Section D

Rear Axles

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Section D — Overview

1. Description

This section of Vehicle Standards Bulletin 6 (VSB6) relates to the fitting of replacement rear axles and differential assemblies to heavy vehicles and consists of the following modification codes:

D1 Rear axle installation
- fitting of alternative rear axle assembly
- fitting of additional rear axle on load sharing rear suspension
- fitting of suspension brackets to axle housing, providing that welding and installation is in accordance with axle manufacturer's recommendation.

D2 Differential substitution
- fitting of alternative differentials in existing axle housings
- fitting of alternative differential ratio
- fitting of traction control device.

D3 Fitting of non-standard rear wheel components
- fitting of non-standard rear wheels, i.e. rims or tyres

2. Related Australian Design Rules

The Australian Design Rules (ADRs) relevant to this section include:

<table>
<thead>
<tr>
<th>ADR no.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>18, 18/..</td>
<td>Instrumentation</td>
</tr>
<tr>
<td>28, 28A, 28/.., 83/..</td>
<td>External Noise of Motor Vehicles</td>
</tr>
<tr>
<td>35, 35A, 35/..</td>
<td>Commercial Vehicle Brake Systems</td>
</tr>
<tr>
<td>65/..</td>
<td>Maximum Road Speed Limiting for Heavy Goods Vehicles and Heavy Omnibuses</td>
</tr>
</tbody>
</table>

3. Record keeping

The person responsible for certifying the modification should:
- collate complete records, including drawings, calculations, test results and copies of the appropriate issue of Australian Standards and ADRs
- retain the records for a minimum of seven years after commissioning of the modified vehicle
- make the records available upon request for inspection by officers of the relevant federal, state or territory authority or heavy vehicle regulator.

Reports and checklists

The person responsible for certifying the modification must complete and record the following reports and checklists as applicable:

D1 Checklist Rear axle installation
D2 Checklist Differential substitution
D3 Checklist Fitting of non-standard rear wheel components

4. Design requirements

Advanced braking systems

Advanced braking systems are an important safety feature fitted to many new vehicles.

Advanced braking systems are programmed by the vehicle manufacturer and are specific to the vehicle to which they are fitted. Changes made to the vehicle, such as engine, tyre size, steering control, suspension characteristics, vehicle mass and its distribution, may impact the performance of the advanced braking system.

Exercise extra caution when modifying vehicles fitted with advanced braking systems. Electric braking systems may be known as:
- electronic stability control (ESC)
- electronic stability program (ESP)
- vehicle stability control (VSC)
- dynamic stability control (DSC)
- vehicle stability assist (VSA)
- roll stability control (RSC)
- roll control system (RCS)
- electronic braking system (EBS)
- trailer electronic braking system (TEBS).

Advanced braking systems and their components may be easily damaged by common modification, maintenance and servicing techniques, such as the use of rattle guns within one metre of the sensors. When undertaking any work on a vehicle fitted with an advanced braking system, ensure all modifiers are familiar with these systems and the precautions that must be taken.

Ensure that before undertaking any modification on a vehicle that is fitted with an advanced braking system, the modifier and approved vehicle examiner (AVE) consult with the vehicle manufacturer to determine the impact on the system.
1. **Scope**

Modifications covered under this code:

**Covered**
- fitting of alternative rear axle assembly
- fitting of additional rear axle on load sharing rear suspension
- fitting of suspension brackets to axle housing, providing that welding and installation is in accordance with the axle manufacturer's recommendation.

**Not covered**
- fitting of axle assemblies not compatible with the original vehicle's components, including fitting of axles that are not compatible with the vehicle's electronic stability control (ESC) system
- modification of axle housings other than what is allowed by the axle manufacturer to fit suspension brackets.

2. **Related standards**

Modified vehicles must comply with all ADRs, Australian Standards, acts and regulations. Below are some but not all of the areas that may be affected by the modifications in this code and require certification, testing or evidence to demonstrate compliance.

The certifier must ensure that the modified vehicle continues to comply with all related ADRs.

<table>
<thead>
<tr>
<th>This...</th>
<th>Must comply with...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brakes</td>
<td>VSB6 Modification Code G4</td>
</tr>
<tr>
<td>Suspension</td>
<td>VSB6 Modification Code F1</td>
</tr>
<tr>
<td>Re-rating of GVM/GCM</td>
<td>VSB6 Modification Code S1</td>
</tr>
<tr>
<td>Change of differential ratio</td>
<td>VSB6 Modification Code D2</td>
</tr>
<tr>
<td>Tail shaft alteration</td>
<td>VSB6 Modification Code C1</td>
</tr>
</tbody>
</table>

3. **Certification procedure**

The certification procedure for this modification code is as follows:

1. **Modifier**
   - Determine if the modification is within manufacturer specifications.
     - If *yes*, the modification will need to be done in accordance with manufacturer specifications.
     - If *no*, the modification will need to be done in accordance with this modification code.

2. **Modifier**
   - Consult with an accredited D1 AVE for guidance on how to perform the modification.

3. **Modifier**
   - Perform modification in accordance with AVE advice and this code.

4. **Modifier**
   - Organise approval inspection by an accredited D1 AVE.

5. **D1 AVE**
   - Perform inspection, complete D1 checklist and determine if compliance has been achieved.
     - If *yes*, proceed to step 6.
     - If *no*, do not proceed, advise modifier rework is required to ensure compliance. Return to step 2.

6. **D1 AVE**
   - Issue modification certificate, affix modification plate, and submit paperwork as required by the relevant AVE registration scheme.

AVEs must be satisfied that vehicle modification requirements are being met. It is advised that before modifications are carried out they are discussed with the certifying AVE.

4. **Design requirements**

**Replacement axles**

**Required:**
- Ensure the replacement axles have mass ratings, torque ratings and gear ratio that are suitable for the vehicle.

**Recommended:**
- If a change in axle ratio is made, ensure that a suitable ratio is selected for road speed and gradeability.

**Suspension**

**Required:**
- If changes to the rear suspension or tail shaft are required, follow the manufacturer's recommendations firstly and then if need be either VSB6 Section C — Tail shafts or VSB6 Section F — Suspension.

5. **Installation requirements**

**Replacement axles**

**Required:**
- Perform all welding on the axle housings (for spring seats, axle seats, torque rod brackets, etc.) in accordance with the axle manufacturer's recommended procedure.
- Install the axles at the axle manufacturer's recommended installation angle.
- If a change in axle ratio is made, ensure that the speedometer and road speed limiter accuracy is maintained. If adjustment of the road speed limiter is required, ensure it is certified in accordance with VSB6 Modification Code A5.

**Brakes**

**Required:**
- Either transfer brakes on any replacement axle from the original axle or fit identical brakes to those on the original axle.
- If different brakes are used or an additional axle installed, perform the modifications in accordance with VSB6 Section G — Brakes.
### D1 Checklist — Rear axle installation

This checklist is for use by the approved vehicle examiner (AVE) when certifying installation of rear axles.

#### Vehicle and modifier details

- **Vehicle make:**
- **Vehicle model:**
- **Month and year of manufacture:**
- **VIN (if applicable):**
- **Vehicle chassis no. (if applicable):**
- **Vehicle modifier (company name):**

#### Axle details

- **Additional/Replacement axle make and model(s):**
- **Axle rating(s) (kg):**
- **Serial no(s):**

#### Advanced braking systems

1. **Is the advanced braking system (where fitted) unaffected or re-certified after the vehicle modification?**

#### Modification details

1. **Has the modification been performed in accordance with the manufacturer's guidelines?**

#### Installation details

1. **Do the replacement or additional rear axles have mass ratings and gear ratios that are suitable for the mass ratings of the vehicle?**
2. **Is all welding on the axle housings (for spring seats, axle seats, torque rod brackets, etc.) performed in accordance with the axle manufacturer's recommended procedure?**
3. **Are the replacement or additional rear axles installed at the axle manufacturer's recommended installation angle?**
4. **Are the brakes on any replacement rear axle either transferred from the original axle, identical brakes to those fitted on the original axle, or certified in accordance with VS66 Section G — Brakes?**
5. **Where there are any additional axles, has the modification to the brake system been performed in accordance with VS66 Section G — Brakes?**
6. **If changes to the rear suspension or tail shafts are required, have the appropriate sections of VS66 been followed, i.e. Sections C — Tail shafts and I — Suspension?**
7. **If a change in axle ratio has been performed, has the modifier ensured that a suitable ratio is selected for road speed and gradability, and that speedometer and road speed limiter accuracy is maintained? (Refer VS66 Modification Code A5)**

#### Compliance

1. **Modification:**
2. **Does this modification meet all the requirements of the manufacturer's guidelines / Modification Code D1?**
3. **Is the quality of the work to an accepted industry standard?**
4. **Does the modified vehicle continue to comply with all affected Australian Design Rules?**

#### Authorisation

- **Other than modification criteria, if the answer to any relevant question is NO the modification is not acceptable.**
- **Comments:**
- **Examined by:**
- **Company (if applicable):**
- **AVE no.:**
- **Signed:**
- **Modification certificate no.:**
- **Modification plate no.:**
- **Date:**

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*Vehicle Standards Bulletin 6 — Version 3.1*

*Section D — Rear axles*
Modification Code D2 — Differential substitution

1. Scope

Modifications covered under this code:

**Covered**
- fitting of an alternative differential in existing axle housing
- fitting of an alternative axle ratio
- fitting of traction control device.

**Not covered**
- Modification of the differential, axles or axle housings to allow installation of non-original equipment manufacturer’s differential components.

2. Related standards

Modified vehicles must comply with all ADRs, Australian Standards, acts and regulations. Below are some but not all of the areas that may be affected by the modifications in this code and require certification, testing or evidence to demonstrate compliance.

The certifier must ensure that the modified vehicle continues to comply with all related ADRs.

<table>
<thead>
<tr>
<th>This...</th>
<th>Must comply with...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in differential ratio</td>
<td>ADR 35, 35A, 35/... (this only applies if the vehicle’s maximum speed is increased from below 70 km/h to above 80 km/h)</td>
</tr>
<tr>
<td></td>
<td>ADR 28, 28A, 28/..., 83/...</td>
</tr>
<tr>
<td></td>
<td>VSB6 Section 5 — Vehicle rating (gradeability and startability requirements)</td>
</tr>
<tr>
<td>Speedometer and speed limiter accuracy</td>
<td>Change speedometer ratio to obtain speedometer accuracy within ADR limits</td>
</tr>
<tr>
<td></td>
<td>ADR 18/...</td>
</tr>
</tbody>
</table>

3. Certification procedure

The certification procedure for this modification code is as follows:

1. **Modifier**
   - Determine if the modification is within manufacturer specifications.
     - If **yes**, the modification will need to be done in accordance with manufacturer specifications.
     - If **no**, the modification will need to be done in accordance with this modification code.

2. **Modifier**
   - Consult with an accredited D2 AVE for guidance on how to perform the modification.

3. **Modifier**
   - Perform modification in accordance with AVE advice and this code.

4. **Modifier**
   - Organise approval inspection by an accredited D2 AVE.

5. **D2 AVE**
   - Perform inspection, complete D2 checklist and determine if compliance has been achieved.
     - If **yes**, proceed to step 6.
     - If **no**, do not proceed, advise modifier rework is required to ensure compliance. Return to step 2.

6. **D2 AVE**
   - Issue modification certificate, affix modification plate, and submit paperwork as required by the relevant AVE registration scheme.

AVEs must be satisfied that vehicle modification requirements are being met. It is advised that before modifications are carried out they are discussed with the certifying AVE.

4. Design requirements

**Replacement differential**

**Required:**
- Ensure the replacement differential has mass ratings, torque ratings and axle ratios that are suitable for the vehicle.

**Supporting modifications**

**Required:**
- If changes are required to support the modification, for example, changes to the rear suspension or tail shaft, follow the applicable VSB6 modification codes.

5. Installation requirements

**Replacement differential**

**Required:**
- If a change in axle ratio is made, ensure that the speedometer and road speed limiter accuracy is maintained.

**Replacement axles**

**Recommended:**
- If a change in axle ratio is made, ensure that a suitable ratio is selected for road speed and gradeability.
D2 Checklist — Differential substitution (example)

Vehicle and modifier details
- Vehicle make:
- Vehicle model:
- Month and year of manufacture:
- VIN (If applicable):
- Vehicle chassis no. (If applicable):
- Vehicle modifier (company name):

Advanced braking systems
- Braking systems: Check Yes, No, N/A as applicable: Yes, No, N/A
  1. Is the advanced braking system (where fitted) unaffected or re-certified after the vehicle modification?

Modification details
- Modification criteria: Check Yes, No as applicable: Yes, No
  1. Has the modification been performed in accordance with the manufacturer’s guidelines?

Substitution details
- Differential: Check Yes, No, N/A as applicable: Yes, No, N/A
  1. Do the replacement differentials have torque ratings and axle ratio suitable for the ratings of the vehicle?
  2. If applicable, has all welding on the axle housing(s) been performed in accordance with the axle manufacturer’s recommended procedure?
  3. If changes to the tail shaft are required, have the manufacturer’s recommendations or VSBS Section C—Tail shafts been followed?
  4. If the axle ratio is changed, is it ensured that maximum speed, gradeability and the accuracy of the speedometer and road speed limiter is maintained?

Compliance
- Modification: Check Yes, No, N/A as applicable: Yes, No
  1. Does this modification meet all the requirements of the manufacturer’s guidelines / Modification Code D2?
  2. Is the quality of the work to an accepted industry standard?
  3. Does the modified vehicle continue to comply with all affected Australian Design Rules?

Authorisation
- Other than modification criteria, if the answer to any relevant question is NO the modification is not acceptable.
- Comments:
- Examined by:
- Company (if applicable):
- AVE no.:
- Signed:
- Modification certificate no.:
- Modification plate no.:
- Date:

Vehicle chassis no./VIN: Date: Signed:
Modification Code D3 — Fitting of non-standard rear wheel components

1. Scope

Modifications covered under this code:

<table>
<thead>
<tr>
<th>Covered</th>
<th>Not covered</th>
</tr>
</thead>
<tbody>
<tr>
<td>fitting of non-standard rear wheels to motor vehicles and trailers, i.e. rims or tyres.</td>
<td>fitting of rear wheels that are not compatible with vehicle components i.e. tyres do not match rim profile, wheel’s P.C.D does not match stud the pattern correctly.</td>
</tr>
<tr>
<td>modifications to wheel rim assemblies, other than those permitted by the wheel rim manufacturer</td>
<td>variations to wheel rim assemblies, other than those permitted by the wheel rim manufacturer</td>
</tr>
<tr>
<td>fitting of rear wheels, i.e. rims or tyres, that exceed the regulatory limits on vehicle dimensions</td>
<td>variations to wheel rim assemblies, other than those permitted by the wheel rim manufacturer</td>
</tr>
<tr>
<td>conversion of dual to single wheels where directly prohibited by the vehicle manufacturer</td>
<td>variations to wheel rim assemblies, other than those permitted by the wheel rim manufacturer</td>
</tr>
<tr>
<td>fitting of non-standard wheels to the front axles (see VSB6 Modification Code E3).</td>
<td>variations to wheel rim assemblies, other than those permitted by the wheel rim manufacturer</td>
</tr>
</tbody>
</table>

2. Related standards

Modified vehicles must comply with all ADRs, Australian Standards, acts and regulations. Below are some, but not all of the areas that may be affected by the modifications in this code and require certification testing or evidence to demonstrate compliance. The certifier must ensure that the modified vehicle continues to comply with all related ADRs.

<table>
<thead>
<tr>
<th>This...</th>
<th>Must comply with...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replace rear axle</td>
<td>VSB6 Section D — Rear Axles</td>
</tr>
<tr>
<td>Width of vehicle (max. of 2.5 m)</td>
<td>ADR 43/..</td>
</tr>
<tr>
<td>Brakes</td>
<td>VSB6 Section G — Brakes</td>
</tr>
<tr>
<td>Re-rating of GVM/GCM/ATM</td>
<td>VSB6 Section S — Vehicle Rating</td>
</tr>
<tr>
<td>Turning circle (max diameter of 25 m)</td>
<td>ADR 43/..</td>
</tr>
<tr>
<td>Suspension substitution</td>
<td>VSB6 Modification Code F1</td>
</tr>
</tbody>
</table>

3. Certification procedure

The certification procedure for this modification code is as follows:

1. Modifier
   Determine if the modification is within manufacturer specifications.
   - If yes, the modification will need to be done in accordance with manufacturer specifications and no modification approval is required.
   - If no, the modification will need to be done in accordance with this modification code.

2. Modifier
   Consult with an accredited D3 AVE for guidance on how to perform the modification.

3. Modifier
   Perform modification in accordance with AVE advice and this code.

4. Modifier
   Organise approval inspection by an accredited D3 AVE.

5. D3 AVE
   Perform calculations, testing, inspection, complete D3 checklist and determine if compliance has been achieved.
   - If yes, proceed to step 6.
   - If no, do not proceed, advise modifier rework is required to ensure compliance. Return to step 2.

6. D3 AVE
   Issue modification certificate, affix modification plate, and submit paperwork as required by the relevant AVE registration scheme.

AVEs must be satisfied that the vehicle modification requirements are being met. It is advised that before modifications are carried out they are discussed with the certifying AVE.

4. Fitting non-standards rear wheel requirements

Non-standard wheels on rear axles are defined as those which:

- Alters the wheel’s overall diameter from manufacturer’s specification; or
- Has a section width which is more than 40mm narrower or wider than a rear tyre specified for the vehicle by the vehicle manufacturer; or
- Alters the track width by more than 25 mm from the original vehicle manufacturer’s specification.

Non-standard rear wheels

Apply the following when a vehicle is modified by fitting non-standard rear wheels, tyres or rims:

**Required:**

- Ensure the rims and tyres do not project beyond the extreme width of the mudguards or cause the vehicle width to exceed the vehicle’s maximum permitted width (in the straight ahead position for steerable axles).
- Tyres and rims must have sufficient load rating for the axle to which they are fitted.
- When fitting non-standard rear wheels take into account any reduction in the manufacturer’s gross axle load rating due to changes in load offset.
- When fitting non-standard wheels and rims to steerable rear axles ensure the vehicle’s turning circle continues to comply with the ADRs.
- When fitting non-standard rear wheels to steerable axles ensure steering geometry is not adversely affected.
- Any change in rim offset must consider the offset bearing load impact which must be within the axle/hub manufacturer’s acceptable limits.
- Ensure all tyre and rim combinations fitted to the same axle have an identical overall diameter.
- Consider effects that may result from fitting non-standard rear wheels, including axle/group performance, startability, gradeability, wheels fouling on components (through full steering range on steerable axles), etc.
• Tyres must be matched to rims approved by the Tyre and Rim Association of Australia or an acceptable alternative as listed in ADR 42/.. Tyre and Rim Selection.

• If rims and/or tyre types to be used are not addressed by the Tyre and Rim Association of Australia or standards permitted by ADR 42/.., the wheel combination must only be fitted if approval is obtained from the relevant heavy vehicle regulator.

In some circumstances rims will be specifically manufactured for a modification. The certifying AVE should ensure that these custom rims are tested to all relevant standards such as SAE J267, J328, etc.

• Ensure non-standard wheels do not affect any advanced braking systems that may be fitted to the vehicle.

• Assess the impact of the modification on maximum axle capacities and the vehicle’s GVM or ATM. Where necessary, a revised GVM or ATM rating as per the applicable VSB6 modification codes may be required.

• When fitting non-standard wheels with a different overall diameter than the original wheels, the vehicle’s speedometer (ADR 18/..) and road speed limiter (ADR 65/..) will need recalibration to ensure compliance.

When converting from a dual wheels to single wheel arrangement, offset rims are often used which can shift a large portion of the load to the outer wheel bearing and outer section of the wheel hub and axle end. The fitment of a single wheel arrangement that alters the load offset through the outer ends of an axle assembly can lead to premature wheel bearing, hub and axle failure.

The fitting of wider tyres may increase the likelihood of aquaplaning under lightly laden conditions.

The minimum clearance between tyres (dual tyre spacing) should be in accordance with tyre manufacturer’s statement of recommendation or “The Tyre & Rim Association of Australia” dual tyre spacing.

Wheel rim widths, flange heights and flange angles affect the service life, performance and safety of a tyre and rim. Fitting tyres to incorrect rims can lead to premature wheel and/or tyre failure.
### D3 Checklist — Fitting of non-standard rear wheel components (example)

#### Vehicle and modifier details
- **Vehicle make:**
- **Vehicle model:**
- **Vehicle chassis no. (if applicable):**
- **Vehicle modifier (company name):**
- **Month and year of manufacture:**

#### Axle and wheel details
- **Rear axle make and model:**
- **Current rear axle rating (kg):**
- **Updated rear axle rating (kg) (if any) with new wheel, i.e. tyre or rim:**
- **Wheel rim manufacturer:**
- **Rim size and offset:**
- **Tyre size:**

#### Advanced rim manufacturer details
- **Rear axle make and model:**
- **Current rear axle rating (kg):**
- **Updated rear axle rating (kg) (if any) with new wheel, i.e. tyre or rim:**
- **Wheel rim manufacturer:**
- **Rim size and offset:**
- **Tyre size:**

#### Installation details
- **Wheels and tyres**
  - **Check Yes, No, N/A as applicable:**
  - **Yes**
  - **No**
  - **N/A**

#### Braking systems
- **Check Yes, No, N/A as applicable:**
- **Yes**
- **No**
- **N/A**

#### Axles
- **Check Yes, No, N/A as applicable:**
- **Yes**
- **No**
- **N/A**

#### Brakes
- **Check Yes, No, N/A as applicable:**
- **Yes**
- **No**
- **N/A**

#### Summary
- **Check Yes, No, N/A as applicable:**
- **Yes**
- **No**
- **N/A**

#### Compliance
- **Check Yes, No as applicable:**
- **Yes**
- **No**

#### Authorisation
- **Other than modification criteria, if the answer to any relevant question is NO, the modification is not acceptable.**

#### Signed
- **Modification certificate no.:**
- **Modification plate no.:**
- **Date:**

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