# Vehicle Standards Bulletin 14

## NATIONAL CODE OF PRACTICE

## for

## LIGHT VEHICLE CONSTRUCTION

## and

## MODIFICATION

## SECTION LV

## ALTERNATIVE POWER UNITS

VERSION 2.0 JANUARY 2011

## Vehicle Standards Bulletin 14

### *National Code of Practice for Light Vehicle Construction and Modification* (VSB 14)

***Important Information for Users***

Users of VSB 14 need to be aware that this document needs to be used in conjunction with the appropriate administrative requirements of the jurisdiction in which they wish to either register a vehicle or to obtain approval for a modification for an already registered vehicle. *Administrative requirements* include, amongst other things, processes for vehicle registration, obtaining exemptions, obtaining modification approvals, vehicle inspections, preparation and submission of reports and the payment of appropriate fees and charges.

If unsure of any of the requirements specified in VSB 14, or if more information is needed for any other issues concerning the administrative requirements, users should contact their relevant Registration Authority **prior** to commencing any work.

While VSB 14 provides advice on the construction of Individually Constructed Vehicles (ICVs) and the execution of modifications, it is not to be taken to be a design manual. Determination of component strength, performance, suitability and functionality must be either calculated or determined on a case by case basis by suitably qualified personnel experienced in each matter under consideration.

Users of VSB 14 also need to ensure that they refer to the most recent version of the relevant Section/s when working on a project. The version is identified by the version number and date on the face page of each Section. The version and date is also located in the footer of each page in each Section. On the website the version number is specified in the Section file name for easy identification.

If a project is taking a long time to complete, check the currency of the version you are using.

Users must be familiar with the provisions stated in the Preface and Introduction. These two Sections provide the necessary background information to assist users in understanding how VSB 14 is administered by Registration Authorities across Australia, on how it is structured, and the meaning of the types of modification codes specified in VSB 14. If not already done so, users should download them for study and reference.

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

Many of the Sections refer to other Sections within VSB 14 for further information or additional requirements. Users must read and apply all relevant Sections.

If in doubt about any issue concerning or contained in VSB 14, users should seek clarification from the appropriate State or Territory Registration Authority.

**Please do not contact Vehicle Safety Standards (VSS) of the Australian Government Department of Infrastructure and Transport in Canberra about VSB 14. VSS provides the website as a service only.**

# CONTENTS

# 1 SCOPE

This Section outlines the minimum design, installation and fabrication requirements for the installation of alternative power units, other than standard internal combustion engines, either as a modification to an existing vehicle or as a source of motive power for an Individually Constructed Vehicle (ICV).

Modifications to an existing vehicle include the conversion of a production vehicle into what is commonly known as a *hybrid* vehicle - i.e. a vehicle that is designed to be fitted with both an electric motor and a combustion engine and able to be driven by either of the two power sources, as directed by the driver or as automatically selected by the power management system.

Each drive system will be supported by guidelines.

Currently only one drive system has been approved for this version of VSB 14, i.e. the *National Guidelines for the Installation of Electric Drives in Motor Vehicles.*

# 2 COMPLIANCE WITH REGULATIONS

This subsection applies to all light vehicles and must be read and applied in conjunction with all the LV Codes applicable to the proposed modifications.

Modified vehicles must continue to comply with the ADRs to which they were originally constructed, except as allowed for in the Australian Vehicle Standards Rules (AVSR). These modified vehicles must also comply with the applicable in-service requirements of the AVSR.

Modified pre-ADR vehicles must continue to comply with the AVSR.

*Compliance with the AVSR* also means compliance with the equivalent regulations of a State or Territory of Australia.

## 2.1 INDIVIDUALLY CONSTRUCTED VEHICLES (ICVs)

All individually constructed vehicles utilising electric drive systems must be built to comply with applicable codes, other than those provisions relating to engine installations, specified in Section LO *Vehicle Standards Compliance*. ICVs must generally comply with the intent of the ADRs applicable at the date of the vehicle's manufacture.

Details of the requirements that must be met are contained within Section LO and each jurisdiction's business rules or administrative arrangements concerning vehicle registration.

## 2.2 MODIFIED VEHICLES

Vehicles modified to operate on electric power must continue to comply with the AVSR. (Each jurisdiction has an equivalent set of vehicle standards).

The AVSR also requires vehicles to continue to comply with ADRs that were applicable to the vehicle in question according to its date of manufacture and ADR category.

The AVSR also has some additional in-service requirements such as limitations on window tinting, tyre wear and tyre selection. In order to ensure that modifications comply with the relevant provisions, please refer to the appropriate section/s of VSB 14.

## 2.3 AUSTRALIAN DESIGN RULES

As stated in Clause 2.2, modified vehicles must meet the same design and safety requirements that applied to the original vehicle when it was manufactured. Where any system governed by an ADR is altered, it is necessary to show that the original requirements of that rule are still met.

The following is a list of requirements and items, that if changed or modified as a result of an electric drive conversion, may detrimentally affect compliance with the ADRs:

- **Seat Anchorages:** (ADRs 3x, 3/...) - seatbelt anchorages (ADRs 5x, 5/...) and child restraint anchorages (ADRs 34x, 34/...) – any structural alteration made in the vicinity of the seat or seatbelt mountings, or the child restraint anchorages, may reduce their strength.

- **Occupant Protection:** (ADRs 10x, 10/..., 21, 21/…, 69/..., 73/...) - structural alterations, particularly in the forward portion of the vehicle, the removal of the original engine or large increases in vehicle mass made by the addition of the traction batteries and motors, may affect the energy absorption characteristics of the vehicle structure, instrument panel or steering column.

- **Demisting of Windscreens:** (ADRs 15, 42/...) – the removal of the engine will necessitate the provision of an alternative source of heat for demisting air (or, perhaps, alternative demisting arrangements). A performance comparable to the original demisting system must be maintained.

- **Motor Vehicle Noise:** (ADRs 28x, 28/..., 83/...) – in general, electric vehicles are quieter than those fitted with internal combustion engines. Alternative gearboxes, chain drives and some electric control apparatus may increase noise levels and attention must be given to ensuring that this does not result in excessive external noise.

- **Emissions:** (ADRs 26, 27x, 30, 30/..., 37, 37/..., 79/...) – the emissions requirements do not apply to purely electric vehicles - however, hybrid vehicles (e.g. battery vehicles with an internal combustion engine powering an onboard generator) will be expected to comply with the intent of relevant emissions ADRs.

- **Braking Systems:** (ADRs 31/..., 35/...) – large increases in vehicle mass, alteration of the centre of gravity and/or removal of the normal vacuum or compressed air source will affect compliance with these rules and it is essential that braking performance be maintained within the limits set out by these rules. The addition of a secondary source of vacuum or compressed air will usually be required. The vehicle must continue to comply with the design rule requirement that vehicles have a brake failure warning lamp that can be tested by turning the ignition switch to the start position.

This is not an exhaustive list and other modifications may also affect ADR compliance.

# 3 GENERAL REQUIREMENTS

## 3.1 FABRICATION

All work must be performed in accordance with recognised engineering standards. Cutting, heating, welding or bending of components should be avoided by choosing unmodified production components wherever possible.

### *3.1.1 Welding, Fasteners and Electroplating*

Mandatory requirements and guidance on the above items are contained in Section LZ *Appendices.*

- For the use of fasteners refer to Appendix A *Fasteners*;
- For welding techniques and procedures refer to Appendix C *Heating and Welding of Steering Components*; and
- For electroplating refer to Appendix D *Electroplating*.

### *3.1.2 Mating Parts*

Standard features such as splines, tapers and keyways must conform to published standards and their mating parts must conform to matching standards.

## 3.2 LADEN MASS LIMITS

The installation of alternative drive systems often requires the fitting of additional supplementary equipment such as batteries, transmissions and control equipment. Modifications to existing production vehicles must therefore take into account the following guidelines relating to laden mass:

- The laden mass of a vehicle, such as a passenger vehicle, must not exceed the vehicle manufacturer's recommended limit for the vehicle in question;
- In the case of vehicles with a designated Gross Vehicle Mass (GVM), the vehicle's GVM must not be exceeded;
- In all cases, the vehicle manufacturer's recommended individual axle loads must not be exceeded. For passenger vehicles a minimum loading allowance of 68 kg for each adult seating position must be included in the determination of laden mass. If provisions exist for carrying luggage, a minimum loading allowance of 13.6 kg for each seating position must be used for determining laden mass; and
- A goods carrying vehicle (ADR category NA, NB) becomes a passenger carrying vehicle when the total number of seating positions multiplied by 68 kgs is 50% or more of the vehicle's load carrying capacity. In this situation engineering evidence must be provided to confirm that the modified vehicle meets the higher safety standards applicable to passenger carrying vehicles.

## 3.3 POWER MANAGEMENT

All alternative drive systems must have power management systems in place that ensure that the application of power and torque occurs in a manner that ensures the vehicle is controllable at all times.

# INSTALLATION OF ELECTRIC DRIVES IN MOTOR VEHICLES

# CODE LV1

## SCOPE

Code LV1 provides for the installation of electric drives in motor vehicles, including ICVs.

## MODIFICATIONS COVERED UNDER CODE LV1

The following is a list of modifications that may be performed under Code LV1:

- Fitting of a replacement electric motor with a continuous power output not greater than 120% of the original engine, including optional engines, offered by the original manufacturer as standard for the vehicle being modified;

- Fitting of a replacement electric motor with a continuous power output not greater than 120% of the original engine, including optional engines, offered by the original manufacturer as standard for the vehicle being modified to work in conjunction with the original engine as found in many *hybrid* vehicles; and

- Fitting of an electric drive to an ICV.

***The above installations only apply to electric motors or drives that have been installed in accordance with the National Guidelines for the Installation of Electric Drives in Motor Vehicles.***

## MODIFICATIONS NOT COVERED UNDER CODE LV1

The following modifications are not covered under Code LV1:

- Fitting of a replacement electric motor that has 20% more power than the original engine, including any optional engines, offered by the original vehicle manufacturer for the vehicle in question;

- Fitting of a replacement electric motor whose specifications are not suitable for use with the existing components of the vehicle;

  **Note**: This includes the fitting of an electric drive that together with all of its necessary components, such as batteries, control systems and transmission, results in a laden mass or GVM that exceeds that recommended by the vehicle manufacturer.

- Fitting of a replacement electric motor that necessitates substantial modification to the vehicle's structure (e.g. firewall, chassis modifications);

- Fitting an electric motor to any motorcycle or ADR category L-group vehicle; and

- Electric drive installations that do not comply with the *National Guidelines for the Installation of Electric Drives in Motor Vehicles.*

**Note:** Vehicles built or modified to this code must comply with all applicable AVSRs, Acts and Regulations.

Persons who build ICVs are deemed to be the manufacturer and are therefore responsible for the entire design and construction of their respective vehicles. This means that ICV builders do not need to utilise any of the other modification codes detailed in VSB 14. However, where ICV builders modify a part of an existing vehicle for incorporation in their vehicle, they should use the appropriate codes as a means of demonstrating continued compliance with the necessary provisions.

Electric drives that do not meet the requirements of Code LV1 may be accepted in certain circumstances. However a direct application to the jurisdiction in which the vehicle is to be registered will be necessary to determine the acceptability of each proposal.

## GUIDELINES AND CHECKLISTS

The guidelines (*National Guidelines for the Installation of Electric Drives in Motor Vehicles)* and checklists are incorporated in a single document. Since this is a relatively large document it will need to be downloaded separately from the Department of Infrastructure and Transport website located at:

**<www.infrastructure.gov.au>.**

The checklist must be fully completed, signed, retained for audit purposes and/or submitted with each application as required by the administrative arrangements of the Registration Authority in the jurisdiction in which the vehicle is to be registered.

The document filename is prefixed by <***NCOP14*** >.