DESIGN REQUIREMENTS FOR CONVERSION OF MOTOR VEHICLES TO ELECTRIC DRIVE IN QLD

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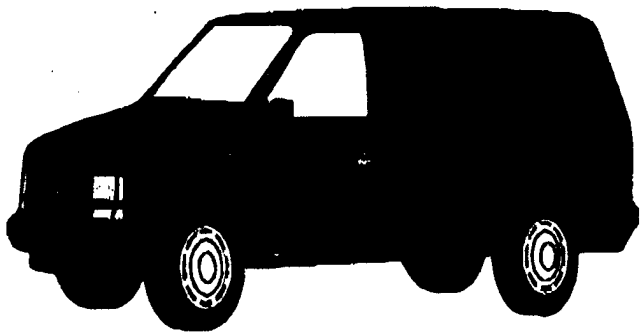

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Third edition March 2002

1. COMPLIANCE WITH DESIGN RULES

Converted vehicles have to meet the same basic set of safety design requirements that applied to the original vehicle. Some of the requirements are set out as Australian Design Rules (ADR'S). Where any system governed by a design rule is altered, it is necessary to show that the original requirements of the rule are still met (this does not apply of course, to the rules on exhaust emissions if the internal combustion engine is removed, but it does apply to vehicle noise).

2. BATTERY INSTALLATIONS

2.1 The batteries that power the vehicle must be fixed in position so that they will not break free in a crash and thus create any hazard to the driver or passengers or any other road users. The battery restraining system must adequately withstand crash deceleration of 20G (eg 20 times battery weight).

Total of battery and container weight	.....kg
Multiply by 20	.....kg
Divide by number of anchoring points	.....kg
Equal the sheer strength of each anchoring point	.....kg

2.2 All batteries, including ancillary equipment batteries, must be effectively scaled off from the vehicle interior so that any liquid spillage or gas leakage into the vehicle cannot occur. (In general, the batteries must either be fully enclosed in a sealed vented compartment or must he individually scaled and externally vented).

2.3 Any battery compartment must be constructed of a corrosion resistant material or be fully lined with a durable corrosion resistant material or coating that will not shrink or crack under extremes of vibration and temperature.

2.4 Any battery compartment seals must be of a non-porous material resistant to corrosion.

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

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

3. VENTING OF BATTERY COMPARTMENTS

3.1 The design of the batteries or battery compartment must provide for venting directly to the 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 for an explosion.

3.2 Depending upon battery type and size of vent, a forced ventilation system might be required.

A forced ventilation system should:

(A) Be corrosion resistant and designed in such a way that it will not ignite vented gases (flameproof motors, etc).

(B) Operate automatically:
- When the batteries are on charge (including under regenerative braking, if used);
- When the batteries are discharging;
- For a sufficient time after the batteries are taken off charge so as to remove any residual gases contained within the battery cases;

(C) Operate by extracting gases and vapours from the compartment and not by blowing the air into the compartment (this is to make sure that if the battery compartment leaks, it will not result in a leakage of gases into the vehicle interior).

(D) Have an air flow rate well in excess of the gas evolution capacity of the batteries under charge and, if necessary, sufficiently large enough to cool the batteries while under charge and drive cycles.

(E) Be adequately protected from mechanical damage.

3.3 The battery compartment ventilation system needs an air inlet and outlet. The inlet should be located at the front bottom of the battery enclosure and the outlet located at the rear top of the enclosure (hot air and hydrogen rise). The inlet opening should be external to the vehicle. If not, it must have a pressure sensitive valve to prevent the reverse flow of gases and liquids into the vehicle interior. The inlet should not be placed in the vicinity of the ventilation system's outlet.

4. POWER SYSTEMS

The electrical propulsion circuit must be isolated from other circuits in the vehicle. If safety equipment such as lights, brakes, windscreen wipers, etc use the same power source as 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.

5. CONTROLS

There must be located within reach of the driver. A master isolating switch. If not of flameproof design, the switch shall not be placed in the battery compartment.

6. ELECTRICAL INSTALLATION STANDARDS

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

6.2 All electrical installation work must be designed and executed in accordance with applicable codes and standards. All power unit wiring and connections must be, where possible, located outside the passenger compartment or load space in order to minimise the possibility of contact by operators or passengers. In cases where placement of electrical wiring in the passenger compartment or load space is unavoidable, the wiring should be contained with in a rigid protective housing.

6.3 It is important to ensure that the insulation of 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 allowances for high peak currents in the stall and heavy acceleration modes.

6.4 All wiring must be effectively secured to the chassis at regular intervals of not more than 600mm. The wiring should be kept free from moving parts and be protected from chafing against sharp edges.

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

6.6 Traction circuit limiting devices (eg a fuse or overload relay), should not be placed within a battery compartment but, nevertheless, must be connected as close as practicable to the batteries.

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

7. OTHER CONSIDERATIONS

7.1 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. This is particularly important with tyre and axle loadings of converted passenger cars and light commercials. Cheek that the strength of every such component is adequate for its new function. Remember: it's the weight of the laden vehicle that matters. Allow at least 68kg per passenger, plus 13.6kg for luggage. Total 81.6kg.

	FRONT	REAR
Laden weight at each axle	..... kg	..... kg
Manufactures maximum laden weight at each axle	..... kg	..... kg
Number of tyres at each axle	.....	.....
Tyre Size	.....	.....
Tyre ply rating	.....	.....
Tyre load rating	.....	.....
Total laden weight of vehicle		..... kg
Manufacturers maximum laden weight of vehicle		..... kg

7.2 If the vehicle is fitted with air or vacuum assisted brakes or power assisted steering, all alternative source of vacuum, air or power assistance must be fitted. The new source must be equal to or greater than the original source.

Vacuum original vehicle	..... IN.HG
Vacuum modified vehicle	..... IN.HG
Air original vehicle	..... KPA
Air modified vehicle	..... KPA
Power steering original vehicle	.....
Power steering modified vehicle	.....

7.3 The fitting of the replacement electric motor must not require removal or weakening of sub-frames, chassis, cross or body members. The steering mechanism of the vehicle must not be altered in any way.

7.4 Automotive type electric motor mountings must be used on suitably fabricated brackets to the satisfaction of the inspecting officer.

7.5 All access holes into the vehicle cabin for gear linkages, cables, etc must be suitably sealed to prevent the entry of road fumes.

7.6 It is the converter's responsibility to ensure that the accuracy of the vehicle's speedometer is maintained.

7.7 All work preformed must be in accordance with recognised engineering standards and to the satisfaction of the inspecting officer.

7.8 The removal of the heating source for windscreen demisting will necessitate the provision of an alternative source of heat or perhaps an alternative demisting arrangement. A performance equal to or better than that o C the original demisting system must be maintained.

8. POINTS TO REMEMBER

8.1 Any electrical potential greater than 32 volts, coupled with a large current capacity, should be regarded as dangerous.

8.2 Electric vehicles can be very quiet in their operation and, in some situations, this might result in increased risk for other road users, particularly pedestrians. Consequently electric vehicles must have effective horns and it is recommended that an audible reversing alarm be fitted.

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

8.4 Consider using current sensitive overload relays instead of simple wire or cartridge type fuses (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 control of the traction motor will not occur and if an emergency does arise, the driver will have the master-isolating switch at his disposal.

8.5 It is recommended that the charging socket be fitted with an interlock circuit, which immobilises the vehicle when the charging cable is connected.

8.6 Vehicles not fitted with a conventional gearbox and using a voltage reverse switch to select reverse gear should be designed so they cannot be accidentally placed in reverse, A switch with a lockout function is acceptable as is a separate "reverse" enabling switch.

9. SPECIAL NOTES

9.1 It is advisable to check with the appropriate electrical authorities concerning the recharging of electric vehicles in domestic or commercial environments.

9.2 Where applicable, the wiring should conform to AS/NZS 3000:2000 (or more recent editions),"Wiring Rules", in particular section 7 9,"Hazardous Locations".

9.3 Further information can be obtained from Compliance Standards Transport House PO Box 673 Fortitude Valley 4006 (07) 3253 4851.