Vehicle Standards Bulletin 14

NATIONAL CODE OF PRACTICE
for
LIGHT VEHICLE CONSTRUCTION
and
MODIFICATION

SECTION LA
ENGINE

1st February 2006

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

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 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 following light vehicle modifications involving engine substitutions and modifications

1.1 MODIFICATIONS NOT REQUIRING CERTIFICATION

- Fitting a replacement new, used or reconditioned engine.
- Fitting a manufacturer's optional engine for that same model vehicle.
- Fitting replacement original equipment (or equivalent) engine & exhaust components.
- Fitting replacement original equipment, equivalent or better, components that have no influence on engine performance or emissions. (e.g. higher volume oil pump than original)

In all of the above cases, if the engine is modified, it must be certified under the relevant Approval Code.

1.2 MODIFICATIONS REQUIRING CERTIFICATION UNDER LA APPROVAL CODES

- Fitting equivalent engines (within 20% of original power and engine weight).
- Fitting performance engines.
- Installing a supercharger or turbocharger.
- Modifying engines and engine components.

NOTE: General design installation and fabrication requirements for all of the above modifications are contained in sub-section 2 *General Requirements* and more specific requirements are contained in the relevant part of sub-sections 4 or 5.

2 GENERAL REQUIREMENTS

2.1 CHOICE OF REPLACEMENT ENGINE

It is recommended that a manufacturer's standard or optional engine should be selected where possible and installed using all the standard components for that vehicle model. However, where this is not feasible, the following requirements should be met:

- Any replacement engine should be of similar weight and power output to that of an engine fitted by the original vehicle manufacturer as standard or optional equipment.
- When the replacement engine is larger in power output than an engine offered by the vehicle manufacturer as standard or optional equipment, the vehicle must be equipped with any necessary upgrading of equipment, e.g. brakes, front suspension, etc.
- The power and/or torque of the replacement engine should not exceed the capacity of the vehicle driveline.

- Using the engine manufacturer's published specifications, the dimensions of the selected engine should be checked against the vehicle to ensure that:
- The engine fits into the available space without major frame, body or other modifications;
- The engine weight and location of centre of mass must not result in excessive weight on the front or rear suspension;
- The location of ancillary equipment, such as the cooling system, the intake and exhaust systems must be suitable for the vehicle layout;
- The replacement engine should be installed in a position and on an angle that allows the driveline to operate correctly;

If the installation requires modifications to the vehicle structure, such as chassis rails and firewalls, the modification must be approved under the applicable LH Approval Code(s).

2.2 ENGINE MODIFICATIONS

Replacement components such as camshafts, carburettors, engine management systems, exhaust systems, etc. are not permitted unless it can be demonstrated that the vehicle continues to meet the appropriate gaseous and noise emission standards (refer Approval Codes LT3 and LT4).

Note: The fitting of nitrous oxide injection systems is not permitted.

2.3 ENGINE MOUNTS

Providing detailed design guidelines for an engine/transmission support system is beyond the scope of this document. However, factors to be considered should include the following:

- The engine mounts must provide for vibration isolation between the engine and the body.
- The design and construction of the engine mounts must be adequate to withstand the torque output of the engine and the inertial forces from accelerating, braking and cornering.
- The installation of replacement engine mounting brackets does not require approval under the LH Approval Codes provided that sub-frames, chassis members or body members are not altered.

2.4 CLEARANCES

The engine must clear all surrounding components in the engine bay at maximum engine movement including under maximum torque in both forward and reverse gears. A clearance of at least 10 mm should be provided beyond that required for maximum engine movement.

Additional clearance should be provided to components likely to deteriorate from the heat from nearby engine and exhaust components. In particular, flexible fuel pipes, power steering hose and steering column shaft couplings incorporating rubber or fabric components should be placed well clear of hot exhaust components and shielded if necessary.

When fitting a replacement engine to a vehicle with a beam type front axle, sufficient clearance must be provided between the top of the axle, steering linkages and drive shaft (on 4WD vehicles) and the engine (usually the sump) to allow the axle full bump movement.

2.5 GUARDING

To minimise the danger to any person working on the vehicle with the engine running, any exposed rotating parts should be guarded.

Radiator cooling fans should be fitted with guards to restrict access to the top of the fan.

2.6 BRAKE BOOSTER

The vacuum hose between the brake booster (where fitted) and the inlet manifold must be securely fastened at each end using hose clamps or similar. The vacuum connection on the inlet manifold must be located in a position that ensures sufficiently low pressure at the brake booster. This is usually downstream of the throttle body or inlet butterfly on petrol engines.

Some highly modified engines might not develop the required low pressure in the inlet manifold at idle for proper functioning of the brake booster. In such cases, the vehicle must be fitted with a vacuum reservoir to meet the ADR braking requirements.

In the case of a diesel engine conversion on a vehicle with vacuum boosted brakes, it must be fitted with a vacuum pump of capacity adequate to meet the ADR braking requirements.

2.7 EXHAUST SYSTEM

Where possible, the muffler(s) and catalytic converter from the exhaust system of the donor vehicle should be used.

Where alternative exhaust systems are fitted, the system must incorporate any engine emission control equipment fitted in the exhaust system of the donor vehicle.

Where an exhaust system runs through an inner mudguard panel, the panel cut-out must not weaken the inner guard and if necessary, the panel must be reinforced to compensate for the cut-out. Exhaust systems passing through inner guard panels must clear the wheels, tyres and suspension components over the full range of travel of the suspension and steering.

Exhaust systems must provide a minimum of 100 mm ground clearance and also meet the ground clearance requirements of ADR 43/…where applicable.

The outlet of an exhaust system must be rearwards of any passenger side entry door or opening window. If any part of the exhaust system, including the outlet pipe, extends beyond the profile of the body (other than on the underside), it must be shielded. Exhaust outlets must also meet the requirements of ADR 42/…where applicable. Vehicles manufactured after June 1988 must not have the exhaust exiting to the left of the vehicle.

2.8 FUEL SYSTEM

Where a replacement engine was originally designed to operate exclusively on unleaded fuel and a catalytic converter is fitted, the fuel filler neck may be modified so it will only accept the small nozzle used on unleaded fuel bowsers and should include a hinged flap. A permanent notice "Unleaded Fuel Only" may be fitted adjacent to the fuel filler. (Refer to Section LM for more information about fuel systems).

Only flexible hose specifically designed, manufactured and marked for use as a fuel hose, may be used for fuel supply or return in the fuel system.

The ends of fuel hoses must be securely fastened with hose clamps or clips to prevent fuel leakage.

Fuel lines must be positioned well clear of any component that can reach high temperatures and cause the fuel to vaporise or damage flexible fuel hoses. These components can include parts of the engine and accessories such as the exhaust system, turbocharger and air-conditioning compressor.

Fuel lines must be adequately supported and shielded where necessary to prevent damage from hot components and road debris.

Fuel lines must be adequately protected from chafing or damage where they pass through panels, bulkheads or chassis members.

Fuel vapour hoses or pipes associated with the evaporative emission system (charcoal canister) must be connected and the system must continue to operate as designed.

2.9 ENGINE COOLING SYSTEM

Hoses between the radiator and the engine should allow for any movement between them. The hoses should be positioned and supported if necessary to avoid excessive force on their connections. Hoses should not be kinked.

The engine thermostat must not be removed. It is designed to enable the engine to quickly reach and remain at its normal operating temperature.

The system should provide sufficient head of water on the coolant pump inlet to prevent cavitation. This may be achieved by avoiding any restriction on the pump suction inlet and ensuring that the coolant level in the reservoir is higher than the highest point in the engine galleries and the coolant pump

A close-fitting shroud should be mounted between the extremities of the radiator and the cooling fan to ensure efficient cooling (and to minimise danger from exposed rotating fan blades).

2.10 WINDSCREEN DEMISTER SYSTEM

Heater hoses that supply the windscreen demister system must be re-connected to ensure that it functions correctly.

2.11 ELECTRICAL SYSTEM

Electrical wires in wiring looms must be protected from mechanical damage by wrapping with tape or enclosing them in conduit, or other covering. Looms must be supported on the vehicle at positions no more than 600 mm apart with allowance being made for the relative movement that can occur between the engine/transmission and the body/chassis.

The replacement engine's alternator output rating and the battery capacity should be compatible with the vehicle's electrical systems and the replacement engine.

Adequate protection from excessive heat should be provided for all electrical harnesses (and other hose, rubber and plastic components). All heat and noise insulation material as originally fitted should be retained.

With some engine substitutions the battery has to be relocated to the passenger or luggage compartment. Unless a special kind of battery is used in these locations, the battery must be fully enclosed and the enclosure vented to outside the vehicle. Electrically insulated enclosures such as marine battery boxes should be used. The battery should be securely fastened to the vehicle. Battery cables must be shielded where necessary to prevent damage from road debris and be secured to the body at a maximum spacing of 600 mm. Rubber grommets must be fitted where cables pass through holes in body panels and chassis sections.

The AVSR requires that a motor vehicle propelled by a compression ignition engine is fitted with a device that prevents the engine from being started accidentally or inadvertently.

In certain older vehicles, that have a cable operated fuel pump stop, this control must be such that the cable remains in the “off” position until such time as the engine is ready to be restarted. Later model diesel engines that have a solenoid operated fuel cutoff system must be able to be switched off using the ignition switch and only be started when the ignition switch is in the "Run" position.

2.12 FABRICATION

All work must be performed in accordance with high quality and 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.

3 AUSTRALIAN DESIGN RULES

The Australian Design Rules (ADRs) most likely to be affected by an engine change or modification are those relating to gaseous emissions and noise.

However, some engine changes can affect compliance with other ADRs such as braking (diesel engine lack of vacuum), and windscreen demisting (air-cooled engines)

Generally when an engine of different design is substituted, the gaseous emission control system of the donor vehicle, from air intake right through the engine to the exhaust outlet, should be exchanged as a package.

A modified vehicle must continue to comply with the Australian Design Rules applicable to that vehicle, including exemptions allowed for in the Road Transport Reform, Vehicle Standards Rules.

The applicable ADRs are individually listed on the Identification Plate of 2nd Edition ADR vehicles. For 3rd Edition ADR vehicles, the Identification Plate contains the vehicle category and the date of manufacture, from which the applicable ADRs can be determined (refer to the applicability tables in Section LO *ADR Compliance*).

NOTE: Each ADR usually has more than one version. The ADRs can be identified in two different formats as illustrated in the following examples:

- ADR 4, ADR 4A, in the Second Edition (pre 1July 1988), and
- ADR 4/00, ADR 4/01, in the Third Edition (after 1 July 1988).

3.1 GASEOUS EMISSIONS AND FUEL SYSTEMS

The requirements to limit gaseous emissions were introduced in ADR 26 in 1972 when passenger vehicles were required to be fitted with a positive crank case ventilation system (PCV) that prevented blow-by gases escaping into the atmosphere and carbon monoxide emissions were limited.

The requirements have since become progressively more stringent and the current rules now apply to all light and heavy commercial vehicles (ADRs 79 and 80).

All passenger vehicles built after July 1976 were required to be fitted with an effective evaporative emission control system to comply with ADR 27A, and this comprised a carbon canister connected to the fuel tank and induction system.

All passenger vehicles built after January 1986 were required to be fitted with an engine that complies with ADR37 and ran on unleaded fuel. These vehicles required a narrow fuel filler with a flap to prevent incorrect refuelling.

Most diesel-engine vehicles were required to comply with ADR30 from mid-1976 and the engines were labelled accordingly.

ALTERNATIVE REPLACEMENT ENGINES FOR PRE-1986 PASSENGER VEHICLES.

Because of the difficulty in identifying the year of manufacture of some replacement engines or the unavailability of replacement emission control equipment for ADR27 engines, it is recommended that a replacement engine designed for use with unleaded fuel and complying with ADR37 be used where possible. Where this is impractical the following alternative is acceptable for replacement engines for pre-1986 passenger vehicles:

- convert the replacement engine to run on unleaded fuel (if necessary);

- fit new catalytic converter(s) where appropriate;
- fit unleaded fuel filler with flap (optional);
- operate the vehicle on unleaded fuel; and
- Ensure the engine is well maintained – alternatively overhaul and retune the engine.

AFTERMARKET ENGINE-MANAGEMENT COMPUTERS.

The use of aftermarket engine-management computers (not OEM) does not guarantee compliance with the relevant Australian Design Rule (ADR) unless that particular computer/engine combination has undergone ADR emission testing and the evidence of compliance is available (refer Approval Code LT3).

GASEOUS EMISSION ADRS

The following is a list of ADRs relating to gaseous emissions:

ADR	Title
26, 27,	Vehicle Engine Emission Control
27A, 27B, 27C,	Vehicle Emission Control
30, 30/…, 79/…	Diesel Engine Exhaust Smoke Emissions
36, 36A, 36/…	Exhaust Emission Control for Heavy Duty Vehicles
37	Vehicle Emission Control
37/…	Emission Control for Light Vehicles
40	Light Duty Vehicle Emission Control
41, 41/…	Mandatory Operation on Unleaded Petrol
44/…	Specific Purpose Vehicle Requirements (LPG)
70/…	Exhaust Emission Control for Diesel Engine Vehicles
79/…	Emission Control for Light Vehicles

3.2 NOISE

Modified vehicles must continue to comply with the ADRs applicable to the vehicle's date of manufacture and ADR category, or the in-service vehicle standard rules for noise emissions as specified in the AVSR.

If the engine and appropriate exhaust system components from a vehicle known to comply with the relevant ADR (or a later ADR) is fitted, the modified vehicle is deemed to comply with the ADR.

In all other cases the vehicle must be tested in accordance with the relevant ADR or with Approval Code LT4.

The following is a list of ADRs relating to exhaust systems and noise emissions:

ADRS	Title & Comments
28, 28A, 28/…	External Noise of Motor Vehicles
42/…	General Safety Requirements (exhaust outlets)
43/…	Vehicle Configuration & Dimensions (Ground Clearance)
83/…	External Noise

4 MODIFICATIONS WITHOUT CERTIFICATION

The following modifications may be carried out provided they do not affect compliance with Australian Design Rules and provided they meet the following requirements:

4.1 MANUFACTURER'S OPTIONAL ENGINE INSTALLATION

Substituting the original engine with a manufacturer's optional engine is a modification that does not require certification. However, any other components (such as brakes, transmissions, suspension, exhaust, etc) that were packaged by the manufacturer as part of the original specification for the optional engine must also be fitted.

4.2 ENGINE RECONDITIONING

Reconditioning an engine is not a modification and therefore does not require certification, providing the engine remains within the manufacturer's specification limits.

Where gaseous and/or noise emission ADRs apply, all standard equipment (such as carburettors, engine management computers, exhaust systems, exhaust gas recirculating valves, oxygen sensors, catalytic converters, etc), relating to noise and emission control must be retained and operate correctly. Any replacement parts should be of a standard equivalent to the original equipment.

5 CERTIFIED MODIFICATIONS (LA APPROVAL CODES)

This section specifies particular requirements and covers limitations on approvals carried out under individual LA Approval Codes.

Each Code is supplemented with a checklist.

EQUIVALENT ENGINE INSTALLATION

CODE LA1

SCOPE

The following is a summary of the modifications that may be approved under Approval Code LA1 – *Equivalent Engine Installation*.

Approvals are **allowed** under Code LA1 for:

1. Fitting of a replacement engine with not more than 20% greater weight and/or power output than engines offered by the first manufacturer as a standard or optional engine.

Approvals are **not allowed** under Code LA1 for:

1. Fitting of a replacement engine that does not comply with the applicable ADRs.
2. Fitting of a replacement engine of which the specifications are not suitable for use with the existing components of the vehicle.
3. Fitting of a replacement engine that necessitates substantial modification to the vehicle's structure (eg. firewall, chassis modifications).

Code LA1 does not apply to L-group vehicles (e.g. motorcycles).

COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS.

The modified vehicle must continue to comply with all applicable ADRs, VSRs, VSBs, Acts and Regulations.

Outlined below are areas of the vehicle that may be affected by the modifications and that may require re-certification, testing and/or data to show compliance for the modified vehicle.

DETAIL	REQUIREMENTS
Gaseous Emissions	ADR 27, 30, 36, 37, 40, 70, 79,
External Noise	ADR 28, 83
Brake System (vacuum recharge	ADR 31, 35
Exhaust Outlets	ADR 42
Ground Clearance	ADR 43

NOTE: To determine the ADRs that apply to the vehicle in question, refer to the Applicability Tables in Section LO. Vehicles manufactured after 1 January 1969 and prior to 1 July 1988 need to comply with the Second Edition ADRs whilst vehicles manufactured after this date need to comply with the Third Edition ADRs. Section LO has separate applicability tables for each edition.

The ADRs apply according to the vehicle's category and date of manufacture. It is the responsibility of the signatory to refer to the appropriate ADR applicable to the vehicle.

SPECIFIC REQUIREMENTS

The replacement engine should be of similar weight and power output (i.e. an increase of not more than 20 %.) to that of an engine fitted by the original vehicle manufacturer as standard or optional equipment.

The power and/or torque of the replacement engine should not exceed the capacity of the vehicle driveline;

Using the engine manufacturer's published specifications, the dimensions of the selected engine should be checked against the vehicle to ensure that:

- the engine fits into the available space without major frame, body or other modifications;
- the engine weight and location of centre of mass must not result in an unacceptable front or rear suspension loading;
- the location of engine ancillaries, such as the cooling system and intake and exhaust systems must be suitable for the vehicle layout; and
- the replacement engine should be installed in a position and angle, which allows the driveline to operate correctly without excessive vibration or undue stresses on couplings.

When engines are modified by using alternative components such as camshafts, carburettors, injectors and engine management systems, proof of compliance with the relevant ADR is required (refer Approval Code LT3 - *Gaseous Emissions Test*)

When engines are fitted with modified exhaust systems, proof of compliance with the relevant standards is required (refer Approval Code LT4 - *Noise Emissions Test*).

FORM No: LA1

CHECKLIST

EQUIVALENT ENGINE INSTALLATION

APPROVAL CODE LA1

(N/A= Not Applicable, Y=Yes, N=No)

1	**ENGINE**			
1.1	Is the weight and power output of the replacement engine not more than 20% greater than that of any engine offered by the original manufacturer for that model?		Y	N
1.2	Does the engine and installation comply with all relevant ADRs and/or in-service rules (i.e. smoke gaseous emissions and noise)?		Y	N
	LT3 Approval Reference Number (Gaseous Emission Test) ……..		N/A	
	LT4 Approval Reference Number (Noise Test)…….		N/A	
2	**INSTALLATION**			
2.1	**General Requirements**			
	Does the replacement engine installation comply with all of the *General Requirements* of Sections 2.1 to 2.12 of this Code?		Y	N
2.2	**Strength**			
	Has the engine been fitted without the alteration of the vehicle's chassis, sub-frames, cross-members or body members? If not, has the alteration been approved under Code LH?		Y	N
	Has strength of all components modified or affected by modification verified as equivalent to original manufacturer's specifications?	N/A	Y	N
	Are the engine mountings designed to withstand the torsional loads transmitted by the replacement engine?		Y	N
2.3	**Fasteners**			
	Are high tensile bolts and self-locking nuts on all new critical mountings?	N/A	Y	N
	Are replacement fasteners at least equivalent to original in strength and quantity?	N/A	Y	N
2.4	**Protection**			
	Has adequate protection been provided for all hoses, electrical harnesses, and rubber or plastic components?		Y	N
	Are fuel lines securely fastened and clear of high temperature components such as the exhaust system, turbocharger and air conditioning compressor?		Y	N

[Continued overleaf]

FORM No: LA1

(N/A= Not Applicable, Y=Yes, N=No)

2.5	**Workmanship**			
	Is the workmanship including welding to a satisfactory high standard?		Y	N
2.6	**Steering**			
	If modified, has the vehicle's steering system been certified as complying with Code LS2? Insert LS1 Approval Reference Number……..	N/A	Y	N
2.7	**Diesel Engines**			
	If the vehicle is fitted with a replacement diesel engine, is an engine stop control that will prevent accidental or inadvertent starting fitted?	N/A	Y	N
	If the vehicle is fitted with a replacement diesel engine, that is fitted with a solenoid control fuel cutoff system, is the engine able to be switched off from the ignition switch and can it only be started when the ignition switch is in the "Run" position?	N/A	Y	N
	If the vehicle has vacuum assisted brakes and a replacement diesel engine, is an adequate capacity vacuum pump (to comply with the ADR braking requirements) fitted?	N/A	Y	N

NOTE: If the answer to any question is **N (No)**, the modification cannot be approved under Code LA1.

REPLACEMENT ENGINE:

Make.....Type.....……..No. of Cylinders/Rotors .....

Displacement.....……...Litres or..... ..... Cubic Inches

Maximum Power Output.....……..…….....kW..... .....BHP

Engine Weight.....

VEHICLE:

Make.....Model.....……..Year of Manufacture.....

Chassis No. or VIN .....

Vehicle Modified By .....

Vehicle Approved By (Signatory).....

Signatory Employer (if applicable).....

Signed …….. Date .....

PERFORMANCE ENGINE INSTALLATION

CODE LA2

SCOPE

The following is a summary of the modifications that may be approved under Approval Code LA2 – *Performance Engine Installation*.

Approvals are **allowed** under Code LA2 for:

1. Fitting of a replacement engine with more than 20% greater weight and/or power output than engines offered by the first manufacturer as a standard or optional engine in accordance with guidelines set out in *Specific Requirements*.

Approvals are **not allowed** under Code LA2 for:

1. Fitting of a replacement engine that does not comply with the applicable ADRs.

2. Fitting of a replacement engine - the specifications of which are not suitable for use with the existing components of the vehicle.

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

4. Fitting of a replacement engine less than 20% more powerful or heavier than any engine offered by the first manufacturer as a standard or optional engine (This is covered by Code LA1)

Code LA2 does not apply to L-Group vehicles (e.g. Motorcycles)

COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS.

The modified vehicle must continue to comply with all applicable ADRs, VSRs, VSBs, Acts and Regulations.

Outlined below are areas of the vehicle that may be affected by the modifications and that may require re-certification, testing and/or data to show compliance for the modified vehicle.

DETAIL	REQUIREMENTS
Emissions	ADR 27, 30, 36, 37, 40, 70, 79,
External Noise	ADR 28, 83
Brake System (vacuum recharge)	ADR 31, 35
Exhaust Outlets	ADR 42
Ground Clearance	ADR 43

NOTE: To determine the ADRs that apply to the vehicle in question, refer to the Applicability Tables in Section LO. Vehicles manufactured after 1 January 1969 and prior to 1 July 1988 need to comply with the Second Edition ADRs whilst vehicles manufactured after this date need to comply with the Third Edition ADRs. Section LO has separate applicability tables for each edition.

The ADRs apply according to the vehicle's category and date of manufacture. It is the responsibility of the signatory to refer to the appropriate ADR applicable to the vehicle.

SPECIFIC REQUIREMENTS

Engine Capacity

For approval under Code LA2, the recommended maximum capacity (swept volume) of engines for passenger cars and passenger car derivatives is outlined in Table LA1 below. An engine may not be a suitable replacement even if its capacity falls within the limits specified in Table LA1.

Table LA1 does **not** apply to commercial or four-wheel-drive type vehicles such as commercial vans, light trucks, small buses, etc. for which there are no set recommended limits.

Table LA1

WEIGHT OF VEHICLE	**Maximum Engine Capacity** (Refer to Notes Below)	
	Naturally Aspirated	Turbo/Supercharged
All vehicles originally weighing less than **800 kg**.	Original weight (kg) x **3.0** = max. capacity in cc's	Original weight (kg) x **2.5** = max. capacity in cc's
All vehicles originally weighing between **800 kg and 1100 kg**.	Original weight (kg) x 4**.0** = max. capacity in cc's	Original weight (kg) x **2.75** = max. capacity in cc's
All vehicles originally weighing more than **1100 kg**.	Original weight (kg) x 5**.0** = max. capacity in cc's	Original weight (kg) x **3.0** = max. capacity in cc's

NOTES:

- The weight of the vehicle referred to in the table is the original (unmodified) tare weight of the model vehicle fitted with the largest engine available for the model but without optional accessories (air conditioning, tow bars etc). The weight of the vehicle whether it is a sedan, station wagon, utility, etc, should be based on the heaviest sedan version of the model (**not** station wagon version).
- The engine capacity to be used for rotary engines is twice the swept volume of all rotors (eg a 13B rotary engine has a swept volume of 1308 cc giving a "capacity" of 2616 cc).

Examples of Maximum Recommended Engine Capacity

Vehicle	**Naturally Aspirated**	**Forced Induction**
70 Corolla (4 cyl 746 kg)	**2238**cc (746 x 3)	**1865**cc (746 x 2.5)
77 Celica (4 cyl 1067 kg)	**4268**cc (1067 x 4)	**2934**cc (1067 x 2.75)
73 Falcon XBGT (1557kg)	**7785** cc (1557 x 5)	**4671**cc (1557 x 3)

Vehicle Weight

If the laden weight of the vehicle either on the front or rear wheels is more than 10% above that for the heaviest model version of the vehicle then justification that the vehicle is capable of satisfactory operation at these loads is required. This must include analysis of axles, suspension, steering, braking, tyre capacity and speed rating.

NOTE: If the original front & rear weights are not available, the weight increase on the front and rear axles can be estimated as follows:

- Subtract the original total weight of the vehicle from the new total weight (after modifications)
- Distribute the difference according to the locations of the components contributing to any weight increase (i.e. engine, transmission, etc); and
- Subtract the distributed amounts from the front & rear weight of the modified vehicle to obtain an estimate of the original weights (front & rear).

Engine Modifications

When ADR complying engines are modified by using alternative components such as camshafts, carburettors and engine management systems, proof of compliance with any relevant emission ADR is required (refer Approval Code LT3 *Gaseous Emissions Test*).

Modified Exhaust Systems

When exhaust systems are modified, proof of compliance with the relevant ADR or in-service vehicle rule is required (refer Approval Code LT4 - *Noise Emissions Test*)

Mandatory Upgraded Safety Equipment

The following vehicle safety systems have to be upgraded in order to provide for the increase in vehicle performance. These are the minimum standards required, but where any ADR applies, the ADR takes precedence:

- Seat belts have to be installed for all seating positions (all outboard seating positions require lap/sash seat belts and inboard seating positions either lap/sash or lap belts – refer Section LK *Occupant Protection)*;
- Windscreen washers have to be fitted;
- Two speed windscreen wipers with a fast speed of at least 45 cycles per minute (cpm) and a slow speed of at least 20 cpm must be fitted (single speed wipers are acceptable if the speed is 45 cpm or more);
- A windscreen demister has to be fitted;
- A flat or convex external rear vision mirror complying with the latest version of ADR14 has to be fitted to the driver's side of the vehicle. (Note: Complying mirrors must have an ECE "E mark");
- If there is no effective internal rear vision mirror, a passenger's side external mirror has to be fitted;
- Flashing direction indicator lights has to be fitted at the front and rear of the vehicle;
- To ensure safe operation of a vehicle the Signatory may specify a higher tyre speed rating than the original specifications and the fitting an additional tyre placard indicating the minimum tyre requirements.

FORM No: LA2

CHECKLIST

PERFORMANCE ENGINE INSTALLATION

APPROVAL CODE LA2

(N/A= Not Applicable, Y=Yes, N=No)

1	**ENGINE**			
1.1	Does the replacement engine comply with the requirements of Table LA1 of this Code?	N/A	Y	N
1.2	Does the engine and installation comply with all relevant ADRs and/or in-service rules (i.e. smoke gaseous emissions and noise)?		Y	N
	Insert LT3 Approval Reference Number…….		N/A	
	Insert LT4 Approval Reference Number…….		N/A	
2	**INSTALLATION**			
2.1	**General Requirements**			
	Does the replacement engine installation comply with all of the *General requirements* of Sections 2.1 to 2.12 of this Code?		Y	N
2.2	**Strength**			
	Has the engine been fitted without the alteration of the vehicle's chassis, sub-frames, cross-members or body members? If not, has the alteration been approved under Code LH?		Y	N
	Has strength of all components modified or affected by modification verified as equivalent to original manufacturer's specifications?	N/A	Y	N
	Are the engine mountings designed to withstand the torsional loads transmitted by the replacement engine?		Y	N
2.3	**Fasteners**			
	Are high tensile bolts and self-locking nuts on all new critical mountings?	N/A	Y	N
	Are replacement fasteners at least equivalent to original in strength and quantity?	N/A	Y	N
2.4	**Protection**			
	Has adequate protection been provided for all hoses, electrical harnesses, and rubber or plastic components?		Y	N
	Are fuel lines securely fastened and clear of high temperature components such as the exhaust system, turbocharger and air conditioning compressor?		Y	N

[Continued overleaf]

FORM No: LA2

(N/A= Not Applicable, Y=Yes, N=No)

2.5	**Workmanship**			
	Is the workmanship including welding to a satisfactory high standard?		Y	N
2.6	**Steering**			
	If modified, has the vehicle's steering system been certified as complying with Code LS2? Insert LS1 Approval Reference Number…….	N/A	Y	N
3	**SAFETY UPGRADE**			
3.1	Has the vehicle been upgraded to comply with all of the specific requirements outlined above in Code LA2	N/A	Y	N
3.2	For vehicles with a modified braking system, has the vehicle been certified to all the requirements of Code LG2? Insert LG1 Approval Reference Number ……	N/A	Y	N

NOTE: If the answer to any question is **N (No)**, the modification cannot be approved under Code LA2.

REPLACEMENT ENGINE:

Make.....Type.....……..No. of Cylinders .....

Displacement.....……..Litres or..... .....cc's

Maximum Power Output.....……..……....kW..... .....BHP

Engine Weight.....

VEHICLE:

Make.....Model.....…….Year of Manufacture .....

Chassis No. or VIN.....

Vehicle Modified By .....

Vehicle Approved By (Signatory).....

Signatory Employer (if applicable).....

Signed …….. Date .....

TURBOCHARGER AND SUPERCHARGER INSTALLATION

CODE LA3

SCOPE

The following is a summary of the modifications that may be approved under Code LA3 – *Turbocharger and Supercharger Installation*.

Approvals are **allowed** under Code LA3 for:

- Fitting of turbochargers or superchargers not originally offered by the engine or vehicle manufacturer.

Approvals are **not allowed** under Code LA3 for:

- Fitting of replacement engines already fitted with a turbocharger or supercharger by the engine manufacturer (these are usually covered by Code LA2).

- Fitting of turbochargers or superchargers that cause the vehicle not to meet the required gaseous emission standards.

Code LA3 does not apply to L-group vehicles (e.g. motorcycles).

COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS.

The modified vehicle must continue to comply with all applicable ADRs, VSRs, VSBs, Acts and Regulations.

Outlined below are areas of the vehicle that may be affected by the modifications and that may require re-certification, testing and/or data to show compliance for the modified vehicle.

DETAIL	REQUIREMENTS
Emissions	ADR 27, 30, 36, 37, 40, 70, 79
External Noise	ADR 28, 83
Brake System (vacuum recharge)	ADR 31, 35
Exhaust Outlets	ADR 42
Ground Clearance	ADR 43

NOTE: To determine the ADRs that apply to the vehicle in question, refer to the Applicability Tables in Section LO. Vehicles manufactured after 1 January 1969 and prior to 1 July 1988 need to comply with the Second Edition ADRs whilst vehicles manufactured after this date need to comply with the Third Edition ADRs. Section LO has separate applicability tables for each edition.

The ADRs apply according to the vehicle's category and date of manufacture. It is the responsibility of the signatory to refer to the appropriate ADR applicable to the vehicle.

SPECIFIC REQUIREMENTS

Forced induction conversions such as turbocharging or supercharging have the capacity to substantially increase a vehicle's power and performance and are generally considered on the same basis as a performance engine conversion.

The following are the options for approving turbocharger and supercharger installations:

- A turbocharger (or supercharger) installation does not require certification, only if the installation is available as an option from the original vehicle manufacturer. All vehicle components that were supplied by the manufacturer as part of the original specification for the turbocharged vehicle must also be fitted.
- A turbocharger (or supercharger) installation can be approved under **Code LA1** only if a turbocharged or supercharged engine is available from a vehicle manufacturer and has no more than 20% more power than the most powerful optional engine offered by the manufacturer for that vehicle model.
- A turbocharger (or supercharger) installation can be approved under **Code LA2** only if a turbocharged or supercharged engine is available from a vehicle manufacturer and has over 20% more power than the most powerful optional engine offered by the manufacturer for that vehicle model.
- All other turbocharger and supercharger installations will require approval under **Code LA3**.

Engine Modifications

When engines are modified, by fitting turbochargers and/or superchargers (with or without alternative components such as camshafts, carburettors and engine management systems), proof of compliance with the relevant ADR is required (Refer Approval Code LT3 *Gaseous Emissions Test*).

Modified Exhaust Systems

When exhaust systems are modified, proof of compliance with the relevant ADR or in-service vehicle rule is required (refer Approval Code LT4 - *Noise Emissions Test*)

Heat Shielding and Clearances

All fuel, lubrication, cooling, brake and electrical components that are located in close proximity to a turbocharger must be shielded to prevent excessive heat affecting the performance or safety of these components. Shielding or increased clearances should also be used to prevent modified exhaust systems transferring excessive heat into the firewall and front floor areas of the body.

Modified Bonnets

Any supercharger and induction system components projecting above the original bonnet line must be covered with an appropriate raised bonnet section meeting the height and visibility requirements detailed in the LH Code and designed to minimise injury to persons struck by the vehicle.

Drive Belts

Supercharger drive belts and pulleys must be shielded to prevent injury from accidental contact with rotating components.

Mandatory Upgraded Safety Equipment

The following vehicle safety systems have to be upgraded in order to provide for the increase in vehicle performance. These are the minimum standards required, but where any ADR applies, the ADR takes precedence:

- Seat belts have to be installed for all seating positions (all outboard seating positions require lap/sash seat belts and inboard seating positions either lap/sash or lap belts – refer Section LK *Occupant Protection)*;
- Windscreen washers have to be fitted;
- Two speed windscreen wipers with a fast speed of at least 45 cycles per minute (cpm) and a slow speed of at least 20 cpm must be fitted (single speed wipers are acceptable if the speed is 45 cpm or more);
- A windscreen demister has to be fitted;
- A flat or convex external rear vision mirror complying with the latest version of ADR14 has to be fitted to the driver's side of the vehicle. (Note: Complying mirrors must have an ECE "E mark");
- If there is no effective internal rear vision mirror, a passenger's side external mirror has to be fitted;
- Flashing direction indicator lights have to be fitted at the front and rear of the vehicle;
- To ensure safe operation of a vehicle the Signatory may specify a higher tyre speed rating than the original specifications and the fitting an additional tyre placard indicating the minimum tyre requirements.

FORM No: LA3

CHECKLIST

TURBOCHARGER AND SUPERCHARGER INSTALLATION

APPROVAL CODE LA3

(N/A= Not Applicable, Y=Yes, N=No)

1	**ENGINE**			
1.1	Do the modified or replacement engine and installation comply with all relevant ADRs and/or in-service rules (i.e. smoke gaseous emissions and noise)?		Y	N
	Insert LT3 Approval Reference Number…….		N/A	
	Insert LT4 Approval Reference Number…….		N/A	
2	**INSTALLATION**			
2.1	**General Requirements**			
	Does the replacement engine installation comply with all of the *General Requirements* of Sections 2.1 to 2.12 of this Code?		Y	N
2.2	**Strength**			
	Has the engine been fitted without the alteration of the vehicle's chassis, sub-frames, cross-members or body members? If not, has the alteration been approved under Code LH?		Y	N
	Has strength of all components modified or affected by modification verified as equivalent to original manufacturer's specifications?	N/A	Y	N
	Are the engine mountings designed to withstand the torsional loads transmitted by the replacement or modified engine?		Y	N
2.3	**Fasteners**			
	Are high tensile bolts and self-locking nuts on all new critical mountings?	N/A	Y	N
	Are replacement fasteners at least equivalent to original in strength and quantity?	N/A	Y	N
2.4	**Protection**			
	Has adequate protection been provided for all hoses, electrical harnesses and rubber or plastic components?		Y	N
	Are fuel lines securely fastened and clear of high temperature components such as the exhaust system, turbocharger and airconditioning compressor?		Y	N

[Continued overleaf]

FORM No: LA3

(N/A= Not Applicable, Y=Yes, N=No)

2.5	**Workmanship**			
	Is the workmanship including welding to a satisfactory high standard?		Y	N
2.6	**Steering**			
	If modified, has the vehicle's steering system been certified as complying with Code LS2? Insert LS1 Approval Reference Number……..	N/A	Y	N
2.7	**Diesel Engines**			
	If the vehicle is fitted with a replacement diesel engine, is an engine stop control (which will prevent accidental or inadvertent starting) fitted within the engine compartment?	N/A	Y	N
	If the vehicle is fitted with a replacement diesel engine, is the engine able to be switched off from the ignition switch and can it only be started when the ignition switch is in the "Run" position?	N/A	Y	N
	If the vehicle has vacuum assisted brakes and a replacement diesel engine, is an adequate capacity vacuum pump (to comply with the ADR braking requirements) fitted?	N/A	Y	N
3	**SAFETY UPGRADE**			
3.1	If power has increased by more than 20%, has the vehicle been upgraded to comply with specific requirements outlined above in Code LA3?	N/A	Y	N
3.2	For vehicles with a modified braking system, has the vehicle been certified to all the requirements of Code LG2? Insert LG1 Approval Reference Number ……	N/A	Y	N

NOTE: If the answer to any question is **N (No)**, the modification cannot be approved under Code LA3.

ENGINE:

Make.....Type.....……..No. of Cylinders .....

Displacement.....……...Litres or..... cc's

Turbocharger/Supercharger.....…….....Maximum Boost Setting..... .....psi.

Maximum Power Output.....……..……....kW..... .....BHP

[Continued overleaf]

FORM No: LA3

VEHICLE:

Make.....Model.....……..Year of Manufacture .....

Chassis No. or VIN.....

Vehicle Modified By .....

Vehicle Approved By (Signatory).....

Signatory Employer (if applicable).....

Signed …….. Date .....

ENGINE MODIFICATIONS
CODE LA4

SCOPE

The following is a summary of the modifications that may be approved under Code LA4 –*Engine Modifications*

Approvals are **allowed** under Code LA4 for:

1. Fitting of equipment or modified components to the original engine (or manufacturer's option) for that vehicle model.

Approvals are **not allowed** under Code LA4 for:

1. Fitting replacement modified performance engines (these are covered by Code LA2).

2. Fitting of turbocharger or supercharger (these are covered by Code LA3).

Code LA4 does not apply to L-group vehicles (e.g. motorcycles).

COMPLIANCE WITH APPLICABLE VEHICLE STANDARDS.

The modified vehicle must continue to comply with all applicable ADRs, VSRs, VSBs, Acts and Regulations.

Outlined below are areas of the vehicle that may be affected by the modifications and that may require re-certification, testing and/or data to show compliance for the modified vehicle.

DETAIL	**REQUIREMENTS**
Gaseous Emissions	ADR 27, 30, 36, 37, 40, 70, 79
External Noise	ADR 28, 83
Brake System (vacuum recharge)	ADR 31, 35
Exhaust Outlets	ADR 42
Ground Clearance	ADR 43

NOTE: To determine the ADRs that apply to the vehicle in question, refer to the Applicability Tables in Section LO. Vehicles manufactured after 1 January 1969 and prior to 1 July 1988 need to comply with the Second Edition ADRs whilst vehicles manufactured after this date need to comply with the Third Edition ADRs. Section LO has separate applicability tables for each edition.

SPECIFIC REQUIREMENTS

Engine modifications such as changes to engine management systems, camshafts and induction systems have the capacity to substantially increase a vehicle's power and performance and are generally considered on the same basis as a performance engine conversion with a safety upgrade required.

Engine modifications can be approved under Approval Code LA4 only if the modifications are made to the original engine or optional engine for that model. Modified replacement performance engines must be approved under Approval Code LA2.

Engine Modifications

When ADR complying engines are modified by using alternative components such as camshafts, carburettors and engine management systems, proof of compliance with any relevant emission ADR is required (refer Approval Code LT3 *Gaseous Emissions Test*).

Modified Exhaust Systems

When exhaust systems are modified, proof of compliance with the relevant ADR or in-service vehicle rule is required (refer Approval Code LT4 - *Noise Emissions Test*)

Mandatory Upgraded Safety Equipment

The following vehicle safety systems have to be upgraded in order to provide for the increase in vehicle performance. These are the minimum standards required, but where any ADR applies, the ADR takes precedence:

- Seat belts have to be installed for all seating positions (all outboard seating positions require lap/sash seat belts and inboard seating positions either lap/sash or lap belts – refer Section LK *Occupant Protection)*;
- Windscreen washers has to be fitted;
- Two speed windscreen wipers with a fast speed of at least 45 cycles per minute (cpm) and a slow speed of at least 20 cpm must be fitted (single speed wipers are acceptable if the speed is 45 cpm or more);
- A windscreen demister has to be fitted;
- A flat or convex external rear vision mirror complying with the latest version of ADR14 has to be fitted to the driver's side of the vehicle. (Note: Complying mirrors must have an ECE "E mark");
- If there is no effective internal rear vision mirror, a passenger's side external mirror has to be fitted;
- Flashing direction indicator lights have to be fitted at the front and rear of the vehicle;
- To ensure safe operation of a vehicle the Signatory may specify a higher tyre speed rating than the original specifications and the fitting an additional tyre placard indicating the minimum tyre requirements.

FORM No: LA4

CHECKLIST

ENGINE MODIFICATIONS

APPROVAL CODE LA4

(N/A= Not Applicable, Y=Yes, N=No)

1	**ENGINE**			
1.1	Is the engine the original engine or a manufacturer's option for that model?		Y	N
1.2	Does the engine and installation comply with all relevant ADRs and/or in-service rules (i.e. smoke gaseous emissions and noise)?	N/A	Y	N
	Insert LT3 Approval Reference Number…….		N/A	
	Insert LT4 Approval Reference Number…….		N/A	
2	**INSTALLATION**			
2.1	**General Requirements**			
	Does the engine installation continue to comply with all of the *General Requirements* of Sections 2.1 to 2.12 of this Code?		Y	N
2.2	**Strength**			
	Has the engine been fitted without the alteration of the vehicle's chassis, sub-frames, cross-members or body members? If not, has the alteration been approved under Code LH?		Y	N
2.3	Strength of all components modified or affected by modification verified as equivalent to original manufacturer's specifications?	N/A	Y	N
2.4	Are the engine mountings designed to withstand the torsional loads transmitted by the modified engine?		Y	N
2.5	**Fasteners**			
	High tensile bolts and self-locking nuts on all new critical mountings?	N/A	Y	N
	Replacement fasteners at least equivalent to original in strength and quantity?	N/A	Y	N
2.6	**Protection**			
	Has adequate protection been provided for all hoses, electrical harnesses and rubber or plastic components?		Y	N
2.7	Are fuel lines securely fastened and clear of high temperature components such as the exhaust system, turbocharger and air conditioning compressor?		Y	N

[Continued overleaf]

FORM No: LA4
(N/A= Not Applicable, Y=Yes, N=No)

2.8	**Workmanship**			
	Is the workmanship including welding to a satisfactory high standard?		Y	N
2.9	**Steering**			
	If modified, has the vehicle's steering system been certified as complying with Code LS2? Insert LS1 Approval Reference Number…….	N/A	Y	N
3	**SAFETY UPGRADE**			
3.1	If power has increased by more than 20%, has the vehicle been upgraded to comply with specific requirements outlined above in Code LA4	N/A	Y	N
3.2	For vehicles with a modified braking system, has the vehicle been certified to all the requirements of Code LG2? Insert LG1 Approval Reference Number ……	N/A	Y	N

NOTE: If the answer to any question is **N (No)**, the modification cannot be approved under Code LA4.

ENGINE:

Make.....Type.....……..No. of Cylinders/Rotors .....

Displacement.....……...Litres or..... .....cc's

Maximum Power Output.....……..……....kW..... .....BHP

VEHICLE:

Make.....Model.....……..Year of Manufacture .....

Chassis No. or VIN.....

Vehicle Modified By .....

Vehicle Approved By (Signatory).....

Signatory Employer (if applicable).....

Signed …….. Date .....