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:

ADR no.	Title
18, 18/..	Instrumentation
28, 28A, 28/.., 83/..	External Noise of Motor Vehicles
35, 35A, 35/..	Commercial Vehicle Brake Systems
42/..	General Safety Requirements
65/..	Maximum Road Speed Limiting for Heavy Goods Vehicles and Heavy Omnibuses
95/..	Installation of Tyres
96/..	Commercial Vehicle Tyres

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.

Modification Code D1 — Rear axle installation

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.

This…	Must comply with…
Brakes	VSB6 Modification Code G4
Suspension	VSB6 Modification Code F1
Re-rating of GVM/GCM	VSB6 Modification Code S1
Change of differential ratio	VSB6 Modification Code D2
Tail shaft alteration	VSB6 Modification Code C1

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 (example)

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

Braking systems	Check Yes, No, N/A as applicable:	Yes	No	N/A
1	Is the advanced braking system (where fitted) un-affected 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?	☐	☐

Installation details

Installation	Check Yes, No, N/A as applicable:	Yes	No	N/A
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 VSB6 Section G — Brakes?	☐	☐	
5	Where there are any additional axles, has the modification to the brake system been performed in accordance with VSB6 Section G — Brakes?	☐	☐	☐
6	If changes to the rear suspension or tail shaft are required, have the appropriate sections of VSB6 been followed, i.e. Sections C — Tail shafts and F — 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 gradeability, and that speedometer and road speed limiter accuracy is maintained? (Refer VSB6 Modification Code A5)	☐	☐	☐

Compliance

Modification	Check Yes, No as applicable:	Yes	No
1	Does this modification meet all the requirements of the manufacturer's guidelines / Modification Code D1?	☐	☐
2	Is the quality of the work to an accepted industry standard?	☐	☐
3	Does the vehicle continue to comply with ADRs and heavy vehicle standards regulations affected by the modification?	☐	☐

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:

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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.

This…	Must comply with…
Change in differential ratio	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) ADR 28, 28A, 28/…, 83/.. VSB6 Section S — Vehicle rating (gradeability and startability requirements) ADR 65/..
Speedometer and speed limiter accuracy	Change speedometer ratio to obtain speedometer accuracy within ADR limits ADR 18/..

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)

D2 Checklist — Differential substitution

This checklist is for use by the approved vehicle examiner (AVE) when certifying a differential substitution.

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) un-affected 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 VSB6 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 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 vehicle continue to comply with ADRs and heavy vehicle standards regulations affected by the modification?	☐	☐

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:

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Modification Code D3 — Fitting of non-standard rear wheel components

1. Scope

Modifications covered under this code:

Covered

- fitting of non-standard rear wheels to motor vehicles and trailers, i.e., rims or tyres.

Not covered

- 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.
- modifications to wheel rim assemblies, other than those permitted by the wheel rim manufacturer
- fitting of rear wheels, i.e., rims or tyres, that exceed the regulatory limits on vehicle dimensions
- conversion of dual to single wheels where directly prohibited by the vehicle manufacturer
- fitting of non-standard wheels to the front axles (see VSB6 Modification Code E3).

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.

This…	Must comply with…
Replace rear axle	VSB6 Section D — Rear Axles
Width of vehicle (max. of 2.5 m)	ADR 43/..
Brakes	VSB6 Section G — Brakes
Re-rating of GVM/GCM/ATM	VSB6 Section S — Vehicle Rating VSB6 modification codes S1, S2, S7, S12
Turning circle (max diameter of 25 m)	ADR 43/..
Tyres	ADR 42/.. ADR 95/.. ADR 96/..
Suspension substitution	VSB6 Modification Code F1

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

> ↘ Variation to the wheel's overall diameter due to the tyre manufacturing process is not considered a modification provided they remain within the vehicle manufacturer's specifications i.e., replacing brand A tyres with brand B tyres which have an identical tyre size designation; however, brand B has a slightly larger overall diameter due to manufacturing tolerances would not be considered a modification.

- Have 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 rear 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 any 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.
- Wheel spacers are not permitted to be fitted unless permitted by the vehicle manufacturer.

- 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.
- Ensure the increased load imposed on outer wheel bearings and outer section of the wheel hub and axle by fitting offset rims remains within the bearing's specifications.
- Tyres must be matched to rims approved by the Tyre and Rim Association of Australia or an acceptable alternative as listed in ADR 42/.., 95/.. or 96/...
- 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/.., 95/.. or 96/.., 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.
- Confirm the vehicle type is not required to be fitted with dual tyres on the rear axle e.g. Tow trucks, single axle non-all-wheel drive omnibuses, etc.
- Ensure clearance between tyres (for dual wheel arrangements) is in accordance with the with tyre manufacturer's statement of recommendation or "*The Tyre & Rim Association of Australia" dual tyre spacing*

Recommended:

- when converting from a dual to single wheel arrangement:
  - ensure tyre pressure specified correlates with the load rating as per the Tyre and Rim Association of Australia

↘ 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.

- consider the increased likelihood of aquaplaning associated with wider tyres
- ensure clearance between tyres (for dual wheel arrangements) is in accordance with the with tyre manufacturer's statement of recommendation or "*The Tyre & Rim Association of Australia" dual tyre spacing*

↘ Fitting tyres to incorrect rims can lead to premature wheel and/or tyre failure.

D3 Checklist — Fitting of non-standard rear wheel components (example)

D3 Checklist — Fitting of non-standard rear wheel components

This checklist is for use by approved vehicle examiners (AVEs) when assessing and certifying the fitting of non-standard rear wheel components, i.e. tyre or rim.

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 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 braking systems

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

Installation details

Wheels and tyres	Check Yes, No as applicable:	Yes	No
1	Do the vehicle's wheels and tyres remain within the extreme width of the mudguards and the maximum width limit for the vehicle (2.5 metres)?	☐	☐
2	Are replacement tyres and wheel rims approved as suitable by the Tyre and Rim Association of Australia, with an acceptable standard permitted by Australian Design Rule (ADR) 42/.., 95/.. or 96/.. or as per manufacturer's specifications?	☐	☐
3	Do the vehicle's wheels and tyres have adequate clearance from all componentry under full movement (including rear steer axles) and full suspension travel?	☐	☐
4	Do wheel nuts engage sufficient wheel stud tread?	☐	☐

Axles	Check Yes, No, N/A as applicable:	Yes	No	N/A
1	Has a ground axle mass rating of the original or replacement rear axle componentry been established to ensure the mass ratings of componentry being used are not exceeded?	☐	☐	☐

Bearings	Check Yes, No, N/A as applicable:	Yes	No	N/A
1	Has bearing life been assessed to ensure it is acceptable?	☐	☐	☐

Brakes	Check Yes, No, N/A as applicable:	Yes	No	N/A
1	If non-standard wheels are fitted which may affect braking performance has brake testing been performed in accordance with VSB6 Section G – Brakes?	☐	☐	☐

Summary	Check Yes, No, N/A as applicable:	Yes	No	N/A
1	If the vehicle's gross vehicle mass (GVM) rating has been affected by the modification, has certification been carried out in accordance with VSB6 Section S — Vehicle Rating?	☐	☐	☐
2	If the trailer's aggregate trailer mass (ATM) rating has been affected by the modification, has certification been carried out in accordance with VSB6 Section S — Vehicle Rating?	☐	☐	☐
3	If the overall diameter of the wheel and tyre combination has changed, has the vehicle's speedometer been recalibrated in accordance with ADR 18/..?	☐	☐	☐
4	If the overall diameter of the wheel and tyre combination has changed, has the vehicle's speed limiter been recalibrated in accordance with ADR 65/..?	☐	☐	☐

Compliance

Modification	Check Yes, No as applicable:	Yes	No
1	Does this modification meet all the requirements of the manufacturer's guidelines/Modification Code D3?	☐	☐
2	Is the quality of the work to an accepted industry standard?	☐	☐
3	Does the vehicle continue to comply with ADRs and heavy vehicle standards regulations affected by the modification?	☐	☐

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:

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