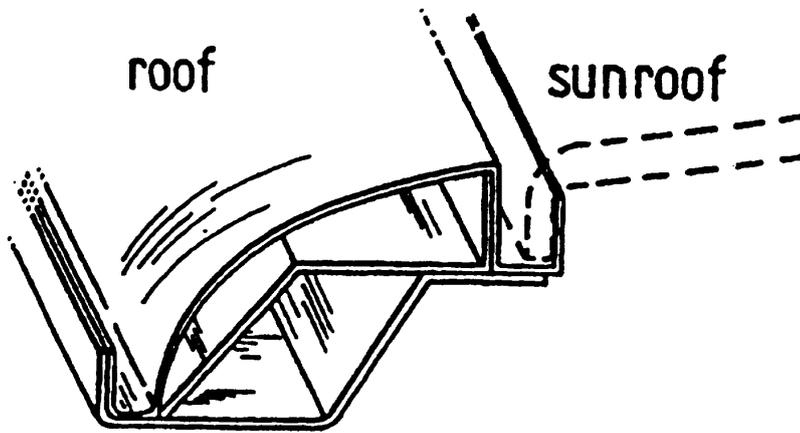


Figure LH 6 Cant Rails and Sunroof Frame

Where sharp edges exist, often as a result of cutting hollow sections, such as door frames, cant rails and door pillars, they should be capped with fully welded steel covers or with “pinch weld” or equivalent (refer Figure LH 7).

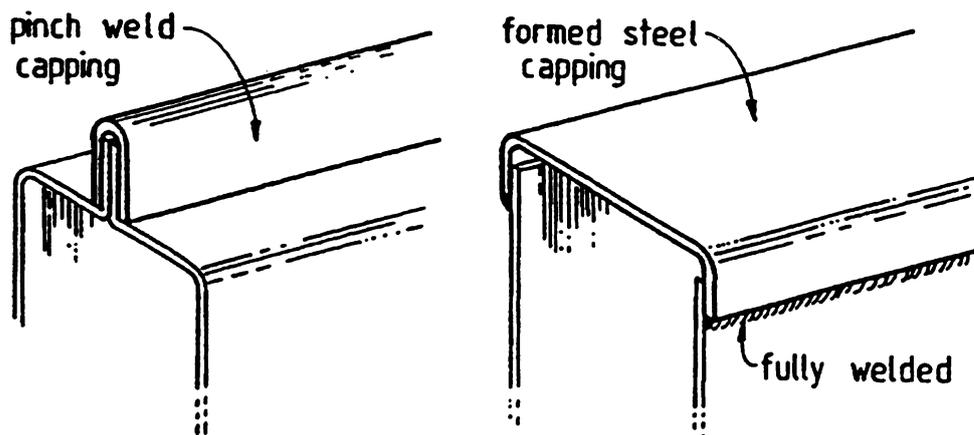


Figure LH 7 Sharp Edges Capped

All unpainted inner panels and joints of steel must be treated with a rust proofing treatment, such as zinc oxide paint or a fish-oil based lacquer.

## 7. BEAMING AND TORSIONAL TESTS

A convertible or cabriolet of monocoque construction must undergo beaming and torsional testing to determine its relevant stiffness, in accordance with the requirements of Code LT1 - *Beaming and Torsional Testing*.

A convertible or cabriolet with a separate floor pan or separate chassis must undergo beaming and torsional testing to determine its relevant stiffness, in accordance with the requirements of Code LT1 - *Beaming and Torsional Testing*, except if originally certified as an "MC" or "NA" Category vehicle.

A lowered roof (chop top) vehicle or a vehicle fitted with a sunroof does not require beaming and torsional testing, except when any of the structural members such as pillars and cant rails have been removed or reduced in cross section.

## 8. CRASH PROTECTION

### FRONTAL IMPACT

All modern vehicles are designed to comply with ADR 10 and later model vehicles with ADR 69 and ADR 73. To prove compliance, a vehicle from the model range is crashed into a barrier. The vehicle must crumple without forcing the dashboard and steering wheel back onto the driver. In a vehicle without separate chassis, the roof structure plays a vital role in supporting the front of the vehicle in such a collision.

### SIDE IMPACT

Removal of the roof and upper section of the vehicle's side door support panels can also have a detrimental effect on the vehicle's ability to withstand a side impact and therefore its compliance with ADR 29 or ADR 72.

The designer must satisfy himself that the modified vehicle's structure has sufficient strength and stiffness to continue to meet the technical requirements of ADR 10, ADR 69, ADR 73 for frontal impact and ADR 29 and ADR 72 for side impact, where applicable.

## 9. SEAT BELTS AND CHILD RESTRAINT ANCHORAGES

Vehicles originally manufactured to comply with ADR 4 must continue to do so.

The upper torso anchorages for the front lap/sash belt and all other anchorages must comply with the requirements of ADR 5.

Vehicles originally manufactured to comply with ADR 34 *Child Restraint Anchorages and Child Restraint Anchor Fittings* must continue to do so. The child restraint anchorages must comply with the requirements of ADR 34.

## 10. ROLL BAR

If a roll bar is incorporated into the design, it should comply with the requirements of Code LK8 - *Roll Bar and Roll Cage Installation*.

## 11. RECORDS

Drawings, specifications and inspection records must be produced and must fully describe the modifications.

**CHECKLIST**  
**ROOF CONVERSION (DESIGN)**  
**APPROVAL CODE LH1**

(N/A= Not Applicable, Y=Yes, N=No)

<b>1.</b>	<b>STRUCTURAL REINFORCEMENT</b>		
1.1	Is all reinforcing material thickness no more than twice original section thickness	<input type="checkbox"/>	<input type="checkbox"/>
1.2	Are stress concentrations avoided at ends of reinforcing sections?	<input type="checkbox"/>	<input type="checkbox"/>
<b>2.</b>	<b>BEAMING AND TORSIONAL TESTS</b>		
2.1	Does the body design comply with the requirements of Code LT1?	<input type="checkbox"/>	<input type="checkbox"/>
<b>3.</b>	<b>COMPLIANCE WITH ADRs</b>		
3.1	Does vehicle design continue to comply with relevant ADRs	<input type="checkbox"/>	<input type="checkbox"/>
<b>4.</b>	<b>SPECIFICATION</b>		
4.1	Have drawings, specifications & report of the design been produced?	<input type="checkbox"/>	<input type="checkbox"/>
4.2	Have materials, fasteners, workmanship and welding been specified as required?	<input type="checkbox"/>	<input type="checkbox"/>

NOTE: If the answer to any question is **N (No)**, the design is not acceptable under Code LH1.

Vehicle Make and Model .....

Description of Conversion .....

Design Approval Number .....

Approved by .....

Company (if applicable) .....

Signed ..... Date .....

## ROOF CONVERSION

### CODE LH2

#### SCOPE

The following is a summary of the modifications that may be approved under Code LH2 - *Roof Conversion*.

Approvals that are **allowed** under this Code include:

- Conversion of vehicles of monocoque construction to convertibles or cabriolets.
- Conversion of vehicles with separate chassis to convertibles or cabriolets.
- Conversion of vehicles to lower (chop top) or other re-configuration of the roof.
- Installation of a sunroof

Approvals that are **not allowed** under this Code include:

- Construction of a complete new body on an existing chassis.
- Conversions that do not have a Code LH1 Design Approval.

Code LH2 does not apply to L-group vehicles (e.g. motorcycles).

#### COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS

The modified vehicle must continue to comply with all applicable ADRs, VSRs, VSBs, and Regulations and Acts.

#### SPECIFIC REQUIREMENTS

The following are specific requirements for Roof Conversions for approval under Code LH2.

The conversions must also comply with the general guidelines contained in sub-section 2 *General Requirements*.

##### 1. DESIGN

The modification must be carried out strictly in accordance with the requirements of the design approved under Code LH1 and as outlined in the design specification and drawings.

##### 2. WORKMANSHIP

The workmanship must be in accordance with the requirements of the design approved under Code LH1 and of sub-section 2 - *General Requirements*.

##### 3. INSPECTION

An inspection must be carried out on the structurally completed vehicle prior to painting and trimming of all modified areas.

Previously modified vehicles that are being assessed must have all trim etc. removed to allow a thorough inspection of all modified areas.

A final inspection is to be carried out on the converted vehicle, when it is in a condition suitable for registration.

FORM No: LH2

**CHECKLIST**  
**ROOF CONVERSION**  
**APPROVAL CODE LH2**

(N/A= Not Applicable, Y=Yes, N=No)

<b>1.</b>	<b>DESIGN</b>		
1.1	Has the vehicle been modified in accordance with the design approved under Code LH1?		Y N
1.2	Insert Design Approval No.....		
<b>2.</b>	<b>WORKMANSHIP</b>		
2.1	Is all work performed in accordance with recognised engineering standards and to the satisfaction of the Inspector?		Y N
	Has all welding been carried out by qualified tradesperson?		Y N
	Does all welding comply with relevant Australian Standards?		Y N
<b>3.</b>	<b>FASTENERS</b>		
3.1	Are high tensile bolts used on all new critical joints and mountings?		Y N
3.2	Are self-locking nuts used on all new critical joints and mountings?		Y N
3.3	Are all replacement fasteners equivalent to or better than original in strength and quality?		Y N
<b>4.</b>	<b>ADR COMPLIANCE</b>		
4.1	Does converted vehicle have Low Volume Identification Plate if?	N/A	Y N
<b>5.</b>	<b>BEAMING AND TORSIONAL TESTS</b>		
5.1	Does the body design comply with the requirements of Code LT1?		Y N
<b>6</b>	<b>INSPECTION</b>		
6.1	Have interim inspection(s) been carried out on all modified areas of the vehicle structure and found to be satisfactory?		Y N
6.2	Has a final inspection been carried out on all modified areas of the vehicle structure and found to be satisfactory?		Y N
<b>7.</b>	<b>RECORDS</b>		
7.1	Have complete records of vehicle, conversion/modifications details been retained in a manner suitable for auditing?		Y N

NOTE: If the answer to any question is **N (No)**, the modification cannot be approved under Approval Code LH2.

[Continued overleaf]

FORM No: LH2

Make ..... Model ..... Year of Manufacture .....

Chassis No. or VIN .....

Vehicle Modified by .....

Dates of Inspection .....

Examined and Approved by .....

Company (if applicable) .....

Signed ..... Date .....

## MODIFIED WHEELBASE CONVERSION (DESIGN)

### APPROVAL CODE LH3

#### SCOPE

The following is a summary of the modifications that may be approved under Code LH3 - *Modified Wheelbase Conversion (Design)*.

Design approvals that are **allowed** under this Code include:

- Extended wheelbase conversion of passenger vehicles and their derivatives.
- Design of extended wheelbase conversion of off-road passenger vehicles.
- Design of extended wheelbase conversion of goods vehicles.

Design approvals that are **not allowed** under this Code include:

- The actual physical modification of particular vehicles (this is covered by Code LH4).

Code LH3 does not apply to L-group vehicles (e.g. motorcycles).

#### COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS

The modified vehicle must continue to comply with all applicable ADRs, VSRs, VSBs, Regulations and Acts.

Outlined below are areas of the vehicle that may be affected by the modifications and that may require re-certification, testing and/or data to show compliance for the modified vehicle.

DETAIL	REQUIREMENTS
Installation of Seats and Seat Anchorages	ADR 3, 3A, 3/00, 3/01 VSB5A, VSB5B
Installation of Seatbelts and Seatbelt Anchorages	ADR 4, 4A, 4B, 4C, 4D, 4/00, 4/01, 4/02, 4/03 ADR 5A, 5B, 5/00, 5/01, 5/02 VSB5A, VSB5B
Child Restraint Anchorages	ADR 5/00, 5/01, 5/02, ADR 34, 34A, 34/00, 34/01, VSB5A, VSB5B
Additional Windows	ADR 8, 8/00, 8/01
Rear Vision Mirrors	ADR 14, 14/00, 14/01, 14/02
Head Restraints	ADR 22, 22A, 22/00
Side Impact Protection	ADR 29, 29/00, 72/00
Braking System	ADR 31, 31/00

**NOTE:** To determine the ADRs that apply to the vehicle in question, refer to the Applicability Tables in Section LO. Vehicles manufactured after 1 January 1969 and prior to 1 July 1988 need to comply with the Second Edition ADRs whilst vehicles manufactured after this date need to comply with the Third Edition ADRs. Section LO has separate applicability tables for each edition.

The ADRs apply according to the vehicle's category and date of manufacture. It is the responsibility of the signatory to refer to the appropriate ADR applicable to the vehicle.

If any of the areas listed above have been affected by the modifications, they must comply with the prescribed standards.

### **SPECIFIC REQUIREMENTS**

The following are specific requirements for Modified Wheelbase Conversion designs to be approved under Code LH3.

The conversions must also comply with the general guidelines contained in sub-section 2 - *General Requirements*.

#### **1. STRENGTH AND SAFETY**

Modification of a passenger vehicle by extending its wheelbase without additional reinforcing can significantly reduce the strength and the safety of the vehicle.

#### **2. BODY FLEXING**

If a vehicle is modified in a way that drastically reduces its stiffness, its durability and driveability are reduced. With reduced stiffness, the body will flex and eventually crack. The increased flexibility will adversely affect the vehicle's handling and make it unpleasant to drive.

#### **3. REINFORCING**

To produce a safe, durable vehicle, reinforcing must be compatible with the vehicle's existing structure. Strengthening should consist of material of similar thickness to that of the vehicle's original structure. In no case should the reinforcing material exceed twice the original thickness. The ends of reinforcing should be tapered to eliminate abrupt changes in section that produce stress concentrations.

An extended wheelbase passenger vehicle of monocoque construction normally requires strengthening, with the addition of extra structural members in the sill and cant rail areas.

An extended wheelbase passenger vehicle with a separate chassis normally requires sill and cant rail reinforcing and chassis reinforcing.

An extended wheelbase vehicle with a separate chassis originally certified as an ADR NA Category vehicle, normally requires only chassis reinforcing.

### SILL REINFORCEMENT

The following Figure LH 8 illustrates three possible methods of reinforcing sill sections, an exterior skirt (A), an internal member (B) or an interior sill section (C). The additional strengthening section should be attached to the original sill along the full length of the sill.

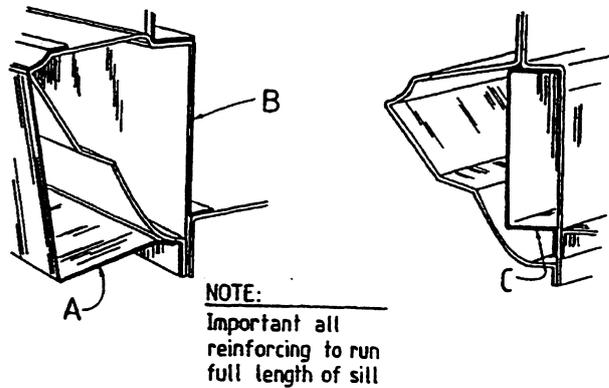


Figure LH 8 Sill Reinforcement Details

### CANT RAIL REINFORCEMENT

The following Figure LH 9 illustrates two possible methods of reinforcing cant rail sections, an internal pressed steel section (D) or a rectangular hollow section (E). The additional section should be attached to the original cant rail along its length.

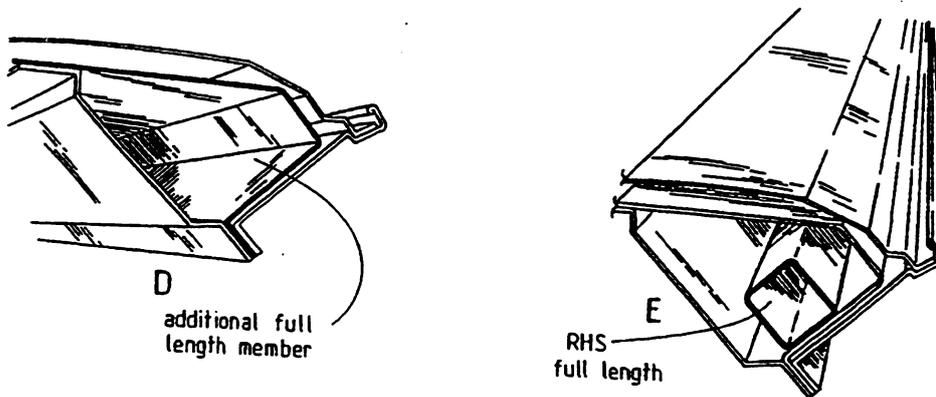


Figure LH 9 Cant Rail Reinforcement Details

## FLOOR CHANNEL SECTION REINFORCEMENT

The following illustrates a method of reinforcing the joints of floor pan main channel sections. In this case, a pressed “top hat” steel section overlaps the original floor pan channel by at least twice its width and is plug welded (refer Figure LH 10). The new channel section should be attached to the floor pan at regular intervals along its length. Its material thickness should be no greater than twice the original floor channel material thickness.

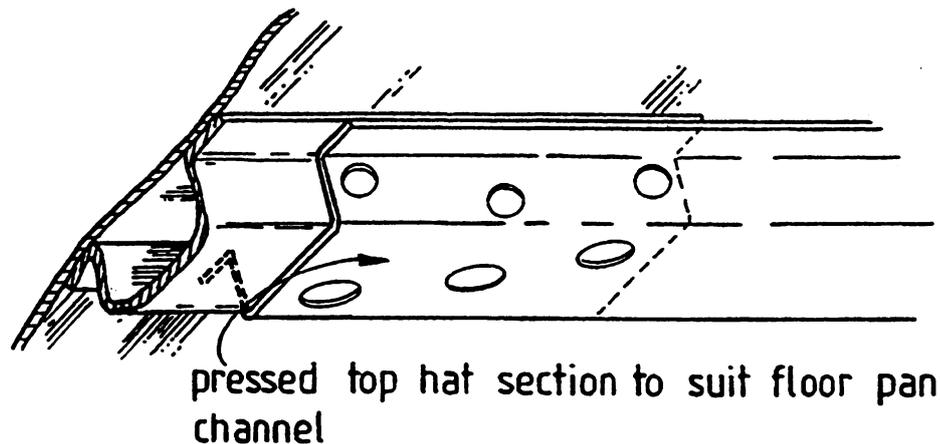


Figure LH 10 Floor Channel Section Reinforcement

All unpainted inner panels and joints of steel must be treated with a rust proofing treatment, such as zinc oxide paint or a fish-oil based lacquer.

### 4. BEAMING AND TORSIONAL TESTS

Extended wheelbase passenger vehicles of monocoque construction must undergo beaming and torsional testing to determine their relevant stiffness, in accordance with the requirements of Code LT1 - *Beaming and Torsional Testing*.

Extended wheelbase passenger vehicles with separate chassis (eg. Cadillac, Lincoln) and goods vehicles with separate chassis (e.g. Hilux, Holden One-Ton) do not need to undergo beaming and torsional testing to determine their relevant stiffness. In the absence of testing these vehicles must be shown to be within the limits for beaming deflection by calculation. The modified vehicle's beaming deflection must be no greater than the beaming deflection of the original vehicle, multiplied by the ratio of the modified wheelbase to the original wheelbase. This can be calculated as outlined below.

### LOADS (VEHICLES WITH A SEPARATE CHASSIS)

A uniformity distributed load should be determined for the original vehicle (without passengers) between the centre lines of the front and rear axles. Point loads of 68 kg per seating position are then to be added.

A uniformity distributed load should then be determined for the modified vehicle in the same manner ensuring that all extra equipment now fitted (eg. seats, TV, driver partition) are included. All passenger point loads are then included at their relevant positions in the vehicle.

Bending moment diagrams are then to be produced from the above loads and the relative dimensions of the original and modified vehicles.

## CALCULATION (VEHICLES WITH A SEPARATE CHASSIS)

The vehicle, viewed side on, is treated as a set of separate beams simply supported at the centre lines of the front and rear axles. The vehicle body forward of the front axle centre line and rearward of the rear axle centre line is to be ignored for the purposes of these calculations.

The moment of inertia, of the original and modified vehicle respectively, can be calculated by assuming that only the cant rails, sills and chassis provide the structural support to the vehicle and that they are separate members in bending and that the sum of their separate moments of inertia constitutes the bending stiffness of the vehicle. If the original and modified vehicle's moment of inertia are both calculated in this manner, a direct comparison can be made without having to determine the absolute values.

With the bending moment diagrams and the moment of inertias of the cant rails, sills and chassis determined, the deflection of the original and modified vehicles can be compared, with the respective vehicle loading being applied as appropriate. If the modified vehicle has a deflection no greater than the original vehicle's deflection multiplied by the percentage increase in wheelbase, the modified vehicle has satisfactory stiffness.

## 5. DRIVE SHAFTS

To ensure reliability and safety, all drive shaft flanges must be mated correctly and all driveline components must be correctly balanced. The services of a driveline specialist should be utilised to ensure compliance with these requirements. Where drive shafts are extended they must be manufactured in accordance with a recognised industry code of practice, which covers recommended shaft lengths and diameters. No drive shaft universal joints shall be at an angle in excess of the universal joint manufacturer's recommendations.

## 6. CRASH PROTECTION

Vehicles originally manufactured to comply with ADR 29 - *Side Impact Protection*, must continue to do so. The vehicle's ability to withstand a side impact must not be reduced. Anti-intrusion rails (refer Figure LH 11) must be fitted along the full length of the cabin. The rails should be designed to meet the strength requirements of ADR 29.

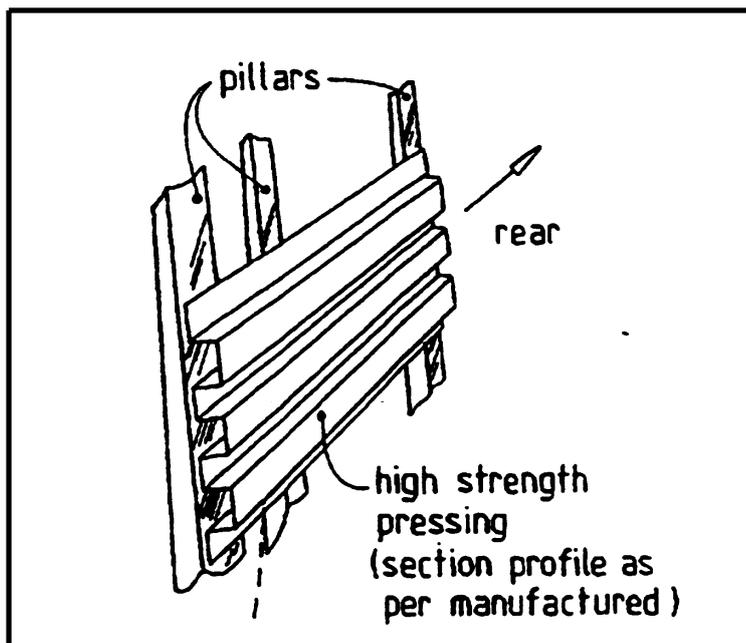


Figure LH 11 Anti-Intrusion Rail

## 7. REARWARD-FACING SEAT

### STRUCTURAL

The seat support frame must withstand the occupant forces normally restrained by seat belts on a forward facing seat in a frontal impact. The support structure must therefore be capable of withstanding a 20 g deceleration of the rearward-facing seat containing an adult in each seating position.

The rearward-facing seat must be capable of simultaneously withstanding the loads shown below:

- the mass of the seat and any supplementary structure at 20 g deceleration.
- an adult occupant mass of 68 kg at 20 g deceleration at each seating position of the seat. (refer Figure LH 12)

The direction and line of application of these forces is detailed in ADR 3.

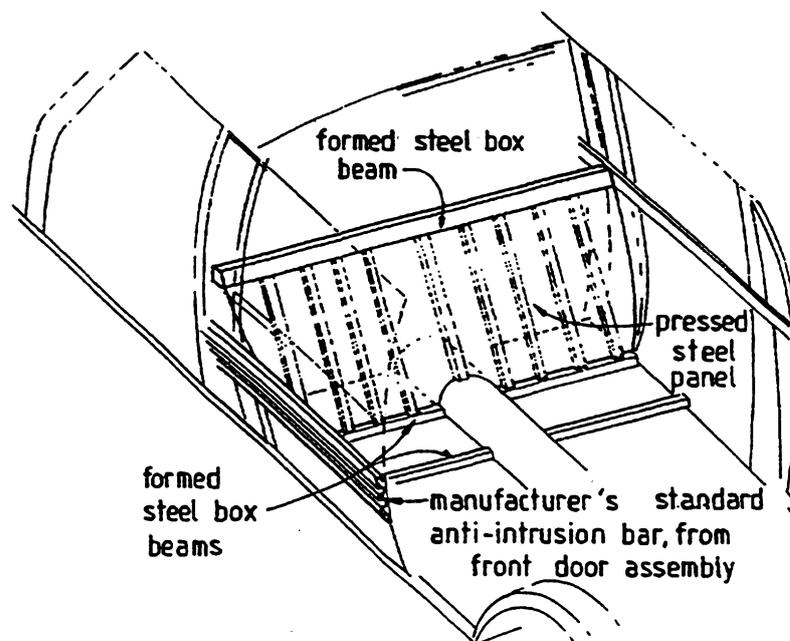


Figure LH 12 Rearward Facing Seat Support Frame

## HEAD RESTRAINTS (REARWARD FACING SEAT)

Head restraints complying with the requirements of ADR 22 must be fitted at all rearward facing seating positions. The recommended height of the head restraint, measured from the uncompressed seat cushion to the uppermost point of the head restraint, is 750mm. Depending upon the compressibility of the seat cushion, a height of less than 750mm may be acceptable provided that the minimum distance from the Seating Reference Point to the top of the head restraint is not less than 700mm.

The head restraint must be capable of withstanding a load of 5.75kg at 20g (1.13kN) located 675mm above the Seating Reference Point along the Torso Line. The deflection of the fully laden rearward facing head restraint must not exceed 100mm in the forward direction.

## 8. HEAD RESTRAINTS (ALL SEATS)

If the vehicle is fitted with a glass partition between the first and second row of seats, a head restraint complying with ADR 22 must be fitted to the front central seating position.

Head restraints of a removable type (i.e. not built in to the seat) will be accepted provided they are not likely to collapse or separate from the seat in a vehicle collision. *Clip-on* type head restraints are not acceptable.

## 9. SEAT BELTS AND CHILD RESTRAINT ANCHORAGES

Vehicles originally manufactured to comply with ADR 4 must continue to do so.

The upper torso anchorages for the front lap/sash belt and all other anchorages must comply with the requirements of with ADR 5.

Vehicles originally manufactured to comply with ADR 34 *Child Restraint Anchorages and Child Restraint Anchor Fittings* must continue to do so and the anchorages must comply with the requirements of ADR 34.

## 10. RECORDS

Drawings, specifications and inspection records must be produced and shall fully describe the modifications.

**CHECKLIST**  
**MODIFIED WHEELBASE CONVERSION (DESIGN)**

**APPROVAL CODE LH3**

(N/A= Not Applicable, Y=Yes, N=No)

<b>1.</b>	<b>STRUCTURAL REINFORCEMENT</b>			
1.1	Is reinforcing material thickness no more than twice original section thickness?	<input type="checkbox"/>	Y	N
1.2	Are stress concentrations avoided at ends of reinforcing sections?	<input type="checkbox"/>	Y	N
1.3	Do floor channel rail sections and joints meet specification requirements?	<input type="checkbox"/>	Y	N
<b>2.</b>	<b>BEAMING AND TORSIONAL TESTS</b>			
2.1	Does monocoque body design comply with Code LT1 requirements?	N/A	Y	N
<b>3.</b>	<b>COMPLIANCE WITH ADRs</b>			
3.1	Does vehicle design continue to comply with relevant ADRs?	<input type="checkbox"/>	Y	N
<b>4.</b>	<b>SPECIFICATION</b>			
4.1	Have drawings, specifications & report of the design been produced	<input type="checkbox"/>	Y	N
4.2	Have materials, fasteners, workmanship and welding been specified as required?	<input type="checkbox"/>	Y	N

NOTE: If the answer to any question is **N (No)**, the design is not acceptable under Code LH3.

Vehicle Make and Model .....

Description of Conversion .....

Design Approval Number .....

Approved by .....

Company (if applicable) .....

Signed ..... Date .....

## MODIFIED WHEELBASE CONVERSION

### APPROVAL CODE LH4

#### SCOPE

The following is a summary of the modifications that may be approved under Code LH4 - *Modified Wheelbase Conversion*.

Modifications that are **allowed** under this Code include:

- Extended wheelbase conversion of passenger vehicles and their derivatives.
- Extended wheelbase conversion of off-road passenger vehicles.
- Extended wheelbase conversion of goods vehicles.

Modifications that are **not allowed** under this Code include:

- Conversions that do not have a design approval in accordance with the requirements of Code LH3.

Lode LH4 does not apply to L-group vehicles ( e.g. motorcycles).

#### COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS

The modified vehicle must continue to comply with all applicable ADRs, VSRs, VSBs, Acts and Regulations.

#### SPECIFIC REQUIREMENTS

The following are specific requirements for Extended Wheelbase Passenger Vehicle Conversions to be approved under Code LH4.

The conversions must also comply with the general guidelines contained in sub-section 2 - *General Requirements*.

##### 1. DESIGN

The modification must be carried out in accordance with the requirements of the design approved under Code LH3 and as outlined in the design specification and drawings.

##### 2. WORKMANSHIP

The workmanship must be in accordance with the requirements of the design approved under Code LH3 and of sub-section 2 - *General Requirements*.

##### 3. INSPECTION

The Inspector must conduct at least two inspections of the vehicle. The first, an interim inspection is to be arranged for the structurally completed vehicle. The inspection is to be carried out prior to painting and trimming the modified areas. This may be carried out in several stages, depending on how the vehicle is modified. A final inspection is to be carried out on the completed vehicle when it is in a condition suitable for registration.

Previously modified vehicles that are being assessed must have all trim etc. removed to allow a thorough inspection of all modified areas.

##### 4 RECORDS

The Inspector must hold a copy of all drawings, specifications, test results and any other data necessary to fully describe the vehicle modifications.

**CHECKLIST****MODIFIED WHEELBASE CONVERSION CODE LH4**

(N/A= Not Applicable, Y=Yes, N=No)

<b>1.</b>	<b>DESIGN</b>			
1.1	Has the vehicle been modified in accordance with the design approved under Code LH3?		Y	N
1.2	Insert Design Approval No.....			
<b>2.</b>	<b>WORKMANSHIP</b>			
2.1	Is all work performed in accordance with recognised engineering standards and to the satisfaction of the Inspector?		Y	N
2.2	Has all welding been carried out by qualified tradespersons?		Y	N
2.3	Does all welding comply with relevant Australian Standards?		Y	N
<b>3.</b>	<b>FASTENERS</b>			
3.1	Are high tensile bolts used on all new critical joints and mountings?		Y	N
3.2	Are self-locking nuts used on all new critical joints and mountings?		Y	N
3.3	Are all replacement fasteners equivalent or better than original in strength and quality?		Y	N
<b>4.</b>	<b>ADR COMPLIANCE</b>			
4.1	Does converted vehicle has Low Volume Identification Plate if applicable?		Y	N
<b>5.</b>	<b>INSPECTION</b>			
5.1	Have interim inspection(s) been carried out on all modified areas of the vehicle structure and found to be satisfactory?		Y	N
5.2	Has a final inspection been carried out on all modified areas of the vehicle structure and found to be satisfactory?		Y	N
<b>6.</b>	<b>BEAMING AND TORSIONAL TESTS</b>			
6.1	Does the body design comply with the requirements of Code LT1?		Y	N

NOTE: If the answer to any question is **N (No)**, the modification cannot be approved under Approval Code LH4.

[Continued overleaf]

FORM No: LH4

Make ..... Model ..... Year of Manufacture .....

Chassis No. or VIN .....

Vehicle Modified by .....

Dates of Inspection .....

Examined and Approved by .....

Company (if applicable) .....

Signed ..... Date .....

## VEHICLE CONSTRUCTION (DESIGN)

### CODE LH5

#### SCOPE

The following is a summary of the design approvals that may be issued under Code LH5 - *Vehicle Construction (Design)*, based on vehicle definitions and *date of manufacture* contained in the ***Introduction - Vehicle Definitions***.

Design approvals that are **allowed** under this Code for vehicles classified as *Modified Production Vehicle* include the following:

- Conversion of the body or cabin of a vehicle with separate chassis frame to a non-standard variation of the body or cabin.
- Structural modifications to extend inner mudguards
- Fitting of a tilt front to a post-1970 production vehicle
- Fitting of fibreglass replacement panels to a post-1970 production vehicle.

Design approvals that are **allowed** under this Code for vehicles classified as *Extensive modification to Production Vehicle* include the following:

- Construction of a vehicle from an unmodified production vehicle chassis assembly, (including engine, transmission, brakes and suspension) and either:
  - ◆ an unmodified body from another vehicle model;
  - ◆ a modified body from another vehicle model; or
  - ◆ a newly constructed body.
- Construction of a vehicle from a modified production vehicle chassis and either:
  - ◆ an unmodified body from another vehicle model;
  - ◆ a modified body from another vehicle model; or
  - ◆ a newly constructed body.
- Construction of a vehicle from a newly constructed chassis and either:
  - ◆ an unmodified body from another vehicle model;
  - ◆ a modified body from another vehicle model; or

Design approvals that are **allowed** under this Code for vehicles classified as *Individually Constructed Vehicle* include the following:

- Construction of a vehicle from a newly constructed chassis and a newly constructed body.

Modification approvals that are **not allowed** under this Code include:

- Design of a convertible or cabriolet conversion (this is covered by LH1)
- Design of an extended wheelbase conversion (this is covered by LH3)
- Conversion of vehicle to one of its model variants (this is covered by Code LH7)
- Construction of a *Street Rod* (this is covered by Code LO6).
- The actual construction of vehicles (this is covered by Code LH6).

Code LH5 does not apply to L-group vehicles (e.g. motorcycles).

## **COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS**

The modified vehicle must continue to comply with all ADRs, VSRs, VSBs, Acts and Regulations applicable at its *date of manufacture* (refer Introduction).

### **ADR APPLICABILITY: (BODY AND CHASSIS)**

For the purposes of assessing compliance with Australian Design Rules, *re-bodied and re-chassied vehicles* are deemed to consist of two major components, these being the rolling chassis, and the body, which are considered separately.

#### **1. ROLLING CHASSIS (INCLUDING ENGINE, SUSPENSION AND BRAKING SYSTEM)**

Rolling chassis for the purposes of ADR compliance is taken to include all components that may affect the vehicle's compliance with chassis or running gear related ADRs. These include engine, brakes, wheels and tyres, suspension and steering.

If the new vehicle uses an unmodified chassis, suspension and braking system from a production motor vehicle, and if the vehicle is similar in mass and mass distribution to that of the donor vehicle, the chassis is considered to be unmodified. No additional ADR certification is required.

If the chassis is a modified production chassis (shortened or lengthened beyond that of any manufacturer's variants), if the suspension or brakes are modified, if the new vehicle is substantially heavier or different in mass distribution from that of the chassis donor vehicle, the vehicle's braking system will require re-certification.

#### **2. BODY**

Body for the purposes of ADR compliance is taken to include all other parts of the vehicle where ADRs apply. These include impact occupant protection measures (crumple zones), occupant restraint including seat belts, child restraint anchorages and air-bags, lighting, glazing, wipers/washers/demister, body structure and panels, doors, steering column, controls and instrumentation.

## **SPECIFIC REQUIREMENTS**

The following are specific requirements for vehicle designs to be approved under Code LH5.

The designs must also comply with the general guidelines contained in sub-section 2 - *General Requirements*.

### **1. STRENGTH AND STIFFNESS**

The vehicle's structure must have adequate strength and stiffness to provide protection for the occupants and to ensure safe handling. If a vehicle is constructed with low stiffness, its durability and driveability are reduced, and the body will flex and eventually crack. The flexing will make it unpleasant to drive.

### **2. BEAMING AND TORSIONAL TESTS**

*Individually Constructed Vehicles* (ICVs) utilising an unmodified production vehicle chassis must undergo beaming and torsional testing to determine their relevant stiffness, in accordance with the requirements of Code LT1 - *Beaming and Torsional Testing*.

ICVs or kit cars utilising a modified production vehicle chassis, a newly constructed chassis or a specifically designed chassis do not need to undergo beaming and torsional testing to determine their relevant stiffness. However, with respect to body or chassis rigidity the manufacturer shall meet the following requirements and take heed of the following information.

The ICV or kit car manufacturer shall remain responsible for the design of the chassis and its inherent structural strength and thus safety.

It is strongly recommended that an ICV or kit car manufacturer obtains professional advice from an appropriate source before commencing manufacture. Sources of such advice may include an original vehicle or "kit" designer, a large vehicle manufacturer or a professional engineer.

The ICV or kit car manufacturer shall keep informed as to current industry practice and produce vehicles in line with established good practice.

The structure of the ICV or kit car body or chassis shall be such that there are no abrupt changes in the strength properties of loaded sections. Abrupt changes in section must be avoided as they will produce stress concentrations and result in cracks and fatigue failure. Manufacturers should inform themselves in this respect or seek qualified assistance.

A torsional rigidity of at least 4,000 Nm per degree is a level that, from experience, is known to preserve a vehicle's body or chassis when subjected to the stresses of operation and allow for the vehicle's proper functioning without rapid deterioration.

### **3. STEERING AND SUSPENSION**

Steering and suspension systems must be designed to ensure adequate strength and to ensure safe vehicle handling.

Steering and suspension systems can comprise components from standard production vehicles with an identical physical layout. However, systems may also be made from a combination of suspension and steering components from various vehicles. The components must be selected to ensure that they have adequate strength for the loads imposed and will not be at risk of fatigue failure.

## **GEOMETRY**

Vehicles must have appropriate steering and suspension geometry to ensure safe vehicle handling.

Steering boxes, racks and drag links must be selected and positioned to minimise bump or roll steer. Where a wheelbase is extended or a vehicle is newly constructed, consideration should be given to steering geometry to ensure that the Ackermann steering geometry has not been affected to an extent where excessive tyre scrub occurs during cornering.

Front and rear suspension roll centres and roll stiffness must be selected to prevent excessive vehicle oversteer or understeer characteristics. Additional or modified sway bars may be required to achieve appropriate handling characteristics.

## **BUMP STEER**

The bump steer characteristics of non-standard steering and suspension systems must be verified. This is normally done by producing a graph of toe-in and toe-out plotted against suspension travel, from the full bump to the full rebound positions. Steering and suspension systems are considered to be non-standard if all of the components are not from the one vehicle model or their relative mounting positions do not comply with the manufacturer's specifications. Standard suspension and steering systems may include replacement springs, sway bars, dampers, adjustment devices, pivot bushes, bearings and joints that do not comply with the manufacturers' specifications.

Throughout the range of suspension travel from the static position up to two thirds of the maximum travel in both the bump and rebound directions, the maximum recorded toe-in and toe-out shall not be greater than 20mm measured at the maximum tyre diameter.

## **WELDING OF STEERING AND SUSPENSION COMPONENTS**

Welding of steering and suspension components should be avoided. When welding is required, the design must be in accordance with the requirements of the National Code of Practice VSB4 *Steering Conversions for Left Hand Drive Vehicles*.

Material specifications, weld preparation, weld procedures, heat treatment and material hardness across the heat-affected zone must be evaluated and approved by the designer.

## **METALLURGICAL TESTING**

A metallurgical test certificate is required for welded steering and suspension components. The components shall be subjected to X-ray and dye crack detection tests, as well as any other appropriate metallurgical tests. Each tested component is to be stamped with an identification number.

## **HANDLING TEST**

All vehicles with non-standard steering and suspension or vehicles with standard steering and suspension that are fitted with wheel rims that increase the original track by more than 50mm, must successfully complete a Lane-Change Manoeuvre Test in accordance with the test procedure in Code LT2.

[Continued overleaf]

**CHECKLIST**  
**VEHICLE CONSTRUCTION (DESIGN)**  
**APPROVAL CODE LH5**

(N/A= Not Applicable, Y=Yes, N=No)

<b>1.</b>	<b>STRUCTURAL DESIGN</b>			
1.1	Is all reinforcing material thickness designed to be no more than twice original section thickness?		Y	N
1.2	Does the design avoid stress concentrations at ends of reinforcing sections?		Y	N
1.3	If fibreglass has been used has it been tested and found to comply with the Standards specified in Section 2.7?		Y	N
<b>2.</b>	<b>BEAMING AND TORSIONAL TESTS</b>			
2.1	Does vehicle design comply with Code LT1 requirements?		Y	N
<b>3.</b>	<b>STEERING AND SUSPENSION</b>			
3.1	Do steering and suspension components have adequate strength as designed?	N/A	Y	N
3.2	Have weld procedures and non-destructive testing (X-ray, ultrasonic, dye penetrant) been specified for modified welded components?	N/A	Y	N
3.3	Has bump steer been checked and does it comply with requirements?	N/A	Y	N
3.4	Does vehicle design comply with requirements of Code LT2, the Lane-Change Manoeuvre Test and is a report attached?	N/A	Y	N
<b>4.</b>	<b>COMPLIANCE WITH ADRs</b>			
4.1	Does the vehicle design comply with applicable ADRs?		Y	N
<b>5.</b>	<b>SPECIFICATION</b>			
5.1	Have drawings, specifications & report of the design been produced?		Y	N
5.2	Workmanship, welding and fasteners specified as required?		Y	N

NOTE: If the answer to any question is **N (No)**, the design is not acceptable under this Code.

[Continued overleaf]

FORM No: LH5

Vehicle Make and Model .....

Description of Construction or Conversion .....

Design Approval Number.....

Approved by .....

Company (if applicable) .....

Signed ..... Date .....

## VEHICLE CONSTRUCTION

### CODE LH6

#### SCOPE

The following is a summary of the vehicle construction and modifications that may be approved under Code LH6 - *Vehicle Construction*.

Construction and modifications that are **allowed** under this Code include:

- Vehicle construction based on a design approved under Code LH5
- Vehicle body modification based on a design approved under Code LH5

Construction and modifications that are **not allowed** under this Code include:

- Construction of a *Street Rod* (this is covered by Code LH9).
- Vehicle construction or body modification without an LH5 design approval.

Code LH6 does not apply to L-group vehicles (e.g. motorcycles).

#### COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS

The modified vehicle must continue to comply with all applicable ADRs, VSRs, VSBs, Acts and Regulations.

#### SPECIFIC REQUIREMENTS

The following are specific requirements for the construction and modification of vehicles in accordance with designs that are approved under Code LH6.

The vehicles must also comply with the general guidelines contained in sub-section 2 - *General Requirements*.

##### 1. DESIGN

The construction and modifications must be carried out in accordance with the requirements of the design approved under Code LH5 and as outlined in the design specification and drawings.

##### 2. WORKMANSHIP

The workmanship must be in accordance with the requirements of the design approved under Code LH5 and of sub-section 2 - *General Requirements*.

##### 3. INSPECTION

An inspection must be carried out on the structurally completed vehicle prior to painting and trimming of all modified areas.

Previously modified vehicles that are being assessed must have all trim etc. removed to allow a thorough inspection of all modified areas.

A final inspection is to be carried out on the completed vehicle when it is in a condition suitable for registration.

##### 4. RECORDS

The Inspector must hold a copy of all drawings, procedures and specifications necessary to fully describe the modifications.

**CHECKLIST****VEHICLE CONSTRUCTION - CODE LH6**

(N/A= Not Applicable, Y=Yes, N=No)

<b>1.</b>	<b>DESIGN</b>		
1.1	Has the vehicle been modified in accordance with the design approved under Code LH5?		Y N
1.2	Insert Design Approval No.....		
<b>2.</b>	<b>WORKMANSHIP</b>		
2.1	Is all work performed in accordance with recognised engineering standards?		Y N
<b>3.</b>	<b>WELDING</b>		
3.1	Has all welding been carried out by qualified tradesperson?		Y N
3.2	Does all welding comply with relevant Australian Standards?		Y N
<b>4.</b>	<b>FASTENERS</b>		
4.1	Are high tensile bolts used on all new critical joints and mountings?		Y N
4.2	Are self-locking nuts used on all new critical joints and mountings?		Y N
4.3	Are all replacement fasteners equivalent to or better than original in strength and quality?		Y N
<b>5.</b>	<b>ADR COMPLIANCE</b>		
5.1	Does vehicle have Low Volume Identification Plate if applicable?		Y N
<b>6.</b>	<b>INSPECTION</b>		
6.1	Have interim inspection(s) been carried out on all modified areas of the vehicle structure and found to be satisfactory?		Y N
6.2	Has a final inspection been carried out on the complete vehicle and found to be satisfactory?		Y N
<b>7.</b>	<b>TESTING</b>		
7.1	Does vehicle design comply with requirements of Code LT2, the Lane-Change Manoeuvre Test and is a report attached?		Y N

NOTE: If the answer to any question is **N (No)**, the construction or modification cannot be approved under this Code.

[Continued overleaf]

FORM No: LH6

Make ..... Model ..... Year of manufacture .....

Chassis No. or VIN .....

Vehicle constructed/modified by .....

Dates of inspection .....

Examined and approved by .....

Company (if applicable) .....

Signed ..... Date .....

## BODY/CHASSIS VARIANT - CONVERSION

### CODE LH7

#### SCOPE

Approval to convert a vehicle to one of its manufacturer's model variants can be obtained under Approval Code LH7.

A manufacturer's model *variant* is a vehicle that varies from the base vehicle model with different features such as additional seating, access and/or load space. Variants often share the same front body structure, but have different rear body configurations e.g. sedans, coupes, convertibles, hatchbacks, utilities and station wagons.

For example, under this Approval Code, some panel vans can be converted to their corresponding utility variant using new utility body panels supplied by the manufacturer, or they can be converted by replacing their rear body or chassis section with that from the utility variant.

Conversions that are **allowed** under this Code include:

- Conversion of any light vehicle to a manufacturer's variant of that model.
- Conversion of a panel van or station wagon to a manufacturer's utility variant.
- Conversion of a sedan to a manufacturer's station wagon variant.
- Conversion of a coupe to a manufacturer's hatchback or convertible variant.
- Conversion of a front wheel drive vehicle to a manufacturer's four wheel drive variant.
- Conversion of a single cab utility to a manufacturer's extended or dual cab utility variant.

Conversions that are **not allowed** under this Code include:

- Conversion of a vehicle to a variant that is different in construction from the manufacturer's variant.
- Conversion of a sedan or coupe to a convertible or cabriolet using non-standard components and reinforcement sections. (This is covered by Codes LH1 & LH2)
- Conversion of a single cab utility to a non-standard extended or dual cab utility. (This is covered by Codes LH5 & LH6).

Code LH7 does not apply to L-group vehicles (e.g. motorcycles).

## COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS

The modified vehicle must continue to comply with all applicable ADRs, VSRs, VSBs, Acts and Regulations.

Outlined below are areas of the vehicle that may be affected by the modifications and that may require re-certification, or data to show compliance for the modified vehicle.

DETAIL	REQUIREMENTS
Installation of Seats and Seat Anchorages	ADR 3, 3A, 3/00, 3/01. VSB5A, VSB5B.
Installation of Seatbelts and Seatbelt Anchorages	ADR 4, 4A, 4B, 4C, 4D, 4/00, 4/01, 4/02, 4/03. ADR 5A, 5B, 5/00, 5/01, 5/02. VSB5A, VSB5B.
Replacement windows	ADR 8, 8/00.

**NOTE:** To determine the ADRs that apply to the vehicle in question, refer to the Applicability Tables in Section LO. Vehicles manufactured after 1 January 1969 and prior to 1 July 1988 need to comply with the Second Edition ADRs whilst vehicles manufactured after this date need to comply with the Third Edition ADRs. Section LO has separate applicability tables for each edition.

The ADRs apply according to the vehicle's category and date of manufacture. It is the responsibility of the signatory to refer to the appropriate ADR applicable to the vehicle.

## SPECIFIC REQUIREMENTS

The following are specific requirements for Body/Chassis Variant Conversions to be approved under Code LH7.

The conversions must also comply with the general guidelines contained in sub-section 2 - *General Requirements*.

## BODY COMPONENTS

Standard body components or equivalent for the variant model must be used for all replacement panels.

Equivalent panels and brackets may be used, provided that the replacement panels are at least equivalent material in thickness and strength.

Where sharp edges exist, they should be capped with fully welded steel covers or pinch weld or equivalent (see Figure LH 7, Code LH1 page 22).

## 1. MECHANICAL COMPONENTS

If any of the standard mechanical components, including engine, transmission, suspension and braking system for the variant model are not used, approval must be obtained under the appropriate Approval Codes.

## 2. GENERAL

Replacement panels must be attached with at least the same number and size of welds as on the standard utility variant.

Where panels are intermittently welded, they must be fully sealed to prevent the ingress of exhaust gases into the cabin.

Glazing must comply with the requirements of ADR 8 - *Safety Glazing Material* and must have the appropriate Standards marking.

The structural integrity of existing seat belt mountings must be maintained by ensuring that all original mounting and reinforcing sections are retained or replaced.

## 3. INSPECTION

An inspection must be carried out on the structurally completed vehicle prior to painting and trimming of all modified areas.

Previously modified vehicles that are being assessed must have all trim etc. removed to allow a thorough inspection of all modified areas.

A final inspection is to be carried out on the converted vehicle, when it is in a condition suitable for registration.

## 4. RECORDS

Drawings, specifications and inspection records must be produced and shall fully describe the modifications.

Reference No .....

FORM No: LH7

**CHECKLIST**  
**BODY/CHASSIS VARIANT – CONVERSION**  
**APPROVAL CODE LH7**

(N/A= Not Applicable, Y=Yes, N=No)

<b>1.</b>	<b>DESIGN</b>			
1.1	Has the vehicle been modified exactly in accordance with the design of the manufacturer's standard variant, using standard or equivalent components?		Y	N
1.2	Are all replacement panels and reinforcing equivalent in thickness and strength to those of the standard variant?		Y	N
1.3	Are replacement panels attached equivalent to original?		Y	N
1.4	If fibreglass has been used has it been tested and found to comply with the Standards specified in Section 2.7?		Y	N
1.5	Insert Design Approval No.....			
<b>2.</b>	<b>FASTENERS</b>			
2.1	Are high tensile bolts used on all structural joints and mountings?		Y	N
2.2	Are self-locking nuts used on all structural joints and mountings?		Y	N
2.3	Are all replacement fasteners equivalent to or better than original in strength and quality?		Y	N
<b>3.</b>	<b>WORKMANSHIP</b>			
3.1	Is all work performed in accordance with recognised engineering standards and to the satisfaction of the Inspector?		Y	N
3.2	Are replacement panels fully sealed to prevent ingress of exhaust gases?		Y	N
3.3	Are all sharp edges capped or covered?		Y	N
<b>4.</b>	<b>WELDING</b>			
4.1	Is all welding carried out by qualified tradesperson?		Y	N
4.2	Does all welding comply with relevant Australian Standards?		Y	N

[Continued overleaf]

(N/A=Not Applicable, Y=Yes, N=No)

<b>5.</b>	<b>ADR COMPLIANCE</b>		
5.1	Do all seats and seat anchorages comply with the relevant ADR?		Y N
5.2	Do all seatbelts and seatbelt anchorages comply with the relevant ADR?		Y N
5.3	Does all replacement glass comply with relevant ADR?		Y N
<b>6.</b>	<b>INSPECTION</b>		
6.1	Were interim inspection(s) carried out on all modified areas of the vehicle structure?		Y N
6.2	Was a final inspection carried out on all modified areas of the vehicle structure?		Y N
<b>7.</b>	<b>RECORDS</b>		
7.1	Have complete records of vehicle details and conversion/construction been retained in a manner suitable for auditing?		Y N

NOTE: If the answer to any question is **N (No)**, the modification cannot be approved under this Code.

Make ..... Model ..... Year of Manufacture .....

Chassis No. or VIN .....

Vehicle Modifier .....

Inspected by .....

Dates of Inspection .....

Approved by ..... Reference No .....

Company (if applicable) .....

Signed ..... Date .....