



长安汽车
CHANGAN

2012

Benni Mini Workshop Manual

This workshop manual provides MY2012 Benni Mini
model service information.

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Workshop Manual

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Description and Operation

About This Manual

Introduction

This manual has been written in a format to meet the needs of technicians. This manual provides general descriptions for accomplishing service and repair work. Following them will help assure reliability.

Spare Parts

The parts from Chana Automobile Co., Ltd. are manufactured according to the original factory standard. Only the original parts from Chana Automobile Co., Ltd. can be used in repair.

Special Tool

The special tool(s) provided at the beginning of each procedure are the special tools required to carry out the repair. Where possible, illustrations are provided to assist in identifying the special tool required. The special tools can be ordered from Chana Automobile Co., Ltd.

Important Safety Instructions

Appropriate service methods and correct repair procedures are essential for the safe, reliable operation on the vehicles as well as the personal safety.

This manual can not possibly provide all such variations and advice or cautions as to each. Anyone who departs from the instructions provided in this manual must assure that the operation methods, tools and components used neither cause personal injury nor break the vehicle integrity.

Warnings, Cautions and Notes in This Manual

 **WARNING:** Warnings are used to indicate that failure to follow a procedure correctly may result in personal injury.

 **CAUTION:** Cautions are used to indicate that failure to follow a procedure correctly may result in damage to the vehicle or repair tools being used.

As you read through this manual, you will come across WARNINGS and CAUTIONS.

How to Use the Manual

This manual covers the maintenance and repair service procedures.

This manual is structured into groups and sections, with specific system sections collected together under their relevant group. A group covers a specific portion of the vehicle.

The manual is divided into six groups, General Information, Chassis, Powertrain, Electrical, Body and Wiring diagram.

The table of content of the manual can guide you to the section. Each section has a regular structure: Specifications, Description and Operation, General Procedures, Symptom Diagnosis and Testing, DTC Diagnosis and Testing, Removal and Installation, Disassembly and Assembly.

All left - hand and right-hand references to the vehicle are taken from a position sitting in the driver seat looking forward.

All left-hand and right-hand references to the engine are taken from a position at the flywheel looking towards the front camshaft pulley.

Specifications

The specifications mainly describe the material specifications, component specifications, general specifications (the contents that cannot be included in other specifications) and torque specifications. The information in the specification shall use the metrics except the torque (Imperial).

Description and Operation

The description and operation mainly describes the system components, functions and principles of the new systems. The “new systems” refers to the systems that never used on the previous models of the manufacturer. The purpose of the brief introduction is to make the technicians get familiar with the functions and principles of the systems. The component location view and the exploded view are also included in this section.

General Procedures

The general procedures mainly introduce the general inspection operation steps of the system.

Symptom Diagnosis and Testing

The symptom diagnosis and testing section describes the diagnosis and inspection for the symptom that can not be judged from the visual inspection only, excluding the diagnosis and inspection using diagnostic tools. The contents include inspection and verification (visual inspection chart), symptom chart and symptom diagnosis procedures.

DTC Diagnosis and Testing

DTC diagnosis and testing refers to the diagnosis and testing for the component or system using diagnostic tools. It covers the terminal list of the control module, DTC code list, data flow list, active test list and DTC diagnosis procedures.

Health and Safety Precautions

Introduction

Many of the procedures associated with vehicle maintenance and repair involve physical hazards or other risks to health. This subsection lists, alphabetically, some of these hazardous operations and the materials and equipment associated with them. Precautions necessary to avoid these hazards are identified.

The list is not exhaustive and all operations and procedures, and the handling of materials, should be carried out with health and safety in mind.

Before using any product the Materials Safety Data Sheet supplied by the manufacturer or supplier should be consulted.

Acid, Alkali and Metal

- Caustic soda, sulphuric acid.
- Electrolyte and cleaning material.
- Irritable and corrosive substances to skins, eyes, noses, throats and clothes. Flammable substance and the substance able to destroy ordinary protective clothing.

Avoid splashing such substances to the skin, eyes and clothes. Wear suitable protective impervious apron, gloves and goggles. Do not breathe mists. Make sure access to eye wash bottles, shower and soap are readily available for splashing accidents.

Place "Eye Hazard" sign.

Airbag

Refer to: Chemical Materials.

Highly flammable, explosive substances - observe No Smoking policy.

Used as a safety restraint system mounted in the steering wheel and passenger side of the console.

The inflator contains a high-energetic propellant which, when ignited, produces a very hot gas (2,500°C).

The gas generant used in airbags is Sodium Azide. This material is hermetically sealed in the module and is completely consumed during deployment. No attempt should be made to open an airbag inflator as this will lead to the risk of exposure to Sodium Azide. If a gas generator is ruptured, full protective clothing should be worn when dealing with the spillage.

After normal deployment, gloves and safety goggles must be worn during the handling process.

Deployed airbags should be disposed of in a plastic bag in accordance with local regulations at an approved chemical waste site.

If directly contact with the generated gas, thoroughly wash the site (affected area) with water. Seek medical assistance if necessary.

1. Airbag - operations to be performed:

- Position the airbag vertically.
- Keep the airbag dry.
- The unsealed side shall be toward the human body in transportation.
- The sealed side of the airbag should be placed upwards.
- Carefully inspect whether the airbag is damaged.
- Stand beside the airbag when connecting it.
- Identify that all the testing devices have been correctly calibrated and maintained.
- Clean both hands when the expanded airbag is carried away.

2. Airbag - forbidden operations:

- Do not place the inflammable substance or gas generator together with the airbag.
- The storage temperature of gas generator shall not exceed 80°C.
- The airbag can not be reversed.
- Do not open the gas generator case.
- Do not place the gas generator near open fire or heat source.
- Do not put any object on the airbag.
- Do not use the damaged airbag.
- Do not touch the airbag and the gas generator within ten min after they are burnt.
- Do not use the electricity meter probe on the airbag circuit.

Air Conditioning Refrigerant

Refer to: Chemical Materials.

Highly flammable substance - observe No Smoking policy.

Skin contact may result in frostbite.

Instructions given by the manufacturer must be followed. Avoid naked lights, wear suitable protective gloves and goggles.

If refrigerant comes into contact with the skin or eyes, immediately flush the affected areas with water. Eyes should also be rinsed with an appropriate irrigation solution and should not be rubbed. Seek medical assistance if necessary.

Air conditioning refrigerant - forbidden items:

- Do not expose the air conditioning refrigerant in the sunshine or heat it.
- Never put the filling bottle vertically when filling. The filling opening should be downwards.
- Avoid the frost on the air conditioning refrigerant bottle.
- Avoid the dropping of the air conditioning refrigerant bottle.
- Do not discharge the air conditioning refrigerant in the atmosphere in any circumstance.
- Do not use the mixed refrigerant, such as fluorine R12 and R134a.

Adhesive and Sealant

Refer to: Chemical Materials.

Highly flammable substance - observe No Smoking policy.

Generally should be stored in No Smoking areas. Cleanliness and tidiness in use should be observed, for example disposable paper covering benches; should be dispensed from applicators where possible; containers, including secondary containers, should be labeled appropriately.

1. Solvent-based Adhesives/Sealers

Follow manufacturer instructions.

2. Water-based Adhesives/Sealers

Those based on polymer emulsions and rubber latexes may contain small amounts of volatile toxic and harmful chemicals. Skin and eye contact should be avoided and adequate ventilation provided during use.

3. Hot Melt Adhesives

In the solid state, they are safe. In the molten state they may cause burns and health hazards may arise from the inhalation of toxic fumes. Use appropriate protective clothing and a thermostatically controlled heater with a thermal cut-out and adequate extraction.

4. Resin-based Adhesives/Sealers, for example Epoxide and Formaldehyde Resin-based

Mixing should be carried out in well ventilated areas, as harmful or toxic volatile chemicals may be released.

Skin contact with uncured resins and hardeners can result in irritation, dermatitis, and absorption of toxic or harmful chemicals through the skin.

Splashes can damage the eyes. Provide adequate ventilation and avoid skin and eye contact.

5. Anaerobic Cyanoacrylate and other Acrylic Adhesives

Many are irritant, sensitizing or harmful to the skin and respiratory tract. Some are eye irritants. Skin and eye contact should be avoided and the manufacturers instructions followed.

Cyanoacrylate adhesives must not contact the skin or eyes. If skin or eye tissue is bonded, cover with a clean moist pad and seek immediate medical attention. Do not touch the injured area with hands. Use in well ventilated areas as vapors can cause irritation to the nose and eyes.

6. Isocyanate (Polyurethane) Adhesives/ Sealers

Refer to: Resin-based Adhesives.

Individuals suffering from asthma or respiratory allergies should not work with or near these materials as sensitivity reactions can occur.

Over exposure is irritating to the eyes and respiratory system. Excessive concentrations may produce effects on the nervous system including drowsiness. In extreme cases, loss of consciousness may result. Long term exposure to vapor concentrations may result in adverse health effects.

Prolonged contact with the skin may have a defeating effect which may lead to skin irritation and in some cases, dermatitis. Splashes entering the eye will cause discomfort and possible damage. Any spraying should preferably be carried out in exhaust ventilated booths, removing vapors and spray droplets from the breathing zone.

Wear appropriate gloves, eye and respiratory protection.

Antifreeze

Refer to: Fire, Solvent.

For example isopropanol, ethylene glycol, methanol.

Highly flammable, flammable, combustible.

Used in vehicle coolant systems and screenwash solutions.

The antifreeze will generate the steam when heated. Avoid inhaling such gas.

The antifreeze or other harmful materials may enter into the human body through the skin. Drinking the antifreeze may cause the death, seek immediate medical assistance.

Do not use any of such substances in the cooling or industrial water use system related to the food manufacturing or drinking system.

Electrolyte

Refer to: Acid and Alkali Metal.

The released gas will cause explosion when charging the battery. Do not use the open fire or the spark when charging the battery. Ensure good ventilation.

Brake Fluid

Refer to: Fire Prevention.

Slight irritability may be caused if the braking fluid is splashed on skin and eyes. Avoid the braking fluid touching skin and eyes. Because the steam pressure is low, the harmful steam can not be inhaled at normal temperature.

Braze Welding

Refer to: Welding.

Chemical Materials

Refer to: Legal Aspect.

The chemical materials include solvent, sealer, adhesive, paint, resin foam, electrolyte, anti-freeze, braking fluid, fuel, oil and grease. Be careful when using and storing the material. They may be noxious, harmful, and has corrosive irritability and are inflammable and will generate some harmful gas and dust.

Long term exposure to the chemical material may affect the health to different extents.

1. Chemical Material - operations to be performed:

- Read the labels on the dangerous article container and the corresponding promotion information and instruction carefully to obtain the relevant safety information. The safety and health data table of the substance can be obtained from the manufacturer.
- Clean the skin and clothes if being polluted by the chemical material. Replace the severely polluted clothes and clean them.

- Compile the operation instructions, and wear the protective clothes to avoid the substance polluting skin and eyes and inhaling the harmful gas, acid mist, dust and smog, etc. and avoid the combustion and explosion caused by such substance.
- Wash hands immediately after touching the substance.
- Keep the working area clean and tidy without leakage.
- The chemical material shall be managed and stored strictly in accordance with the national and local regulation.
- Keep the materials away from the children.

2. Chemical material - forbidden operations:

- Do not mix the chemical material arbitrarily without following the manufacturer instructions. Mixing some chemical materials will generate the harmful substance; the noxious and harmful gas will be released or the explosion may occur.
- Do not spray the chemical material in the narrow space with person in the automobile, especially to spray the solvent chemicals.
- Do not heat or burn the chemical materials arbitrarily without following the manufacturer instruction, some chemical materials are combustible, and some substance will release the noxious or harmful gas when burnt.
- Do not put the container open, the gas emitted in the container may be toxic to the human body or cause the explosion. Some gas lighter than air will accumulate in the small section.
- Do not transport the chemical materials with the container without label.
- Do not wash hands or clothes with the chemical materials. The chemical materials, especially the solvent and fuel will make the skin dry, and also stimulate the skin to catch dermatitis, or the hands or clothes will absorb some noxious and harmful gas through the skin.

- Do not store other articles with the empty tank used to store the chemical material without the special treatment.
- Do not smell the chemical material. The sudden gases of high concentration will cause the poisoning or the injury.

Clutch Oil

Refer to: Brake Fluid.

Anti-corrosion Material

Refer to: Solvent and Fire Prevention.

Highly flammable substance - observe No Smoking policy.

These materials are varied and the manufacturers instructions must be followed. They may contain solvents, resins or petroleum products. Skin and eye contact should be avoided. They should only be sprayed in conditions of adequate ventilation and not in confined spaces.

Cutting

Refer to: Welding.

Dewaxing

Refer to: Solvent and Fuel (Kerosene).

Dust

Powder, dusts or clouds may be irritant, harmful or toxic to the skin. Avoid inhaling the ash of the powder chemical material or other ashes. Wear respiratory protection if ventilation is inadequate.

Fine dusts of combustible material can present an explosion hazard. Avoid explosive limits and sources of ignition.

Electric Shock

Electric shock can result from the use of faulty electrical equipment or from the misuse of equipment in good condition.

Make sure that electrical equipment is maintained in good condition and frequently tested. Faulty equipment should be labeled and preferably removed from the workstation. Make sure that flexes, cables, plugs and sockets are not frayed, kinked, cut, cracked or otherwise damaged. Make sure that electrical equipment and flexes do not come into contact with water. Make sure that

electrical equipment is protected by the correct rated fuse.

Never misuse electrical equipment and never use equipment that is in any way faulty. The results could be fatal.

Make sure that the cables of mobile electrical equipment cannot get trapped and damaged, such as in a vehicle hoist. Make sure that the designated electrical workers are trained in basic First Aid.

In cases of electric shock:

- Switch off the power supply before approaching the victim.
- If this is not possible push or drag the victim from the source of electricity, using dry non-conductive material.
- Commence resuscitation if trained to do so.
- Seek medical assistance.

Engine Oil

Refer to: Lubricants and Grease.

Exhaust Gas

Exhaust gas contains asphyxiating, harmful and toxic chemicals and particles such as carbon oxides, nitrogen oxides, aldehydes, lead and aromatic hydrocarbons. Engines should be run only under conditions of adequate exhaust extraction or general ventilation and not in confined spaces.

Gasoline (petrol) Engine

There may not be adequate warning of odor or of irritation before toxic or harmful effects arise. These may be immediate or delayed.

Noise Insulation Fiber

Refer to: Dust.

Used in noise and sound insulation. The fibrous nature of surfaces and cut edges can cause skin irritation. This is usually a physical and not a chemical effect. Precautions should be taken to avoid excessive skin contact through careful organization of work practices and the use of gloves.

Fire Prevention

Refer to: Welding, Foam and Legal Aspect.

Many of the materials found on or associated with the repair of vehicles are highly flammable. Some give off toxic or harmful fumes if burnt. Observe strict fire safety when storing and handling flammable substances or solvents, particularly near electrical equipment or welding processes. Make sure, before using electrical or welding equipment, that there is no fire hazard present. Have a suitable fire extinguisher available when using welding or heating equipment.

First Aid

Apart from meeting any legal requirements it is desirable for someone in the workshop to be trained in First Aid procedures.

Splashes in the eye should be flushed carefully with clean water for at least ten minutes.

Soiled skin should be washed with soap and water. In case of cold burns, from alternative fuels, place affected area in cool to cold water. Individuals affected by inhalation of gases and fumes should be removed to fresh air immediately. If effects persist, consult a doctor.

If liquids are swallowed inadvertently, consult a doctor giving him the information on the container or label. Do not induce vomiting unless this action is indicated on the label.

Foams-Polyurethane

Refer to: Fire Prevention.

Used in sound and noise insulation. Cured foams used in seat and trim cushioning.

Follow manufacturers instructions. Unreacted components are irritating and may be harmful to the skin and eyes. Wear gloves and goggles.

Individuals with chronic respiratory diseases, asthma, bronchial medical problems, or histories of allergic diseases should not work in or near uncured materials. The components, vapors or spray mists can cause direct irritation, sensitivity reactions and may be toxic or harmful.

Vapors and spray mists must not be inhaled. These materials must be applied with adequate

ventilation and respiratory protection. Do not remove the respirator immediately after spraying; wait until the vapors/mists have cleared.

Burning of the uncured components and the cured foams can generate toxic and harmful fumes. Smoking, naked flames or the use of electrical equipment during foaming operations and until vapors/mists have cleared should not be allowed. Any heat cutting of cured foams or partially cured foams should be conducted with extraction ventilation.

Refrigerant

[Refer to: Air-Conditioning Refrigerant](#)

Fuel

[Refer to: Fire, Solvent and Legal Aspect.](#)

Keep the fuel away from the skin. Wash with the clean water and the soap if touching.

Gasoline

Highly flammable substance - observe No Smoking policy.

Swallowing the gasoline will stimulate mouth and throat, if the gasoline is absorbed by the stomach, it will cause sleepiness and unconsciousness. A small quantity of gasoline will cause the death of the child. When the inhaled fluid reaches the lung, the severe damage will be caused. Contacting the gasoline for a long time will make the person skin dry and have the strong irritability. The gasoline entering into eyes will cause blindness. A great amount of benzene is contained in the gasoline, inhaling the benzene is toxic to person. The gasoline concentration must be very low, the excessively high concentration will stimulate person eyes, nose and throat and make person vomit, dizziness and dyspnea chest discomfort, even make person lose consciousness.

The gasoline shall be transported or used in the places of air circulation. The damage to human respiratory system due to the gasoline leakage must be strictly avoided.

For the cleaning and maintenance of gasoline storage, there must have special preventive measures. The gasoline can not be used as the cleaning agent and also can not be siphoned with mouth.

Kerosene (Paraffin)

Used also as heating fuel, solvent and cleaning agent.

Flammable substance - observe No Smoking policy.

Irritation of the mouth and throat may result from swallowing. Liquid contact dries the skin and can cause irritation or dermatitis. Splashes in the eye may be slightly irritating. In normal circumstances the low volatility does not give rise to harmful vapors. Exposure to mists and vapors from kerosene at elevated temperature should be avoided (mists may arise in dewaxing). Avoid skin and eye contact and make sure there is adequate ventilation.

High Pressure Gas Cylinder

[Refer to: Fire Prevention.](#)

Gases such as oxygen, acetylene, argon and propane are normally stored in cylinders at pressures of up to 138 bar. Great care should be taken in handling these cylinders to avoid mechanical damage to them or to the valve gear attached. The contents of each cylinder should be clearly identified by appropriate markings.

Cylinders should be stored in well-ventilated enclosures, and protected from ice and snow, or direct sunlight. Fuel gases, for example acetylene and propane, should not be stored in close proximity to oxygen cylinders.

Care should be exercised to prevent leaks from gas cylinders and lines, and to avoid sources of ignition.

Gas

[Refer to: High Pressure Gas Cylinder.](#)

General Tool and Equipment

It is essential that all tools and equipments are maintained in good condition and that the correct safety equipment is used where required.

Never use tools or equipments for any purpose other than that for which they were designed. Never overload equipment such as hoists, jacks, axle and chassis stands or lifting slings. Damage caused by overloading is not always immediately

apparent and may result in a fatal failure the next time that the equipment is used.

Do not use damaged or defective tools or equipment, particularly high-speed equipment such as grinding wheels. A damaged grinding wheel can disintegrate without warning and cause serious injury.

Wear suitable eye protection when using grinding, chiseling or sand blasting equipment. Wear a suitable breathing mask when using abrasive blasting equipment, working with asbestos-based materials or using spraying equipment. Make sure there is adequate ventilation to control dusts, mists and fumes.

High Pressure Air, Lubrication and Oil Test Equipment

Refer to: Lubricants and Grease.

Always keep high-pressure equipment in good condition, and regularly maintained, particularly at joints and unions.

Never direct a high-pressure nozzle, for example diesel injector, at the skin as the fluid may penetrate to the underlying tissue, and cause serious injury.

Legal Aspect

There are many laws and regulations relating to health and safety in the use and disposal of materials and equipment in a workshop.

For a safe working environment and to avoid environmental pollution, technicians should be familiar, in detail, with many health and safety laws and regulations within their country.

Lubricant and Grease

Avoid all prolonged and repeated contact with mineral oil. All lubricants and greases may be irritating to the eyes and skin.

1. Used oil

Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants, which may cause skin cancer. Adequate

means of skin protection and washing facilities must be provided.

Do not employ used engine oils as lubricants or for any application where appreciable skin contact is likely to occur.

2. Health Precautions:

- Avoid long contact with the oil, especially the engine oil.
- Wear the protective clothes, including the gloves.
- Do not put the wiping cloth with oil stains in the pocket.
- Avoid the oil polluting the clothes.
- Do not wear the clothes and shoes seriously stained with oil. Wash the protective clothes regularly.
- Perform the first aid immediately when injured.
- Protect hands with the protective cream before working.
- Wash with the soap and the clear water. Do not wash the skin with gasoline, diesel oil, kerosene, diluents and solvent.
- If the skin is abnormal, go to hospital immediately.
- Degrease the oil first if possible.
- Wear the goggles if the oil may cause damage to eyes.

3. Environmental Precautions

Burning used engine oil can be recommended only for units of approved design. If in doubt check with the appropriate local authority and manufacturer of approved appliances.

Dispose of used oil and used oil filters through authorized waste disposal contractors or licensed waste disposal sites, or to the waste oil reclamation trade. If in doubt, contact the relevant local authority for advice on disposal facilities.

It is illegal to pour used oil on to the ground, down sewers or drains, or into watercourses.

Noise

Some operations may produce high noise levels, which could, in time, damage hearing. In these cases, suitable ear protection must be worn.

Sound Insulation Material

Refer to: Foam, Insulation Fiber.

Coating

Refer to: Oil and Chemical Material.

Highly flammable, flammable substance - observe No Smoking policy.

1. Monocomponent

Can contain harmful or toxic pigments, driers and other components as well as solvents. Spraying should be carried out only with adequate ventilation.

2. Multicomponent

Can contain harmful and toxic unreacted resins and resin hardening agents. The manufacturer instructions should be followed.

Refer to: Resin-based Adhesives.

Spraying should preferably be carried out in exhausted ventilated booths far from the crowds. Individuals working in booths should wear appropriate respiratory protection.

Pressure Equipment

Refer to: High Pressure Gas, Lubricants and Oil Test Equipment.

Solder

Solders are mixtures of metals such that the melting point of the mixture is below that of the constituent metals (normally lead and tin). Solder application does not normally give rise to toxic lead fumes in welding. Oxy-acetylene flames should not be used, as they are much hotter and will cause lead fumes to be produced.

Some fumes may be produced by the application of any flame to surfaces coated with grease, and inhalation of these should be avoided. Removal of excess solder should be undertaken with care, to make sure that fine lead dust is not produced, which can give toxic effects if inhaled. Respiratory protection may be necessary. Solder spillage and

filings should be collected and removed promptly to prevent general air contamination by lead. Avoid ingestion of lead or inhalation of solder dust.

Solvent

Refer to: Chemical Materials, Fuel and Fire Prevention.

For example acetone, white spirit, toluene, xylene, trichloroethane. Used in cleaning and dewaxing materials, paints, plastics, resins and thinners. Some may be highly flammable or flammable. Skin contact will degrease the skin and may result in irritation and dermatitis following repeated or prolonged contact. Some can be absorbed through the skin in toxic or harmful quantities.

Splashes in the eye may cause severe irritation and could lead to loss of vision. Brief exposure of high concentrations of vapors or mists will cause eye and throat irritation, drowsiness, dizziness, headaches and, in the worst circumstances, unconsciousness.

Repeated or prolonged exposure to excessive but lower concentrations of vapors or mists, for which there might not be adequate warning indications, can cause more serious toxic or harmful effects.

Avoid splashes to the skin, eyes and clothing. Wear protective gloves, goggles and clothing if necessary.

Make sure there is good ventilation when in use, avoid breathing fumes, vapors and spray mists and keep containers tightly sealed. Do not use in confined spaces.

When spraying materials containing solvents, for example paints, adhesive, coatings, use extraction ventilation or personal respiratory protection in the absence of adequate general ventilation.

Do not apply heat or flame except under specific and detailed manufacturers instructions.

Suspended Load

 **WARNING: Never improvise lifting tackle.**

There is always a danger when loads are lifted or suspended. Never work under an unsupported, suspended or raised load, for example a suspended engine.

Always make sure that lifting equipment such as jacks, hoists, axle stands and slings are adequate and suitable for the job, in good condition and regularly maintained.

Underseal

Refer to: Anti-corrosion Material.

Welding

Refer to: Fire Prevention, Electric Shock and High Pressure Gas Cylinder.

The welding procedures include (resistance welding) spot welding, arc welding and gas welding.

1. Resistance Welding

This process may cause particles of molten metal to be emitted at a high velocity, and the eyes and skin must be protected.

2. Arc Welding

This process emits a high level of ultra-violet radiation, which may cause arc-eye, and skin burns to the operator and to other persons nearby. Gas-shielded welding processes are particularly hazardous in this respect. Personal protection must be worn, and screens used to shield other people.

Contact lens wearers are advised to revert to ordinary spectacles when arc welding as the arc spectrum is believed to emit microwaves which dry out the fluid between the lens and the eye, even result in blindness. Metal spatter will also occur, and appropriate eye and skin protection is necessary.

The heat of the welding arc will produce fumes and gases from the metals being welded, the rods and from any applied coatings or contamination on the surfaces being worked on. These gases and fumes may be toxic and inhalation of these should be avoided. The use of extraction ventilation to remove the fumes from the working area may be necessary particularly in cases where the general ventilation is poor, or where considerable welding work is anticipated. In extreme cases or confined spaces where adequate ventilation cannot be provided, airfed respirators may be necessary.

3. Gas Welding (Gas Cutting)

Oxy acetylene torches may be used for welding and cutting, and special care must be taken to prevent leakage of these gases, with consequent risk of fire and explosion.

The process will produce metal spatter and eye and skin protection is necessary. The flame is bright, and eye protection should be used, but the ultra-violet emission is much less than that from arc welding, and lighter filters may be used.

The process itself produces few toxic fumes, but such fumes and gases may be produced from coatings on the work, particularly during cutting away of damaged body parts. Inhalation of the fumes should be avoided.

In brazing, toxic fumes may be produced from the metals in the brazing rod, and a severe hazard may arise if brazing rods containing cadmium are used. In this event particular care must be taken to avoid inhalation of fumes and expert advice may be required.

Special precautions must be taken before any welding or cutting takes place on vessels, which have contained combustible materials, for example boiling or steaming out of fuel tanks.

Warning Symbols on Vehicle

Decals showing warning symbols will be found on various vehicle components. These decals must not be removed. The warnings are for the attention of owners/operators and persons carrying out service or repair operations on the vehicle.

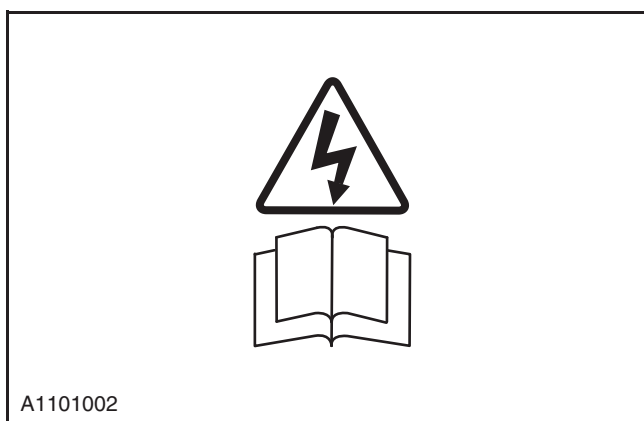
The most commonly found decals are reproduced below together with an explanation of the warnings.

1. Components or assemblies displaying the caution triangle and open book symbol advise consultation of the relevant section of the owner literature before touching or attempting adjustments of any kind.



2. Components or assemblies displaying the warning triangle with the “electrified” arrow and open book symbol give warning of inherent high voltages. Never touch these with the engine running or the ignition switched on.

Refer to: Electric Shock.



3. Vehicles and replacement components which contain asbestos are identified by this symbol.

Refer to: Acid and Alkali Metals.

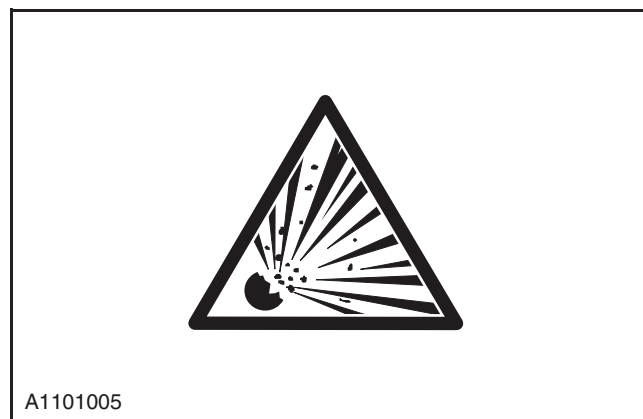


4. Displaying the caution circle with a deleted lighted match symbol, caution against the use of naked lights or flames within the immediate vicinity due to the presence of highly flammable or explosive liquids or vapors.

Refer to: Fire Prevention.



5. Displaying this symbol (normally in conjunction with 5 above) warn of the presence of potentially explosive matter within the immediate vicinity.



6. Displaying this symbol warn that children should not be allowed in the immediate vicinity unsupervised.



White Spirit

Refer to: Solvent.

Standard Workshop Practice

Vehicle in Workshop

When working on a vehicle in the workshop always make sure that:

- The parking brake is applied or the wheels are securely chocked to prevent the vehicle moving forwards or backwards.
- Remove the ignition key before starting work in front of the vehicle.
- If the engine is to be run, there is adequate ventilation, or an extraction hose to remove exhaust fumes.
- There is adequate room to raise the vehicle and remove the wheels, if necessary.
- Fender covers are always fitted if any work is to be carried out in the engine compartment.
- The battery is disconnected if working on the engine, underneath the vehicle, or if the vehicle is raised.

 **WARNING:** When electric arc welding on a vehicle, always disconnect the generator wiring to prevent the possibility of a surge of current causing damage to the internal components of the generator.

If using welding equipment on the vehicle, a suitable fire extinguisher is readily available.

Towing the Vehicle

 **WARNING:** When the vehicle is being towed, the ignition switch must be in position ACC (steering lock released and hazard warning lamps illuminated). Only then will the turn signal lamps, horn and brake lamps be operational. Failure to follow these instructions may result in personal injury.

 **CAUTION:** The removable towing eye (if equipped), has a left-hand thread and must be fully tightened before towing can commence. When towing is necessary, the vehicle towing eyes should be used. The rope must be securely fastened to the towing eyes and must also be attached to the other vehicle such that the rope will not foul the bodywork.

When a vehicle with automatic transmission is towed, the gear selector must be in position N (Neutral). Never tow a vehicle with automatic transmission at a speed greater than 50 km/h or for a distance greater than 50 km. If it is necessary to tow the vehicle a greater distance, the drive wheels must be lifted clear off the ground.

Alternatively the vehicle can be transported on a low loader or a trailer.

Connecting a Slave Battery Using Jumper Cables

 **WARNING:** If the slave battery has recently been charged and is gassing, cover the vent plugs or covers with a damp cloth to reduce the risk of explosion should arcing occur when connecting the jumper cables. Failure to follow these instructions may result in personal injury.

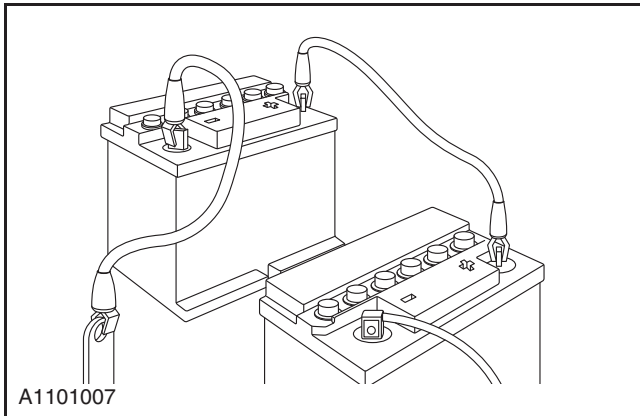
 **WARNING:** A discharged battery condition may have been caused by an electrical short circuit. If this condition exists there will be an apparently live circuit on the vehicle even when all normal circuits are switched off. This can cause arcing when the jumper cables are connected.

 **WARNING:** While it is not recommended that the vehicle is jump started, it is recognized that this may occasionally be the only practical way to mobilize a vehicle. In such an instance, the discharged battery must be recharged immediately after jump starting to avoid permanent damage.

- Always make sure that the jumper cables are adequate for the task. Heavy duty cables must be used.
- Always make sure that the slave battery is of the same voltage as the vehicle

battery. The batteries must be connected in parallel.

- Always make sure that switched electric circuits are switched off before connecting jumper cables. This reduces the risk of arcing occurring when the final connection is made.



⚠ WARNING: Make sure that the ends of the jumper cables do not touch each other or ground against the vehicle body at any time while the cables are attached to the battery. A fully charged battery, if shorted through jumper cables, can discharge at a rate well above 1,000 amps causing violent arcing and very rapid heating of the jumper cables and terminals, and can even cause the battery to explode. Failure to follow these instructions may result in personal injury.

Always connect the jumper cables in the following sequence:

- Slave battery positive first and then vehicle battery positive.
- Slave battery negative next and then vehicle ground at least 300 mm from the battery terminal, for example engine lifting eye.

Always reduce the engine speed to idle before disconnecting the jumper cables. Before removing the jumper cables from the vehicle that had the discharged battery, switch on the heater blower (high) or the heated rear windshield, to reduce the voltage peak when the cables are removed.

Always disconnect the jumper cables in the reverse order to the connecting sequence and do not short the ends of the cables.

Do not rely on the generator to restore a discharged battery. For a generator to recharge a battery, it would take in excess of eight hours continuous driving with no additional loads placed on the battery.

Component Cleaning

To prevent the ingress of dirt, accumulations of loose dirt and greasy deposits should be removed before disconnecting or dismantling components or assemblies. Components should be thoroughly cleaned before inspection prior to reassembly.

Cleaning Methods:

- Dry cleaning.
- Removal of loose dirt with soft or cable brushes.
- Scraping dirt off with a piece of metal or wood.
- Wiping off with a rag.

⚠ WARNING: Compressed air is sometimes 'wet' so use with caution, especially on hydraulic systems.

- Blowing dirt off with compressed air. (wear goggles in the operation).
- Removal of dry dust using cleaner. This method must always be used to remove friction lining material dust.
- Steam cleaning.

⚠ WARNING: Most solvents require careful handling and some are harmful. Refer to Health and Safety Precautions and to the manufacturers literature for the relevant safety precautions. Failure to follow these instructions may result in personal injury.

Various solvents are available which are suitable for component cleaning. Some components, such as brake hydraulic parts and electrical assemblies should be cleaned only with recommended solvents.

Refer to: Solvents, Sealants and Adhesives.

Calibration of Essential Measuring Equipment

 **WARNING:** Failure to follow this instruction may result in personal injury or damage to components.

It is of fundamental importance that certain essential equipment, for example torque wrenches, multimeters, exhaust gas analyzers or rolling roads, are regularly calibrated in accordance with the manufacturers instructions.

Solvents, Sealants and Adhesives

Introduction

 **WARNING:** Always handle all solvents, sealers and adhesives with extreme care. Some contain chemicals or give off fumes which can be dangerous to health. Always follow the manufacturer instructions. If in doubt about any substance, particularly a solvent, do not use it.

 **WARNING:** If in doubt about the suitability of any proprietary solvent or sealer for a particular application, contact the manufacturer of the product for information regarding storage, handling and application.

The Health and Safety Precautions subsection refers to some commonly used chemicals and materials, hazards associated with their use, and safety measures to be taken.

Road/Roller Test

Road or roller test may be carried out for various reasons and a procedure detailing pre-test checks, engine starting and stopping, pre-driving checks, on-test checks and final checks to be completed on completion of the test is given below.

Unless complete vehicle performance is being checked, the full road test procedure need not be carried out. Instead, those items particularly relevant to the system(s) being checked can be extracted.

 **WARNING:** If the brake fluid level is low, pedal travel is excessive or a hydraulic leak is found, do not attempt to road test the vehicle until the reason for the low fluid level, excessive pedal travel or hydraulic leak is found and rectified.

It is suggested that pre-test checks and functional tests of those systems and circuits which affect the safe and legal operations of the vehicle, With the ignition switched off, check: such as brakes, lights and steering, should always be carried out before the road or roller test.

- The engine oil level.
- The engine coolant level.
- The tires, for correct pressure, compatible types and tread patterns, and wear within limits.
- That there is sufficient fuel in the tank to complete the test.
- All around the engine, transmission and under the vehicle for oil, coolant, hydraulic and fuel leaks. Make a note of any apparent leaks and wipe off the surrounding areas to make it easier to identify the extent of the leak on completion of the test.

Starting the Engine

 **CAUTION:** On initial drive away from cold and within the first 1.5 km, do not depress the accelerator pedal beyond half travel. Never operate at high engine speed or with the accelerator pedal at full travel whilst the engine is cold.

With the Ignition Switched Off, Check

- That the parking brake is applied.
- That the gear lever is in the neutral position.
- That all instrument gauges (except fuel gauge) read zero.

With the Ignition Switched on, Check

- That the ignition controlled warning lamps are illuminated.
- That the engine temperature gauge registers a reading compatible with the engine temperature.

- That the fuel gauge registers a reading appropriate to the fuel level in the tank.
- The operation of the parking brake warning lamp and fluid level warning indicator.

Road or Roller Testing and Inspection

 **WARNING:** If road testing, check the brake operation while still traveling at low speed before continuing with the test. If the brakes pull to one side, or appear to be otherwise faulty, do not continue with the road test until the fault has been found and rectified.

- That the clutch pedal operation is not stiff or heavy.
- That the initial gear engagement is smooth and there is no evidence of clutch drag.
- That the parking brake control operates smoothly and releases quickly and completely. that the clutch takes up the drive smoothly, without slip or judder.
- That gear changing is smooth with no abnormal noises or vibrations from the transmission.
- The engine power output is satisfactory, full power is achieved, acceleration is smooth and pedal operation is not stiff or heavy, and engine speed returns to idle correctly.
- There is no excessive or abnormally colored smoke from the engine under normal driving, heavy load or overrun conditions.
- That steering operation, including power steering(if equipped), is smooth, accurate, not excessively heavy or with excessive free play or vibration. that the steering does not pull to one side and self centers smoothly after cornering.
- That the speedometer, coolant temperature gauge and tachometer (if equipped) register the correct readings and operate correctly.
- That the switches and controls operate smoothly and positively, warning and indicator lamps operate correctly and the direction indicator control self cancels

when the steering is returned to the straight ahead position.

- That the heating and ventilation systems operate correctly and effectively.
- The brake operation is normal.

Bake Testing

 **WARNING:** When brake testing, avoid breathing the fumes from hot brakes, this may contain asbestos dust which is hazardous to health. Failure to follow this instruction may result in personal injury.

Avoid brake testing on busy roads where it may cause inconvenience or danger to other road users.

 **WARNING:** Brake testing which includes heavy brake applications should not be carried out with new brake pads/discs or linings/drums until the components have bedded-in. New brake friction components will not reach full efficiency until the bedding-in process is complete.

Test the brakes at several speeds within the normal operating range using both light and heavy pedal pressure. Note any tendency to snatch, pull or drag, and any undue delay in application or release. Allow the vehicle to coast and note any tendency to pull to one side, or evidence that the brakes are binding.

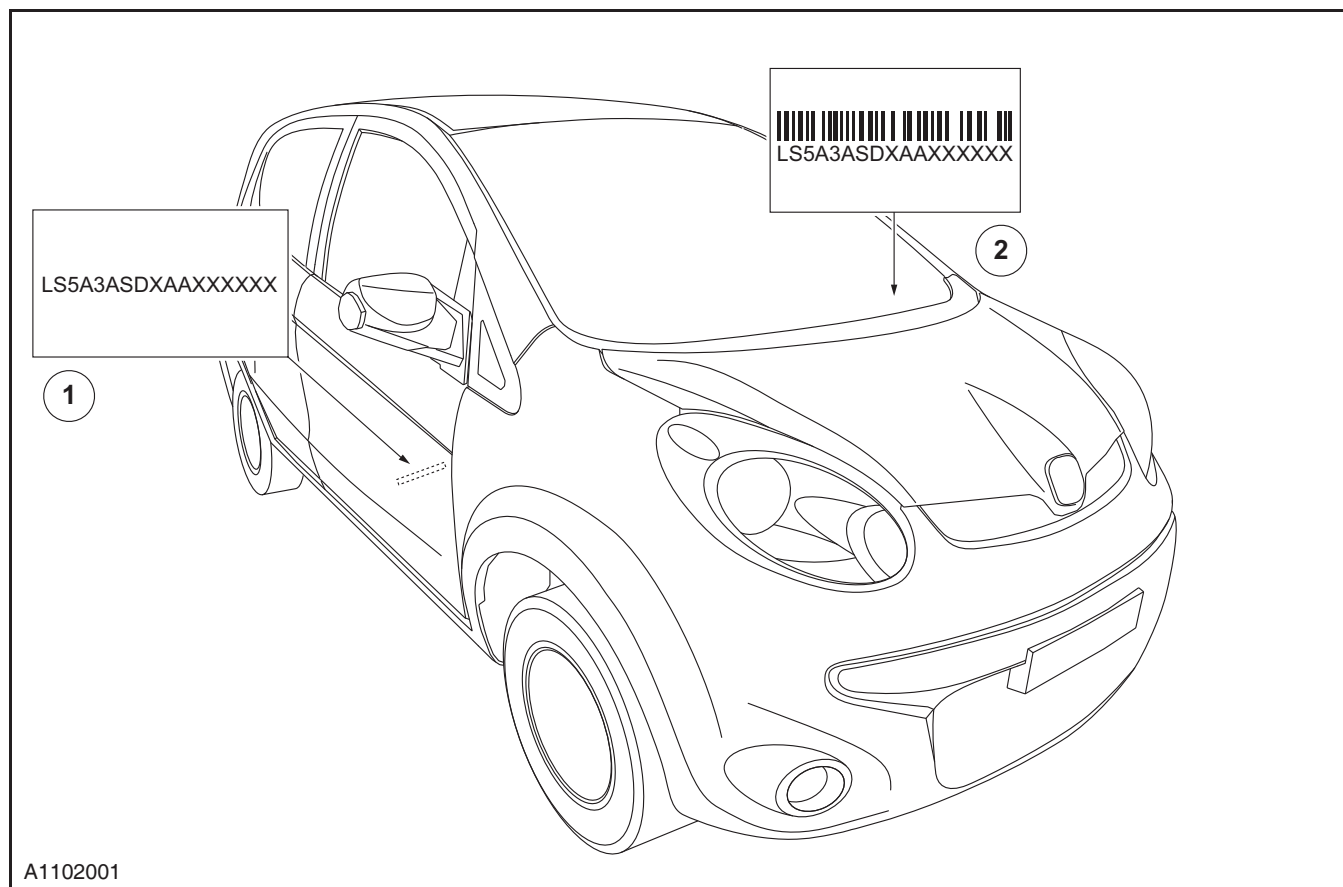
After stopping the vehicle (not immediately after a period of heavy braking), carefully check the brake temperature. A brake disc or brake drum that feels hot or is appreciably hotter than the others, indicates that the brake is binding.

After Completion of The Test, Check

- Oil, coolant, hydraulic, air and fuel leaks.
- Abnormal temperature of any moving components or assemblies, for example wheel hubs, transmission and axle, which might indicate over tightness or lack of lubrication.

Description and Operation

Vehicle Identification Number (VIN)

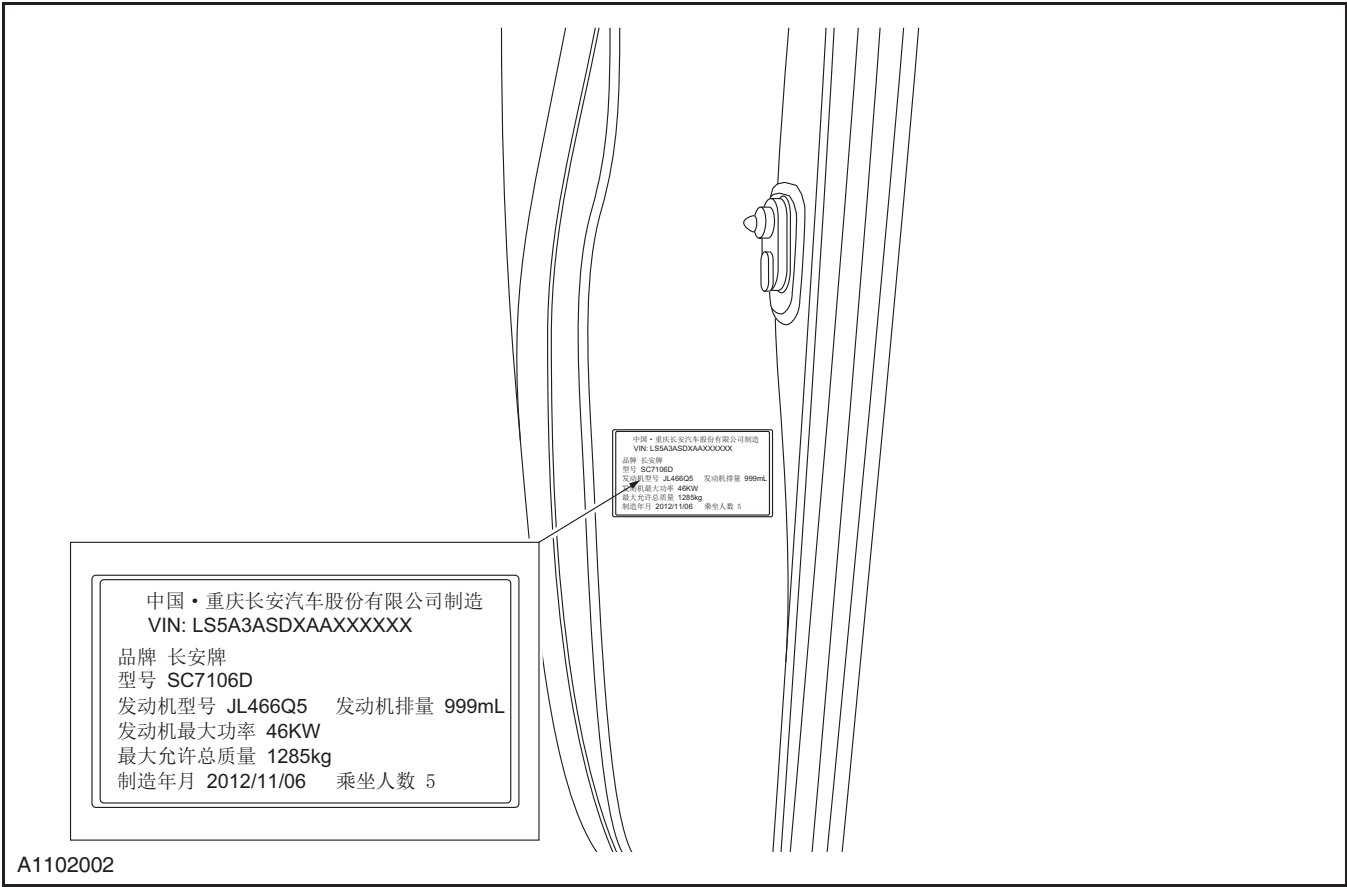


Item	Description	Item	Description
1	VIN position on body	2	VIN position on instrument panel

VIN Interpretation

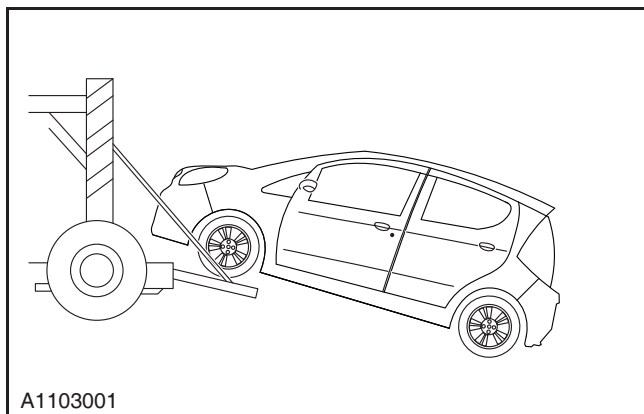
Item	Description	Item	Description
1 ~ 3	Manufacturer identification code	8	Driving mode
4	Vehicle classification code	9	Inspection number
5	Vehicle main parameter code	10	Year of manufacture
6	Engine model	11	Manufacturing factory code
7	Body type	12 ~ 17	Production serial number

Nameplate



Description and Operation

Traction



For the front-drive vehicle, the front wheels shall be lifted and the rear wheels shall be on the ground in traction. Turn the ignition key to position ACC; unlock the steering wheel and make the front wheel face the front. Then lock the steering wheel with special locking mechanism and turn on the warning lamp.

The hook is placed in the onboard tool kit. Install it when using.

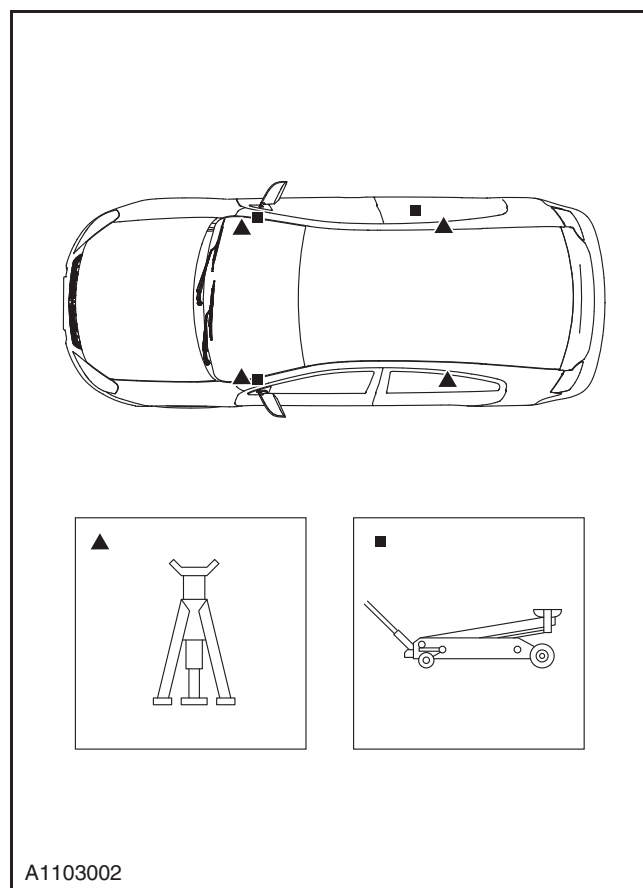
WARNING: The front wheels are forbidden to land on the ground in traction, otherwise, the transmission may be damaged.

CAUTION: The traction distance shall not exceed 80 km with the driving speed less than 20 km/h. When using soft connection tractor, the distance between towing vehicle and towed vehicle shall be more than 4 m, less than 10 m. The traction angle shall not be over 30 degree.

Jacking

WARNING: Always park the vehicle on a hard level surface. If the vehicle must be jacked up on a soft surface use load spreading blocks under the jack. Always chock the wheel diagonally opposite the jacking point. Failure to follow these instructions may result in personal injury.

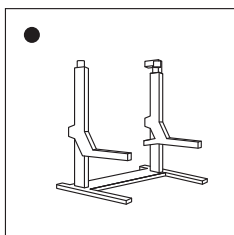
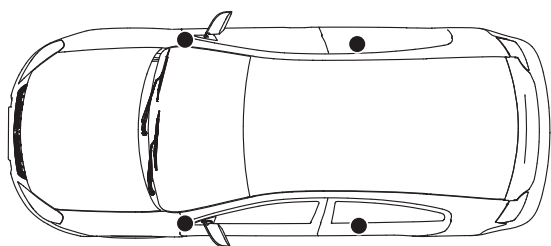
When using the vehicle jack, it is important to conform to the following guides for correct operation. The correct jacking point must be used. The open area between the front and rear wheels is always selected as jacking point. A pad shall be applied to protect the painting when using the jack.



Lifting

⚠ WARNING: It is important to use the correct lifting position for the lifting safety. Otherwise, the vehicle may be damaged or injury may be caused.

⚠ CAUTION: When lifting the vehicle with a two post lift, vehicle lift arm adapters must be used under the lifting points.



A1103003

Description and Operation

Maintenance Items

People must pay special attention to safety in maintenance before checking the vehicle, to prevent from accidents. Please pay special attention to the following conditions:

1. Do not start the engine in the forbidden area.
2. If it is necessary to start engine in maintenance, apply the parking brake completely and set the gearshift lever at neutral.
3. Do not touch any component of ignition system after starting the engine.
4. Keep the hands, clothes, tools and other things away from cooling fan and drive belt and any other rotating components when the engine operates.
5. Do not touch any heat extraction components, such as: exhaust manifold, air condition high pressure pipe and muffler in order to avoid being scalded.
6. Keep electrical conductors away from the battery cathode and anode to avoid shortcircuit and accidents such as battery damage, fire and explosion.
7. Do not drain the fluid of the vehicle, such as gasoline, oil, coolant, brake fluid and power steering fluid. The fluid may pollute environment.
8. Prevent water from entering the control unit during cleaning and maintenance.
9. Electronic control system uses high-voltage oil. Even if the engine is not running, high-voltage gasoline must be kept in the oil. The oil pipe and fuel filter should be replaced in a well-ventilated place.
10. As the throttle of electronic control system has been adjusted on its limit screws, those limit screws are not allowed to be changed at any time.
11. During fault hot-state analogue or operations which might cause temperature rise of the vehicle, people should keep the temperature of electronic control unit under 80 °C .
12. Disconnect the wiring harness connectors of all control modules and the wiring harness of battery in welding.
13. Those equipment might cause electromagnetic interference should not be installed near the electronic control unit to avoid interference.
14. Turn the ignition switch to "OFF" when disconnecting the control module wiring harness connector.

Daily Maintenance

Daily maintenance means three inspections, i.e. the inspections of vehicle safety structure and the retaining situations of all components before/in and after driving. Keep the oil, air filter, fuel filter and battery clean. Prevent water, fuel, air and electricity leakage.

Regular Maintenance Item and Interval

The following chart determines the regular maintenance based on driving mileage or month. The inspection, adjustment, lubrication and other maintenance should strictly follow the regular period in the chart.

Regular maintenance symbols:

R-Replace, A-Adjust, I-Inspect, L-Lubricate, C-Clean, T-Tighten to the specified torque, F-Fill, Top Up.

Interval: This interval should be judged by odometer reading or months, whichever comes first.	km (x1,000)	2	10	20	30	40	50	60	70	80
	months	2	6	12	18	24	30	36	42	48
ENGINE										
1.Fan (Water pump, compressor) drive belt (tension, wear, etc.)		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
2.Timing belt (tension, wear, damage)		I.A.R	I.A.R	I.A.R	I.A.R	I.A.R	I.A.R	I.A.R	I.A.R	I.A.R
3.Valve Clearance		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
4.Engine Bolt (cylinder head, manifold fastener)		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
5.Oil filter		R	R	R	R	R	R	R	R	R
6.Engine Oil ★		R	R	R	R	R	R	R	R	R
7.Engine coolant		I.F	I.F	I.F	I.F	I.F	I.F	I.F	I.F	I.F
IGNITION										
8.Ignition coil (damage, leaking)		-	I.R	J.T	-	J.T	-	J.T	-	J.T
9.Spark Plug		-	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
FUEL										
10.Air filter	Normal condition	C	C	R	C	R	C	R	C	R
	Dusty condition	C	R	R	R	R	R	R	R	R

Interval: This interval should be judged by odometer reading or months, whichever comes first.	km (x1,000)	2	10	20	30	40	50	60	70	80
	months	2	6	12	18	24	30	36	42	48
11.Fuel filter		R	Replace every 10,000 KM or 6 months (But shorten the service interval under severe conditions)							
12.Fuel tank, fuel lines and connectors, pipe clip		I	I	I	I	I	I	I	I	I
CRANKCASE EMISSION CONTROL										
13.Crankcase ventilation hose and connections		-	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
14.Fuel vapour system		-	I.A.R	I.A.R	I.A.R	I.A.R	I.A.R	I.A.R	I.A.R	I.A.R
15.PCV valve		-	I	I	I	I	I	I	I	I
ELECTRICAL APPARATUS										
16.Wiring harness, connections and lights		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
CHASSIS AND BODY										
17.Clutch		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
18.Brake fluid (amount, leakage pollution)		I.F	I.F	I.F	I.F	I.F	I.F	I.F	I.F	I.F
19.Brake pedal (stroke)		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
20.Parking braking lever and cable		I.A	Inspect And Adjust Every 10,000 KM (But shorten the service interval under severe conditions)							
21.Front: Brake discs and pads (wear)		I	I	I	I	I	I	I	I	I
22.Rear: Brake drums and shoes (wear)		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
23.Brake hoses and pipes (leakage, damage)		I	Inspect Every 10,000 KM (But shorten the service interval under severe conditions)							
24.Tire (abnormal wear and pressure, etc.)		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
25.Wheel and Wheel nut (damage, tightness)		IT	Inspect And Tighten Every 10,000KM (But shorten the service interval under severe conditions)							
26.Main bolt and nut (tightness)		I.T	Inspect And Tighten Every 10,000 KM (But shorten the service interval under severe conditions)							

Interval: This interval should be judged by odometer reading or months, whichever comes first.	km (x1,000)	2	10	20	30	40	50	60	70	80
	months	2	6	12	18	24	30	36	42	48
27. Steering system (clearance, tightness)		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A
28. Transmission oil		R	R	R	R	R	R	R	R	R
29. Toe-in		I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A	I.A

★ The engine oil used for Changan model must be above SM 10W/40.

Description and Operation

This chapter briefly introduces the generation of noise and vibration on the vehicle and how to eliminate them.

NVH Meaning in Automotive Engineering

N = Noise-audible unpleasant sound.

V = Vibration-perceptible vibration.

H = Harshness-audible and perceptible jittering and vibration.

Noise Type in Automotive Engineering

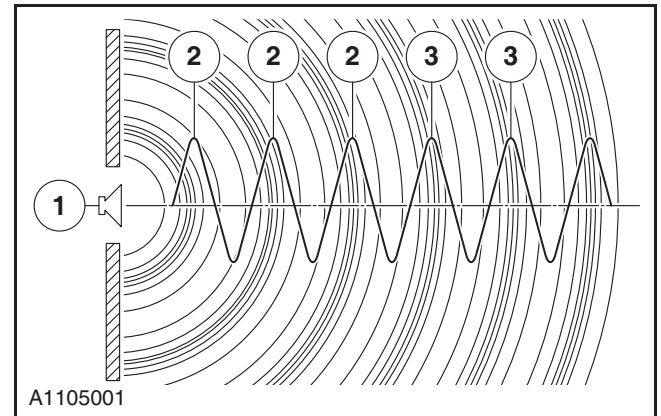
Accordinging to sound intensity, the noise in automotive engineering can be classified as following:

- Slight noise-low thunder, buzz.
- Moderate noise-rapid drone.
- Strong noise-loud howling, harsh whistle.
- Loud howling and whistle will hurt the ears.

Different positions on the vehicle make noises in different intensity:

- Slight noise mostly comes from engine.
- Slight noise also can be produced on road, especially on rough road. It is another type of slight noise, such as the vibration of vehicle which driver can feel.
- Strong noise (such as howling and harsh whistle) is commonly generated by airflow or accessories (such as alternators and driving belts).
- Chatter sound can be heard when vehicle runs on rough road. The unstable noise is usually caused by the shock absorber, chassis components or loose components inside the vehicle.

Sound Transmitted Through Air



Item	Component	Description
1	-	Sound source (such as engine)
2	-	Sound wave
3	-	Amplitude

Sound Transmitted Through Object

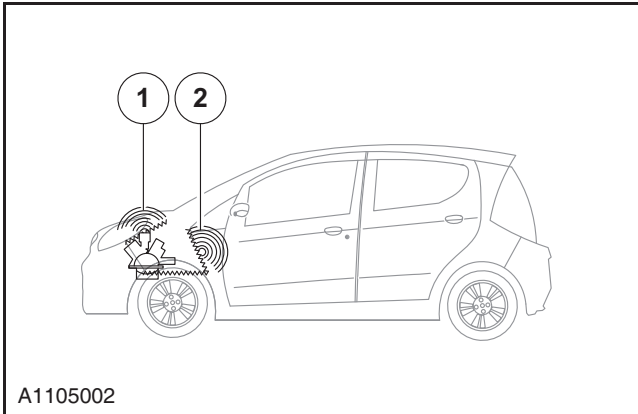
The sound can transmit through liquid or solid (such as vehicle body).

The speed (sound velocity) of sound depends on the object materials. Generally, the transmitting speed of sound in liquid and solid is faster than in air (about 5 times).

Sound Transmitted Through air and Object

CAUTION: The noise transmitting through air and object is the main concern of the automotive engineering.

Noise transmitted through the vehicle



Item	Component	Description
1	-	The noise transmitted through air
2	-	The noise transmitted through vehicle body

Example:

- The noise from engine.
- Directly through air.
- It is transmitted from engine to vehicle body with vibration and spreaded to the cab by the way of sound wave.

Vibration Process Engineering

- Vibration waves with a frequency lower than 20 Hz (low frequency) or higher than 20,000 Hz (20 kHz, high frequency) can not be heard by human ears.
- The engine with flexible installation can vibrate up and down when running on rough road.
- When flexible installation of engine is in trouble, vibration will be transmitted from engine to vehicle body and even cab.

Applicable for the following:

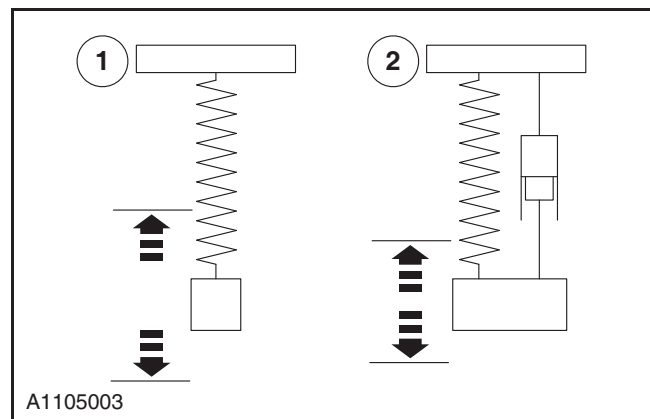
- Vehicle process engineering does not only concerns audible low frequency vibration but also the high frequency vibration that can be not heard.
- Generally, the low frequency vibration is visible.
- The high-frequency vibration is palpable through the floor and the steering wheel.

Resonance

- Every object has its inherent vibration frequency.
- If a certain system vibrates with its inherent vibration frequency, it will cause resonance.
- When engine reaches resonance frequency, the engine will run unstably (engine critical speed).
- Once the engine speed exceeds the critical point, it will run stably at once.

Damping

- The vibration can be reduced if a damper is connected with spring in parallel.
- The vehicle shock absorber is made based on this principle.
- Damping influences the resonance of object and system.
- The vibration can be weaken with shock absorber in order to eliminate the vibration of vehicle body.
- In fact, vehicle shock absorber is a damper and the vibration on vehicle body is weakened by the way of damping.



Item	Component	Description
1	-	Non-damping vibration
2	-	Damping vibration

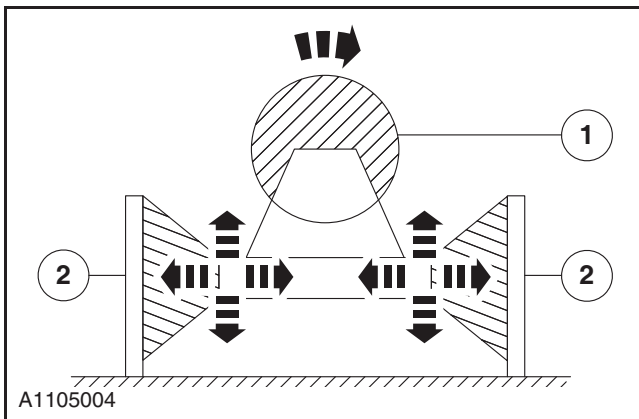
Sound Insulation

In vibrational science, the meaning of sound insulation is the decoupling of component and system.

Example:

- Engine should be installed on elastic support in order to reduce the vibration that is transmitted to vehicle body.
- In vehicle process engineering, rubber gasket is most related to sound insulation technology. It acts as a spring.
- The effect of decoupling depends on the structure of components.

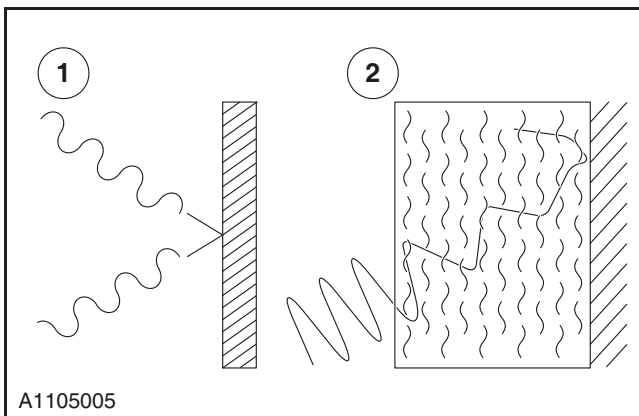
The Directional Installation of Rubber Gasket Can Reach the Best Sound Insulation Effect



Item	Component	Description
1	-	Engine
2	-	Engine installation

Absorb

- Sound is reflected when meeting hard surface.
- Sound will be absorbed when meeting soft external surface. The effect depends on the material and thickness of absorbing object.



Item	Component	Description
1	-	Reflected wave
2	-	Attracted wave

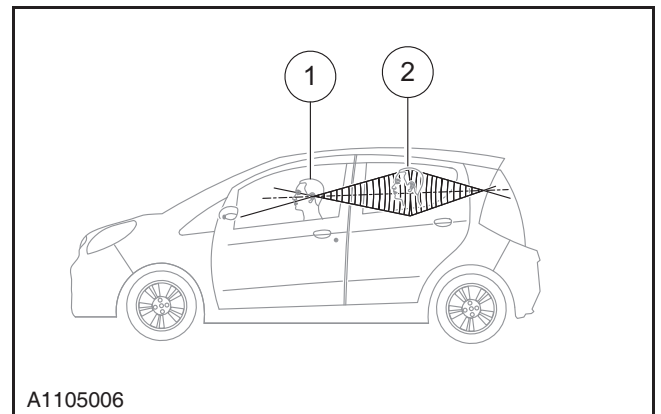
Example:

- All sound insulation components such as door decorated board, carpet, ceiling, carrier and seat should be insulated with vehicle body.
- In this way, the sound wave will be reflected directly and reduce the occur of Hall effect.

Noise and Vibration on Vehicle

The noise levels are different based on the different positions of passengers on vehicle.

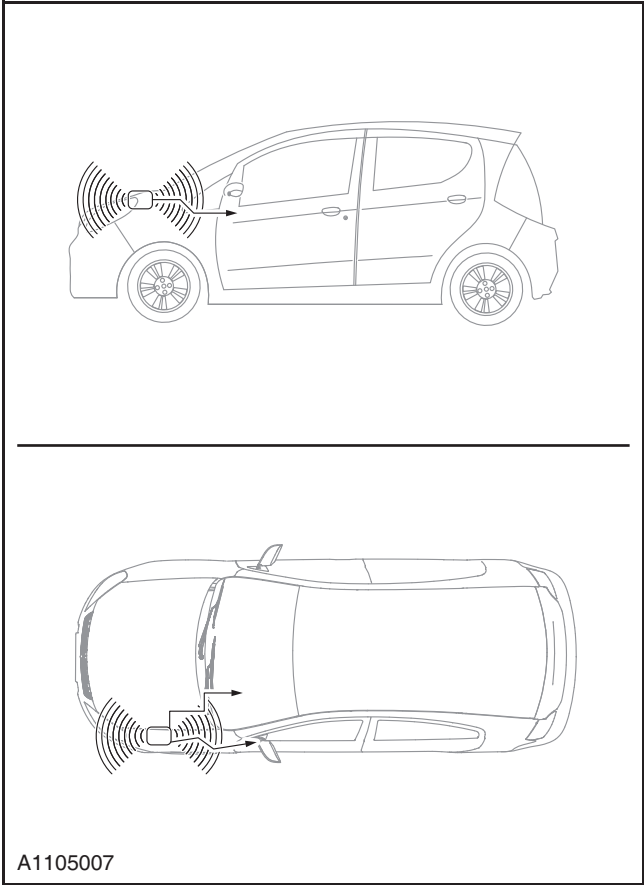
Vehicle Sound/Noise Wave (Standing Wave)



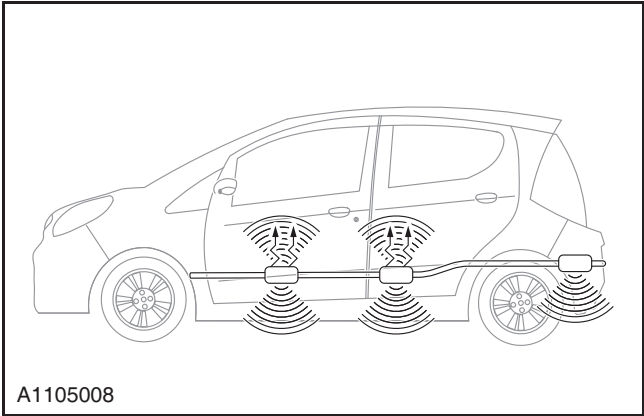
Item	Component	Description
1	-	Driver is at "wave trough"
2	-	Rear passengers are in "wave peak"

Noise and Vibration Caused by Intake and Exhaust System

Air intake system can be regarded as the vehicle air and solid noise source.



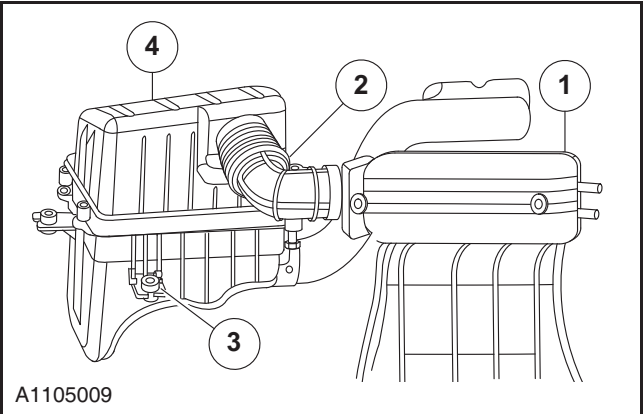
Air exhaust system can be regarded as the vehicle air and solid noise source.



Transmission route of sound:

- The chart above shows the transmission route of noise caused by intake and exhaust system.
- In addition to air noise, the solid noise in the intake and the exhaust system is also the main source. In order to minimize the noise, the sound isolation cushion must be installed firmly.
- The exhaust system is a typical vibrating component, and a good sound insulation device is required in the installation. The system layout, trends and connecting points of the vehicle body shall be properly selected to reduce the solid noise.

Air Intake System

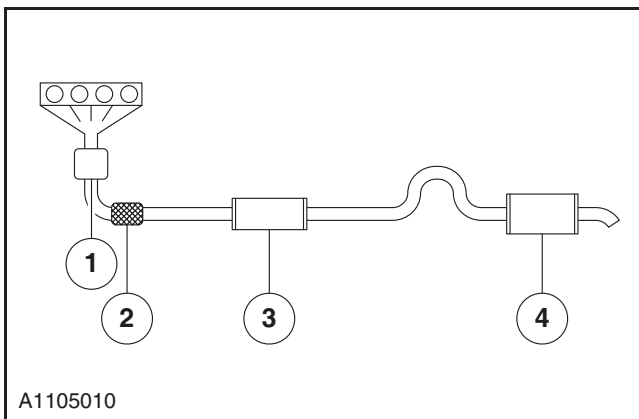


Item	Component	Description
1	-	Air intake manifold
2	-	Connecting pipe
3	-	Retaining component (Rubber gasket)
4	-	Air filter

- Length and cubage of air intake system has been fixed and can not be changed in maintenance. Pay attention to the tightening and leakages between connecting components in operation.
- The great air pressure changes on the surface air intake system components will cause strong vibration.
- Influence of temperature; for example, heating air filter will change its rigidity.

- In order to avoid the solid vibration on the surface of air intake system transmitting to vehicle body, pay attention to the following points in maintenance: a) whole air intake system is insulated with vehicle body, install the rubber gasket and keep proper degree of freedom; b) air intake pipe should not be connected with vehicle body directly. It is necessary to add foam sound absorbent pad on the connecting positions with vehicle or other components.

Exhaust System



Item	Component	Description
1	-	Catalytic converter
2	-	Decoupling equipment
3	-	Front muffler
4	-	Rear muffler

Exhaust system can not be installed too tightly.

CAUTION: The rubber gasket in suspension exhaust system can also transmit vibration, sometimes it is noise source. So it is necessary to leave a suitable free play in installing exhaust system.

Rubber gasket can not be installed too tightly.

Exhaust manifold and catalytic converter (if connected with engine directly) must be connected with engine rigidly (no gaps at the bracket connection).

Simple problem inspection:

- Remove all suspension bushings in exhaust system.
- Suspect exhaust system with rope (at most two suspension points).

- Check the noise level of cab in road test.
- If the noise is eliminated, it means the exhaust bushing is noise source.
- Take drive belt after installing every bushing and check noise level.
- Based on this procedure, the bushing causes noise will be found out.

Vehicle Body

Function

- The requirement to vehicle is allround, especially the vehicle in driving. Here, what we emphasize are other main components that cause noise in vehicle, such as engine and bushing. The vehicle body is one of the most important part involving NVH.
- The components we described here only means the the componets to cause vibration and noise based on function. Vehicle body includes or concerns all these components.
- Vehicle body can not only cause air noise but alos solid noise.
- Vehicle body must absorb the virbation from all components and try to stop transmitting the virbation to the vehicle body.
- The main components of NVH in the vehicle body are the roof steel plate, the side wall and the floor. The vibration or noise shall be increased greatly due to the strutcture, just as an amplifier.

Higher Requirements for Vehicle Body

- Good falling or knock performance.
- Spacious interior.
- Corrosion resistance.
- Light weight.
- Excellent aerodynamic appearance.

Because can not satisfy all these requirements at the same time, we only adopt a half-way solution. For example, to satisfy NVH performance, the integral rigidity of vehicle body must be ensured together with the good resiliency in crash and with certain flexibility of vehicle body. So we only can adopt the method of crumpling or twist partial areas.

Example:

The ensure of vehicle body water proofness can not ensure the requirements to noise and vibration at the same time, so the following elements should be considered:

- Correctly install the vehicle window.
- Correctly install the sealing strip.

Other precautions:

- All pipes to engine compartment.
- Door and window weather strip.
- Heater and vent.
- Sunroof drain pipe.

The cross components of side wall and vehicle body are usually the transmitted passage to vibration and noise, possible rectification methods are:

- Install at separated positions at critical localisations (such as A post and side wall) in order to reach the good sound insulation performance.



CAUTION: The foam block or foam filled block is a good sound insulation measure. If the noise occur in wind, tire, engine or road surface, check the foam block at the relative positions.

- Install foam block at influenced area.
- Fill foam block at the relative gaps or holes.

Diagnosis and Testing

Inspection and Verification

1. Start the vehicle to reshow the malfunction, verify the customer concern.
2. Visually inspect for obvious signs for malfunction.
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the symptom chart.

How to Use The Diagnostic Procedures

Noise, vibration and harshness (NVH) concerns have become more important as vehicles have become more sensitive to these vibrations. This section is designed to aid in identifying these concerns.

The section provides diagnostic procedures based on symptom. For example, if the symptom occurs at high speed, the most likely place to start is under shake and vibration while driving.

Road test can distinguish the symptom type, such as how to distinguish the vibration from the shake.

A series of Road Test Quick Checks are provided to make sure that a cause is either pinpointed or eliminated.

Confirm the concern, proceed to the appropriate section and execute the correct diagnosis. When the cause is identified, the job is partly done.

Follow the diagnostic procedure as outlined.

Quick Checks are described within the step, while more involved tests and adjustments are outlined in General Procedures.

Always follow each step exactly and make notes to recall important findings later.

Customer Interview

The road test and customer interview (if possible) provide information that will help identify the concern and will provide direction to the correct starting point for diagnosis.

Identify the Condition

NVH usually occur in four areas:

- Tire
- Engine accessories
- Suspension
- Driveline

It is important, therefore, that an NVH concern be isolated into its specific area(s) as soon as possible. The easiest and quickest way to do this is to carry out the Road Test as outlined. To assist in the diagnosis and testing procedure(s), use a suitable approved NVH diagnosis tester.

Noise Diagnostic Procedure

Non-Axle Noise

The five most common sources of non-axle noise are exhaust, tires, roof racks, trim panels and transmission.

Therefore, make sure that none of the following conditions are the cause of the noise before proceeding with a driveline teardown and diagnosis:

- In certain conditions, the pitch of the exhaust may sound very much like gear noise. At other times, it can be mistaken for a wheel bearing rumble.
- Tires, especially snow tires, can have a high pitched tread whine or roar, similar to gear noise. Radial tires may have this characteristic. Also, any non-standard tire with an unusual tread construction may emit a roar or whine noise.
- Trim panels can also cause whistling or whining noise.
- Clunk may be a metallic noise heard when the automatic transaxle is engaged or it may occur when the throttle is applied or released. It is caused by backlash somewhere in the driveline.
- Bearing rumble sounds like marbles being tumbled. This condition is usually caused by a damaged wheel bearing.

Noise Conditions

- Gear noise is typically a howling or whining due to gear damage or incorrect bearing preload. It can occur at various

speeds and driving conditions, or it can be continuous.

- Chuckle is a particular rattling noise that sounds like a stick against the spokes of a spinning bicycle wheel. It occurs while decelerating from 64 km/h (40 mph) and can usually be heard all the way to a stop. The frequency varies with vehicle speed.
- Knock is very similar to chuckle, though it may be louder and occurs on acceleration or deceleration. The teardown will disclose what has to be corrected.

Clicking, Popping or Grinding Noises May be Caused by The Following:

- Worn, damaged or incorrectly installed wheel bearing, suspension or brake component.
- Check and rule out tires, exhaust and trim items before disassembling the transmission to diagnose and correct gear noise.

Vibration Conditions

Vibration at highway speeds may be caused by the following:

- Out-of-balance front or rear wheels.
- Out-of-round tires.

Shudder or vibration during acceleration may be caused by the following:

- Damaged powertrain/drivetrain mounts.
- Excessively high constant velocity (CV) joint operating angles caused by incorrect ride height. Check ride height, verify correct spring rate and check items under inoperative conditions.

Road Test

A gear-driven unit will produce a certain amount of noise. Some noise is acceptable and may be audible at certain speeds or under various driving conditions, as on a newly paved asphalt road. The slight noise is in no way detrimental and must be considered normal.

The road test and customer interview (if available) provide information needed to identify the condi-

tion and give direction to the correct starting point for diagnosis.

1. Make notes throughout the diagnosis routine. Make sure to write down even the smallest bit of information, because it may turn out to be the most important.
2. Do not touch anything until a road test and a thorough visual inspection of the vehicle have been carried out. Leave the tire pressures and vehicle load just where they were when the condition was first observed. Adjusting tire pressures, vehicle load or making other adjustments may reduce the condition(s) intensity to a point where it cannot be identified clearly. It may also inject something new into the system, preventing correct diagnosis.
3. Make a visual inspection as part of the preliminary diagnosis routine, writing down anything that does not look right. Note tire pressures, but do not adjust them yet. Note leaking fluids, loose nuts and bolts, or bright spots where components may be rubbing against each other. Check the load space for unusual loads.
4. Road test the vehicle and define the condition by reproducing it several times during the road test.
5. Carry out the Road Test Quick Checks as soon as the condition is reproduced. This will identify the correct diagnostic procedure. Carry out the road test quick checks more than once to verify they are providing a valid result. Remember, the road test quick checks may not tell where the concern is, but they will tell where it is not.

Road Test Quick Checks

1. 24 ~ 80 km / h :

With light acceleration, a moaning noise is heard and possibly a vibration felt in the front floor panel. It is usually worse at a particular engine speed and at a particular throttle setting during acceleration at that speed. It may also produce a moaning sound, depending on what component is causing it. Refer to Tip-in Moan in the driveline noise and vibration symptom chart.

2. Acceleration/Deceleration:

With slow acceleration and deceleration, a shake is sometimes noticed in the steering wheel/column, seats, front floor panel, front door trim panel or front end sheet metal. It is a low frequency vibration (around 9-15 cycles per second). It may or may not be increased by applying the brakes lightly. Refer to Idle boom/shake/vibration in the driveline noise and vibration symptom chart.

3. High Speed:

A vibration is felt in the front floor panel or seats with no visible shake, but with an accompanying sound or rumble, buzz, hum, drone or booming noise. Coast with the clutch pedal depressed (manual transmission) or shift control selector lever in "N" (NEUTRAL) (automatic transmission) and engine idling. If vibration is still evident, it may be related to wheels, tires, front brake discs, wheel hubs or front wheel bearings. Refer to shake and vibration while driving in the driveline noise and vibration symptom chart.

4. Engine speed sensitive:

A vibration is felt whenever the engine reaches a particular rpm. It will disappear in neutral coasts. The vibration can be duplicated by operating the engine at the problem rpm while the vehicle is stationary. It can be caused by any component, from the accessory drive belt to the clutch or torque converter which turns at engine speed when the vehicle is stopped. Refer to shake and vibration while driving in the driveline noise and vibration symptom chart.

5. Noise and vibration while turning (clicking, popping or grinding noises) may be due to the following:

- Worn, damaged or incorrectly installed front wheel bearing.
- Damaged powertrain/drivetrain mounts.

Road Conditions

An experienced technician will always establish a route that will be used for all NVH diagnosis road tests. The road selected should be reasonably smooth, level and free of undulations (unless a particular condition needs to be identified). A smooth asphalt road that allows driving over a range of speeds is best. Gravel or bumpy roads are unsuitable because of the additional road noise produced. Once the route is established and consistently used, the road noise variable is eliminated from the test results.

 **CAUTION: Some concerns may be apparent only on smooth asphalt roads.**

If a customer complains of a noise or vibration only on a particular road, the source of the concern may be the road surface. If possible, try to test the vehicle on the same type of road.

Vehicle Preparation

Carry out a thorough visual inspection of the vehicle before carrying out the road test. Record anything which is unusual. Do not repair or adjust any condition until the road test is carried out, unless the vehicle is inoperative or the condition could pose a hazard to the technician.

After verifying that the condition has been corrected, make sure all components removed have been installed.

