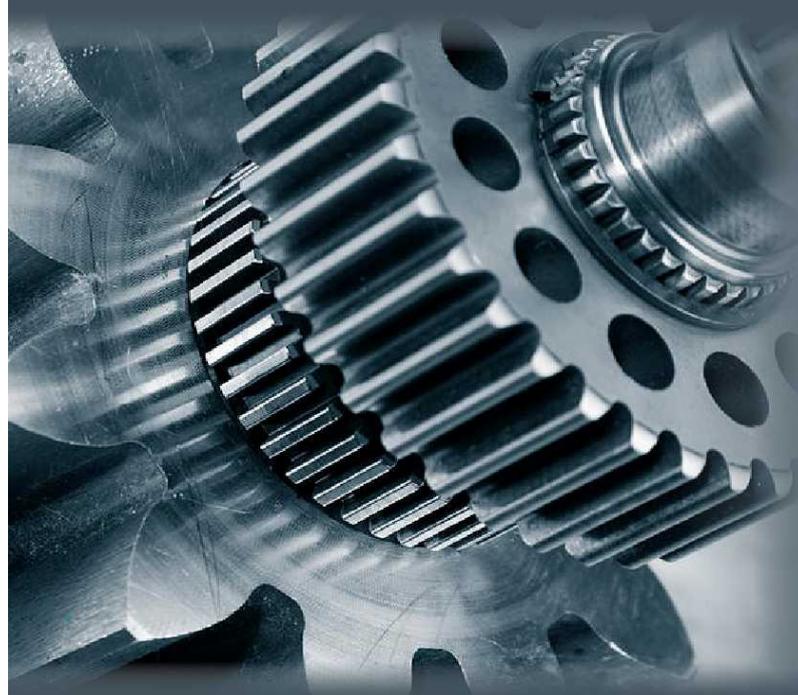


NATIONAL CODE OF PRACTICE



**VSB 6**

HEAVY VEHICLE MODIFICATIONS

**Section J**  
**Body Mounting**

**HEAVY VEHICLE MODIFICATIONS****1. SCOPE**

This Section relates to the installation of bodies to chassis frame mountings for heavy vehicles.

This Section does not include certification of omnibus body; however it includes mounting of complying bus body on complying rolling chassis.

The mounting of fifth wheels/turntables is the subject of Section P - Tow Couplings/Fifth Wheels.

This Section does not include recommendations for truck body design.

This Section does not include body-related requirements for ADR etc. compliance, for the completed vehicle.

**2. GENERAL INFORMATION**

As most vehicle manufacturers issue body building instructions for their range of vehicles, it is recommended that these guidelines be adopted to achieve the maximum performance and serviceability from the vehicle. In the case of specialised bodies, primarily tanks and in particular aluminium tanks, the body manufacturer will provide mounting guidelines that should be adhered together with the chassis manufacturer's guidelines. The intent of this Section is to assist body builders installing equipment on to vehicles where the manufacturer's recommendations are not available and also to highlight some requirements that may not be addressed in the manufacturer's instructions.

**3. ADR'S AFFECTED**

This Section does not cover any ADR related modifications. It is possible, however, that during body mounting, some ADR compliance may be affected. The completed vehicle must be surveyed to ensure that all ADR compliance is still valid.

**4. AFFECTING MODIFICATIONS**

Modifications that could affect the body mounting system include:

- Change of body type.
- Change of body size.
- Extended or shortened wheelbase.
- Fitment of an additional axle.
- Fitment of chassis reinforcements and/or adaptations.
- Chassis extension, such as increased rear overhang.

## HEAVY VEHICLE MODIFICATIONS

## 5. GENERAL REQUIREMENTS

## 5.1 Overall Vehicle Considerations

Before proceeding with the manufacture or fitting of a truck body, an analysis of the vehicle, in conjunction with the required payload (size and weight) should be performed to establish whether the nominated vehicle has the capacity to satisfy the requirements. Items that must be checked include:

- Axle loads do not exceed the manufacturer's axle capacities or State legal load limits.
- Distribution of axle loads by the position of the body and payload (this may be dependent on the vehicle's wheelbase and rear overhang).
- Chassis strength.
- Where a vehicle body and mounting is incapable of supporting a load at the vehicle GVM the vehicle must be re-rated to a GVM within the body and mounting capabilities.
- Overall dimensions of the vehicle.

Note: The rear overhang and loading space must comply with ADR requirements. Refer Appendix 1 for Recommended Dimensional Limits - NA and NB Vehicles.

- The Load Space must not project beyond the end of the chassis by more than 1.5 times final chassis depth unless the body structure is self supporting at full load.
- Position of Centre of Gravity - refer Figure 1. There is a point, on a cab chassis vehicle, at which the mass is effectively centered. This is termed the centre of gravity. If the vehicle is to be stable when cornering, the centre of gravity of a bodied vehicle should be as low and as near to the centre of the vehicle as possible. Any part of the body or equipment placed above the original centre of gravity will cause the new centre of gravity to be higher. Raising the centre of gravity is inevitable when mounting a body or adding equipment, but all possible steps should be taken to minimise this effect by mounting heavy parts of the body or equipment as low and as symmetrically about the chassis frame as possible.

Care should be taken to ensure that the functional capabilities of the vehicle are not inhibited and that sufficient clearance to allow accessibility for maintenance is provided when a body is installed.

## HEAVY VEHICLE MODIFICATIONS

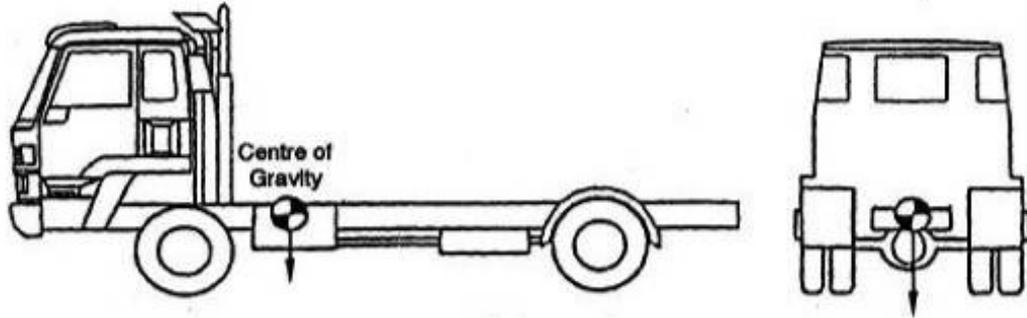


Figure 1

## 5.2 Basic Structural Considerations

It is recommended that the vehicle manufacturer's Body Builder's Manual be consulted to obtain specific details which are applicable to that vehicle. If possible, the standard manufacturer's mountings and method of attachment must be used. The following requirements should be met:

- The attachment of the body must be capable of supporting the maximum loads imposed by the payload and the body weight at the extreme conditions (i.e. braking, overturning moment etc.) while still evenly distributing the load throughout the chassis. Where point load situations due to the fitment of load cells / scales occur, the equipment and or truck manufacturers guidelines should be followed. In the absence of such guidelines mounting points must be designed to spread the load over a sufficient area of chassis to avoid point loading stress.
- The majority of the body loads should be transmitted directly to the web of the chassis frame rail.
- A designed factor of safety for body mounting components must ensure that at 3x the designed maximum load the stress level in the component should be below the yield limit.
- On a conventional cab chassis with a rigid body, there is often a gross discontinuity in total structure stiffness at the front of the body, leading to high stresses in the chassis members immediately in front of the body. This effect *may* be minimised by ensuring that the sub frame of a body extends for the entire length of the body without any breaks or joins. The front end of the sub frame should offer a progressive load bearing transition to the chassis frame rail. Refer Figure 2 for two methods of preventing stress concentration.

Typical spacing for body mounting brackets is 900 mm but can be altered to suit the installation.

HEAVY VEHICLE MODIFICATIONS

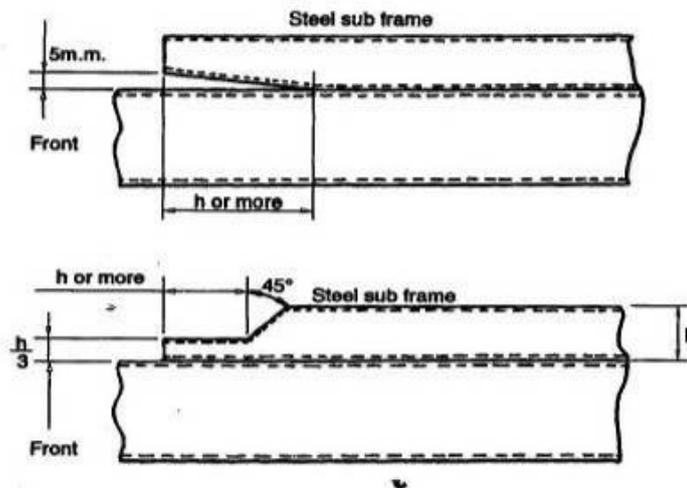


Figure 2

Suitably designed vibration isolators may be used between body and chassis mounting brackets. It should be placed between the faces of the chassis frame bracket and the body mounted bracket, and will take up any slight misalignment of body brackets. Where rivets prevent mounting flush to the top flange a flat mild steel or compressed polyurethane (or other suitable material) spacer drilled to clear the rivets may be fitted.

- It may also find application in prevention of noise intrusion into cab. The body mounting attachments should not be located within the shaded areas of Figures 3 and 4.

NOTE: Manufacturer's recommendations in this area should be observed.

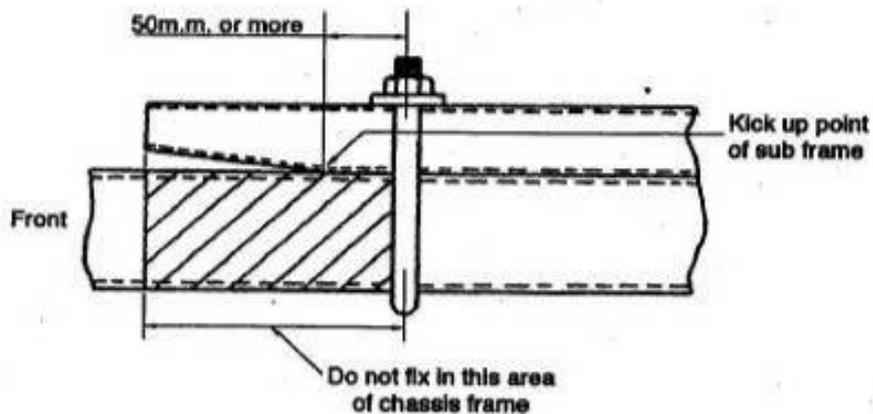
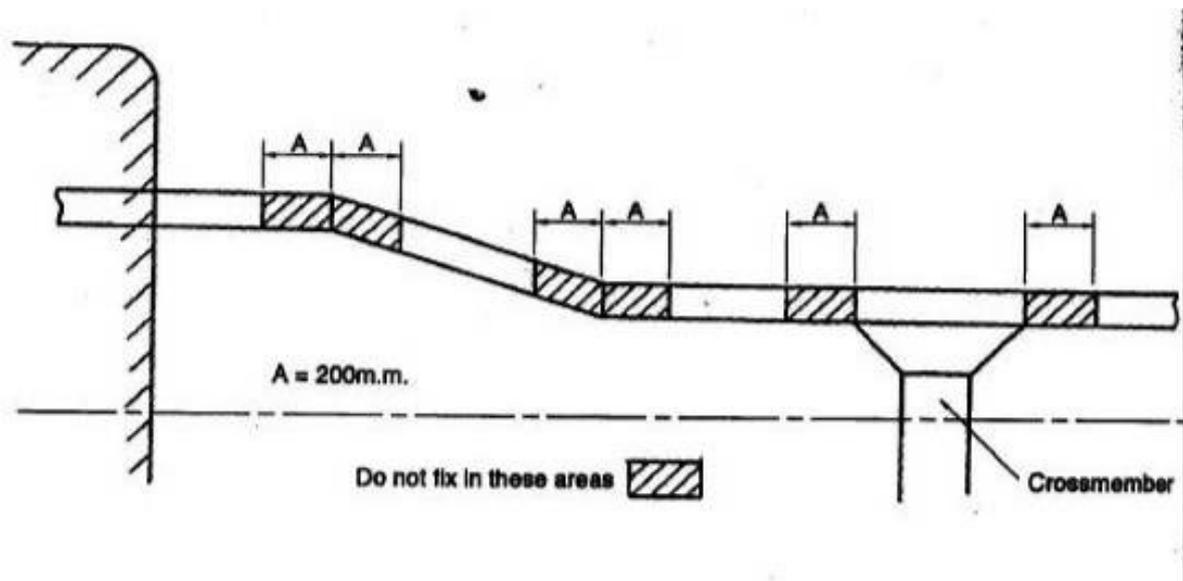


Figure 3. Attachment Front End of Sub Frame

## HEAVY VEHICLE MODIFICATIONS



**Figure 4. Attachment Locations Chassis Frame**

(Always refer to manufacturer's body mounting directives over the above guidelines).

### 5.3 Detail Structural Considerations

The following detail requirements should be met:

The lower attachment hole on all body mounting brackets should be below the neutral axis of the chassis frame rail. The bottom edge of the bracket should be as near as possible to the web of the frame rail to prevent frame cracking. The minimum acceptable mounting is to bolt the attachment along one row in line with the top row of chassis bolts.

- Body mountings should be so located that:
  - In relation to changes in the frame rail section, suspension mounting points and other frame attachments, stress concentrations in the frame are kept to a minimum.
  - Regular inspection and maintenance can be readily carried out on the mounting and adjacent vehicle parts.
  - There is sufficient clearance of mountings from moving parts such as propeller shafts, suspension links, etc.
- Metric standard bolts grade 8.8 (SAE Grade or 5) must be used with the appropriate grade nuts for fastening body mounting to the chassis frame. Refer Australian Standard AS 1110. Vibration proof fasteners of equivalent strength such as Huck bolts are an acceptable alternative. Bolt manufacturers specifications must be considered to ensure that alternative fasteners are of equivalent strength.
- Drilling of frame side members for attachment of body mounting brackets must be in accordance with Section H - Chassis Frames - of the National Code of Practice for Heavy Vehicle Modifications. It is good practice to use existing chassis holes where possible.

## HEAVY VEHICLE MODIFICATIONS

- When components of dissimilar metal are bolted together, isolating compound or other approved means of preventing corrosion due to electrolysis must be employed.

## 5.4 Selection of Mount Types

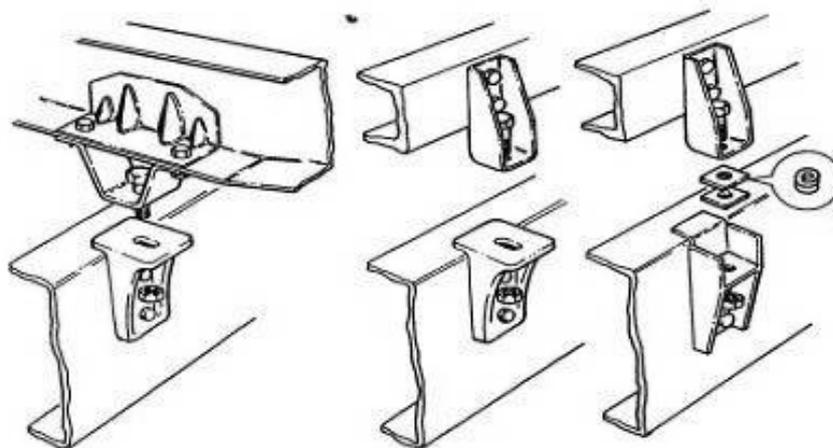
An important factor in the choice of body mounting type to be used is the rigidity of the body structure. Mounting types commonly used with flexible, rigid and semi rigid bodies are described in the following sections.

## 6. PLATFORM BODIES

When a body that is relatively flexible under beaming and torsional loads is fitted to a conventional "ladder" type chassis for operation on normal road surfaces, mountings that firmly attach the body to the chassis can be used. The two preferred mounting systems are "Outrigger Mount" and "Fishplate" systems. The "U - Bolt" mounting system is not preferred but where it is adopted for its simplicity, the preparations listed below must be followed. See also Section 6.3.

## 6.1 Outrigger Type Mounts

It is recommended that all flexible bodies be attached by "outrigger" type mounting brackets. These brackets must be securely attached to the web of the chassis frame rail. Some typical examples of this style of body mounting are shown in Figure 5.



**Figure 5. Typical Body Mounting Brackets**

When outrigger brackets are fitted:

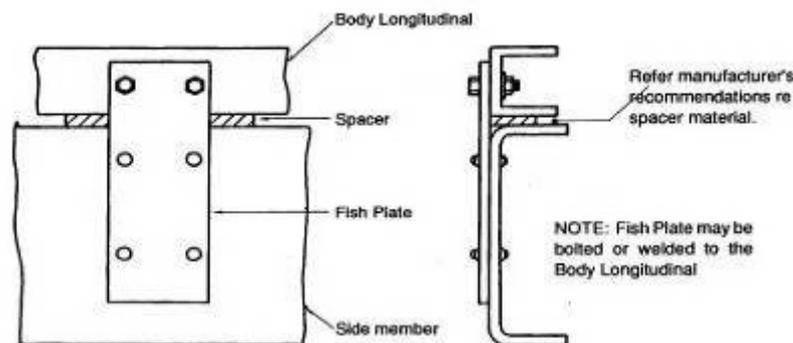
- A clearance space must be provided between the frame and the body longitudinals and cross members.
- To prevent flexing of the web, the bracket should extend at least half way down the web of the frame.
- To facilitate body fitting, one pair of brackets can have plain holes to provide fore and aft body location, the remaining brackets can have slotted holes.

## HEAVY VEHICLE MODIFICATIONS

- In addition, the frame brackets can be designed to engage with the body bracket so that the bolts joining them do not carry shear loads due to braking, etc. Refer the type shown on the right of figure 5.

## 6.2 Fish-Plate Mounts

If the space available along the side of the chassis frame precludes the use of outrigger brackets, the body may be attached in these areas with “fish-plates”. Where required a spacer be placed between the chassis frame and body. Refer Figure 6.



**Figure 6. Details of Typical Fish Plate Attachment**

## 6.3 “U - Bolt” Mounting

A simple method that is frequently used for attaching the body is U-Bolts. This is not the preferred method for body mounting because:

- The load is carried on the top flange, not the web.
- The runner stiffens the frame thus reducing the flexibility along part of the frame length.
- The U-bolts holding the runners are often over tightened causing the frame flange to buckle. Once buckled, the flanges have their strength greatly reduced.
- When wood or metal spacers are positioned between top and bottom flanges to stop the flange being buckled, local stiffening occurs with resultant loss of flexibility.
- Fixing of the body relies on friction and high clamping forces, with no positive location. However tight the U-Bolts are when fitted, they work loose, or the wooden runners shrink and the body is then free to slide on the frame.
- Runner shrinkage and wear over a period of time can occur and the body mounting becomes loose. Often U-bolts are over tightened at this time to prevent recurrence and frame distortion results.

If U-bolt mounting is to be used, then the installation must satisfy the following conditions:

## HEAVY VEHICLE MODIFICATIONS

- The frame (particularly the flanges) must not be distorted. If the vehicle does not have a box type frame, metal spacers must be inserted between the top and bottom flanges of the chassis frame rail to prevent distortion when the U-bolts are tightened. The spacers should be secured in place by the U-bolts as shown in Figure 7. Do not use spacers made from hardwood as these can shrink and drop out.
- When wooden runners are used, they must be protected from the direct pressure of the U-bolts either by a steel capping under the bolt or by a shaped spacer, as shown in Figure 7.
- The body must be located fore and aft on the frame and prevented from moving during violent braking by the use of at least four (4) outrigger brackets or fishplates. A bracket or fishplate must be located at the front and rear of the body on both sides of the vehicle.
- A minimum of three U bolts per side of chassis shall be used with the maximum pitch spacing of 1750mm.
- Minimum U bolt diameters shall be:
  - Bodies to 2 tonne capacity - 12 mm
  - Bodies over 2 tonne capacity – 16 mm.
  - Class 4.6 steel U bolts are recommended.

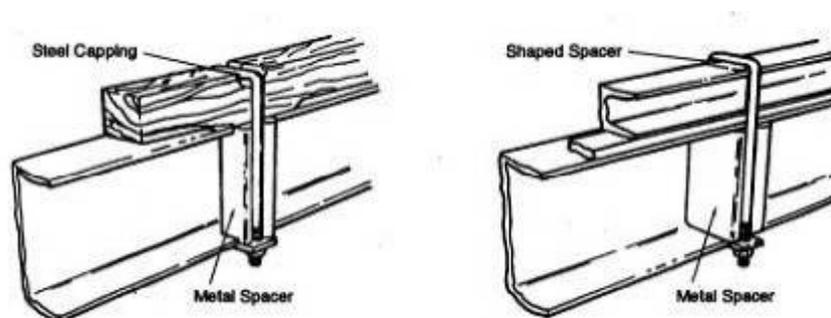


Figure 7. Typical U-Bolt Body Mountings

## 7. TIPPER BODIES

Short, rigid bodies mounted on short wheelbase vehicles, such as tippers, should have a sub-frame mounted securely on the chassis by means of fishplate or outrigger brackets to provide a strong integral structure for mounting hoist and tipper body pivots, guide brackets, etc.

All loads should be distributed over the maximum possible length of the chassis. For a front mounted hoist, the base of the cylinder should be pin-jointed to a cross member that is attached to the side rails with bolts through drilled and reamed holes in the vertical webs of the rails. Figure 8 shows a typical installation where the ram force  $F$  acts at a distance  $L$  from the centre of the bolting configuration and causes torsional moment ( $F \times L$ ), which must be resisted in the main by the attaching bolts. As the number of bolts is increased or as the spacing of these mounting bolts ( $b$  and  $d$ ) is increased, the resistance offered by the joint is increased. Fewer bolts and larger spacings can be used with the result

HEAVY VEHICLE MODIFICATIONS

that the load is spread over a greater area of the frame. A reduction in dimension L will also reduce the torsional moment about the mounting.

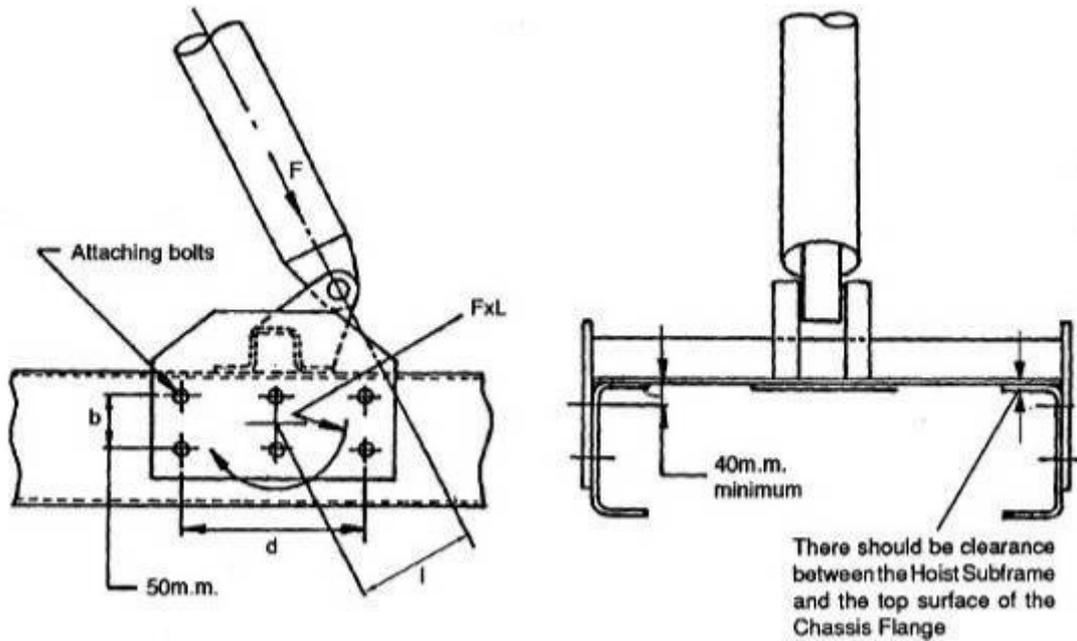


Figure 8

Longitudinal packers should be used on the chassis to distribute tipper body loads, wherever practicable. For tipper bodies without longitudinals, the supports on the chassis for each body cross member should be a minimum of 450 mm in length. Vertical adjustment and/or resilient bearer blocks should be provided to ensure even distribution of load between all supports. A correctly designed support bracket allows the centre line of the body-runners to pass through the centre of the bracket. A typical support bracket is shown in Figure 9.

## HEAVY VEHICLE MODIFICATIONS

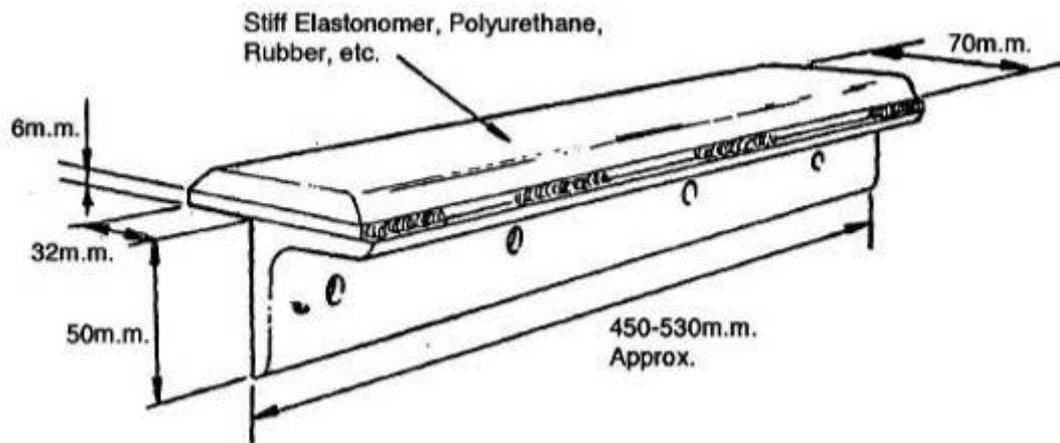


Figure 9

The brackets for the tipping pivot must be mounted in a manner that evenly distributes the loads into the chassis. These pivots should be mounted as near as practicable to the rear suspension to reduce the loads applied to the chassis during the tipping operation. The forward section of the tipping body must be transversely restrained by suitable guides.

## 8. TANKER BODIES

### 8.1 Recommended System

Long and rigid bodies, such as tankers, may require greater provision for relative movement between the body and frame while still retaining the chassis frame flexibility. A 3 or 5 point resilient mounting system is the recommended mounting configuration. A typical example is shown in Figure 10.

The brackets must be of sufficient strength to safely support the load. The front mounting should be a special cross member with a centrally located trunnion to support the tank. This front mounting should be located as far forward as possible. The second pair of mounting brackets should be placed as close as possible to the foremost rear suspension hanger bracket. A smaller pair of mounting brackets should also be positioned adjacent to the rearmost rear suspension hanger bracket.

HEAVY VEHICLE MODIFICATIONS

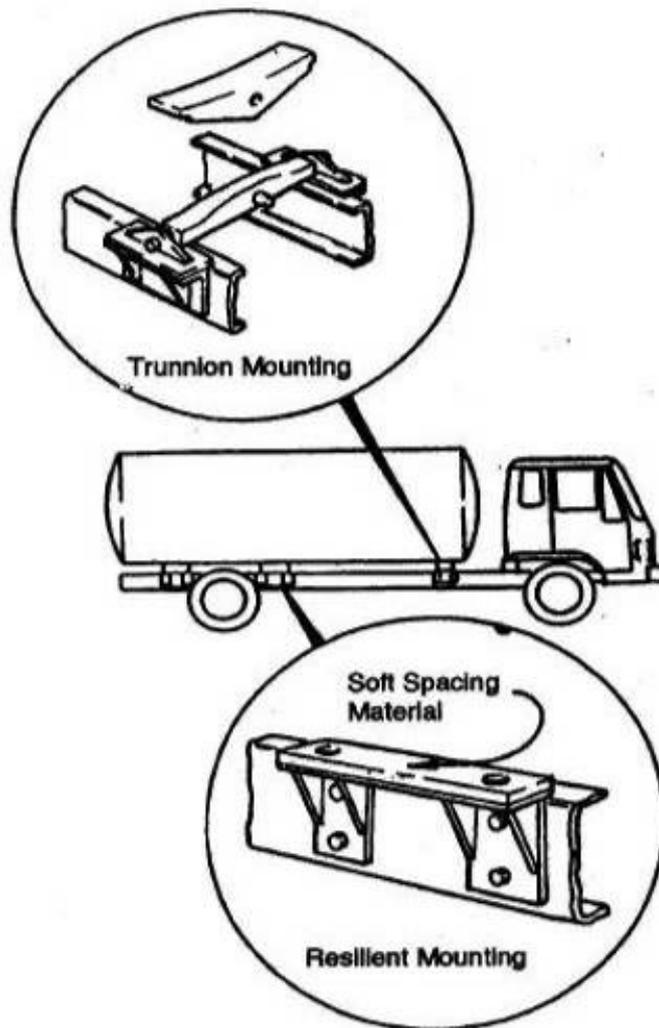


Figure 10

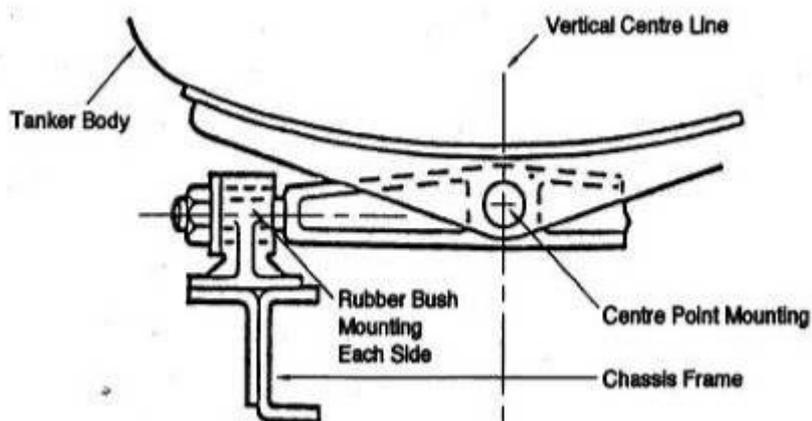


Figure 11. Details of a Typical Front Mounting Bracket

HEAVY VEHICLE MODIFICATIONS

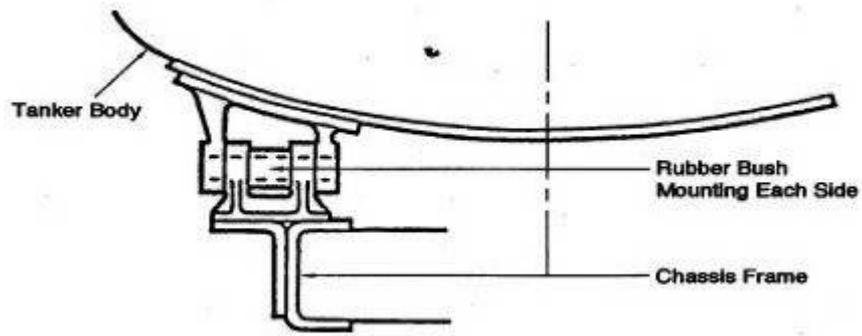


Figure 12. Details of a Typical Rear Mounting Bracket

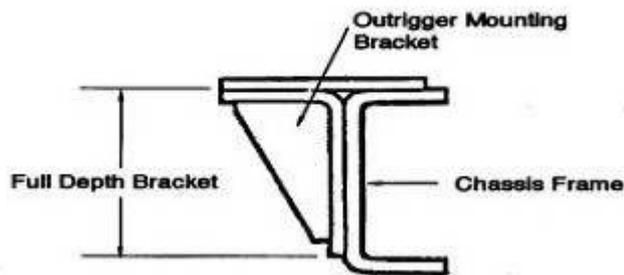


Figure 13. Details of a Typical Chassis Mounting Bracket

8.2 Alternative Mounting for Tankers

Rigid type mountings system may be used provided that the mounts are sufficiently flexible and suitably located so as to allow the chassis to flex. If such mountings are arranged in a 3 point layout (refer to Figure 14) or a 4 point diamond plan (refer to Figure 15), the chassis is free to deflect torsionally with no undue stress concentrations in either the chassis or the body. Due to the large concentrated loads that result from these mounting methods, substantial load bearing cross members must be used.

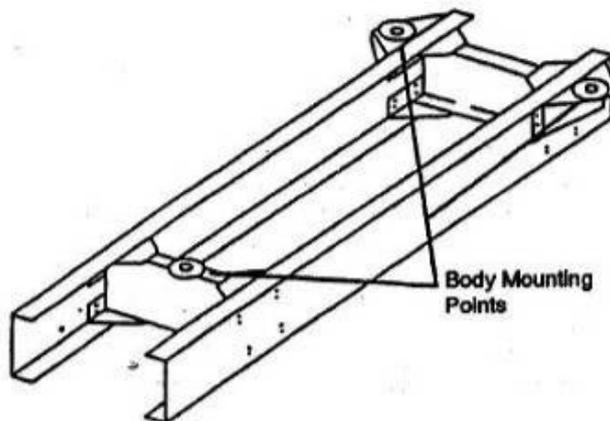


Figure 14. Typical 3 Point Mounting

## HEAVY VEHICLE MODIFICATIONS

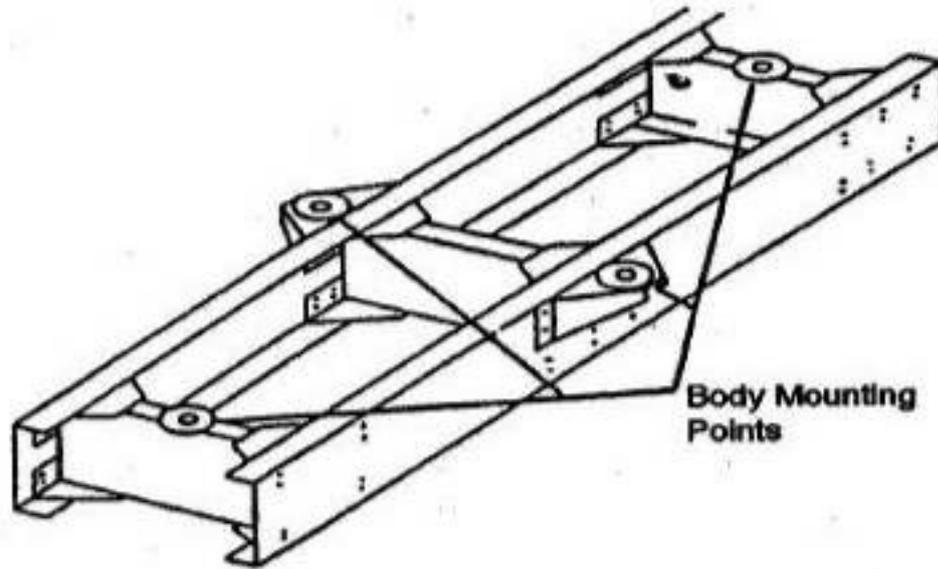


Figure 15. Typical 4 Point Mounting

### 8.3 Tankers for Dangerous Liquids

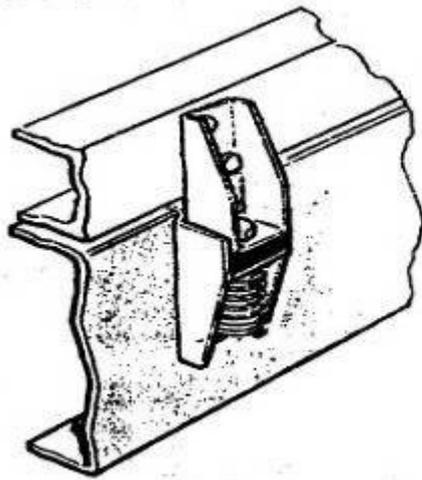
If a tank is to carry liquid dangerous goods, the road tank vehicle must satisfy special requirements as outlined in Australian Standard AS 2809 - Parts 1 to 5. If the tanker may be used to carry dangerous goods, modifiers are urged to consult officers of the State or Territory authority controlling transport of such goods.

## 9. SEMI-RIGID BODIES

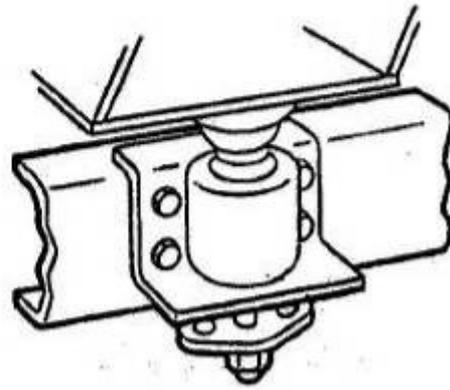
When it is considered that a body might be too rigid to withstand the beaming and twisting of the frame expected in service, some vertical compliance must be provided in the body mountings. This can be obtained by fitting resilient mountings or mountings with slotted holes and friction inserts.

- Resilient mountings may comprise a steel spring or a rubber bush and are usually used in conjunction with outrigger brackets (refer Figure 16). In some cases, brackets or “lugs” engaging frame side rails and/or cross members must be provided for body location and to resist horizontal forces (refer Figure 17).

HEAVY VEHICLE MODIFICATIONS



Spring Type Mounting



Proprietary Type Mounting

Figure 16 – Typical Resilient Mountings

- Mountings which are especially suited to occasional large beaming or torsional frame deflections, carry the body load on the top of the frame or bracket and allow the retaining bolts to move vertically upwards in a slotted hole against the resistance of a friction pad clamped between the frame and the bracket (refer Figure 18).

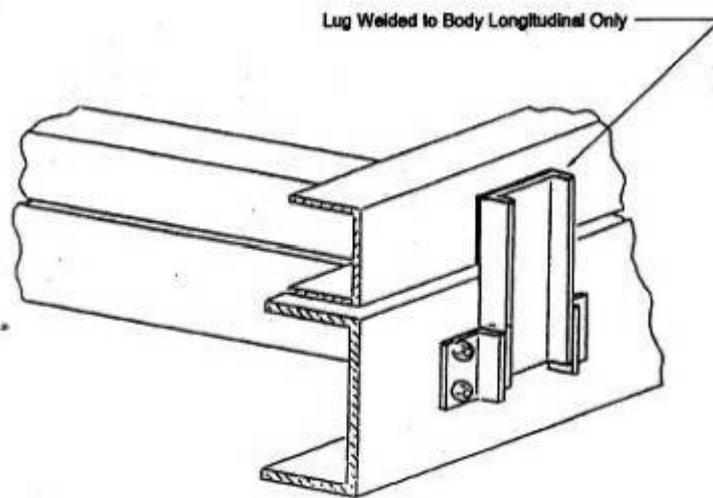
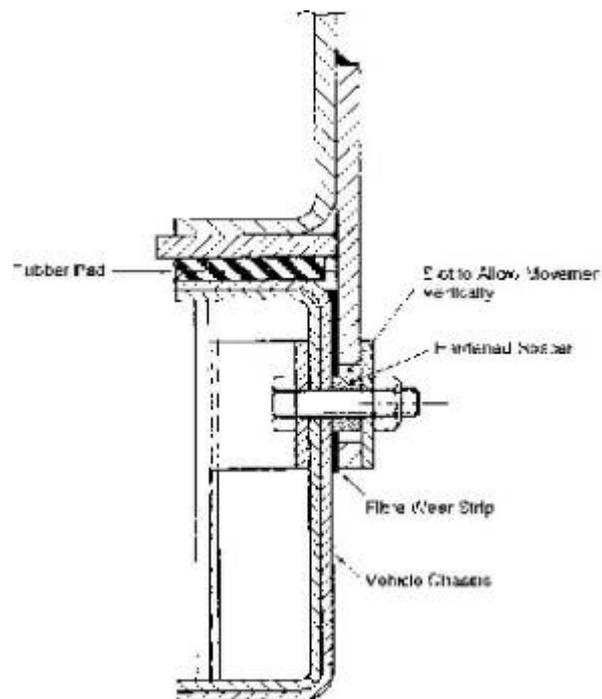


Figure 17. Additional Horizontal Restraint used with some body mountings

## HEAVY VEHICLE MODIFICATIONS



**Figure 18. Body Mounting with Vertical Compliance and Friction Damping**

## 10. RECORDING

The Appendices of this document are:

- Appendix 1 - Recommended Dimensional Limits - NA2, NB and NC Vehicles
- Appendix J1 which:
  - Summarises the scope of modification work which may be certified under this Modification Code; and
  - Includes a list of Sections of the National Code of Practice covering other areas of the vehicle which may have been affected by the modification and which should be analysed to determine whether they, too, require re-certification.
  - Includes a checklist appropriate to the Modification Code J1 that should be completed.

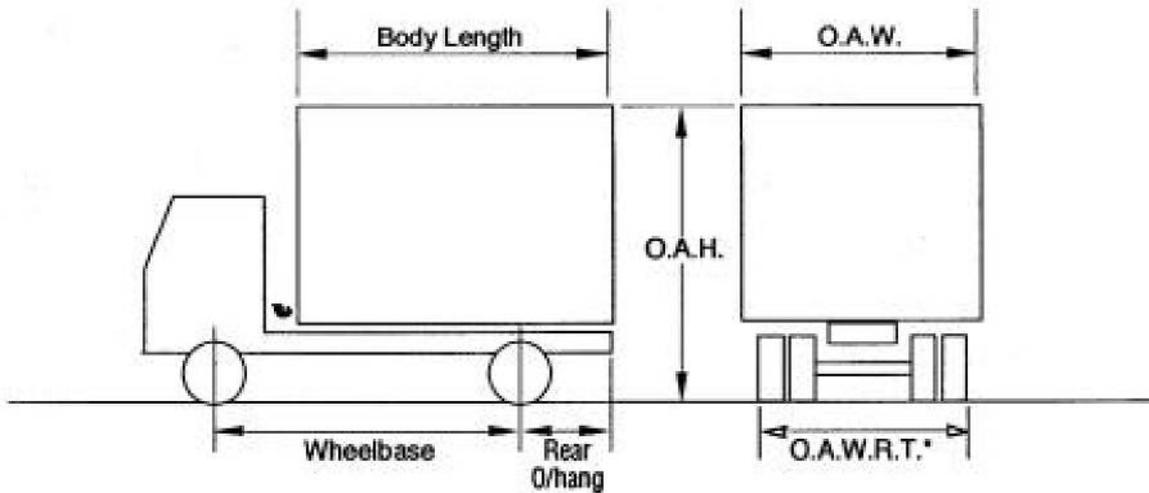
It is suggested that analysis work records, sketches and other vehicle data, together with copies of the Calculation Sheet and completed Checklists, be retained by the Certifying Officer for at least the period specified in Part A of this National Code of Practice.

## HEAVY VEHICLE MODIFICATIONS

## Appendix 1

## Recommended Dimensional Limits NA2, NB &amp; NC Vehicles

These limits are to maintain the safety and integrity of the vehicle with body fitment.



## Maximum Recommended Dimensional Limits

1. **Body Overall Width** Both Vans and Trays = O.A.W.R.T. + 300mm but not > 2.5 metres
2. **Overall Height** – Both Vans and Trays = 1.85 x O.A.W.R.T. but not > 4.3 metres
3. **Lengths** – Vans Only = Manufacturers Max Wheelbase Option + 20%

Notes 1 OAWRT = Over all width across rear tyres

2 Wheelbase, rear overhang and therefore the ideal body length should be determined by load distribution calculations based on water level load conditions<sup>1</sup>. Where general freight bodies are configured for other than water level loading, it is recommended that the body be clearly marked with a securely mounted marker at the Longitudinal Point for the Load Centre of Gravity at maximum legal GVM and at the rearmost point to which the vehicle can be loaded to GVM. Further markers may optionally be fitted to indicate the permissible load at points toward the rear or front of the body. **The body must also be marked with maximum payload capacity.** All markers should be highly visible and designed to last the life of the body.

- 3 Refer paragraph 5.1 of this Modification Code re body overhang beyond chassis rail
- 4 Legal maximum width, height and length must not be exceeded
- 5 Where body width exceeds the recommended dimension of OAWRT + 300mm the vehicle manufacturers' advice on recommended tyre pressures should be sought and this information recorded on the modification records.
- 6 The manufacturer's maximum body width specification establishes the maximum width allowable even if less than the calculated possible width.

<sup>1</sup> **Water level loading is calculated assuming a homogenous load evenly distributed over the load space until the vehicle reaches GVM. Axle loads can then be calculated in this condition.**

## HEAVY VEHICLE MODIFICATIONS

## Appendix J1

## Modification Code J1

## BODY MOUNTING

Modifications that are covered under the Modification Code are:

1. Mounting of bodies of all types other than omnibus bodies to commercial vehicles.
2. Modification or replacement of body mountings.
3. Fitting of body equipment - hoists etc.

Modifications that are **not** covered under this Modification Code are:

1. Mounting of bodies in a manner that is likely to lead to failure of the vehicle chassis.
2. Mounting of bodies in a manner that provides insufficient restraint of the body and any possible load under any operational conditions.
3. Fitting of omnibus bodies.

NOTE: The modified vehicle/modifications must continue to comply with all applicable ADR's, Australian Standards or Regulations/Acts.

Outlined below are areas of the vehicle that may have been affected by the modifications and that may require recertification, testing and/or data to show compliance for the modified vehicle.

**DETAIL****REQUIREMENTS**

Lights

Australian Design Rule 13/..

Mudguards

Australian Design Rule 42/..

Vehicle Dimensions

Australian Design Rule 43/..

Exhaust Repositioning

ADR 42/..., Modification Code A4

**HEAVY VEHICLE MODIFICATIONS**

**Checklist J1**

**BODY MOUNTING**

## HEAVY VEHICLE MODIFICATIONS

**Appendix J2**  
**Modification Code J2**  
**Truck Bus Body Fitment**

**1. SCOPE**

- 1.1 This Appendix sets out the requirements for fitment of a bus-body i.e. a passenger carrying pod onto a truck cab-chassis. Certification of bus-body fitted to a rolling chassis based on Bus Chassis Sub-Assembly Registration Number (BC-SARN) should be carried out using Second Stage Manufacture (SSM) Approval process and is NOT covered under this code.

**2. Applicable Vehicle Standards...**

- 2.1 Refer to applicable ADR table for MD or ME category vehicles.
- 2.2 In addition, regulations of the State or Territory Registering Authority (STRA) may apply. If the Truck-Bus is used for transporting public passengers, specific requirements under Passenger Transport regulations of STRA may apply.

**3. General Arrangements...**

- 3.1 If the truck cab-chassis is new and unregistered, the Truck-Bus must be certified using Second Stage of Manufacture (SSM) Approval process administered by the Commonwealth Department of Infrastructure and Regional Development (DIRD).
- 3.2 This code must NOT be used to circumvent the intent of Second Stage of Manufacture (SSM) Approval process. For example certification of a bus-body fitting to a near new truck cab-chassis that is registered but is less than 12 months old. In such cases an approval must be obtained from the STRA before commencing the modification project. STRA may require supporting evidence that is normally required for obtaining SSM Approval for such Truck-Bus.
- 3.3 Date of manufacture of Truck-Bus for registration purpose
- Note that many STRAs may take the date of manufacture shown on the compliance/identification plate of the truck cab-chassis as the date of manufacture of the Truck-Bus. The final decision in this matter rests with the STRA.
- 3.4 Date of manufacture of Truck-Bus for determination of applicable safety standards

**HEAVY VEHICLE MODIFICATIONS**

Truck-Bus is a composite vehicle consisting of truck cab-chassis and bus-body for carrying passengers. While it is necessary for the composite vehicle to meet safety standards applicable to a bus, determination of the applicable standards is not straightforward, as the build dates of the truck cab-chassis and bus-body could be and often are different.

This code requires that when truck cab-chassis or bus-body of a Truck-Bus is being replaced, the replacement item must be newer than the part being replaced.

When determining the safety standards applicable to a Truck-Bus, this code requires that the date of manufacture of the Truck-Bus be taken same as the date of manufacture of truck cab-chassis or the bus-body, whichever is newer.

**3.5 Other Requirements**

- 3.5.1 If bus-body is reused, any SSM approval plate or manufacturer's plate on the bus-body must be retained for the purpose of records and traceability; attachment of the bus-body to the replacement truck-chassis must be recertified.
- 3.5.2 While it is acceptable to have driver's cabin of a Truck-Bus detached from the passenger compartment (bus-body), it is necessary to have effective means of communication at all times between the driver and the passenger(s), by audio and/or visual means.
- 3.5.3 ADR 58/00 Requirements for Omnibuses Designed for Hire and Reward apply to all Hire & Reward buses. The doors and the (internal/external) approaches to the doors must be visible to the driver, i.e. using mirrors or cameras, from normal driving position. The driver must be able to open/unlock and close/lock each passenger door from normal driving position.

**4. Applicable Standards of Evidence...**

- 4.1 Compliance to all affected ADRs must be addressed by the certifying officer who must retain evidence of compliance. **Simple statements of assurance will not be acceptable.**
- 4.2 Typically affected ADRs on truck-chassis may include

ADR 35/... *Commercial Vehicle Brake Systems*

ADR 65/... *Maximum Road Speed Limiting for Heavy Goods Vehicles and Omnibuses*

**HEAVY VEHICLE MODIFICATIONS**

ADR 80/... *Emission Control for Heavy Vehicles and*  
ADR 83/... *External Noise.*

4.3 Typically affected ADRs on bus-body may include

ADR 4/... Seat Belts  
ADR 5/... Anchorages for Seat Belts and Child Restraints  
ADR 34/... Child Restraint Anchorages & Child Restraint Anchor Fittings  
ADR 42/... General Safety Requirements  
ADR 44/... Specific Purpose Vehicle Requirements  
ADR 58/... Requirements for Omnibuses Designed for Hire and Reward  
ADR 59/... Omnibus Rollover Strength  
ADR 66/... Seat Strength, Seat Anchorage Strength and Padding in  
Omnibuses and  
ADR 68/... Occupant Protection in Buses

**5. Inspection Procedure...**

- 5.2 For a Truck-Bus that requires STRA approval (e.g. Truck-Bus using near new truck cab-chassis), the STRA may require a detailed professional engineering report.
- 5.3 For Truck-Buses certified under this code, the certifying officer must inspect the vehicle, complete the checklist, fit a modification plate to the vehicle and issue a certificate of modification.

**HEAVY VEHICLE MODIFICATIONS**

**Checklist J2  
Truck Bus Body Fitment**