Section M

Fuel Systems

Contents

Section M — Overview

1. Description

This section of Vehicle Standards Bulletin 6 (VSB6) relates to the modification of fuel systems and the fitting of modified fuel systems to heavy vehicles.

In accordance with the following modification code, this section provides for the following modifications to be certified providing performance of the fuel system is not adversely affected:

M1	**Fuel system alterations** • altering length of fuel tank • removal of baffles • conversion of fuel tank into a multi-compartment tank e.g., hydraulic oil and fuel • relocation of filler neck • changing shape of tank.

2. Related Australian Design Rules

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

ADR no.	Title
36, 36A, 36/..	Exhaust Emission Control for Heavy Duty Vehicles
43/..	Vehicle Configuration and Dimensions
58/..	Requirements for Omnibuses Designed for Hire and Reward
70/..	Exhaust Emission Control for Diesel Engined Vehicles
80/..	Emission Control for Heavy Vehicles

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 checklist as applicable:

M1 Checklist	Fuel system alterations

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 M1 — Fuel system alterations

1. Scope

Modifications covered under this code:

Covered

- fitting of additional fuel tank
- fitting of alternative fuel tank
- repositioning of fuel tank
- removal of auxiliary fuel tank
- repositioning of fuel lines
- fitting of alternative fuel lines
- relocation of filler neck
- lengthening or shortening of fuel tanks
- removal of baffles
- changing shape of tank, i.e., cut-outs to suit footstep etc.
- conversion of fuel tank to multi-compartment tank, i.e., oil and fuel.

Not covered

- conversion of a vehicle to a different type of fuel (see VSB6 Section A — Engines)
- addition of fuel filters (minor modification)
- addition of fuel coolers (minor modification).

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…
Repositioning existing tank	Good engineering practice
Fit additional tank: other vehicle	Good engineering practice
Filler position	ADR 58/..
Emission requirements (petrol)	ADR 36, 36A, 36/..80/..

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**, perform modification in accordance with manufacturer specifications and proceed to step 4. • If **no**, proceed to step 2.
2.	Modifier	Consult with an accredited M1 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 M1 AVE.
5.	M1 AVE	Perform inspection, complete M1 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.	Modifier	M1 AVE issues modification certificate, affixes modification plate, and submits 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. Compliance requirements

Fuel tank mounting

Required:

- Comply with ground clearance requirements as per ADR43/.. or relevant heavy vehicle standards regulation, including the 1:15 gradient clearance requirement.

Fuel systems and lines

Required:

- If the vehicle has a petrol engine and was originally manufactured to comply with ADR 36, 36/.. or 80/.. , retain the original evaporative emission control system to control emissions from evaporating fuel.

5. Design requirements

As there are no specific Australian Standards that cover fuel tanks for use on vehicles, the below technical requirements are based on the repealed ADR 17 and are considered to be the minimum requirements. Additional guidance may be obtained by referring to other related standards, e.g., AS1554 Structural welding.

Fuel tank construction requirements

Address the following requirements when mounting fuel systems and tanks on all vehicles:

Required:

- Ensure that each fuel tank is designed in accordance with good engineering practice.

Recommended:

- Ensure that each fuel tank can withstand an internal pressure of 150% of the safety vent design pressure (P) derived from the formula for diameter shown in the performance recommendations of this modification code.
- Fit each fuel tank with a safety vent or fusible plug.
- Ensure each fuel tank provides for at least 5% air space when full to allow for the expansion of fuel without spilling.
- Do not let fuel tank drain fittings (other than fuel cross-over pipes and related fittings) extend by more than 20 mm beyond the surface of the fuel tank on which they are fitted, or a plane tangential to at least three points on the fuel tank located within 75 mm of the centre line of the fittings.
- If possible, test each fuel tank as recommended according to the performance recommendations of this modification code.
- When destructive tests are performed, enter evidence of the tests, their results, and the fuel systems to which they apply in the design control documents.

Performance recommendations

Recommended performance characteristics:

Rate of filling of fuel tanks without spillage from tank:

- 45 L/min for tanks used to store petrol, motor spirit or petroleum spirit
- 66 L/min for all other tanks.

Rate of total leakage from a fuel tank and fittings:

- do not exceed 30 g/min when filled with normal fuel and inverted for 5 min relative to its installed position in the vehicle.

Formula for deriving safety vent design pressure (P) for diameter:

Derive the safety vent design pressure (P) from the following formula for diameter:

$$d = \sqrt{\frac{1047\ Sw}{0.145P+14.7}} \times \frac{0.145P\ +448}{131} mm$$

where:

Sw = maximum surface area of the tank expressed in square metres below liquid fuel level when the fuel tank has been filled to the point of overflow.

P = pressure expressed in kPa at which the safety vent is fully open, provided that in the case of safety vents designed to fuse, the value of P is not less than the vapour pressure of the fuel relative to the temperature at which the vent fuses.

6. Installation requirements

Fuel tank mounting requirements

Address the following when mounting fuel systems and tanks on all vehicles:

Required:

- On motor vehicles, do not mount the fuel tank forward of the front axle.
- On semitrailers, mount the fuel tanks between the landing legs and the front axle.
- Ensure that rear mounted fuel tanks do not reduce the departure angle of the vehicle.
- Install fuel tanks securely using the original vehicle manufacturer's mounting brackets wherever possible. If not possible, mount the tank with brackets that are appropriately designed for the tank size, weight, and shape, and have an appropriate factor of safety.

Fuel systems and lines requirements

Address the following when installing fuel systems and lines on all vehicles:

Required:

- Ensure that fuel lines and fuel system components remain clear of heat sources (excluding fuel heaters) and sources of ignition such as exhaust or electrical systems.
- Ensure that the proximity of the fuel system to electrical wiring does not constitute a fire hazard.
- Design the filler pipe to prevent overflow from a filling operation spilling onto any part of the exhaust or electrical systems, other than fuel level indicator assemblies.
- Ensure the fuel system is free from leaks.
- Fit all fuel lines and filters securely.
- Do not locate fuel fillers, breathers, and overflow pipes inside the cabin.
- Meet the engine manufacturer's requirements for inlet fuel temperature as failure to do so may result in reduced engine performance or damage.

Recommended:

- Use fuel lines and connectors of compatible size, type, and thread form.
- Avoid positioning fuel system components so that they are the widest part of the vehicle.
- Connect fuel return lines in accordance with original equipment manufacturer’s requirements. When the manufacturer’s requirements are unavailable, ensure the fuel can return to the tank from which it was drawn. If fuel is returned to another tank in the fuel system, it is advisable that crossover lines allow for sufficient transfer of fuel between tanks. This is common in road train applications.

7. Testing requirements

It is recommended that a fuel tank which has at least one part that is not protected by either the cab or the longitudinal chassis side rails is constructed or modified in accordance with good engineering practice, which may include verification by means of either or both of these tests:

Corner test	Use this only when a corner of the fuel tank (e.g., intersection of edges in the case of a rectangular tank or any point on the circular seam of a cylindrical tank) is not protected by either the cab or the longitudinal chassis side rails.
Filler pipe test	Use this only when the extremity of the filler pipe part of the fuel tank is in an area that is not protected by either the cab or the longitudinal chassis side rails.

Preparation for tests

Always use a new fuel tank for each impact test when assessing a tank that is not protected by either the cab or the longitudinal chassis side rails.

To prepare a tank for impact tests:

1. Plug the fuel outlet pipe connection of the fuel tank.
2. Plug openings other than filler pipes.
3. Fill the fuel tank with water to a level such that its total mass is at least equal to that when filled with normal fuel.
4. Plug the filler pipes.

Conducting tests

Corner test:

1. Select the corner to be tested as being the one exposed when the fuel tank is in its position on the vehicle.
2. Position the fuel tank so that the impact point is vertically below its centre of gravity.
3. Allow the fuel tank to fall freely through a height of not less than 9 m onto an unyielding surface (e.g., a steel plate 9 mm in thickness supported on a concrete surface).

Filler pipe test:

1. Position the test fuel tank so that the filler pipe closure is vertically below the tank’s centre of gravity.
2. Allow the tank to fall freely through a height of not less than 3 m onto an unyielding surface.

M1 Checklist — Fuel system alterations (example)

M1 Checklist — Fuel system alterations

This checklist is for use by approved vehicle examiners (AVEs) when assessing fuel system alterations.

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?	☐	☐

Installation details

Fuel tank	Check Yes, No, N/A as applicable:	Yes	No	N/A
1	Is the fuel tank/s securely mounted?	☐	☐	☐
2	Does the vehicle meet the dimension requirements, including width and ground clearance?	☐	☐	
3	Has the modification to the fuel tank/s been performed in accordance with VSB6?	☐	☐	
Fuel lines	**Check Yes, No, N/A as applicable:**	**Yes**	**No**	**N/A**
4	Are all fuel lines and filters securely mounted away from heat and sources of ignition (i.e. exhaust and electrical system)?	☐	☐	
Fuel system	**Check Yes, No, N/A as applicable:**	**Yes**	**No**	**N/A**
5	Is the fuel system free from leaks?	☐	☐	
6	Are all of the fuel fillers, breathers or overflow pipes located outside the cabin?	☐	☐	
7	Are all components of the fuel system clear of the heat and ignition sources (i.e. exhaust and electrical system)?	☐	☐	
Compliance	**Check Yes or No as applicable:**	**Yes**	**No**	
8	Is the quality of the work to an accepted industry standard?	☐	☐	
9	Does the modified vehicle continue to comply with all affected Australian Design Rules (ADRs)?	☐	☐	
10	Have all modification details been recorded in accordance with VSB6 record keeping requirements?	☐	☐	

Compliance

Modification	Check Yes, No as applicable:	Yes	No
1	Does this modification meet all the requirements of the manufacturer's guidelines / Modification Code M1?	☐	☐
2	Is the quality of the work to an accepted industry standard?	☐	☐
3	Have all modification details been recorded in accordance with VSB6 record keeping requirements?	☐	☐
4	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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