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VEHICLE certification NEW ZEALAND

A DIVISION OF THE NEW ZEALAND HOT ROD ASSOCIATION (INC.)

EVTRANZ

ELECTRIC MOTOR VEHICLE

CODE OF CONSTRUCTION & INSPECTION FORMS

FOR ELECTRIC VEHICLES

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If any Certifying Agents have any queries on any part of the Certification Process, please contact Vehicle Certification New Zealand.
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INTRODUCTION

The preliminary notes are for the assistance of VCNZ Certifiers with limited experience of Electric Motor Vehicles, and people who intend to construct an electrically powered Light Motor Vehicle. The notes apply to vehicles that are to be originally manufactured for electric drive or are to be converted from petrol or diesel operation. Certifiers should re-familiarise themselves with these notes prior to each Certification Inspection.

BATTERY INSTALLATION

- Battery Location - All batteries located within the passenger compartment are required to be fully enclosed in a sealed environment, incorporating adequate venting to this compartment to outside the passenger/driver compartments. The enclosure must be constructed of corrosive resistant materials throughout. Positive ventilation in this area must utilise sparkless/brushless motors.

2.5G? See C1-1

- Battery Restraints - All batteries located outside the passenger/driver compartment must meet standard requirements of restraint horizontally and vertically to (1.5G.) All batteries located in the passenger/driver compartment must be restrained to a horizontal force of 20G and a vertical force of 4.5G.

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

N/A - Common Water Replenishing System - Any battery system that contains a common water replenishing system, must be designed so that propagation of flame between battery cases cannot occur.

VENTING OF BATTERY COMPARTMENTS

- Design - 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.

- Ventilation - The battery compartment ventilation system needs an air inlet and outlet which should be at opposite ends of the enclosure. The inlet opening should be external to the vehicle. The inlet opening should not be placed in the vicinity of the ventilation systems outlet and with the vehicle in motion it should preferably be in an area where the local air pressure is likely to be higher than static atmosphere pressure.

- Operation - Depending on the battery type and compartment, a ventilation system may be required. This should;

(a) Be corrosive resistant and designed in such a way that it will not ignite vented gases,

(b) Operate automatically;

(i) when the batteries are on charge (including under regenerative braking, if used);
(ii) when batteries are discharging;
(iii) 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 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 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. Advice should be sought from battery manufacturers about heat and gas generation.

(e) Be adequately protected from mechanical damage.

* CHECK — IS THIS FOR REVERSE OPERATION OF ELECTRIC MOTOR OR DOES IT APPLY TO GEARBOX SELECTED REVERSE ALSO.

SEEMS UNNECESSARY FOR GEARBOX CASE AS IS SAME AS NORMAL CAR CASE. 7

POWER UNIT

- Power Unit - 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 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 controlled discharge cycle of the traction batteries.

CONTROLS

- Master Switch - They must be located within the reach of the driver, a switch for isolating the power supply to the motor and it's control apparatus.

- Isolator - A mechanical master switch must also be fitted to isolate the power source from the motor controller circuitry. 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 electro-mechanical device.

* - Reverse - A warning light located on the dash must illuminate when reverse is selected.

ELECTRICAL INSTALLATION

- Installation - All electrical installation work must be designed and executed in accordance with applicable New Zealand codes and standards. All power unit wiring and connection must be double insulated and, where possible, located outside the passenger compartment or loadspace in order to minimise the possibility of contract by the operator or passengers. In cases where placement of the electrical wiring in the passenger compartment is unavoidable, the wiring should be contained within a rigid protective housing. ?

  It is important to ensure that the insulation of the traction circuit is suitable for it's intended application. Most automotive cable is not designed for the higher voltages or for constant high current operations. The designer should make allowance for the high peak currents in the stall and acceleration.

- Cabling - Main power cables require a current/power rating that exceeds the amperage draw of the main traction motor under stall (locked rotor) conditions or alternatively, 1.5 times the continuous current rating as stated on the motor nameplate. If not suitably shielded, H D welding cable or similar, all cabling should be suitably protected and restrained at intervals of no less than 350 mm. ? ?

- Fixing - All wiring must be effectively secured to the chassis at regular intervals of not more than 400mm. The wiring should be kept free from moving parts and be protected from chafing against sharp edges.

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

✓ Fail Safe - All electrical control apparatus for the traction circuit should be designed on fail-safe principles, ie:. the failure of any individual component within the traction circuit should stop the motor.

- Current Limiting Device - Any traction circuit current limiting device (eg:. a fuse or overload relay), must not be placed within a battery compartment but, nevertheless, must be connected as close as practicable to the the batteries.

- Circuit Breaker - A suitable DC rated main ~~use~~ fuse or circuit breaker should be incorporated to protect the traction battery pack from dead short circuit. This should be factored 20% higher than the maximum amperage available to the motor and ancillaries, but rated less than the 5 minute cable rating.

The vehicle may have incorporated into the circuiting an approved automotive inertia de copula switch to disable all circuiting in the event of collision.

- Charging Interlock - If the vehicle is fitted with an external charging supply connection then it must be fitted with an interlock circuit which immobilises the vehicle when the charging cable is connected.

- Onboard Charges - Vehicles with onboard charges must have an electrical Warrant of Fitness for the vehicle.

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.

This is particularly important with tyre and axle loadings of converted passenger cars and light vehicles. Check that the strength of every such component is adequate for its new function (manufacturers can sometimes supply data about these loadings). Remember that it's the laden vehicle that matters - allow at least 70 kg per passenger (including luggage).

POINTS TO REMEMBER

- Electric vehicles must comply with all applicable New Zealand regulations and statutory requirements. Likely regulations are Transport Regulation 1976, Transport (Vehicle Standards) Regulations 1990, Electrical Wiring Regulations 1933, Dangerous Goods Regulations 1985. When using DC to DC converters care must be taken to ensure that any RFI or EMI generated does not effect the operation of the control circuitry.

- Any electrical potential greater than 32 volts, coupled with a large current capacity, should be regarded as dangerous and labelled appropriately. The traction circuit should be fitted with a minimum of a cartridge type fuse which will disconnect the battery pack in the event of an accident causing an electrical short.

- To ensure satisfactory service over the range of climate conditions found in New Zealand, it is recommended that electric vehicles be designed for prolonged operation in temperatures ranging from -10C to +40C.

- Consider using current sensitive overload relays or controllers 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. If an emergency does arise, the driver will still have available the battery isolating switch.

\lternative fuel Battery Logo stickers must be affixed to front and rear bumpers.

— WHERE ARE THESE AVAILABLE?

REGULATIONS

C1 - BATTERIES AND ELECTRICS

C1.1 Battery mounting must meet the following restraint requirements:

(a) All batteries located outside the passenger/driver compartment must meet standard requirements of restraint horizontally and vertically to 2.5G. Standard automotive clamps are sufficient.

COMMENT: ..... ☐

(b) All batteries located in the passenger/driver compartment must be restrained to a horizontal force of 20G and a vertical force of 4.5G. Requirements are proof of design by a suitably experienced approved engineer.

COMMENT: ..... ☐

C1.2 Is the battery compartment fully sealed from the passenger compartment? ..... YES ☐
If NO, give reasons: ..... NO ☐
.....

C1.3 All batteries located within the passenger compartment are required to be fully enclosed in a sealed environment, incorporating adequate positive venting of this compartment to outside the passenger/driver compartments.

COMMENT ..... ☐

C1.4 Is the battery compartment constructed from corrosion resistant materials? ..... YES ☐
Name materials used: .....

If the answer is NO, is the battery compartment lining or internal surface coating corrosion and heat resistant? ..... NO ☐
Name materials used: .....

C1.5 Are all materials used to seal the battery compartment openings or fittings non porous and corrosion resistant? Name the materials used: ..... YES ☐
If the answer to question C1.5 is NO, give reasons: ..... NO ☐
.....

C1.6 Are all battery compartment openings and fitting fully sealed including the bore of any conduit (but excluding ventilation ducts)? ..... YES ☐
If no, give reasons: ..... NO ☐
.....

C1.7 Describe method of preventing flame propagation between battery cases for any battery system which is inter-connected by a common vent to water replenishing system:
.....
.....
.....

C1.8 Describe method of venting batteries to atmosphere:

(a) Natural Venting: ..... ☐

(b) Extraction: ..... ☐

(c) Other (describe): ..... ☐

C1.9 Forced ventilation must utilise sparkless brushless motors, incorporating charging and discharging with timed run-on for minimum of three minutes after operation.

COMMENT: ..... ☐

C1.10 Are all materials used in the ventilation system corrosion-resistant? ..... YES ☐

If NO, give reasons: ..... NO ☐

.....

C1.11 Does the ventilation system provide sufficient air flow to expel the gas effectively? Explain how this has been determined: ..... YES ☐

..... NO ☐

C1.12 Is all electrical equipment which is likely to come in contact with gasses (given off by the batteries) flame proof? ..... YES ☐

..... NO ☐

C1.13 Does the ventilation system operate automatically during discharging (including during regressive braking if used and also for a sufficient time after charging to remove residual gases)? . YES ☐

If NO, give reasons: ..... NO ☐

.....

C1.14 Is the ventilation fan located in the outlet of the ducting? ..... YES ☐

If NO, give reasons stating method of preventing entry of gases into passenger compartment in the event of a failure of a battery compartment seal. ..... NO ☐

.....

C1.15 Where is the inlet to the battery ventilation system located? .....

.....

.....

.....

C1.16 Where is the outlet to the battery ventilation system located? .....

.....

.....

C1.17 Does any safety related system (eg: lights, demister, brakes, windscreen wipers, etc) use power from the same source as the elective motor? ..... YES ☐

If the answer is YES, do these systems operate preferentially to the electric motor(s)? .....

.....

If NO, give reasons: ..... NO ☐

.....

C1.18 Do all safety related systems operate satisfactorily at all times while the vehicle is able to be propelled by the electric motor(s)? ..... YES ☐

..... NO ☐

C1.19 Where the base vehicle was originally fitted with vacuum boosted brakes, air brakes or power steering, describe how performance of these systems has been maintained after conversion: .....

.....

.....

C1.20 All electrical control systems for the traction circuit should incorporate fail safe principles disabling the motor in the event of failure of an individual component.

COMMENT: ..... ☐

C1.21 What type of battery isolation switch is fitted to the vehicle? .....

.....

.....

C1.22 What is the maximum continuous current rating of the switch? .....

.....

.....

C1.23 Does the switch isolate all phases or poles of the electric motor power source? ..... YES ☐

If NO, give reasons: ..... NO ☐

.....

C1.24 Is the isolation switch flameproof? ..... YES ☐

..... NO ☐

C1.25 Is any part of the switch located in the battery compartment? ..... YES ☐
If YES, give reasons: ..... NO ☐
.....

C1.26 Can the switch be operated by the driver while seated in the normal driving position? .... YES ☐
If YES, give reasons: ..... NO ☐
? NO surely!

C1.27 Are any cable for the electric traction motor located within the passenger compartment?. YES ☐
State the method of protecting the cables against accidental damage: ..... NO ☐
.....

C1.28 Are any cables for the electric traction motor located under the vehicle? ..... YES ☐
State method of protecting cable against accidental damage: ..... NO ☐
.....

C1.29 What is the maximum voltage available in the traction circuit? .....

C1.30 What is the maximum continuous and peak current rating of the electric motor(s)?

Continuous: .....
Peak: .....

C1.31 What is the maximum voltage rating of the electrical cable which supplies the electric traction motor(s)? .....
volts.

C1.32 What is the continuous (and peak if known) current rating of the electrical cable which supplies the electric traction motor(s)?

Continuous: ..... amps
Peak: ..... amps

C1.33 If the peak current rating of the motor(s) exceeds the continuous current rating of the cable, for what period of time can the cable safety carry the peak current of the motor(s)? ..... minutes.

C1.34 If the cable is enclosed in a protective housing, has any compensation been made in the cable's current carrying capacity for temperature build-up? ..... YES ☐
If NO, give reasons: ..... NO ☐
.....

C1.35 Does the electrical circuit which supplies the electric traction motor(s) contain a current limiting device (eg: fuse of overload relay)? ..... YES ☐
If YES, describe the device and it's location: ..... NO ☐
.....

C1.36 A suitable DC rated main fuse or circuit breaker should be incorporated to protect the traction battery pack from dead short circuit. This should be factored 20% higher than the maximum amperage available to the motor and ancillaries.

COMMENT: ..... ☐

C1.37 State the current rating of the drive and the type of current for which the drive was originally designed, (eg: 300 amps). DC ..... amps.

NOTE - This does not apply when vehicle is equipped with secondary motor generator system for charging. Charger must be supplied by residual current protection devices, permanently wired into the circuit. If a mains connected charger is located on board, a current electrical WOF must be carried and displayed, available from a registered electrical inspector.

C1.38 All replacement or modified wiring must be neat and tidy, routed away from any moving parts and heat, and be secured. Main power cables require a current/power rating that exceeds the amperage draw of the main traction motor under stall (locked rotor) amp condition or alternatively, 1.5

times the continuous current rating as stated on the motor nameplate. If not suitably shielded, HD welding cable or similar, all cabling should be suitably protected and restrained at intervals of no less than 350mm

COMMENT: ☐

C1.39 All wiring and main cable terminations should be checked as having sufficient connections and insulating covers/boots or similar, to a tradesmanlike standard. Use of the vehicle's chassis as part of the traction circuit is not permitted.

COMMENT: ☐

C1.40 The released accelerator pedal must incorporate a suitable mechanical switch to disconnect supply to the traction unit.

COMMENT: ☐

C1.41 When the vehicle is in reverse, a warning light must be visible to the driver.

COMMENT: Surely only for electric reverse ☐

C1.42 The state of the traction battery pack charge must be shown, either by way of LED scale or similar volt meter or amp hr meter, to give the operator an indication of remaining battery reserve during the vehicle operation.

COMMENT: Curtis "Fuel" Gauge ☐

C1.43 Ensure that there is a visible means of identification at the front and rear of the vehicle showing the vehicle is electrically powered.

COMMENT: Alternative Fuel Stickers ☐

C1.44 When the traction motor circuit is live, a green power light must be visible to the driver.

COMMENT: Instal "Live" light in dash. ☐

C2 - ENGINE MOUNTING:

C2.1 All electric motor mountings must be designed and constructed in such a way that they will withstand all fore and aft, rotational, and up/downward loads imposed on them, and in such a manner that their design will not impair the life of the rubber mounts by stress.

COMMENT: ☐

C2.2 All fabricated electric motor mounts should be welded by either an NZHRA-Approved Engineer or a Certified Welder, in either case with paperwork provided. If this can not be complied with, particular attention must be paid to the weld quality, and if the quality of the weld is in doubt, either re-welding by an NZHRA-Approved Engineer or Certified Welder, or N.D.T. Certificates may be required.

COMMENT: ☐

C2.3 When bolting through a boxed or RHS chassis (eg:. for electric motor mounts), bolts must pass through tubular reinforcing to prevent crushing of the chassis section (Refer Fig. 3A NZHRA Code of Construction Manual).

COMMENT: ☐

C2.4 Attachment of electric motor mounts to motor, and mounts to chassis, if bolted, must utilise fasteners of a size, type, and grade suitable for the loads that will be imposed on them.

COMMENT: ☐

C2.5 All bolts used in the mounting of an electric motor to a chassis or subframe must be secured with nylocs, spring washers, or other approved locking devices, and must be in good condition. Note that OEM-type serrated washer-head bolts or nuts are acceptable when used in original applications.

COMMENT: ..... ☐

C2.6 Rubber mounts used in any electric motor conversion must be of a type and size no less than that originally used by the replacement engine manufacturer, and must withstand all loads imposed on them.

COMMENT: ..... ☐

C2.7 The electric motor must be mounted in such a way that it can not come into contact with any other part of the engine compartment, or items within the compartment, at maximum engine movement (torque) on the engine mounts. Attention should especially be paid to electrical wiring, flexible hoses, pipes, etc that may become damaged immediately or eventually by heat or movement from engine torque.

COMMENT: ..... ☐

C2.8 The engine mounts must be designed, manufactured and mounted in such a way, that upon failure of either one or both of the engine mounts, the engine weight could not cause the steering system to seize. It is highly recommended that torque straps etc be used to ensure that upon engine mount failure, the straps will hold the engine mount failure, the straps will hold the engine in a 'safe' position, or where there is minimal room between a donor engine and a steering rack, a protection bracket should be manufactured and fitted to prevent contact.

COMMENT: ..... ☐

C3 - TRANSMISSION MOUNTING:

C3.1 All transmission or drive mounting fabrication must be capable of supporting the weight and torque being applied, and must be of a sound design.

COMMENT: ..... ☐

C3.2 All transmission or drive mount welding should be carried out by either an NZHRA-Approved Engineer, or a Certified Welder, in either case with paperwork provided. If this cannot be complied with, particular attention must be paid to the quality of the weld, and if that is in doubt, then either re-welding by an NZHRA-Approved Engineer or a Certified Welder, or N.D.T. Certificates may be required.

COMMENT: ..... ☐

C3.3 When bolting through a boxed or RHS chassis or subframe (eg:. for transmission cross-member) bolts must pass through tubular reinforcing to prevent crushing of the chassis or subframe section. (Refer Fig. 3A NZHRA Code of Construction Manual).

COMMENT: ..... ☐

C3.4 Attachment of transmission mount to transmission, cross-member to chassis (if bolted) must utilise bolts of a size, type and grade suitable for the loads that will be imposed on them.

COMMENT: ..... ☐

C3.5 All bolts used in the mounting of a transmission to a chassis or subframe must be secured with Nyloc nuts, spring washers, OEM-type serrated washer-head bolts or nuts in original applications or other approved locking device, and they must be in good condition.

COMMENT: ..... ☐

C3.6 All conversions involving the use of an automatic transmission must feature an operative inhibitor switch, to permit only neutral and park starts.

COMMENT: ..... ☐

C3.7 Gear-shift operations, in both manual and automatic transmissions, must give correct and logical operation, without any interference caused by the shift mechanism touching any other components or part of the vehicle's structure.

COMMENT: ..... ☐

C3.8 Any part of a unitary construction vehicle that has been cut or removed (eg:. for shifter fitment) should be adequately restrengthened.

COMMENT: ..... ☐

C3.9 Rubber mounts in any transmission conversion must be of a type that will withstand all loads imposed on them. Note also that all transmissions must be mounted in the same way as the engine - ie: if engine is rubber mounted, so must be the transmission; if engine is solid-mounted (although a discouraged practice) then so too should be the transmission.

COMMENT: ..... ☐

C4 - DRIVESHAFT:

C4.1 If a conversion necessitates lengthening or shortening of a driveshaft, welding may only be carried out by;

(a) A recognised driveshaft manufacturing specialist;

(b) A suitably equipped engineering shop using a Certified Welder, or;

(c) A suitably equipped and experienced NZHRA-Approved Engineer.

If this cannot be complied with, particular attention must be paid to the weld quality, and if the quality of welding is in doubt, then re-welding by one of the above, or N.D.T. Certificate may be required. This is deemed a critical area for weld quality.

COMMENT: ..... ☐

C4.2 Driveshafts may be lengthened by the addition of a butt-welded section of tubing, provided that it follows the accepted industry practice of using a counter-bored, press-fitted and welded extension bush made of the same material as the original driveshaft, and does not exceed 100mm in length.

COMMENT: ..... ☐

C4.3 Driveshaft tubing must be of a diameter and wall thickness appropriate for the vehicle's power, torque and weight (eg:. Heavy wall 3" tube for Motor Caravan etc.)

COMMENT: ..... ☐

C4.4 Driveshaft universals must (where available) be of a type and size that matches both the weight, power and torque of the vehicle, together with the fasteners used to attach the driveshaft.

COMMENT: ..... ☐

C4.5 All driveshaft angles must be within the universal manufacturer's specifications, and all universal angles and phasing must be in alignment, unless exact duplication of factory "misalignment" is used.

COMMENT: ..... ☐

C4.6 Driveshaft universals must have as a minimum 3 degree angle to prevent brinelling (premature destruction of bearing due to the lack of rotary movement).

COMMENT: ..... ☐

C4.7 A correct amount of the driveshaft yoke must be engaged into the transmission, and remain correct throughout all rear suspension travel.

COMMENT: ..... ☐

C4.8 Driveshaft universals must not be able to bind or exceed manufacturer's specifications throughout both extremities of suspension travel.

COMMENT: ..... ☐