Vehicle Standards Bulletin 14

NATIONAL CODE OF PRACTICE

for

LIGHT VEHICLE CONSTRUCTION

and

MODIFICATION

SECTION LV

ALTERNATIVE POWER UNITS

1st February 2006

Warning to Users

Users of the NCOP 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 these requirements, or if more information is needed for any other issues or processes, users should contact their relevant registration authority prior to commencing any work.

Whilst the NCOP provides assistance with respect to the construction of 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 the NCOP also need to ensure that they refer to the most recent version of the relevant Section/s when working on a job or project. The version is identified by the date on the face page of each Section. On the website, each Section has the version date contained in the Section file name for easy identification.

It is prudent to check for new versions if a job or project is taking a long time to complete.

If they have not already done so, users must also download the Preface and Introduction.

These two Sections provide the necessary background information to assist users in understanding how the NCOP is administered by registration authorities across Australia, on how it is structured, and the meaning of the types of modification codes specified in the NCOP.

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

Many of the Sections refer to other Sections for further information or additional requirements. Users ***must*** *download all relevant Sections. Lack of information due to insufficient downloads will not be accepted as an excuse by authorities.*

If in doubt about any issue concerning or contained in the NCOP, users should seek clarification from the appropriate state or territory registration authority.

Please do not contact the Department of Transport and Regional Services (DOTARS) about the NCOP. DOTARS provides the central NCOP 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 one drive system has been approved for this edition of the NCOP, i.e. – ***National Guidelines for the Installation of Electric Drives in Motor Vehicles.***

2 COMPLIANCE WITH REGULATIONS

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 Australian Design Rules (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/administrative arrangements concerning vehicle registration.

2.2 MODIFIED VEHICLES

Vehicles modified to operate on electric power must continue to comply with the Australian Vehicle Standards Rules 1999 (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, tyre selection etc. In order to ensure that modifications comply with the relevant provisions, please refer to the appropriate section/s of the NCOP.

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.

For example, the ADRs that may be affected by an electric drive conversion include:

- ***Seat Anchorages (ADR 3/...)***, seatbelt anchorages (ADR 5/...) and child restraint anchorages (ADR 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 10/..., 21/…, 69/..., & 73/...)*** - structural alterations, particularly about 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 (ADR 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 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, 27, 30/..., 37/... & 79/...)*** – the emissions requirements do not apply to purely electric vehicles; however, hybrid vehicles (i.e. 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.

3 GENERAL REQUIREMENTS

FABRICATION

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

WELDING

Welding of components, except where expressly specified to a higher standard, must be performed in accordance with recognised general engineering practices taking into account the function of the welded joint. This typically involves, for each task in question:

- choosing the appropriate welding method together with the most suitable welding materials
- ensuring appropriate job preparation is performed
- ensuring all subject joints and heat affected areas are effectively prepared and sealed in accordance with current trade techniques to minimise the onset of corrosion.

In addition, welds, particularly on structural members, should not be ground back to such an extent that the strength of the joint would be affected.

Where a higher or alternative weld standard is specified, the requirements of that standard must be satisfied.

Guidance on good welding techniques can be found in AS/NZS 1554.1:2004 *Structural steel welding - Welding of steel structures*.

FASTENERS

Unless supported by specific engineering design, all fasteners on transmission mountings or in highly stressed locations must be high tensile ISO Grade 8.8 (mm sizes), SAE Grade 5 (inch sizes) or equivalent, as a minimum specification. All other fasteners are to be at least of similar strength and number to those in the original installation. Self-locking nuts should be used in preference to spring washers.

MATING PARTS

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

ELECTROPLATING

To prevent cracks forming in the parent metal under brittle chromium plating or from hydrogen embrittlement of steel components, electroplating of highly stressed components including bolts, is not permitted unless a part of the original manufacturing process.

LADEN MASS LIMITS

The installation of alternative drive systems often requires the fitment 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 manufacturer's recommended limit for the vehicle in question.
- In the case of vehicles with a designated GVM, the vehicle's GVM must not be exceeded.
- In all cases, recommended individual axle loads must not be exceeded and a minimum loading allowance of 65 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 80 kg for each adult seating position must be used for determining laden mass.

POWER MANGEMENT

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

The following is a summary of the modifications that may be approved under Approval Code LV1 – ***Installation of Electric Drives in Motor Vehicles***.

Approvals are **allowed** under Code LV1 for:

1. Fitting of a replacement electric motor with not more than 20% more power output than engines, including optional engines, offered by the original manufacturer as standard for the vehicle being modified.

2. Fitting of an electric motor with not more than 20% power output than engines, including optional engines, offered by the original manufacturer as a standard for the vehicle being modified to work in conjunction with the original engine as found in many "hybrid" vehicles.

3. Fitting of an electric drive to an ICV.

The above approvals 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.

Approvals are **not allowed** under Code LV1 for:

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

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

   This includes the fitment 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.

3. Fitting of a replacement electric motor that necessitates substantial modification to the vehicle's structure (eg. firewall, chassis modifications).

4. Fitting an electric motor to any L-group vehicles (eg motorcycles and motor trikes).

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

Note 1:

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 utilize any of the other modification codes detailed in this NCOP. 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.

Note 2

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 DOTARS website, <www.dotars.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 which the vehicle is to be registered.

The document filename is <NCOP14 Guidelines Electric Drive 20sept2005.pdf>.