Vehicle Standards Bulletin 14

NATIONAL CODE OF PRACTICE

for

LIGHT VEHICLE CONSTRUCTION

and

MODIFICATION

NATIONAL GUIDELINES

for

THE INSTALLATION OF ELECTRIC DRIVES

IN MOTOR VEHICLES

1st February 2006

National Code of Practice for Light Vehicle Construction and Modification (NCOP)

Warning to Users

Users of the NCOP together with its Guidelines need to be aware that these documents need 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 and its Guidelines provide assistance with respect to the construction of ICVs and the execution of modifications, these are not to be taken to be design manuals. 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.

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National Code of Practice for the Construction and Modification of Light Vehicles

Guidelines for the Installation of Electric Drives in road vehicles

PREFACE

BACKGROUND

These Guidelines have been sourced from documents prepared by the Roads and Traffic Authority of NSW and Queensland Transport. The original documents were further developed by the Department for Transport, Energy and Infrastructure (DTEI (SA)) in consultation with electrical engineers.

These Guidelines have subsequently been endorsed by all Australian State and Territory Jurisdictions responsible for vehicle standards and the registration of vehicles for road use.

These Guidelines apply to the Installation of Electric Drives in road vehicles.

INTENT

This bulletin is for the assistance of people who intend to utilise an electrical drive in a passenger car or light commercial vehicle. It applies to vehicles that are to be manufactured specifically for electric drive by individuals (i.e. Individually Constructed Vehicles (ICVs)) and to vehicles that are to be converted from petrol or diesel operation.

SCOPE

These Guidelines form an integral part of the *National Code of Practice for Light Vehicle Construction and Modification* (NCOP). Section LO *Vehicle Standards Compliance* of the NCOP outlines the minimum requirements for the assessment and certification of compliance with the Australian Design Rules (ADRs) for individually constructed vehicles. Section LO also provides additional information about the Australian Design Rules, their applicability dates and 'reasons for rejection'.

The NCOP also has other sections under which modifications or vehicle construction can be shown to be in conformity with the ADRs.

As this bulletin specifically covers electric drive issues only, Builders or Modifiers must refer to the NCOP for more detailed information about vehicle modifications and ICV construction.

RELATIONSHIP WITH THE LAWS OF AUSTRALIAN JURISDICTIONS

Subject to Federal laws and the laws of the States and Territories of Australia, this document defines standards of practice for the design, manufacture and/or modification of vehicles

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intended to be powered by electrical means. Other procedures are acceptable subject to adequate technical justification.

NOTE**:** Nothing in these Guidelines is to be regarded as in any way limiting the powers and duties of the Chief Executive Officer of the registration authority in question, or any agent or employee of that Officer, under the appropriate Act/s of that jurisdiction, or subsidiary legislation made there under.

Where any Australian Design Rule or any Australian Vehicle Standards Rule is referred to in these guidelines, the appropriate Australian Design Rule or Australian Vehicle Standards Rules 1999 should be read in full to avoid misinterpretation.

It is also important to note that each jurisdiction may have different clause numbers in its adopted version of the Australian Vehicle Standards Rules.

ADMINISTRATION

These Guidelines provide a nationally consistent set of technical specifications for the installation of electric drives in motor vehicles. Jurisdictions have their own administrative procedures and requirements for the registration of new vehicles and for the approval of modifications. Owners must familiarise themselves with the provisions of the jurisdiction in which they reside. Similarly, owners of electrically powered vehicles who wish to transfer their vehicle to another state or territory need to obtain relevant information from that jurisdiction.

Definition of "Signatory"

For the purposes of the NCOP and these Guidelines, engineers and tradespersons involved in the approval process will be defined collectively under the generic term of ***Signatory***. Wherever the term ***Signatory*** is used, it always means that the signatory referred to is one who has the necessary knowledge and technical expertise to assess and sign-off the matter under consideration.

NCOP Codes

Persons authorised under an authorised modification scheme, operated by a jurisdiction, may stamp the NCOP codes on a modification plate. The plate specifications, stamping and fixing must be in accordance with the jurisdiction's business rules for the scheme in question.

Persons not authorised to attach modification plates to a vehicle must also use these codes when submitting applications to their local registering authority. In all cases the appropriate checklists must be completed. Authorised persons must hold the checklists for auditing purposes, whilst non-authorised persons must submit the signed-off check lists with their respective applications.

Please refer to your registering authority's business rules for more detailed information about the management of checklists.

Work performed to these Guidelines qualifies for Code LV1.

FUTURE DEVELOPMENTS

It is recognised that a set of Guidelines that covers all eventualities is not feasible. This document needs to be recognised as being a "live document" and hence will need to be revised from time to time to include future developments arising from regulatory changes, improvements in technology and the development of alternative designs.

The document may also be revised to improve its editorial content.

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FUTURE REVISIONS

Future revisions are the responsibility of the Australian Motor Vehicle Certification Board Working Party. Revisions, other than those of a legal or editorial nature, will be processed in consultation with the appropriate user groups.

The Working Party may consider applications from individuals concerning recommended revisions to the Guidelines. However, it is preferable that applications are submitted after consideration by the appropriate user groups. In any event, the Working Party will consult widely before making a final decision on any proposed amendments to the Guidelines.

DATE AT WHICH THE DOCUMENT TAKES EFFECT

This document takes effect at the date of issue.

DOCUMENT FORMAT

This document will be available in electronic format and will be available for download from the Department of Transport and Regional Services website. < www.dotars.gov.au >

Please note that whilst the Guidelines may be downloaded in sections for the convenience of persons who may have a specific issue to address, it is vital that any referenced sections applicable to the specific work being undertaken are downloaded also. "Lack of information" resulting from insufficient downloads will not be accepted as an excuse for non-compliance by jurisdictions.

REVISION HISTORY

Revision	Comments
First Published	This document was approved at the AMVCB Working Party meeting held on xxx

NOTE**:** Builders, modifiers and owners need to be aware that compliance with these Guidelines does not guarantee that a vehicle will be registered by the Jurisdiction in question. If, for example, a vehicle does not handle or brake satisfactorily or has any other feature which renders the vehicle unsafe or not roadworthy, it may not be registered. Further, changes to relevant legislation may mean that a vehicle cannot be registered without appropriate modifications.

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ACKNOWLEDGMENTS

This document has been adopted by the Australian Motor Vehicle Certification Board Working Party (AMVCB WP) as the nationally accepted Guidelines for the installation of electric drives in Australia. These Guidelines form an integral part of the *National Code of Practice for Light Vehicle Construction and Modification*. The national code of practice is a major project currently being undertaken by the AMVCB WP.

The AMVCB WP wishes to acknowledge the key role played by Mr Rickman Smith (Department for Transport, Energy and Infrastructure (SA)) in developing these Guidelines in consultation with electrical engineers.

The project was managed by Mr John Dombrose on behalf of the AMVCB WP as an integral part of the *National Code of Practice for Light Vehicle Construction and Modification*.

Members of the AMVCB WP at the time of Publication include:

- Barry Hendry National Transport Commission
- Dr Gray Scott VicRoads
- Harry Vertsonis RTA (NSW)
- Rod Paule DUS (ACT)
- Roland Earl DTEI (SA)
- Robert Gibson Transport QLD
- Simon Saunders DPI (NT)
- Tony Beard DIER (Tas)
- John Dombrose DPI (WA)

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1 COMPLIANCE WITH REGULATIONS

1.1 INDIVIDUALLY CONSTRUCTED VEHICLES (ICV)

All individually constructed vehicles must be built to comply with applicable codes specified in the National Code of Practice for Light Vehicle Construction and Modification (NCOP), Section LO. ICVs must generally comply with the intent of the Australian Design Rules 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.

A summary of the checklists and ICV approval codes are listed below for the reader's convenience.

Certified Approvals (LO Approval Codes)	
LO1	Australian Design Rule Compliance
	Checklist LO1-1 ADR Compliance Summary
	Checklist LO1-2 – 2nd Edition
	Checklist LO1-3 - 3rd Edition MA, MB & MC
	Checklist LO1-4 - 3rd Edition MD, ME, NA & NB.
LO2	ICV Passenger Cars and Derivatives
LO3	Personally Imported Vehicle Compliance
LO3	Personally Imported Vehicle Compliance Checklist
LO4	ICV Tricycle LEM1
LO4	ICV Tricycle LEM1 Checklist (Refer to Guidelines)
LO5	ICV Tricycle LEP1
LO5	ICV Tricycle LEP1 Checklist (Refer to Guidelines)
LO6	Street Rods
LO6	Street Rods Checklist (Refer to Guidelines)

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1.2 MODIFIED VEHICLES

Vehicles modified to operate on electric power must comply with the Australian Vehicle Standards Rules 1999. (Each jurisdiction has an equivalent set of vehicle standards.)

The AVSR 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 have 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 appropriate section of the NCOP.

1.3 AUSTRALIAN DESIGN RULES

As stated in clause 1.2, 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 Australian Design Rule (ADR) is altered, it is necessary to show that the original requirements of the rule, or a later one, are still met.

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 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.

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2 TECHNICAL AND SAFETY REQUIREMENTS

2.1 BATTERY RESTRAINT

The batteries that power the vehicle must be fixed in position so that they will not easily break free in a crash and thus create a hazard to the driver, passengers or other road users. The battery restraint system must adequately withstand at least the following crash accelerations:

Front impact	–	20 g (i.e. 20 times the battery weight);
Side impact	–	15 g;
Rear impact	–	10 g;
Vertical (rollover) impact	–	10 g.

2.2 CONTAINMENT OF WET CELL BATTERIES

All batteries that contain liquid or give off gases, including batteries powering ancillary equipment, must be effectively sealed off from the vehicle interior so that any gas or spilled liquid cannot leak into the vehicle. The batteries must be either fully enclosed in a sealed compartment (or compartments) or must be individually sealed and externally vented.

Battery compartments must be constructed of corrosion resistant material or be fully lined with a durable corrosion resistant material, or coating, that will not shrink or crack under the vibrations and temperatures likely to be encountered in a motor vehicle.

Battery compartment seals must be made of a corrosion resistant non-porous material (open cell foam is *unacceptable*).

Except for any ducting used for ventilation, all battery compartment exterior openings or fittings (including the bore of any conduit) must be fully sealed so that the transmission of gases or flames is prevented (fully sealed and externally vented batteries need not comply with this section).

Any battery system which is sealed and externally vented, or contains a water replenishing device that connects a number of batteries, must be designed so that propagation of flame between battery cases cannot occur.

2.3 VENTING OF BATTERY COMPARTMENTS

The design of the batteries, or battery compartments, must provide for venting directly to atmosphere of all gases given off by normal battery operation. This is of utmost importance with lead acid batteries because, during recharging, hydrogen can be given off in quantities sufficient to cause an explosion.

Depending on battery type and the size of the vents, a forced ventilation system might be required. A forced ventilation system should:

- be corrosion resistant and designed in such a way that it will not ignite vented gases (e.g. by using flameproof motors);
- operate automatically:
  - when the batteries are on charge (including under regenerative braking, if used);
  - when the batteries are discharging; and
  - for a sufficient time after the batteries are taken off charge so as to remove the residual gases contained within the battery cases;

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- operate by extracting gas from the battery compartment and not by blowing air into the compartment (this is to ensure that if the battery compartment leaks, it will not result in gas being forced into the vehicle interior);
- have an air flow rate well in excess of the gas formation capacity of the batteries under charge and, if necessary, large enough to cool the batteries during the charge and discharge cycles (advice should be sought from battery manufacturers about heat and gas generation);
- be adequately protected from mechanical damage.

The battery compartment ventilation system needs an air inlet and outlet. The inlet and the outlet should be at opposite ends of the enclosure. The inlet opening should be external to the vehicle (not underneath); if not, it must have a pressure sensitive valve to prevent reverse flow of gases and liquids into the vehicle interior. The inlet opening should not be placed in the vicinity of the ventilation system outlet. With the vehicle in motion the inlet should preferably be in an area where the local pressure is likely to be higher than static atmospheric pressure. A suitable position for an inlet is at the base of the windscreen. The outlet should be in an area where the localised air pressure is less than the static atmospheric pressure, a suitable position being on the side of the vehicle at the rear (the outlet must not be placed underneath the vehicle).

2.4 LABELLING OF BATTERY COMPARTMENTS

Electric vehicles employ higher voltages than normal internal combustion vehicles and batteries contain chemicals, particularly acids, which may cause a hazard in the event of a crash. It is strongly advised that each battery compartment is labelled with the appropriate hazard symbols and an indication of the voltage likely to be encountered.

2.5 POWER UNIT

The electrical propulsion circuit must be isolated from other circuits in the vehicle. If safety equipment such as lights, brakes and windscreen wipers use the same power source as the traction motor, these services must be supplied in preference to the traction circuit. The design of any ancillary equipment supply should be such that satisfactory operation of all equipment, particularly brakes and headlights, is available throughout the discharge cycle of the traction batteries.

2.6 CONTROLS

A master switch for isolating the power supply to the motor and its control apparatus must be located within easy reach of the driver. The master switch must isolate all electrical connections to the power source. If not of flameproof design, the switch shall not be placed within a battery compartment. It must be operable by direct mechanical action and must not rely on any electrical or electromechanical device.

2.7 ELECTRICAL INSTALLATION STANDARDS

All electrical control apparatus, the motor and major ventilation system components must be effectively sealed or otherwise resistant to water and dust ingress.

All electrical installation work must be designed and executed in accordance with acceptable codes and standards. All power unit wiring and connections must be insulated (double insulated if appropriate) and provided with adequate mechanical protection. Where possible, all wiring should be located outside the passenger compartment or load space in order to minimise the possibility of contact by the operator or passengers. In places where the placement of electrical wiring in the passenger compartment or load space is unavoidable, the wiring should be contained within a rigid protective housing.

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All wiring must be effectively secured to the chassis at regular intervals of not more than 600 mm, unless supported by a conduit or other rigid protective housing. The wiring should be kept away from moving and hot parts and be protected from chafing against sharp edges.

It is important to ensure that the size and insulation of the cable used in the traction circuit is suitable for its intended application. Most automotive cable is not designed for the higher voltages used in electric vehicles or for constant high current operations. The designer should make allowance for high peak currents in the stall and heavy acceleration modes.

All electrical control apparatus for the traction circuit should be designed on fail-safe principles; i.e. the failure of any individual component within the traction circuit should stop the motor.

Any traction circuit over-current protection device (e.g. a fuse or overload relay), shall not be placed within a battery compartment but, nevertheless, must be connected as close as practicable to the batteries (see also below under *Other Issues*).

If a wire or cartridge type fuse is used for over-current protection and the vehicle has a direct current supply source, it is necessary to ensure that the fuse is rated by its manufacturer for use with direct current.

2.8 WEIGHT CONSIDERATIONS

One problem, which must not be overlooked, is the possibility that some mechanical components of the converted vehicle might become overloaded because of the increase in weight caused by the addition of the traction batteries and motors. This is particularly important with the tyre and axle loadings of converted passenger cars and light commercial vehicles. Check that the strength and fatigue resistance of every component is adequate for its new function (manufacturers can supply advice about these loadings) and bear in mind that a change in weight distribution can overload components (e.g. front axle) without there necessarily being an increase in the overall weight.

Remember that it is the weight of the laden vehicle that matters—allow *at least* 68 kg per passenger, plus 13.6 kg of luggage for each passenger, for a total minimum allowance of 81.6 kg per passenger.

This allowance is the legal minimum. Given the size of the Australian population, it is recommended that the allowance chosen is higher. The intended use of the vehicle should also be considered—a vehicle intended for shopping or as a family runabout will require a higher allowance than a vehicle used purely for commuting.

2.9 BRAKES AND STEERING

If the original vehicle was fitted with air brakes, vacuum assisted brakes or power assisted steering, an alternative source of energy must be fitted. The power and capacity of the new source must be of sufficient capacity to provide efficient functioning of the system and meet all the legal capacity requirements.

3 OTHER ISSUES

3.1 Electrical Safety

Any electrical potential greater than 32 volts, connected to a low impedance source, such as a traction battery, must be regarded as dangerous. It is recommended that all electric vehicles

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that use such voltages be equipped with some form of automatic power disconnection device (such as a battery isolating inertia switch), to minimise the hazard of fire or electric shock in the event of a crash.

It is also strongly suggested that the master switch is readily visible to, and identifiable by, persons outside the vehicle. This will assist emergency and rescue personnel if the driver is unconscious or otherwise unable to ensure that the battery is safely isolated.

Similarly, it is suggested that the main battery insulated conductors are coloured according to:

- negative cables – black;
- positive cables carrying less than, or no more than, 32 V – red;
- positive cables carrying greater than 32 V – orange.

Vehicles not fitted with a conventional gearbox and using a voltage reversal switch to select reverse drive should be designed so that they cannot be accidentally placed in reverse. A switch with a lockout function is acceptable, as is a separate reverse enabling switch. As electric vehicles are normally much quieter than conventional ones the safety of bystanders should be given serious consideration. It may be necessary to install a reversing aid such as a closed circuit television, a proximity sensor or a reversing alarm.

To ensure satisfactory service over the range of climatic conditions found in Australia, it is recommended that electric vehicles be designed for prolonged operation at ambient temperatures ranging from -10°C to +50°C.

Consider using current sensitive overload relays instead of simple wire or cartridge type fuses in the traction circuit (current sensitive so that the current to the motor is reduced to a safe level when overload occurs). Solid-state apparatus is acceptable. This will ensure that a total loss of drive does not occur and if an emergency does arise, the driver will have the battery-isolating switch at his or her disposal.

It is strongly recommended that the charging supply socket be fitted with an interlock circuit, which immobilises the vehicle when the charging cable is connected. Consideration should be given to the ventilation of the charging station, and to installing “No Smoking” signs where ventilated batteries are used.

3.2 ALTERNATIVE STANDARD

The electrical system of the vehicle will be acceptable if it can be shown to comply with the technical requirements of UN ECE Regulation No 100 *Uniform Provisions concerning the Approval of Battery Electric Vehicles with Regard to Specific Requirements for the Construction and Functional Safety*. It must be noted that such a vehicle is still required to comply with the other ADRs that may be affected by a conversion.

SPECIAL NOTES

ELECTRICAL INSTALLATIONS

Before starting construction of an electric vehicle some knowledge can be gained by reading Australian/New Zealand Standard AS/NZS 3000:2000*: Electrical installations* (known as the Australian/New Zealand Wiring Rules), in particular, section 7.9 *Hazardous Areas*.

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Radio frequency (RF) remote controls

Note: Manufacturers and importers of devices that utilise low powered radio frequency (RF) must ensure that these units comply with the Radio communications Standard AS/NZS 4268:2003 *Radio Equipment and Systems – Short Range Devices – limits and Methods of Measurements*. It is the responsibility of each supplier to assess their products against the standards to determine whether or not their products are affected by these requirements.

Builders or modifiers must therefore ensure that any RF devices they manufacture or use are appropriately labelled as complying with the above standards.

The Australian Communications and Media Authority (ACMA) is the body responsible for administering the laws relating to electromagnetic and radiofrequency emissions.

More information is available from the Authority or its website, www.acma.gov.au.

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Checklist LV1
CODE LV1 Electrical Power Installation Checklist
20 September 2005

Owner Details

Owner's Name _____

Address _____

_____

Telephone _____ Mobile _____

Email _____

Vehicle Details

Make _____ Model _____ Year of Manufacture _____

Vehicle Mass (kg) _____ Fuel Tank Certification Number (where applicable) _____

VIN/Chassis Number _____

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Motive Power Source

Does the vehicle have a hybrid power source? Y ☐ N ☐ NA ☐

If Yes:

Briefly describe the hybrid type _____

Electric Motor Details

Make _____ Type _____

Maximum Power Output _____ kW

Year of manufacture _____

Combustion Engine Details if Applicable

Make _____ Type _____ No. of Cylinders/Rotors _____

Displacement _____ Litres or _____ Cubic Inches Year of Manufacture _____

ADR Engine was designed to comply with _____ Maximum Power Output _____ kW or _____ BHP

Signatory Approval

Vehicle Approved By (Signatory) _____

Signatory Employer (if applicable) _____

Signed _____ ***Date*** _____

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(NA= Non Applicable, Y=Yes, N= No, Sig= Signatory)

MAKE:	**MODEL**	**CATEGORY**
ENGINE/MOTOR No. (Where required)	**VIN:**	

If the vehicle is an Individually Constructed Vehicle (ICV)

Clause	Feature	Compliance	Sig
1.1	Has this vehicle, other than the electric drive and controls, been built to comply with the provisions of NCOP Section LO for the type and category of ICV that applies to this vehicle?	Y ☐ N ☐ NA ☐	
1.1	Are all ICV checklists completed and signed?	Y ☐ N ☐ NA ☐	

If this vehicle is a modified production vehicle

Clause	Feature	Compliance	Sig
1.2	Have all modifications been carried out in accordance with the appropriate Sections of the NCOP?	Y ☐ N ☐ NA ☐	
1.2	Are all modification checklists completed and signed?	Y ☐ N ☐ NA ☐	

Battery Restraint

Clause	Feature	Compliance	Sig
2.1	Are the batteries restrained to cope with the specified forces?	Y ☐ N ☐ NA ☐	

Containment of Wet Cell Batteries

Clause	Feature	Compliance	Sig
2.2	Are batteries properly sealed so that escaping gasses or fluid cannot enter the vehicle cabin?	Y ☐ N ☐ NA ☐	
2.2	Are battery compartments made from corrosion resistant material or lined with appropriate material?	Y ☐ N ☐ NA ☐	
2.2	Except for ventilation are all exterior battery compartment openings fully sealed?	Y ☐ N ☐ NA ☐	
2.2	Has the potential for flame propagation between battery cases been minimised?	Y ☐ N ☐ NA ☐	

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(NA= Non Applicable, Y=Yes, N= No, Sig= Signatory)

MAKE:	**MODEL**	**CATEGORY**
ENGINE/MOTOR No. (Where required)	**VIN:**	

Venting of Battery Compartments			
Clause	**Feature**	**Compliance**	Sig
2.3	Are battery compartments properly vented?	Y ☐ N ☐ NA ☐	
2.3	If forced ventilation is required is it designed to:		
	• Minimise the risk of ignition?	Y ☐ N ☐ NA ☐	
	• Operate automatically?	Y ☐ N ☐ NA ☐	
	• Extract the gases (i.e. by not blowing air into the compartments)?	Y ☐ N ☐ NA ☐	
	• Have a greater air flow capacity than the rate at which gases form?	Y ☐ N ☐ NA ☐	
	• Have sufficient capacity to keep the batteries at an acceptable temperature?	Y ☐ N ☐ NA ☐	
2.3	No inlet or outlet openings located underneath the vehicle?	Y ☐ N ☐ NA ☐	
2.3	Inlet and outlet openings are well separated?	Y ☐ N ☐ NA ☐	

Labelling of Battery Compartments			
Clause	**Feature**	**Compliance**	Sig
2.4	Are battery compartments labelled so as to display appropriate hazard symbols and indicative voltages?	Y ☐ N ☐ NA ☐	

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(NA= Non Applicable, Y=Yes, N= No, Sig= Signatory)

MAKE:	**MODEL**	**CATEGORY**
ENGINE/MOTOR No. (Where required)	**VIN:**	

Power Unit

Clause	**Feature**	**Compliance**	Sig
2.5	Are the electrical propulsion circuits separated from other electrical circuits?	Y ☐ N ☐ NA ☐	
2.5	Are all electrically operated essential safety items on the vehicle preferentially supplied?	Y ☐ N ☐ NA ☐	

Controls

Clause	**Feature**	**Compliance**	Sig
2.6	Is a master switch for isolating power located within easy reach of the driver?	Y ☐ N ☐ NA ☐	
2.2	Is the switch operated by direct mechanical means?	Y ☐ N ☐ NA ☐	
2.2	If located inside a battery compartment, is the switch flameproof?	Y ☐ N ☐ NA ☐	

Electrical Installation Standards

Clause	**Feature**	**Compliance**	Sig
2.7	Has all electrical work been carried out to an acceptable standard? (Quote Std……)	Y ☐ N ☐ NA ☐	
2.7	Are all power connections properly insulated and provided with mechanical protection?	Y ☐ N ☐ NA ☐	
2.7	Are all cables running through passenger compartments or load spaces properly contained within rigid protective housings?	Y ☐ N ☐ NA ☐	
2.7	Are all cables not contained in a housing or conduit supported at not less than 600mm intervals?	Y ☐ N ☐ NA ☐	
2.7	Have all cables been designed to ensure they have both the capacity and insulation properties to handle the expected high peak currents?	Y ☐ N ☐ NA ☐	
2.7	Are all electrical controls designed on a fail-safe basis?	Y ☐ N ☐ NA ☐	
2.7	Are all fuses and/or overload relays located outside of battery compartments?	Y ☐ N ☐ NA ☐	
2.7	Are all electrical components used in DC circuits rated for DC use?	Y ☐ N ☐ NA ☐	

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(NA= Non Applicable, Y=Yes, N= No, Sig= Signatory)

MAKE:	**MODEL**	**CATEGORY**
ENGINE/MOTOR No. (Where required)	**VIN:**	

Weight

Clause	Feature	Compliance	Sig
2.8	Is the vehicle structure, including tyres, of sufficient capacity to carry the completed vehicle and its expected load?	Y ☐ N ☐ NA ☐	
2.8	Have all individual components been checked for load capacity?	Y ☐ N ☐ NA ☐	

Brakes and Steering

Clause	FEATURE	COMPLIANCE	Sig
2.9	Have brakes and steering been checked and found to comply with the appropriate requirements as specified in Sections L and LS of the NCOP?	Y ☐ N ☐ NA ☐	

Special Notes

Clause	Feature	Compliance	Sig
3.1	Are all RF devices tested and labelled against AS/NZS 4268:2003?	Y ☐ N ☐ NA ☐	

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