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# 2014
# MD/MS201 Workshop Manual

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# Workshop Manual

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# 1.1 Service Information

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## Description and Operation

# About This Manual

### Introduction

This manual has been written in a format that is designed 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 Changan Automobile Co., Ltd. are manufactured according to the original factory standard. Only the genuine parts from Changan Automobile Co., Ltd. can be used in repair.

### Special Tool

Special tool(s) list 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 Changan 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 cannot 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

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

**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.**

**Refer to: Notes are used to provide additional information to effectively help improve repair efficiency.**

### 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 five groups: Overview, Chassis, Powertrain, Electrical and Body.

Table of Contents of the manual includes all sections. Each section has a regular structure: Specifications, Description and Operation, General Inspection, 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

Specifications mainly describes the material specifications, component specifications, general specifications (the contents that can be included in other specifications) and torque specifications. The information in the specifications shall use the metrics except the torque (imperial).

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### Description and Operation

Description and Operation mainly describes the system components, functions and principles of the new systems. The "new systems" refer 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 Inspection

General Inspection mainly describes the general inspection steps of the system.

### Symptom Diagnosis and Testing

Symptom Diagnosis and Testing section describes the diagnosis and inspection for the symptom that cannot be judged from the visual inspection only, excluding the diagnosis and inspection using diagnostic tool. 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 tool. It covers engine control module terminal list, 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 skin, eyes, nose, throat 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 acid mist. Make sure that the eye wash bottle, shower and soap are readily available for splashing accidents.

Place Eye Hazard sign.

### 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. Wear suitable protective gloves and goggles to avoid highlight.

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 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 Freon R12 and R134a.

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## Adhesives and Sealants

Refer to: Chemical Materials.

Highly flammable substance - observe No Smoking policy.

Generally, they 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 fume.

   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

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

   Skin will incur dermatitis and inhale toxic or harmful chemicals if contacting with uncured resins.

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

5. Anaerobic, Cyanoacrylate (super-glues) 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 (super - glues) 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 vapor 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 vapor and spray droplet from the breathing zone.

   Wear appropriate gloves, eye and respiratory protection.

## Antifreeze

Refer to: Inflammables, Solvent.

For example, isopropanol, ethylene glycol and methanol.

Highly flammable, flammable, combustible.

Used in vehicle coolant systems, screenwash solutions.

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

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The antifreeze or other harmful materials may enter the human body through the skin. Drinking the antifreeze accidentally may cause death, so 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, Alkali and Metal.**

The released gas will cause explosion when charging the battery. Open fire or spark is forbidden 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 cannot 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, antifreeze, braking fluid, fuel, oil and grease. Be careful when using and storing the materials. They may be noxious, harmful, corrosive, irritable and inflammable and will generate some harmful gas and dust.

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

1. Chemical Materials - 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 materials. Replace the severely polluted clothes and clean them.
   - Compile operation instructions, and wear 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, tidy and no leakage.
   - The chemical materials shall be managed and stored strictly in accordance with the national and local regulation.
   - Keep the materials away from the children.
2. Chemical Materials - forbidden operations:
   - Do not mix the chemical materials 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 materials 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, because some chemical materials are combustible, and some substance will release noxious or harmful gas when burnt.
   - Do not leave the container open, as the gas emitted from the container may be toxic to the human body or cause an explosion. Some gas lighter than air will accumulate in small sections.
   - Do not transport the chemical materials with containers 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 irritate the skin to catch dermatitis, or some noxious

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and harmful gas will be absorbed through the skin.

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

## Clutch Fluid

**Refer to: Brake Fluid.**

## Anti-corrosion Materials

**Refer to: Solvent and Fire Prevention.**

Highly flammable substance - observe No Smoking policy.

These materials are miscellaneous and the manufacturers instructions must be followed. They may contain solvents, resins or petroleum products, so skin and eye contact should be avoided. They should not be sprayed in a confined space without well ventilation.

## Cutting

**Refer to: Welding.**

## Dewaxing

**Refer to: Solvent and Fuel (Kerosene).**

## Dust

Dust may be toxic, harmful and irritant to the skin. Avoid inhaling the powder chemical material or other dust. Wear respiratory protection if ventilation is inadequate.

Fine dusts of combustible materials can present an explosion hazard. Avoid explosive limits and fire sources.

## 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 all electrical equipment is maintained in good condition and regularly tested. Faulty equipment should be labeled and preferably removed from the workstation. Make sure that wires, cables, plugs and sockets are not frayed, kinked, cut, cracked or otherwise damaged. Make sure that the electrical equipment and wires do not come into contact with water. Make sure that the electrical equipment is protected by the correct rated fuse.

Never misuse the electrical equipment and never use the equipment that is in any way faulty. Failure to do so could be fatal.

Make sure that the cables of electrical tools do not get trapped and damaged in a vehicle hoist. Make sure that the electrical workers are trained in basic First Aid.

In case of an electric shock:

- Switch off the power supply before touching the victim.
- If it is impossible to switch off the power supply, push or drag the victim away from the power source, 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. Engine 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.

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## Noise Insulation Fiber

**Refer to: Dust.**

Used in noise and sound insulation. The fibrous nature of surfaces and cut chips can cause skin irritation. This is usually a physical but 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 fume if burnt. Observe strict fire safety precautions when storing and handling flammable substances or solvents, particularly near electrical equipment or during welding process. Make sure that there is no fire hazard present and have a suitable fire extinguisher available before 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 gas and fume should be removed to fresh air immediately. If effects persist, consult a doctor.

If liquids are swallowed inadvertently, consult a doctor and give 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. Some components, vapor or spray mist can cause direct irritation, sensitivity reactions and may be toxic or harmful.

Vapor and spray mist 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 vapor/mist has been cleared.

Burning of the uncured components and the cured foams can generate toxic and harmful fume. Smoking, naked flames or the use of electrical equipment during foaming operations 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 fuel away from skin. Wash with clean water and soap if stained with fuel.

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## Gasoline (Petrol)

Highly flammable substance - observe No Smoking policy.

Swallowing gasoline will stimulate mouth and throat, and if the gasoline is absorbed by the stomach, it will cause sleepiness and unconsciousness. A small quantity of gasoline will cause death of a 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 eyes will cause blindness. A great amount of benzene is contained in the gasoline, which is toxic to person. The gasoline concentration must be very low, the over-high concentration will stimulate eyes, nose and throat and make person vomit, dizziness and dyspnea, even make person lose consciousness.

The gasoline shall be transported or used in a place with air circulation. Operating in confined spaces is not allowed.

For the cleaning and maintenance of gasoline storage, there must have special preventive measures. The gasoline cannot be used as the cleaning agent and cannot be siphoned with mouth neither.

## 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 to the eye may be slightly irritating. In normal circumstances, the low volatilization does not generate harmful vapor. Volatilization under high temperature should be avoided (mist 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 (2000 psi). 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 gas, 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 fire sources.

## Gas

**Refer to: High Pressure Gas Cylinder.**

## General Tool and Equipment

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

Never use tools or equipment for any purpose other than that for which they were designed. Never overload equipment such as hoists and jacks. 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 wheel, 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 dust, acid mist and fume.

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## High Pressure Air, Lubricant 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.

## Lubricants and Grease

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

3. Environmental Precautions

   Burning the 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 the used engine oil 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 the 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.

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## Coating

Refer to: Oil and Chemical Materials.

Flammable substance - observe No Smoking policy.

1. Monocomponent

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

2. Multicomponent

   It could 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 fume in welding. Oxy - acetylene flame should not be used, as they are much hotter to produce lead fume.

Some fume 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, which can give toxic effects if inhaled, is not produced. 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.

## Solvents

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 vapor or mist will cause eye and throat irritation, drowsiness, dizziness, headaches and, in the worst circumstances, unconsciousness.

Repeated or prolonged exposure of lower concentrations of solvent will produce vapor or mist, 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 fume, vapor and spray mist and keep containers tightly sealed. Do not use in a confined space.

When spraying materials containing solvents, for example paints, adhesive and 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 guidance.

## 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.

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Always make sure that lifting equipment such as jacks, hoists, axle stands and slings are, 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 fume and gas from the metal molten pool being welded, when the core or coat are contaminated. The gas and fume may be toxic and inhalation of these should be avoided. The extraction ventilation to remove the fume 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, 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 gas leakage, 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 fume and gas may be produced from coatings on the work, particularly during cutting off damaged parts. Inhalation of the fume should be avoided.

   In brazing, toxic fume 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 fume and expert advice may be required.

   SPECIAL PRECAUTIONS MUST BE TAKEN BEFORE ANY WELDING OR CUTTING ON VEHICLES AS COMBUSTIBLE GAS (VOLATILIZING AND EVAPORATING FROM FUEL TANK) IS EXISTED.

## Warning Signs on Vehicle

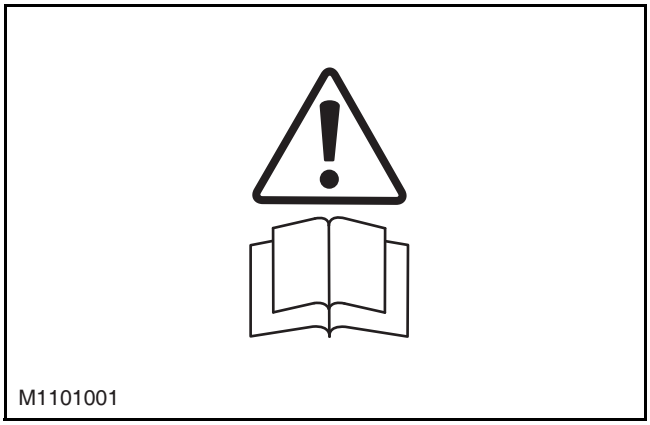
Decals showing warning symbols will be found on various vehicle components. These decals must not be removed. Owners/operators must attach great importance to signs.

The most frequently used 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.

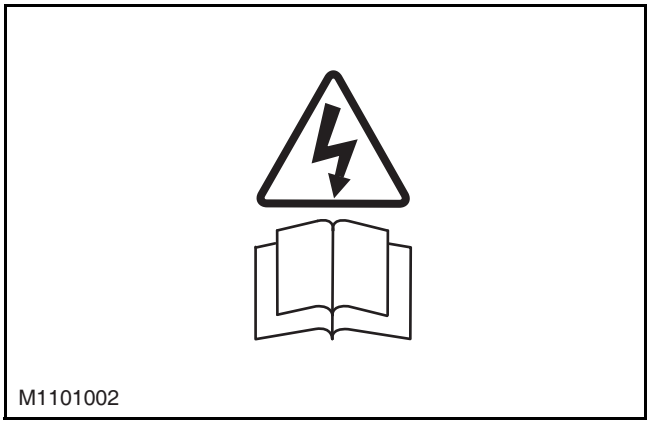
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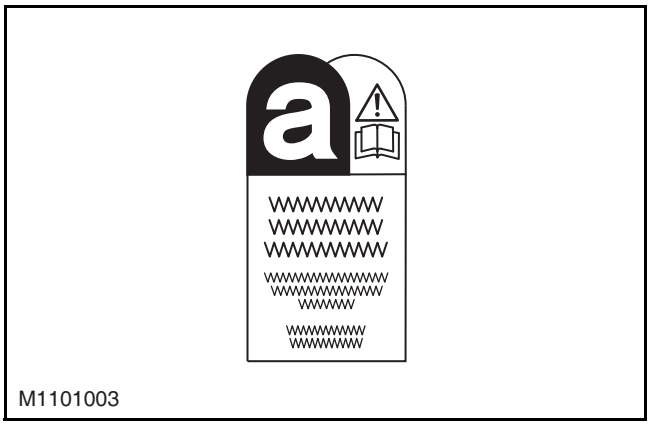
2. Components or assemblies displaying the warning triangle with the "electrified" arrow and open book symbol give warning of inherent high voltage. Never touch these with the engine running or the ignition switched on.

   **Refer to: Electric Shock.**


M1101002

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

   **Refer to: Acid and Alkali Metals.**

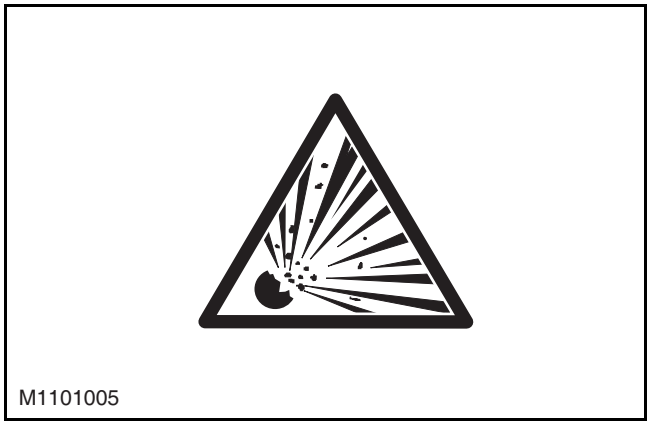

M1101003

4. Displaying the caution circle with a deleted lighted match symbol, cautions against the use of naked light or flame within the immediate vicinity due to the presence of highly flammable or explosive liquid or vapor.

   **Refer to: Fire Prevention.**


M1101004

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


M1101005

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


M1101006

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### 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 starting engine, make sure that there is adequate ventilation, or an extraction hose to remove exhaust fume.
- There should be adequate room to raise the vehicle and remove the wheels, if necessary.
- Fender covers are always fitted if any work is carried out in the engine compartment.
- The battery should be disconnected if working on the engine, underneath the vehicle, or if the vehicle is raised.

**CAUTION: When electric arc welding is carried out on a vehicle, always disconnect the alternator wiring, preventing the possibility of a surge of current to cause damage to the internal components of the alternator.**

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

## Vehicle Towing

**WARNING: When the vehicle is being towed, the ignition switch must be in ACC (steering lock released and hazard warning lamp 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 with left-hand thread must be fully tightened before towing. 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 for a greater distance, the drive wheels must be lifted off the ground.

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

## Connecting Another Slave Battery Using Jumper Cables

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

**WARNING: A drained battery condition may be 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.**

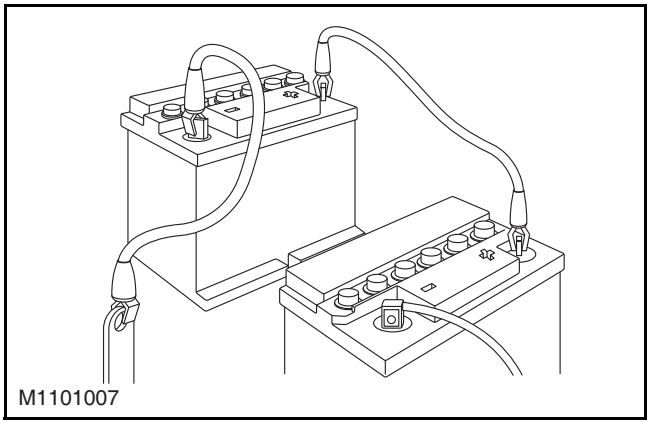
**WARNING: While it is not recommended that the vehicle is jump started, it is recognized that this may occasionally be the only practical way to mobilize a vehicle. In such an instance, the drained battery must be recharged immediately after jump starting to avoid permanent damage.**

- Always make sure that the jumper cables are adequate for the task. Heavy duty cables must be used.

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- 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.


M1101007

**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 1000 A 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 body ground at least 12 inches (300 mm) from the battery terminal, for example engine lifting eye.

Always reduce the engine rotating speed to idle before disconnecting the jumper cables. Before removing the jumper cables from the vehicle with a drained 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 alternator to restore a drained battery. For an alternator 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.
- Removing loose dirt with soft or cable brushes.
- Scraping dirt off with a piece of metal or wood.
- Wiping off with a rag.

**CAUTION: Compressed air is sometimes wet, so use with caution, especially on hydraulic systems.**

- Blowing dirt off with compressed air. (Wear goggles in the operation)
- Removing 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.**

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### 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 chemicals or fume given off are 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 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.

- Engine oil level.
- Engine coolant level.
- 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.

### Engine Starting

**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 rotating speed or with the accelerator pedal at full travel whilst the engine is cold.**

### With 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 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.

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- 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 Test

**WARNING: During road test, 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 is disengaged smoothly, without slip or judder.
- That gear changing is smooth without 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 rotating speed returns to idle correctly.
- There is no excessive or abnormal smoke from the engine under normal driving, heavy load or overrun conditions.
- That steering operation, including power steering (if equipped), is smooth, accurate; that steering wheel is over-heavy or over-light; that the steering does not pull to one side and self centers smoothly after cornering.
- That the speedometer, fuel pressure warning lamp, coolant temperature gauge and tachometer (if equipped) register the correct readings and operate correctly.
- That the switches and controls operate smoothly, warning and indicator lamps operate correctly and the direction indicator turns off when the steering is returned.
- That the heating and ventilation systems operate correctly and effectively.
- That the brake system operates correctly and effectively.

## Brake Test

**WARNING: When brake test, avoid breathing the fume 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 test on busy roads where it may cause inconvenience or danger to other road users.

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

Test the brakes at several speeds within the normal operating range using both light and heavy pedal force. 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 Test Completion, Check for:

- 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.

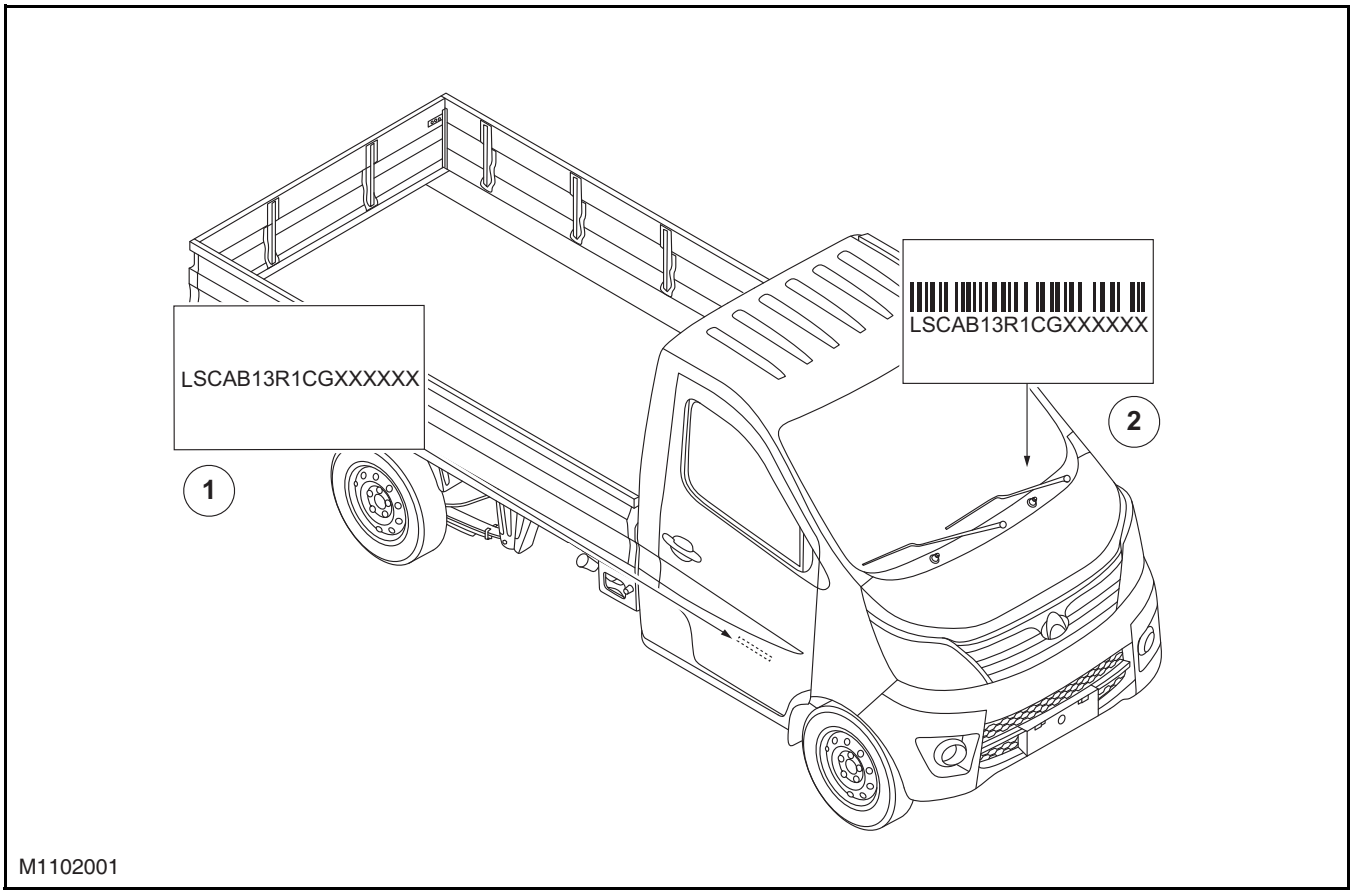
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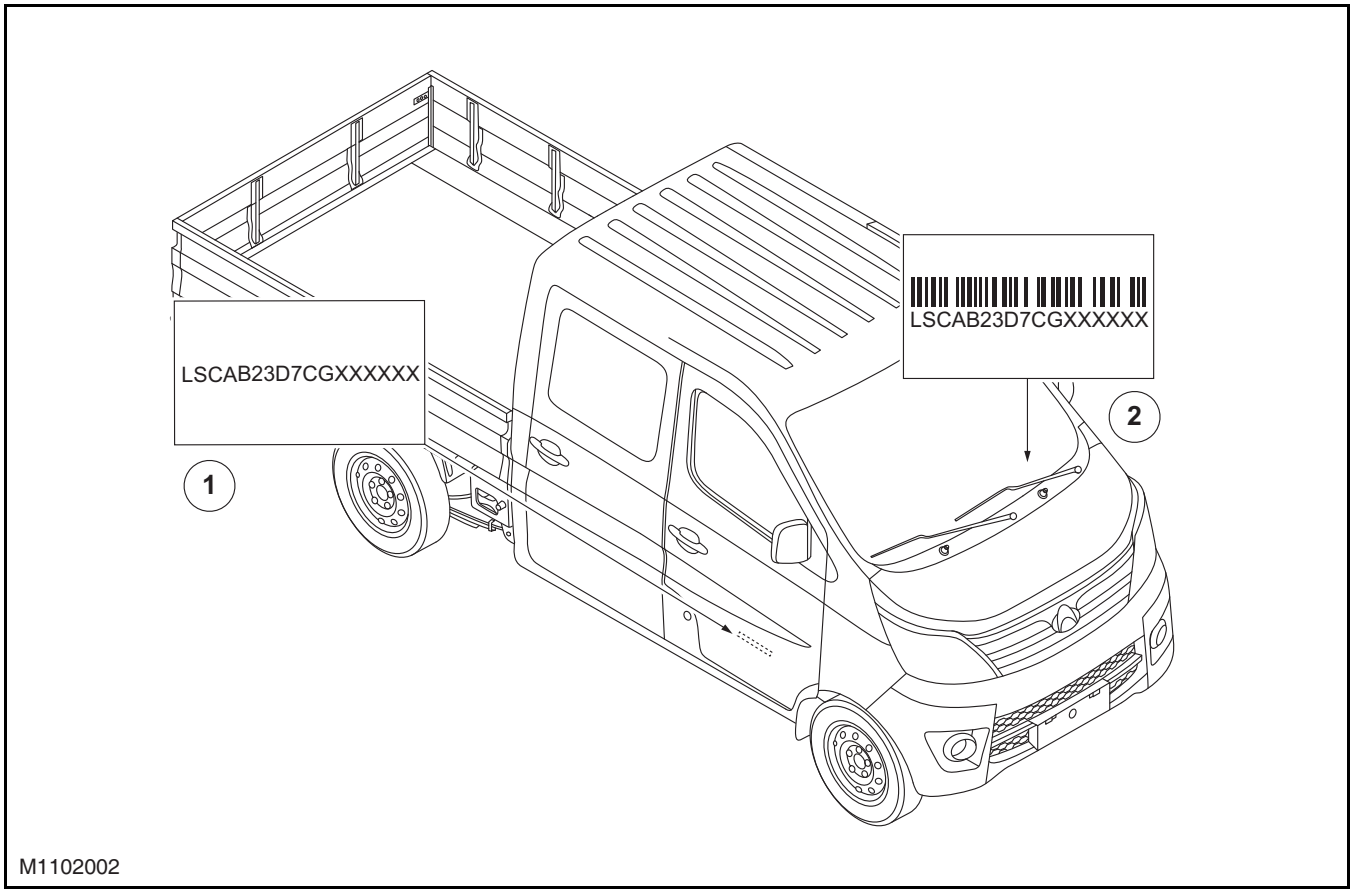
## Description and Operation

# Vehicle Identification Number



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

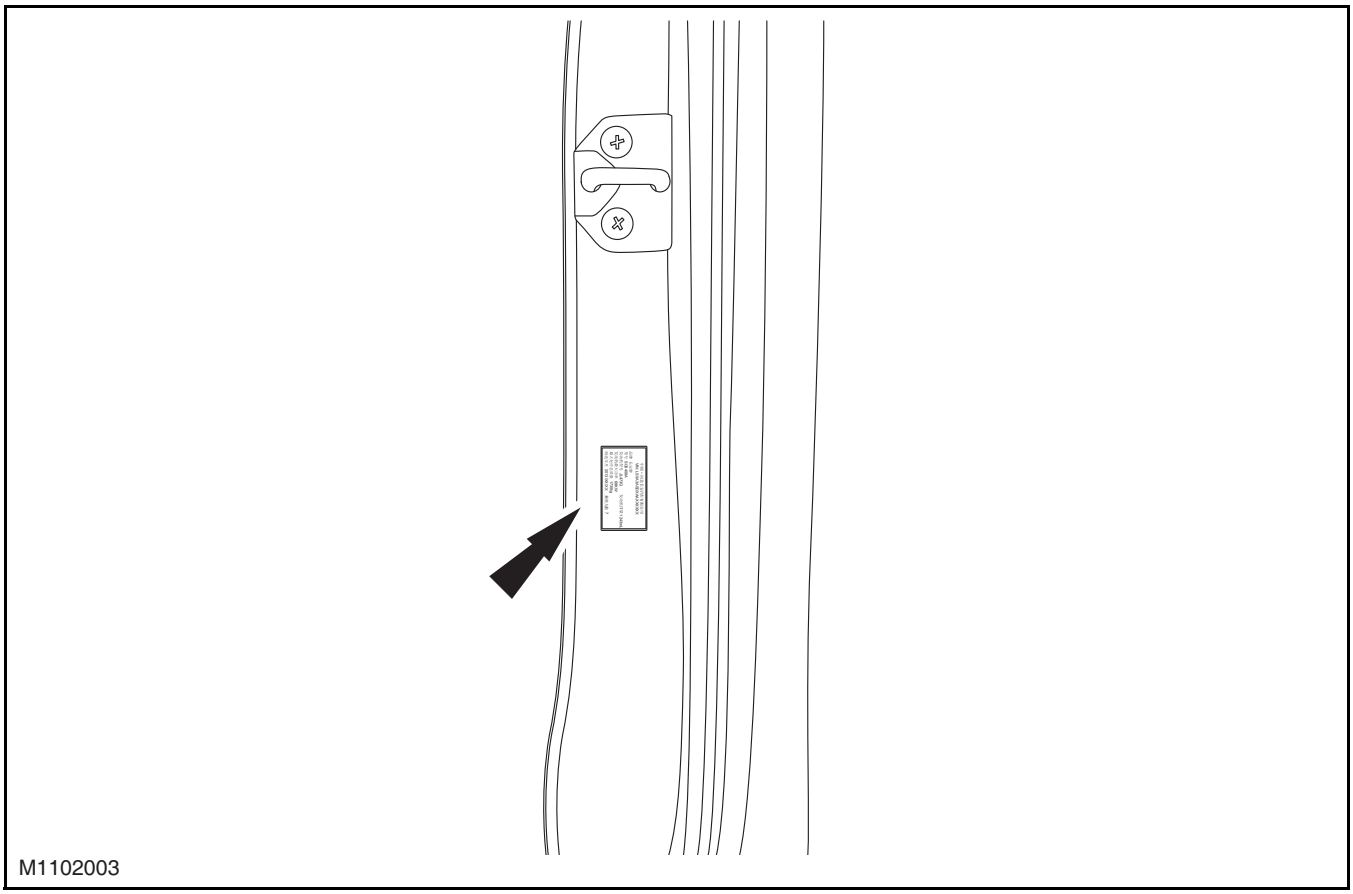
**Meaning of VIN**

| Item | Description | Item | Description |
|---|---|---|---|
| 1 ~ 3 | Manufacturer identification code | 8 | Driving type |
| 4 | Vehicle brand | 9 | Check digit |
| 5 | Main vehicle parameter code | 10 | Year of manufacture |
| 6 | Engine type | 11 | Manufacturing factory code |
| 7 | Vehicle body type | 12 ~ 17 | Production serial number |

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# Nameplate



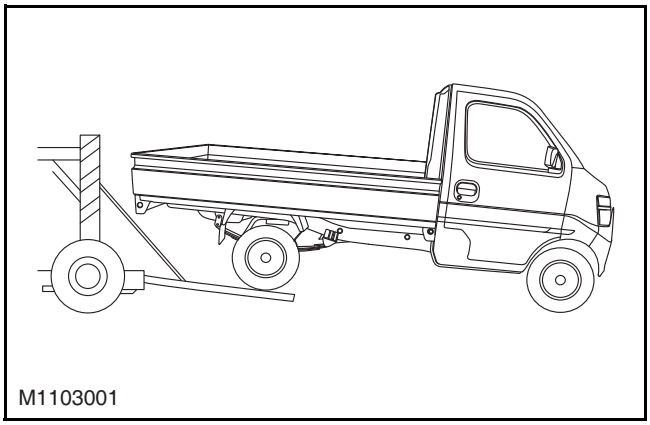
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## Description and Operation

# Traction



M1103001

The vehicle is driven by rear wheels so as to raise the rear tires and make the vehicle stand on its front tires and ignition switch at "ACC", unlock the steering wheel to make front wheels facing the front. The steering wheel is locked firmly by dedicated locking tools and the hazard warning lamp is illuminated.

If you use front towing hook to tow the vehicle from the ground, the rear wheels should be secured in a movable platform. The towing hook is in the onboard tool kit and installed when necessary.

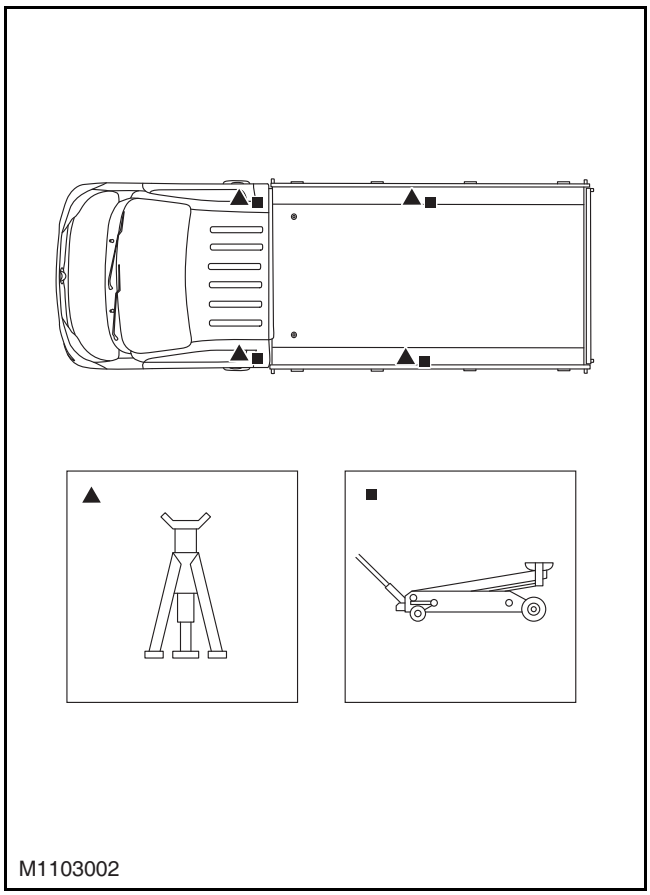
**CAUTION: It is prohibited to make the rear wheels on the ground in the traction. Otherwise, the transmission may be damaged.**

**CAUTION: The traction distance shall not exceed 80 km and the speed shall not exceed 50 km/h.**

# Jacking

**WARNING: Always park the vehicle on a hard level surface. If the vehicle must be jacked up on a soft surface, place 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 to repair vehicle, it is important to conform to the following guides for correct operation. It is necessary to verify the correct jacking points which are usually selected at open area between the front and rear wheels. A pad shall be applied to protect the painting from damaging when using the jack.



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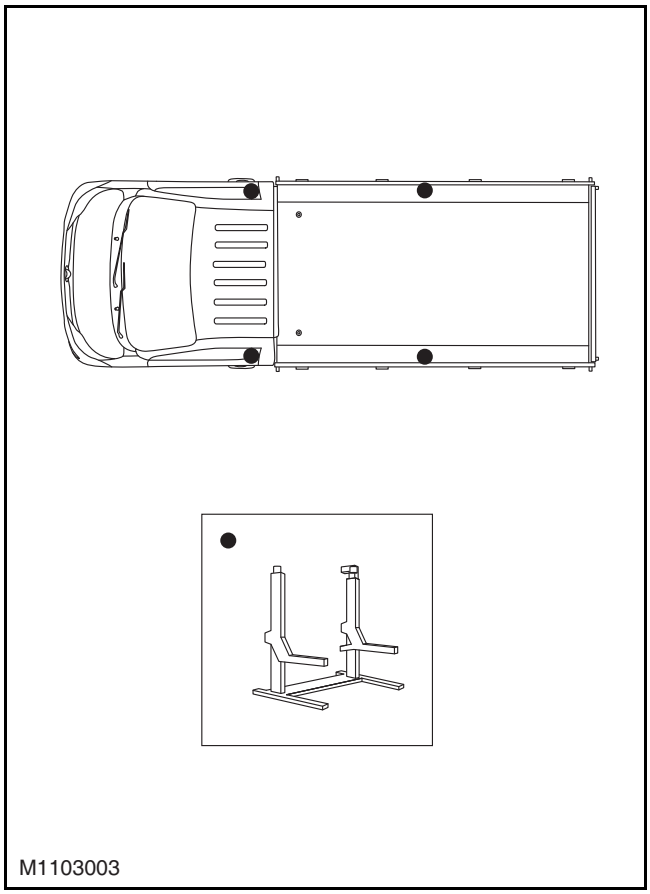
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# Lifting

**WARNING: It is important to use the correct lifting points for 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.**



M1103003

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## Description and Operation

# Maintenance Items

Before conducting vehicle inspection or when conducting maintenance, pay close attention to the safety in case of accidents. Pay close attention to the following situations:

1. Do not start the engine in the forbidden area.
2. If it is necessary to start engine for 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 negative and positive to avoid short-circuit and accidents such as battery damage, fire and explosion.
7. Do not drain the any fluid of the vehicle, such as gasoline, oil, coolant, brake fluid and power steering fluid. The fluid may pollute environment.
8. Prevent water from flowing into the control units when conducting washing and maintenance.
9. For electronic control system, the oil is supplied by pressure. Even if the engine is not operating, oil circuit is also filled with high pressure oil. So that the replacement of oil pipe and oil filter should be made in a location with good air ventilation.
10. Do not try to adjust the throttle limiting screws at any time for the throttle limiting screws has already been adjusted when produced.
11. Do not raise the temperature of electronic control unit to over 80°C in the malfunction heating simulation or the maintenance that may increase the temperature of vehicle.
12. Disconnect the wiring harness connectors of all control modules and the wiring harness of battery in welding.
13. Equipment that may cause electro-magnetic interference should not be installed near electronic control unit to prevent interference.
14. When disconnecting the wiring harness connectors of control modules, ignition switch must be turned to "OFF".

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# Daily Maintenance Schedule

Daily maintenance means three inspections, that is to say that the inspections of vehicle safety structure and connection condition of all components before/during/after driving. Keep 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 months. The inspection, adjustment, lubrication and other maintenance should strictly follow the regular period in the chart.

Regular maintenance symbols:

G - Replace

R - Lubricate

X - Tighten to specified torque

J - Inspect

T - Adjust

**1.** Regular Maintenance Interval and Items

| Maintenance Interval / Item | x 1000 km | 2.5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Month | 1 | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 |
| **ENGINE** | | | | | | | | | | |
| 1. Fan (water pump, compressor) Drive belt (tension, wear, etc. ) | | | | J.T.G | | G | | J.T.G | | G |
| 2. Camshaft timing belt (tension, wear, damage) | | | | J.T.G | | J.T.G | | J.T.G | | J.T.G |
| 3. Valve clearance | | | | JG | | JG | | JG | | JG |
| 4. Oil filter ★ | | First maintenance is made after 2500 km or two months, and replacement after first maintenance should be made every 5000 km. | | | | | | | | |
| 5. Engine oil ★ | | | | | | | | | | |
| 6. Engine coolant | | Fill at any time | | | | | | | | |
| 7. Engine bolt (all retainers between cylinder head, manifold) | | | | X | | X | | X | | X |
| 8. Cooling system hose and connector (coolant leakage, damage, etc.) | | JT | | JTR | | JTR | | JTR | | JTR |
| 9. Exhaust system (except the Three-way catalytic converter) | | | | J.T.G | | J.T.G | | J.T.G | | J.T.G |

Remark: a) symbols in chart: J - Inspection T - Adjust G - Replace R - Replace when necessary
X - Tighten

b) Service interval should be judged by odometer reading or months, whichever comes first.

c) ★ Service interval is shortened under severe conditions.

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| Interval: Judged by odometer reading or months (whichever comes first) / Item | | km (× 1000) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Month | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 |
| **IGNITION** | | | | | | | | | | |
| 10. Ignition coil (damage, deformation) | | | - | J.T.G | - | J.T.G | - | J.T.G | - | J.T.G |
| 11. Spark plug | | | G | G | G | G | G | G | G | G |
| 12. Ignition timing | | | J.T | J.T | J.T | J.T | J.T | J.T | J.T | J.T |
| **FUEL** | | | | | | | | | | |
| 13. Air filter | Cement or asphaltic pavement | First maintenance should be made when the odometer reading is 5000 km, and after that, service after first maintenance should be made every month or 2500 km (Clean, blow ash), replace every year or 20000 km. | | | | | | | | |
| | Sandstone road | | | | | | | | | |
| 14. Fuel tank, fuel lines and connectors, pipe clip | | | - | J.T.G | - | J.T.G | - | J.T.G | - | J.T.G |
| 15. Throttle body assembly | | First maintenance of throttle body assembly is the same with third maintenance of vehicle, and then maintain every 10000 km | | | | | | | | |
| 16. Fuel filter | | | G | G | G | G | G | G | G | G |
| **CRANKCASE VENTILATION CONTROL** | | | | | | | | | | |
| 17. Crankcase ventilation hose and connectors | | | J.T.G | - | J.T.G | - | J.T.G | - | J.T.G | - |
| 18. Fuel vapor storage device | | | J.T.G | - | J.T.G | - | J.T.G | - | J.T.G | - |
| 19. PCV valve | | | - | J.T.G | - | J.T.G | - | J.T.G | - | J.T.G |
| **ELECTRICAL DEVICE** | | | | | | | | | | |
| 20. Electric wiring harness, connections and lights | | | - | J.T.G | - | J.T.G | - | J.T.G | - | J.T.G |
| **CHASSIS AND BODY** | | | | | | | | | | |
| 21. Clutch | | | J.T | J.T | J.T | J.T | J.T | J.T | J.T | |
| 22. Brake fluid (amount, leakage pollution) | | | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | G |
| 23. Brake pedal (stroke) | | | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G |
| 24. Parking braking lever and cable | | | J.T | J.T | J.T | J.T | J.T | J.T | J.T | J.T |
| 25. Front: Brake calipers and pads (wear) | | | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G |
| 26. Rear: Brake drums and shoes (wear) | | | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G |
| 27. Brake hoses and pipes (leakage, damage) | | | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G |
| 28. Tire (abnormal wear and pressure) | | | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G |

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| Interval: Judged by odometer reading or months (whichever comes first) / Item | km (× 1000) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|---|
| | Month | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 |
| 29. Wheel and Wheel nut (damage, tightness) | | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G |
| 30. Bolt and nut (tightness) | | - | X | - | X | - | X | - | X |
| 31. Steering system (clearance, tightness) | | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G | J.T.G |
| 32. Rear axle differential oil | | Replace at first maintenance and then maintain regularly. | | | | | | | |
| | | J.G | G | J.G | G | J.G | G | J.G | G |
| 33. Clutch free stroke adjustment (adjust clutch cable) | | Inspection and adjustment at first maintenance, and then every 5000 km | | | | | | | |
| 34. Accelerator pedal free stroke adjustment (adjust accelerator pedal cable) | | Inspection and adjustment at first maintenance, and then every 5000 km | | | | | | | |
| **COOL AIR** | | | | | | | | | |
| 35. Refrigerant Amount | | Fill at any time | | | | | | | |
| 36. Refrigeration system | | J.T | J.T | J.T.G | J.T | J.T | J.T | J.T | J.T.G |
| 37. Compressor | | - | - | - | J.T.G.R | - | - | - | J.T.G.R |
| 38. Condenser | | Clean at any time | | | | | | | |
| 39. Evaporator | | - | - | - | J.T | - | - | - | J.T |
| 40. Dryer | | - | - | - | G | - | - | - | G |
| 41. Refrigerant pipe | | - | X | - | X | - | X | - | X |

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**2.** Maintenance under severe conditions

If your vehicle is always driving under severe conditions, please refer to the following chart to make maintenance:

A: Repeat short distance

B: Driving on rough and muddy road

C: Driving on dusty road

D: Driving on severe cold or saline road

E: Repeat short distance under severe cold weather, for example, frost weather

Maintenance under severe conditions:

| Severe Condition Item | Component | Maintenance Method | Maintenance Interval |
|---|---|---|---|
| BC | Drive belt | J.T.G | 10000 km or 6 months |
| ACDE | Engine oil and oil filter | G | 5000 km or 3 months |
| ABD | Exhaust pipe and device | J.T.G | 10000 km or 6 months |
| C | Air filter | J.T.G | 2500 km or 3 months |
| ABCE | Spark plug | G | 5000 km or 3 months |
| ABD | Propeller shaft | J.T.G | 10000 km or 6 months |
| BE | Manual transmission and nut | G | 20000 km or 12 months |
| B | Bolt and nut in chassis | X | 10000 km or 6 months |
| ABC | Brake disc and lining (front) brake drum and toe (rear) | J.T.G | 10000 km or 6 months |
| BCDE | Suspension ball joint and dust boot | J.T.G | 10000 km or 6 months |

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## 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

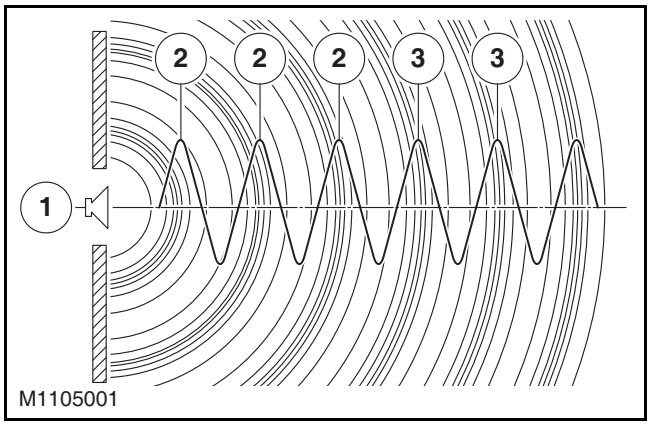
According to sound intensity, the noise in automotive engineering can be classified as following:

- 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 alternator, drive belt).
- 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).

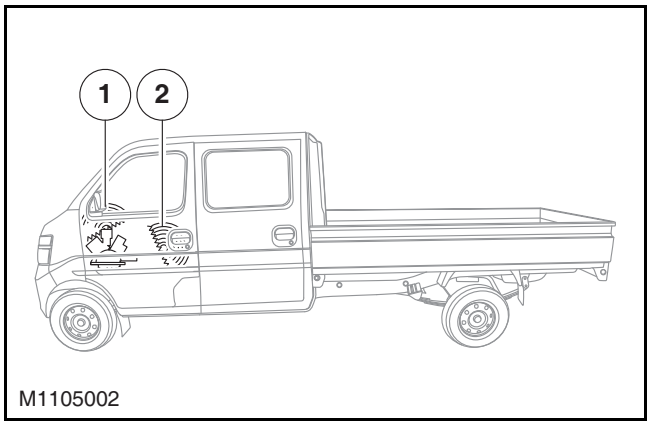
## Sound Transmitted Through air and Object

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

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### Noise Transmitted Through Vehicle



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

Example:

- Noise from engine.
- Directly through air.
- It is transmitted from engine to vehicle body with vibration and spread 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) cannot 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:

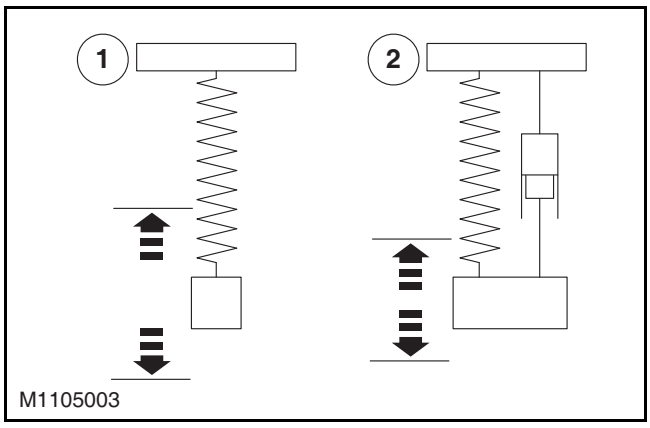
- Vehicle process engineering concerns not only audible low frequency vibration but also the high frequency vibration that cannot be heard.
- Generally, the low frequency vibration is visible.
- The high-frequency vibration is palpable through the floor and the steering wheel.

### 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 rotating 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 weakened 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.



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

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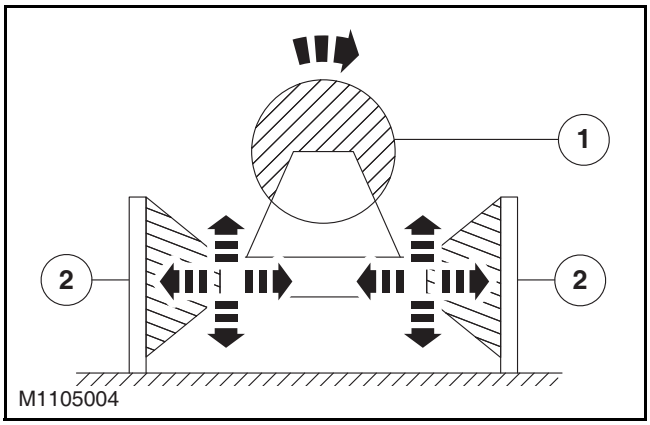
## Sound Insulation

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

Example:

- The engine is installed on elastic support, so that the vibration is transmitted into the vehicle body as small as possible.
- 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.

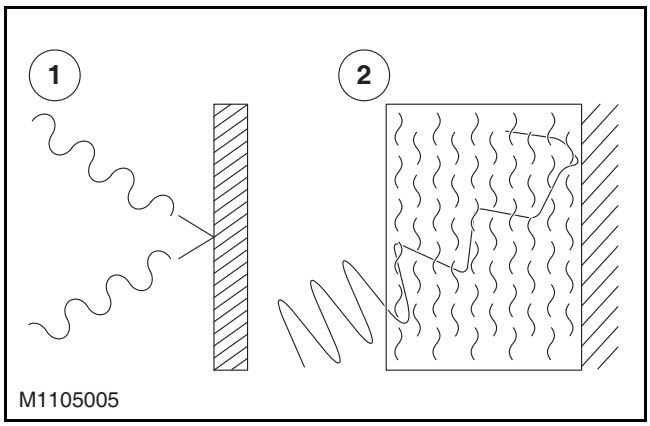
**The directional installation of rubber gasket can reach the best sound insulation effect.**




| Item | Component | Description |
|---|---|---|
| 1 | - | Engine |
| 2 | - | Engine installation |

## Sound Absorption

- 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.
- Then the sound wave will be reflected directly to reduce the occurrence of Hall Effect.

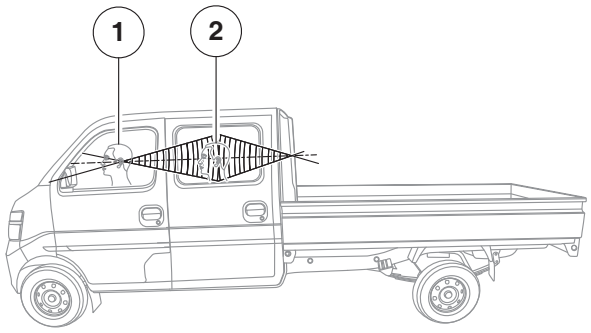
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# Noise and Vibration on Vehicle

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

## Vehicle Sound / Noise Wave (Standing Wave)

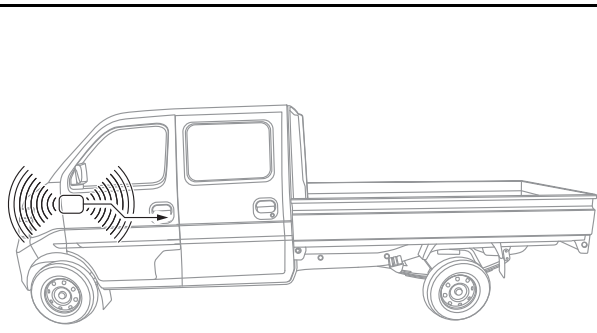



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| Item | Component | Description |
|---|---|---|
| 1 | - | Driver is in "wave trough" |
| 2 | - | Rear passengers are in "wave peak" |

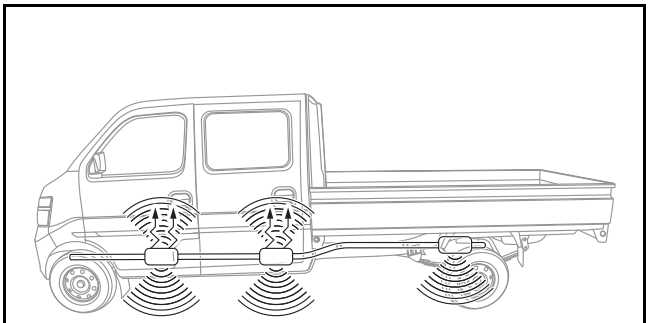
# Noise and Vibration Caused By Intake and Exhaust Systems

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



M1105007

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

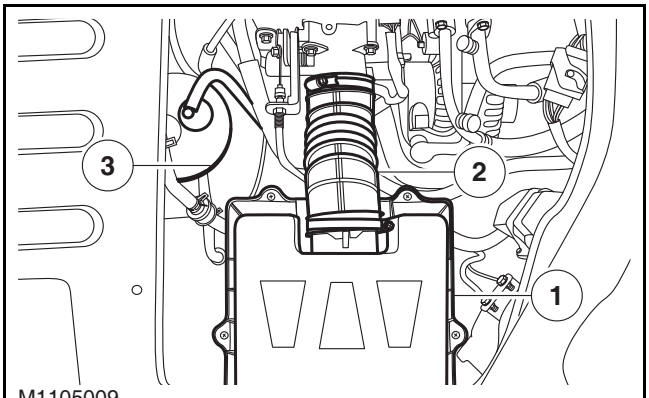


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Transmission route of sound:

- The transmission ways of noise generated by intake and exhaust systems are shown as in the picture above.
- In addition to air noise, the solid noise in the intake and the exhaust systems is also the main source. In order to minimize noise, the sound insulation cushion must be installed firmly.
- The exhaust system is a typical vibrating component, and a good sound insulation device is required in figure. The layout, routing and connecting points with body shall be properly selected to reduce the solid noise.

## Air Intake System




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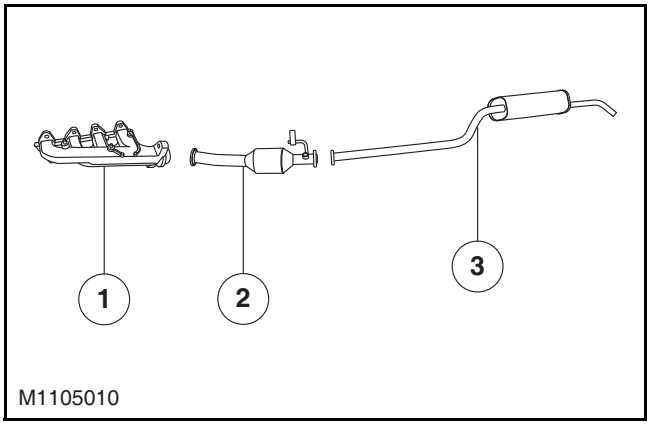
| Item | Component | Description |
|---|---|---|
| 1 | Air filter | - |
| 2 | Intake hose | - |
| 3 | Canister | - |

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- Length and cubage of air intake system has been fixed and cannot be changed in maintenance. Pay attention to securely connect the components with no air leaks in operation.
- The great air pressure changes on the surface of air intake system components will cause strong vibration.
- Influence of temperature will change its rigidity, such as heating air filter (thereby influencing vibration level).
- In order to avoid the solid vibration on the surface of air intake system transmitting to vehicle body, pay attention to the following in maintenance: a) whole air intake system, installed on the rubber gasket, is insulated from vehicle body, 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



M1105010

| Item | Component | Description |
|---|---|---|
| 1 | Exhaust manifold | - |
| 2 | Three-way catalytic converter | - |
| 3 | Muffler | - |

Exhaust system cannot be installed too tightly.

**CAUTION: The rubber gasket in suspension exhaust system can also transmit vibration, and sometimes it is also noise source. So it is necessary to leave suitable degree of freedom in installing exhaust system.**

Exhaust manifold and catalytic converter (if connected with engine directly) must be rigid-connected with engine (no gaps at bracket connections).

Simple problem testing:

- Remove all suspension bushings in exhaust system.
- Suspend the 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 road test once after installing one bushing and check noise level.
- Based on this procedure, the bushing causing 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. However, the vehicle body is one of the most important parts involving NVH.
- The components we described here only mean the components to cause vibration and noise based on function. Vehicle body includes or concerns all of these components.
- The vehicle body not only causes air noise, but also causes solid noise.
- The vehicle body must absorb vibration from all components, and try to ensure the vibration is not transmitted to the interior of the vehicle body.

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- The main components of NVH in the vehicle body are the roof steel plate, quarter and floor. The vibration or noise shall be increased greatly due to the structure, just as an amplifier.

## Higher Requirements for Vehicle Body

- Good falling or crash capability
- Spacious interior.
- Corrosion resistance.
- Light weight.
- Excellent aerodynamic appearance.

Because all these requirements cannot be satisfied 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 a good buffering in crash and certain flexibility of vehicle body. So we only can adopt the method of crumpling or twisting partial areas.

Example:

The well-designing of vehicle body water proof cannot ensure the requirements to noise and vibration at the same time, so the following elements should be considered:

- Correctly install windows.
- Correctly install weatherstrips.

Other precautions:

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

The cross components of quarter and vehicle body are usually the transmitting passage of vibration and noise, and possible rectification methods are:

- Install insulation materials at critical localisations (such as A pillar and quarter) in order to reach the good sound insulation performance.

**CAUTION: The foam block or foam packing is a good sound insulation measure. If the wind noise and other noises from tire, engine or road exist, check the foam block at relative positions.**

- Install foam block at effected area.
- Fill foam packing at relative gaps or holes.

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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Start vehicle to reproduce the malfunction, and verify the customer concern.
2. Visually inspect to find obvious causes of malfunction.
3. If an obvious cause for an observed or reported concern has been found, solve the fault (if possible) before proceeding to the next step.
4. If the malfunction still exists after inspection, verify the symptom by referring to the Symptom Chart.

# How to Use Diagnosis Procedure Section

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

This section is used to assort and identify these problems. For example, if the condition occurs at high speed, the most likely start point for diagnosis is "shake and vibration while driving".

The road test procedure can classify the conditions, such as identify the vibration from shake.

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

Confirm condition, proceed to appropriate section and start correct diagnosis. When the condition is identified, the job is partly done.

Follow the diagnosis procedure. Quick Checks are described in the Steps, while more involved tests and adjustments are outlined the in General Inspection.

Always follow each step exactly and make notes as important data for reference later.

### Customer Interview

The road test and customer interview (if available) 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 a 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 removal and diagnosis:

- In certain conditions, the pitch of the exhaust may sound very much like gear noise. Some 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. Meridian tire may have this characteristic. Also, any non-standard tire with an unusual tread construction may emit roar or whine noise.
- Trim panels can also cause whistling or whining noise.
- When the transmission gear position is changed, metallic noise may be heard. This sound is caused by the engagement of gears when changing the gear position.
- Bearing rumble sounds like marbles being tumbled. This condition is usually caused by a damaged wheel bearing.

### Noise Conditions

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- 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 and can usually be heard all the way to a stop. The frequency varies with vehicle speed.
- Knock is very similar to chuckle, and it may be louder during acceleration or deceleration. The removal 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 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 holders.
- Excessively High Constant Velocity (CV) joint operating angles caused by incorrect body height. Check body height, verify correct spring rate and check abnormal items.

## 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 some driving conditions, such as on a newly paved asphalt road. Slight noise is considered as normal.

The road test and customer interview (if available) provide information needed to identify the condition and give direction to the correct starting point for diagnosis.

1. Make notes throughout the diagnosis process. Make sure to write down even the smallest bit of information, because it may turn out to be the most important.
2. Do not change 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 pressure, vehicle load or making other adjustments may reduce the condition(s) intensity to a point where it cannot be identified clearly. It may also input something new into the system, preventing correct diagnosis.
3. Make a visual inspection as part of the preliminary diagnosis process, writing down anything that does not look right. Note tire pressure, but do not adjust them yet. Note leaking fluid, 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 rotating speed and at a particular throttle setting during acceleration at that speed. It may also produce a moaning sound, depending on the component that causes noise. Refer to Moaning in the symptom chart.

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2. Acceleration/Deceleration:

   With slow acceleration and deceleration, a shake is sometimes noticed in the steering wheel/steering 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 sometimes may be increased by applying the brakes lightly. Refer to Idle boom/shake/vibration in the symptom chart.

3. High Speed:

   An invisible vibration is felt in the front floor panel or seats, but with an accompanying sound or booming or drone noise. When coasting with the clutch pedal depressed (manual transmission) and engine idling and 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 symptom chart.

4. Engine Rpm Sensitive:

   A vibration is felt whenever the engine reaches a particular rpm. It will disappear in neutral coasts. The vibration can be reproduced 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. Refer to shake and vibration while driving in the 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 holders.

## Road Conditions

An experienced technician will always select 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 the 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. Note anything 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.

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## Specifications

# General Specifications

| Item | | Specifications |
|---|---|---|
| Front wheel alignment parameter | Front wheel toe-in | 0 ± 1.5 mm |
| | Front camber angle | 0.5° ~ 1.8° |
| | Kingpin inclination angle | 9.5° ± 2.5° |
| | Kingpin caster angle | 4.1° ± 1° |
| Rear wheel alignment parameter | Rear wheel toe-in | - |
| | Rear camber angle | - |

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## Description and Operation

# System Overview

The primary aim of vehicle engineering is to ensure the safety and reliability of steering and suspension systems. Only component with enough strength can bear and absorb extreme shock. Steering system, front and rear suspension system must keep certain geometrical relationship with vehicle body.

Steering and suspension systems require the front wheels to return automatically and minimize the front wheel rolling resistance and road friction force. It helps users to control the vehicle directions easily and comfortably.

Comprehensive wheel alignment inspection should include measuring rear wheel toe-in angle and camber angle. 4-wheel alignment can make sure all 4 wheels turn to the same direction accurately. After geometrical alignment, vehicle can get best fuel economy, tire service life and optimal steering performance.

**1.** Kingpin caster angle

Kingpin caster angle, observed from vehicle side, means front/back rake deviating from the vertical at the highest point of steering axial line. Back rake is positive and front rake is negative. Kingpin caster angle influences the direction control when steering but has no impact on the tire worn. Too soft spring or overload will influence the kingpin caster angle. When the kingpin caster angle of vehicle is positive, pull the vehicle toward its center. Even minimal positive kingpin caster angle will lead the sideslip and rolling of the vehicle. Kingpin caster angle is measured in degrees and unadjustable.

**2.** Camber angle

Camber angle is the angle with tire top deviating from vertical, when observed from the front of vehicle. The camber angle is positive when tire tilts outward and the camber angle is negative when tire tilts inward. Camber angle is the angle deviating from vertical. Camber angle will influence direction control and tire wear. If vehicle positive camber angle is too large, it will lead outer tire shoulder wear. If vehicle negative camber angle is too large, it will lead inner tire shoulder wear. Camber angle cannot be adjusted.

**3.** Toe-in

Toe-in means the front direction of tire moves outward from geometric center line or thrust line and toe-out means the front direction of tire moves outward from geometric center line or thrust line. Toe-in is used to ensure the parallel rolling of tire. Toe-in can counteract the slight deviation of the wheel supporting system in wheel rolling forward. The specified toe-in angle is the setting value that toe-in reaches 0° when vehicle drives forward.

Incorrect toe-in or toe-out will lead tire wear and fuel economy reduction. Because every steering and suspension system component will be seriously worn with the increasing driving mileage, the toe-in should be increased to compensate the wear of these components. It is necessary to calibrate toe-in angle finally.

**4.** Steering axis inclination

Steering axis inclination (SAI) means the inclination that steering knuckle top deviating from the vertical. Observing from vehicle head, steering axis inclination is the angle between vertical and the straight line through strut center and lower ball joint. Steering axis inclination is helpful to vehicle straight-drive and assist wheel to return to right ahead. Steering axis inclination of FWD vehicle is negative.

**5.** Wrap angle

Observing from vehicle head, wrap angle is the angle between camber angle and straight line through strut center and lower ball joint. Wrap angle is counted by degrees. A lot of alignment bench cannot measure wrap angle directly. When confirming wrap angle, substract negative camber angle or add positive camber angle from steering axes inclination.

**6.** Scrub radius

Scrub radius is the distance between the vertical and the line through strut center and lower ball joint. Scrub radius is a design feature of vehicle and unadjustable.

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**7.** Rear dislocation

Rear dislocation is the distance that a front wheel hub bearing assembly falling behind the other front wheel hub bearing assembly. Rear dislocation is caused by road obstruction and crash.

**8.** Steering angle

Steering angle is the angle of every front wheel related to vertical direction when steering.

**9.** Front suspension

The front suspension is Macpherson (strut swing arm) independent suspension. The upper end of the strut is connected with the body by the supporting parts. The strut is separated from support parts through rubber fitting parts. A strut bearing is installed at the lower part of rubber fitting parts. The lower end of strut is connected with the upper end of steering knuckle. The lower end of steering knuckle is connected with ball joint. The ball joint and swing arm compose one device. The tie rod end is connected with the steering knuckle. Therefore, the movement of steering wheel is passed to the tie rod end, then to the steering knuckle. Finally, the wheels and tires rotate. In this operation, the strut will rotate through strut bearing and lower ball joint with the movement of the steering knuckle.

**10.** Rear suspension

Rear suspension mainly consists of leaf spring, rear axle, shock absorber, buffer plate, saddle plate, internal and external plate, U-bolt, rear bushing. The shock absorber is installed between body and rear axle to absorb the up/down vibration of the body. Leaf spring is installed on the rear axle. The front spring end is mounted on the body through rubber bushing. The rear spring end is connected with the body through internal and external plate. The rear axle moves up and down with the spring during vehicle running.

## General Inspection

# Front Strut Assembly Inspection

**1.** Inspect the shock absorber for leakage. If the shock absorber is damaged, replace it as a whole, because it cannot be disassembled.

**2.** Inspect and adjust the tire pressure to the specification. When inspecting the shock absorber, push the front end at the body side to shake the vehicle three to four times using same force and paying attention to the vibration damping of the shock absorber. In addition, note the times of vehicle shaking after releasing hands. Compare the vibration damping and bouncing times of shock absorber at the left and right side. They must be the same at both sides. If the shock absorber is normal, the vehicle body should stop shaking or only shake once or twice slightly after releasing hands. Compare it to other vehicles or shock absorbers with normal vibration damping.

**3.** Inspect for damage or deformation.

**4.** Inspect the bearing for wear, abnormal noise or seizure.

**5.** Inspect the spring retainer for cracks or deformation.

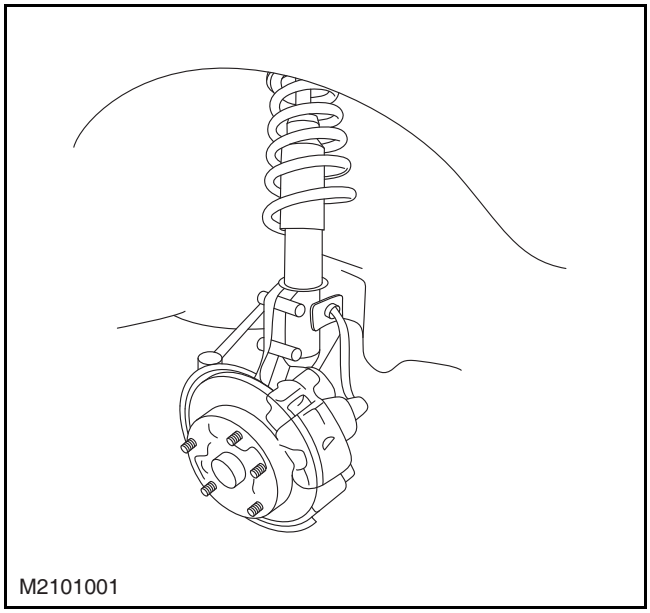
**6.** Inspect the anti-collision cushion for damage.

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7. Inspect the shock absorber retainer or strut fitting parts for wear, cracks or deformation.

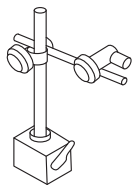
Replace if worn, cracked, deformed or damaged parts are found from step 2 to 7.



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# Wheel Bearing Inspection

## Special Tool

| | |
|---|---|
|  09900-20701 | Dial indicator retainer 09900-20701 |

## General Tool

| |
|---|
| Dial indicator |

**CAUTION: Do not mix up front shaft swing arm ball joint loose and bearing loose.**

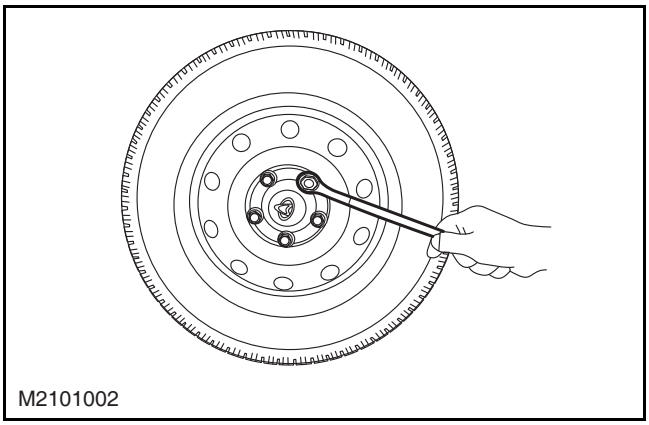
1. Lift the vehicle head.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Hold the bottom and top of wheel and shake forcefully. Inspect if front wheel bearing is loose.
3. Inspect every wheel disc for dents, deformation and cracks. It is necessary to replace the severely damaged wheel disc.
4. Inspect the wheel nut for looseness. Retighten it to the specification if necessary.

   **Tightening torque**

   Wheel nut: 110 ± 5 Nm



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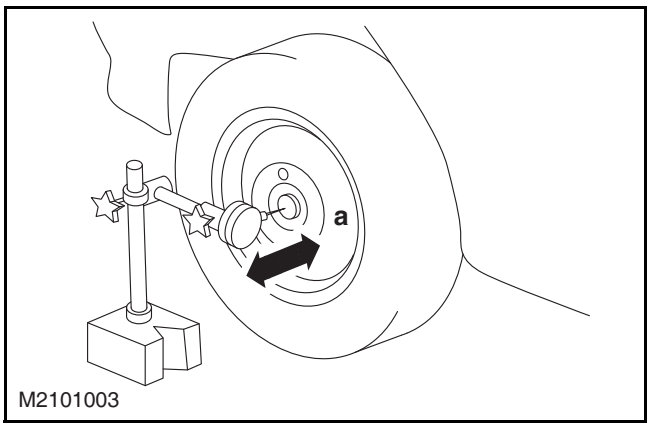
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5. Inspect the worn extent of wheel bearing. Install a suitable dial indicator retainer or similar equipment on the wheel hub, then push and pull the wheel hub. Measure thrust clearance between wheel hub and front hub bearing assembly.

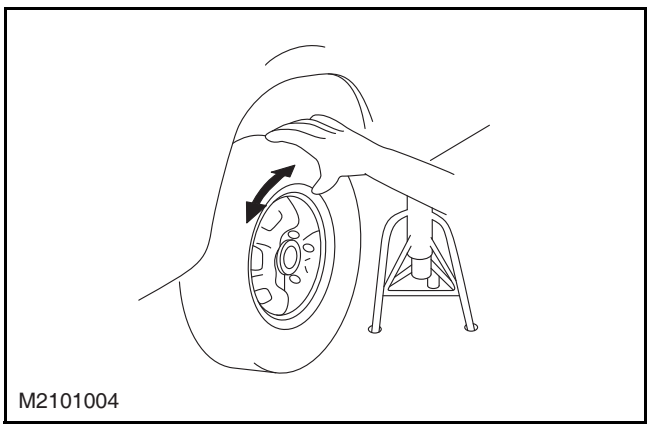
   Thrust clearance limit "a" for front wheel bearing: no more than 0.1 mm.
   Thrust clearance limit "a" for rear wheel bearing: no more than 0.8 mm.

   If the measured value exceeds the limit value, replace the wheel hub assembly.



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6. Rotate the wheel to inspect the wheel hub bearing for noise and if it rotates smoothly. Replace the wheel hub assembly if any wrong is found.


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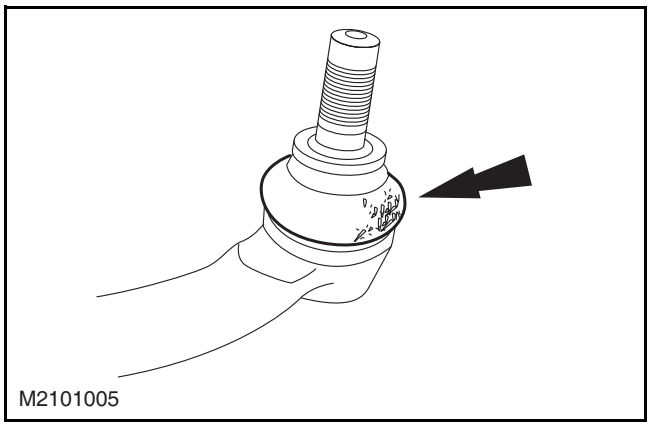
## Tie Rod Ball Joint Inspection

**CAUTION: Inspect the wear of tie rod ball joint first before inspecting or performing front suspension alignment.**

1. Lift the vehicle.
2. Remove the tie rod ball joint.

   **Refer to: Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).**

3. Inspect the tie rod ball joint. Inspect if the dust boot of steering tie rod ball joint is damaged, and if the end joint moves in the ball joint. Inspect if the ball joint is worn or stuck with/ without abnormal noise. If there is failure or clearance due to serious wear, replace it.


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## Front Shaft Swing Arm Ball Joint Inspection

1. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Remove the front shaft swing arm.

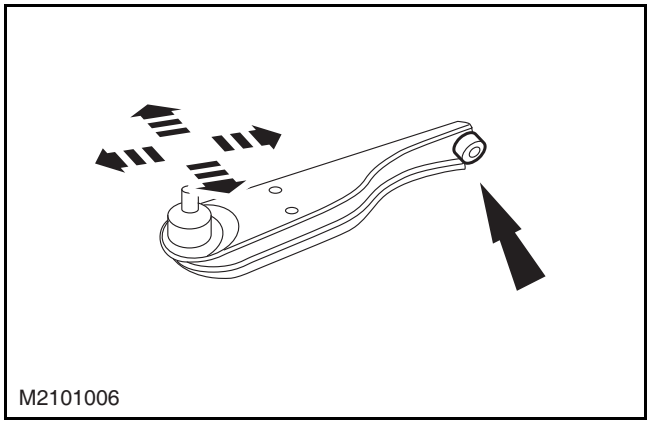
   **Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).**

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3. Inspect the swing arm bushing for damage and wear. Inspect the swing arm ball joint for damage. Inspect the dust boot for damage. Inspect the swing arm ball joint for smooth rotation. Inspect the ball joint clearance, and replace it if any wrong is found.

**CAUTION: The swing arm and ball joint cannot be separated, so if either is damaged, replace the swing arm assembly as a whole.**



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## Suspension Device Inspection

**CAUTION: All vehicles are equipped with low pressure gas-fluid suspension device. This device cannot be adjusted and reinjected.**

1. Oil leakage. It is allowed to deposit a layer of oil film (exudation) on front and rear shock absorber devices, which is normal. Oil leakage means a layer of thick oil film accumulating on the surface of shock absorber shell. It is normally noticed due to a collection of dust on it. The oil leakage in shock absorption is a normal function and not necessary to replace shock absorber. The leakage means when the shock absorber suspension device is covered by leaking oil and the oil will drop on ground.

   If this situation appears:

   - Be sure the observing oil film is only from the shock absorber device.
   - Replace shock absorber if it is worn and damaged.

2. Vehicle body sink. Generally, the problem is solved by replacing front and rear shock absorbers. Because the shock absorber we designed is hydraulic pressure device which is not as same as suspension spring and cannot be used to bear load. So replacing suspension device cannot solve sink problem.

**CAUTION: When a suspension device is damaged, it is unnecessary to replace in pairs. Because of adopting new technology and strengthening management in manufacturing, sealing technology is greatly improved to increase the reliability of shock absorber.**

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## Vehicle Inspection

1. Inspect the pressure of all tires.
2. Inspect the tire to make sure the alignment of tie rod ball joint and tire dynamic balance and if there are cracks and abnormal bulges on tire.
3. Inspect the suspension equipment that can be selected, such as the suspension of drawbar heavy trailer. This suspension is firmer than standard suspension in driving.
4. Inspect if the vehicle is overloaded. Inspect if there are heavy things in the trunk.
5. After finishing above steps, carry out road test to verify the symptoms reported by customer.

## Lift Vehicle for Inspection

1. Noise:

   The loose suspension and suspension assembly accessories may make noise. Inspect and tighten suspension assembly and its accessories. Replace the lower bracket bushing if it is damaged. Inspect if there is external damage on front and rear suspension assemblies.

2. Bottom/Rebound:

   Inspect the travel of rubber shock absorber bushing. Replace the shock absorber bushing with a new one if it is damaged or lost. Inspect if the shock absorber bushing is overloaded. Replace it if such problem appears.

3. Replace the shock absorber if it is worn.

## Worktable Test

Because shock absorber is full of compressed air, it is completely extended when it is not limited. No extension means that the shock absorber is damaged, and replace with a new one. Inspect the length of shock absorber. If it does not satisfy the requirement, which means that a part fails to meet the requirement, replace the shock absorption device. When suspension device is in vertical position, compress the suspension assembly and allow it to stretch 3 times to clean the air entering the pressure chamber during inspection.

**WARNING: When removing dust boot or limit block, try to avoid the shock absorber push rod droop too much, which may lead damage of inner components.**

The shock absorber should be set on a vise upright. Use long travel to compress shock absorber as quick as possible. Every compressing action must be stable and consistent. It is normal that the stretch resistance exceeds compressing resistance.

The following situations are abnormal:

- In the process of installing or returning after installation, the shock absorber lags and jumps.
- Stuck.
- Noise, except light swish, such as the click sound in rapid returning.
- Leakage.
- Piston swags against shock absorber casing while shock absorber pull rod is fully extended.

If shock absorber is still unstable after air cleaning, please replace a new shock absorber.

**Refer to: Front Strut Assembly (2.1.2 Front Suspension, Disassembly and Assembly).**
**Rear Shock Absorber Assembly (2.1.3 Rear Suspension, Removal and Installation).**

## Rear Shock Absorber Inspection

Inspect the shock absorber regularly as following:

1. Inspect if there is oil leakage in rear shock absorber. (A layer of oil film is allowed and make sure leakage is not from other components).
2. Inspect the working state of rear shock absorber.
3. Inspect the working state of upper and lower bushings.

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# Road Test

Tire vibration diagnosis is started with road test. The road test and customer service interview can obtain more information for vibration source.

Road test shall be carried out at flat road. In the case of vibration, note and record the following:

- Vehicle speed at the time of vibration.
- Type of vibration that occurs within each speed range.
- Mechanical vibration or audible sound.

Effect on vibration when the following conditions change:

- Engine torque.
- Vehicle speed.
- Engine speed.
- Vibration type - sensitivity: torque sensitivity, speed sensitivity or engine speed sensitivity.

The following explanation can be used to differentiate the vibration source.

1. Torque sensitivity

   It means that this condition would be turned better or worse due to acceleration, deceleration, coast, constant speed or engine torque applied.

2. Speed sensitivity

   It means that vibration would occur at the same speed, and would not be affected by engine torque, engine speed or drive axle gear.

3. Engine speed sensitivity

   It means that vibration occurs at different speeds and different gears. Sometimes it can be tested when the engine speed is increased or decreased at "neutral" gear or in stall of transmission. In case it is related to engine speed, then it might be irrelevant with the tires.

   In case tire sobbing sound is displayed after road test, but without shaking or vibration, it shows the noise is caused due to the contact between tires and road.

   Generally, huge noise indicates that tires are flat, or soft material touches the road. Tire sobbing sound would be mistaken as axle noise, which would appear continuously within a certain speed range.

# Front Wheel Toe-in Inspection and Adjustment

**General Tool**

| |
|---|
| Wheel alignment gauge |

## Inspection

1. Adjust toe-in on flat ground according to instruction with wheel alignment gauge. Before front wheel alignment, perform the following inspection and repair to ensure the correctness of alignment sampling value and adjustment method.
   - Inspect all tires for proper pressure and treads for consistent wear.
   - Make sure vehicle under the condition of curb weight. Spare tire, jack and onboard tool are equipped in place. Take out other tools or goods.
   - Bounce the vehicle up and down to set suspension system in normal position.
   - Inspect the ball joint for loose connection. Inspect the tie rod end, and correct it before adjusting if looseness is found.
   - Inspect the wheel and tire for runout.
   - Inspect the balance height of vehicle.
   - Inspect the swing arm for looseness.
   - Inspect the stabilizer bar for looseness or damage.

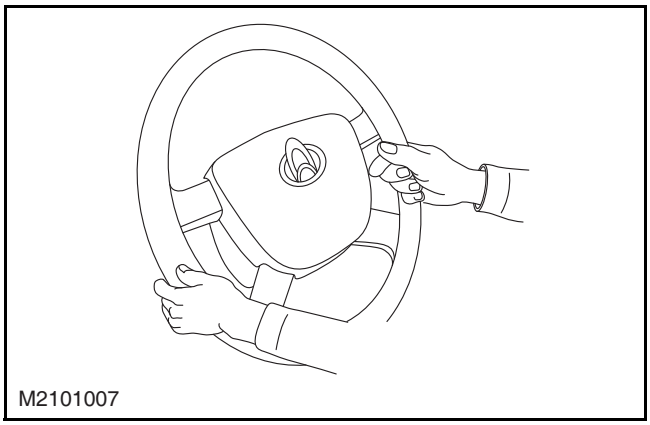
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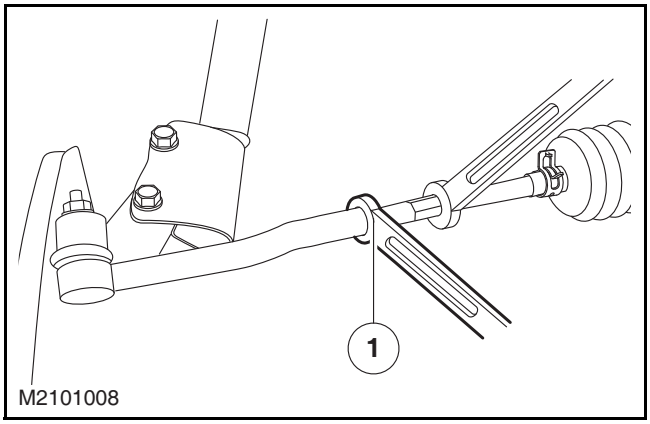
## Adjustment

Rotate the adjusting nuts of steering tie rods, and adjust the front wheel toe-in to specified value by changing the length of steering tie rods at both sides. First, apply some lubricant between steering tie rods and rack dust boot to prevent distortion before rotating the steering tie rods. After toe-in adjustment, the exposed thread length of the left and right tie rod adjusting nuts should be within 4 mm.

**1.** Turn the steering wheel to center position and lock it.

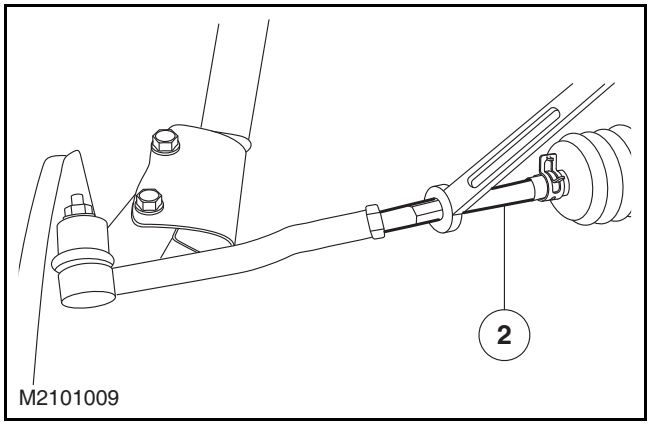

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**2.** Loosen the tie rod ball joint locking nuts.



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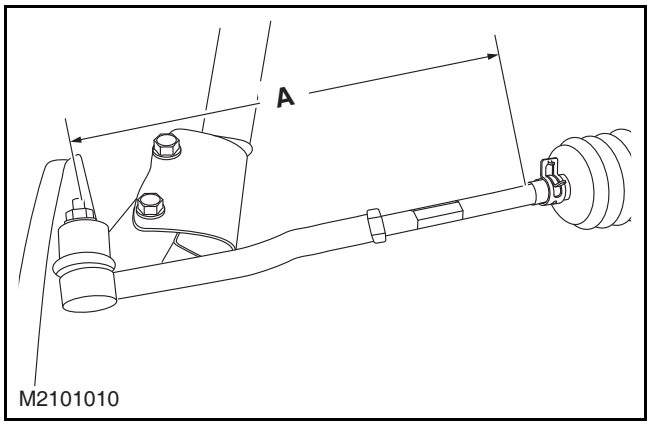
**3.** Turn the left and right tie rods with the same torque to adjust the toe-in.



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**4.** Tighten the locking nuts of left and right steering tie rods to the specific torque after adjustment.

Tightening torque: 30 ~ 55 Nm



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**5.** Inspect the toe-in.

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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical damage.

**Visual Inspection Chart**

| Mechanical |
|---|
| • Tire pressure |
| • Wheel and tire |
| • Wheel steering knuckle |
| • Tie rod ball joint |
| • Front shaft swing arm assembly |
| • Front suspension press rod assembly |
| • Connecting rod |
| • Front stabilizer bar |
| • Front strut and spring |
| • Rear leaf spring assembly |
| • Rear shock absorber |

3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the symptom chart.

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the control module for this fault, and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Vehicle pull | • Tires mismatch or uneven<br>• Front wheel misalignment<br>• Incorrect tire pressure<br>• Meridian tire warpage due to lateral force<br>• Spring broken or loose<br>• Brake drag<br>• Rear dislocation<br>• Front or rear suspension component loose, bent or damaged | **Refer to: Diagnosis Procedure for Vehicle Drift (2.1.1 Suspension System - Overview, Symptom Diagnosis and Testing).** |
| Abnormal driving track (Vehicle cannot keep straight driving) | • Wheel and tire<br>• Wheel alignment<br>• Wheel bearing<br>• Ball joints of front suspension arm and tie rod loose<br>• Front stabilizer bar<br>• Front strut<br>• Rear suspension | **Refer to: Diagnostic Procedure for Abnormal Driving Track (Vehicle Cannot Keep Straight Driving) (2.1.1 Suspension System - Overview, Symptom Diagnosis and Testing).** |
| Vehicle driving shimmy | • Tire out of balance and excessive wear<br>• Front wheel drive shaft worn<br>• Steering system worn<br>• Suspension device assembly loose and worn<br>• Front shaft swing arm ball joint worn<br>• Front shaft swing arm bushing of front suspension loose and worn<br>• Stabilizer bar bushing worn<br>• Rear shock absorber and bushing worn or loose<br>• Incorrect wheel alignment<br>• Rear leaf spring bushing worn | **Refer to: Diagnosis Procedure for Vehicle Driving Shimmy (2.1.1 Suspension System - Overview, Symptom Diagnosis and Testing).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Vehicle shudders in driving | • Tire out of balance and overworn | • Inspect the tire.<br>**Refer to: Tire Abrasion Inspection (2.1.4 Wheel and Tire, General Inspection).** |
| | • Wheel hub bearing worn | • Replace the wheel hub bearing.<br>**Refer to: Front Wheel Hub Bearing (2.1.2 Front Suspension, Removal and Installation).** |
| | • Steering system worn | • Replace the worn steering system parts. |
| | • Front shaft assembly of front suspension loose and worn | • Inspect the suspension assembly. |
| | • Front shaft swing arm ball joint worn | • Replace the front shaft swing arm ball joint.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).** |
| | • Front shaft swing arm bushing of front suspension loose and worn | • Replace the front shaft swing arm ball joint.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).** |
| | • Stabilizer bar bushing worn | • Replace the front shaft swing arm bushing of front suspension.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).** |
| | • Rear suspension leaf spring and bushing worn or loose | • Replace the rear suspension leaf spring or bushing.<br>**Refer to: Rear Leaf Spring Assembly (2.1.3 Rear Suspension, Removal and Installation).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Vehicle shudders in driving | • Front wheel misalignment | • Inspect and adjust the front wheel alignment.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System - Overview, General Inspection).** |
| Steering wheel deviates from central position | • Wheel alignment<br>• Steering system components<br>• Front wheel hub bearing loose or retaining nut loose | **Refer to: Diagnosis Procedure for Steering Wheel Deviating From Central Position (2.1.1 Suspension System - Overview, Symptom Diagnosis and Testing).** |
| Excessive noise | • Steering tie rod end is worn or not flexible<br>• Wheel bearing is worn or has other fault<br>• Steering gearbox bolt loose<br>• Damping spring<br>• Tire<br>• Front shaft swing arm ball joint | **Refer to: Diagnosis Procedure for Excessive Noise (2.1.1 Suspension System - Overview, Symptom Diagnosis and Testing).** |
| Abnormal or excessive wheel wear | • Spring loose or damaged<br>• Tire out of balance<br>• Front wheel misalignment<br>• Strut (shock absorber) fault<br>• Poor road condition<br>• Vehicle overload<br>• Tire rotation is not performed<br>• Wheel bearing worn or loose<br>• Wheel or tire swing<br>• Insufficient tire pressure<br>• Poor driving habit<br>• Wheel distortion | **Refer to: Diagnosis Procedure for Abnormal or Excessive Wheel Wear (2.1.1 Suspension System - Overview, Symptom Diagnosis and Testing).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Heavy steering | • Front wheel misalignment | • Perform the wheel alignment.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System - Overview, General Inspection).** |
| | • Incorrect vehicle driving height (front/rear high or low) | • Load meets the standard, and replace with standard spring components. |
| | • Tight matching of steering gear, without or with little oil, or steering tie rod worn | • Repair or replace the worn components of steering system. |
| | • Front shaft swing arm ball joint stuck | • Replace the front shaft swing arm ball joint.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).** |
| | • Tire worn, under-inflated or out-of-balance | • Inspect the tire.<br>**Refer to: Tire Abrasion Inspection (2.1.4 Wheel and Tire, General Inspection).** |
| | • Steering column stuck | • Repair or replace. |
| Body shakes | • Front stabilizer bar link loose | • Tighten the stabilizer bar link bolt and nut or replace the bushing or joint. |
| | • Shock absorber strut or fitting parts failure | • Replace the strut or fitting parts.<br>**Refer to: Front Strut Assembly (2.1.2 Front Suspension, Disassembly and Assembly).** |
| | • Suspension assembly loose or worn | • Inspect the suspension assembly and replace the worn parts. |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Poor driving comfort | • Front coil spring or rear leaf spring becomes soft | • Inspect the damping spring and replace when necessary.<br>**Refer to: Front Strut Assembly (2.1.2 Front Suspension, Disassembly and Assembly).**<br>**Refer to: Rear Leaf Spring Assembly (2.1.3 Rear Suspension, Removal and Installation).** |
| | • Front or rear suspension assembly worn | • Replace the worn suspension assembly components. |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Unstable direction | • Tire out of balance, with too large runout or damaged | • Inspect the tire.<br>**Refer to: Tire Abrasion Inspection (2.1.4 Wheel and Tire, General Inspection).** |
| | • Toe-in value exceeds regulating range | • Perform the wheel alignment.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System - Overview, General Inspection).** |
| | • Steering system worn | • Replace the worn steering system components. |
| | • Front shaft swing arm ball joint and tie rod ball joint damaged or loose | • Replace the front shaft swing arm and tie rod. |
| | • Damping spring becomes soft | • Inspect the damping spring and replace when necessary.<br>**Refer to: Front Strut Assembly (2.1.2 Front Suspension, Disassembly and Assembly).** |
| | • Front or rear suspension assembly worn | • Replace the worn suspension assembly components. |
| | • Stabilizer bar bushing or link worn | • Replace the stabilizer bar bushing or link.<br>**Refer to: Front Stabilizer Bar (2.1.2 Front Suspension, Removal and Installation).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Steering wheel cannot return normally | • Front wheel misalignment | • Inspect and adjust the front wheel alignment.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System - Overview, General Inspection).** |
| | • Steering system worn | • Inspect the steering system.<br>**Refer to: Steering System (2.4.1 Steering System - Overview, General Inspection).** |
| | • Front shaft swing arm or steering tie rod ball joint stuck | • Replace the front shaft swing arm or steering tie rod ball joint.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).**<br>**Refer to: Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).** |
| | • Incorrect tire pressure | • Adjust the tire pressure. |
| Front wheel shimmy, vibration or bounce | • Tire or wheel out of balance<br>• Wheel bearing damaged or worn<br>• Steering tie rod ball joint worn<br>• Front left/right suspension swing arm ball joint worn<br>• Excessive wheel runout<br>• Tire bumped or damaged<br>• Tire/Wheel assembly runout with overload<br>• Front wheel misalignment<br>• Steering drive rod loose or damaged<br>• Steering gearbox retaining bolt loose | • Balance the wheel or replace the tire or wheel.<br>• Replace the wheel bearing.<br>• Replace the steering tie rod ball joint.<br>• Replace the front suspension swing arm.<br>• Repair or replace the wheel and/or tire.<br>• Replace the tire.<br>• Replace the tire or wheel.<br>• Inspect and adjust the front wheel alignment.<br>• Tighten or replace the drive rod.<br>• Tighten the steering gearbox bolt. |

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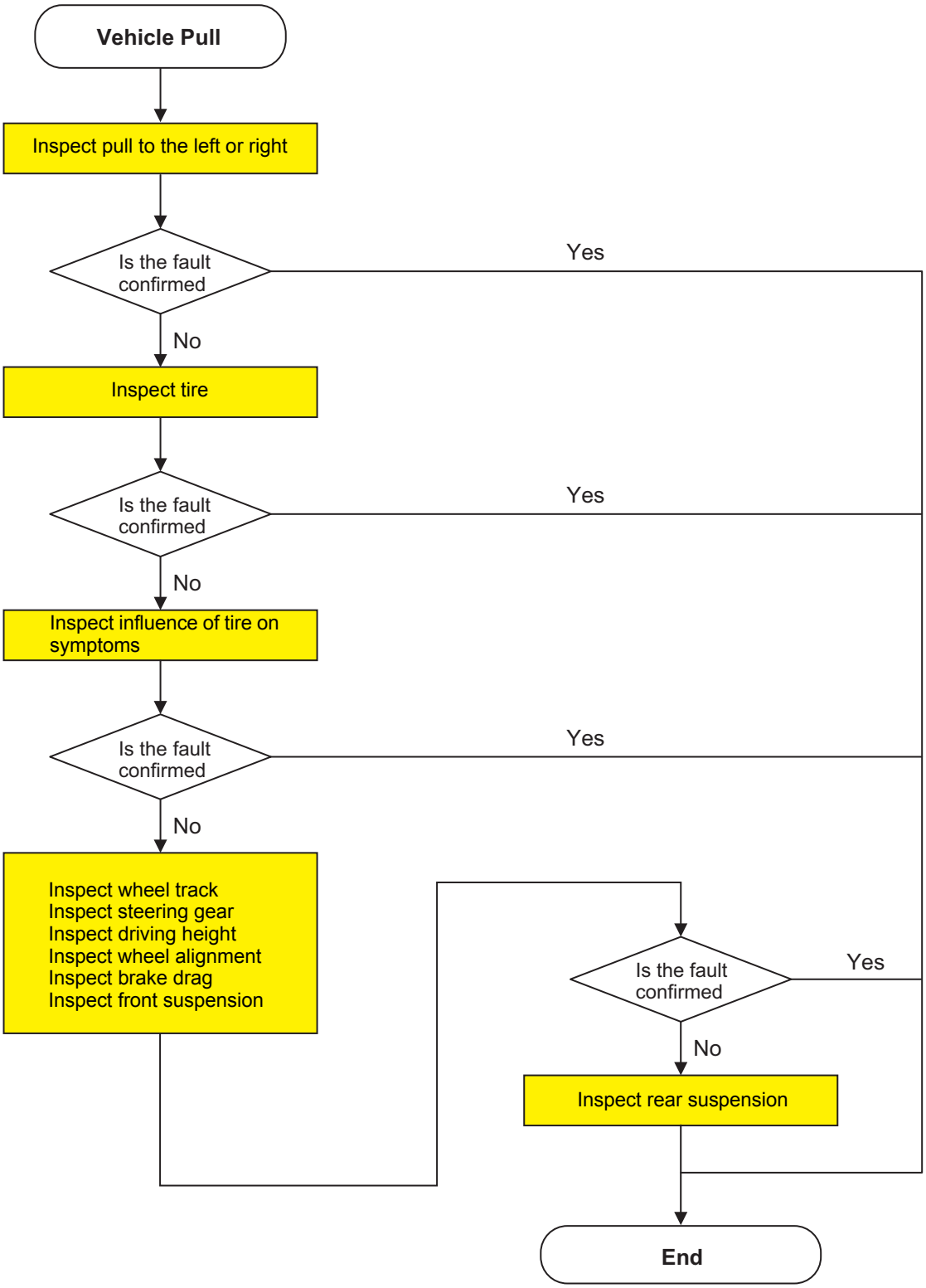


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Vehicle inclines or shakes in turning | • Stabilizer bar loose<br>• Shock absorber, strut or fitting parts fault<br>• Spring damaged or droop<br>• Overload | • Tighten the stabilizer bar bolt or nut or replace the bushing or joint.<br>• Replace the strut or fitting parts.<br>• Replace the spring.<br>**Refer to: Front Strut Assembly (2.1.2 Front Suspension, Disassembly and Assembly).**<br>**Refer to: Rear Leaf Spring Assembly (2.1.3 Rear Suspension, Removal and Installation).**<br>• Inspect the load. |
| Suspension is pressed to bottom | • Overload<br>• Shock absorber or strut fault<br>• Spring fault or droop | • Inspect the load.<br>• Replace the shock absorber or strut.<br>• Replace the spring. |

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# Diagnosis Procedure for Vehicle Pull



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect pull to the left or right | |
| **WARNING: To avoid personal injury caused by losing control, road test should be conducted by two persons jointly in order to maintain safe driving. Keep appropriate control of the steering wheel. Failure to follow this instruction may result in personal injury.** | |
| | A. Drive the vehicle on flat road at a speed of 80 km/h.<br>B. Make sure there is no crosswind and strong wind in driving.<br>C. Drive back and forth at least 2 times.<br>D. If the vehicle deviating value is 12 ft within 7 seconds, it indicates vehicle pull.<br>Does the vehicle still pull?<br>**Yes**<br>Go to step 2.<br>**No**<br>Adjust the steering wheel to straight ahead position. |
| 2. Inspect tire | |
| | A. Inspect whether all wheel and tire types are the same.<br>B. Inspect whether all tire wear is similar.<br>C. Inspect the tire for bulges or cracks.<br>D. Inspect the tire pressure.<br>Is the tire normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Adjust or replace the tire. |
| 3. Inspect influence of tire on symptoms | |
| | A. Rotate the right and left tires of front suspension.<br>B. Install 4 tires in good state when necessary.<br>Does the vehicle still pull?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the tire. |
| 4. Inspect wheel track | |
| | A. Inspect the wheel track.<br>Are wheel track same?<br>**Yes**<br>Go to step 5.<br>**No**<br>Calibrate the wheel track. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect steering gear | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the steering connecting rod for excessive wear.<br>Is the steering connecting rod overworn?<br>**Yes**<br>Replace or repair the damaged components.<br>**No**<br>Go to step 6. |
| 6. Inspect driving height | |
| | A. Inspect the driving height.<br>Is the driving height normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Repair the inconsistent driving height fault. |
| 7. Inspect wheel alignment | |
| | A. Inspect the wheel alignment.<br>Is the wheel alignment data within specified range?<br>**Yes**<br>Go to step 8.<br>**No**<br>Perform the wheel alignment. |
| 8. Inspect brake drag | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the wheel for brake drag.<br>Is there brake drag?<br>**Yes**<br>Repair the brake drag.<br>**No**<br>Go to step 9. |

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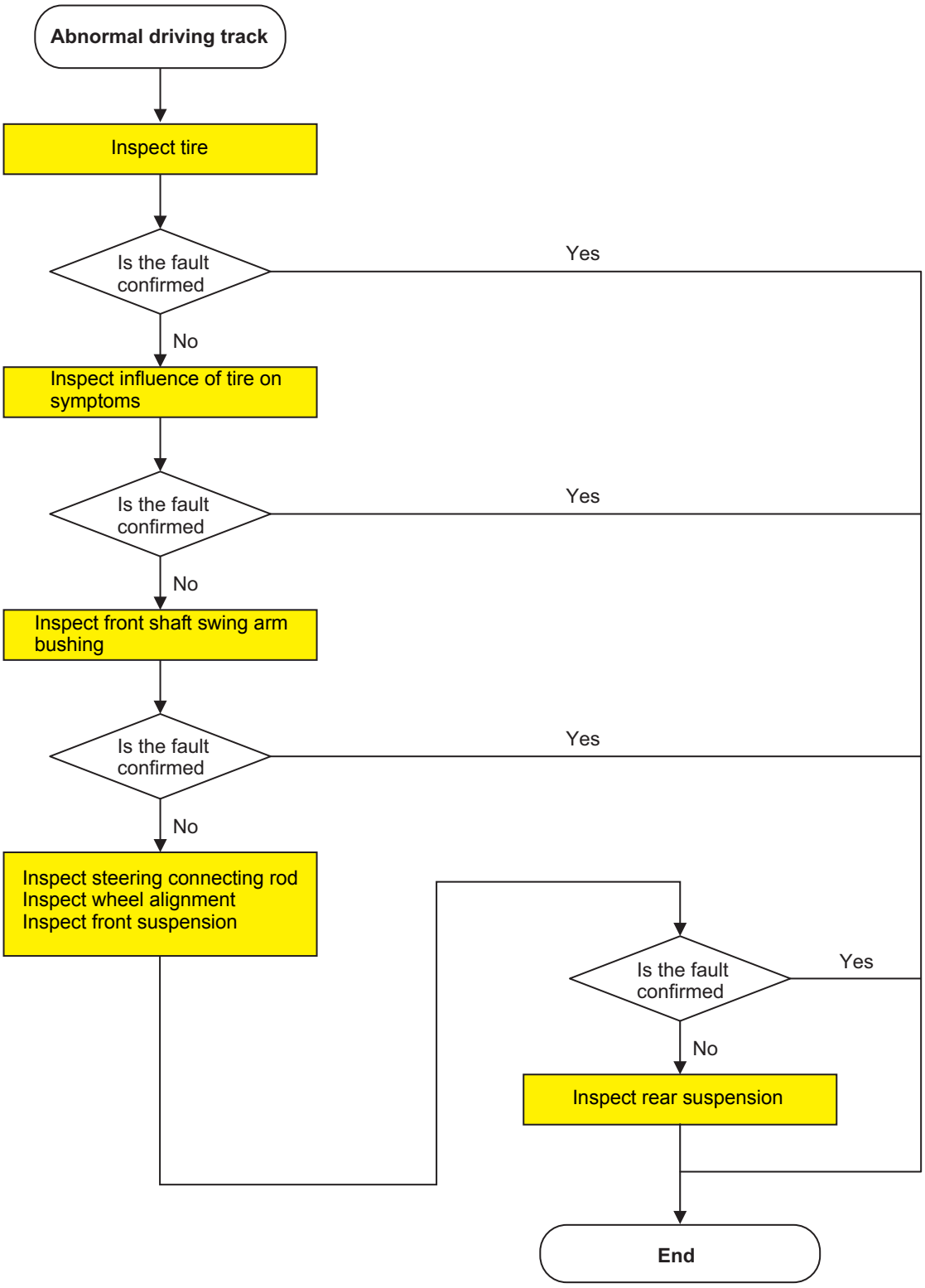


| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect front suspension | |
| | A. Inspect the front suspension components.<br>Are the front suspension components loose or damaged?<br>**Yes**<br>Repair or replace the damaged components.<br>**No**<br>Go to step 10. |
| 10. Inspect rear suspension | |
| | A. Inspect the rear suspension.<br>Is the rear suspension normal?<br>**Yes**<br>Inspect the suspension parts for wear. Replace or repair the damaged parts if necessary.<br>**Refer to: Rear Leaf Spring Assembly (2.1.3 Rear Suspension, Removal and Installation).**<br>**Refer to: Rear Shock Absorber Assembly (2.1.3 Rear Suspension, Removal and Installation).**<br>**No**<br>Adjust or repair the rear suspension abnormal fault. |

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# Diagnosis Procedure for Abnormal Driving Track (Vehicle Cannot Keep Straight Driving)



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| Test Conditions | Details/Results/Actions |
|---|---|
| **WARNING: To avoid personal injury caused by losing control, road test should be conducted by two persons jointly in order to maintain safe driving. Keep appropriate control of the steering wheel. Failure to follow this instruction may result in personal injury.** | |
| 1. Inspect tire | |
| | A. Inspect whether wheel and tire types are the same.<br>B. Inspect whether all tire wear is similar.<br>C. Inspect the tire for bulges or cracks.<br>D. Inspect the tire pressure.<br>Is the tire normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Adjust or replace the tire. |
| 2. Inspect influence of tire on symptoms | |
| | A. Rotate the right and left tires of front suspension.<br>B. Install 4 tires in good state when necessary.<br>Is the vehicle behavior abnormal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the tire. |
| 3. Inspect front shaft swing arm bushing | |
| | A. Inspect whether the front shaft swing arm bushing is cracked, loose or motional.<br>Is the front shaft swing arm normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the front shaft swing arm bushing.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).** |

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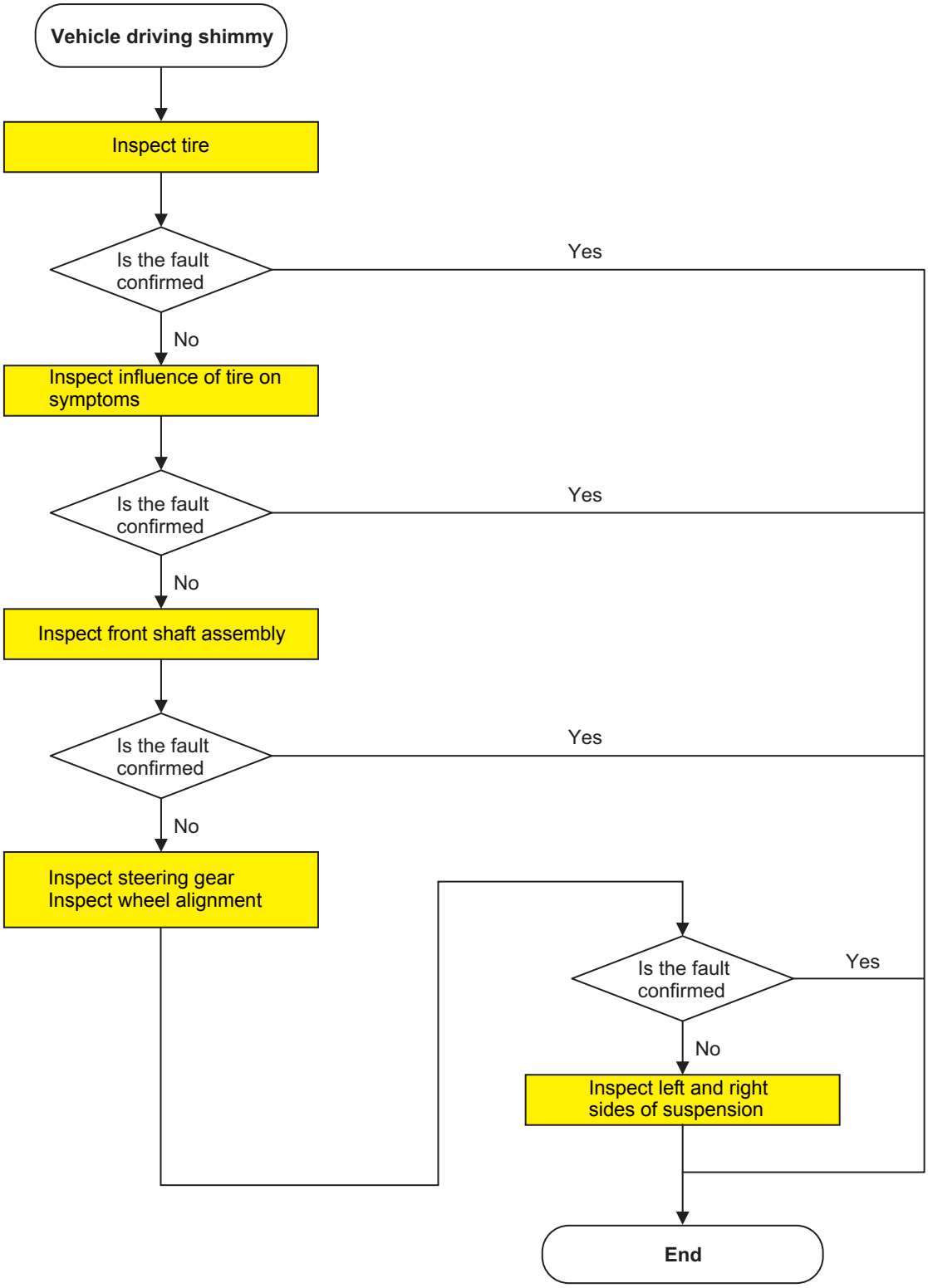


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect steering connecting rod | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the steering connecting rod for excessive wear.<br>Is the steering connecting rod overworn?<br>**Yes**<br>Replace or repair the damaged components.<br>**No**<br>Go to step 5. |
| 5. Inspect wheel alignment | |
| | A. Inspect the wheel alignment.<br>Is the wheel alignment data within specified range?<br>**Yes**<br>Go to step 6.<br>**No**<br>Perform the wheel alignment. |
| 6. Inspect front suspension | |
| | A. Inspect the front suspension components.<br>Are the front suspension components loose or damaged?<br>**Yes**<br>Repair or replace the damaged components.<br>**No**<br>Go to step 7. |
| 7. Inspect rear suspension | |
| | A. Inspect the rear suspension.<br>Is the rear suspension normal?<br>**Yes**<br>Inspect the suspension parts for wear. Replace or repair the damaged parts if necessary.<br>**Refer to: Rear Leaf Spring Assembly (2.1.3 Rear Suspension, Removal and Installation).**<br>**Refer to: Rear Shock Absorber Assembly (2.1.3 Rear Suspension, Removal and Installation).**<br>**No**<br>Adjust or repair the rear suspension abnormal fault. |

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# Diagnosis Procedure for Vehicle Driving Shimmy



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| Test Conditions | Details/Results/Actions |
|---|---|
| **WARNING: To avoid personal injury caused by losing control, road test should be conducted by two persons jointly in order to maintain safe driving. Keep appropriate control of the steering wheel. Failure to follow this instruction may result in personal injury.** | |
| 1. Inspect tire | |
| | A. Inspect whether wheel and tire types are the same.<br>B. Inspect whether all tire wear is similar.<br>C. Inspect the tire for bulges or cracks.<br>D. Inspect the tire pressure.<br>Is the tire normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Adjust or replace the tire. |
| 2. Inspect influence of tire on symptoms | |
| | A. Rotate the right and left tires of front suspension.<br>B. Install 4 tires in good state when necessary.<br>Is the vehicle behavior abnormal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the tire. |
| 3. Inspect front shaft assembly | |
| | A. Inspect the front shaft for any distortion and deformation.<br>Is the front shaft normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the front shaft assembly.<br>**Refer to: Front Shaft Welding Assembly (2.1.2 Front Suspension, Removal and Installation).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect steering gear | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the connection components of steering gear for looseness or excessive wear.<br>Are the connection components of steering gear loose or overworn?<br>**Yes**<br>Replace the wheel bearing.<br>**No**<br>Go to step 5. |
| 5. Inspect wheel alignment | |
| | A. Inspect the wheel alignment.<br>Is the wheel alignment data within specified range?<br>**Yes**<br>Go to step 6.<br>**No**<br>Perform the wheel alignment. |
| 6. Inspect left and right sides of suspension | |
| | A. Inspect left and right sides of the suspension.<br>Is the height or rigidity of left and right sides of the suspension consistent?<br>**Yes**<br>Repair or replace the damaged components.<br>**No**<br>Inspect the left and right shock absorbers of the suspension for the same effectiveness. In case of any failure, repair or replace with a new one. |

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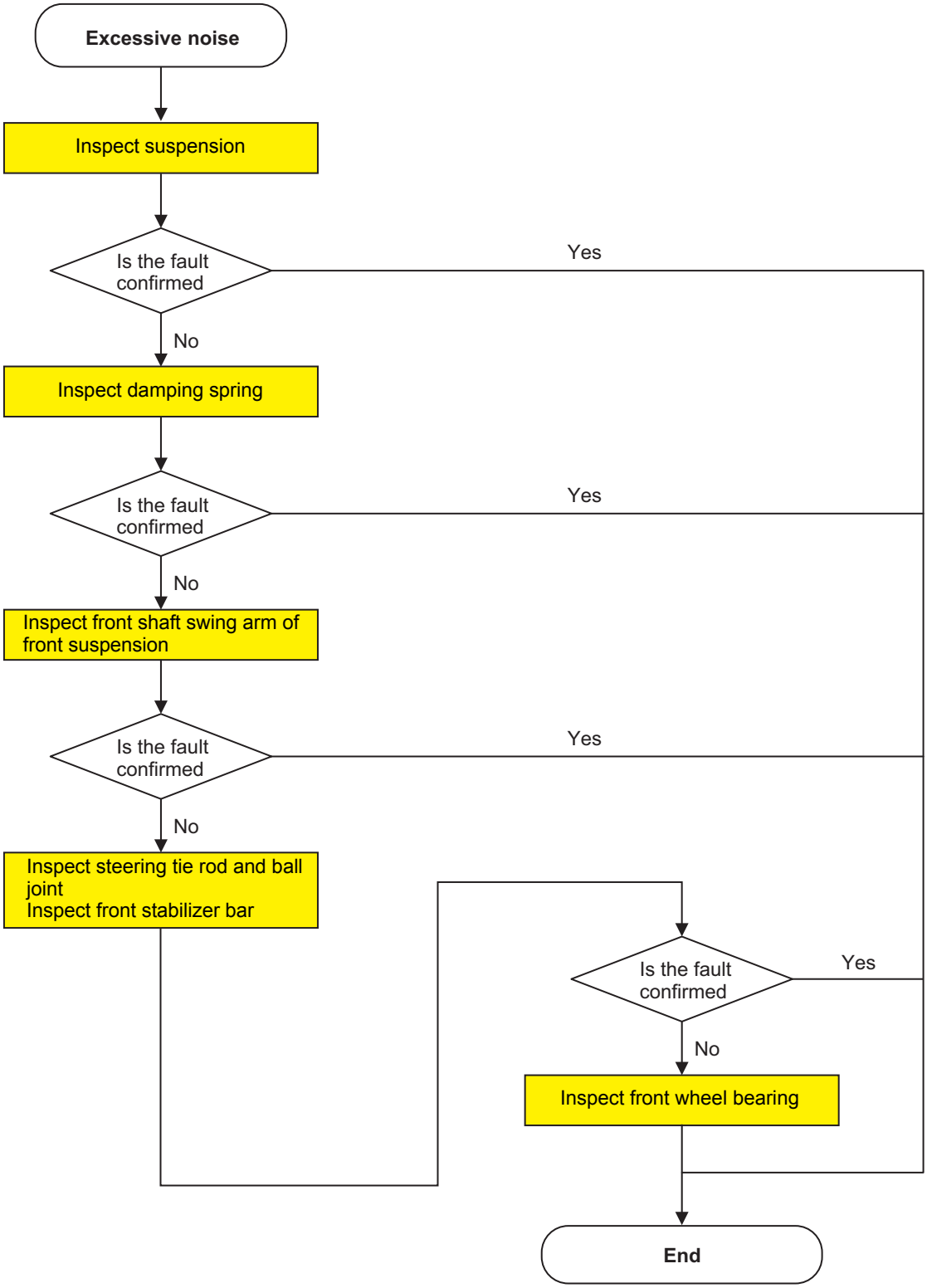
# Diagnosis Procedure for Steering Wheel Deviating From Central Position

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect steering gear | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the connection components of steering gear for looseness or excessive wear.<br>Are the connection components of steering gear loose or overworn?<br>**Yes**<br>Replace or repair the damaged components.<br>**No**<br>Go to step 2. |
| 2. Inspect wheel alignment | |
| | A. Inspect the wheel alignment.<br>Is the wheel alignment data within specified range?<br>**Yes**<br>**Refer to: Diagnosis Procedure for Abnormal Driving Track (2.1.1 Suspension System - Overview, Symptom Diagnosis and Testing).**<br>**No**<br>Perform the wheel alignment. |

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# Diagnosis Procedure for Excessive Noise



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect suspension | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the retaining bolts of suspension components.<br>Are the bolts loose or cracked?<br>**Yes**<br>Tighten or replace the bolts.<br>**No**<br>Go to step 2. |
| 2. Inspect damping spring | |
| | A. Inspect if the damping spring is damaged.<br>Is the damping spring damaged?<br>**Yes**<br>Replace the damping spring.<br>**No**<br>Go to step 3. |
| 3. Inspect front shaft swing arm of front suspension | |
| | A. Inspect the front shaft swing arm bushing of front suspension for excessive wear or damage.<br>Is the front shaft swing arm bushing of front suspension worn?<br>**Yes**<br>Replace the front shaft swing arm bushing of front suspension.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).**<br>**No**<br>Go to step 4. |

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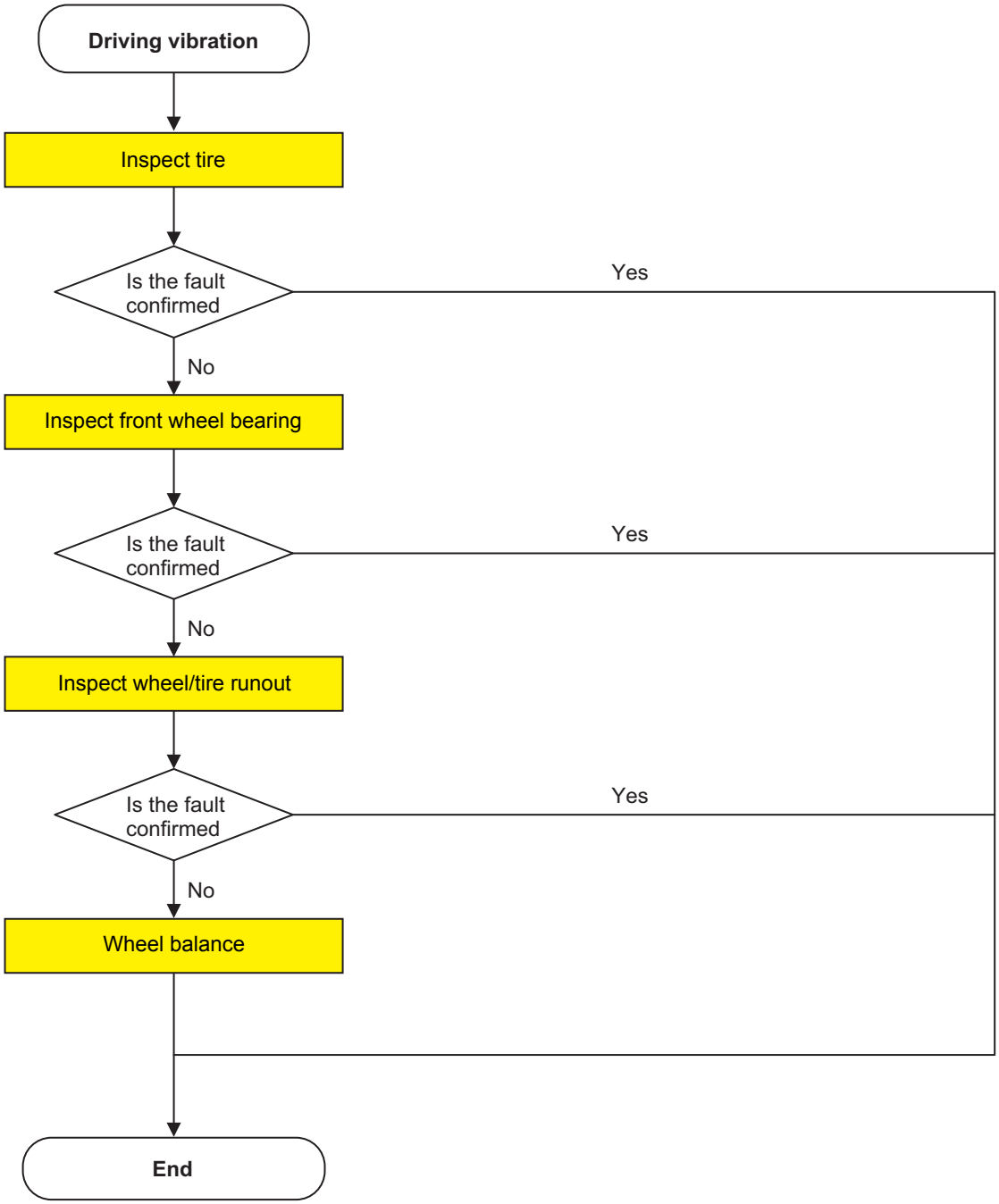


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect steering tie rod and ball joint | |
| | A. Inspect the steering tie rod ball joint, front shaft swing arm ball joint, steering tie rod inner ball joint for wear, stuck rotation or looseness.<br>Are they normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair or replace the components. |
| 5. Inspect front stabilizer bar | |
| | A. Inspect the front stabilizer bar and link for looseness or excessive wear.<br>Are they normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the worn components. |
| 6. Inspect front wheel bearing | |
| | A. Inspect the front wheel bearing.<br>B. Hold the bottom and top of the wheel and shake forcefully. Inspect the bearing for excessive looseness.<br>C. Rotate the front wheel and inspect the working condition.<br>Is the bearing loose or noisy?<br>**Yes**<br>Replace the front wheel bearing if necessary.<br>**Refer to: Front Wheel Hub Bearing (2.1.2 Front Suspension, Removal and Installation).**<br>**No**<br>Verify the customer concern. |

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# Diagnosis Procedure for Driving Vibration



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect tire | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect whether the tire is damaged or overworn.<br>Is the tire damaged or worn?<br>**Yes**<br>Replace the tire.<br>**No**<br>Go to step 2. |
| 2. Inspect front wheel bearing | |
| | A. Inspect the front wheel bearing.<br>B. Hold the bottom and top of the wheel and shake forcefully. Inspect the bearing for excessive looseness.<br>C. Rotate the front wheel. Inspect the working condition of front wheel.<br>Is the bearing loose or noisy?<br>**Yes**<br>Replace the front wheel bearing.<br>**Refer to: Front Wheel Hub Bearing (2.1.2 Front Suspension, Removal and Installation).**<br>**No**<br>Go to step 3. |
| 3. Inspect wheel/tire runout | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Measure the radial and axial runouts of wheel/tire with a dial indicator.<br>**Refer to: Wheel Runout Inspection (2.1.4 Wheel and Tire, General Inspection).**<br>Are they normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the wheel and tire. |

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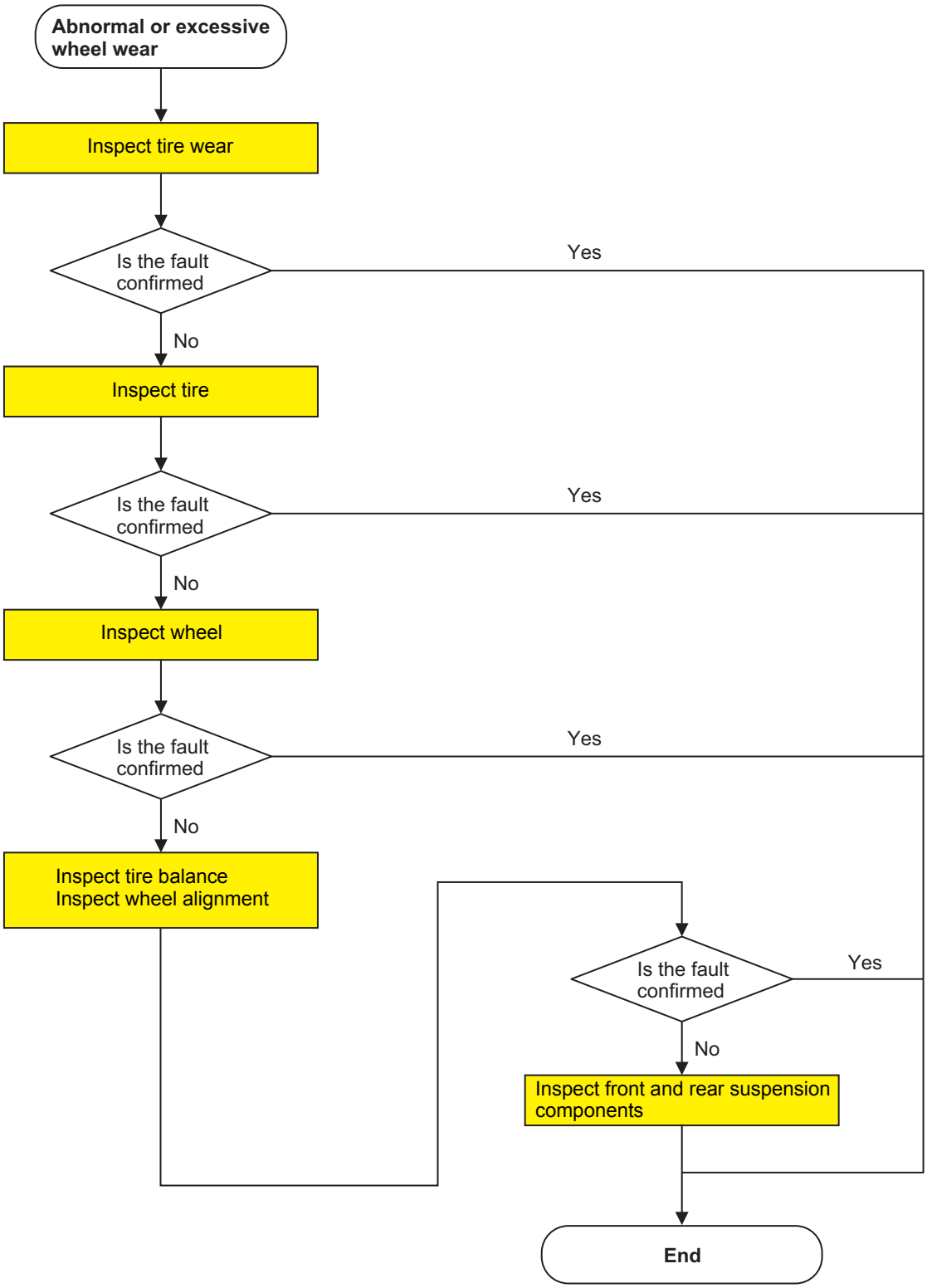


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Wheel balance | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Remove the wheel and tire.<br>C. Balance the wheel on a balance machine. Carry out the road test.<br>Can the vibration be felt?<br>**Yes**<br>Repair.<br>**Refer to: 1.1.5 Noise, Vibration and Harshness.**<br>**No**<br>Make sure that the maintenance has been finished. |

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# Diagnosis Procedure for Abnormal or Excessive Wheel Wear



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect tire wear | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the tire wear.<br>Is the tire tread wear regular?<br>**Yes**<br>Perform tire rotation and replace the tire when necessary.<br>**No**<br>Go to step 2. |
| 2. Inspect tire | |
| | A. Inspect the tire pressure and model.<br>Is the tire pressure normal and model same?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the tire with different model and adjust the pressure.<br>**Refer to: General Specifications (2.1.4 Wheel and Tire, Specifications).** |
| 3. Inspect wheel | |
| | A. Inspect the wheel for distortion and deformation.<br>B. Inspect the wheel runout.<br>**Refer to: Wheel Runout Inspection (2.1.4 Wheel and Tire, General Inspection).**<br>Is the wheel normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Adjust or replace the wheel. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect tire balance | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Remove the tire.<br>C. Inspect tire balance on a balance machine.<br>Is the tire balance normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Balance and replace when necessary. |
| 5. Inspect wheel alignment | |
| | A. Inspect the wheel alignment.<br>Do the wheel alignment parameters meet the specification requirement?<br>**Yes**<br>Go to step 6.<br>**No**<br>Adjust the wheel alignment parameters. |
| 6. Inspect front and rear suspension components | |
| | A. Inspect whether the retaining bolts of front suspension components are tightened firmly.<br>B. Inspect the front shaft swing arm bushing and stabilizer bar bushing for any cracks, looseness and missing.<br>C. Inspect the ball joint of front suspension for looseness.<br>D. Inspect if the rear suspension axle for any cracks, looseness and missing.<br>Are the front and rear suspension components normal?<br>**Yes**<br>Inquire about the vehicle load, speed and the driver's habit. Correct the overload, overspeed and any incorrect driving habit.<br>**No**<br>Repair the front and rear suspension faults. |

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Steering tie rod ball joint retaining nut | 30 ~ 55 | 22 ~ 41 | - |
| Wheel nut | 110 ± 5 | - | - |
| Front wheel hub bearing retaining nut | 175 | 129 | - |
| Retaining nut between front strut and body | 60 ~ 85 | 44 ~ 63 | - |
| Retaining nut between front strut and steering knuckle | 80 ~ 110 | 59 ~ 81 | - |
| Retaining nut between front suspension press lever and front shaft swing arm | 80 ~ 110 | 59 ~ 81 | - |
| Connecting bolt between front shaft and body | 75 | 55 | - |
| Retaining bolt between front shaft swing arm and steering knuckle | 45 ~ 65 | 33 ~ 48 | - |
| Retaining nut of front suspension press lever on the lever retainer | 18 ~ 28 | 13 ~ 21 | - |
| Retaining nut between front shaft swing arm and front shaft | 60 ~ 85 | 44 ~ 63 | - |
| Connecting rod upper retaining nut | 40 ~ 60 | 30 ~ 44 | - |
| Connecting rod lower retaining nut | 18 ~ 28 | 13 ~ 21 | - |
| Retaining bolt between steering gear and front shaft | 50 ± 5 | - | - |
| Front stabilizer bar retaining bolt | 20 ~ 30 | 15 ~ 22 | - |

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## Description and Operation

# System Overview

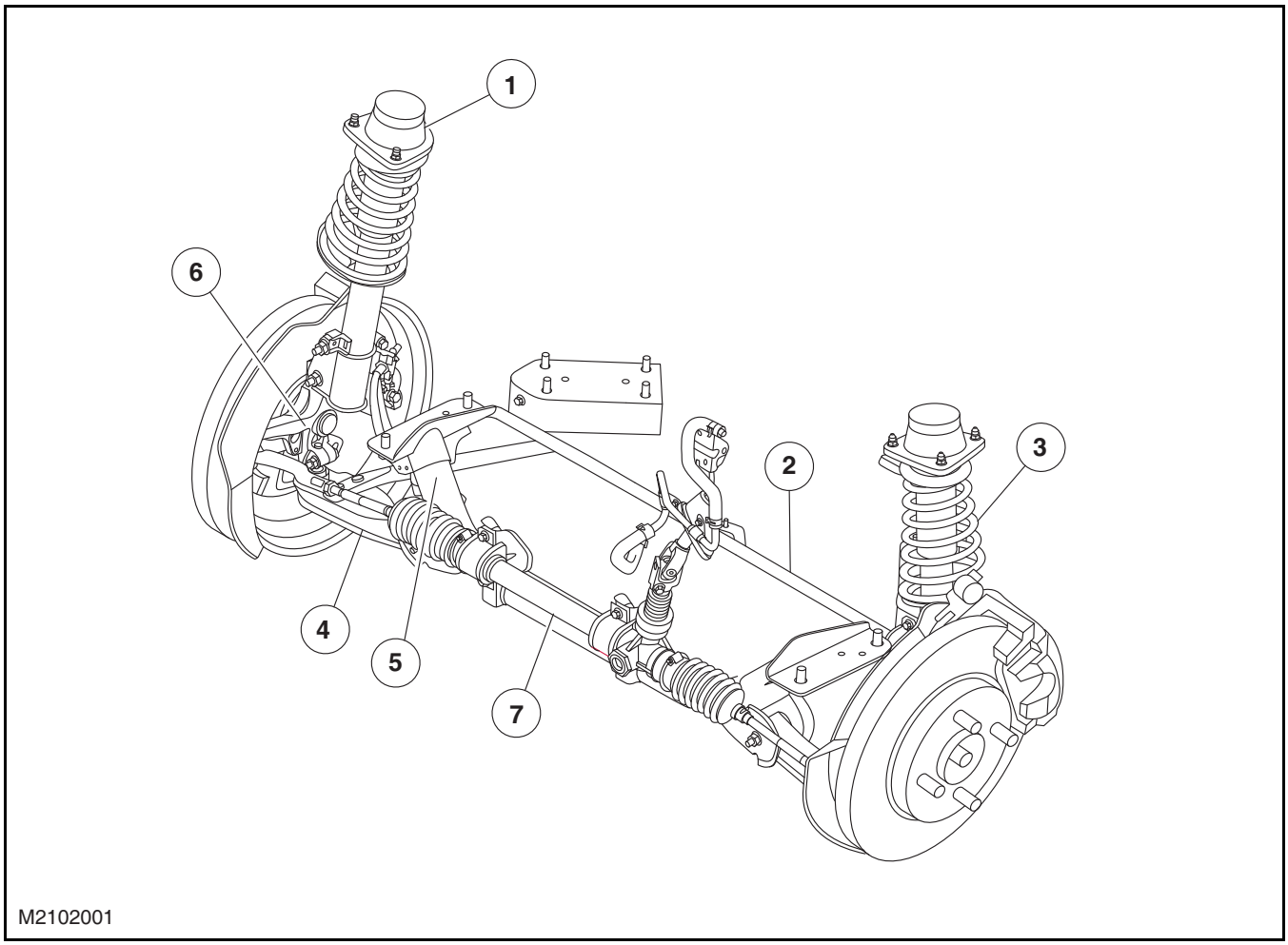
The front suspension is strut swing arm independent suspension. The upper end of strut is connected with the body by the supporting parts. The strut is separated from support parts through rubber fitting parts. A strut bearing is installed on the lower part of rubber fitting parts.

The lower end of strut is connected with the upper end of steering knuckle. The lower end of steering knuckle is connected with the ball joint. The ball joint and swing arm compose one device. The tie rod end is connected with the steering knuckle.

Therefore, the movement of steering wheel is passed to the tie rod end, then to the steering knuckle. Finally, the wheels and tires rotate. In this operation, the strut will rotate through strut bearing and lower ball joint with the movement of the steering knuckle.

# Location View

### Front Suspension Assembly View




M2102001

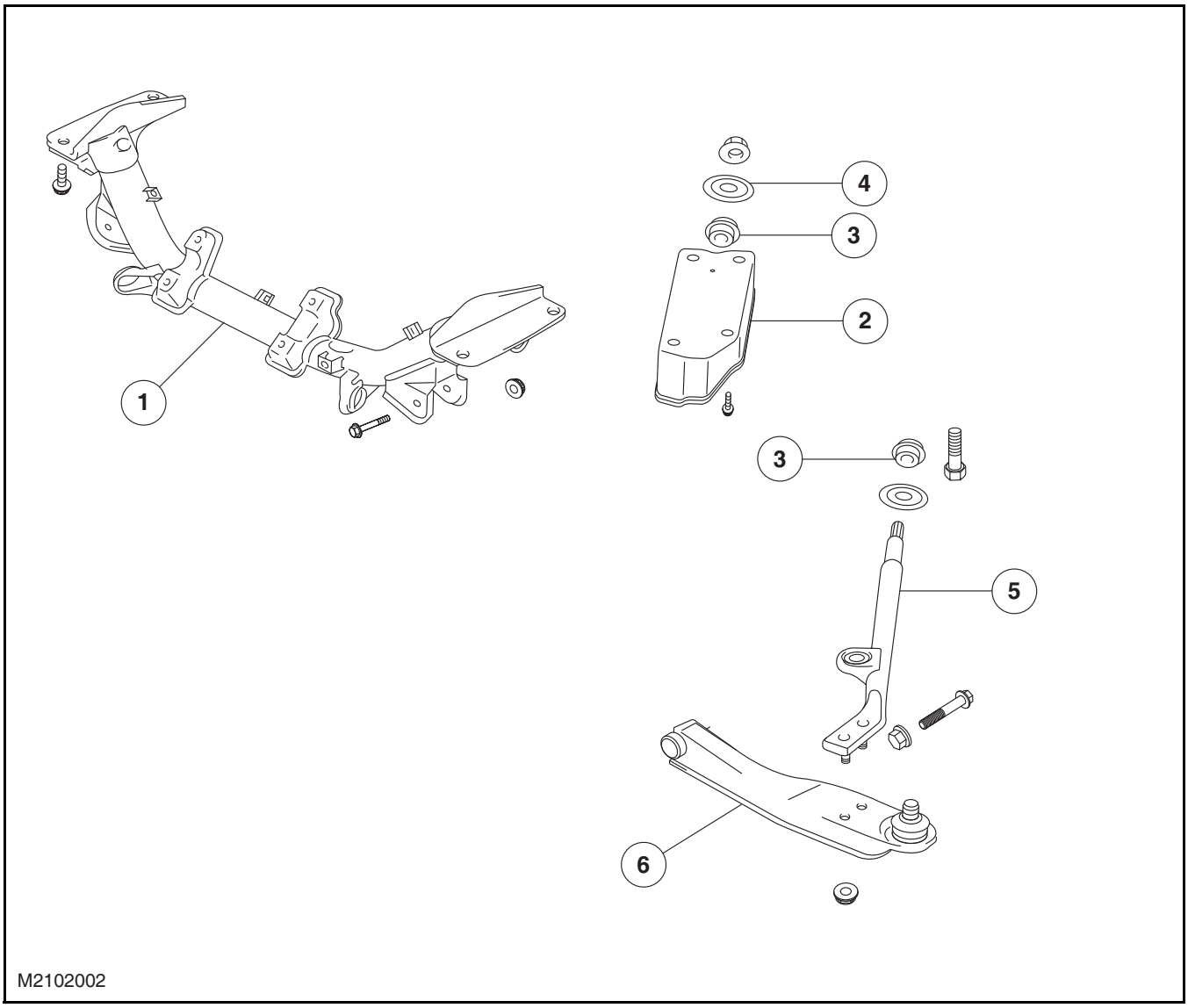
| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Front strut assembly | 5 | Front shaft welding assembly |
| 2 | Front stabilizer bar | 6 | Steering knuckle |
| 3 | Coil spring | 7 | Steering gear assembly |
| 4 | Front shaft swing arm | | |

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# Components Exploded View

## Front Suspension Exploded View

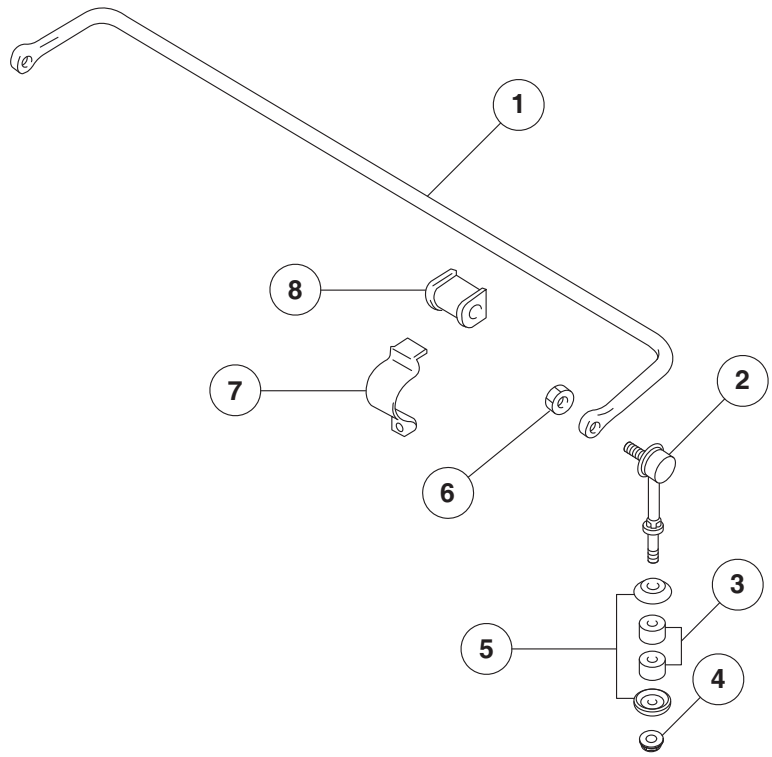



M2102002

| Item | Description | QTY |
|---|---|---|
| 1 | Front shaft welding assembly | 1 |
| 2 | Press lever retainer assembly | 1 |
| 3 | Press lever bushing | 2 |
| 4 | Washer | 1 |
| 5 | Front suspension press lever welding assembly | 1 |
| 6 | Front shaft swing arm assembly | 1 |

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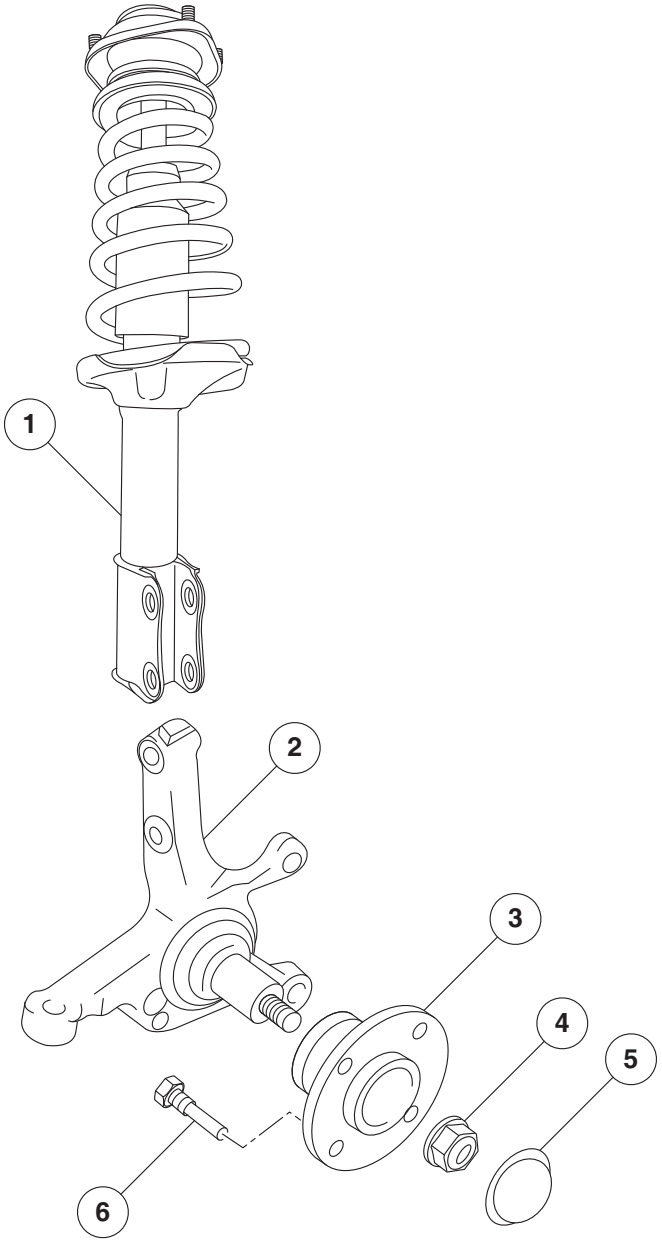



M2102003

| Item | Description | Qty. |
|---|---|---|
| 1 | Front stabilizer bar | 1 |
| 2 | Connecting rod assembly | 2 |
| 3 | Connecting rod rubber cushion | 4 |
| 4 | Nut | 2 |
| 5 | Washer | 4 |
| 6 | Nut | 2 |
| 7 | Front stabilizer bar bracket | 2 |
| 8 | Front stabilizer bar bushing | 2 |

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M2102004

| Item | Description | Qty. |
|---|---|---|
| 1 | Front strut assembly | 1 |
| 2 | Steering knuckle | 2 |
| 3 | Front wheel hub bearing assembly | 2 |
| 4 | Wheel hub bearing nut | 2 |
| 5 | bearing cap | 2 |
| 6 | Bolt | 8 |

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## Symptom Diagnosis and Testing

Refer to: Symptom Chart (2.2.1 Suspension System - Overview, Symptom Diagnosis and Testing).

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## Removal and Installation

# Front Shaft Swing Arm Assembly

### Removal

1. Remove the tire.

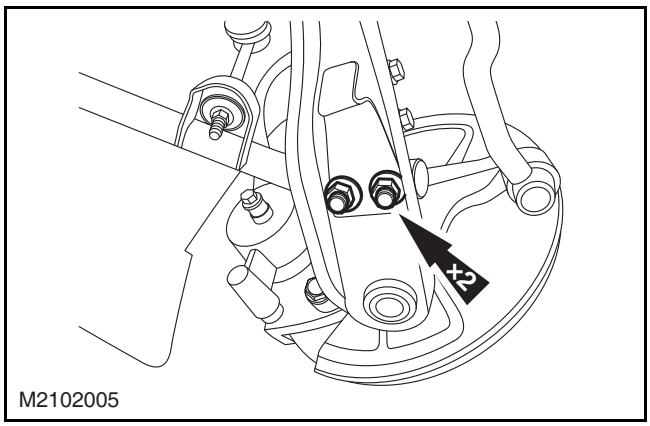
   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the connecting nuts between front suspension press lever and front shaft swing arm.

   Torque: 80 ~ 110 Nm



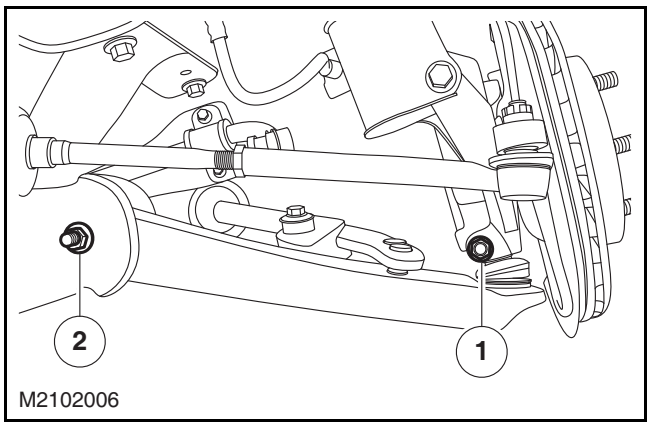
M2102005

4. Remove the retaining bolt (1) between front shaft swing arm and steering knuckle.

   Torque: 45 ~ 65 Nm

5. Remove the connecting bolt (2) between front shaft swing arm and front shaft.

   Torque: 60 ~ 85 Nm



M2102006

6. Remove the front shaft swing arm assembly.

### Installation

1. Installation is in the reverse order of removal.

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# Front Suspension Press Lever Welding Assembly

## Removal

1. Remove the wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

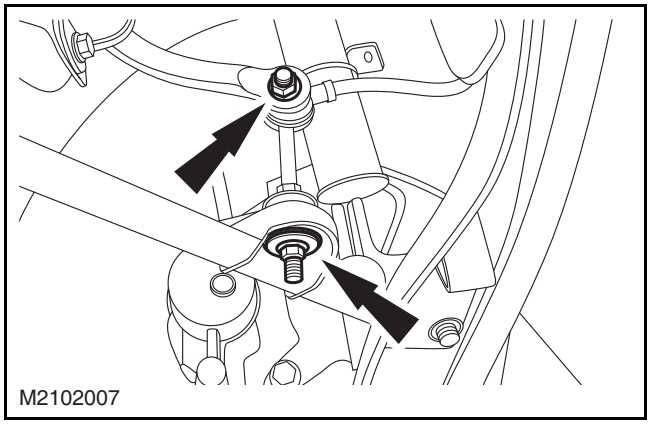
2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the retaining nuts from the connecting rod and remove the connecting rod.

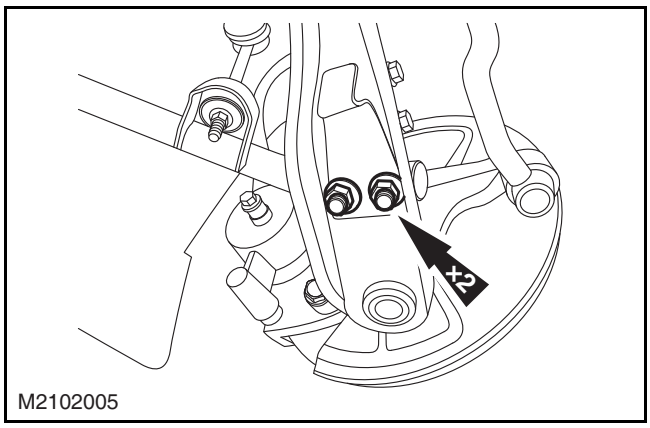
   Torque for upper nut: 40 ~ 60 Nm

   Torque for lower nut: 18 ~ 28 Nm


M2102007

4. Remove the connecting nuts between front suspension press lever and front shaft swing arm.

   Torque: 80 ~ 110 Nm



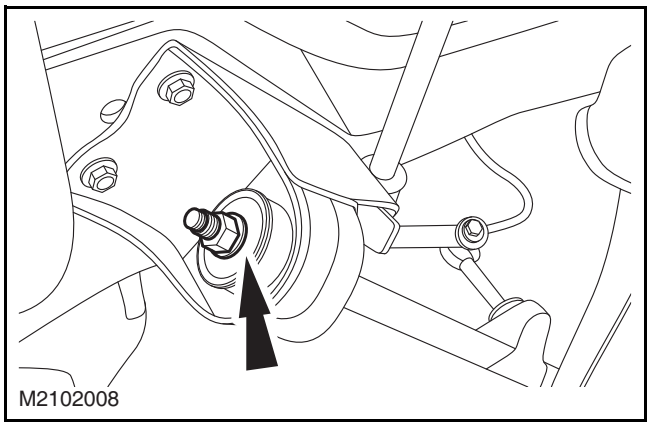
M2102005

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**5.** Remove the retaining nut of front suspension press lever from the lever retainer.

Torque: 18 ~ 28 Nm




**6.** Remove the front suspension press lever welding assembly.

## Installation

**1.** Installation is in the reverse order of removal.

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# Front Wheel Steering Knuckle

## Removal

1. Remove the wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Lift the vehicle.

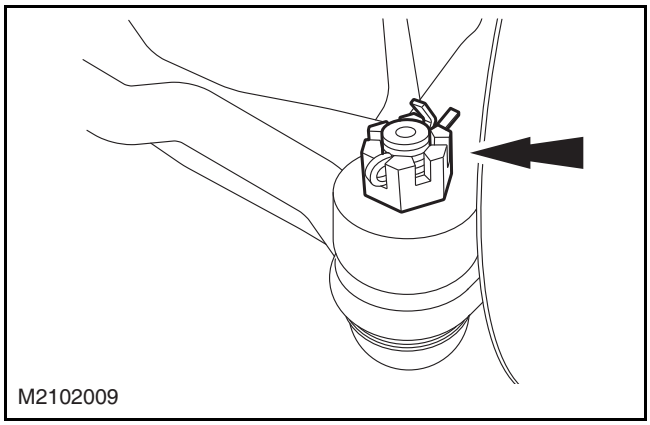
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the front wheel hub bearing.

   **Refer to: Front Wheel Hub Bearing (2.1.2 Front Suspension, Removal and Installation).**

4. Remove the nut cotter pin and retaining nut from the tie rod ball joint.

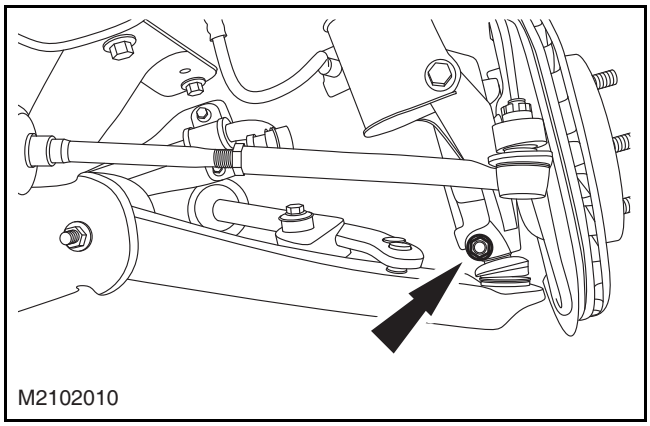
   Torque: 30 ~ 55 Nm



M2102009

5. Remove the retaining bolt between front shaft swing arm and steering knuckle.

   Torque: 45 ~ 65 Nm



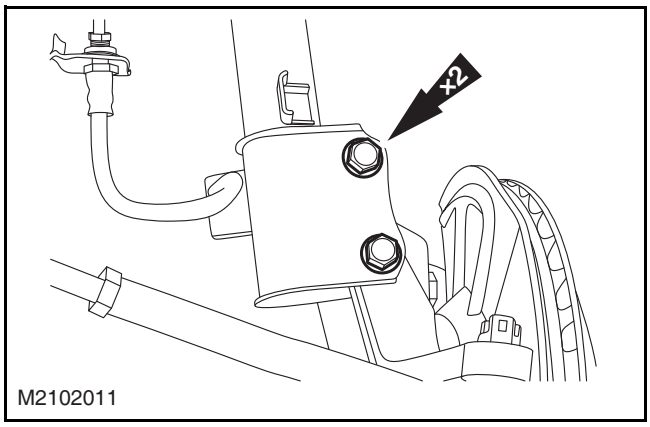
M2102010

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6. Remove the connecting bolts and nuts between front strut and steering knuckle.

   Torque: 80 ~ 110 Nm




7. Remove the steering knuckle.

## Installation

1. Installation is in the reverse order of removal.

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# Front Wheel Hub Bearing

## Removal

1. Remove the wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

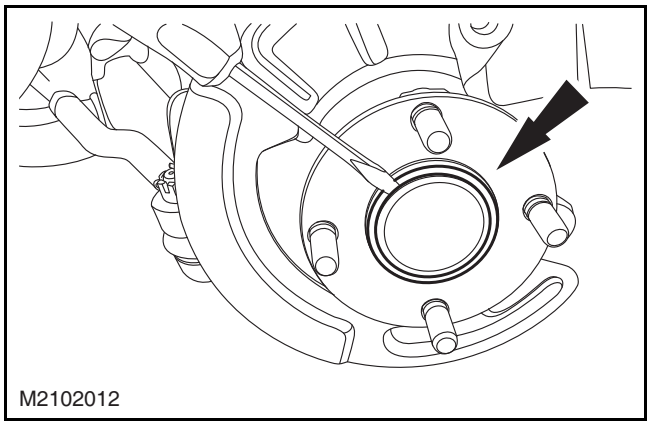
2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the brake disc.

   **Refer to: Brake Disc (2.3.3 Front Disc Brake, Removal and Installation).**

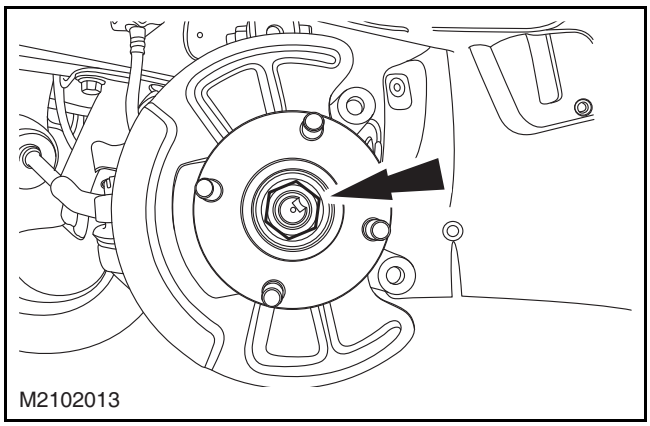
4. Use a suitable tool to remove the bearing cap.



M2102012

5. Remove retaining nut from the front wheel hub bearing.

   Torque: 175 Nm

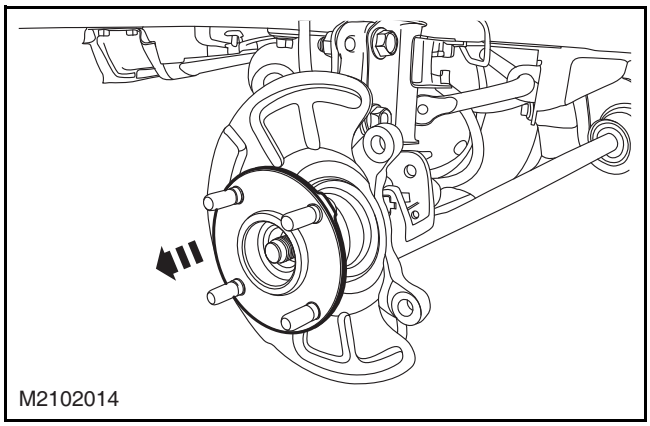


M2102013

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6. Remove the front wheel hub bearing.


M2102014

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Install the front wheel hub bearing retaining nut with a new one, and use chisel to caulk the retaining nut after reaching the torque.**

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# Front Strut Assembly

## Removal

1. Remove the wheel.

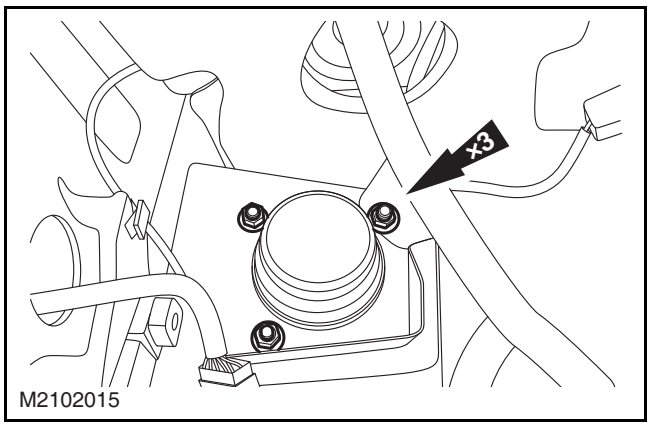
   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

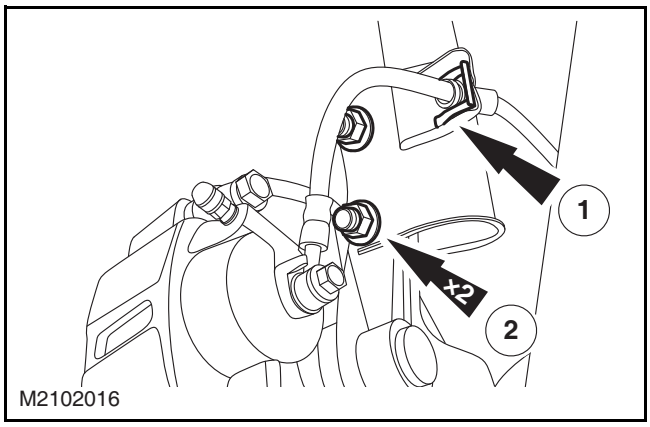
3. Remove 3 upper retaining nuts from the front strut assembly.

   Torque: 60 ~ 85 Nm




4. Remove the E-ring (1) from the brake hose and separate the brake hose and front strut.
5. Remove the connecting bolts and nuts (2) between front strut and steering knuckle. Remove the front strut assembly.

   Torque: 80 ~ 110 Nm




## Installation

1. Installation is in the reverse order of removal.

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# Front Shaft Welding Assembly

## Removal

1. Remove the wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Lift the vehicle.

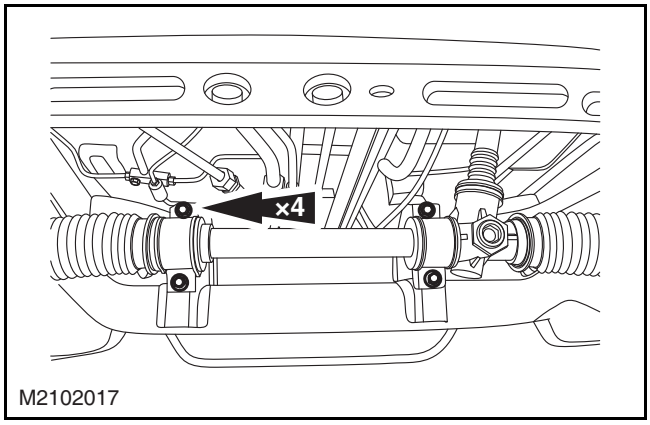
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the left and right front shaft swing arms.

   **Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).**

4. Remove 4 retaining bolts between steering gear and front shaft.

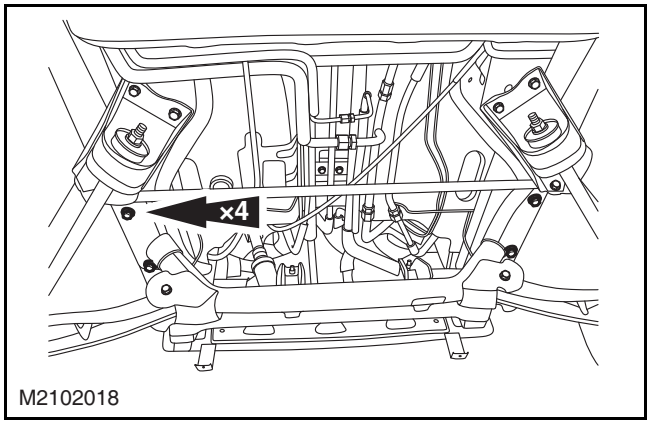
   Torque: 50 ± 5 Nm



M2102017

5. Remove 4 connecting bolts between front shaft and body. Remove the front shaft.

   Torque: 75 Nm



M2102018

## Installation

1. Installation is in the reverse order of removal.

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# Front Stabilizer Bar

## Removal

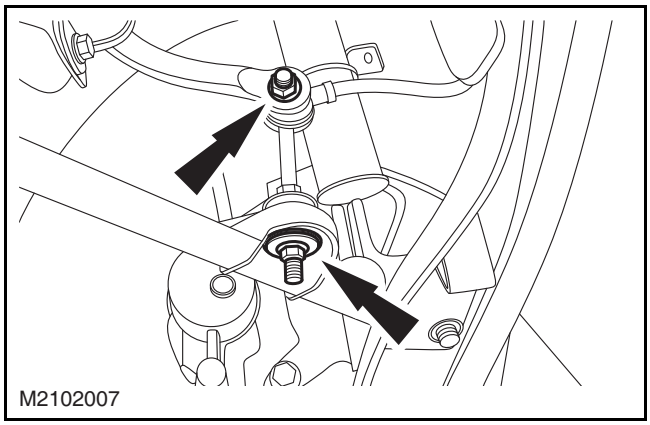
1. Lift the vehicle.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Remove the left and right connecting rods.

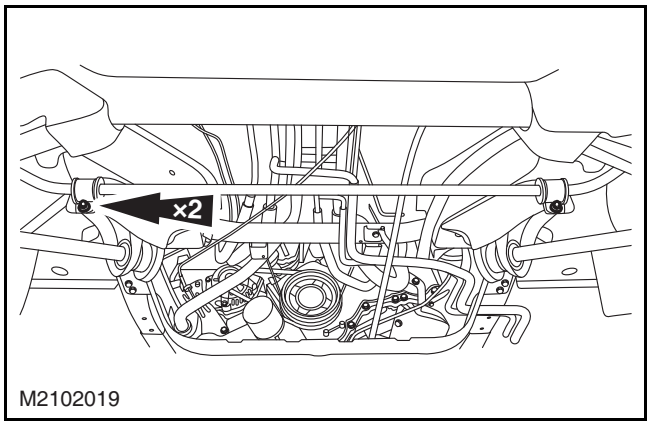
   Torque for upper nut: 40 ~ 60 Nm

   Torque for lower nut: 18 ~ 28 Nm




3. Remove 2 retaining bolts from the left and right sides of front stabilizer bar. Remove the front stabilizer bar.

   Torque: 20 ~ 30 Nm




## Installation

1. Installation is in the reverse order of removal.

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## Disassembly and Assembly

# Front Strut Assembly

### General Tool

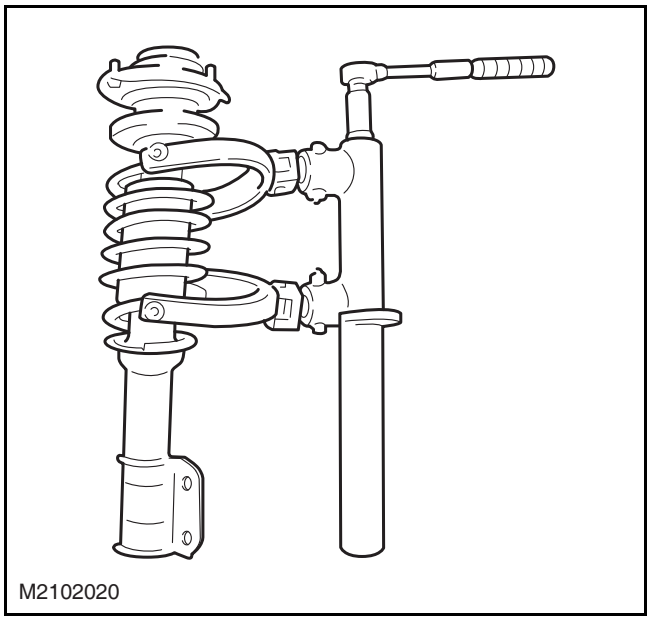
| |
|---|
| Spring compression tool |

## Disassembly

**1.** Use the damping spring compression tool to compress the coil spring partially.

**CAUTION: Please be careful not to be hurt when treating the coil spring in over compressed state.**

General tool: Spring compression tool



M2102020

**2.** Disassemble the front shock absorber and coil spring.

1 Remove the dust boot.

2 Remove the rubber cushion.

3 Remove the nut.

4 Remove the spring washer.

5 Remove the front strut support.

6 Remove the bearing.

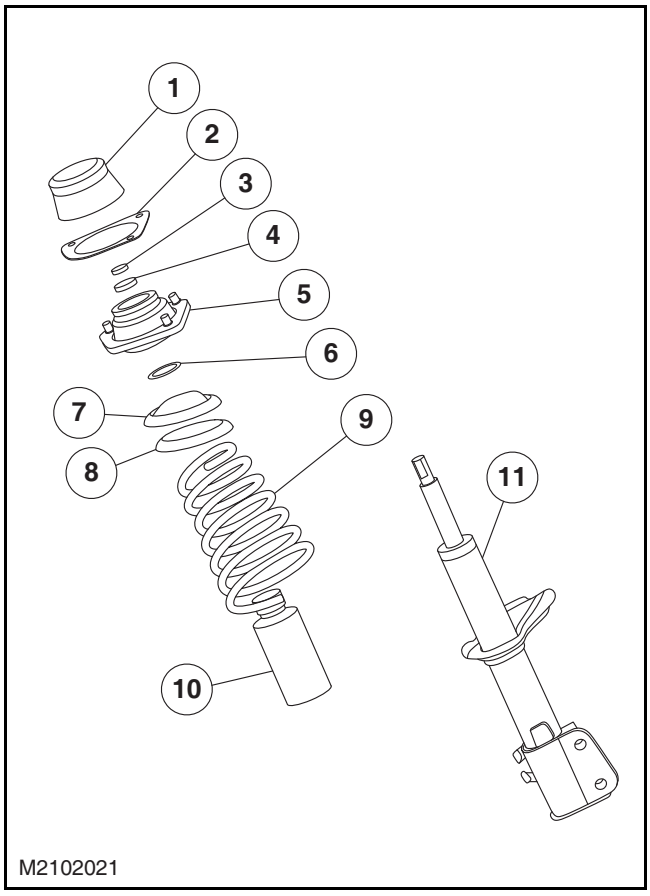
7 Remove the upper retainer of coil spring.

8 Remove the rubber cushion.

9 Remove the front coil spring.

10 Remove the anti-collision cushion.

11 Remove the front shock absorber assembly.




M2102021

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## Assembly

1. Assembly is in the reverse order of disassembly.

**CAUTION: Put the end of spring correctly on the spring retainer.**

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Connecting bolt between rear shock absorber and body | 60 ~ 80 | 44 ~ 59 | - |
| Connecting bolt between rear shock absorber and rear axle | 85 ~ 95 | 63 ~ 70 | - |
| U-bolt, nut | 65 ~ 85 | 48 ~ 63 | - |
| Rear axle rear shackle nut | 68 ~ 88 | 50 ~ 65 | - |
| Connecting bolt between leaf spring and body | 120 ~ 140 | 89 ~ 103 | - |
| Wheel nut | 110 ± 5 | - | - |
| Brake hose joint | 16 ± 2 | - | - |

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## Description and Operation

# System Overview

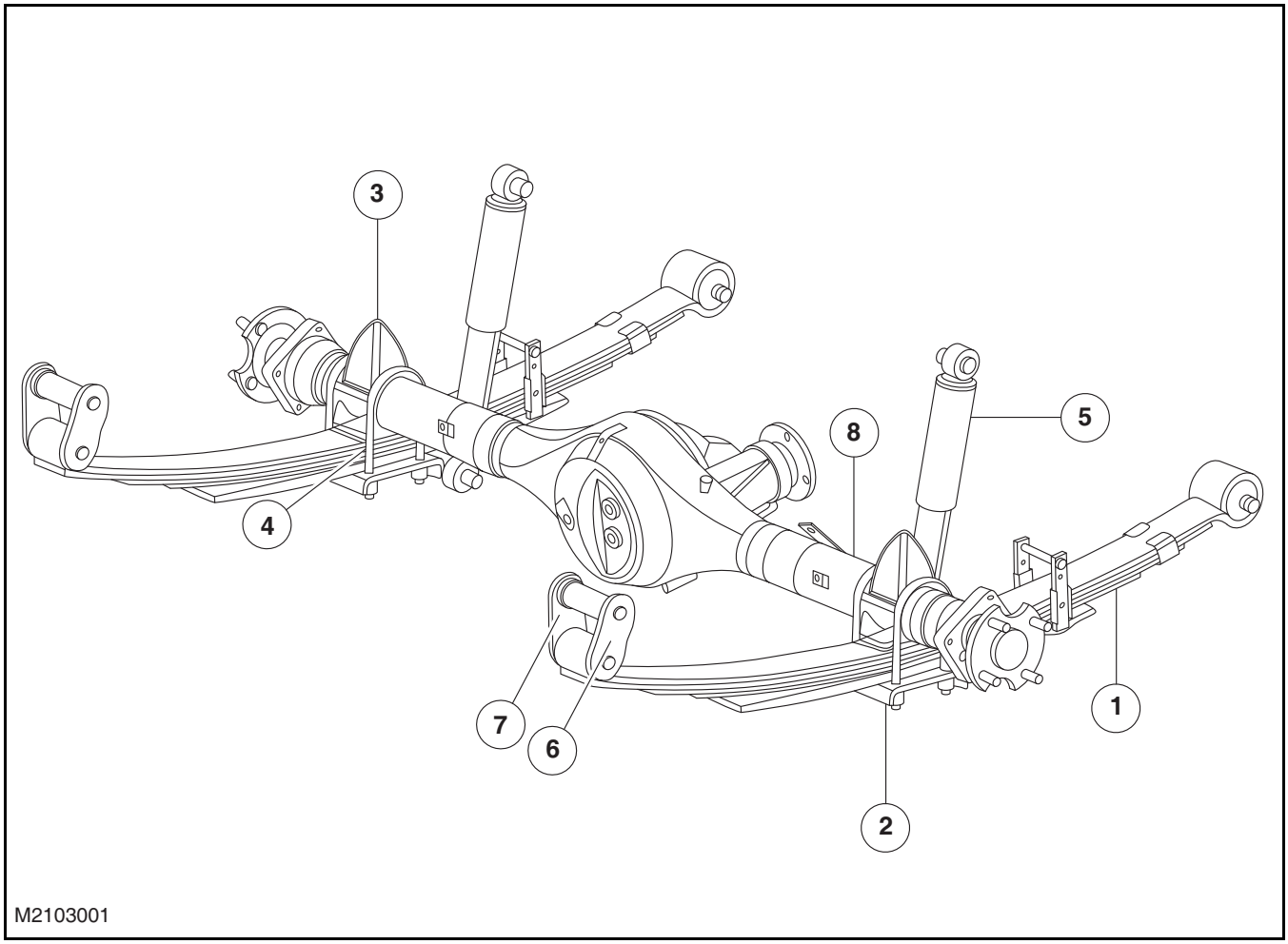
Rear suspension mainly consists of leaf spring, rear axle, shock absorber, buffer plate, saddle plate, internal and external plate, U-bolt, rear bushing.

The shock absorber is installed between body and rear axle to absorb the up/down vibration of the body.

Leaf spring is installed on the rear axle. The front spring end is mounted on the body through bushing. The rear spring end is connected with the body through internal and external plate. The rear axle moves up and down with the spring during vehicle running.

# Location View

### Rear Suspension Assembly View




M2103001

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Rear leaf spring assembly | 5 | Rear shock absorber assembly |
| 2 | Saddle plate welding assembly | 6 | Rear shackle internal plate assembly |
| 3 | Buffer plate assembly | 7 | Rear shackle external plate |
| 4 | U-bolt | 8 | Rear axle assembly |

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## Symptom Diagnosis and Testing

Refer to: Symptom Chart (2.1.1 Suspension System - Overview, Symptom Diagnosis and Testing).

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## Removal and Installation

# Rear Axle

### Removal

1. Remove the wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the drive shaft.

   **Refer to: Drive Shaft (2.2.2 Drive Shaft, Removal and Installation).**

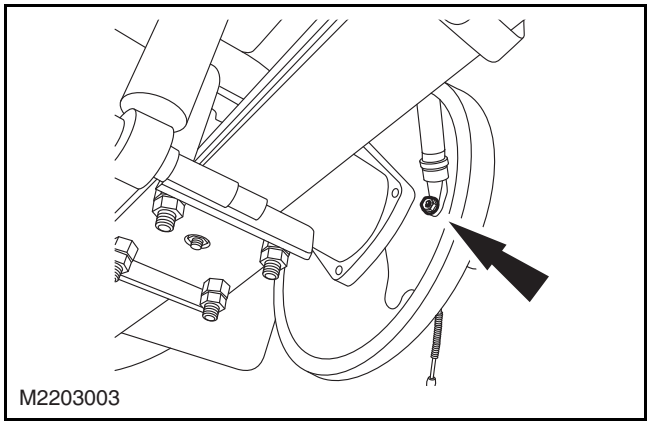
4. Remove the brake drum.

   **Refer to: Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).**

5. Remove the parking brake cable.

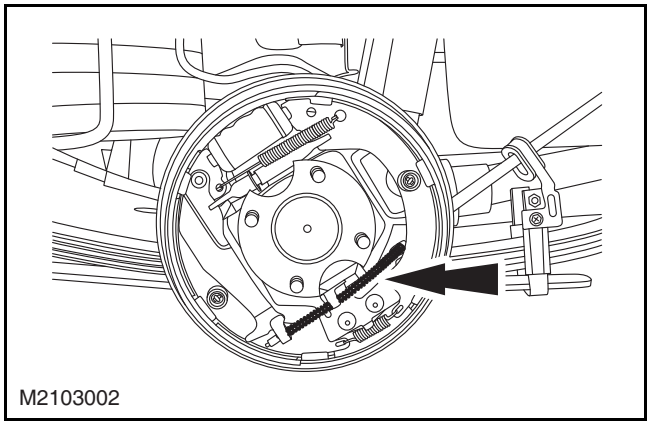
   1 Remove the retaining bolt between parking brake cable and brake baseplate.

   Torque: 9 Nm



M2203003

   2 Remove the parking brake cable from the brake shoe.



M2103002

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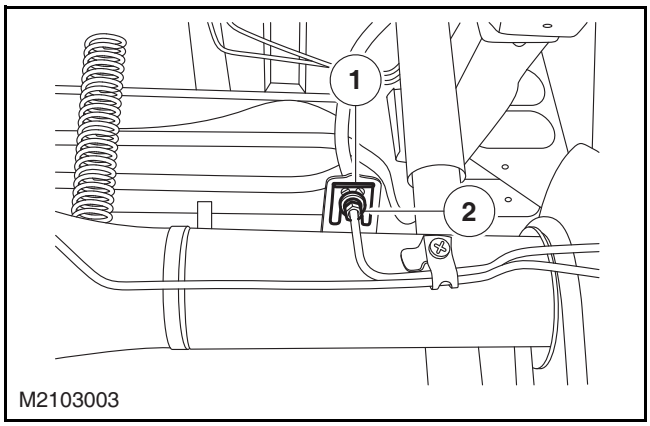


6. Remove the brake hose after draining the brake fluid.

   1 Remove the E-ring (1) from the brake hose.

   2 Remove the joint (2) from the brake hose.

   Torque: 16 ± 2 Nm

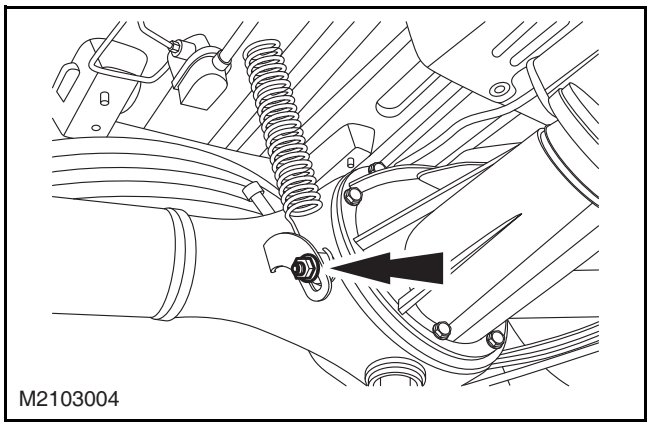



**CAUTION: Plug the brake pipe to avoid dirt entering it after removing the brake pipe.**

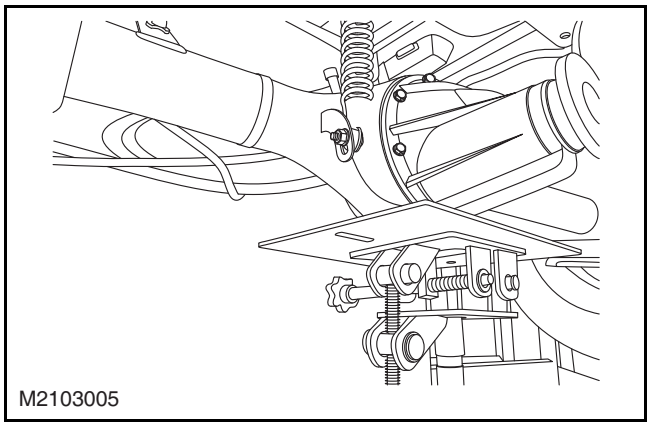
**CAUTION: Drain the brake fluid into a proper container. Wash it with water completely if the brake fluid splashes on the body or component.**

7. Remove the retaining bolt from the spring connected to load sensing proportioning valve and rear axle.

   Torque: 25 ± 5 Nm




8. Put the jack at the proper position of rear axle.

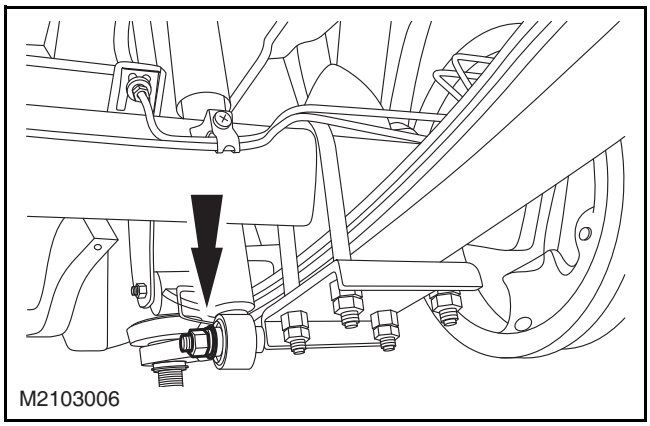


https://truckmanualshub.com/



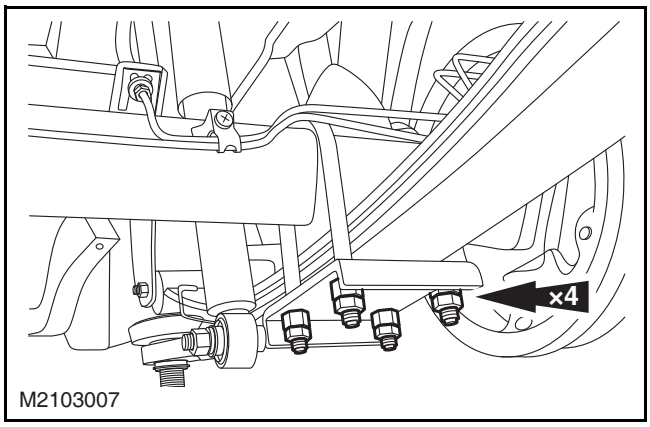
9. Remove the lower retaining nuts from the rear left and right shock absorbers. Disconnect the lower part of shock absorber from the rear axle.

   Torque: 85 ~ 95 Nm




10. Remove the U-bolts and nuts. Remove the buffer plate assembly and saddle plate.

    Torque: 65 ~ 85 Nm




11. Remove the rear axle assembly.

## Installation

**CAUTION: Tighten the rear suspension parts after the vehicle weight is borne by wheels.**

1. Installation is in the reverse order of removal.
2. Bleed the brake system.

   **Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

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# Rear Leaf Spring Assembly

## Removal

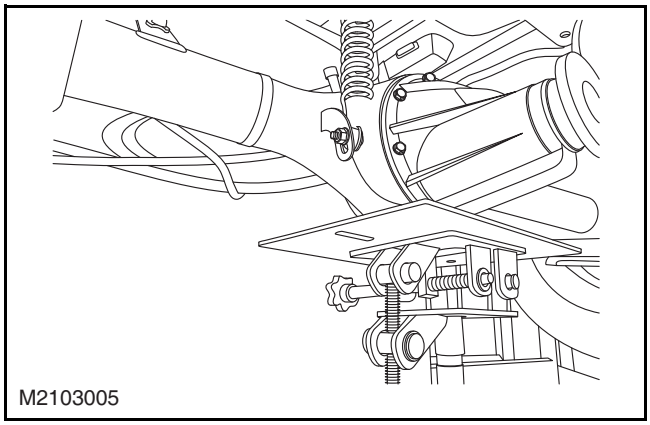
1. Remove the wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Lift the vehicle.

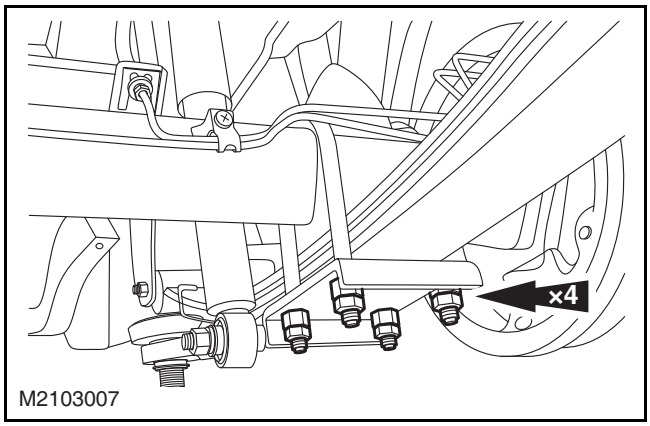
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Put the jack at the proper position of rear axle.


M2103005

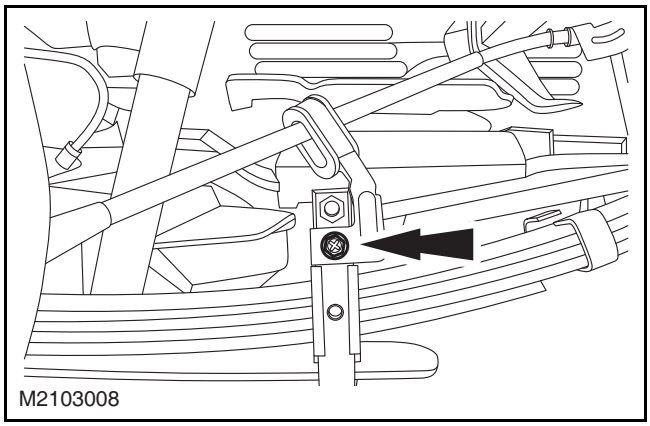
4. Remove the rear shock absorbers, U-bolts and nuts. Remove the buffer plate assembly and saddle plate.

   Torque: 65 ~ 85 Nm



M2103007

5. Remove the retaining screw from the parking brake cable bracket.

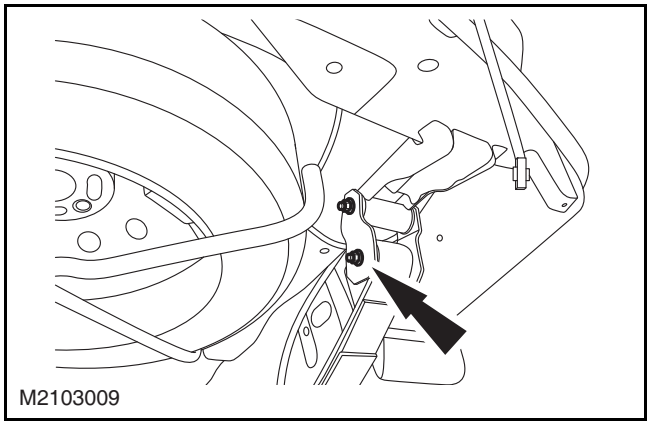

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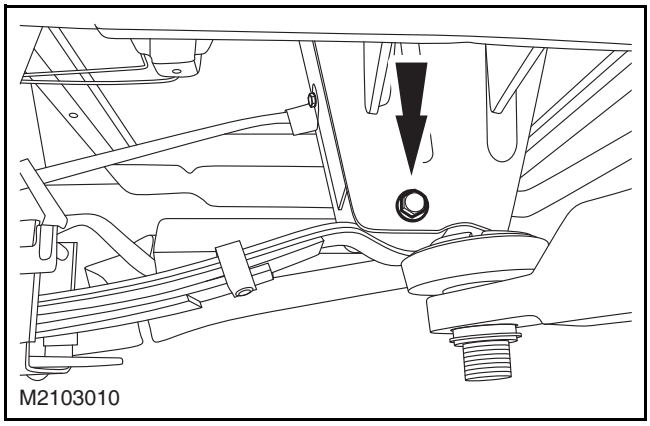
6. Remove 2 retaining nuts from the rear shackle internal and external plate.

   Torque: 68 ~ 88 Nm


M2103009

7. Remove the connecting bolt between leaf spring and body, and then remove the leaf spring.

   Torque: 120 ~ 140 Nm


M2103010

### Installation

1. Installation is in the reverse order of removal.

## Rear Shock Absorber Assembly

### Removal

1. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

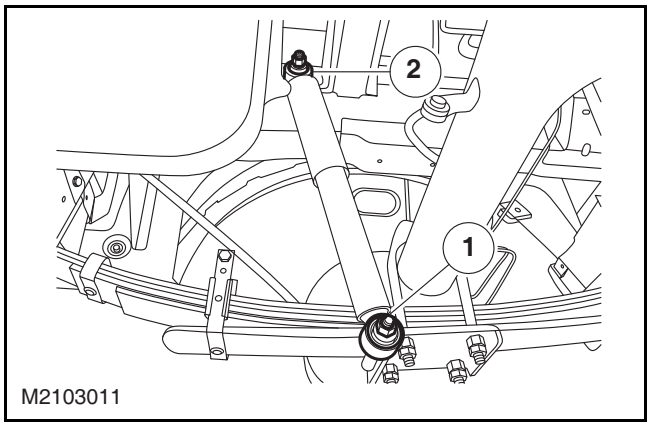
2. Remove the rear shock absorber bolt and nut.

   1 Remove the lower retaining bolt and nut (1) from the rear shock absorber.

   Torque: 85 ~ 95 Nm

   2 Remove the upper retaining nut (2) from the rear shock absorber, and remove the rear shock absorber.

   Torque: 85 ~ 95 Nm



M2103011

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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Tighten the bolts and nuts when the vehicle is lowered without any load.**

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## Specifications

# General Specifications

| Item | | Specifications |
|---|---|---|
| Tire | | 175/70R14LT |
| Front tire pressure | Unloaded | 250 kPa |
| | Full loaded | 300 kPa |
| Rear tire pressure | Unloaded | 250 kPa |
| | Full loaded | 400 kPa |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Wheel nut | 110 ± 5 | - | - |

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## Description and Operation

# Components Description

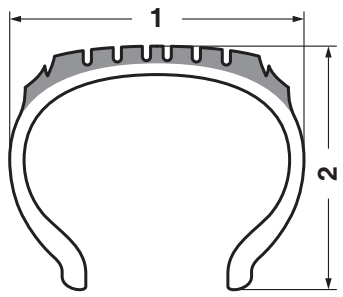
## Tire Identification

Tire model, size, load index and applicable speed level have been coded with letter and number, which is stamped on the side wall. See "Tire Identification Table" for code explanations. 175/70R14LT tire as an example is applied in the table.

**Tire Identification Table**

| | | |
|---|---|---|
| LT | Tire type<br>(not at all tires) | P - Passenger vehicle<br>T - Spare tire<br>C - Commercial vehicle<br>LT - Light-duty truck |
| 175 | End face width | mm |
| 70 | Height-to-width ratio | End face height/ width |
| R | Structure type | R - Radial tire<br>B - Bias tire |
| 14 | Wheel diameter | inch |

Height-to-width ratio = height (2) ÷ width (1)

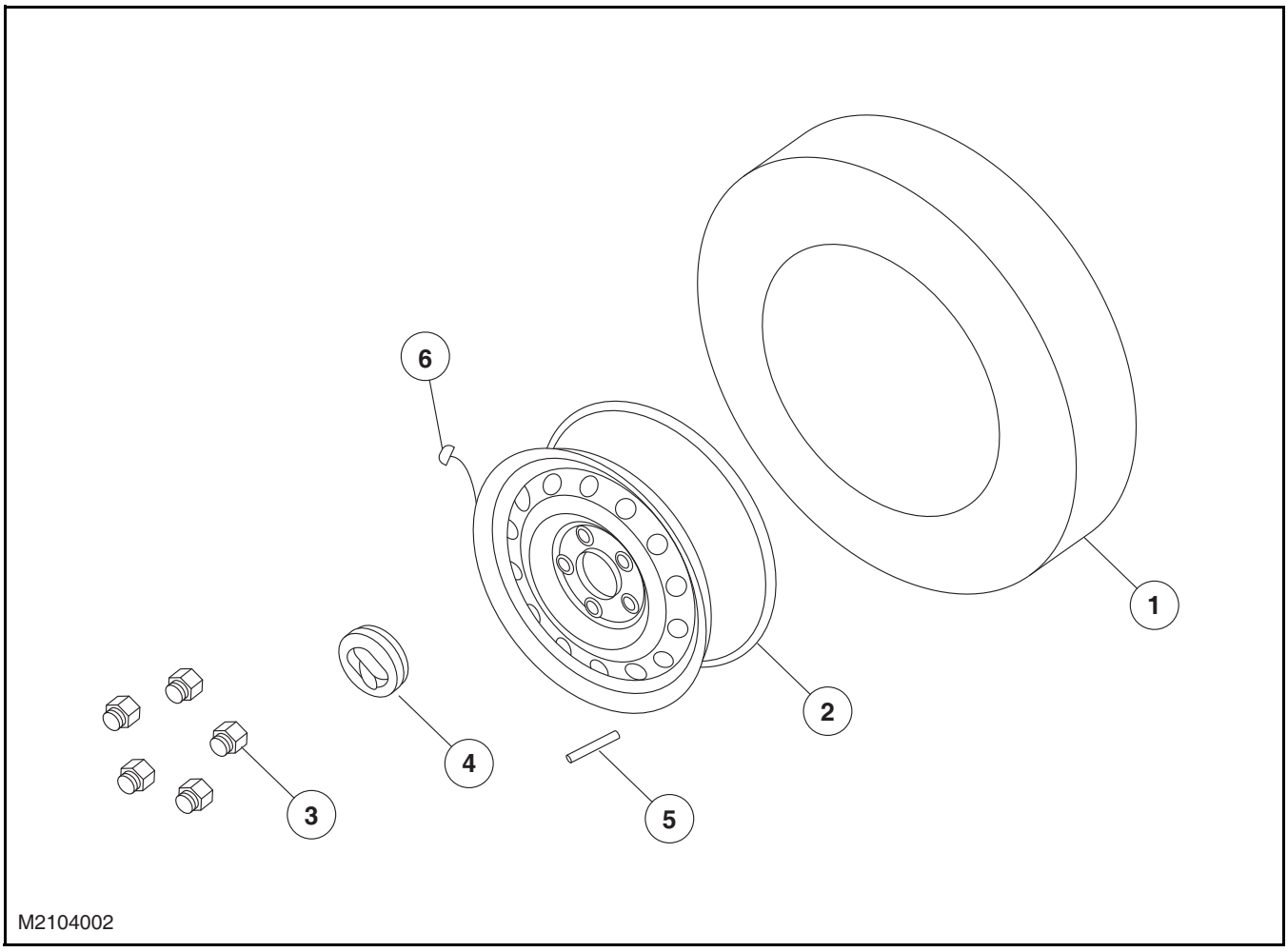



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# Components Exploded View




| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Tire (175/70R14LT) | 1 | 4 | Wheel center cover | 1 |
| 2 | Wheel 14 × 5J | 1 | 5 | Air valve | 1 |
| 3 | Wheel nut | 5 | 6 | Balancer weight | As required |

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## General Inspection

**WARNING: Tires with different types are not allowed on one vehicle unless for emergency (temporary backup), such as radial tire, bias tire or bias cord tire.**

**WARNING: Do not start vehicle while replacing tire. When the wheels are on the ground, it may cause vehicle movement.**

**WARNING: Tire sealant available in the market is combustible. Please often remind customers not to use it.**

**WARNING: Wear the safety goggles or mask while repairing the wheel and tire assembly.**

**WARNING: After replacing the wheels or wheel bolts become loose, retighten the bolts when the vehicle has run 800 km.**

**WARNING: If the wheel bolts are not tightened within specified mileages, it may cause the wheel departing from the body during running.**

**WARNING: Wheel axle, wheel and tire have their maximum load. Overloading is forbidden.**

**WARNING: Do not repair wheels through welding, heating or hammer knocking. And all damaged wheels must be replaced.**

**WARNING: Do not remove the tightened tire nuts through heating, preventing wheel heating to reduce service life and damage hub bearing.**

**WARNING: Before removing the tire valve core, reduce the tire pressure through the valve core piston.**

Failure to follow above instructions may cause personal injury.

## Removal/Installation and Charging of Tire

Removal and installation of tire shall be carried out with a tire changer. Follow the operation manual of manufacturer to operate machines. Do not remove the tire only with a manual tool or a special pry bar, to avoid tire bead or wheel rim damage.

Before installation, remove the lubricant, old rubber or light rust at the rim edge with a wire brush or thick floss. Before installing or removing the tire, lubricate the tire bead with specified lubricant. After installing the tire, charge it to specified pressure, and check if tire bead is well seated.

Pay attention to the following when charging:

1. Check the tire pressure under cold condition every month or before long-distance running (the vehicle is parked more than three hours or running no more than 1.6 km), and if not sufficient, charge it to specified pressure.
2. The tire would heat up during running, and the corresponding pressure would increase by 28 kPa. After running, do not discharge the air or reduce pressure to avoid "cold pressure" reduction.
3. During charging, if charging to standard value cannot make the tire bead seat on the rim, discharge it first, and then charge after relubrication.
4. Charging pressure shall not be too high or low; otherwise it would cause driving difficult, tire crack, tire core damage and center tread wear. If charging pressure is too low, it would cause squeal, steering heavy, quick wear and unevenness of tread edge, as well as rim damage or crack, tire cord broken, tire temperature over high, operability reduction and fuel consumption rising, etc.
5. The two tires of same axle shall be charged to same value, otherwise it would cause operability reduction, pull during acceleration, driving and braking.
6. After charging, check if the air valve is leaking. The cap shall be covered at the valve to prevent dust or water from entering.

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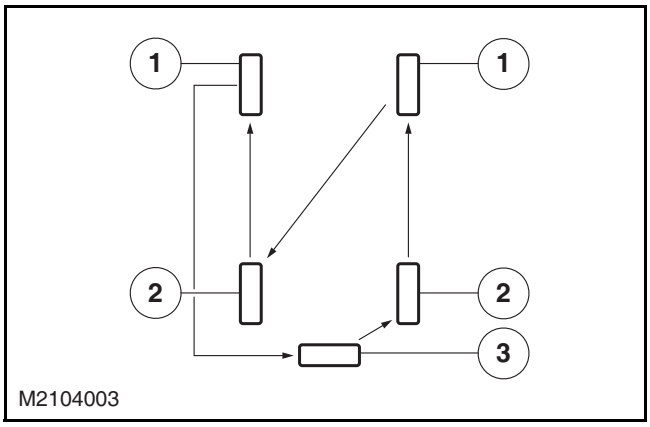


Tire Pressure Table

| Wheel | Unloaded | Full loaded |
|---|---|---|
| Front wheel tire | 250 kPa | 300 kPa |
| Rear wheel tire | 250 kPa | 400 kPa |

## Tire Rotation

Due to difference of installation position, load and working conditions, the tires of the same vehicle are worn unevenly. To form the same abrasion and extend the service life of tires, have the tires rotated regularly. Perform radial tire rotation at first 10000 km. Then, we recommend tire rotation and pressure adjustment at every 10000 km.




| Item | Description |
|---|---|
| 1 | Front tire |
| 2 | Rear tire |
| 3 | Spare tire |

## Inspection and Verification

To have the maximum performance, check if tire pressure and tires are normal. If the malfunction symptom appears, it is necessary to perform dynamic balance, rotation or front wheel alignment. Inspect regularly if the tires have fresh cuts, scratches, abrasions, blisters and materials stuck in the tire tread. In case the tire temperature rises up quickly or something are scattered on the rough road, it is necessary to check tires more frequently.

As more direct check, the tread is marked with abrasion indicating line at its bottom. When this line is shown, the tire shall be replaced.

## Tire Abrasion Diagnosis

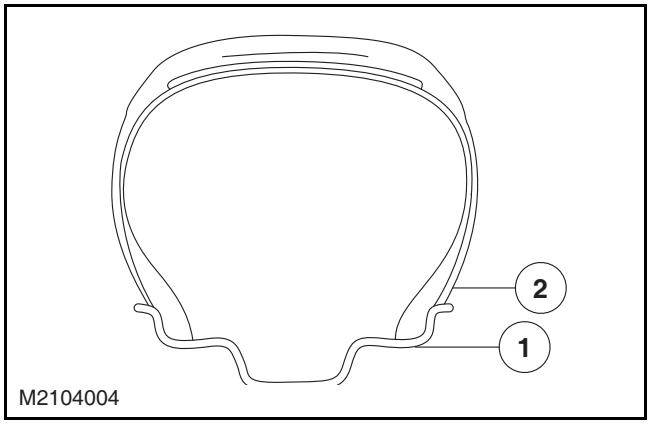
In case the abrasion indicating line is shown or tire shoulder is severely worn, replace the tire. Tire shoulder abrasion is usually caused by camber angle of radial tire or toe-in that is overlarge. Sometimes, incorrect rear wheel toe-in setting or damaged strut would cause severe depression of non-drive tire or abrasion of "fan shape" tire. Severe error of rear wheel toe-in would also cause other unusual abrasions.

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# Wheel Runout Inspection

Measure wheel runout with an accurate dial indicator on/off the vehicle with or without the tire. Make sure that the installation surface is correct. Measure the radial runout (1) and axial runout (2) at the inner and outer side of wheel rim flange. Fix the dial indicator at the wheel and tire assembly, rotate the wheel slowly one turn and record the reading. In case the measured value exceeds the specified value, and destructive vibration, which cannot be removed by wheel balancing, may possibly occurs, replace the wheel. Reading value resulted from weld joint, paint or abrasion will be ignored.




| Wheel Type | Radial Runout Limit | Axial Runout Limit |
|---|---|---|
| Steel wheel | 1.14 mm | 1.40 mm |

If bends, recessing, excessive axial or radial runout, weld joint gas leakage, bolt hole stretched, wing nut looseness or heavy rust occurs in the wheel, it is necessary to replace it. The replaced wheel must have same load performance, diameter, wheel rim tolerance and assembling structure as original one. Wheel with incorrect size or type may affect the service life of wheel and bearing, brake cooling, reading of speedometer/odometer, ground clearance, and clearance between tire and body, chassis.

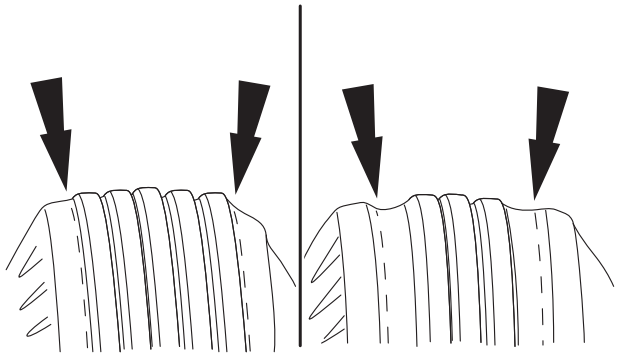
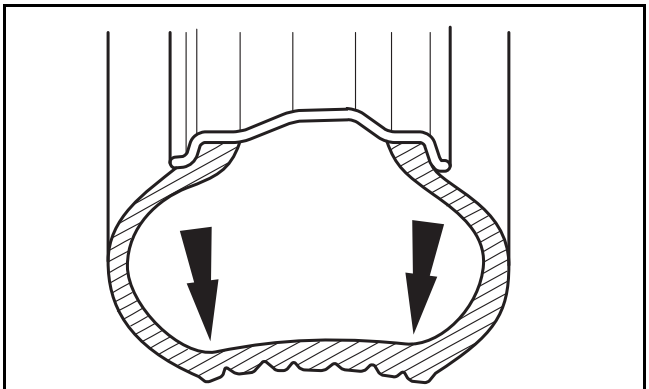
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# Initial Inspection before Tire Alignment

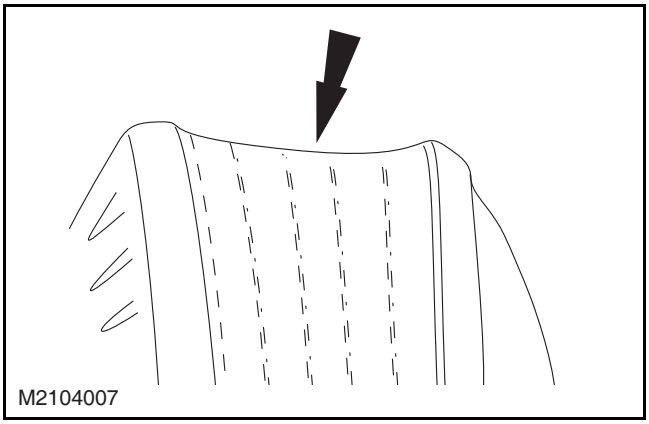
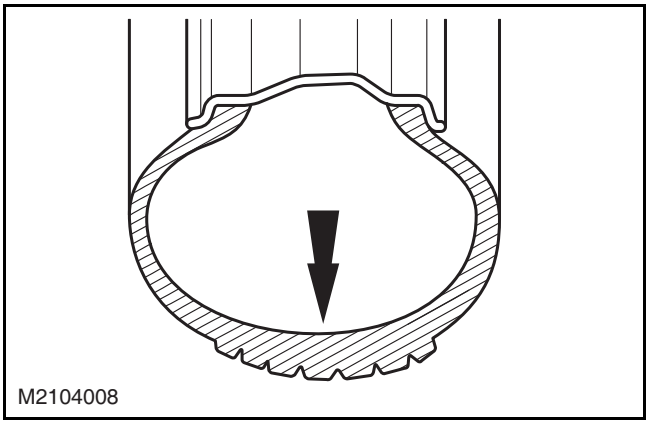
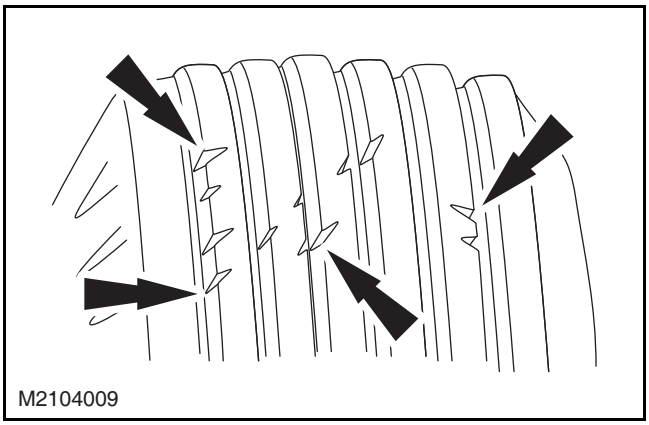
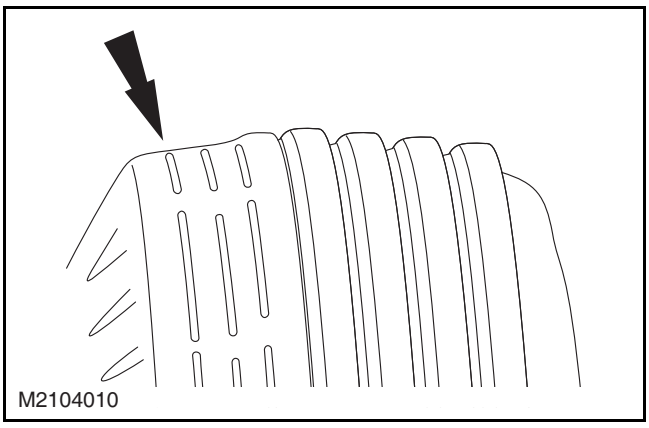
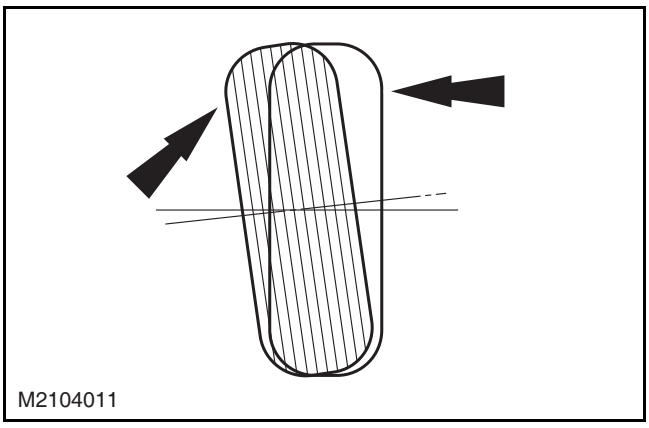
| Inspection | Operation |
|---|---|
| Check if the tire model, wheel type is consistent. | Check the tires and wheels, and replace when necessary. |
| Check if the tire charging pressure is proper, and tread abrasion is normal. | Charge the tire to correct pressure. Replace when necessary. |
| Check if the wheel bearing is loose. | Tighten the axle nut to correct specification. Replace the strut wheel bearing when necessary. |
| Check if the ball joint and steering tie rod end are loose. | Tighten the ball joint and steering tie rod. |
| Check the wheel and tire runout. | Measure and correct the tire runout. |
| Check the vehicle unladen height. | Correct the unladen high speed. Make correction before adjusting toe-in. |
| Check the wheelbase. | Correct the wheelbase. |
| Check if the rack and pinion gear installation is loose. | Tighten the rack and pinion gear assembly frame. |
| Check if the strut operation is correct. | Replace the strut assembly. |
| Check if the control arm is loose? | Tighten the control arm connecting bolt. Replace the control arm bushing when necessary. |

# Tire Abrasion Inspection

| Symptom | Reasons |
|---|---|
| • Tire shoulder quick abrasion | • Insufficient tire charging<br>• No tire rotation |
|  <br>M2104005 |  <br>M2104006 |

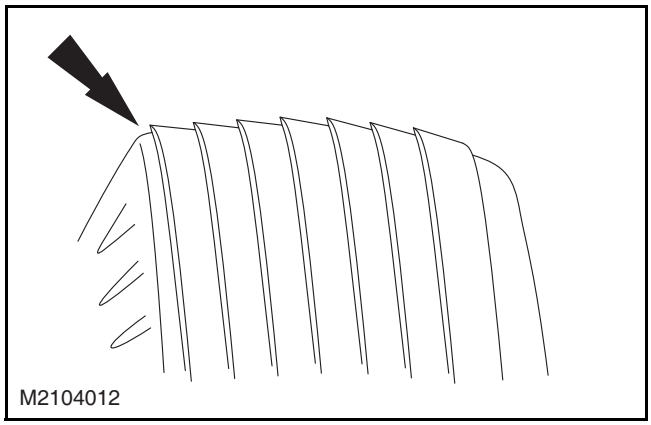
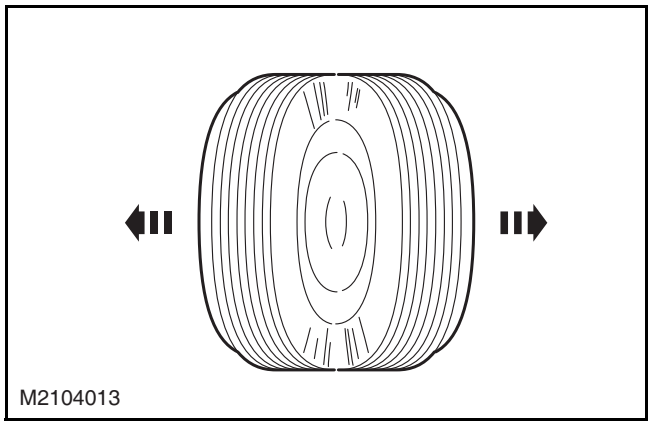
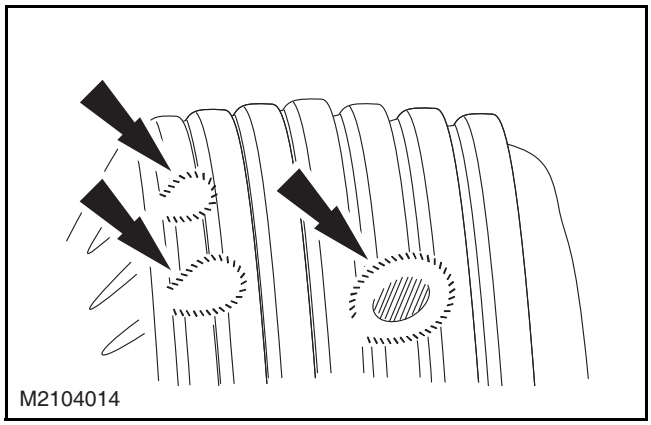
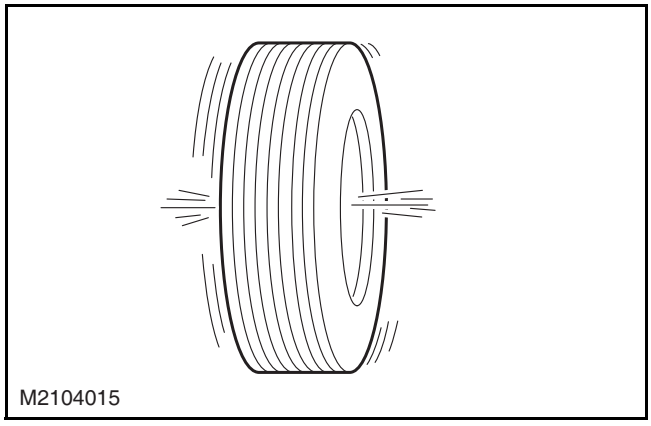
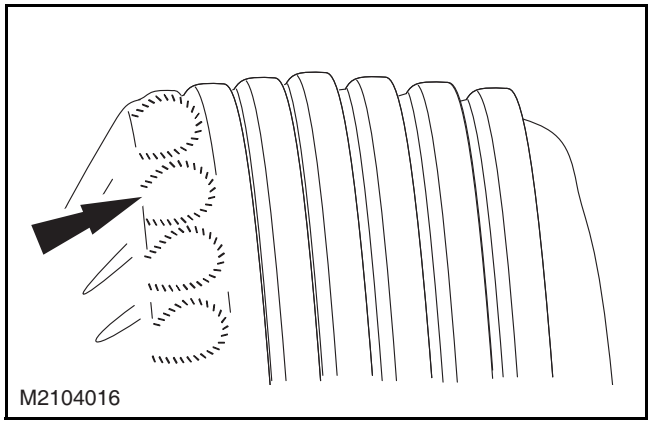
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<table>
<tr><th>Symptom</th><th>Reasons</th></tr>
<tr><td>• Central quick abrasion<br>  <br>M2104007</td><td>• Tire overcharging<br>• No tire rotation<br>  <br>M2104008</td></tr>
<tr><td>• Tread cracks<br>  <br>M2104009</td><td>• Insufficient Charging<br>• Overspeed</td></tr>
<tr><td colspan="2">Measures: Adjust the pressure and rotate the tires under cold state according to specifications.</td></tr>
<tr><td>• Unilateral abrasion<br>  <br>M2104010</td><td>• Too large camber<br>  <br>M2104011</td></tr>
<tr><td colspan="2">Measures: Adjust camber to specified value.</td></tr>
</table>

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| Symptom | Reasons |
|---|---|
| • Feathery abrasion<br>  <br>M2104012 | • Incorrect toe-in<br>  <br>M2104013 |
| **Measures:** Adjust toe-in to specified value. | |
| • Small pattern polished<br>  <br>M2104014 | • Wheel imbalanced<br>• Tire defective<br>  <br>M2104015 |
| **Measures:** Tire dynamic balance. | |
| • Large abrasion for edge pattern<br>  <br>M2104016 | • No tire rotation<br>• Suspension abrasion or adjustment required |
| **Measures:** Rotate tires.<br>**Measures:** Adjust or repair suspension. | |

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## Symptom Diagnosis and Testing

**Special Equipment**

| |
|---|
| Four-wheel alignment gauge |
| Tire balance machine |
| Tire disassembling machine |

# Inspection and Verification

To have the maximum performance, check if tire pressure and tire is normal. If the malfunction symptom appears, it is necessary to perform dynamic balance, rotation or front wheel alignment. Inspect regularly if the tires have cuts, scratches, abrasions, blisters and materials stuck in the tire tread. In case the tire temperature rises up quickly or something are scattered on the rough road, it is necessary to check tires more frequently.

As more direct check, the tread is marked with abrasion indicating line at its bottom. When this line is shown, the tire shall be replaced.

Tire abrasion diagnosis

In case the abrasion indicating line is shown or tire shoulder is severely worn, replace the tire. Tire shoulder abrasion is usually caused by camber angle of radial tire or toe-in that is overlarge.

Sometimes, incorrect rear wheel toe-in setting or damaged strut would cause severe depression of non-drive tire or "fan shape" abrasion of tire

Severe error of rear wheel toe-in would also cause other unusual abrasions.

Road Test

Tire vibration diagnosis is started with the road test. The road test and customer service interview (if possible) can obtain more information for vibration source.

Road test shall be carried out at flat road. In case of vibration, note and record the following:

- Vehicle speed at the time of vibration.
- Type of vibration that occurs within each speed range.
- Mechanical vibration or audible sound.

Effect on vibration when the following conditions change:

- Engine torque
- Vehicle speed
- Engine speed

Vibration type

- Sensitivity: torque sensitivity, speed sensitivity or engine speed sensitivity.

The following explanation can be used to differentiate the vibration source:

1. Torque sensitivity

   It means that this condition would be turned better or worse due to acceleration, deceleration, coast, constant speed or engine torque applied.

2. Speed sensitivity

   It means that vibration would occur at the same speed, and would not be affected by engine torque, engine speed or drive axle gear.

3. Engine speed sensitivity

   It means that vibration occurs at different speeds and different gears. Sometimes it can be tested when the engine speed is increased or decreased at "neutral" gear or in stall of transmission. In case it is related to engine speed, then it might be irrelevant with the tires.

   In case tire sobbing sound is displayed after road test, but without shaking or vibration, it shows the noise is caused due to the contact between tires and road.

   Generally, huge noise indicates that tires are flat, soft material touches the road. Tire sobbing sound would be mistaken as axle noise, which would appear continuously within a certain speed range.

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the control module for this fault, and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Tire abrasion | • Tire rotation<br>• Tire pressure<br>• Wheel distortion<br>• Tire out of balance<br>• Wheel alignment<br>• Suspension component<br>• High speed running<br>• Rear axle<br>• Overload<br>• Poor driving habit | **Refer to: Diagnosis Procedure for Abnormal or Excessive Wheel Wear (2.1.1 Suspension System - Overview, Symptom Diagnosis and Testing).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Vehicle vibration due to wheel and tire | • Tire pressure too high | • Adjust the tire pressure. |
| | • Wheel or tire out of balance | • Balance the wheel and tire assembly. |
| | • Uneven tire abrasion | • When necessary, replace with a new tire to eliminate vibration. |
| | • Brake disc out of balance | • Check the brake disc for dirt or scraps. If not, it may have heavy fouling. |
| | • Tire with water inside | • Remove the water. |
| | • Wheel distortion | • Replace with a new wheel. Attempt to repair the wheel would cause crack and reduce the strength. |
| | • Incorrect assembly of tire bead | • Rotate the wheel on the vehicle. Inspect the junction part between tire and wheel. In case some part swings during rotation, it maybe caused due to poor assembly of wheel and tire. Remove the tire and clean junction part between wheel and tire. |
| | • Wheel or tire runout too large | • Measure the runout of wheel or tire with a dial indicator. If the runout is not within specified range, check the runout of wheel bolts further. Replace if outside the standard range. |
| | • Wheel bolt loose or damaged or bolt hole expanded | • Tighten or replace when necessary. |
| | • Foreign matter between installation surfaces of wheel and hub. | • Clean the installation surface. |
| | • Front wheel bearing damaged | • Replace the front wheel bearing.<br>**Refer to: Front wheel Hub Bearing (2.1.4 Wheel and Tire, Removal and Installation).** |

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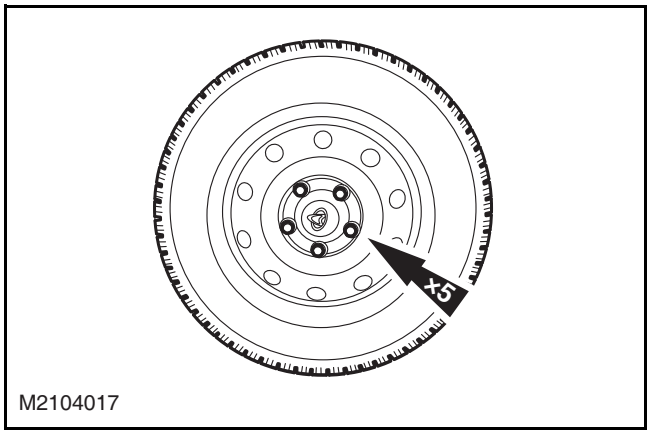
# Removal and Installation

# Wheel and Tire

## Removal

1. Unscrew the wheel nuts counterclockwise.

   Torque: 110 ± 5 Nm



M2104017

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the wheel and tire.

**CAUTION: Do not unscrew the blocked wheel bolts through heating. Heating may damage the wheel and hub.**

**CAUTION: Remove the rust or dust on the wheel, hub or installation face of brake disc. They may cause the wheel bolts or wheels loose when driving. Failure to follow the above instructions may cause personal injury.**

## Installation

1. Installation is in the reverse order of removal.

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# 2.2 Drive System

## 2014 MD/MS201

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## Description and Operation

# System Overview

Driveline system is MR (Mid-engine, Rear wheel drive) design and differential is installed in the rear axle assembly. The Engine transmits the power from transmission to rear axle assembly through a propeller shaft with cross universal joint. The power is assigned to drive shaft through the differential installed on the rear axle assembly, and then to two rear wheels by each drive shaft. To adapt up-and-down movement of rear axle and engine, the propeller shaft shall rotate with different lengths and angles. The propeller shaft assembly consists of propeller shaft, front and rear universal joints. The propeller shaft is connected with the drive bevel gear through flange joint and connected with the transmission output shaft through internal spline sliding sleeve yoke. There are two cross universal joints at both sides of propeller shaft, and four needle bearings are installed for the cross shaft of each universal joint. The front universal joint yoke has internal spline sleeve. The spline end of transmission output shaft is installed inside the front universal joint yoke. The rear universal joint is flanged type, which is connected to the front end flange in the differential with bolts. The differential is fixed in the middle housing of rear axle through bolts. The inner end of each drive shaft has an external spline, which is connected with the internal spline of differential. Two drive shafts are fixed in the rear axle housing, and connected with the housing through the bearing. The drive shaft is not flexible and cannot be stretched in and out. The other end of drive shaft is the hub flange, which is connected to the wheel directly as a whole with drive shaft.

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## General Inspection

## Drive Shaft Inspection

1. Measure the central radial runout of drive shaft and the flange inner side end face runout with a V block and dial indicator.

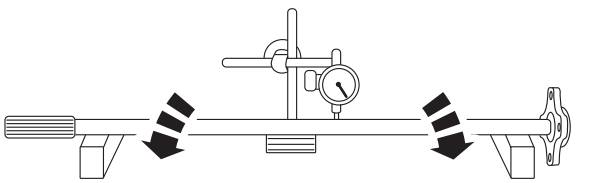
   Standard value: 0.7 mm or less

   If radial and end face runout exceed the standard value, correct them and replace the drive shaft with a new one when necessary.

2. Inspect if the spline of drive shaft is severely worn, or obviously distorted or cracked. If the spline tooth is severely worn with distorted shape, replace the drive shaft with a new one.

3. If the neck journal at combination of drive shaft and oil seal has obvious groove or the severe wear affecting its sealing, or there are cracks at root part of drive shaft flange, replace the drive shaft.

4. Inspect if the drive shaft has cracks through magnetic-particle method.



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## Drive Shaft Oil Seal Inspection

1. Inspect if the oil seal lip and seal spring are damaged.

2. Inspect if the junction surface between drive shaft oil seal retaining ring and oil seal is smooth without rust, scratch, burr or other abnormalities.

3. Inspect the differential side oil seal installation surface for rust, scratch, burr or other abnormalities.

4. Inspect if the oil seal holder is deformed or broken.

## Drive Shaft Bearing Inspection

1. Inspect if each bearing is worn or damaged. When bearings have any defects, replace them.

## Journal and Case Inspection

1. Inspect if the drive bevel gear and the journals at both ends of differential are worn. If the wear is not obvious, reuse it after chromium plating and grind treatment; if severe wear or damage, replace it.

2. Inspect if the bearing saddle bore of final drive case is worn, repair or replace it accordingly. In case of cracks in the final drive case and differential case, replace them.

3. Inspect if the axle housing is deformed or cracked, in case of severe distortion or deformation of the axle case, or cracks or ruptures on junction surface with final drive case, replace the axle housing.

## Final Drive and Differential Assembly Inspection

1. Gear technical condition is usually inspected through visual inspection. If the gear technical condition is poor, replace it.

   1 Fatigue flaking point area of drive and driven bevel gear shall not exceed 25% of tooth surface, and the gear tooth damages shall not exceed 20% of tooth length and 33% of tooth height. In the above mentioned conditions, at most 3 damaged gear teeth are allowed for drive bevel gear, and 4 for driven gear.

   2 The defect on the teeth working surface of planetary gear and drive shaft gear should be not more than 33% of tooth height, and not more than 25% of tooth length. Besides 3 damaged teeth at most is allowed on one gear.

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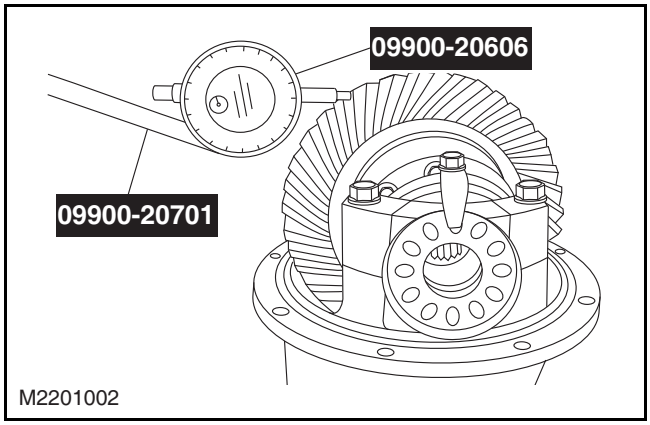
3 If there are scratches on the spherical face of planetary gear and the end face of drive shaft gear, with the width more than 33% of working surface and depth more than 0.50 mm, grind it. For slight freckles, flaking, burr or scratches, reuse it after grind; if the damages exceed specified permissible range, usually replace it.

4 Final drive and differential assembly are supplied as one set. Therefore, if one is damaged and needs to be replaced, replace them as one set. Otherwise it cannot ensure correct engagement for gears.

**2.** Inspect the engagement clearance of drive and driven bevel gears

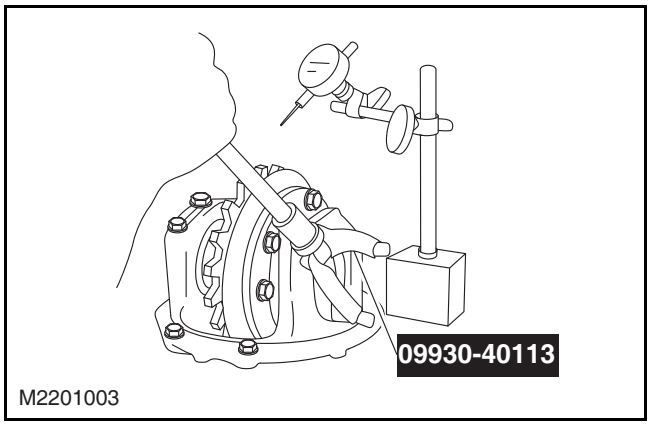
**CAUTION: Drive and driven bevel gears are supplied as one set, even if just drive bevel gear or driven bevel gear needs to be replaced, replace them as one set meanwhile.**

1 Inspect the clearance between drive bevel gear and driven bevel gear. The final drive case assembly should be installed in general way, and temporarily tighten drive shaft bearing cover bolts securing the differential case assembly downward. Make the contact terminal of dial indicator face the dedendum on the drive side of gear. The convex surface of large end of driven bevel gear is vertical to tooth face. Hold the drive bevel gear with one hand, and gently rotate the driven bevel gear with the other hand. At this point, the reading on the dial indicator is the engagement clearance of drive and driven bevel gears. The standard value is 0.10 ~ 0.20 mm. If the clearance does not meet the requirements, replace the final drive and differential assembly.




**3.** Adjust the engagement clearance of drive and driven bevel gears

Use two bearing adjusters to adjust the gear clearance. Respectively rotate both adjusters an equal amount inward and outward (while loosening the bearing cover nut slightly). Turn the adjuster 1 hole and the clearance changes by approximately 0.1 mm.

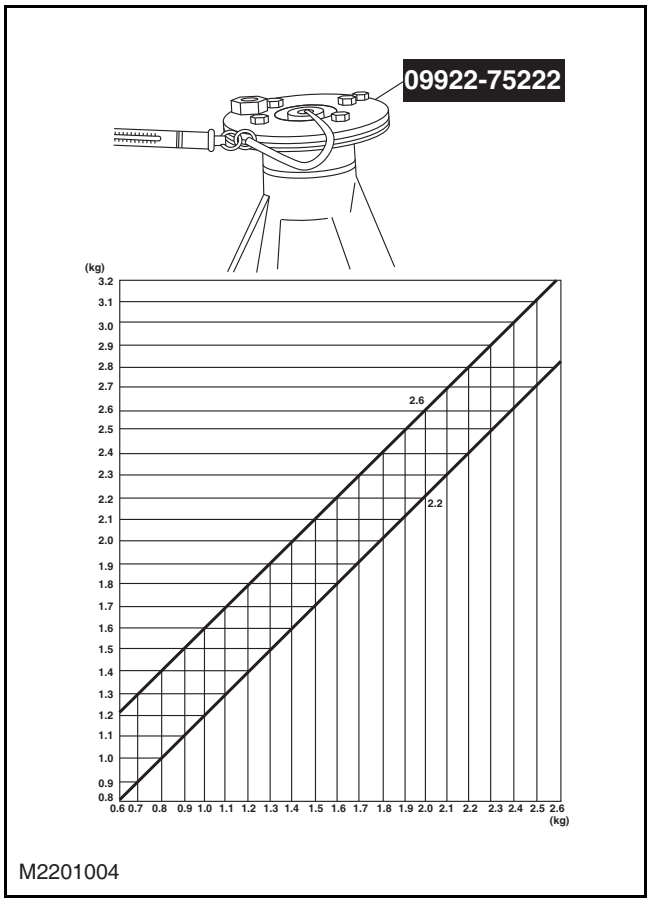



When adjusting the clearance, adjust the preload value of drive shaft bearing: install the torsion pulley (special tool) to the drive bevel gear and measure with spring balance. When the torque reading at starting to rotate the driven bevel gear is within the range specified in the following figure, the preload value of drive shaft bearing is judged as qualified. As shown in the following figure: when the measured preload value of drive bevel gear bearing is 2.0 kg, the total preload value (kg) of drive and driven bevel gears is 2.2 ~ 2.6 kg. The bearing cover bolts should be tightened as specified torque after adjusting.

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Tightening torque for bearing cover bolt after adjustment: 50 Nm



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4. Inspect the engagement clearance of drive shaft gear and planetary gear

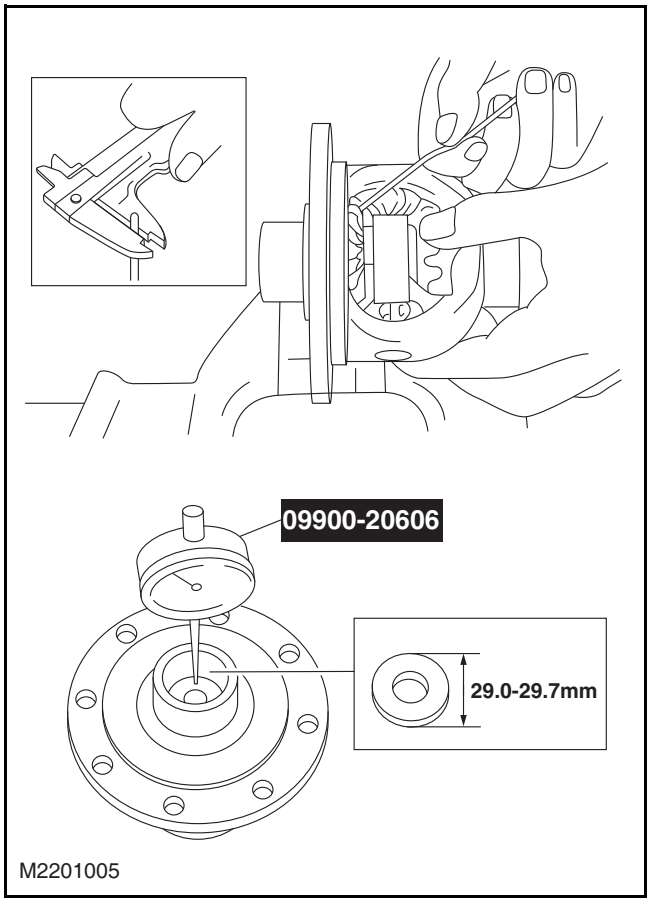
   Inspect the engagement clearance with a soft fuse. Clamp it on the working surface of drive shaft gear and planetary gear, and rotate the gear to squeeze the fuse, then measure the thickness of the squeezed fuse to obtain the engagement clearance.

   Standard engagement clearance:
   0.05 ~ 0.15 mm.

   If necessary, the clearance can be adjusted by changing the thickness of thrust washer. Thrust washer thickness: 0.9 mm, 1.0 mm, 1.1 mm, 1.2 mm.

   If the clearance does not meet the requirements, replace the final drive and differential assembly.

**CAUTION: If the differential drive shaft gear clearance cannot be measured through fuse, measure the drive shaft gear thrust clearance. If the maximum thrust clearance is 0.37 mm, the gear clearance is considered as qualified. To measure the thrust clearance, place an appropriate flat washer or shim on the drive shaft gear and measure as shown in the following figure.**



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5. Inspect the engagement imprint:

   Clean working and non-working surfaces of 10 teeth in the driven bevel gear, apply coloring material (such as red lead powder) evenly on the tooth surfaces. Rotate driven bevel gear to engage the coloring area with drive bevel gear, hold the flange of driven bevel gear with hands to rotate it back and forth, and apply a certain force on the drive bevel gear to engage it repeatedly, and then observe the engagement imprint on the gear teeth.

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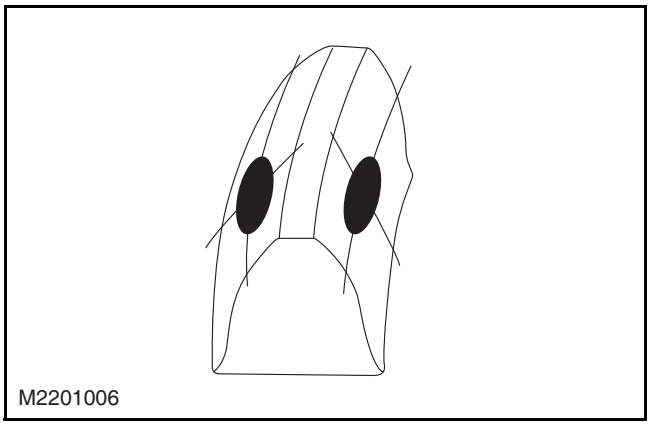


**CAUTION: Do not rotate the driven bevel gear over one circle, as this may hinder accurate inspection.**

Correct engagement imprint is: regardless of working surface (convex surface) or non-working surface (concave surface) of drive bevel gear, the imprint is located in the center of tooth surface and is slightly leaning to the inner end.

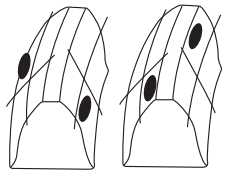
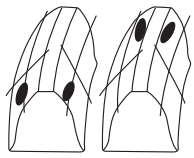
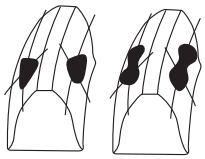
If it is incorrect, readjust or replace the final drive and differential assembly.

1 Correct engagement imprint



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2 Diagnosis and solutions with incorrect engagement imprint

| Mechanical | Electrical |
|---|---|
|  M2201007 | High contact<br>The drive bevel gear is too backward, so the thickness of drive bevel gear adjusting shim should be increased. |
|  M2201008 | Low contact<br>The drive bevel gear is too forward, so the thickness of drive bevel gear adjusting shim should be decreased. |
|  M2201009 | Replace the differential case. |
|  M2201010 | 1. Inspect the driven bevel gear seat or the differential case.<br>2. Replace the drive bevel gear and driven bevel gear.<br>3. Replace the differential case. |
|  M2201011 | 1. Replace the drive and driven gears.<br>2. Replace the differential case. |

**6.** Gear oil filling and inspection

Oil level can be inspected roughly through the refill plug hole. For filling, if the oil overflows from the refill plug hole or oil level is at the hole when the plug is removed, it means the oil level is proper. Otherwise, fill the gear oil with specified grade to the specified height. Then tighten the refill plug to the torque of 35 ~ 50 Nm.

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# Propeller Shaft Inspection

**1.** Inspect the dynamic balance of propeller shaft

1 Turn the rear wheels to rotate the propeller shaft and measure radial runout of its front, middle and rear ends.

Standard value: 0.7 mm

- If radial runout of both front and middle ends exceeds standard value, make sure to replace the propeller shaft with a new one.
- If radial runout of front and middle ends is within standard range, but that of rear end exceeds standard value, then mark its high point and proceed with next step.
- If the radial runout of each point is within standard range, also proceed with next step.

2 Rotate the propeller shaft and final drive relatively 1/2 circle.

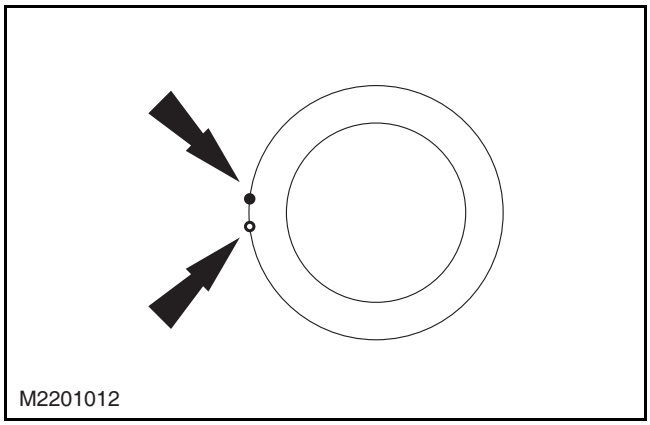
- If it is turned only 1/4 circle, inspection and adjustment can be more accurate.

3 Inspect the radial runout of rear end in the propeller shaft.

- If the radial runout of rear end still exceeds standard value, mark the high point and proceed with next step.
- If the radial runout of rear end is within standard range, inspect if driveline system is vibrating during road test. In case of vibration, mark the high point and proceed with next step.

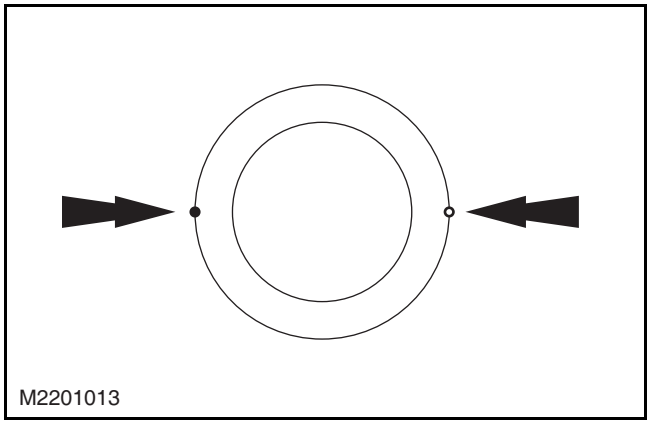
4 Compare two high points marked in above steps.

- If the two marked points are close, within approximately 20 mm apart, replace the propeller shaft with a new one.



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- If the two marked points are located at two relative sides of propeller shaft, it means the flange of final drive is main reason for vibration.



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- After replacement with new final drive flange, the radial runout should be within limit range.
- Carry out road test to inspect if the driveline system vibrates. If vibration still exists, balance the propeller shaft.

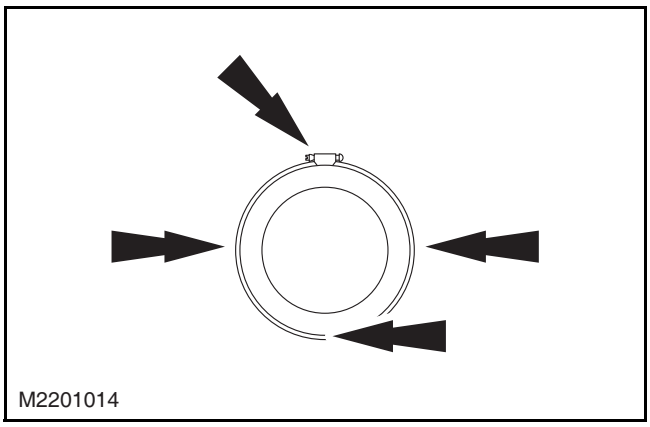
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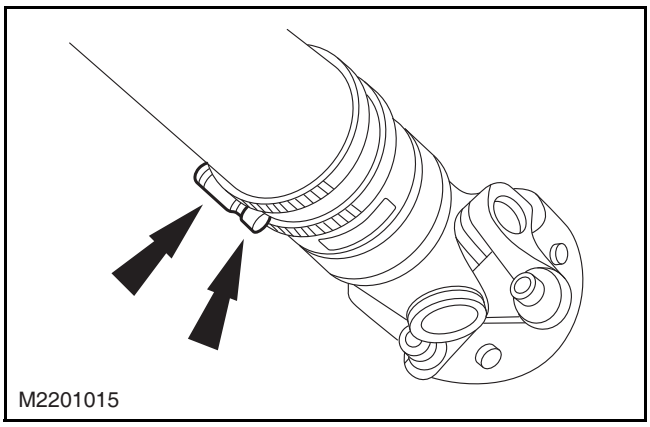
**2.** Balance the propeller shaft

1 Install 1 or 2 clamps at the rear end of propeller shaft.

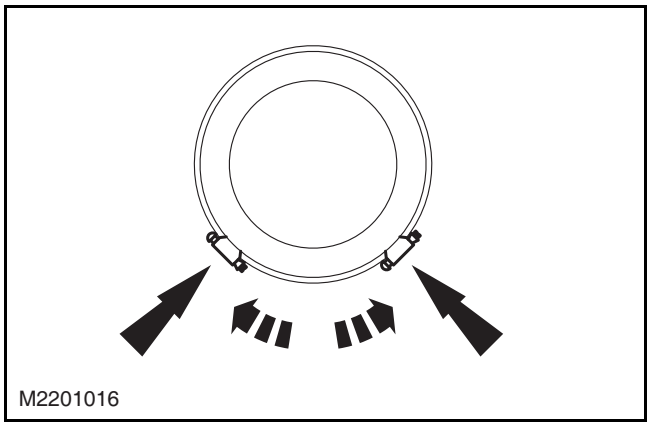
- Divide the circumference surface at rear end into four equal parts, and put the clamp collet at one of them.
- Carry out road test to inspect for vibration. Change the direction of clamp, confirm the position with minimum vibration. If two neighboring positions have the same improvement effect on the vibration, place the clamp between two positions.


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**3.** If the vibration continues to exist, add a clamp at the same position and carry out road test to inspect for vibration.

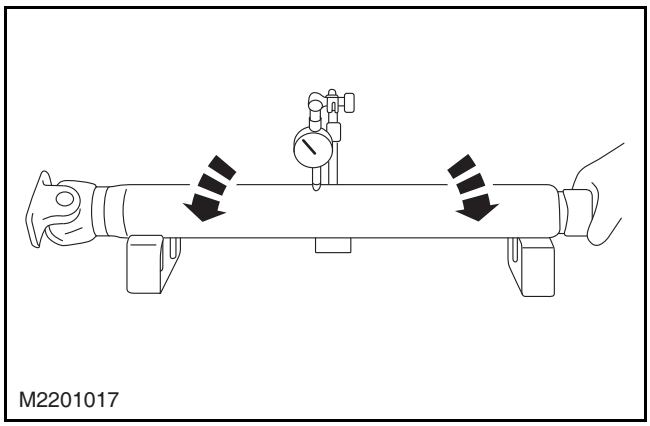

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- If the vibration is not improved, turn the clamp reversely by a equal distance from the position with minimum vibration confirmed previously. Separate the collets of two clamps about 8 cm, and carry out road test again to inspect for vibration.
- Increase the pitch and repeat above steps until the best position is found or vibration is reduced to acceptable level.


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**4.** Inspect the radial runout of propeller shaft

- Measure the radial runout of propeller shaft with V block and dial indicator.
  Specified radial runout range: 0.7 mm
  If radial runout exceeds standard value, calibrate the propeller shaft with a press machine or replace it.

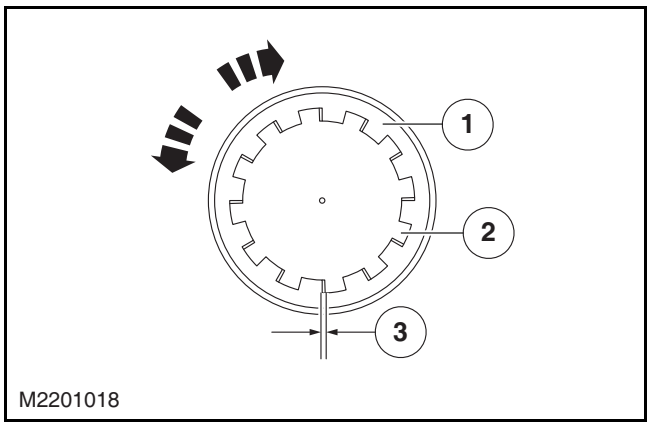

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**5.** Inspect the sliding spline tooth clearance of propeller shaft

- Measure the clearance (3) at normal rotating direction of spline shaft (2) and spline shaft sleeve (1) with a slip gauge.
  Standard value: 0.02 ~ 0.01 mm
  If the sliding spline tooth clearance exceeds standard value, replace the propeller shaft with a new one.



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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical damage.
3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

| Symptom | Possible Faults | Solutions |
|---|---|---|
| When the vehicle starts or the speed suddenly changes, the vehicle body shakes and drive device makes impact sound | • Cross and needle bearing worn or loose, or bearing needle broken | Refer to: Diagnosis Procedure for Vehicle Body Shakes and Drive Device Makes Impact Sound with Vehicle Starting or Vehicle Speed Suddenly Changing (2.2.1 Driveline System - Overview, Symptom Diagnosis and Testing). |
| | • Flange spline groove of drive axle final drive severely worn | |
| | • Spline tooth at the second shaft of transmission and spline shaft sleeve of propeller shaft severely worn | |
| | • Retaining bolts of each connecting parts loose | |
| When driving, it gives out periodic sound which becomes louder as the speed increases, and worse still, the vehicle body shakes and vibrates, even the hands holding the steering wheel feel numb | • Propeller shaft bent, axle tube sagged or balance piece sealing off, and unbalanced rotation causing sound | • Inspect the dynamic balance of propeller shaft.<br>Refer to: Propeller Shaft Inspection (2.2.1 Driveline System - Overview, General Inspection). |
| | • Flange or shaft tube of the propeller shaft inclined, and unbalanced rotation causing sound | |
| Drive shaft noise | • Engagement spline of drive shaft and differential damaged | Refer to: Diagnosis Procedure for Drive Shaft Noise (2.2.1 Driveline System - Overview, Symptom Diagnosis and Testing). |
| | • Drive shaft deformed or contacting other components | |
| | • Drive shaft bearing damaged | |
| Drive axle makes noises during running | • Gear or bearing severely worn or damaged | Refer to: Diagnosis Procedure for Drive Axle Noise During Running (2.2.1 Driveline System - Overview, Symptom Diagnosis and Testing). |
| | • Fit clearance of drive and driven bevel gears too large | |
| | • Retaining bolts of driven bevel gear loose | |
| | • Planetary gear, drive shaft inner end or drive shaft gear spline groove of differential worn or loose | |
| | • Gear oil insufficient or grade incorrect | |

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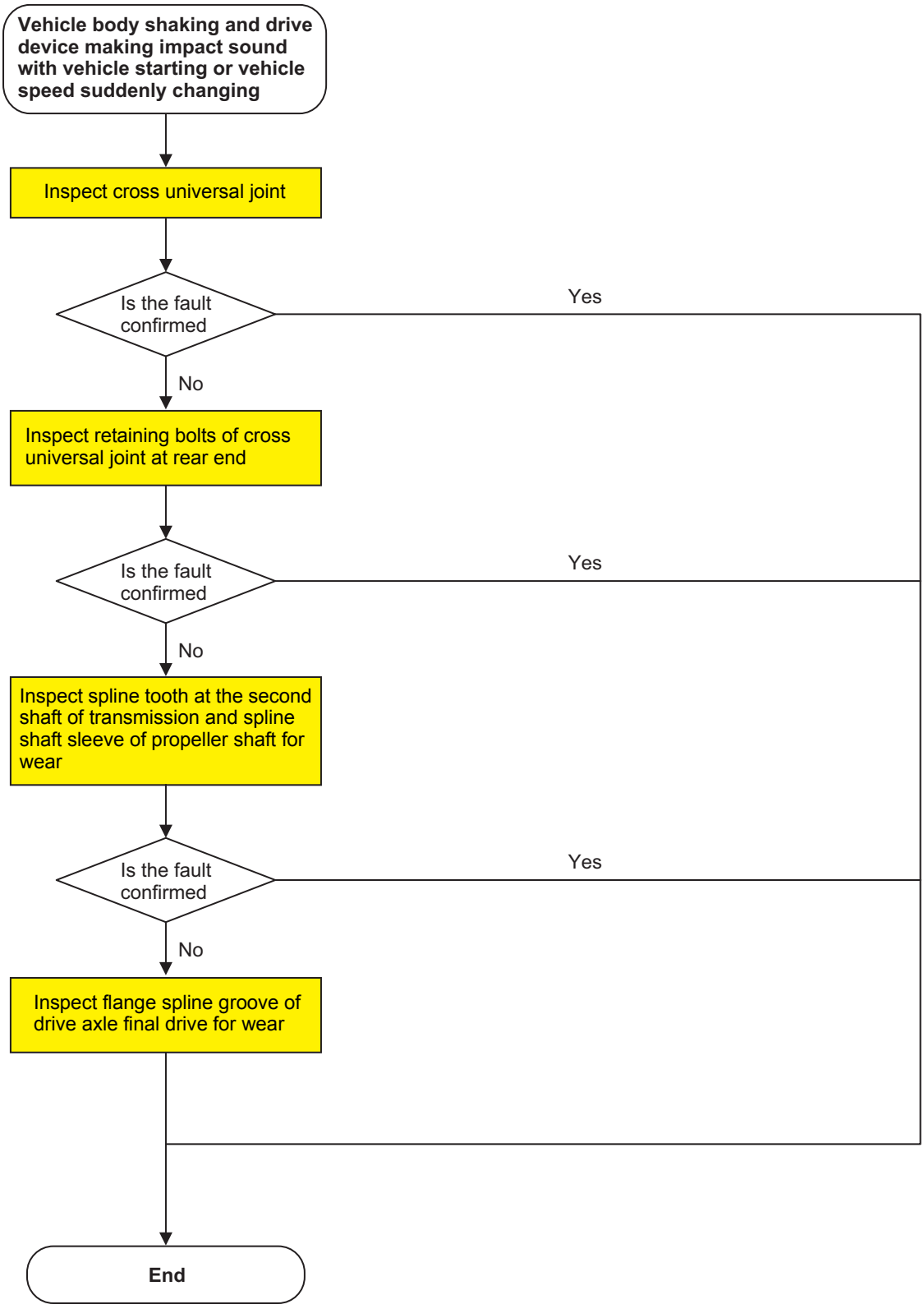


| Symptom | Possible Faults | Solutions |
|---|---|---|
| After a certain mileage, the drive axle temperature is too high | • The bearing is assembled too tight, so the friction intensifies, heat increases and temperature rises while rotating | **Refer to: Diagnosis Procedure for High Drive Axle Temperature after a Certain Mileage (2.2.1 Driveline System - Overview, Symptom Diagnosis and Testing).** |
| | • Gear engagement clearance is too small | |
| | • Oil seal is too tight | |
| | • Drive axle lacks of gear oil, gear oil deteriorates or does not meet the specified requirements | |
| Gear oil leaks from the drive axle final drive oil seal or gasket | • Gear oil in the drive axle filled too much or deteriorated | • Inspect the gear oil, and replace when necessary. |
| | • Drive bevel gear front oil seal is worn and damaged, causing gear oil leaking | • Inspect drive bevel gear front oil seal, and replace when necessary. |
| | • Refill or drain plug is not tightened as specified torque | • Tighten the refill or drain plug as specified torque. |
| Drive shaft falling-off | • Retaining bolts of brake baseplate and rear axle damaged | • Inspect and repair the rear axle, brake baseplate, and replace the retaining bolts. |

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# Diagnosis Procedure for Vehicle Body Shaking and Drive Device Making Impact Sound with Vehicle Starting or Vehicle Speed Suddenly Changing



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect cross universal joint | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the cross and needle bearing for wear or looseness, or bearing needle for breakage.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair or replace the fault parts. |
| 2. Inspect retaining bolts of cross universal joint at rear end | |
| | A. Inspect the retaining bolts of cross universal joint at rear end.<br>Is the connection normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the fault part. |
| 3. Inspect spline tooth at the second shaft of transmission and spline shaft sleeve of propeller shaft for wear | |
| | A. Remove the drive shaft.<br>B. Inspect the spline tooth at the second shaft of transmission and the spline shaft sleeve of propeller shaft for wear.<br>**Refer to: Propeller Shaft Inspection (2.2.1 Driveline System - Overview, General Inspection).**<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the fault part, and replace when necessary. |

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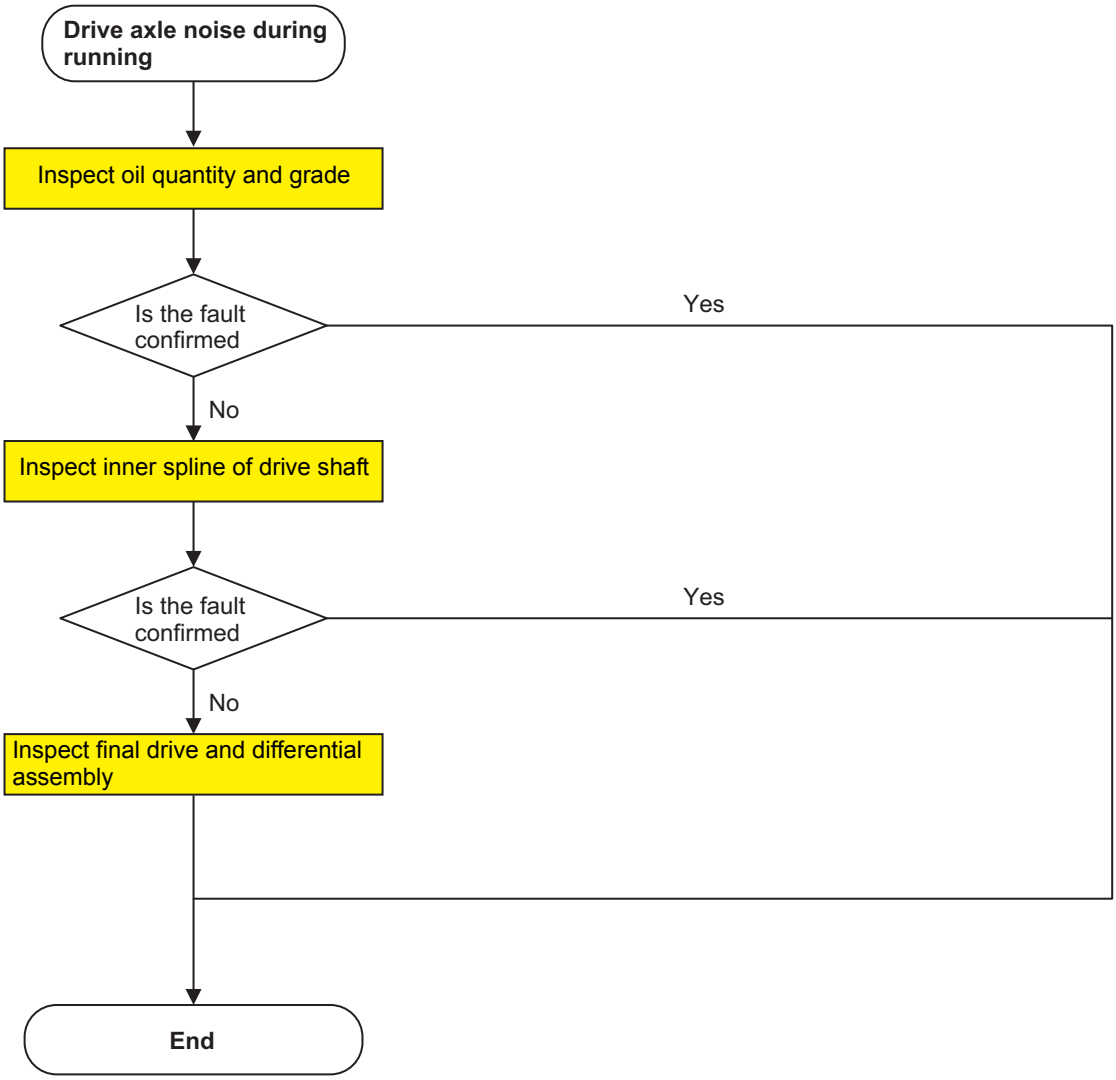


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect flange spline groove of drive axle final drive for wear | |
| | A. Remove the drive axle final drive.<br>**Refer to: Final Drive and Differential Assembly (2.2.4 Differential, Removal and Installation).**<br>B. Inspect the flange spline groove of drive axle final drive for wear.<br>Is it normal?<br>**Yes**<br>Make sure the system is normal.<br>**No**<br>Repair the fault part, and replace when necessary. |

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# Diagnosis Procedure for Drive Axle Noise During Running



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1. When driving in gear, the drive axle makes large sound, but it weakens or disappears when coasting or running at low speed.
2. When turning, the drive axle makes large sound, but it weakens or disappears when running straight.
3. When starting or suddenly changing the vehicle speed, the drive axle rattles, and when running at low speed, it makes impact sound.

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect oil quantity and grade | |
| | A. Inspect the oil quantity and grade.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Fill or replace gear oil with one as specified grade. |
| 2. Inspect inner spline of drive shaft | |
| | A. Remove the drive shaft.<br>**Refer to: Drive Shaft (2.2.3 Drive Shaft, Removal and Installation).**<br>B. Inspect the drive shaft.<br>**Refer to: Drive Shaft Inspection (2.2.1 Driveline System - Overview, General Inspection).**<br>Is the connection normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the drive shaft. |

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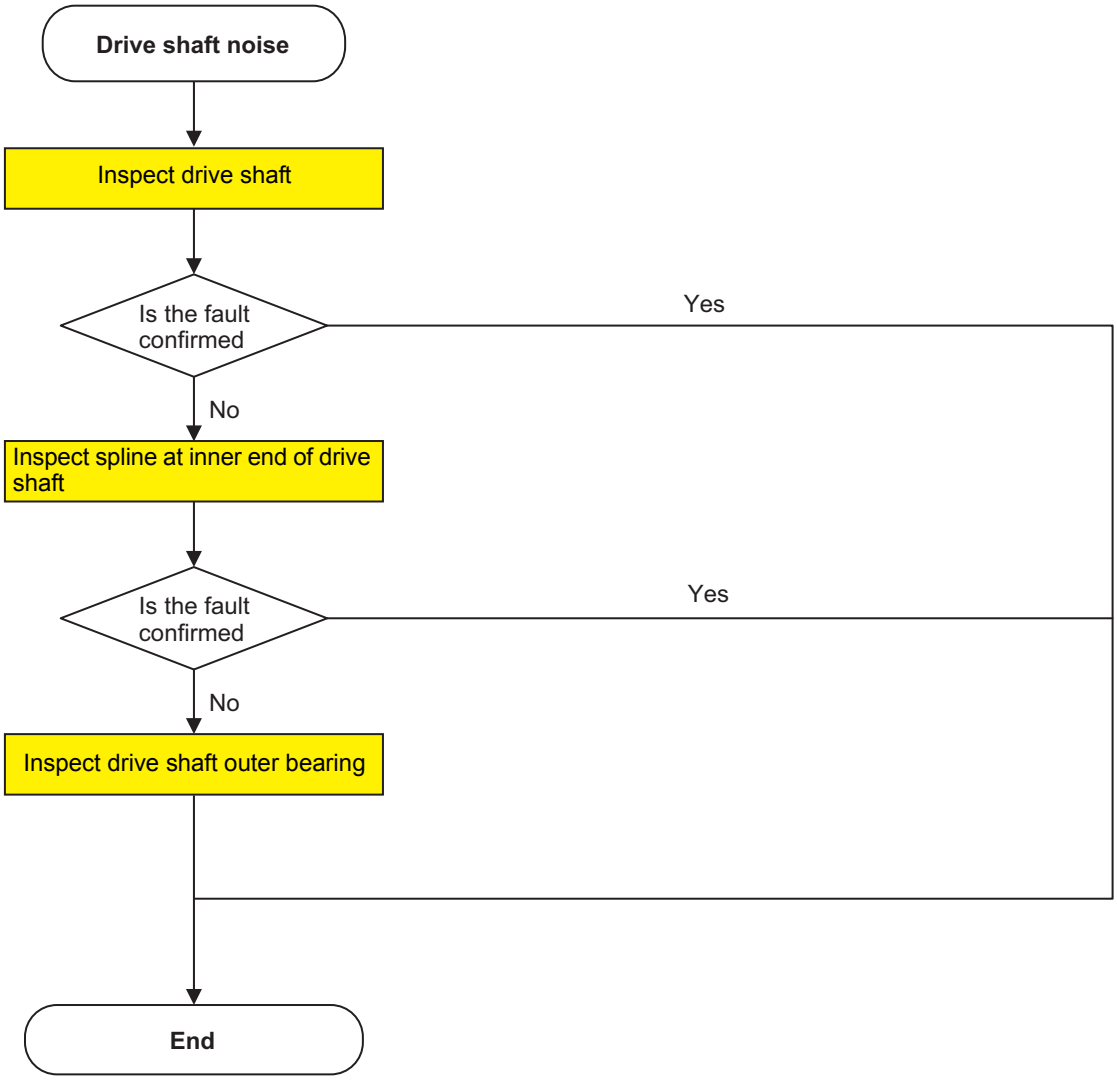


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect final drive and differential assembly | |
| | A. Remove the final drive and differential assembly.<br>**Refer to: Final Drive and Differential Assembly (2.2.4 Final Drive and Differential Assembly, Removal and Installation).**<br>B. Inspect the final drive and differential assembly.<br>**Refer to: Final Drive and Differential Assembly Inspection (2.2.1 Driveline System - Overview, General inspection).**<br>Is it normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the final drive and differential assembly. |

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# Diagnosis Procedure for Drive Shaft Noise



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect drive shaft | |
| | A. Remove the drive shaft.<br>**Refer to: Drive Shaft (2.2.3 Drive Shaft, Removal and Installation).**<br>B. Inspect if the drive shaft is bent or deformed.<br>**Refer to: Drive Shaft Inspection (2.2.1 Driveline System - Overview, General Inspection).**<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault part or replace the drive shaft. |
| 2. Inspect spline at inner end of drive shaft | |
| | A. Inspect the spline at inner end of drive shaft for wear and damage.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the fault part or replace the drive shaft. |
| 3. Inspect drive shaft outer bearing | |
| | A. Remove the drive shaft.<br>**Refer to: Drive Shaft (2.2.3 Drive Shaft, Removal and Installation).**<br>B. Inspect the drive shaft outer bearing.<br>Is it normal?<br>**Yes**<br>**Refer to: Drive Shaft Outer Bearing (1.1.5 Noise, Vibration and Harshness).**<br>**No**<br>Replace the drive shaft outer bearing. |

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# Diagnosis Procedure for High Drive Axle Temperature after a Certain Mileage

| Symptom | Details/Results/Actions |
|---|---|
| 1. Inspect oil quantity and grade | |
| | A. Inspect the oil quantity and grade.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Fill or replace gear oil with one as specified grade. |
| 2. Inspect final drive and differential assembly | |
| | A. Remove the final drive and differential assembly.<br>**Refer to: Final Drive and Differential Assembly (2.2.4 Final Drive and Differential Assembly, Removal and Installation).**<br>B. Inspect the final drive and differential assembly.<br>**Refer to: Final Drive and Differential Assembly Inspection (2.2.1 Driveline System - Overview, General inspection).**<br>Is it normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Repair the fault part or replace the final drive and differential assembly. |

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## Specifications

# Grease

| Item | Type |
|---|---|
| Lithium based grease | High grade grease C (99000-25030) |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Connecting bolt between propeller shaft and differential | 50 ± 10 | - | - |

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## Description and Operation

# System Overview

The propeller shaft has nonconstant velocity cross universal joint at both ends.

- Front nonconstant velocity cross universal joint (including drive fork, driven fork, needle bearing, axial positioning parts, sealings and inner circlip and the like) is installed at the transmission output shaft.
- Rear nonconstant velocity cross universal joint (same as the structure of front nonconstant velocity cross universal joint) is installed at the differential of rear axle.
- Front nonconstant velocity cross universal joint is connected at the spline of output shaft through a spline shaft sleeve, which is flexible.
- Rear nonconstant velocity cross universal joint is fixed at the flange of rear axle differential input shaft through a bolt with check washer, which is not flexible.

The propeller shaft would transmit the torque from engine to rear axle. To adapt up-and-down relative movement of rear axle and engine, the propeller shaft shall rotate with different lengths and angles.

Front and rear nonconstant velocity cross universal joints allow the length variation of drive shaft during its axial movement.

As nonconstant velocity cross universal joints are used in the front and rear for a dual cardan type, constant velocity can be realized.

**CAUTION: For removal and installation of propeller shaft, pay attention to the oil seal of transmission output shaft to prevent damage.**

**CAUTION: Dual nonconstant velocity cross universal joint shall have its working angle, no more than 50 degrees.**

**CAUTION: Inspect if the junction surface between propeller shaft and oil seal of transmission output shaft and the internal spline are damaged.**

**CAUTION: After the propeller shaft is removed, plug up the transmission output shaft side with a suitable tool to prevent oil outflow and dust pollution.**

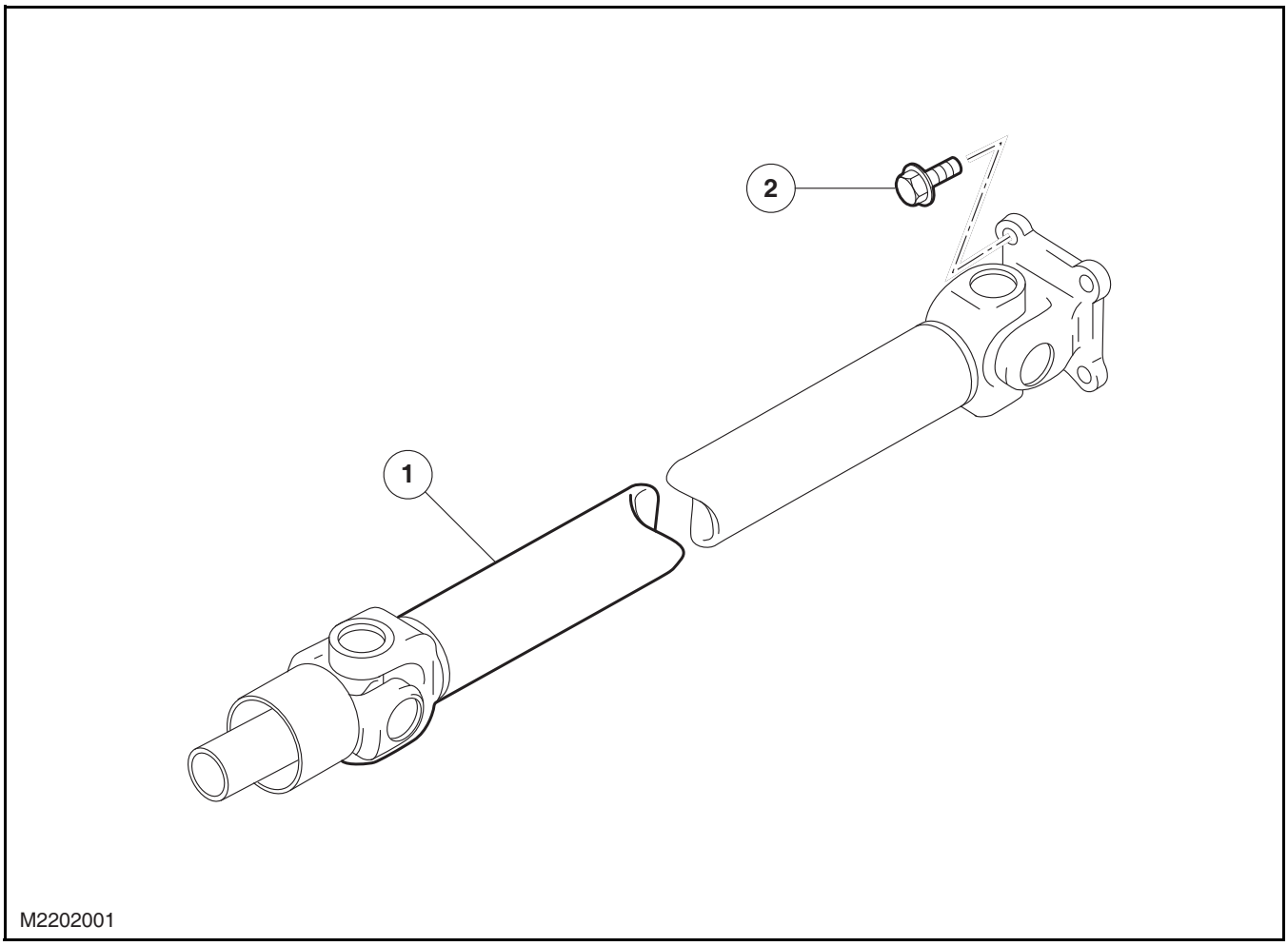
**CAUTION: For installation, clean the junction surface between propeller shaft and oil seal of transmission output shaft and the internal spline.**

**CAUTION: Do not drop off the propeller shaft, which may cause internal damage of cross universal joint.**

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# Components Exploded View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Propeller shaft | 2 | Hexagon bolt and elastic washer component |

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## General Inspection

## Driveline System Vibration Inspection

1. Inspect the dynamic balance of front wheels and adjust when necessary.
2. Inspect the dynamic balance of rear wheels and adjust when necessary.
3. Carry out road test to inspect if driveline system is vibrating during running.

## Dynamic Balance of Propeller Shaft Inspection

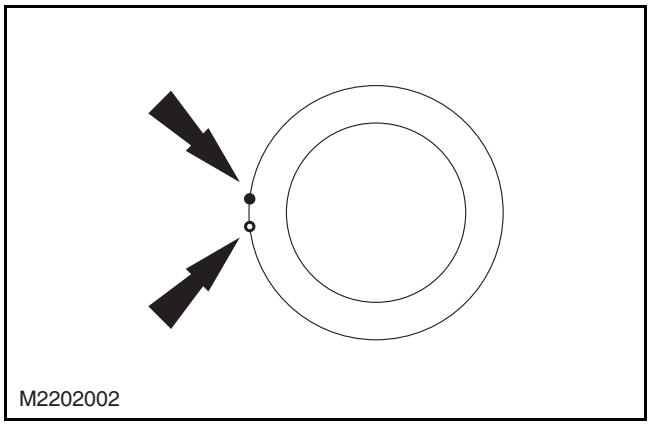
1. Turn the rear wheels to rotate the propeller shaft and measure radial runout of its front, middle and rear ends.

   Standard value: 0.7 mm or less

   - If radial runout of both front and middle ends exceeds standard value, make sure to replace the propeller shaft with a new one.
   - If radial runout of front and middle ends is within standard range, but that of rear end exceeds standard value, then mark its high point and proceed with next step.
   - If the radial runout of each point is within standard range, also proceed with next step.
2. Remove the propeller shaft, then rotate it and final drive relatively for 1/2 circle to install.

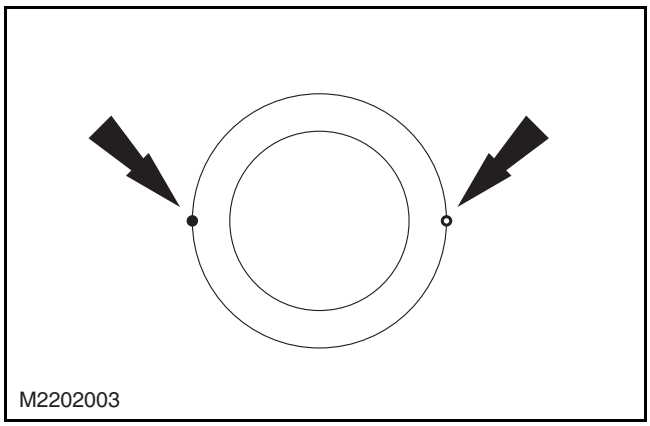
   **Refer to: Propeller Shaft (2.2.2 Propeller Shaft, Removal and Installation).**

   - If it is turned only 1/4 circle, inspection and adjustment can be more accurate.
3. Inspect the radial runout of rear end in the propeller shaft.
   - If the radial runout of rear end still exceeds limit value, mark the high point and proceed with next step.
   - If the radial runout of rear end is within standard range, inspect if driveline system is vibrating during road test. In case of vibration, mark the high point and proceed with next step.
4. Compare two high points marked in above steps.
   - If the two marked points are close, within approximately 20 mm apart, replace the propeller shaft with a new one.



M2202002

   - If the two marked points are located at two relative sides of propeller shaft, it means the flange of final drive is main reason for vibration.
   - After replacement with new final drive flange, the radial runout shall be within limit range.
   - Carry out road test to inspect if the driveline system vibrates. If vibration still exists, balance the propeller shaft.



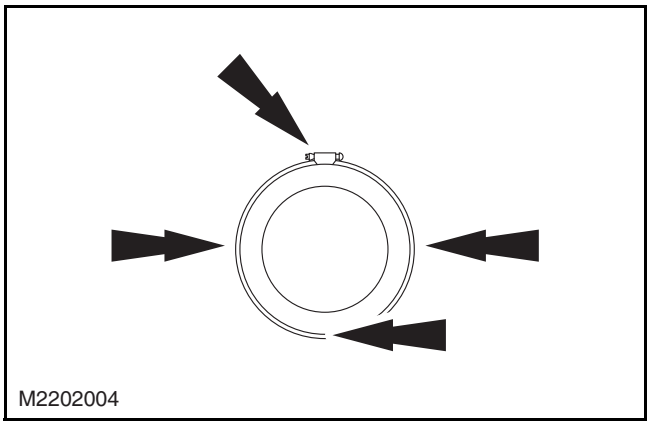
M2202003

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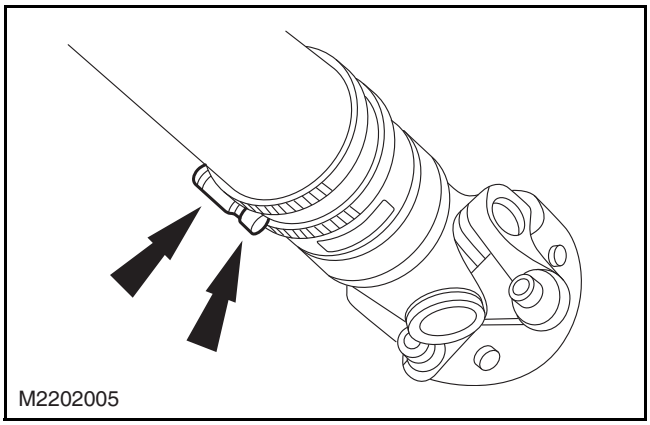


## Balance Propeller Shaft

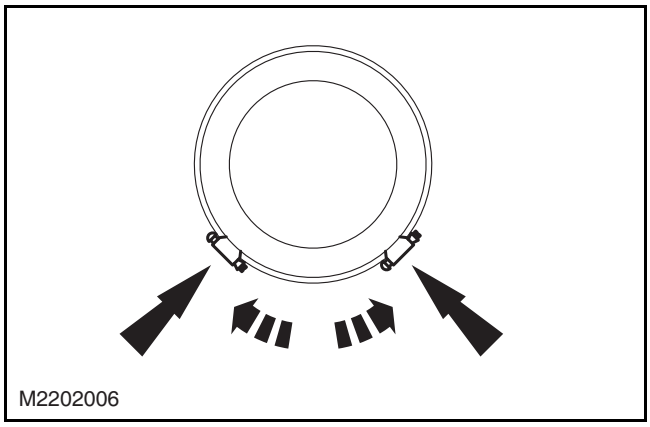
1. Install 1 or 2 clamps at the rear end of propeller shaft.
   - Divide the circumference surface at rear end into four equal parts, and put the clamp collet at one of them.
   - Carry out road test to inspect for vibration. Change the direction of clamp, confirm the position with minimum vibration. If two neighboring positions have the same improvement effect on the vibration, place the clamp between two positions.


M2202004

2. If the vibration continues to exist, add a clamp at the same position and carry out road test to inspect for vibration.


M2202005

   - If the vibration is not improved, turn the clamp reversely by a equal distance from the position with minimum vibration confirmed previously. Separate the collets of two clamps about 10 cm, and carry out road test again to inspect for vibration.
   - Increase the pitch and repeat above steps until the best position is found or vibration is reduced to acceptable level.

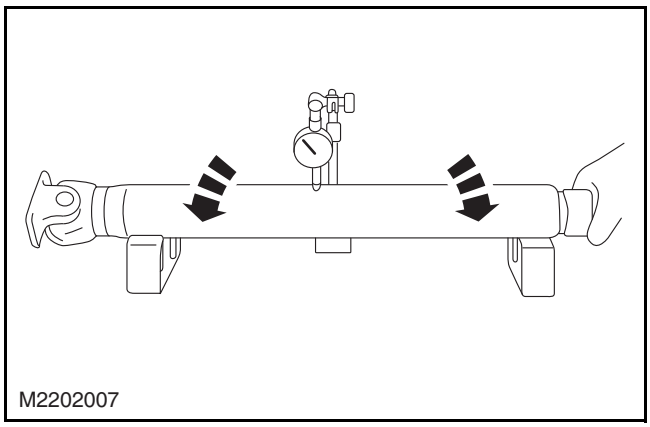

M2202006

## Inspection

1. Inspect the radial runout of propeller shaft.
   - Measure the radial runout of propeller shaft with a V platform and dial indicator.

   Standard value: 0.7 mm or less

   If radial runout exceeds standard value, calibrate the propeller shaft with a press machine or replace it.

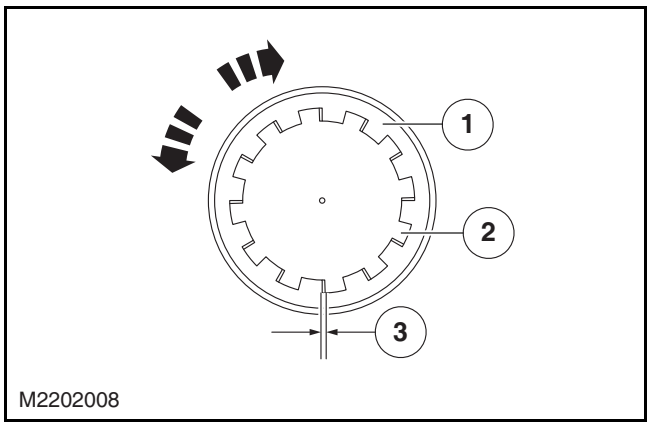

M2202007

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**2.** Inspect the sliding spline tooth clearance of propeller shaft.

- Measure the clearance at normal rotating direction of spline shaft and spline shaft sleeve with a clearance gauge.
  Standard value: 0.02 ~ 0.01 mm
  If the sliding spline tooth clearance exceeds standard value, replace the propeller shaft with a new one.



M2202008

| Item | Description |
|---|---|
| 1 | Spline shaft sleeve |
| 2 | Spline shaft |
| 3 | Clearance |

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## Symptom Diagnosis and Testing

Refer to: (2.2.1 Driveline System - Overview, Symptom Diagnosis and Testing).

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## Removal and Installation

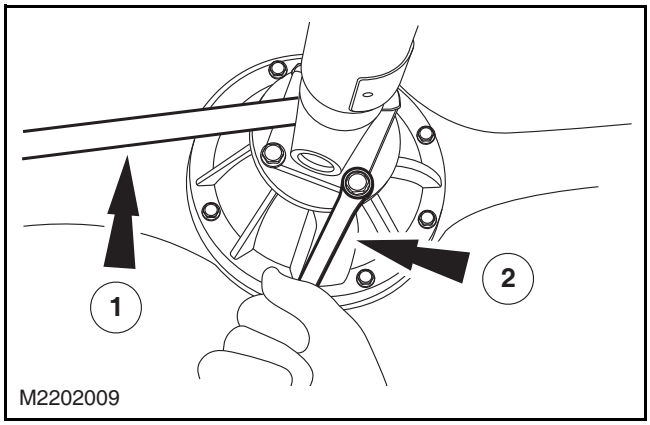
# Propeller Shaft

### Removal

1. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Use suitable tools as shown in figure. Fix and adjust the position of propeller shaft with tool (1), and remove the retaining bolts with tool (2).



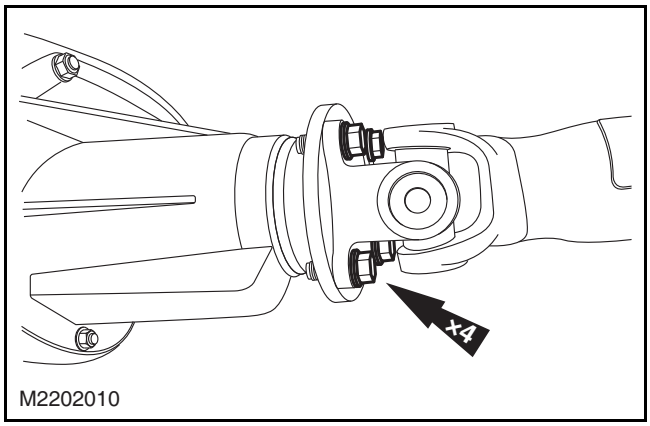
M2202009

3. Remove 4 retaining bolts from nonconstant velocity cross universal joint at the rear end of propeller shaft.

   Torque: 50 ± 10 Nm

**CAUTION: Bolts here have spring shims. Do not replace them with other bolts.**

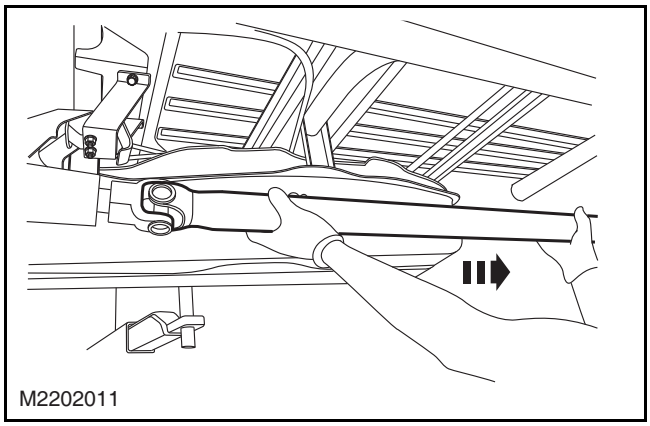
**CAUTION: Before removing propeller shaft, put matchmarks on each flange and propeller shaft.**



M2202010

4. Remove the propeller shaft.

**CAUTION: Plug up the transmission output shaft side with a suitable tool to prevent transmission oil leakage.**


M2202011

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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Before installation of propeller shaft, clean the junction surface between spline shaft sleeve of nonconstant velocity cross universal joint and transmission output shaft oil seal.**

**CAUTION: Apply a small amount of grease to the junction surface between universal joint spline shaft sleeve and transmission output shaft oil seal for easy installation and preventing damage to transmission output shaft oil seal.**

**CAUTION: Inspect for lack of transmission oil, fill when necessary.**

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## Specifications

# Material Specifications

| Item | Type | Capacity |
|---|---|---|
| Gear oil | Hypoid gear oil SAE90, SAE80W or GL-5 85W/90 | 1.4 L |
| Sealant | Sealant 366E | - |
| Lithium based grease | Suzuki superior grease A | - |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Drain plug | 55 | 41 | - |
| Refill plug | 50 ± 10 | - | - |
| Brake baseplate retaining bolt | 23 | 17 | - |
| Parking brake cable retaining bolt | 9 | - | 80 |

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## Description and Operation

# System Overview

The drive shaft is semi-floating type, used for connecting the differential drive shaft gear and hub. The inner end of each drive shaft has an external spline, which is connected with the internal spline of differential. Two drive shafts are fixed in the rear axle housing, and connected with the housing through the bearing. The drive shaft is not flexible and cannot be stretched in and out. The other end of drive shaft is the hub flange, which is connected to the wheel directly as a whole with drive shaft. The drive shaft would transmit the torque from the engine to the wheels.

# Precautions for Drive Shaft Maintenance

**CAUTION: Pay attention to the oil seal holder to prevent damage during removal and installation of drive shaft.**

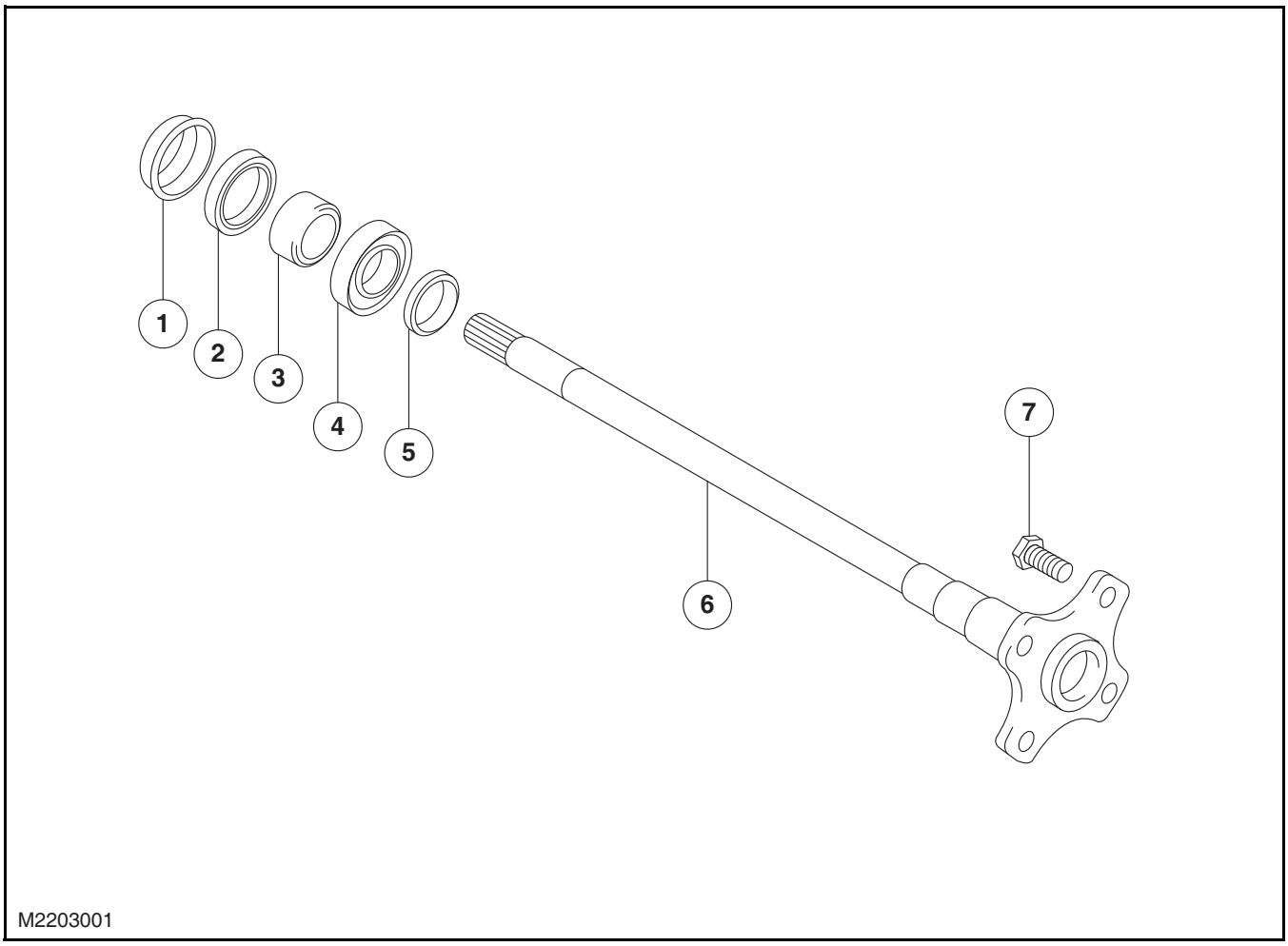
**CAUTION: Pay extra attention during removal, installation, disassembly and assembly of drive shaft. Follow the instructions below:**

- Inspect the polished surface and the spline for damaged.
- Do not drop the drive shaft, which may damage the polished surface and spline.
- Use suitable tools to remove the drive shaft to prevent damage of brake baseplate.
- Before installing the drive shaft, clean the junction surface between brake baseplate and rear drive axle, and apply the sealant again.
- Make sure to install the drive shaft in place to prevent deformation and oil leakage due to improper installation of brake baseplate.

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# Components Exploded View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Oil seal holder | 5 | Drive shaft bushing |
| 2 | Drive shaft oil seal assembly | 6 | Drive axle drive shaft assembly |
| 3 | Drive shaft retaining ring | 7 | Bolt |
| 4 | Drive shaft bearing | | |

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## Symptom Diagnosis and Testing

**Refer to: Symptom Chart (2.2.1 Driveline System - Overview, Symptom Diagnosis and Testing).**

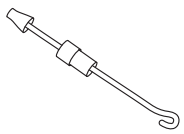
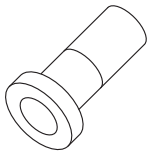
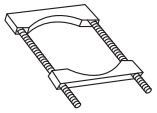
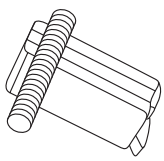
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# Removal and Installation

## Drive Shaft

### Special Tool

| | |
|---|---|
|  <br>09942-15510 | Slide hammer<br>09942-15510 |
|  <br>09943-17912 | Brake drum remover<br>09943-17912 |
|  <br>09913-75520 | Oil seal installer<br>09913-75520 |
|  <br>09921-57810 | Bearing remover<br>09921-57810 |
|  <br>09927-18411 | Universal puller<br>09927-18411 |
|  <br>09944-96010 | Bearing outer race remover<br>09944-96010 |

### General Tool

| |
|---|
| Hydraulic device |
| Oil bucket |
| Rubber hammer |

### Material

| Item | Type |
|---|---|
| Sealant | Sealant 366E |
| Lithium based grease | Suzuki superior grease A |
| Gear oil | Hypoid gear oil SAE90, SAE80W or GL-5 85W/90 |

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## Removal

1. Remove the rear wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Remove the brake drum.

   **Refer to: Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).**

3. Remove the brake shoe.

   **Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).**

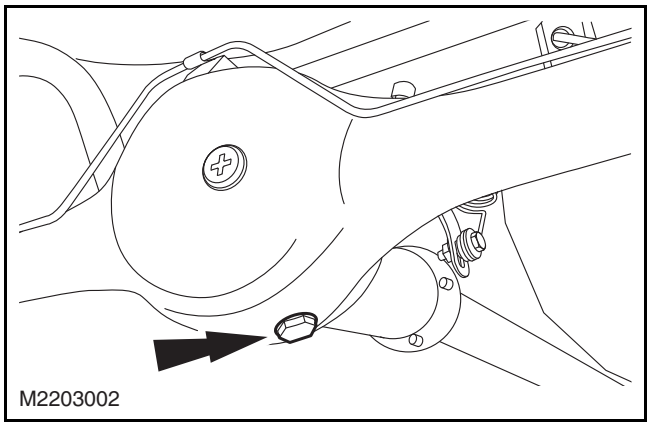
4. Remove the brake wheel cylinder.

   **Refer to: Brake Wheel Cylinder (2.3.2 Rear Drum Brake, Removal and Installation).**

5. Remove the differential drain bolt and drain the differential oil.

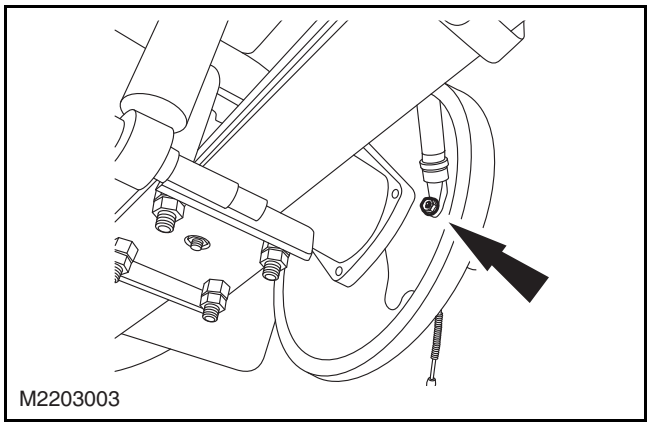
   Torque: 55 Nm

**CAUTION: The differential oil drain bolt is one applied with sealant, replace it with new one and reapply the sealant after removing.**


M2203002

6. Remove the retaining bolt between parking brake cable and brake baseplate.

   Torque: 9 Nm

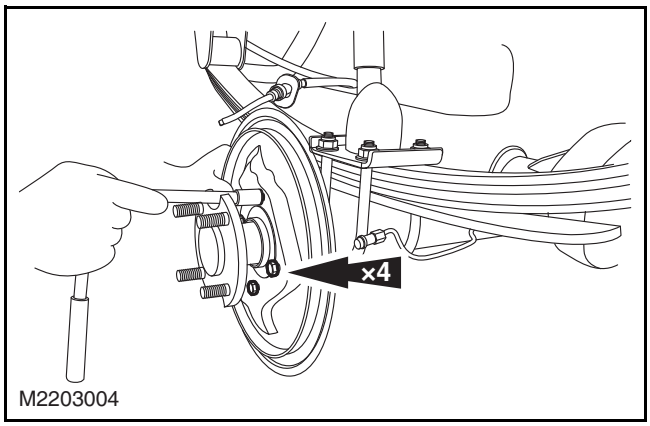

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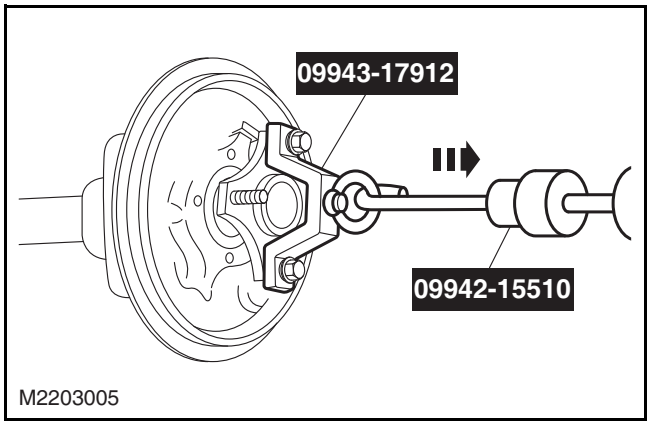
**7.** Remove 4 brake baseplate retaining bolts.

Torque: 23 Nm

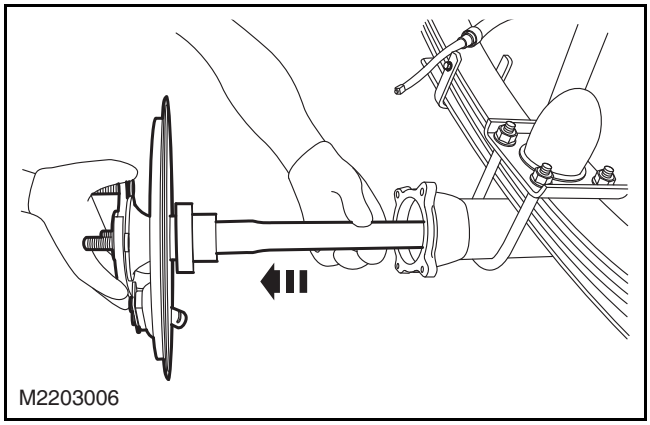



**8.** Use the special tool to pull out the drive shaft.

Special tool: 09943-17912, 09942-15510




**9.** Remove the drive shaft.

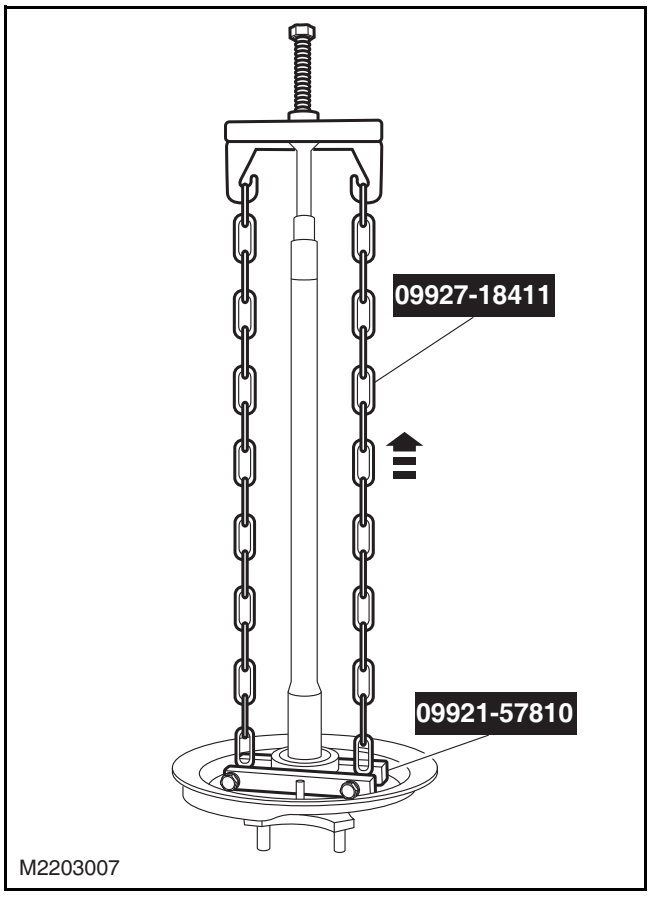


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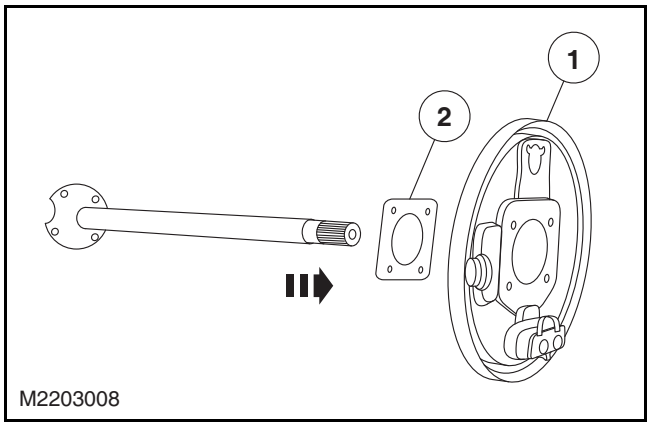


**10.** Use the special tool to remove the drive shaft bearing, retaining ring and bushing.

Special tool: 09921-57810, 09927-18411

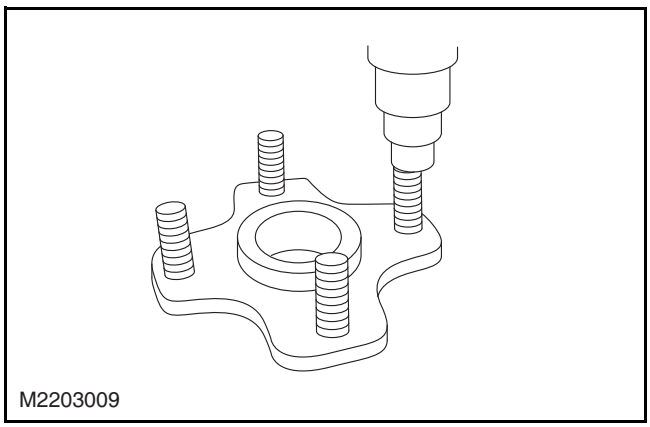



**11.** Remove the brake baseplate (1) and bearing plate (2).




**12.** Remove the tire bolts.

General tool: Hydraulic device

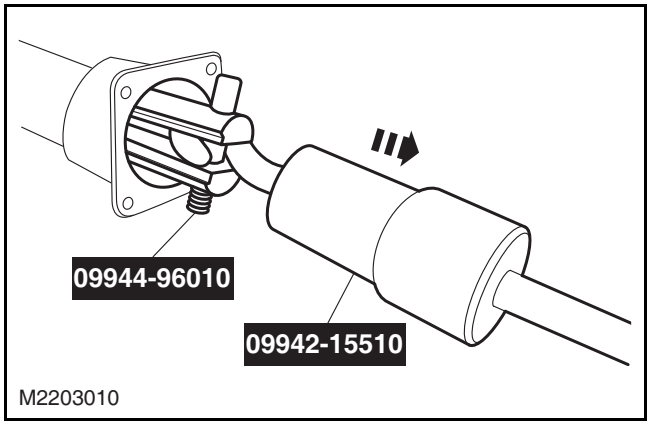


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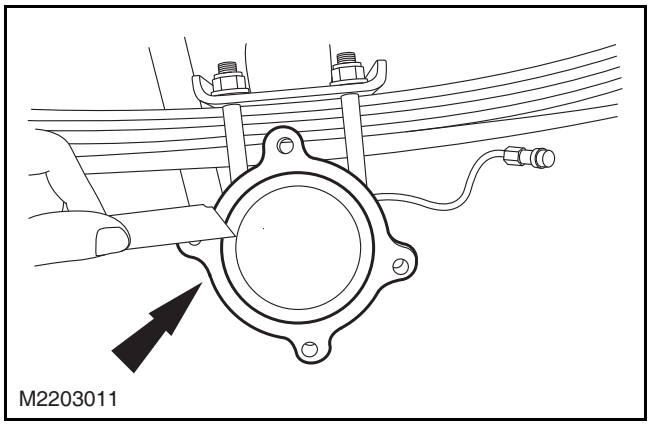
**13.** Use the special tool to remove the drive shaft oil seal and oil seal holder.

Special tool: 09944-96010, 09942-15510




## Installation

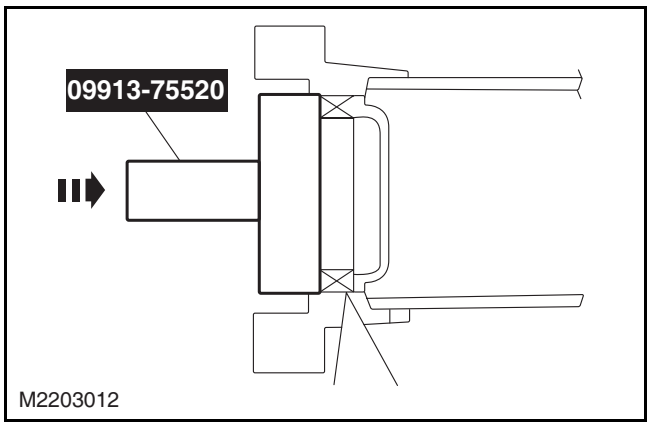
**1.** Clean the old sealant on the junction surface of brake baseplate and drive shaft.




**2.** Use the special tool to install the drive shaft oil seal and oil seal holder.

Special tool: 09913-75520

General tool: Rubber hammer



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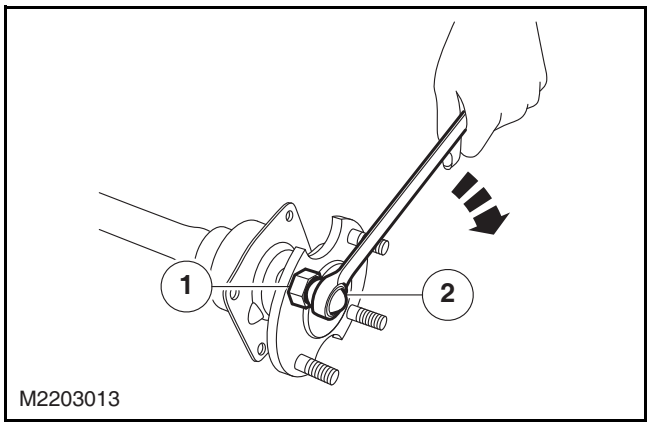
**3.** Install the tire bolts.

1 Install the tire bolt to flange plate.

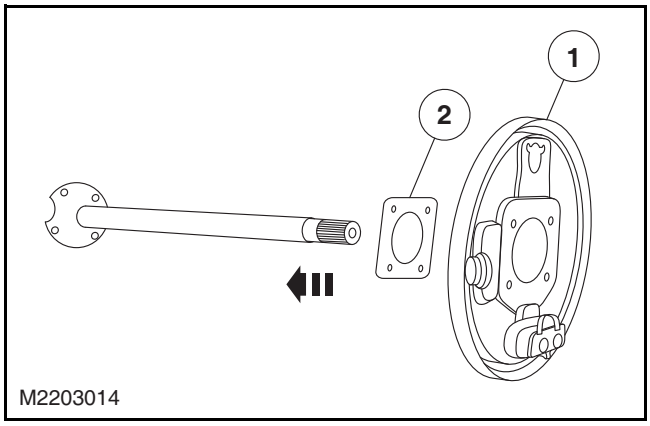
2 Install the washer (1) and nut (2).

3 Tighten the tire bolt to proper position.

4 Remove the nut (2) and washer (1).




**4.** Install the brake baseplate (1) and bearing plate (2).



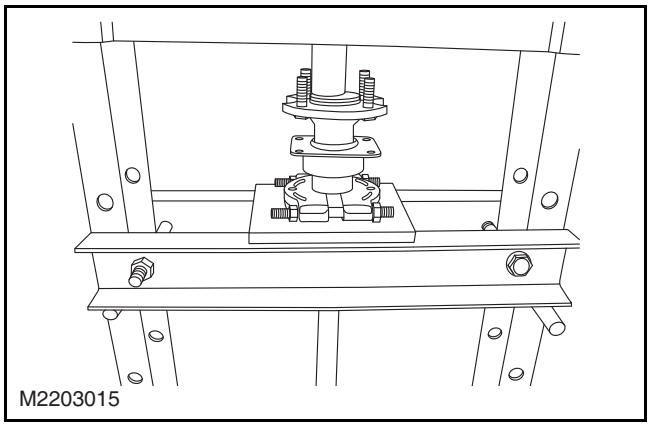

**5.** Use the hydraulic device to press the drive shaft bushing, bearing and retaining ring in sequence.

General tool: Hydraulic device

**CAUTION: Install the drive shaft bushing with its bore conical surface facing outward and brake drum side.**

**CAUTION: Install the drive shaft bearing with its sealing surface facing toward brake drum side.**

**CAUTION: When installing the drive shaft retaining ring, avoid damage to its outside.**

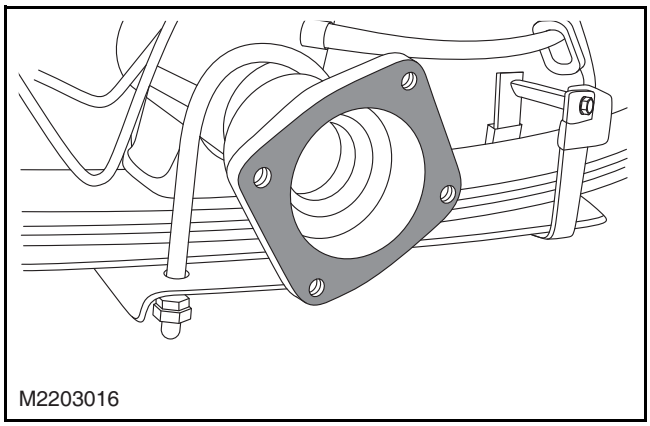


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6. Uniformly apply 2 ~ 3 mm sealant on the junction surface between brake baseplate and drive shaft.

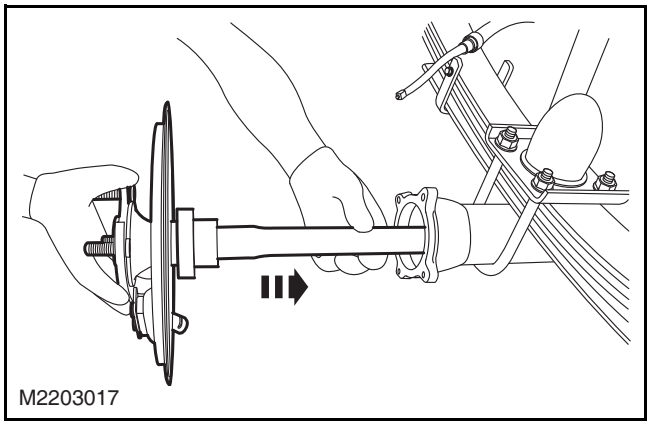
   Material: Sealant


M2203016

7. Install the drive shaft.

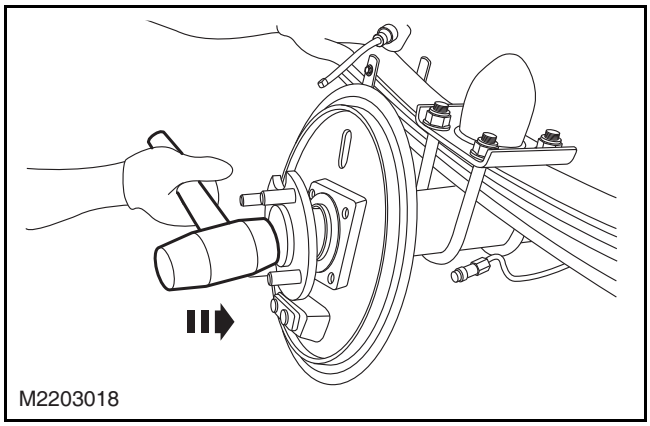
**CAUTION: Apply grease on the tip of drive shaft oil seal before installing the drive shaft.**

   Material: Lithium based grease


M2203017

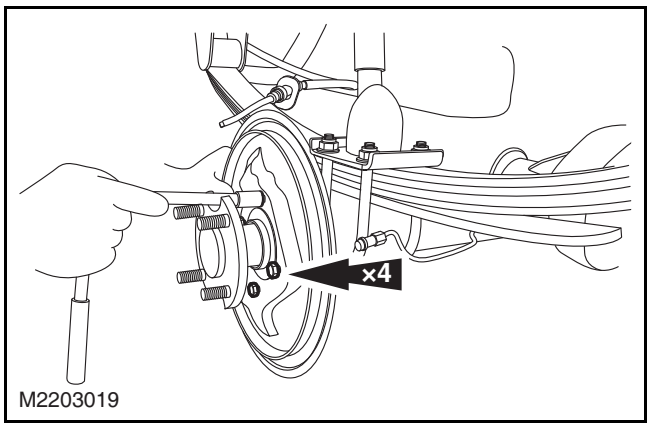
8. Install the drive shaft in place.

   General tool: Rubber hammer


M2203018

9. Install the brake baseplate retaining bolts.

   Torque: 23 Nm



M2203019

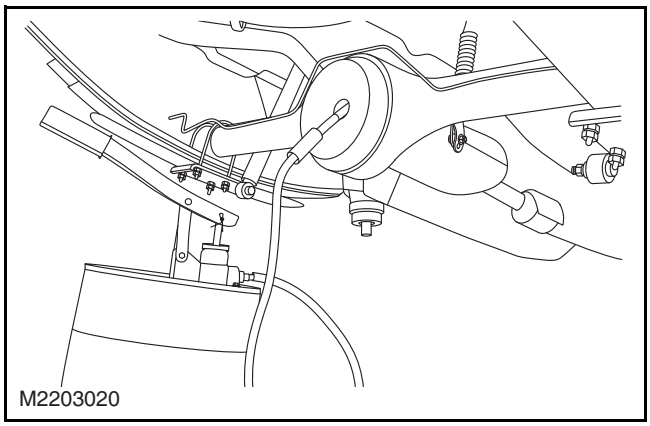
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**10.** Fill the differential oil.

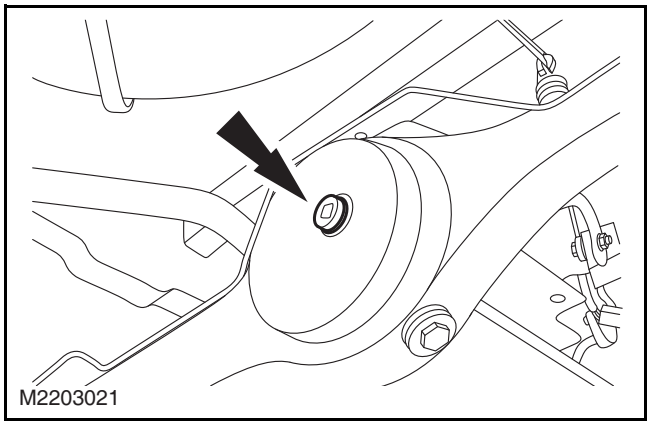
General tool: Oil bucket

Material: Gear oil


M2203020

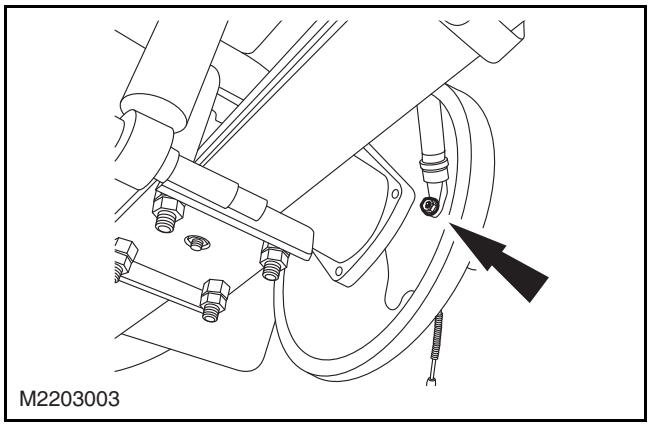
**11.** Install the differential refill plug.

Torque: 50 ± 10 Nm


M2203021

**12.** Install the parking brake cable retaining bolt.

Torque: 9 Nm


M2203003

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13. Install the brake wheel cylinder.

    **Refer to: Brake Wheel Cylinder (2.3.2 Rear Drum Brake, Removal and Installation).**

14. Install the brake shoe.

    **Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).**

15. Install the brake drum.

    **Refer to: Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).**

16. Install the rear wheel.

    **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

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## Specifications

# General Specifications

| Item | Type |
|---|---|
| Differential oil | Hypoid gear oil SAE90, SAE80W or GL-5 85W/90 |
| Differential oil capacity | 1.4 L |
| Thread sealant | Superior thread sealant 1333B |
| Lithium based grease | Suzuki superior grease A |
| Sealant | Suzuki Bond No.1215 |

**CAUTION: If the vehicle is running in a area with the temperature lower than -15°C (15°F) in cold seasons, it is recommended to use SAE80W or 75W/80-85 oil for regular maintenance.**

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Differential bearing cover retaining bolt | 50 | 37 | - |
| Flange retaining nut | 200 | 148 | - |
| Driven gear retaining bolt | 85 | 63 | - |
| Final drive retaining nut | 23 | 17 | - |

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## Description and Operation

# System Overview

The differential gear drive mechanism adopts hypoid design and so do the drive and driven gear teeth, which means the installation position of driven gear is slightly lower than central line of drive gear. Therefore, the design can lower the vehicle body height, and the engagement among gears can generate friction and slipping, which is the reason to use hypoid gear oil.

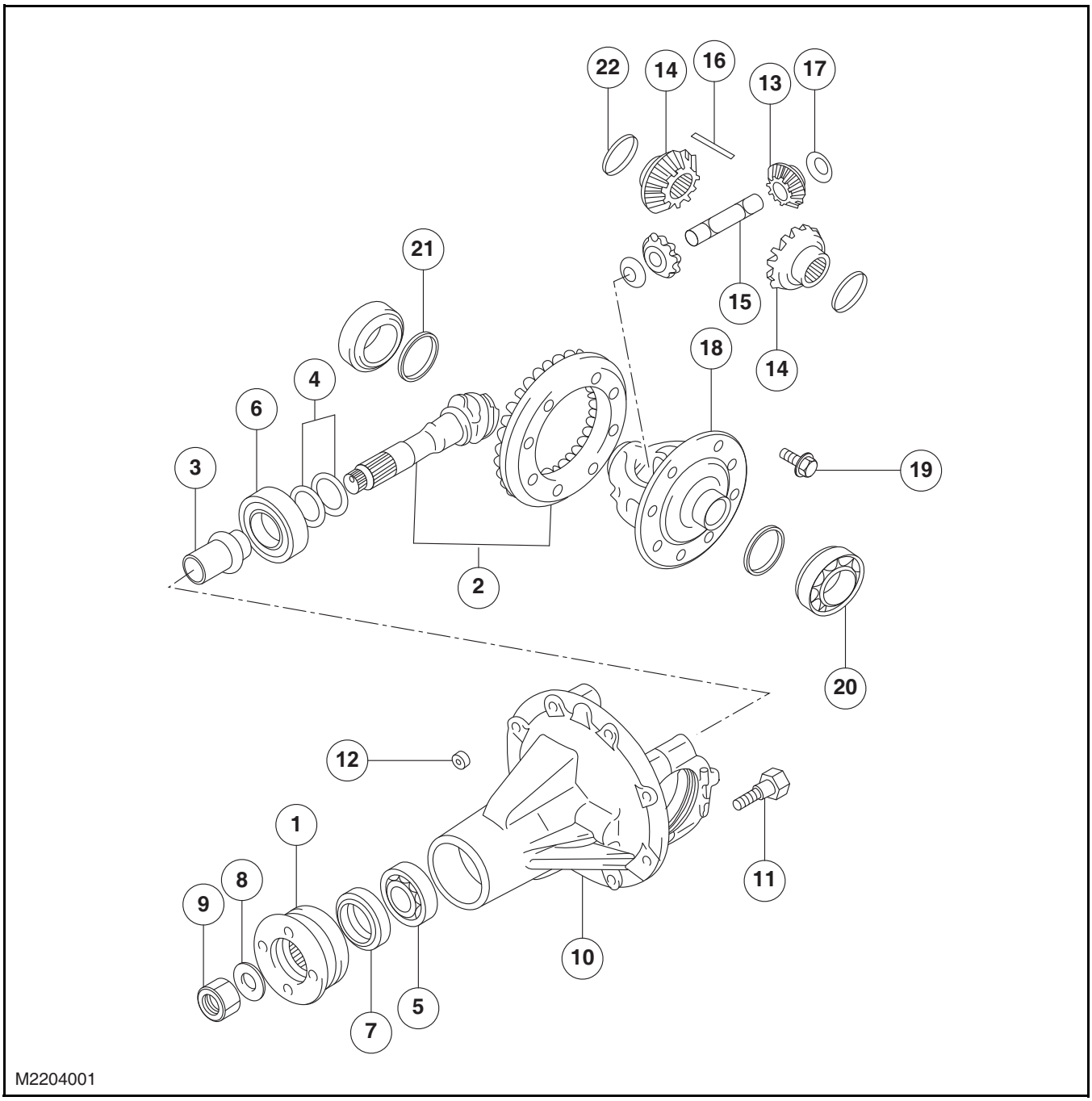
# Symptom Chart

| Symptom | Possible Faults | Solutions |
|---|---|---|
| Gear noise | • Gear oil deteriorated or wet | • Change and refill. |
| | • Gear oil insufficient or type is not correct | • Change or fill. |
| | • Incorrect clearance between drive and driven bevel gears | • Adjust. |
| | • Incorrect engagement contact between drive and driven bevel gears | • Adjust or replace. |
| | • Driven bevel gear retaining bolts loose | • Replace or retighten. |
| | • Differential drive shaft gear or drive gear damaged | • Replace. |
| Bearing noise | • (Unchanged noise) gear oil deteriorated or wet | • Change and refill. |
| | • (Unchanged noise) gear oil insufficient or type is not correct | • Change and refill. |
| | • (Noise occurs while sliding) drive bevel gear bearing damaged | • Replace. |
| | • (Noise occurs while sliding) differential drive shaft bearing or rear axle shaft damaged | • Replace. |
| Oil leakage | • Ventilation plug clogged | • Clean. |
| | • Oil seal worn or damaged | • Replace. |
| | • Excessive oil | • Adjust oil level. |

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# Components Exploded View



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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Flange | 12 | Nut |
| 2 | Drive/driven bevel gear | 13 | Planetary gear |
| 3 | Drive bevel gear spacer | 14 | Drive shaft gear |
| 4 | Adjusting shim | 15 | Planetary gear shaft |
| 5 | Rolling bearing | 16 | Spring pin |
| 6 | Rolling bearing | 17 | Thrust washer |
| 7 | Drive bevel gear oil seal | 18 | Differential case |
| 8 | Flange locking nut washer | 19 | Bolt |
| 9 | Flange locking nut | 20 | Differential bearing |
| 10 | Final drive case | 21 | Gasket |
| 11 | Bearing cover bolt | 22 | Thrust washer |

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## Symptom Diagnosis and Testing

Refer to: Symptom Chart (2.2.1 Driveline System - Overview, Symptom Diagnosis and Testing).

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# Removal and Installation

# Final Drive

### General Tool

| |
|---|
| Oil bucket |

### Material

| Item | Type |
|---|---|
| Sealant | Sealant 366E |
| Gear oil | Hypoid gear oil SAE90, SAE80W or GL-5 85W/90 |
| Thread sealant | Superior thread sealant 1333B |

## Removal

1. Remove the wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Remove the left and right drive shafts.

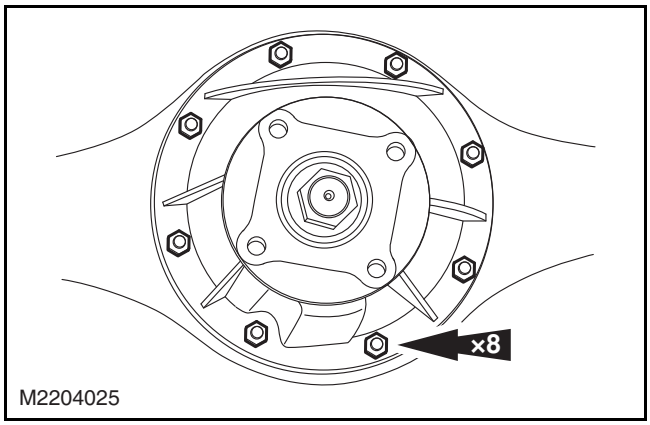
   **Refer to: Drive Shaft (2.2.3 Drive Shaft, Removal and Installation).**

3. Remove the propeller shaft.

   **Refer to: Propeller Shaft (2.2.2 Propeller Shaft, Removal and Installation).**

4. Remove 8 final drive retaining nuts.

   Torque: 23 Nm




5. Remove the final drive with differential assembly.

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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: The differential oil drain bolt is one applied with sealant, replace it with new one and reapply the sealant after removing.**

**CAUTION: Before installation, clean the junction surface between front differential assembly and rear axle, and reapply the sealant.**

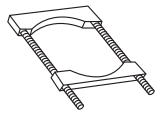
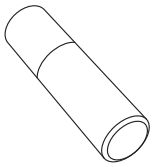
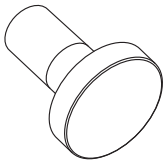
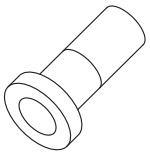
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## Disassembly and Assembly

# Final Drive

### Special Tool

| | |
|---|---|
|  <br>09921-57810 | Bearing remover<br>09921-57810 |
|  <br>09940-51710 | Bearing installer<br>09940-51710 |
|  <br>09913-75510 | Bearing installer<br>09913-75510 |
|  <br>09913-75520 | Bearing installer<br>09913-75520 |

### General Tool

| |
|---|
| Puller |
| Hydraulic device |

### Material

| Item | Type |
|---|---|
| Sealant | Sealant 366E |
| Gear oil | Hypoid gear oil SAE90, SAE80W or GL-5 85W/90 |
| Lithium based grease | Suzuki superior grease A |
| Thread sealant | Superior thread sealant 1333B |

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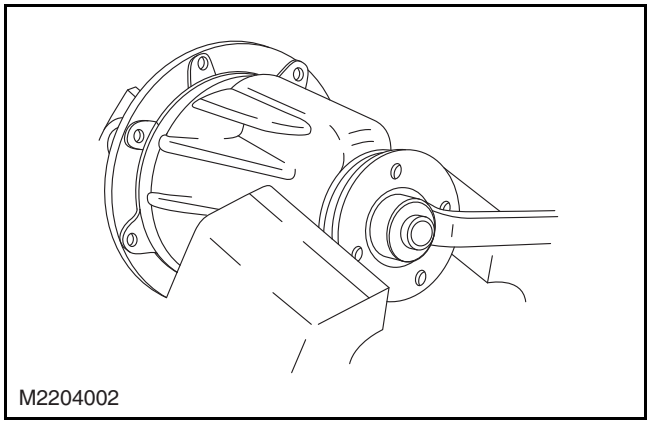


## Disassembly

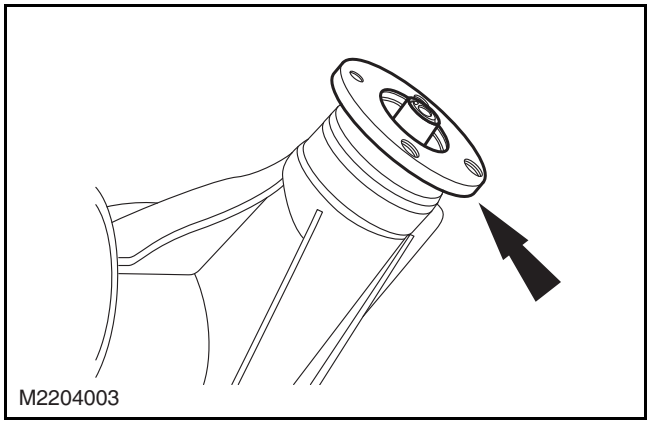
1. Remove the final drive assembly.

   **Refer to: Final Drive (2.2.4 Differential, Removal and Installation).**

2. Clamp the flange tightly, remove the flange retaining nut and remove the washer.


M2204002

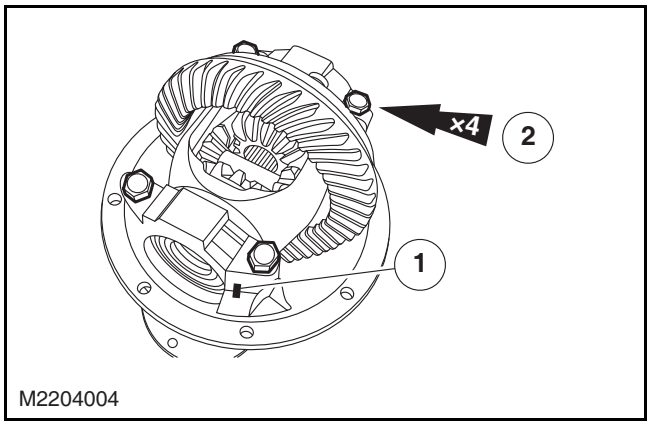
3. Remove the flange from the final drive.


M2204003

4. Remove the bearing cover.

   1 Mark the differential bearing cover.

   2 Remove 4 retaining bolts from the right and left differential bearing covers, and remove the bearing covers.

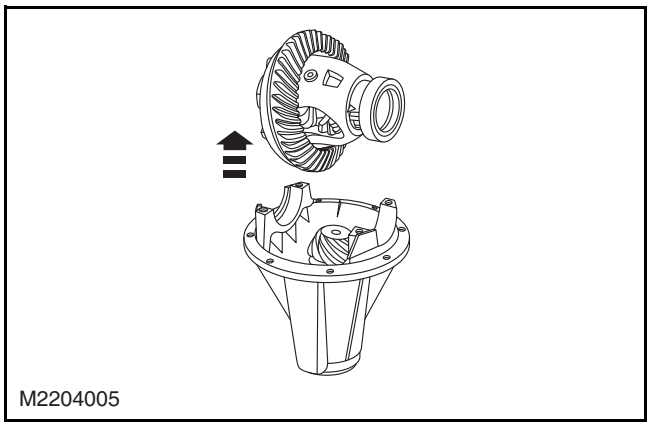


M2204004

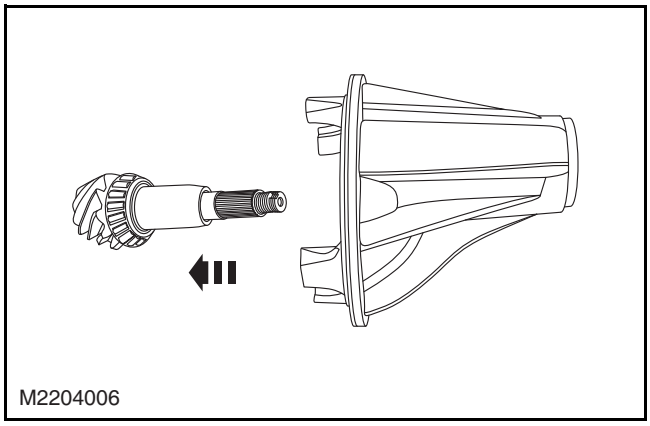
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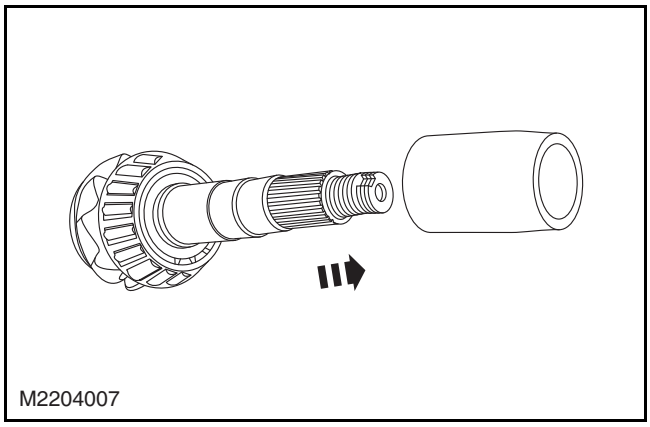
**5.** Remove the differential.


M2204005

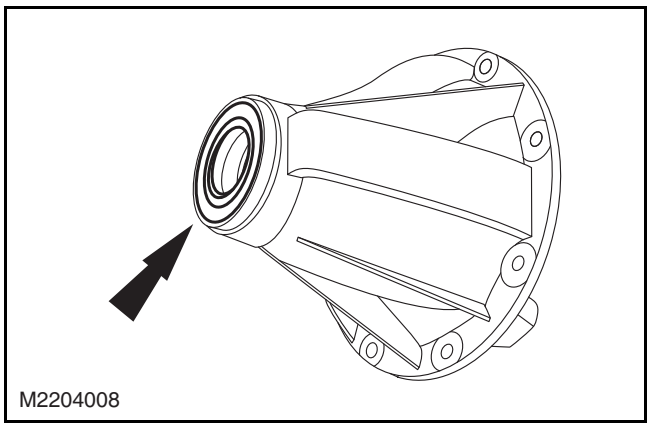
**6.** Remove the drive bevel gear shaft.


M2204006

**7.** Remove the drive bevel gear spacer from drive bevel gear shaft.


M2204007

**8.** Remove the drive bevel gear oil seal.

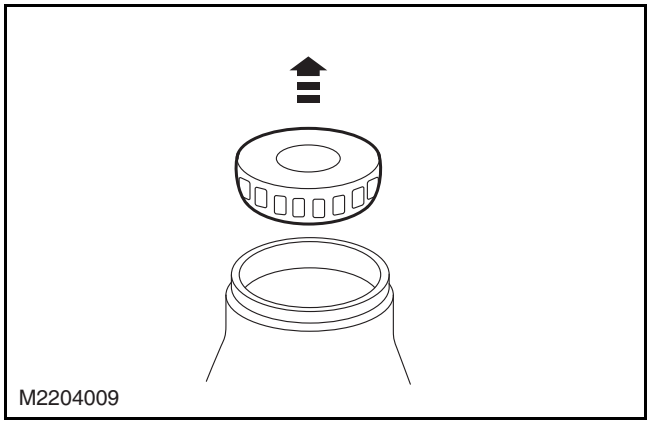

M2204008

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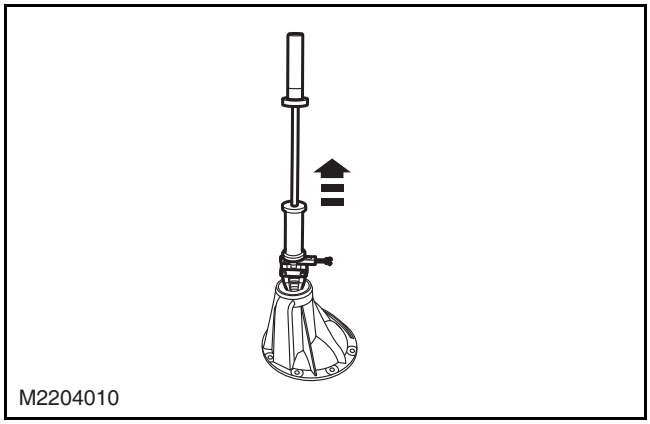
**9.** Remove the drive bevel gear front bearing.

1 Remove the front bearing from the final drive case.


M2204009

2 Use a suitable tool to remove the front bearing outer race.

General tool: Puller

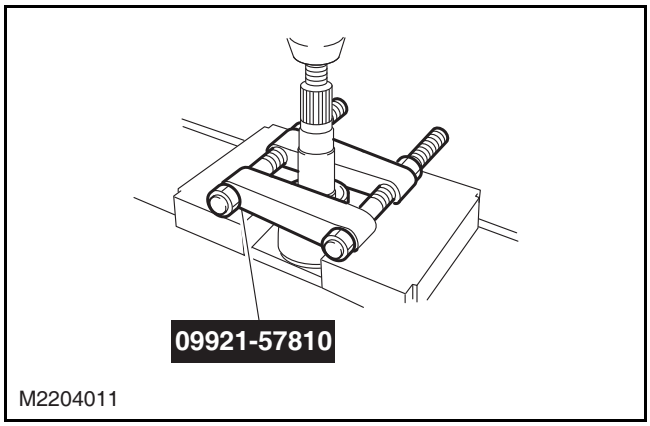

M2204010

**10.** Remove the drive bevel gear rear bearing.

1 Use the special tool to remove the rear bearing from drive bevel gear.

Special tool: 09921-57810

General tool: Hydraulic device



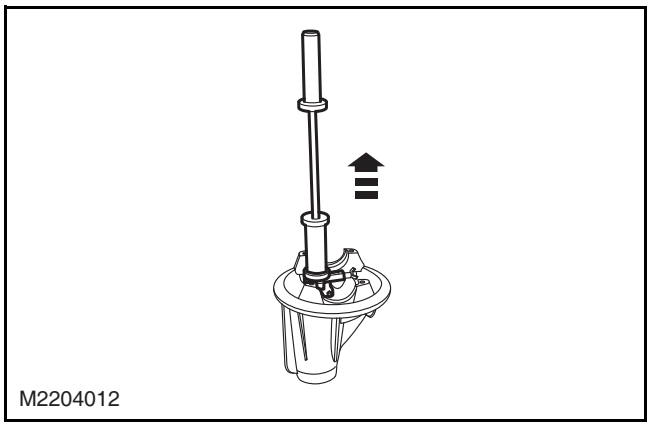
M2204011

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2 Use a suitable tool to remove the rear bearing outer race.

General tool: Puller


M2204012

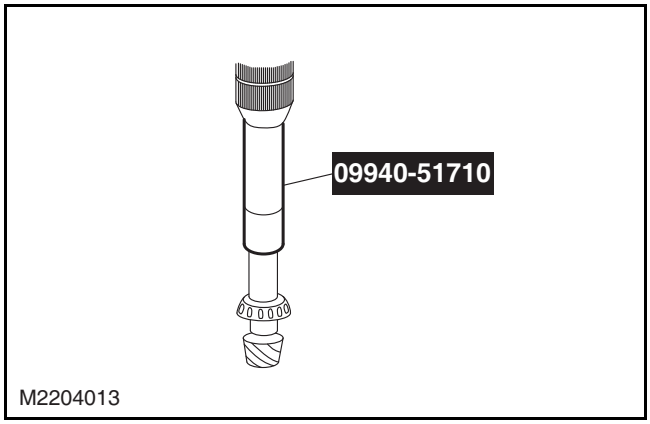
## Assembly

**1.** Install the drive bevel gear rear bearing.

1 Use the special tool to install the rear bearing to drive bevel gear.

Special tool: 09940-51710

General tool: Hydraulic device

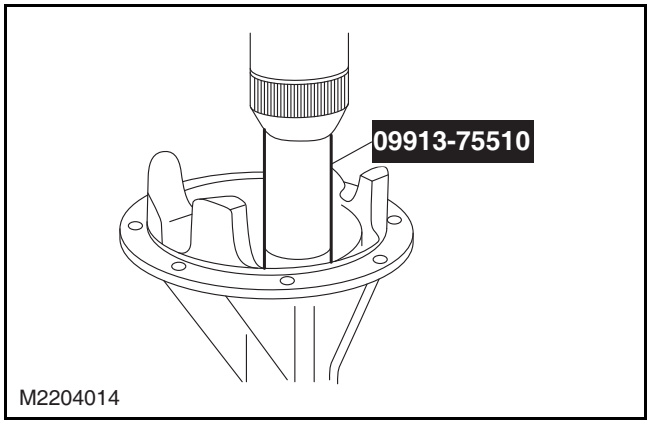


M2204013

2 Use suitable tools to install the rear bearing outer race.

Special tool: 09913-75510

General tool: Hydraulic device



M2204014

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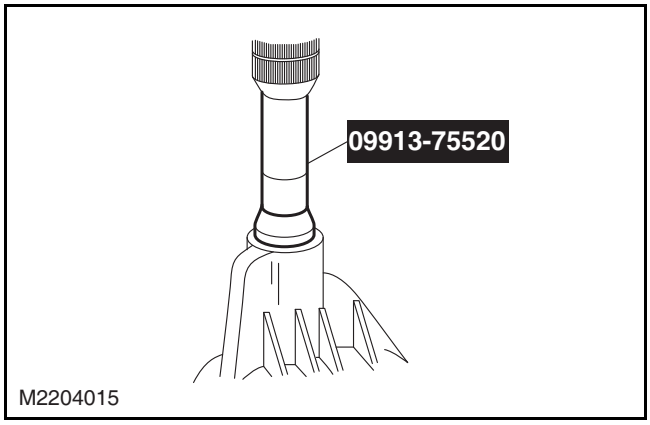


**2.** Install the drive bevel gear front bearing.

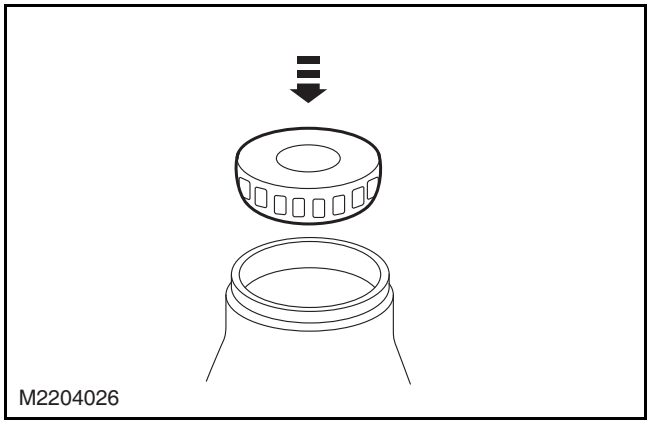
1 Use the special tool to install the front bearing outer race.

Special tool: 09913-75520

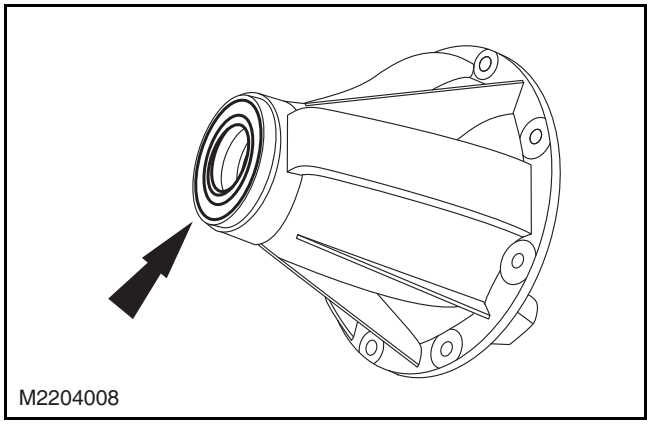
General tool: Hydraulic device



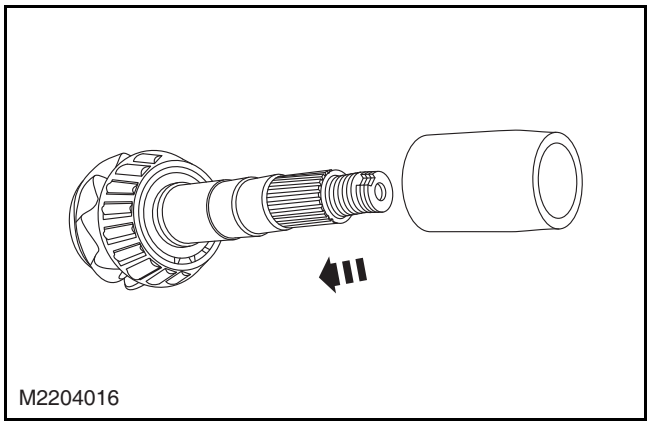

2 Install the front bearing into the final drive case.




**3.** Install the drive bevel gear oil seal.



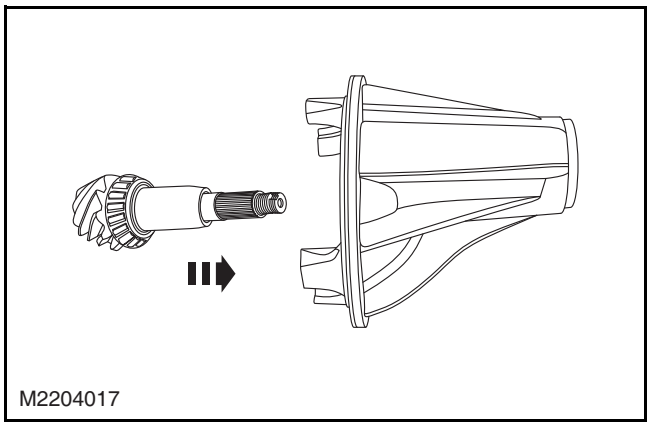

**4.** Install the drive bevel gear spacer to the drive bevel gear shaft.



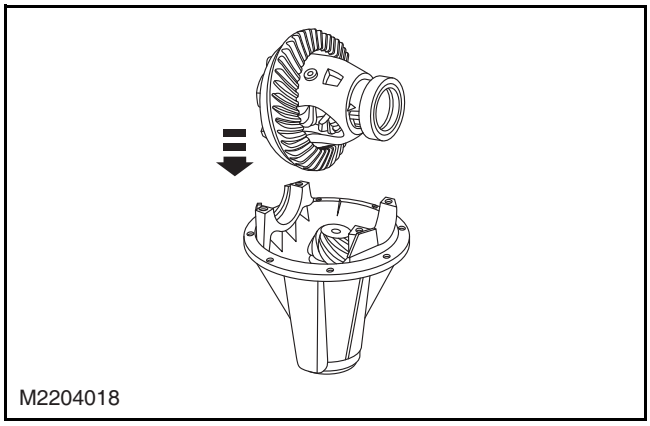
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**5.** Install the drive bevel gear shaft.


M2204017

**6.** Install the differential.

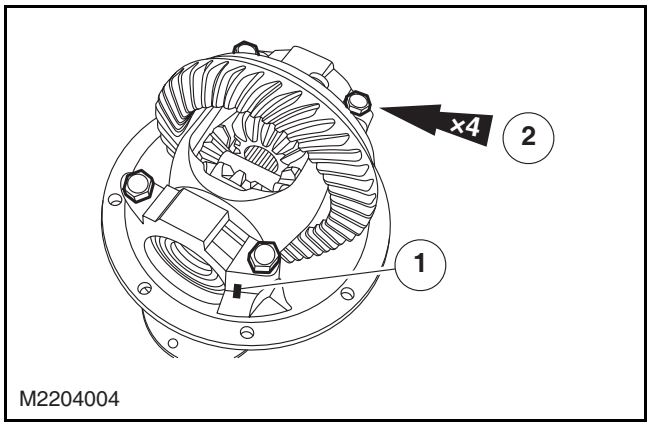

M2204018

**7.** Install the left and right differential bearing covers.

1 Align the mark on the bearing cover during installation.

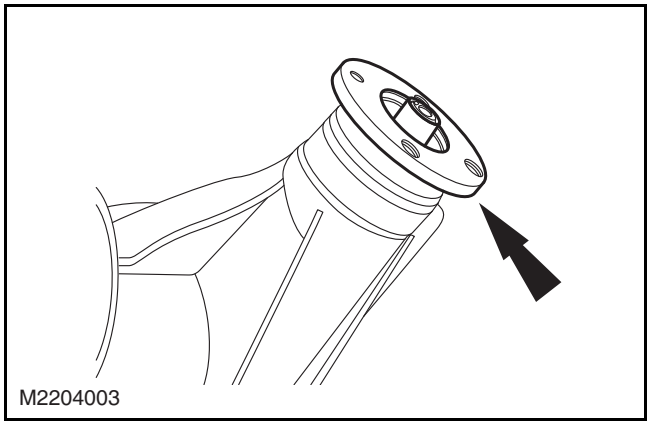
2 Tighten 4 bearing cover retaining bolts.

Torque: 50 Nm



M2204004

**8.** Install the final drive flange.

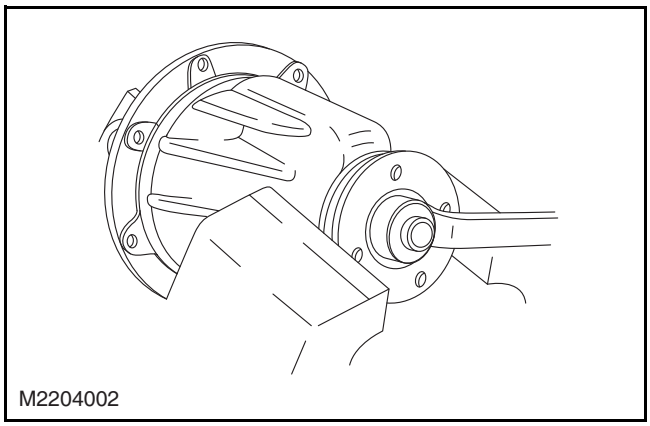

M2204003

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**9.** Install the flange washer and tighten the flange retaining nut.

Torque: 200 Nm


M2204002

**10.** Install the final drive assembly.

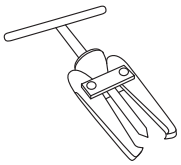
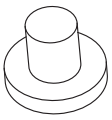
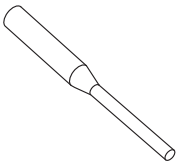
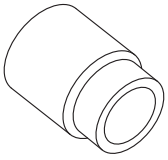
**Refer to: Final Drive (2.2.4 Differential, Removal and Installation).**

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# Differential

### Special Tool

| | |
|---|---|
|  <br>09913-60910 | Bearing/gear puller<br>09913-60910 |
|  <br>09913-85230 | Bearing remover<br>09913-85230 |
|  <br>09922-85811 | Spring platinum remover<br>09922-85811 |
|  <br>09940-53111 | Bearing installer<br>09940-53111 |

### General Tool

| |
|---|
| Hammer |
| Hydraulic device |

### Material

| Item | Type |
|---|---|
| Sealant | Sealant 366E |
| Gear oil | Hypoid gear oil SAE90, SAE80W or GL-5 85W/90 |
| Thread sealant | Superior thread sealant 1333B |

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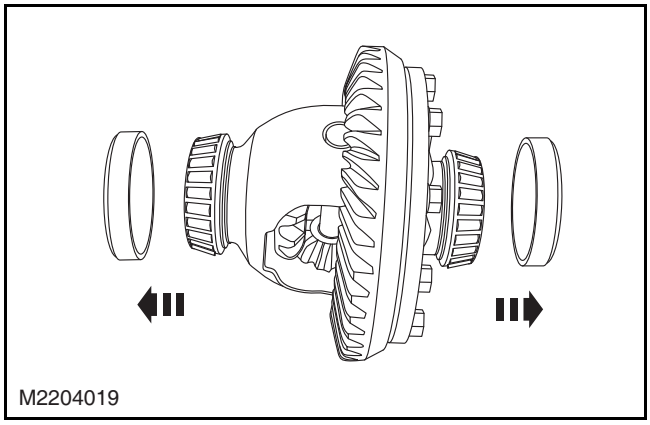
## Disassembly

1. Remove the differential.

   **Refer to: Final Drive (2.2.4 Differential, Disassembly and Assembly).**

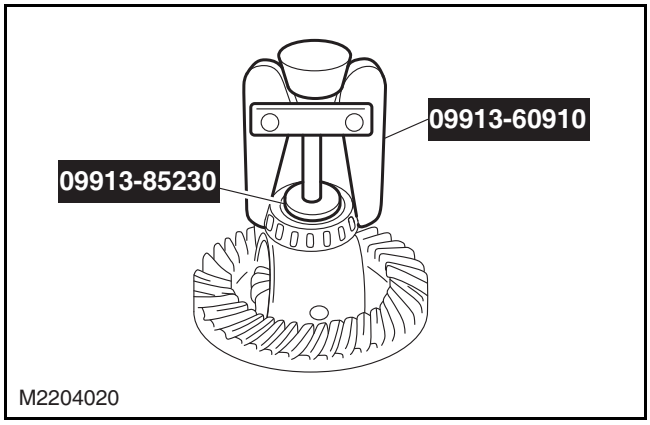
2. Remove the differential bearing.

   1 Remove the differential bearing outer race.


M2204019

   2 Use the special tool to remove the differential bearing.

   Special tool: 09913-60910, 09913-85230

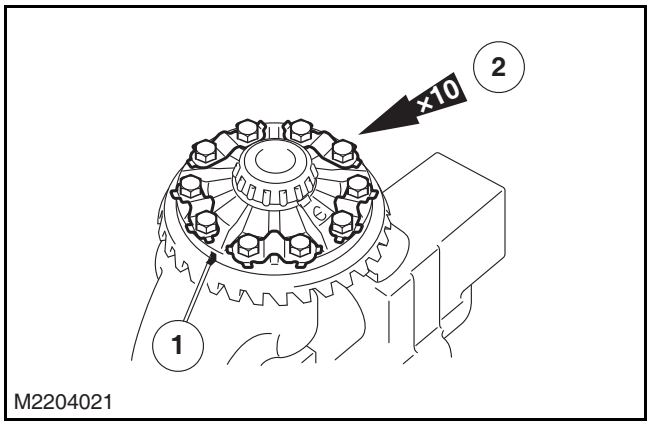


M2204020

3. Remove the driven bevel gear.

   1 Mark the driven bevel gear and differential.

   2 Remove 10 retaining bolts from the driven bevel gear and remove the driven bevel gear.



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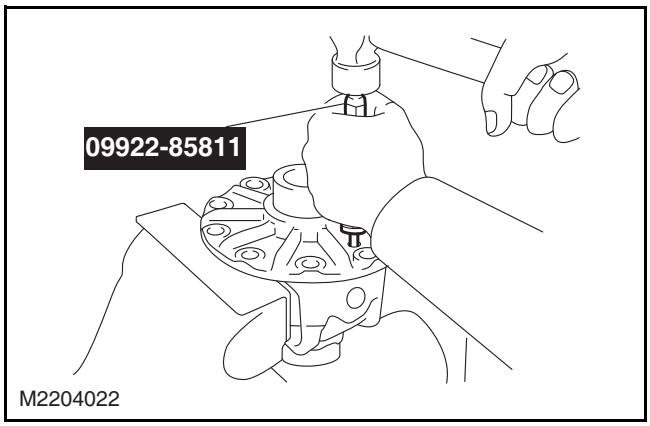


**4.** Remove the differential planetary gear.

1 Use the special tool to pry the spring pin.

Special tool: 09922-85811

General tool: Hammer




2 Remove the planetary gear shaft and planetary gear.

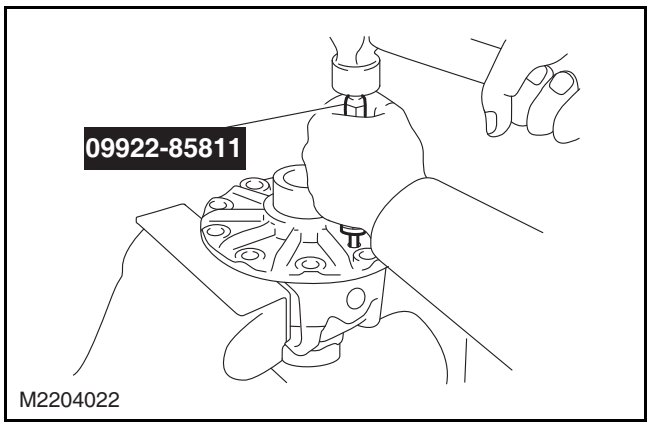
## Assembly

**1.** Install the differential planetary gear.

1 Install the planetary gear and planetary gear shaft into the differential case, and tap in the spring pin.

Special tool: 09922-85811

General tool: Hammer

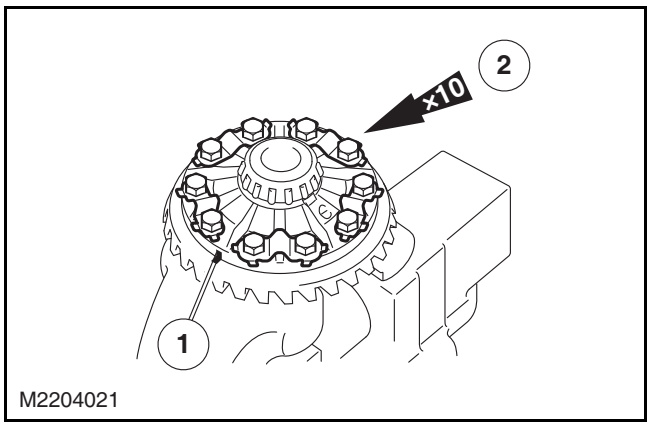



**2.** Install the driven bevel gear.

1 Align the marks on the driven bevel gear and differential.

2 Install 10 driven gear retaining bolts.

Torque: 85 Nm



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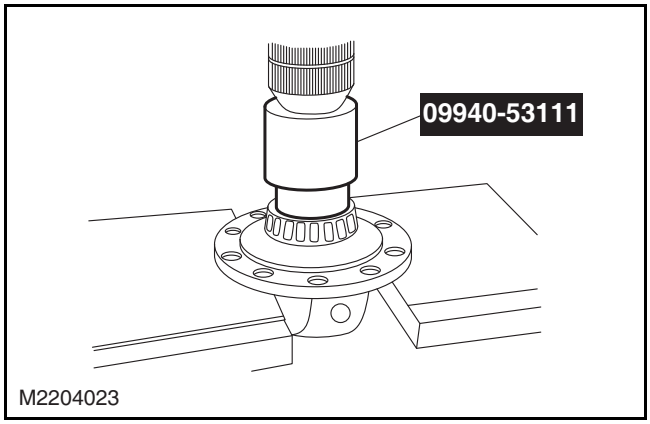


**3.** Install the differential bearing.

1 Use the special tool to install the differential bearing.

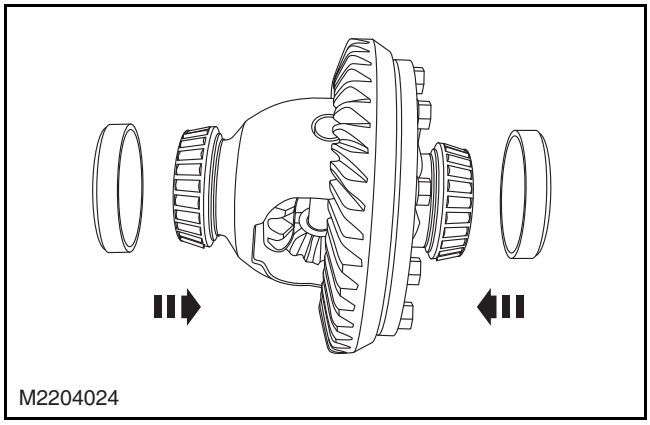
Special tool: 09940-53111

General tool: Hydraulic device



M2204023

2 Install the differential bearing outer race.


M2204024

**4.** Install the differential.

**Refer to: Final Drive (2.2.4 Differential, Disassembly and Assembly).**

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# 2.3 Brake System

## 2014 MD/MS201

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## Specifications

# Material Specifications

| Item | Type | Rated Capacity (L) |
|---|---|---|
| Brake fluid | HZY3/HZY4 | 0.48 ± 0.035 |

# General Specifications

| Front Disc Brake | Specifications |
|---|---|
| Brake disc normal thickness | 17 mm |
| Brake disc limit thickness | 15 mm |
| Brake disc maximum runout | 0.15 mm |
| Brake disc limit offset | 0.15 mm |
| Brake friction block minimum thickness | 7 mm |

**WARNING: When the brake disc limit thickness has been reached, install a new brake disc. Take extra care when performing a polishing treatment on the brake disc that has not reached the limit thickness.**

**WARNING: When the brake disc limit thickness has been reached, install a new brake disc.**

| Rear Drum Brake | Specifications |
|---|---|
| New brake drum normal diameter | 254 mm |
| Brake drum limit diameter | 256 mm |
| New primary brake shoe friction lining thickness | 7 mm |
| New secondary brake shoe friction lining thickness | 7 mm |
| Brake shoe friction lining limit thickness | 3 mm |

**WARNING: When the brake drum limit diameter has been reached, install a new brake drum. Take extra care when performing a polishing treatment on the brake drum that has not reached the limit diameter.**

**WARNING: When the brake shoe friction lining limit thickness has been reached, install a new brake shoe.**

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## Description and Operation

# System Overview

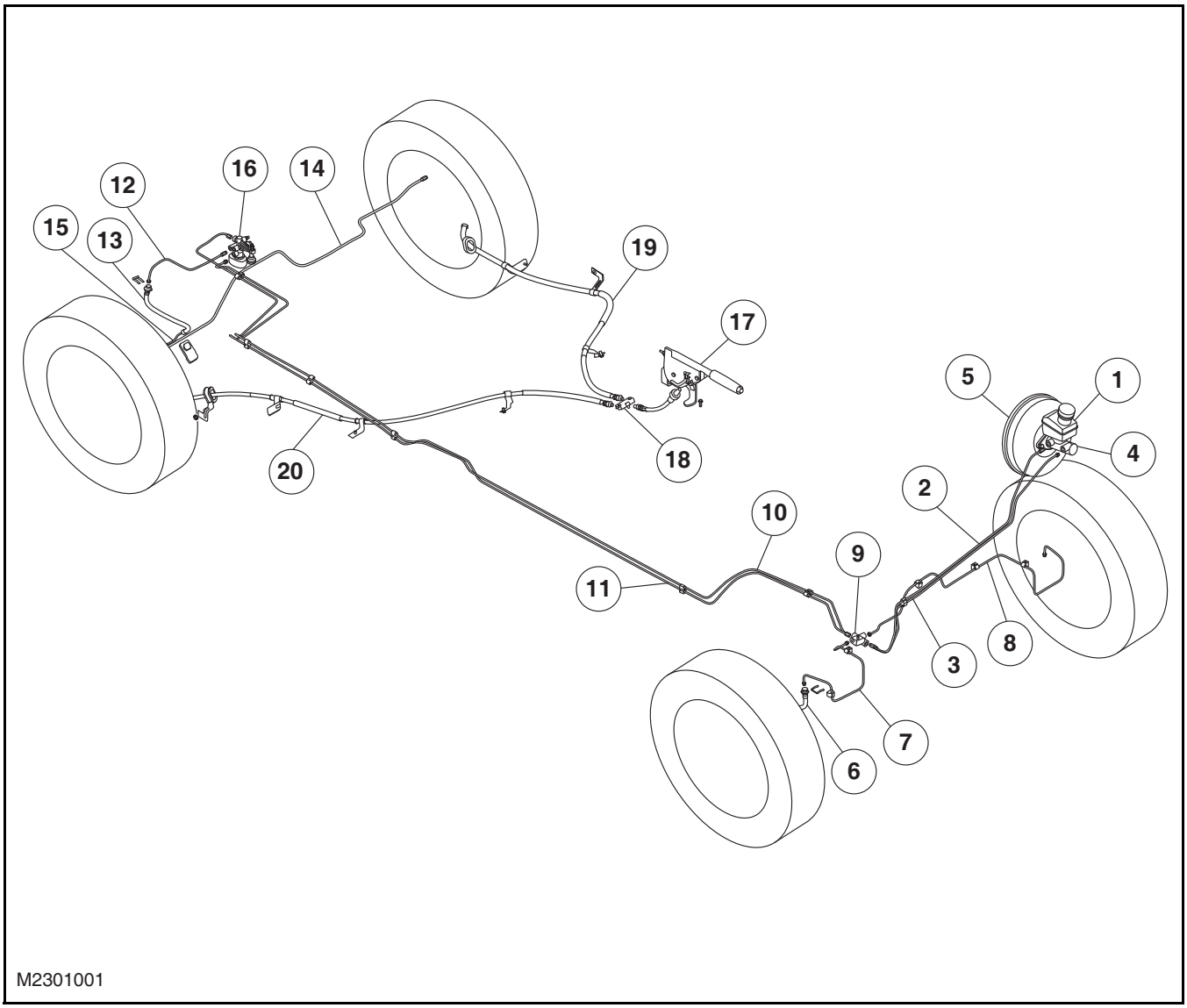
- The brake system uses parallel dual brake master cylinder. The brake pipe is connected to the brake master cylinder and has two independent circuits. One is connected to the front brakes (left and right) and the other is connected to rear brakes (left and right). When the brake pedal is depressed, hydraulic pressure will be generated inside the brake master cylinder, causing the piston to move back and forth. The brake master cylinder and brake booster are located in the left side of front compartment. The vacuum booster can increase brake force and reduce the force applied to the brake pedal by the driver.
- The disc brakes are used for front hydraulic brakes and the drum brakes are used for rear hydraulic brakes. The front disc brake uses floating brake caliper, which is installed on the steering knuckle. The rear drum brake uses conventional leading trailing shoe and can automatically adjust the brake clearance.
- The parking brake system is a mechanical system that operates the rear drum brakes by parking brake lever and only apply brake force to rear wheels by the cables and mechanical links. The parking brake and driving brake use the same brake shoes. The parking brake lever is located between two front seats, and the system can be enabled by pulling it up.
- The vehicle without ABS should have a "Load Sensing Proportioning Valve (LSPV)" installed.

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# Location View

## Brake Pipe



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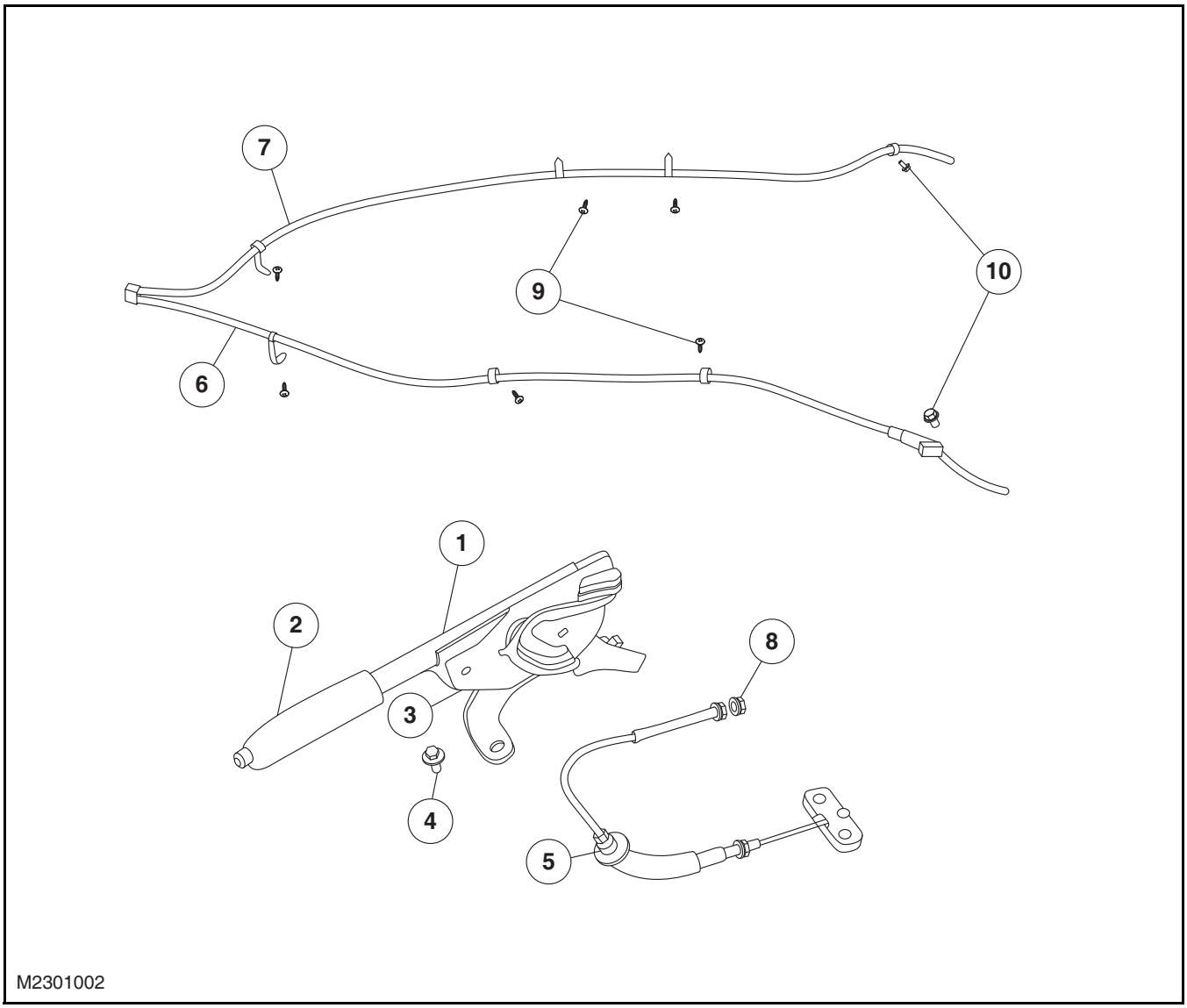


| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Brake fluid reservoir | 11 | Brake pipe assembly (6-way passage II - LSPV port 1) |
| 2 | Brake pipe assembly (master cylinder primary cavity - 6-way passage I) | 12 | Brake pipe assembly (LSPV - rear brake hose) |
| 3 | Brake pipe assembly (master cylinder secondary cavity - 6-way passage II) | 13 | Rear brake hose |
| 4 | Master cylinder | 14 | Brake pipe assembly (left wheel cylinder - right wheel cylinder) |
| 5 | Vacuum booster | 15 | Brake pipe assembly (rear brake hose - right wheel cylinder) |
| 6 | Front brake hose | 16 | Load sensing proportioning valve assembly |
| 7 | Brake pipe assembly (6-way passage I - front right hose) | 17 | Parking brake lever |
| 8 | Brake pipe assembly (6-way passage I - front left hose) | 18 | Cable equalizer |
| 9 | 6-way joint | 19 | Left parking brake cable |
| 10 | Brake pipe assembly (6-way passage I - LSPV port 2) | 20 | Right parking brake cable |

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## Parking Brake and Cable




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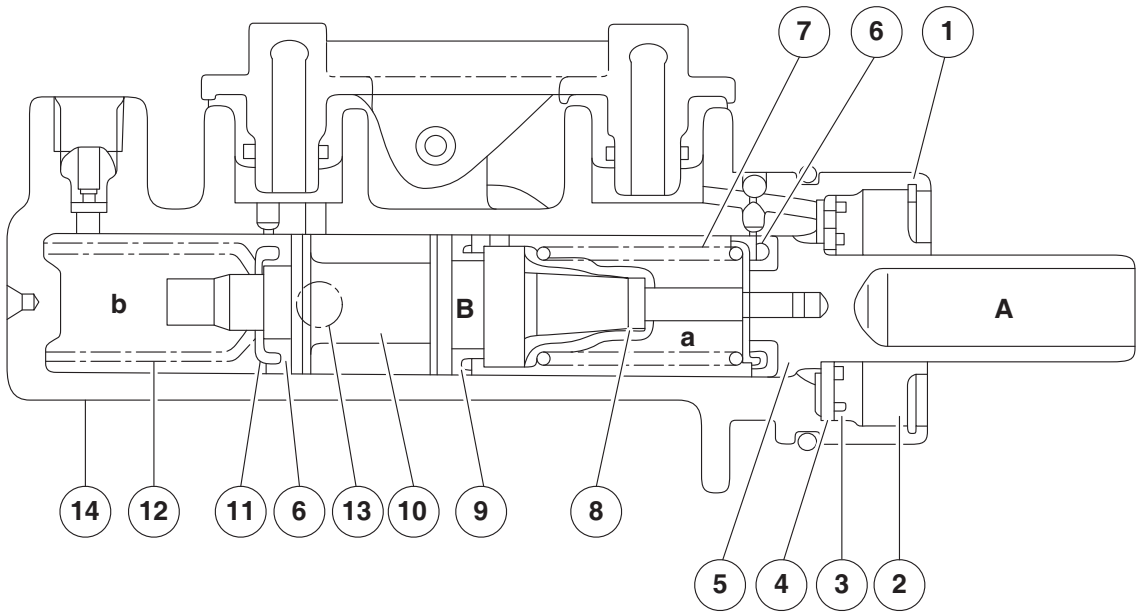
| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Parking brake lever assembly | 6 | No.2 parking brake cable assembly (left) |
| 2 | Handle | 7 | No.2 parking brake cable assembly (right) |
| 3 | Parking brake switch assembly | 8 | Hexagonal nut with serrated flange |
| 4 | Hexagon flange bolt | 9 | Hexagonal cross head screw |
| 5 | No.1 parking brake cable assembly | 10 | Hexagon flange bolt |

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## Brake Master Cylinder Assembly

The brake master cylinder has 2 pistons and 3 piston cups and its hydraulic pressure is generated in the first piston chamber (a) and second piston chamber (b). The hydraulic pressure generated in the first piston chamber acts on the front brakes and that generated in the second piston chamber acts on the rear brakes.




M2301005

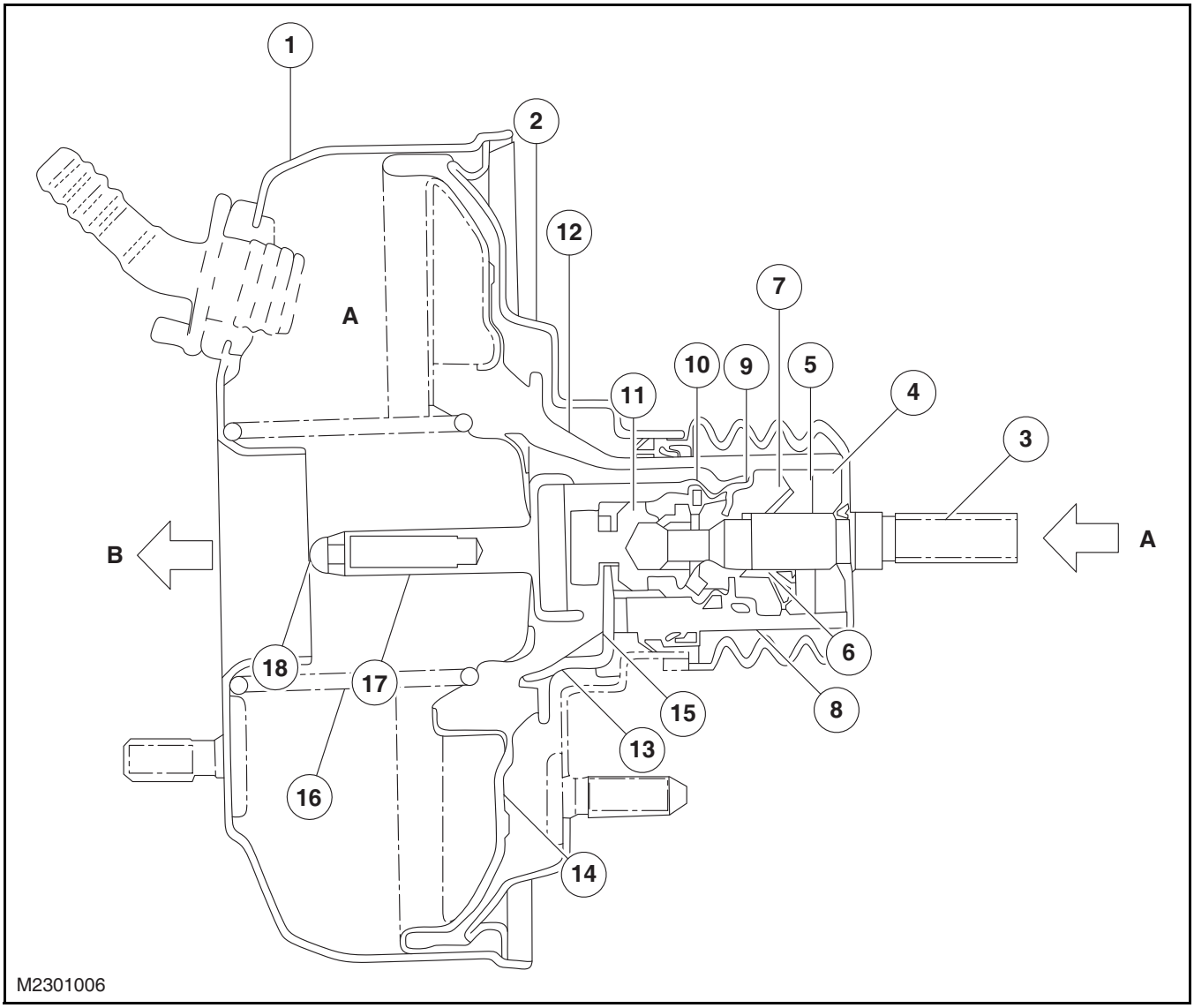
| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Piston stopper ring | 9 | Second piston cup |
| 2 | Piston stopper | 10 | Second piston |
| 3 | Cylinder head | 11 | Return spring seat |
| 4 | Panel | 12 | Second piston return spring |
| 5 | First piston | 13 | Second piston stopper bolt |
| 6 | Piston cup | 14 | Brake master cylinder |
| 7 | First piston return spring | A | First piston |
| 8 | First piston spring holder | B | Second piston |

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## Booster Assembly

The booster is located between master cylinder and brake pedal. When brake pedal is depressed, the engine vacuum negative pressure is used to increase the mechanical brake force.




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | No.1 booster | 11 | Booster valve |
| 2 | No.2 booster | 12 | Booster piston |
| 3 | Valve lever | 13 | Valve stopper |
| 4 | Air cleaner element | 14 | Booster diaphragm |
| 5 | Air cleaner separator | 15 | Reaction disc |
| 6 | Gas valve return spring | 16 | Booster piston return spring |
| 7 | Gas valve return spring | 17 | Booster piston rod |
| 8 | Control valve spring holder | 18 | Booster rod adjusting screw |
| 9 | Control valve spring | A | Brake pedal |
| 10 | Booster control valve | B | Master cylinder |

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## Operation

When the brake pedal is depressed, the brake force passes through the valve lever, booster gas valve, reaction disc, piston rod and finally to the master cylinder piston. Also, the pressure difference between piston chambers "A" and "B" acts on the booster piston, generating assist power. Therefore, a small force applied on the brake pedal will from a powerful pushing force for the master cylinder rod, consequently generating a higher hydraulic pressure.

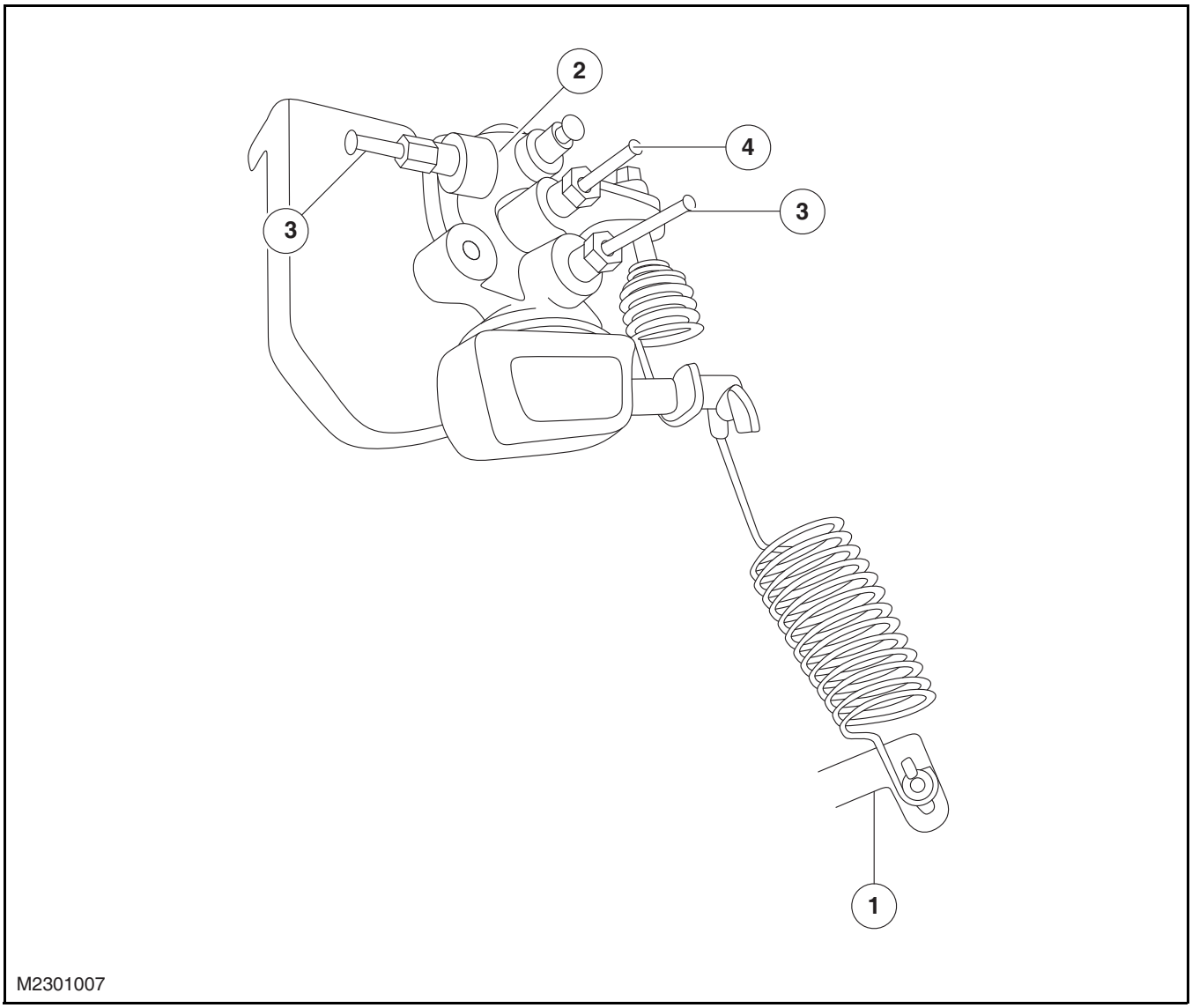
If a fault occurs in any component related with vacuum in the booster, the brake force will not be increased. Still, the brake force by depressing the brake pedal will be transmitted to the valve lever, booster gas valve, valve stopper pin and booster piston, finally push the master cylinder rod. Therefore, there will be no operation fault in the brake itself.

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## Load Sensing Proportioning Valve Assembly

Load Sensing Proportioning Valve (LSPV) is located inside the brake circuit connecting master cylinder and rear brakes, which can control the hydraulic pressure to rear brakes according to vehicle load condition (or load weight) so as to prevent rear wheels from locking too early. It can also release excessively high pressure supplied to rear brakes. In case that the hydraulic circuit of front brakes fails, the hydraulic pressure generated in the master cylinder will be directly provided to rear wheel brake for brakes control.




M2301007

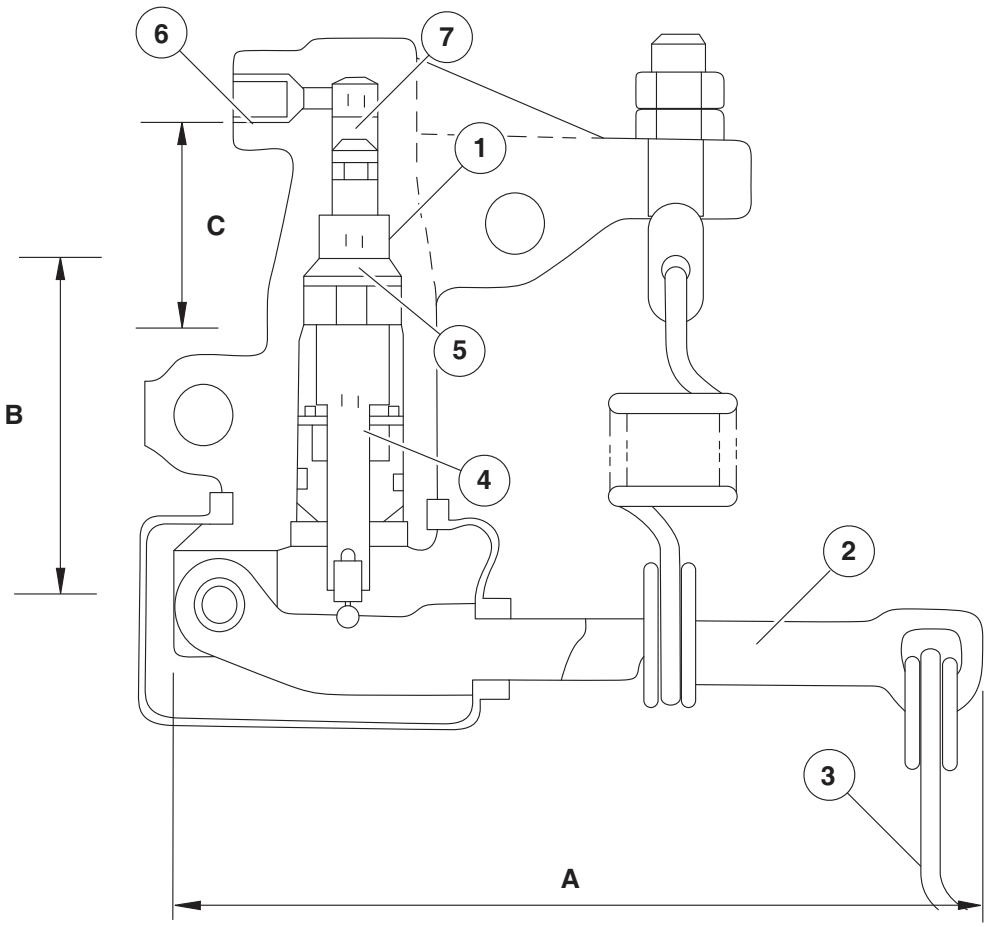
| Item | Description | Item | Description |
|---|---|---|---|
| 1 | LSPV spring support (rear axle housing) | 3 | From master cylinder |
| 2 | LSPV (Load Sensing Proportioning Valve) assembly | 4 | To rear brakes (left and right) |

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## Construction

The LSPV mainly consists of three parts including the sensor ("A"), hydraulic pressure control ("B") and fail-safe ("C"). The primary components of sensor part are the control lever and spring. When the spring is affected by the load, it can sense the change of vehicle height and convert it to load signal. The hydraulic pressure control part mainly includes the plunger and the valve system executing proportion control. The primary components of fail-safe part is the piston and fail-safe piston. The piston chamber can suck hydraulic pressure through the front brakes. When a fault occurs in the front brake system, the fail-safe piston will release the pressure from valve system which is connected to rear brakes.




M2301008

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Plunger | 5 | To rear brake |
| 2 | LSPV control lever | 6 | From master cylinder second piston chamber (front brake) |
| 3 | Sensor spring | 7 | Overflow plug |
| 4 | From first piston chamber (rear brake) | | |

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## General Inspection

# Road Test

**WARNING: The road test technicians must be trained and have good driving skills.**

Road test is carried out to compare the actual braking performance with standard performance expected by the driver. The ability to compare and judge the braking performance depends on the technician's experience. The technician must have thorough knowledge of the brake system operation and receive a systematic instruction to make correct comparison and detect problems.

Before a road test, make sure the vehicle conforms to the following conditions:

- The front suspension attachments are not loose.
- The tires have not been excessively worn, and have almost the same tire tread on both left and right tires.
- The tire pressure is within the specification range.
- Wheel alignment is correct.
- Brake fluid level is normal.

The road test must be done on a dry, clean and even road. An experienced technician will always select a route that is suitable for brake diagnosis road tests. The roads selected should be reasonably smooth and level rather than gravel or rough road. It is mainly because gravel or rough roads make the adhesive force of tires and road surface different. Cambered road is also not appropriate for road test, because most of vehicle weight is centered at two relatively lower wheels. Once the route is established and consistently used, the road surface factors cannot be considered.

Before a road test, obtain a complete description of the customer concerns. From the description, the technician can match the Possible Causes with the symptoms. Certain components will be tagged as possible suspects while other will be eliminated. More importantly, according to the description of the customer, the technician can inspect or eliminate the potential hazards before the road test. The technician can also put all problems on some particular components, vehicle speed or conditions, which helps determine a method of carrying a road test.

A road test should start with the general inspection for the brake performance. According to the description of the customer, the vehicle braking should be inspected with different pedal pressures under different vehicle speeds to see if the vehicle can be stopped effectively at a constant speed. To determine if the concern is in the front or rear braking system, first use the brake pedal and then use the parking brake control. If the symptoms (pull, vibration, isolation) occur only with the parking brake, the concern is in the rear brake system.

During the road test, brake locking should be avoided. Such situation does not mean the brake works normally. A powerful braking and maintaining wheel turning will stop the vehicle in a shorter distance than locked brakes.

If the fault becomes evident during this test, verify that it is consistent with the description. If the concern is not evident, attempt to reappear the condition using the information gained from the description.

If a fault exists, use the Symptom Chart to summarize it to a specific sub-system and corresponding condition description. Through this description, a list of Possible Causes can be used to further narrow down the cause to a specific component or condition.

# Hydraulic Leakage Inspection

**CAUTION: In normal condition, the brake fluid level goes down as the brake shoe is worn. The brake fluid level will become excessively low if the brake shoe gets worn beyond the specification. If the brake shoe wear is within the specification while the brake fluid level also gets excessively low, it shows that there is brake fluid leakage in the brake system. Repair or replace the damaged parts even if there is a slight leakage.**

**CAUTION: When the vehicle is running on a rainy or snowy day, the leak trace can be washed away since the brake fluid is water soluble.**

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Inspect as follows:

1. Verify the brake fluid level is excessively low or goes down too fast.
2. Visually inspect for brake fluid leakage.
3. Remove the front wheels.

   **Refer to: Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).**

   Inspect the front brake wheel cylinders for any leakage and the brake shoes for any wear.
4. Remove the rear wheels and brake drums.

   **Refer to: Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).**

   Inspect the rear brake wheel cylinders for any leakage and the brake shoes for any wear.
5. Remove the brake master cylinder.

   **Refer to: Brake Master Cylinder (2.3.2 Hydraulic Brake Control, Removal and Installation).**

   Inspect the brake master cylinder piston seal for any leakage.
6. Repair the possible faults above and carry out the brake system bleeding.

   **Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

## Substandard or Polluted Brake Fluid

Improper brake fluid, brake fluid containing mineral oil or water will cause the fluid boiling or damage to rubber components inside the hydraulic system.

If the first piston cup plumps up, it means the rubber components are damaged. This damage will also cause the piston cup of brake cylinder plump up.

If rubber components are obviously damaged, remove all hydraulic components and clean with ethanol. Before assembling, dry these components with compressed air, making this system without ethanol. Replace all rubber components of this system, including hoses. When brake unit is working, check if there is brake fluid on the friction lining; replace the brake pad if brake fluid is too much.

If the seal rings of master cylinder piston are normal, check for leakage or overheating. If not, discharge the brake fluid, wash it with brake fluid; then refill and discharge the air inside the system.

If the grade of brake fluid used in this system is suspected or polluted one is used, wash this system.

## Brake Fluid Level Inspection

Use the brake fluid labeled on the reservoir cover or the one recommended in the user's manual. Do not use other brake fluid.

The brake fluid level shall be between the lowest and highest level marked on the reservoir. During running, fill the liquid to the highest level when the warning light is on.

When the brake fluid is reduced quickly, the brake system should be inspected for leaking. Then repair the leaking part, and refill it to the specified level.

⚠ **CAUTION: Do not use damper fluid or other fluid with mineral oil. Do not use wet container containing mineral oil. Mineral oil would cause expansion and deformation of rubber components inside the brake system. If the brake fluid contains water, the boiling point will be**

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**decreased. Cover all fluid containers to prevent pollution.**

## Brake Pedal Free Height Adjustment

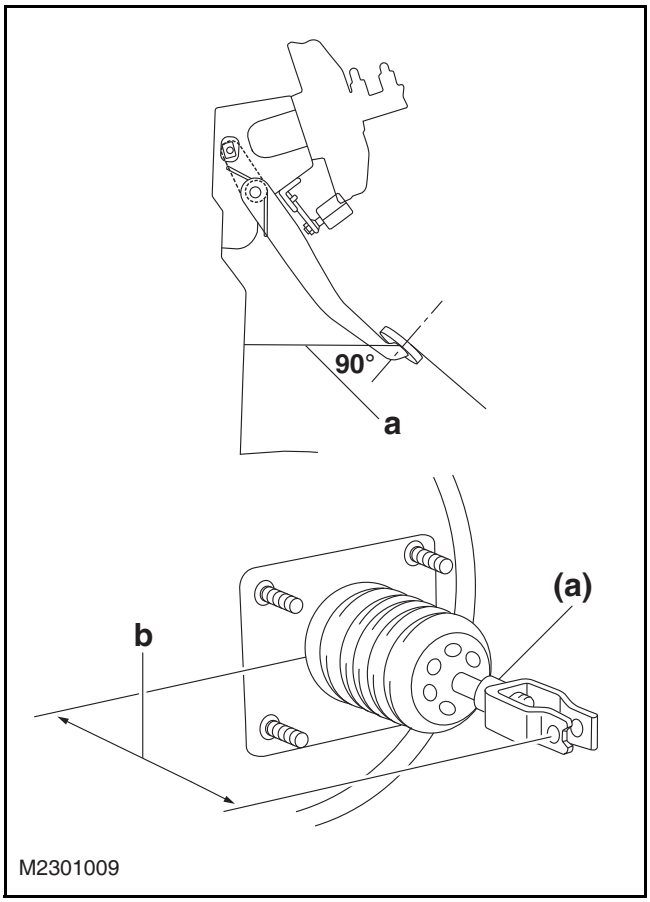
Inspect the brake pedal free height. If the free height does not accord with technical requirements, inspect and adjust according to step (1) and (2).

Brake Pedal Free Travel "a"

1. Inspect the distance between booster installation surface and U pin hole center. When reinstalling the U pin, adjust this distance.

   Length "b": 116 ± 0.5 mm

   Tightening torque (a): 25 ± 5 Nm



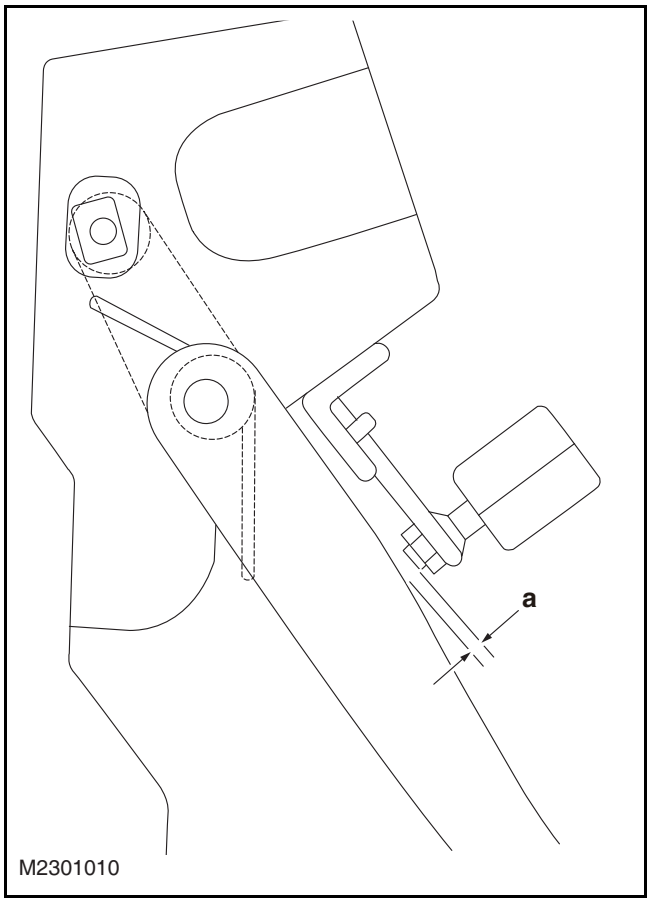

2. Inspect the brake lamp switch position; if it doesn't meet the technical requirements, adjust it.

## Brake Lamp Switch Adjustment

For switch installation, adjust according to requirements below. Pull up the brake pedal towards yourself to adjust the switch position, making the clearance between thread end and brake pedal accord with technical requirements, and tighten the locking nut according to specified torque.

Clearance "a": 1.5 ~ 2.5 mm

Tightening torque (a): 15 ± 5 Nm




## Brake Master Cylinder Inspection

Inspect the master cylinder casting for cracks or brake fluid around it. If there are a small amount of liquid drops, leakage exists. Also, moisture regain of casting is not normal.

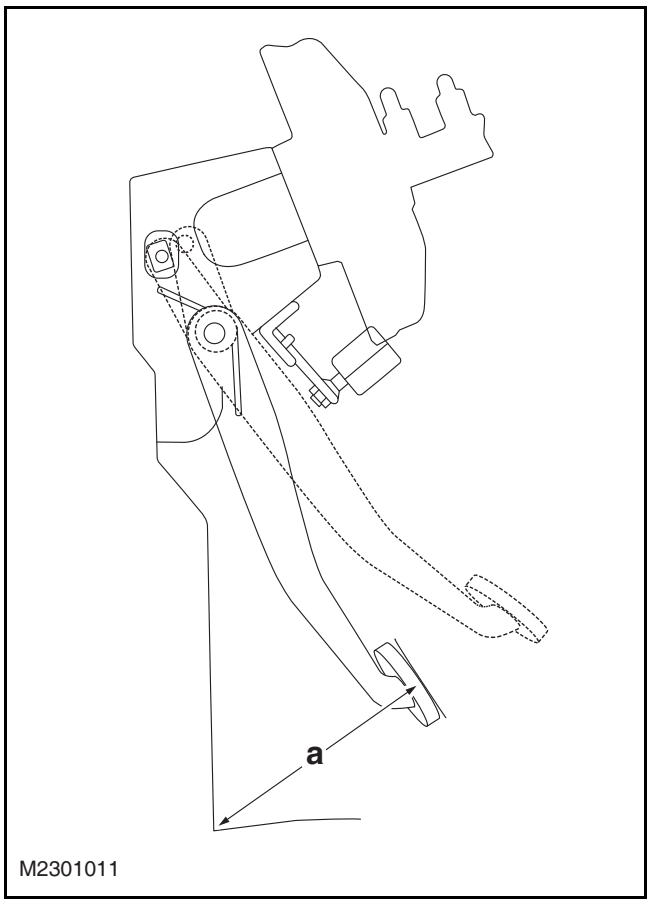
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## Pedal Stroke Inspection

1. Start the engine.
2. Depress the brake pedal several times.
3. When depressing the brake pedal with a force about 30 kg, measure the clearance "a" between brake pedal and cowl inner wall.

   Clearance "a": more than 155 mm



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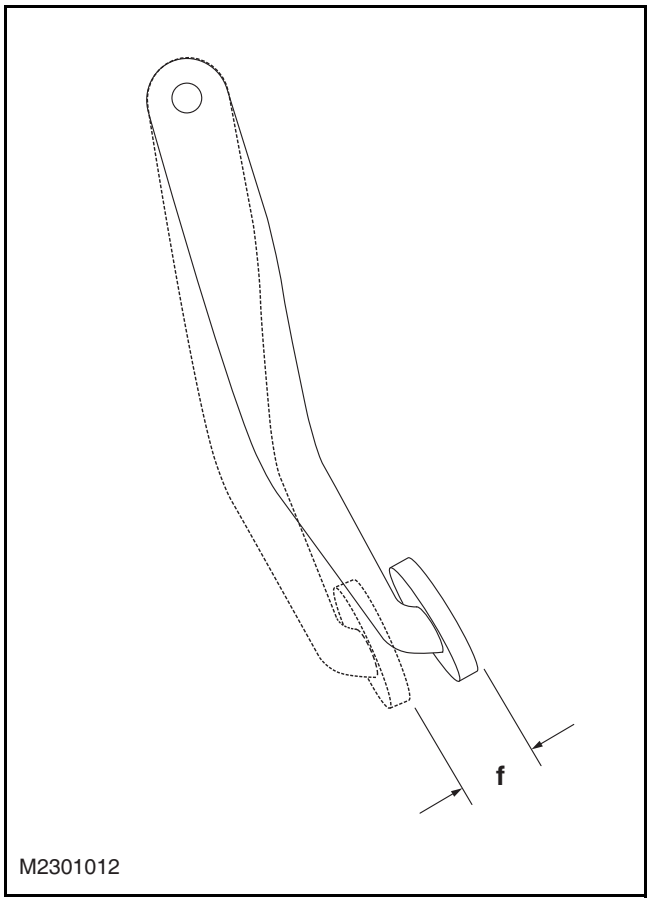
4. If the clearance "a" is less than specified dimension, it is probably caused by the wear of rear brake shoes or air in the pipes. If always so even after replacement of the brake shoes and discharging of the system, it is most likely that a fault occurs in the regulator of rear brake shoe or the length of booster push rod is out of adjustment, which is, however, only with small probability.

   When inspecting the regulator, remove the brake drum (see Brake Drum Inspection); if damaged, repair or replace.

## Brake Pedal Play Inspection

The pedal play shall be within the following technical range; otherwise inspect if the brake lamp switch is well installed. Adjust when necessary. And also inspect the tightening of pedal shaft bolts and master cylinder pins. Replace if damaged.

Pedal clearance "f": 1 ~ 8 mm



M2301012

## Rear Drum Brake Shoe Adjustment

Rear brake is equipped with a self-adjusting mechanical unit. However, after the brake shoe is replaced or the brake drum is removed for other maintenances, adjust the clearance between brake drum and brake shoe. After installation of all components, depress the brake pedal with a force of 30 kg until no "click" sound from the self-adjusting mechanical unit can be heard.

Then, inspect if brake drums are stuck and brake system has good performance. Last, lower the vehicle and carry out brake test.

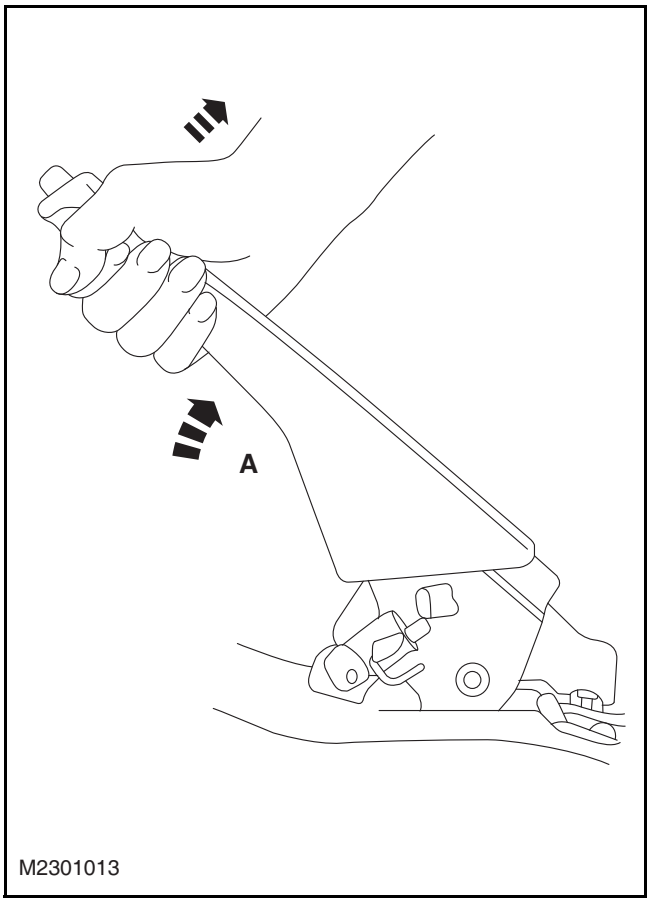
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# Parking Brake Inspection and Adjustment

1. Inspection

   Hold and pull up the parking brake lever with a force of 20 kg. After pulling the lever according to above requirements, count the number of ratchet teeth at "A". The number of ratchet teeth is 5 ~ 10.



M2301013

Also inspect that rear left and right wheels are well locked. The teeth can be counted in another way that pull up the park brake lever without pressing its button and listen to the clicking sound from the ratchet. One clicking sound means one tooth.

If the number of teeth does not accord with technical requirements, adjust the cable to obtain specified parking brake travel according to the following step 2.

**CAUTION: Inspect if the tooth tip is worn or damaged. Otherwise, replace the parking brake lever.**

2. Adjustment

**CAUTION: Before adjustment of cables, ensure the following conditions:**

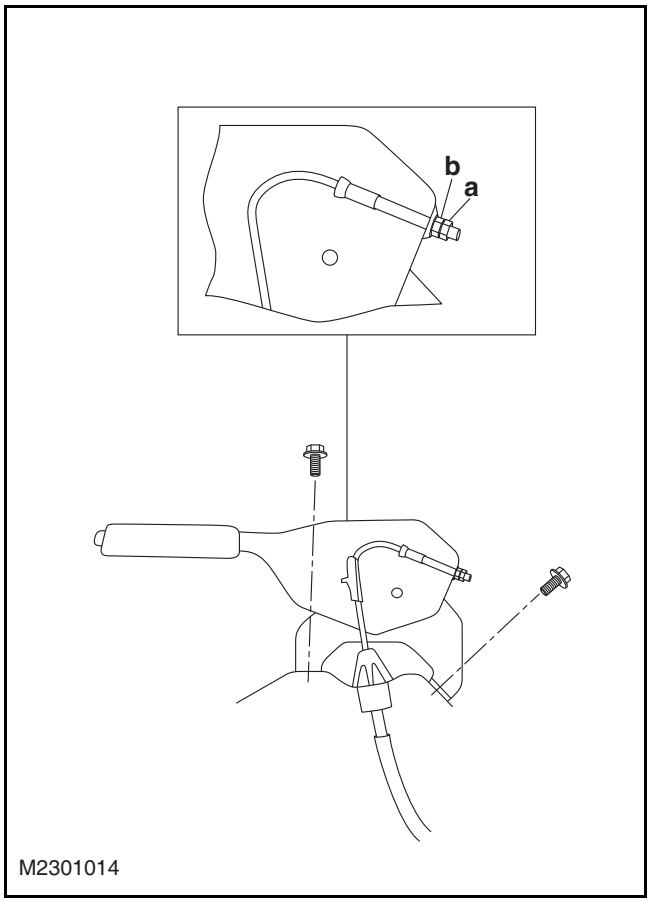
- The brake system shall be free of air.
- Brake pedal travel is proper.
- Depress the brake panel several times with a force of about 20 kg.
- Pull up the parking brake lever several times with a force of about 20 kg.
- Abrasion of rear brake shoe shall not exceed limit range.

After meeting above mentioned five conditions, adjust the parking brake lever travel through loosening or tightening the parking brake nuts.

Tightening torque:

(a): 5 Nm

(b): 5 Nm



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**CAUTION: After adjustment, inspect if the brake drum is stuck. Parking brake travel: 5 ~ 10 teeth while parking brake lever is pulled up with a force of 20 kg.**

## Brake Hose and Oil Pipe Inspection

Inspect if brake hose assembly is damaged by stones, and inspect for cracks, wear, leakage or air hole. When necessary, make a thorough inspection through the light and mirror; If above mentioned conditions are found, replace the brake hose.

Inspect if the oil pipes are damaged, cracked, bent or corroded. Replace if finding faults.

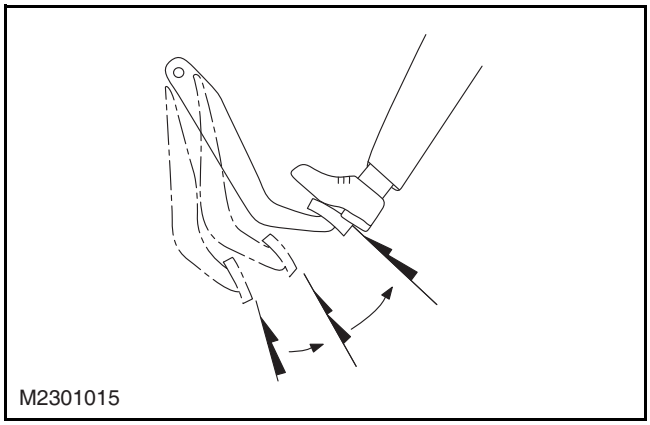
## Booster Operation Inspection

There are 2 methods to inspect the booster operation: one is to use the testing device; the other is not to use it. Generally, the booster operation only can be inspected roughly without the testing device.

**CAUTION: During inspection, make sure that no air is in the hydraulic pipes.**

### Inspect the Airtightness (without Testing Device)

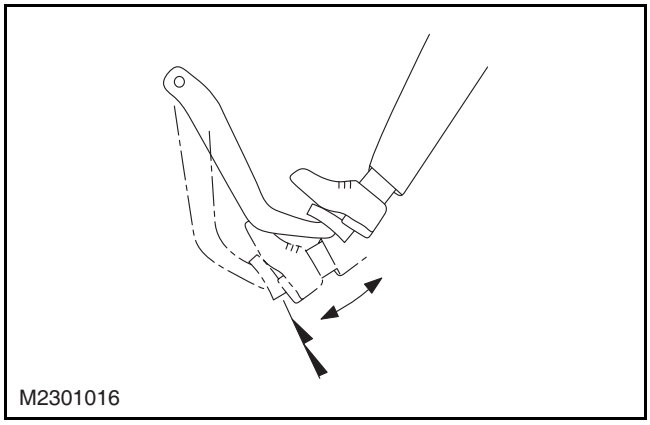
1. Start the engine.
2. Stop the engine after running for 1 ~ 2 minutes.
3. Depress the brake pedal several times with the equal force as usual, and observe the pedal travel. If the pedal goes down greatly for the first time and the travel decreases for the second and third time, the airtightness has been formed.



M2301015

4. If the pedal travel does not change, the airtightness has not been formed.

**CAUTION: If damage to vacuum tube and sealings are found by inspection, replace the damaged parts. Repeat the entire procedure after the operation is completed.**



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### Inspect the Operation

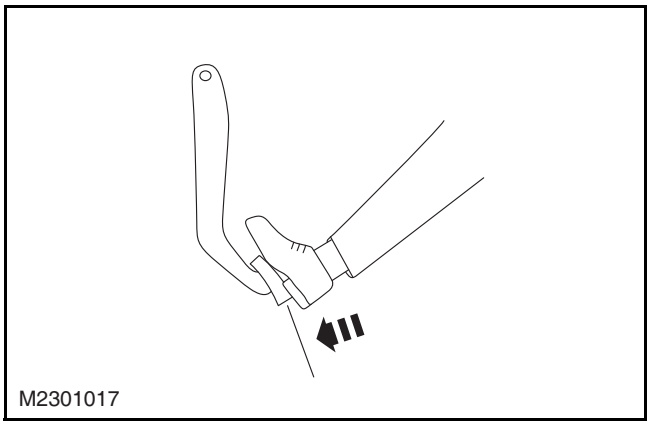
1. After the engine is stopped, depress the brake pedal several times with the equal force and verify that the pedal travel does not change.
2. Depress the brake pedal while starting the engine. If the pedal travel increases slightly, it indicates operation is well. But if no change, it indicates a malfunction.

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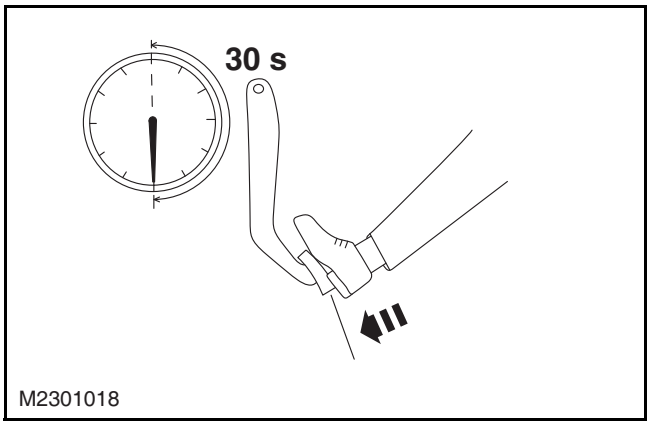


### Inspect the Airtightness (with Load)

1. Depress the brake pedal with the engine running, and then stop the engine with the pedal depressed.


M2301017

2. Depress the pedal for 30 seconds. If the pedal height does not change, it indicates the condition is good. If the pedal goes up, it indicates a malfunction.



M2301018

## Brake System Bleeding

**WARNING: As brake fluid contains polyethyleneglycol ether and carbowax, avoid eye and skin contact.**

**WARNING: If brake fluid contacts the eyes, flush the eyes for 15 minutes with cold water. Go to see a doctor right away if the eyes is still painful.**

**WARNING: Brake fluid should be washed away completely if the skin touches the fluid.**

**WARNING: Drink some water and try vomiting, and go to see the doctor right away if brake fluid is swallowed.**

**WARNING: Wear glasses for safety.**

**CAUTION: Brake fluid should be washed away and wiped out with clean water if it is splashed onto paintwork.**

**CAUTION: Make sure that the vehicle is parked on a flat ground.**

**CAUTION: Bleed as the following sequence: rear right, front left, rear left and front left.**

**CAUTION: Depress the brake for 3 ~ 5 times or until the brake pedal force begins to increase obviously to eliminate the remaining vacuum in the brake booster with the ignition switch at "LOCK" and the brake in cold state.**

**CAUTION: During bleeding, new and clean brake fluid must be added to the brake fluid reservoir so as to make sure that brake fluid level remains at a position above the middle of the scale.**

**CAUTION: Bleed air in the brake master cylinder holes if it is known or doubted that air exists, and then bleed air in the LSPV (load sensing proportioning valve) and brake wheel cylinder.**

Once the air enters the hydraulic pipe, bleed it from the brake fluid.

The brake system hydraulic pipe consists of two independent pipelines: one connecting to front wheel brakes and the other connecting to rear wheel brakes. When one brake pipe or hose is removed from the wheel, discharge it at two ends of removed pipe or hose. When any connecting components between master cylinder and each brake (wheel) are removed, brake fluid must be discharged at left and right brake calipers, left wheel cylinder and LSPV (Load Sensing Proportioning Valve).

1. Add brake fluid to the master cylinder reservoir. When discharging, at least half of brake fluid should remain in the reservoir.
2. Remove the drain plug cover. Insert the vinylite pipe to drain plug, and other end to container.

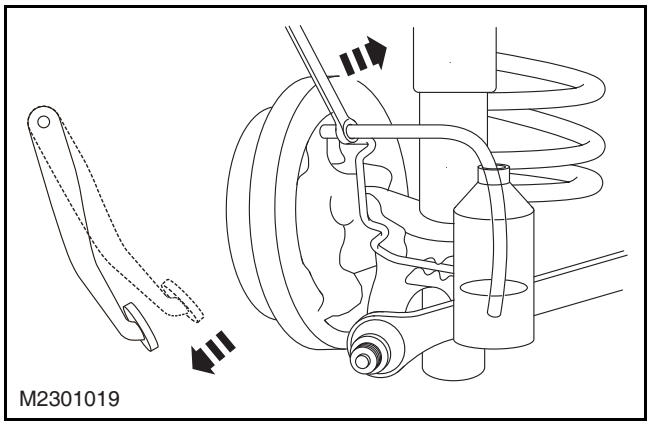
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3. Depress the brake pedal several times and hold it, then loosen the drain plug for about 1/3 to half turn.
4. When the pressure inside is nearly released, retighten the drain plug.
5. Repeat this operation until there is no bubbles.
6. After that, tighten the drain plug while keeping the brake pedal depressed.

   Tightening torque for LSPV: 8 Nm

   Tightening torque for front brake: 11 Nm
7. Then cover the drain plug.
8. After bleeding, apply hidraulic pressure to the pipe and inspect for leakage.
9. Refill the reservoir with brake fluid and make it reach the specified level.
10. Inspect if the brake pedal feels like stepping on the sponge; if it is weak, repeat the bleeding steps.

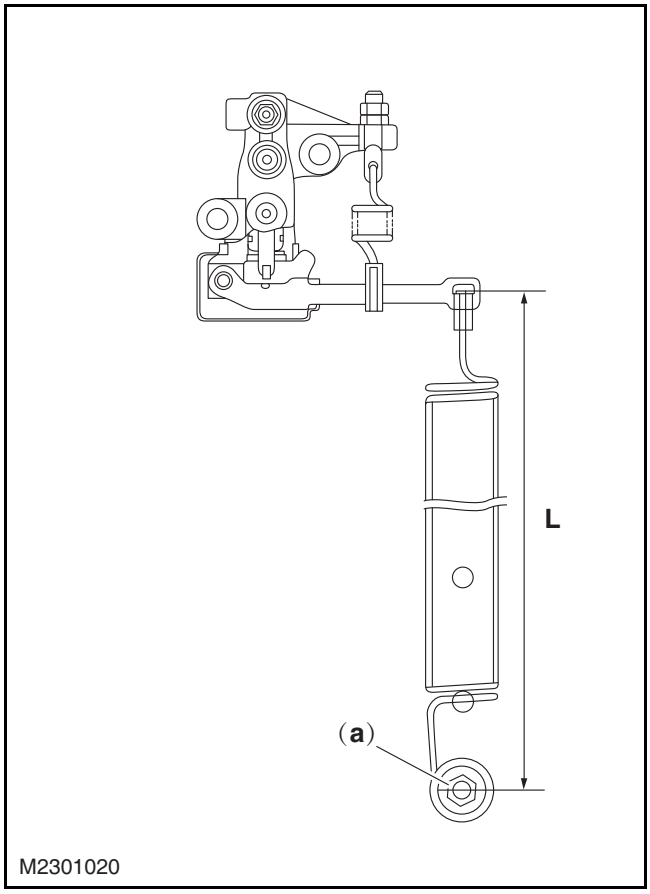

M2301019

## Load Sensing Proportioning Valve Inspection and Adjustment

Inspect and adjust the LSPV (Load Sensing Proportioning Valve) assembly as follows: Before proceeding with the inspection and adjustment, the following requirements should be met.

- Top up the fuel tank with fuel.
- The vehicle is equipped with spare tire, tools, jack and handle.
- There is no load on the vehicle.

1. Park the vehicle on a level ground.
2. Push up the LSPV rod by hand until it stops. Measure the length ("L" shown in the figure) of coil spring while pulling it out.



M2301020

3. The spring length "L" should accord with the following: 225 mm in spring length (L).

**CAUTION: Do not depress the brake pedal while measuring the spring length.**

4. If the spring length is not as specified, adjust the spring to the specified length by changing the tightening position of bolt (a) as shown in the left figure. After adjustment, tighten the nut as specified torque.

   Torque (a): 25 ± 5 Nm.

**CAUTION: Inspect the LSPV seat and brake pipe joint to make sure there is no leakage. If there is a leakage, replace the damaged elements.**

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# Brake Disc Runout and Thickness Inspection

**CAUTION: Before measurement, inspect if the front wheel bearings are loose.**

**CAUTION: After performing a disc surface finishing or replacing the brake disc, replace the brake pad.**

Inspect the brake disc surfaces and wearing parts for scratches. During periodical inspection or replacement, it is normal to find scratches on the brake disc surfaces. The brake disc is not damaged, unless its wear is severe. However, when the scratch on the disc surface is too deep or high, replace the brake disc. If only one side has scratches, polish and repair this side.

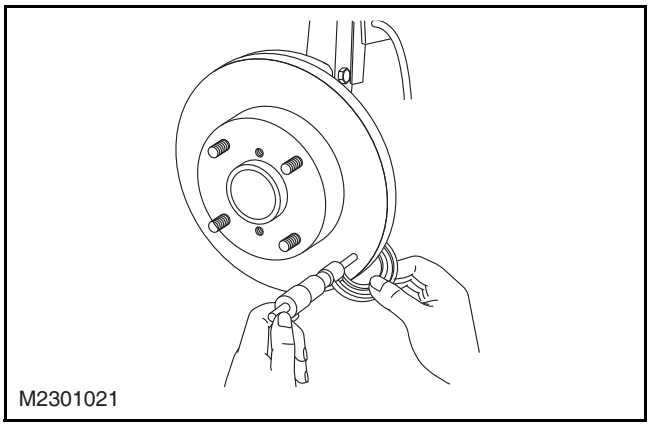
## Brake Disc Thickness Inspection

Use a micrometer to measure the brake disc thickness at 8 positions separated by 45°, with 15 mm away from the outer edge of brake disc.

If the variation reaches or exceeds 0.015 mm or the brake disc thickness is less than the specified minimum value, the brake disc needs a surface finishing or to be replaced.

Standard: 17.0 mm

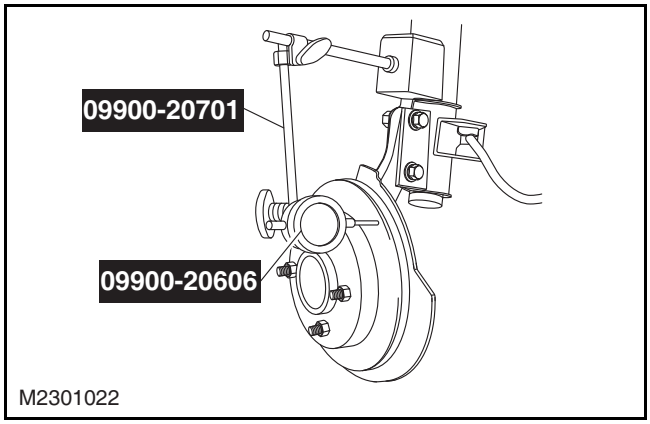
Limit: 15.0 mm


M2301021

## Brake Disc Runout Inspection

Secure the brake disc facing the wheel hub with wheel nuts. Install the dial indicator and retainer on the hanging post. Install he dial indicator at the position approximately 10 mm away from the brake outer edge so that it contacts the brake disc at an angle of 90 degrees. Rotate the brake disc until the dial indicator reaches the minimum reading and then return it to zero. Slowly rotate the brake disc until the dial indicator reaches the maximum reading. Mark and record the brake disc runout.

Brake disc limit offset: 0.15 mm



M2301022

# Brake Pad Inspection

1. Inspect the brake pads for wear, and replace with new ones when they are excessively worn.

**CAUTION: Never use sand paper to polish the brake pad linings. Otherwise, the hard particles of sand paper may penetrate into the lining and may cause damage to brake disc. Replace the brake pads with new ones when necessary.**

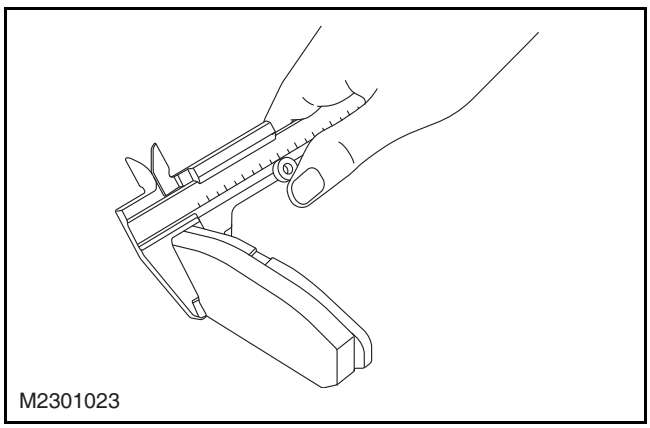
Pad thickness (lining + brake pad body)

Standard value: 15 mm

Limit value: 6 mm

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**CAUTION: When removing the brake pad, inspect if the brake fluid is leaking on the caliper. If so, repair it.**

2. Wheel cylinder slide pin/caliper pin bolt inspection

   Inspect if the slid pin moves smoothly.

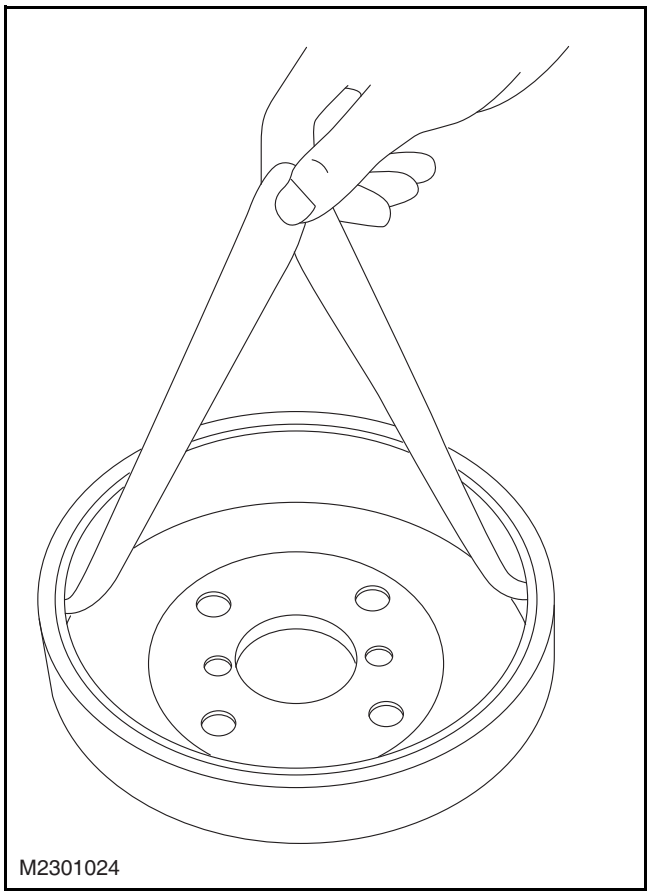
   If finding damages, repair or replace and apply rubber grease on the surface of pin and caliper pin bolt. The viscosity of rubber grease is basically not affected at -40°C.

3. Dust boot and pin slide bushing

   Inspect the dust boots and bushings for cracks and damage. otherwise, replace them.

## Brake Drum Inspection

Inspect if the brake drum is clean. Measure the inner diameter to inspect if its brake surface is worn.


M2301024

### Brake drum inner diameter:

Standard value: 254 mm

Limit value: 256 mm

Whenever the brake drum is removed, clean it thoroughly and inspect if there are cracks, scratches or deep grooves.

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### Cracks, scratches or grooves of brake drum

It is not safe to continue to use cracked brake drum; replace in time. Do not weld the cracked brake drum.

Slight scratches do not affect smoothness greatly. However, too many or too severe scratches would cause the brake pad excessively worn. Repair the brake drum surface.

If the brake pad has slight abrasion and brake drum has groove, the drum shall be polished with good carborundum cloth. Do not use lathe.

**CAUTION: When removing the brake drum, visually inspect the brake pump for leakage; if so, repair it.**

## Brake Shoe Inspection

If the wear of brake friction linings are beyond the limit, replace them.

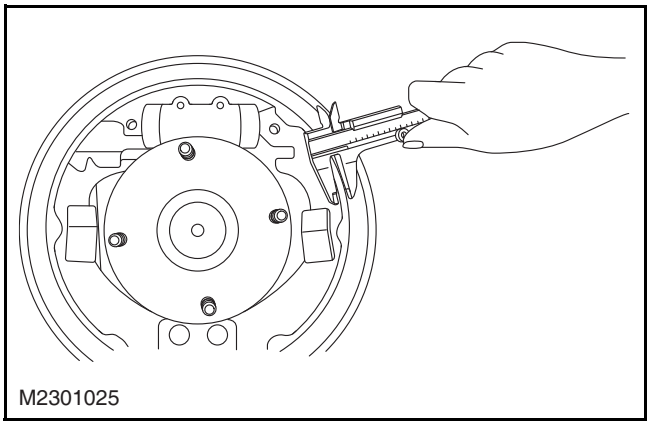
Friction lining thickness (lining + brake shoe rim)

Standard value: 6.9 mm

Limit value: 3.6 mm

If the wear of one friction lining reaches the maximum limit, replace all linings at the same time.

**CAUTION: Never use sand paper to polish the linings. Otherwise, the hard particles of sand paper may penetrate into the lining and damage the brake drum. Replace with new ones when necessary.**



M2301025

## Wheel Cylinder Inspection

1. Cylinder dust boot

   Inspect if the dust boot are broken, cracked or damaged; If finding any damage, replace in time.

2. Piston sealing

   Excessive or uneven abrasion of brake pad lining may cause unsmooth piston return. Under this condition, replace the rubber sealing parts.

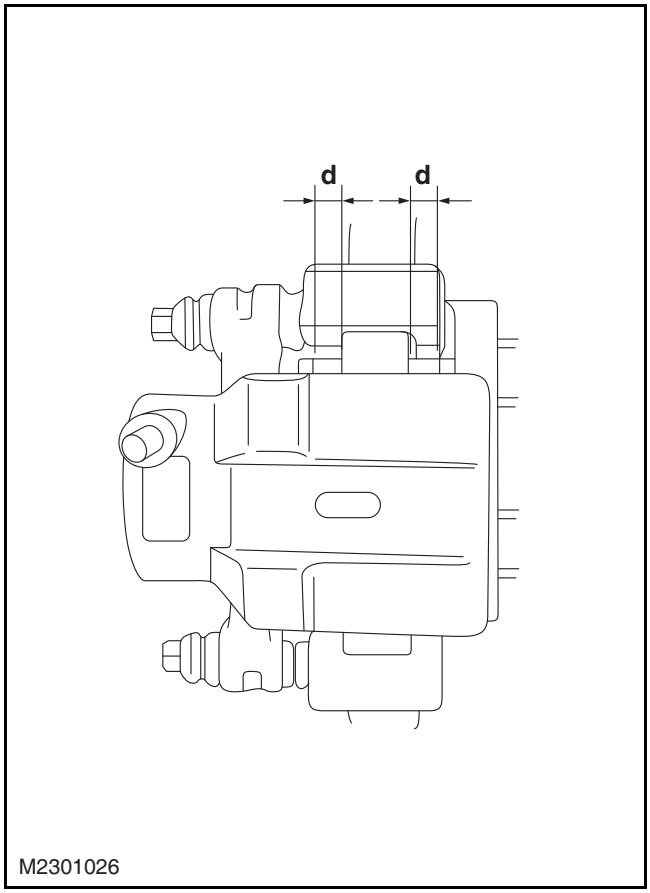
## Front Brake Pad Lining Inspection

Whenever the tire is removed (tire rotation installation or other reasons), follow the maintenance schedule to periodically inspect the brake pad linings. Inspect the thickness of inner and outer linings of brake pad from the caliper end (or through the hole).

If a lining is worn and its thickness ("d" in the figure) is less than specified value, replace all linings at the same time.

Thickness "d"

Limited dimension: 1.0 mm




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## Rear Brake Shoe Inspection

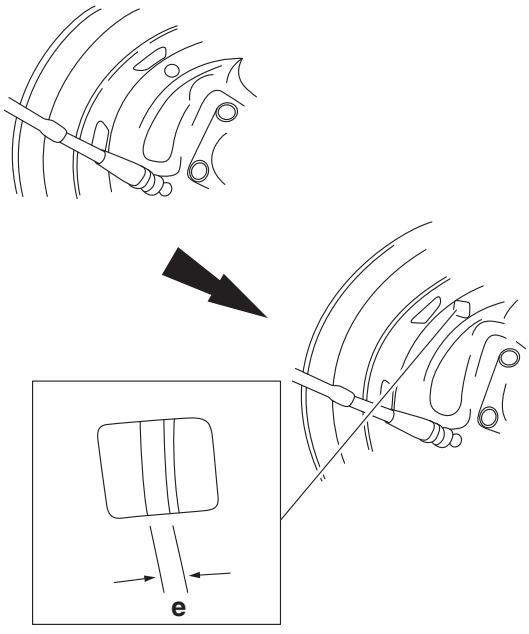
Thickness "e"

Limited dimension: 1.0 mm

This inspection should be performed after inspecting the brake pedal travel. Even if the pedal travel is normal, perform this inspection according to requirements below.

Inspect the brake shoe wear as follows:

1. Lift the vehicle.
2. Remove the rubber plug from the brake baseplate.
3. Visually inspect the brake shoe thickness through the baseplate hole. If the thickness "e" of one shoe is less than the limit dimension, replace all brake shoes at the same time.




M2301027

## Rear Drum Brake Shoe Adjustment

Rear brake is equipped with a self-adjusting mechanical unit. However, after the brake shoe is replaced or the brake drum is removed for other maintenances, adjust the clearance between brake drum and brake shoe. After installation of all parts, repeatedly depress the brake pedal with a force of 30 kg until no "click" from the self-adjusting mechanical unit can be heard.

Then, inspect if brake drums are stuck and brake system has good performance. Last, lower the vehicle and carry out brake test.

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## Symptom Diagnosis and Testing

# Inspection and Verification

**CAUTION: Before the diagnosis, verify if the brake system warning indicator is normal.**

1. Verify the customer concern.
2. Visually inspect for obvious mechanical and hydraulic fault.

**Visual Inspection Chart**

| Mechanical |
| --- |
| • Brake fluid level<br>• Brake line leakage |

3. Solve the known problems before proceeding to the next step.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

**General Equipment**

| |
| --- |
| • Vernier caliper<br>• Dial indicator |

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# Symptom Chart

**CAUTION:**
**1. Replace each component with much care since it may influence the performance of the brake system and lead to driving danger. Standard components produced by Changan Automobile Corporation should be used.**
**2. It is very important to keep components and the area clean when repairing the brake system.**
**3. The component must be disassembled if any brake leakage is found. If any abnormal condition is found, install a new component.**
**4. Wrap the brake lines to prevent any dust, mud or other foreign matters from entering the lines when disassembling the brake components.**
**5. Do not damage or distort the brake lines when removing or installing them.**
**6. During the installation of brake lines or hoses, make sure that they are not distorted or bent.**
**7. Keep the brake hoses away from the shock absorber oil and grease and the like.**
**8. After installing the brake pipes and hoses, make sure that they do not interfere with other components.**
**9. Do not stick the brake fluid to the body or paintwork. If the brake fluid leaks on the paintwork, it should be cleaned immediately.**

If the fault occurs, but the brake system operation indicator is normal and the cause cannot be confirmed by basic inspection, diagnose and repair in order of the following table.

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Uneven braking (brake operation not coordinating) | • Water or oil on friction lining of brake pad (block) or shoe | • Replace<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).**<br>**Refer to: Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).** |
| | • The clearance between brake drum and brake shoe is out of adjustment (self-adjusting mechanical unit failure) | • Inspect the inoperative self-adjusting mechanical |
| | • Brake disc or brake drum is out of round | • Replace the brake disc or brake drum.<br>**Refer to: Front Brake Disc (2.3.3 Front Disc Brake, Removal and Installation).**<br>**Refer to: Rear Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).** |
| | • Uneven tire pressure | • Inflate the tires evenly.<br>**Refer to: Brake Disc Runout and Thickness Inspection (2.1.3 Brake System - Overview, General Inspection).** |
| | • Wheel brake pump failure | • Repair or replace.<br>**Refer to: Brake Master Cylinder and Brake Fluid Reservoir (2.3.5 Hydraulic Brake Control, Removal and Installation).** |
| | • Poor front wheel alignment | • Adjust as specified. |
| | • Tires on axle do not match | • Use tires with the same tread on the same axle. |
| | • Poor fluid circulation in brake pipe or hose | • Inspect if the hoses are softened and the pipes are damaged, and replace with new hoses and double brake pipes. |
| | • Brake caliper assembly failure | • Inspect if the piston becomes stuck or moves slowly, and properly lubricate the caliper slide bushing to slide the caliper |
| | • Loose suspension components | • Inspect all the suspension components |
| | • Loose caliper | • Inspect and tighten the bolts as specified. |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Insufficient brake force | • Fluid leaks from brake pipe | • Confirm the leaking part and repair. |
| | • Oily brake disc or brake pad (block) | • Clean or replace.<br>**Refer to: Front Brake Disc (2.3.3 Front Disc Brake, Removal and Installation).**<br>**Refer to: Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).** |
| | • Brake overheating | • Locate the cause and repair. |
| | • Poor contact of brake shoes on brake drum | • Repair them for proper contract. |
| | • Oil or water on brake shoe friction lining | • Replace<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |
| | • Brake pad (block) lining worn | • Replace<br>**Refer to: Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).** |
| | • Brake wheel cylinder damaged | • Repair or replace.<br>**Refer to: Brake Wheel Cylinder (2.3.2 Rear Drum Brake, Removal and Installation).** |
| | • Brake caliper assembly failure | • Repair or replace.<br>**Refer to: Brake Caliper (2.3.3 Front Disc Brake, Removal and Installation).** |
| | • Improper length adjustment of LSPV (if equipped) sensor spring | • Inspect and adjust.<br>**Refer to: Load Sensing Proportioning Valve Inspection and Adjustment (2.3.1 Brake System - Overview, General Inspection).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Insufficient brake force | • Air in brake system | • Bleed air.<br>**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).** |
| | • LSPV sensor spring damaged | • Replace<br>**Refer to: Load Sensing Proportioning Valve (2.3.5 Hydraulic Brake Control, Removal and Installation).** |
| | • LSPV (if equipped) sleeve damaged | • Replace<br>**Refer to: Load Sensing Proportioning Valve (2.3.5 Hydraulic Brake Control, Removal and Installation).** |
| Noise (squeaks when not braking) | • Front brake friction lining worn | • Replace the friction lining.<br>**Refer to: Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).** |
| Rear brake locks too early (for vehicles with LSPV) | • Improper length adjustment of LSPV sensor spring | • Inspect or adjust.<br>**Refer to: Load Sensing Proportioning Valve Inspection and Adjustment (2.3.1 Brake System - Overview, General Inspection).** |
| | • LSPV assembly failure | • Replace the assembly. |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Excessive pedal travel | • Partial failure in brake system | • Inspect the brake system, repair when necessary and fill qualified brake fluid. |
| | • Insufficient brake fluid in brake master cylinder reservoir | • Inspect the brake system for leakage and air; inspect the warning lamp and bleed the system when necessary. |
| | • Air in brake system (pedal feels as soft as sponge) | • Bleed air.<br>**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).** |
| | • Rear brake system cannot be adjusted (self-adjusting mechanical unit failure) | • Repair the self-adjusting mechanical unit and adjust the rear brakes. |
| | • Bent brake shoes | • Replace the brake shoes.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |
| | • Rear brake shoe worn | • Replace the brake shoes.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |
| Brake return is blocked (every time pedal is released, brake cannot return to its original position in time) | • Master cylinder cannot return normally | • Repair the master cylinder. |
| | • Brake pipes or hoses are clogged and quantity of flow is reduced | • Inspect if the hoses are softened and the pipes are damaged, and replace with new hoses and double brake pipes. |
| | • Improper adjustment of parking brake on rear brake | • Inspect and adjust as technical requirements. |
| | • Return spring inside brake cannot return or is damaged | • Replace |
| | • The parking brake cables or link react slowly | • Repair or replace.<br>**Refer to: Parking Brake Cable (2.3.4 Parking Brake and Operation).** |
| | • Wheel brake pump or caliper piston gets stuck | • Replace when necessary. |
| | • Piston seals in caliper are worn severely | • Replace the piston seals. |

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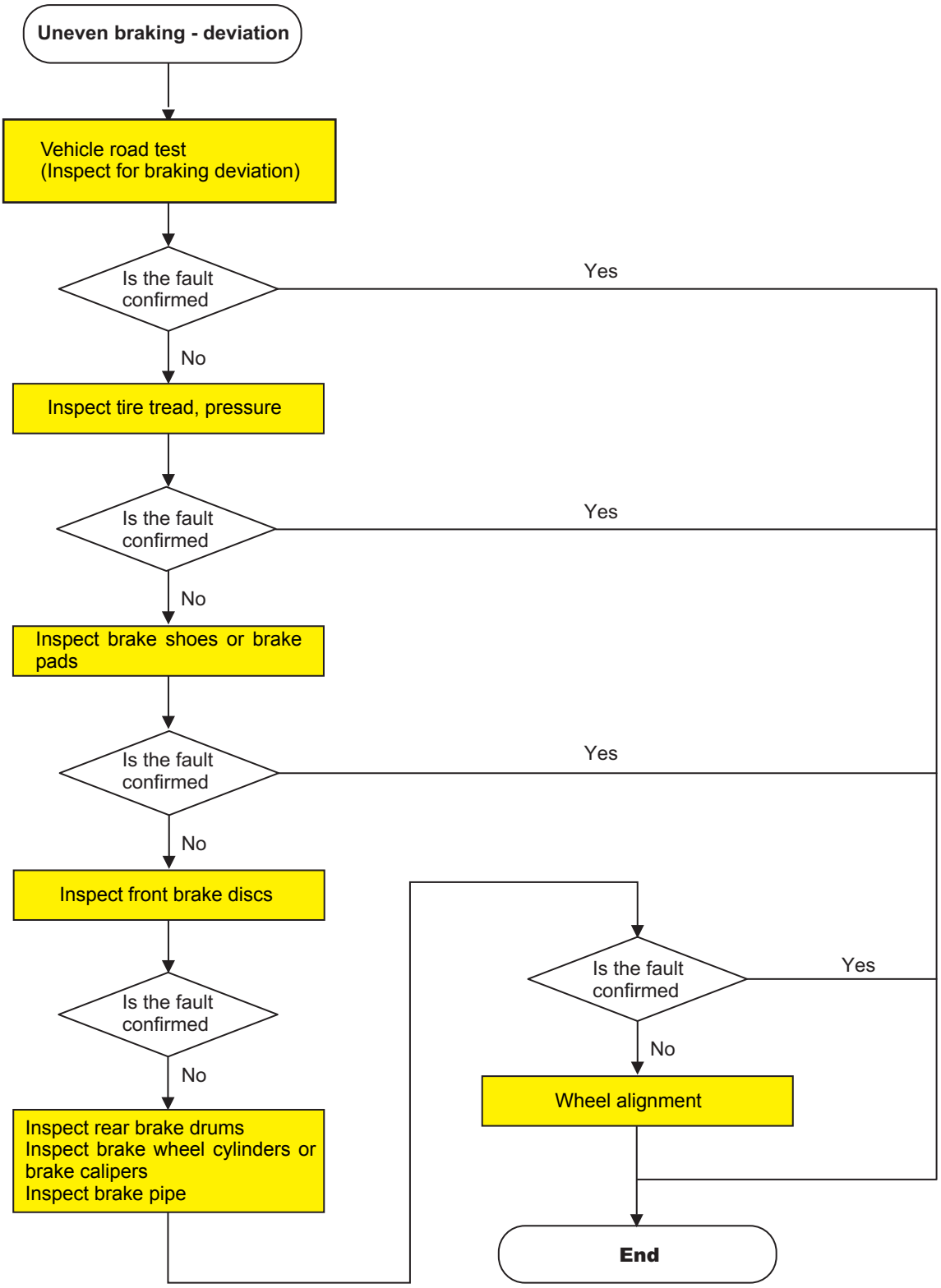


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Pedal pulsating (pulsates when braking with pedal depressed) | • Wheel bearing damaged or loose | • Replace the wheel bearing. |
| | • Deformed steering knuckle or rear wheel shaft | • Replace the steering knuckle or rear wheel shaft. |
| | • Excessive brake disc runout | • Inspect, machining and replace the brake disc. |
| | • Parallelism does not accord with technical requirements | • Inspect, replace or machining the brake disc if it does not accord with technical requirements. |
| | • Rear brake drum is out of round | • Inspect the runout, repair or replace the brake drum when necessary.<br>**Refer to: Rear Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).** |
| Braking noise | • Brake shoe becomes glazed or has foreign matters on it | • Repair or replace.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |
| | • Brake shoe worn or deformed | • Replace<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |
| | • Front wheel bearing loose | • Replace |
| | • Baseplate deformed or retaining bolt loose | • Replace or tighten the retaining bolts. |
| Brake warning lamp turns on after engine starts | • Parking brake not released | • Release the parking brake, inspect and turn off the brake warning lamp. |
| | • Insufficient brake fluid | • Add brake fluid. |
| | • Fluid leaks from brake pipe | • Inspect and repair the leaking part, add brake fluid and bleed the air.<br>**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).** |
| | • Brake warning lamp circuit fault | • Repair |
| Brake warning lamp turns on when braking | • Fluid leaks from brake pipe | • Inspect the leaking part, repair and add brake fluid. |
| | • Insufficient brake fluid | • Add brake fluid. |
| Brake warning lamp does not turn on when parking brake is applied | • Brake warning lamp circuit fault | • Replace the lamp bulb or repair the circuit. |

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# Diagnosis Procedure for Uneven Braking - Deviation



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| Symptom | Details/Results/Actions |
|---|---|
| 1. Vehicle road test | |
| | A. Carry out road test.<br>B. Inspect for braking deviation.<br>Does braking deviation occur?<br>**Yes**<br>Go to step 2.<br>**No**<br>The vehicle is normal. |
| 2. Inspect tire tread, pressure | |
| | A. Inspect if tire tread is consistent.<br>B. Inspect if tire pressure is normal.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the tire or adjust the tire pressure. |
| 3. Inspect brake shoes or brake pads | |
| | A. Inspect if brake shoe is oil leaking and unusually worn.<br>B. Inspect if brake pad or lining is unusually worn.<br>Is there any unusual abrasion or oil leaking?<br>**Yes**<br>Clean or replace the brake shoe or pad.<br>**Refer to: Brake Shoe (2.3.2 Rear drum brake, Removal and Installation) or Brake Pad (2.3.3 Front disc brake, Removal and Installation).**<br>**No**<br>Go to step 4. |
| 4. Inspect front brake discs | |
| | A. Inspect if the front brake discs are abnormally worn, distorted or deformed.<br>Is it normal?<br>**No**<br>Replace the front brake discs.<br>**Refer to: Front Brake Disc (2.3.3 Front Disc Brake, Removal and Installation).**<br>**Yes**<br>Go to step 5. |

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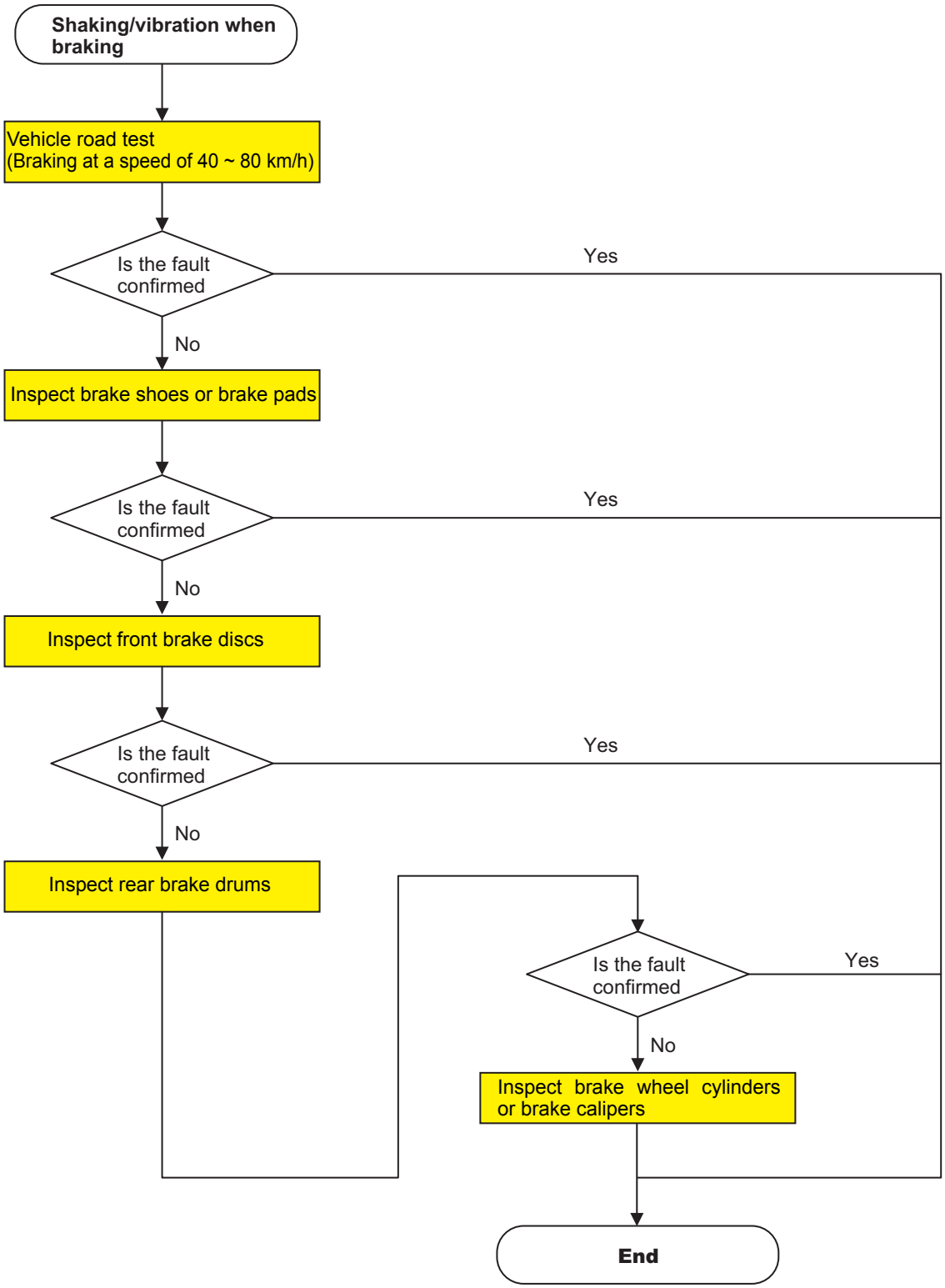


| Symptom | Details/Results/Actions |
|---|---|
| 5. Inspect rear brake drums | |
| | A. Inspect if the rear brake drums are abnormally worn or deformed.<br>Is it normal?<br>**No**<br>Replace the brake drums.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).**<br>**Yes**<br>Go to step 6. |
| 6. Inspect brake wheel cylinders or brake calipers | |
| | A. Inspect if the brake wheel cylinders or brake calipers are stuck.<br>Is it normal?<br>**No**<br>Repair or replace the brake wheel cylinders or brake calipers.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation) or Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).**<br>**Yes**<br>Go to step 7. |
| 7. Inspect brake pipe | |
| | A. Inspect if the brake pipes or hoses are distorted or deformed.<br>Is it normal?<br>**Yes**<br>Replace the brake pipes or hoses.<br>**No**<br>Go to step 8. |
| 8. Wheel alignment | |
| | A. Inspect if the wheel alignment is normal.<br>Is it normal?<br>**No**<br>Adjust the wheel alignment.<br>**Refer to: Wheel Alignment (2.1.1 Suspension System - Overview, General Inspection).**<br>**Yes**<br>The maintenance is finished. |

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# Diagnosis Procedure for Shaking/Vibration When Braking



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| Symptom | Details/Results/Actions |
|---|---|
| 1. Vehicle road test | |
| | A. Perform braking during road test at a speed of 40 ~ 80 km/h.<br>B. Inspect for brake shaking/vibration.<br>Does brake shaking/vibration occur?<br>**Yes**<br>Go to step 2.<br>**No**<br>The vehicle is normal. |
| 2. Inspect brake shoes or brake pads | |
| | A. Inspect if the brake shoes or brake pads are unusually worn, damaged or oily.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the brake shoes or brake pads.<br>**Refer to: Brake Shoe (2.3.2 Rear drum brake, Removal and Installation) or Brake Pad (2.3.3 Front disc brake, Removal and Installation).** |
| 3. Inspect front brake discs | |
| | A. Inspect if the front brake discs are abnormally worn, distorted or deformed.<br>Is it normal?<br>**No**<br>Replace the front brake discs.<br>**Refer to: Front Brake Disc (2.3.3 Front Disc Brake, Removal and Installation).**<br>**Yes**<br>Go to step 4. |

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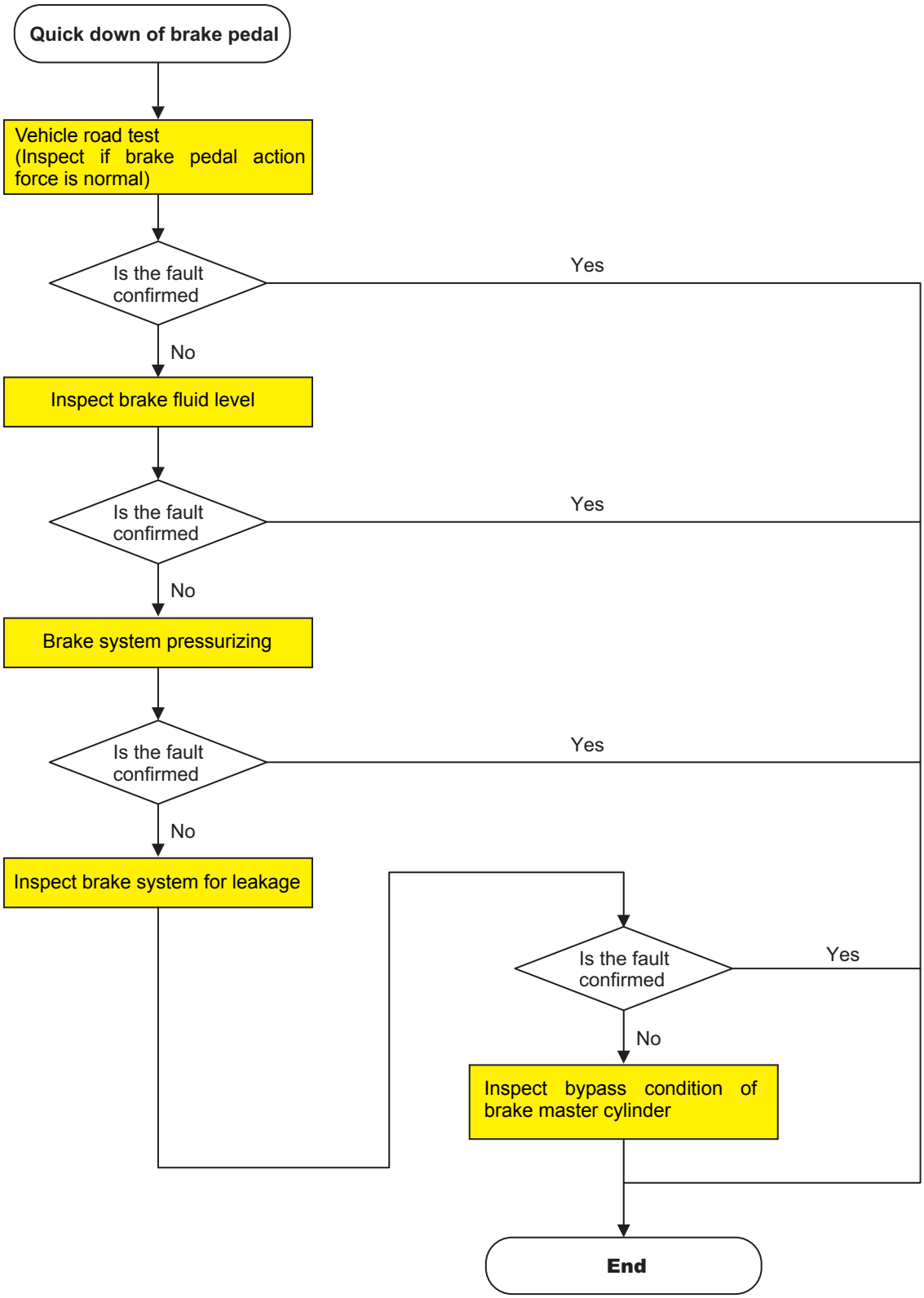


| Symptom | Details/Results/Actions |
|---|---|
| 4. Inspect rear brake drums | |
| | A. Inspect if the rear brake drums are abnormally worn, out of round or deformed.<br>Is it normal?<br>**No**<br>Replace the brake drums.<br>**Refer to: Rear Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).**<br>**Yes**<br>Go to step 5. |
| 5. Inspect brake wheel cylinders or brake calipers | |
| | A. Inspect if the brake caliper bolts are loose.<br>B. Inspect if the sliding parts are lack of lubrication.<br>C. Inspect if the wheel hub bolts are loose or lost.<br>Is it normal?<br>**No**<br>Tighten the brake caliper retaining bolts; lubricate the sliding parts; tighten or replace the wheel hub bolts.<br>**Yes**<br>The maintenance is finished. |

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# Diagnosis Procedure for Quick Down of Brake Pedal



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| Symptom | Details/Results/Actions |
|---|---|
| 1. Vehicle road test | |
| | A. Carry out road test, and depress the brake pedal.<br>B. Inspect if the brake pedal action force is normal.<br>Is the action force normal?<br>**Yes**<br>The vehicle is normal.<br>**No**<br>Go to step 2. |
| 2. Inspect brake fluid level | |
| | A. Inspect the brake fluid reservoir level.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect if there is a leakage at sealing of reservoir.<br>**Refer to: Brake Fluid Level Inspection (2.3.1 Brake System - Overview, General Inspection).** |
| 3. Brake system pressurizing | |
| | A. Depress the brake pedal quickly for five times.<br>Inspect if the brake pedal height increases and remains?<br>**Yes**<br>Inspect the parking brake and adjust when necessary.<br>**Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection).**<br>If the fault still exists, bleed air in the brake system.<br>**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**<br>**No**<br>Go to step 4. |

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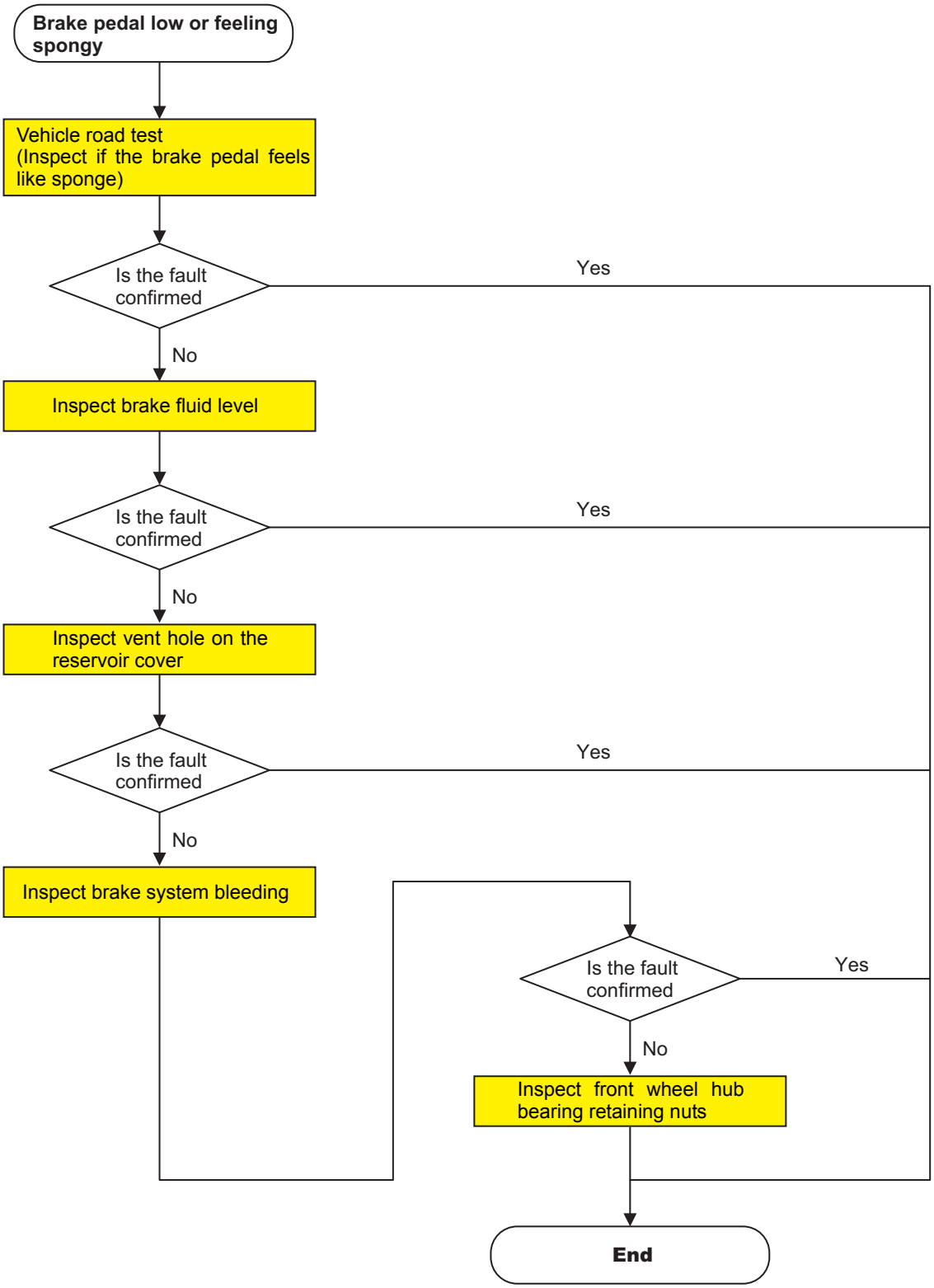


| Symptom | Details/Results/Actions |
|---|---|
| 4. Inspect brake system for leakage | |
| | A. Inspect the brake system for external leakage.<br>Is there any leakage?<br>**Yes**<br>Repair the leaking part and replace the corresponding part when necessary. Add brake fluid and bleed the air.<br>**No**<br>Go to step 5. |
| 5. Inspect bypass condition of brake master cylinder | |
| | A. Bypass condition test.<br>**Refer to: Bypass Condition Test (2.3.1 Brake System - Overview, General Inspection).**<br>Is it normal?<br>**No**<br>Replace the brake master cylinder.<br>**Refer to: Brake Master Cylinder and Brake Fluid Reservoir (2.3.5 Hydraulic Brake Control, Removal and Installation).**<br>**Yes**<br>The maintenance is finished. |

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# Diagnosis Procedure for Brake Pedal Low or Feeling Spongy



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| Symptom | Details/Results/Actions |
|---|---|
| 1. Vehicle road test | |
| | A. Carry out road test, and depress the brake pedal.<br>B. Inspect if the brake pedal feels spongy.<br>Is it normal?<br>**Yes**<br>The vehicle is normal.<br>**No**<br>Go to step 2. |
| 2. Inspect brake fluid level | |
| | A. Inspect the brake fluid reservoir level.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect if there is a leakage at sealing of reservoir.<br>**Refer to: Brake Fluid Level Inspection (2.3.1 Brake System - Overview, General Inspection).** |
| 3. Inspect vent hole on the reservoir cover | |
| | A. Inspect if the vent hole on the reservoir cover is clogged or dirty.<br>Is it clogged or dirty?<br>**Yes**<br>Clean the reservoir cover.<br>**No**<br>Go to step 4. |
| 4. Inspect brake system bleeding | |
| | A. Inspect the air in the brake system.<br>Is there any air in the brake system<br>**Yes**<br>Bleed air in the brake system.<br>**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**<br>**No**<br>Go to step 5. |

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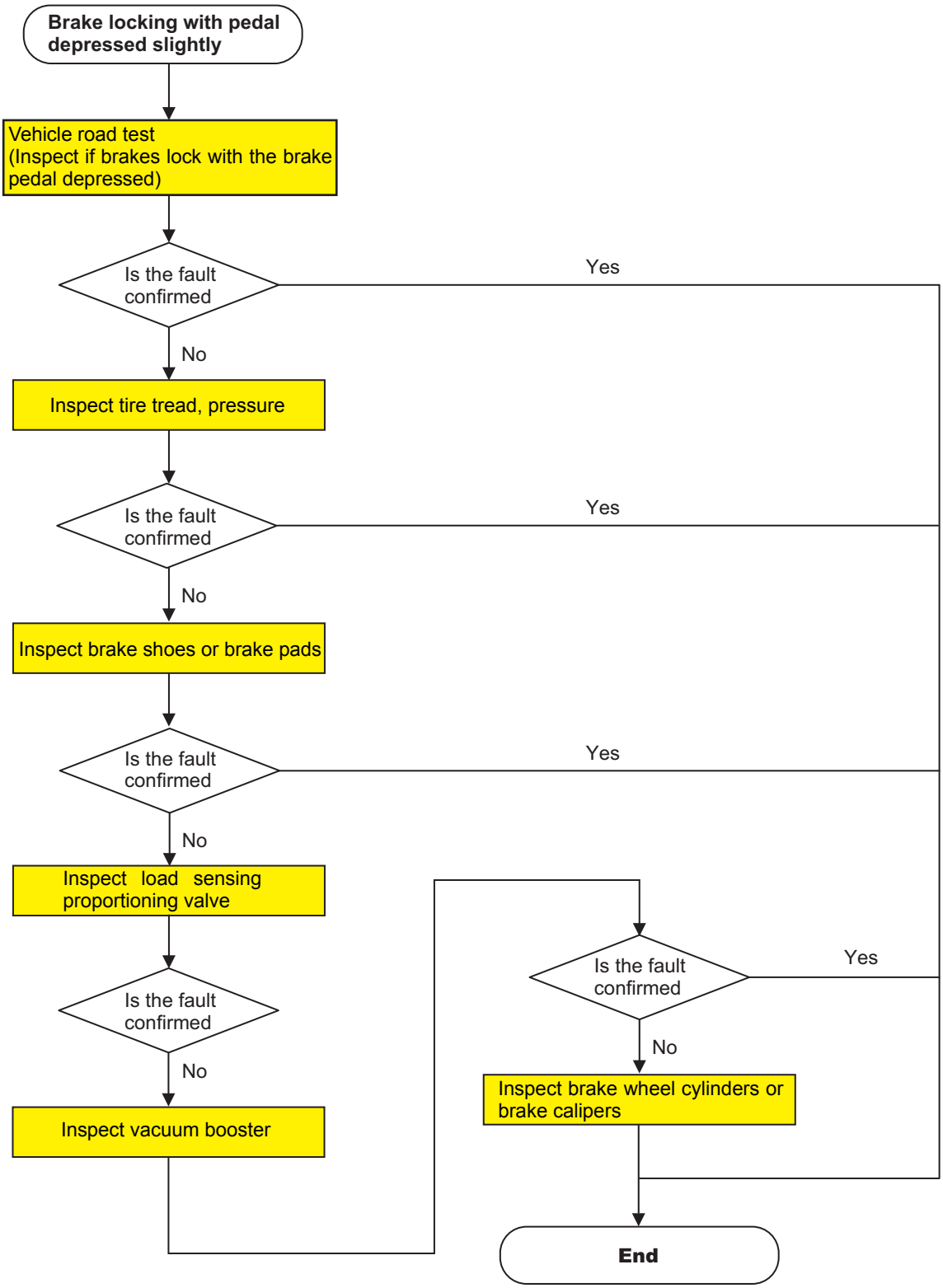


| Symptom | Details/Results/Actions |
|---|---|
| 5. Inspect front wheel hub bearing retaining nuts | |
| | A. Inspect if the front wheel hub bearing retaining nuts are loose.<br>Is it normal?<br>**No**<br>Replace and tighten the front wheel hub bearing retaining nuts.<br>**Yes**<br>Inspect the parking brake adjustment.<br>**Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection).**<br>The maintenance is finished. |

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# Diagnosis Procedure for Brake Locking with Pedal Depressed Slightly



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| Symptom | Details/Results/Actions |
|---|---|
| 1. Vehicle road test | |
| | A. Carry out road test, and depress the brake pedal.<br>B. Inspect for brake locking.<br>Is it normal?<br>**Yes**<br>The vehicle is normal.<br>**No**<br>Go to step 2. |
| 2. Inspect tire tread, pressure | |
| | A. Inspect for excessive tires wear or abnormal tire pressure.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the tires.<br>**Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).** |
| 3. Inspect brake shoes or brake pads | |
| | A. Inspect the brake shoes or pads for proper installation or contamination from fluid or excessive wear.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the brake shoes or brake pads.<br>**Refer to: Brake Shoe (2.3.2 Rear drum brake, Removal and Installation) or Brake Pad (2.3.3 Front disc brake, Removal and Installation).** |

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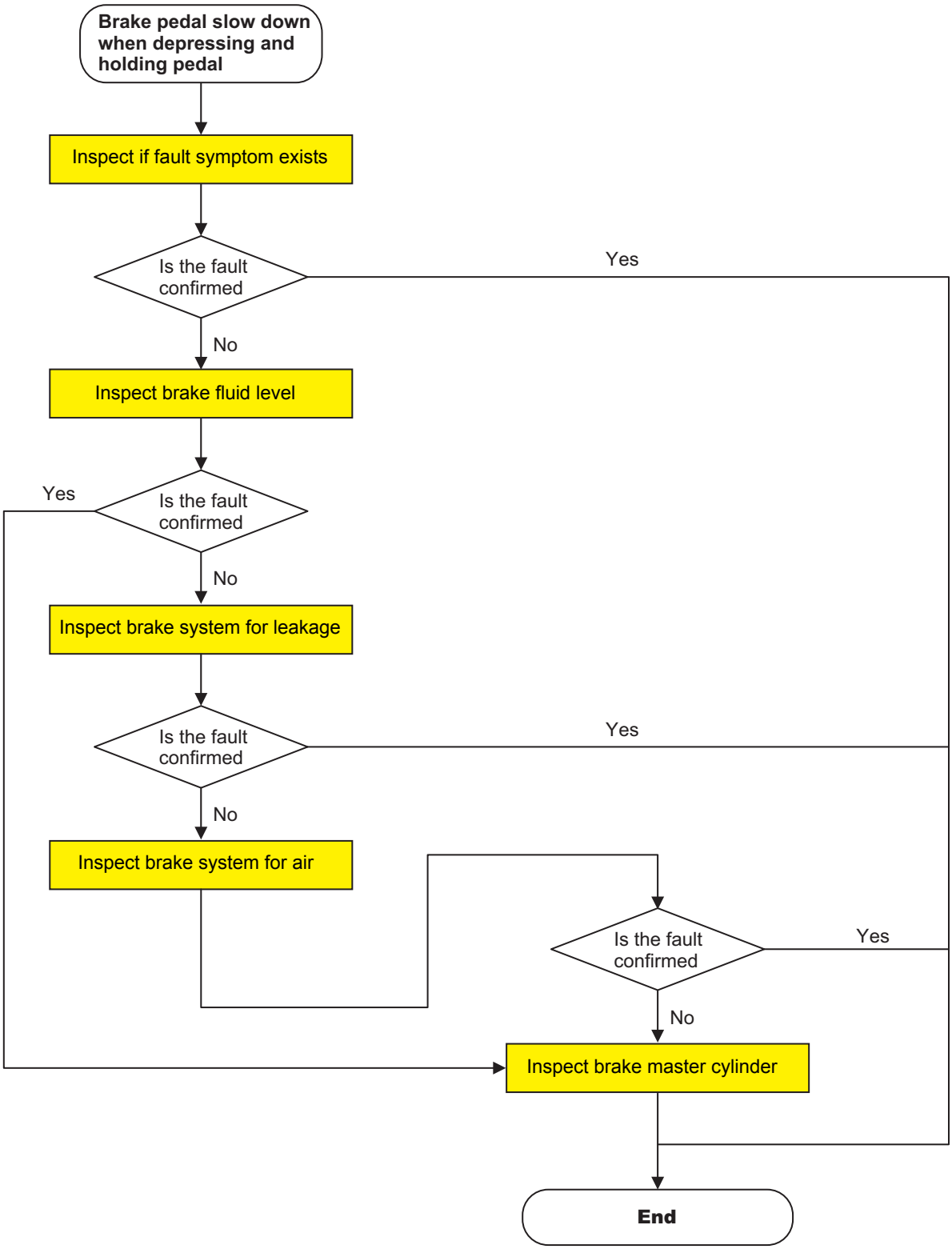


| Symptom | Details/Results/Actions |
|---|---|
| 4. Inspect load sensing proportioning valve | |
| | A. Inspect if the load sensing proportioning valve fails.<br>Is it normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect or adjust the load sensing proportioning valve.<br>**Refer to: Load Sensing Proportioning Valve Inspection and Adjustment (2.3.1 Brake System - Overview, General Inspection).** |
| 5. Inspect vacuum booster | |
| | A. Inspect if the brake booster is normal.<br>Is it normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the brake booster.<br>**Refer to: Brake Booster (2.3.6 Booster brake, Removal and Installation).** |
| 6. Inspect brake wheel cylinders or brake calipers | |
| | A. Inspect if the sliding parts are lack of lubrication.<br>Are they lack of lubrication?<br>**Yes**<br>Lubricate the sliding parts.<br>**No**<br>The maintenance is finished. |

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# Diagnosis Procedure for Brake Pedal Slow Down When Depressing and Holding Pedal



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| Symptom | Details/Results/Actions |
|---|---|
| 1. Inspect if fault symptom exists | |
| | A. Depress the brake pedal and hold it, and inspect if the pedal slowly goes down.<br>Is it normal?<br>**Yes**<br>The vehicle is normal.<br>**No**<br>Go to step 2. |
| 2. Inspect brake fluid level | |
| | A. Inspect the brake fluid reservoir level.<br>Is it normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 3. |
| 3. Inspect brake system for leakage | |
| | A. Inspect the brake system for external leakage.<br>Is there any leakage?<br>**Yes**<br>Repair the leaking part and replace the corresponding parts when necessary. Add brake fluid and bleed the air.<br>**No**<br>Go to step 4. |
| 4. Inspect brake system for air | |
| | A. Inspect the brake system for air.<br>Is there any air in the brake system?<br>**Yes**<br>Bleed air in the brake system.<br>**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**<br>**No**<br>Go to step 5. |

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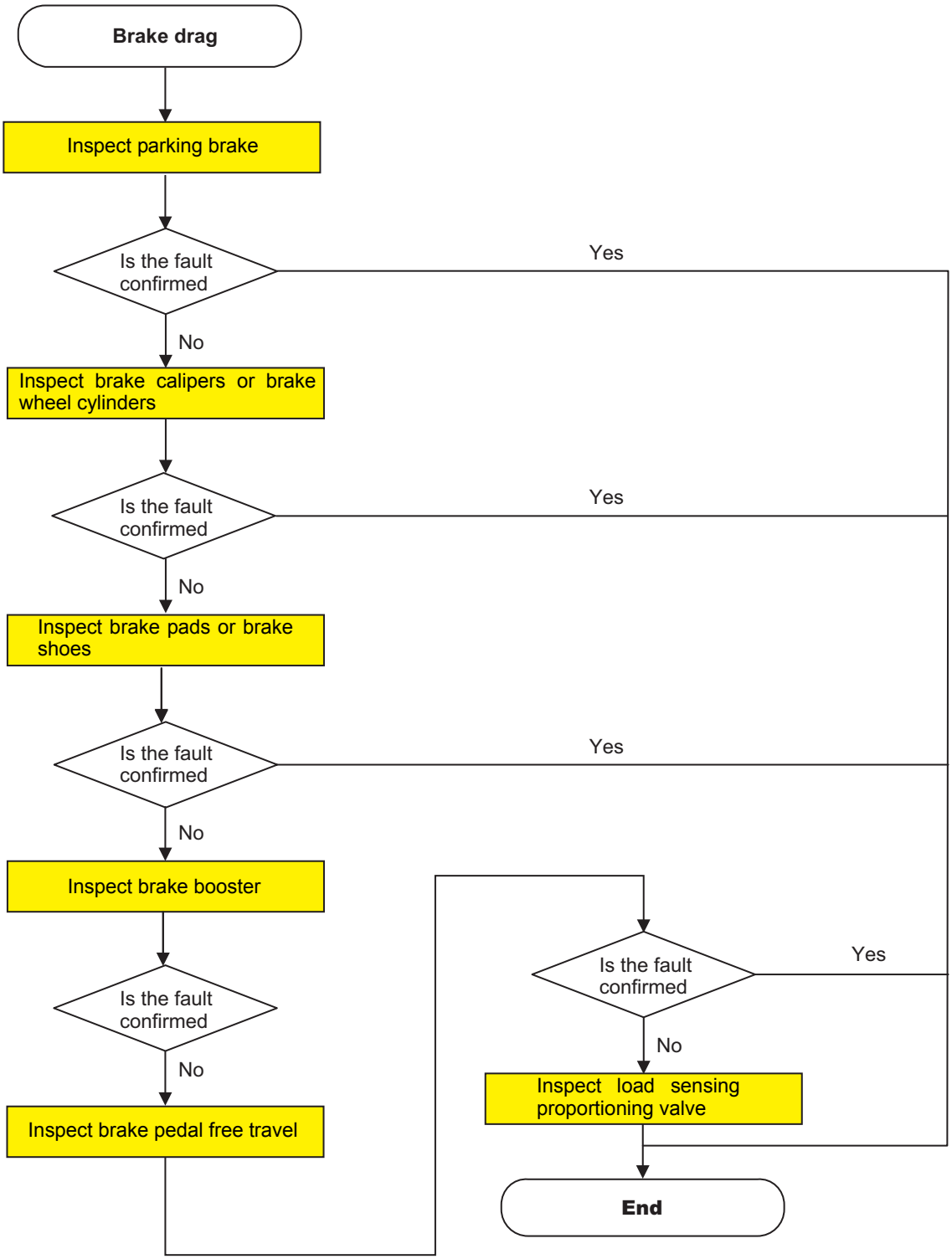


| Symptom | Details/Results/Actions |
|---|---|
| 5. Inspect brake master cylinder | |
| | A. Inspect if the brake master cylinder is normal.<br>Is it normal?<br>**No**<br>Replace the brake master cylinder.<br>**Refer to: Brake Master Cylinder and Brake Fluid Reservoir (2.3.5 Hydraulic Brake Control, Removal and Installation).**<br>**Yes**<br>The maintenance is finished. |

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# Diagnosis Procedure for Brake Drag



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| Symptom | Details/Results/Actions |
|---|---|
| 1. Inspect parking brake | |
| | A. Release the parking brake lever and inspect if the parking brake is completely released.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Inspect and repair the stuck parking brake cable and adjust the parking brake.<br>**Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection).** |
| 2. Inspect brake calipers or brake wheel cylinders | |
| | A. Inspect if the brake calipers or brake wheel cylinders are stuck.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the brake calipers.<br>**Refer to: Brake Caliper (2.3.3 Front Disc Brake, Removal and Installation).**<br>Replace the brake wheel cylinders.<br>**Refer to: Brake Wheel Cylinder (2.3.2 Rear Drum Brake, Removal and Installation).** |
| 3. Inspect brake pads or brake shoes | |
| | A. Inspect if the brake pads or brake shoes are stuck.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the brake pads.<br>**Refer to: Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).**<br>Replace the brake shoes.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |

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| Symptom | Details/Results/Actions |
|---|---|
| 4. Inspect brake booster | |
| | A. Inspect if the brake booster is stuck.<br>Is it normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Adjust the length of brake booster push rod or replace the brake booster.<br>**Refer to: Brake Booster (2.3.6 Booster brake, Removal and Installation).** |
| 5. Inspect brake pedal free travel | |
| | A. Inspect if the brake pedal free travel is normal.<br>Is it normal?<br>**No**<br>Adjust the length of brake booster push rod.<br>**Yes**<br>Go to step 6. |
| 6. Inspect load sensing proportioning valve | |
| | A. Inspect if the load sensing proportioning valve fails.<br>Is it normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Inspect or adjust the load sensing proportioning valve.<br>**Refer to: Load Sensing Proportioning Valve Inspection and Adjustment (2.3.1 Brake System - Overview, General Inspection).** |

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## Specifications

# Material Specifications

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

# Rear Drum Brake Specifications

| Rear Drum Brake | Specifications |
|---|---|
| Brake friction lining normal thickness | 7 mm |
| Brake friction lining limit thickness | 3 mm |
| Brake drum inner diameter normal thickness | 254 mm |
| Brake drum inner diameter limit thickness | 256 mm |

**WARNING: When the brake drum limit diameter has been reached, install a new brake drum. Take extra care when performing a polishing treatment on the brake drum that has not reached the limit diameter.**

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Brake oil pipe retaining nut | 16 ± 2 | - | - |
| Brake wheel cylinder retaining bolt | 12 | 9 | - |

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## Description and Operation

# System Overview

The drum brake assembly has a brake shoe clearance self-adjusting unit, which can always keep a proper clearance between brake drum and brake shoe.

# Components Description

The rear drum brake consists of the following components:

### Brake Shoe

Applies the mechanical output force from the hydraulic brake wheel cylinder to the brake drum friction surface.

### Brake Drum

Reduces the rotating speed of tire and wheel assembly to stop the vehicle by using the mechanical output force applied by the brake shoes to the brake drum friction surface.

### Brake Wheel Cylinder

Receives the hydraulic pressure from the brake master cylinder and transforms it into mechanical output force to act on the brake shoes.

### Support Pin and Clearance Self-adjusting Unit

Used to support the brake shoes and automatically adjust the brake clearance.

### Brake Shoe Upper and Lower Return Springs

Used to tightly press the two brake shoes on the brake wheel cylinder piston and retaining support pin; when the brake master cylinder returns, the upper spring enables the brake wheel cylinder piston to return automatically.

### Operation of Rear Drum Brake

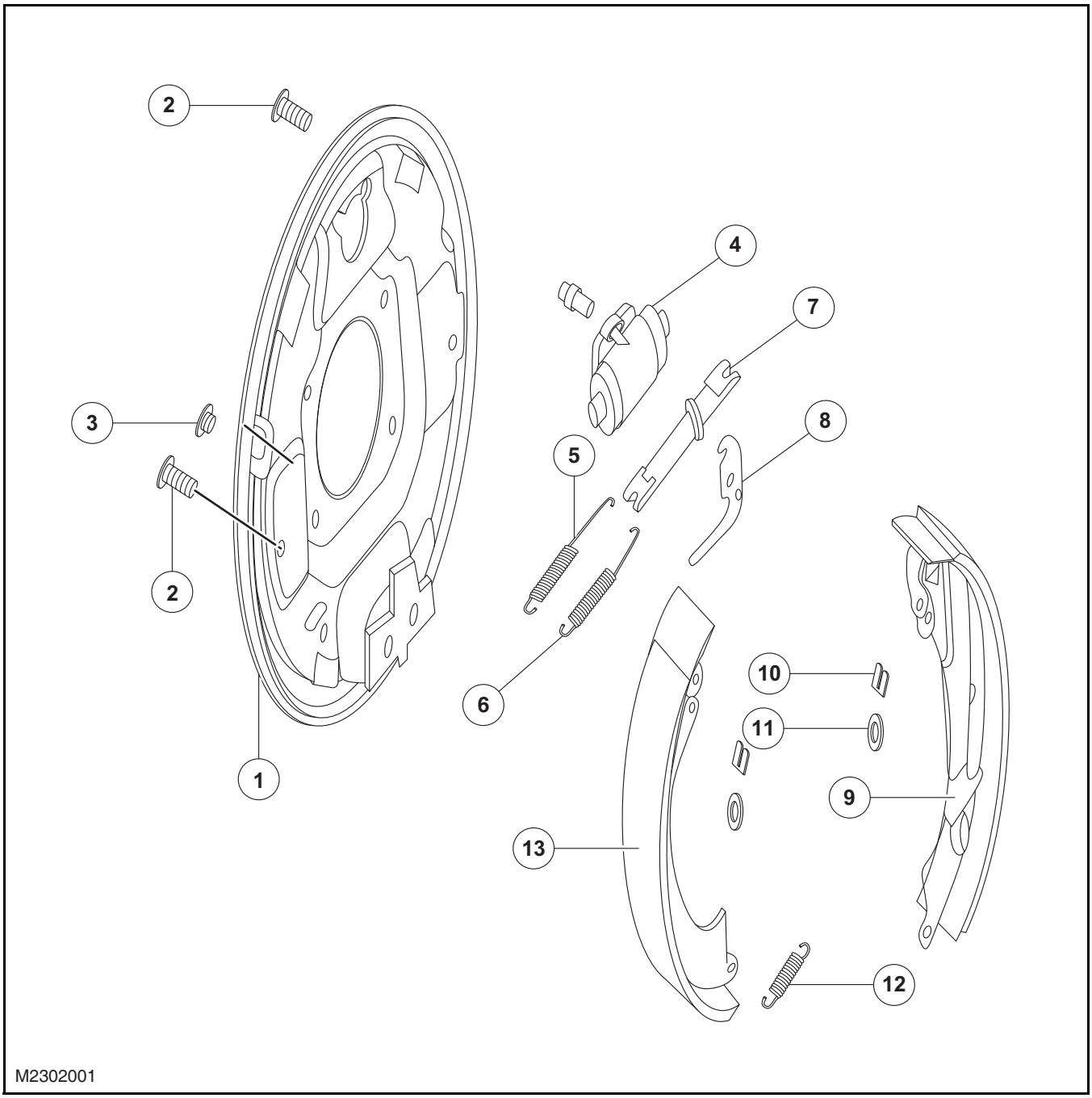
When the brake pedal is depressed, the piston pushes the brake shoe towards the brake drum in radial direction. So the brake shoe is pressed against the brake drum to generate brake force. Moving distance of the rod arm is the same as abrasion loss. With the movement of rod arm, the adjusting board also moves, as they are integrated as a whole. The adjusting board will not turn the gears of self-adjusting unit once until the clearance between brake shoe and brake drum is greater than the moving distance, then the self-adjusting unit will push the rod arm to move the brake shoe towards the brake drum in radial direction and the condition will be maintained. As a result, each time the parking brake lever is pulled up, the clearance between brake shoe and brake drum is automatically adjusted once until it is consistent with the designed value.

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# Exploded View

## Rear Drum Brake



https://truckmanualshub.com/



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Rear brake baseplate | 8 | Clearance adjusting board |
| 2 | Pressure spring push and pull rod | 9 | Rod arm |
| 3 | Observation hole plug | 10 | Pressure spring |
| 4 | Wheel cylinder assembly | 11 | Pressure spring seat |
| 5 | Upper return spring | 12 | Lower return spring |
| 6 | Upper return spring | 13 | Rear brake shoe |
| 7 | Clearance self-adjusting assembly | | |

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## Removal and Installation

# Brake Drum

### Removal

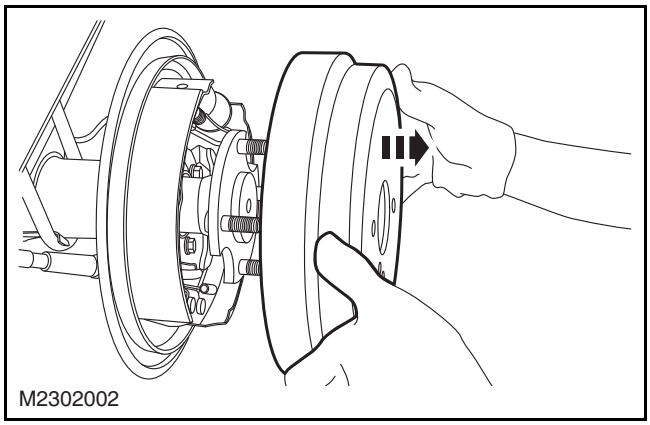
1. Remove the tire.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Release the parking brake lever.
3. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

4. Remove the brake drum.


M2302002

### Installation

1. Installation is in the reverse order of removal.

**CAUTION: After installing the brake drum, adjust the shoe clearance.**

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# Brake Shoe

### Material

| Item | Type |
|---|---|
| Grease | SAM1C-9107-A |

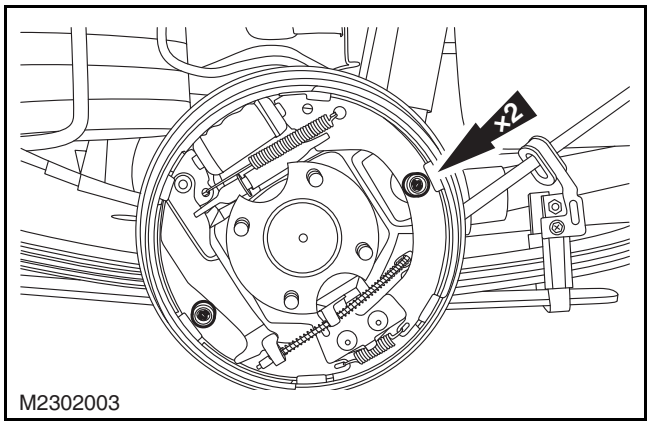
## Removal

1. Remove the brake drum.

   **Refer to: Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).**

2. Remove the left and right pressure springs of brake shoe.

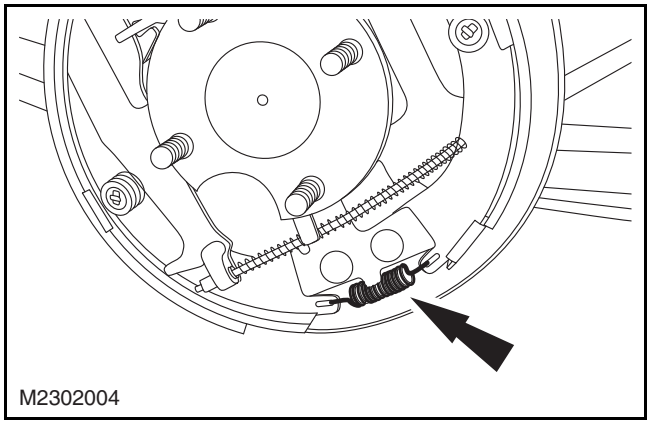
**CAUTION: Wear goggles for installation.**



M2302003

3. Remove the brake shoe lower return spring.

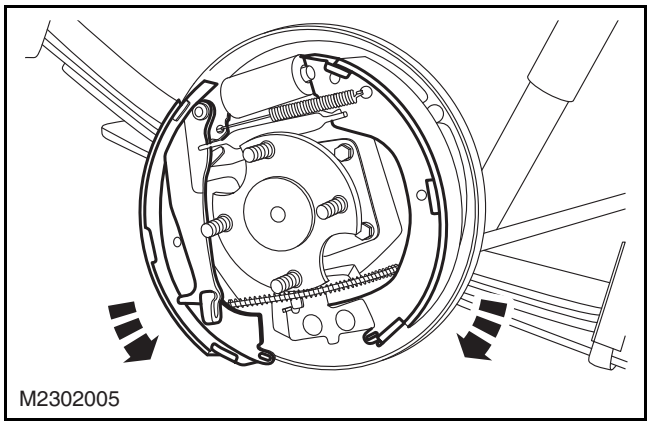
**CAUTION: Wear goggles for installation.**


M2302004

4. Detach the brake shoe from the brake wheel cylinder.

**CAUTION: Do not damage the brake wheel cylinder dust boot when removing the brake shoe.**

**CAUTION: Wear goggles for installation.**


M2302005

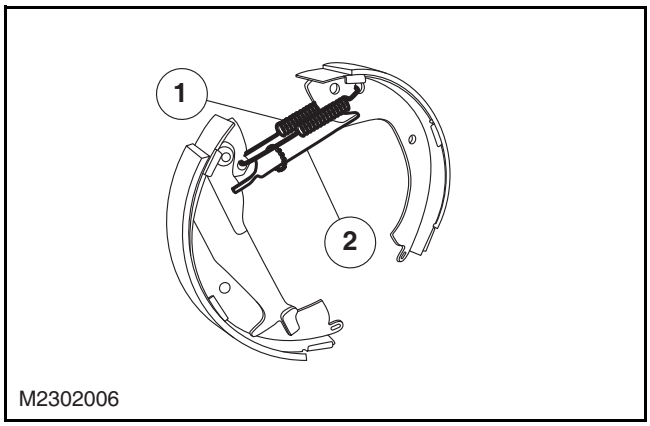
https://truckmanualshub.com/



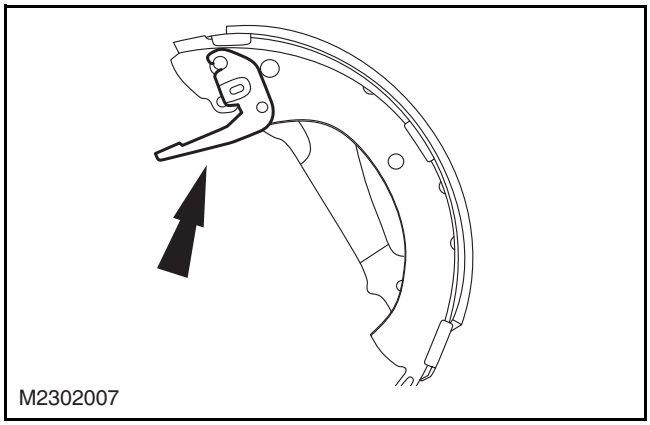
5. Remove the brake shoe upper return spring (1).

**CAUTION: Wear goggles for installation.**

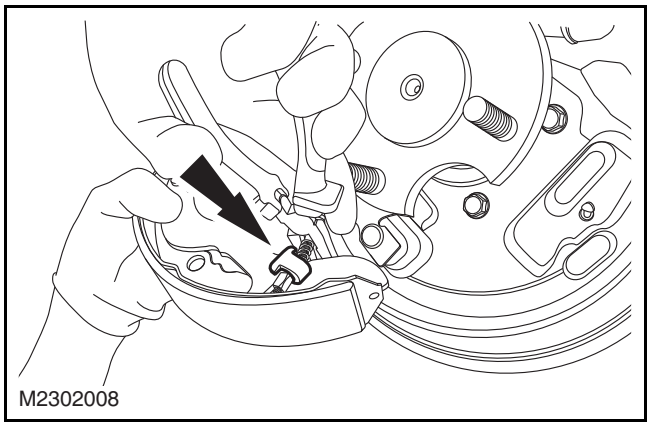
6. Remove the clearance self-adjusting unit (2) from the brake shoe.




7. Remove the adjusting board from the brake shoe.




8. Remove the parking brake cable and brake shoe.



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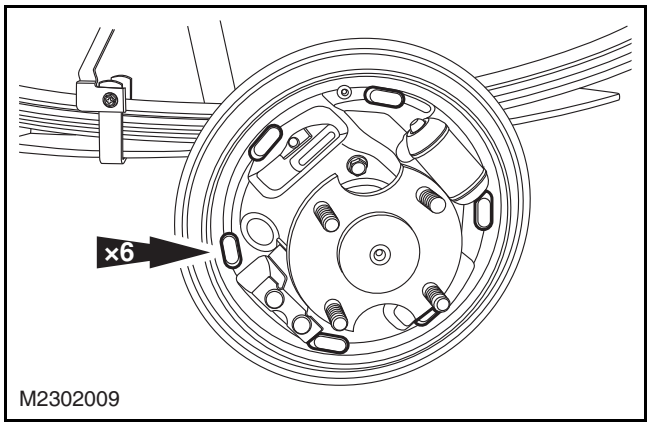
## Installation

1. Clean, inspect and apply grease to the brake baseplate contact area.

   Material: Grease

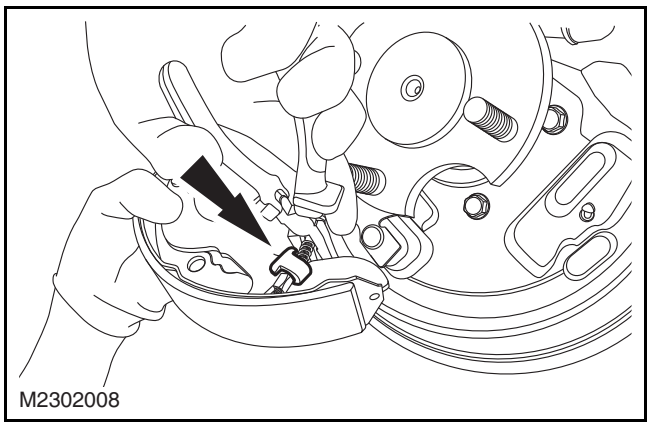
**CAUTION: Do not apply too much grease to avoid flowing onto the brake shoe.**

**CAUTION: For installation, ensure the glove and other things would not leave the oil or grease on the brake shoe.**

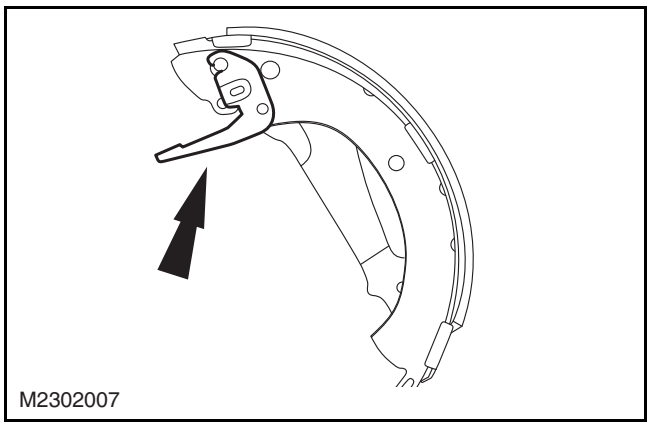


M2302009

2. Install the parking brake cable.


M2302008

3. Install the adjusting board.

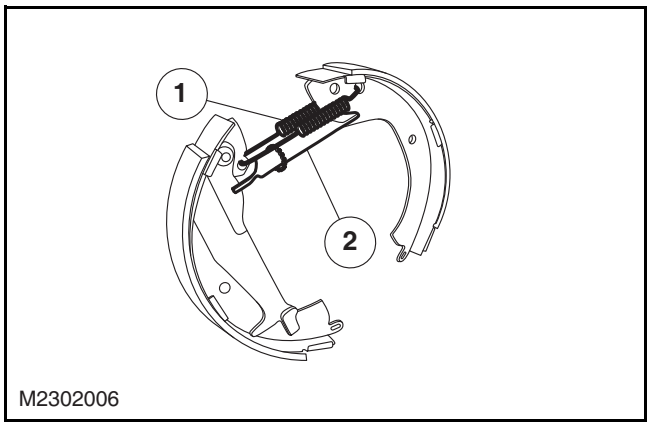

M2302007

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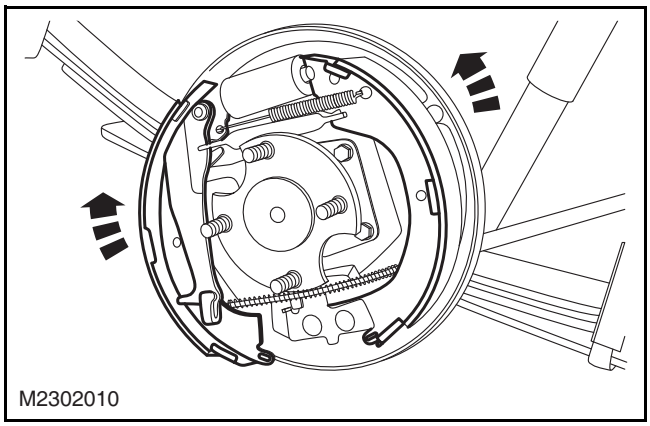
4. Install the self-adjusting unit (2).
5. Install the brake shoe upper return spring (1).

**CAUTION: Wear goggles for installation.**



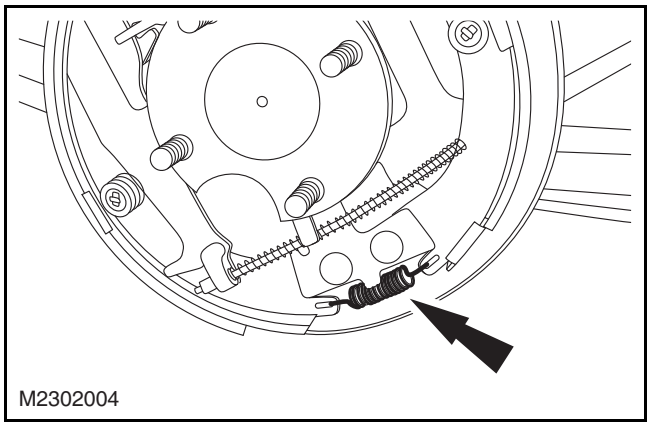

6. Install the brake shoe support pin between brake wheel cylinder and wheel bearing flange.

**CAUTION: Do not damage the brake wheel cylinder dust boot for installation. Do not jack up the piston on one end of wheel cylinder excessively to disengage the piston on the other end from the wheel cylinder.**



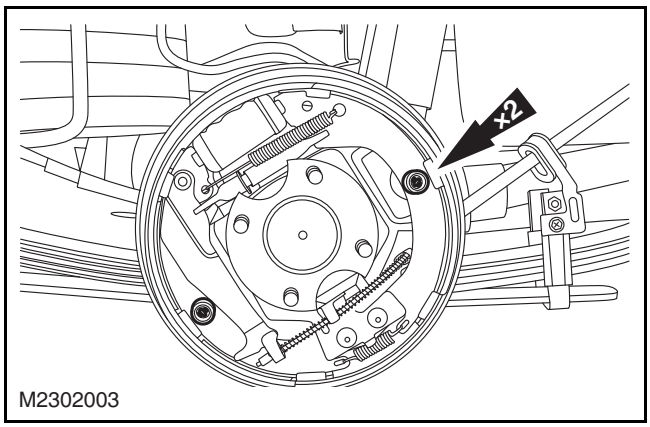

7. Install the brake shoe lower return spring.

**CAUTION: Wear goggles for installation.**




8. Install the left and right pressure springs of brake shoe.

**CAUTION: Wear goggles for installation.**



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9. Adjust the self-adjusting unit to the minimum position.
10. Install the brake drum.

    **Refer to: Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).**

11. Adjust the parking brake cable.

    **Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection).**

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# Brake Wheel Cylinder

### Material

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

## Removal

1. Remove the rear wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

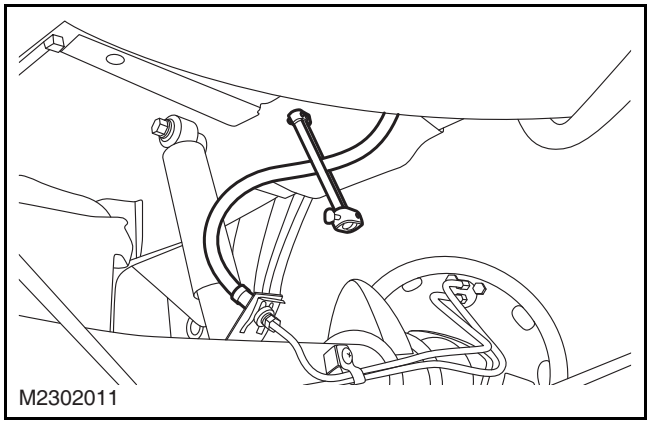
2. Remove the brake drum.

   **Refer to: Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).**

3. Remove the brake shoe.

   **Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).**

4. Clamp the brake hose at rear axle with oil pipe clip.

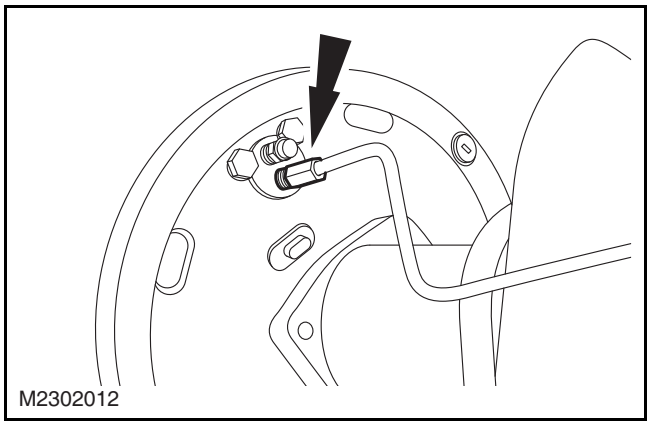

M2302011

5. Remove the brake wheel cylinder pipe.

   Torque: 16 ± 2 Nm

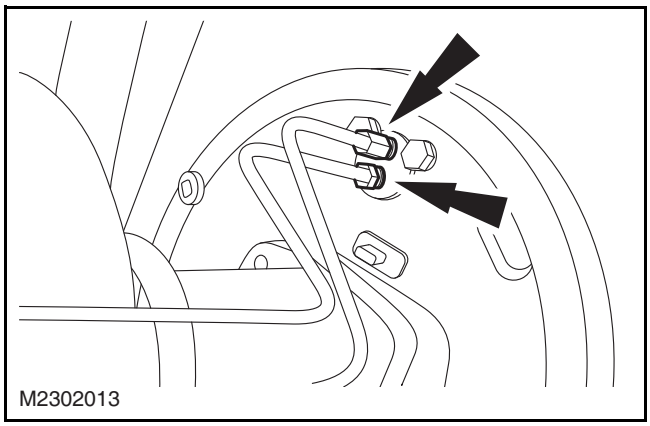
**CAUTION: Remove 2 pipes when removing the rear right brake wheel cylinder.**

**CAUTION: If brake fluid is splashed on the paintwork, the affected area must be immediately washed with cold water.**


M2302012

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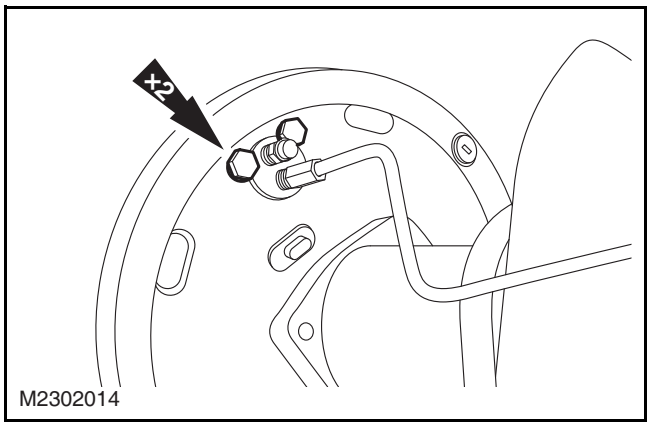




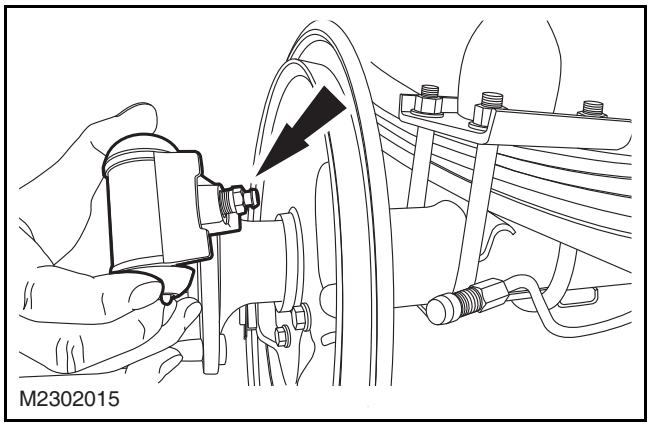

**6.** Remove 2 retaining bolts from the brake wheel cylinder.

Torque: 12 Nm

⚠ **CAUTION: Seal the brake wheel cylinder oil inlet to prevent oil loss and dirt.**




**7.** Remove the brake wheel cylinder.



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## Installation

1. Installation is in the reverse order of removal.
2. Bleed air in the brake system.

**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

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# Brake Baseplate

### Material

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |
| Sealant | Sealant 366E |

## Removal

1. Remove the rear wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Remove the brake drum.

   **Refer to: Brake Drum (2.3.2 Rear Drum Brake, Removal and Installation).**

3. Remove the brake shoe.

   **Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).**

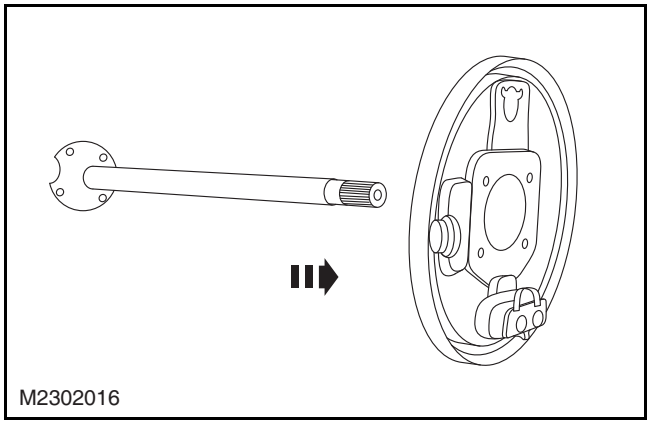
4. Remove the brake wheel cylinder.

   **Refer to: Brake Wheel Cylinder (2.3.2 Rear Drum Brake, Removal and Installation).**

5. Remove the drive shaft.

   **Refer to: Drive Shaft (2.2.3 Half Shaft, Removal and Installation).**

6. Remove the brake baseplate.



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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: When reinstalling the brake baseplate after removed, reapply sealant to junction surface between brake baseplate and rear axle.**

2. Bleed air in the brake system.

**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

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## Specifications

# Material Specifications

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

# Front Disc Brake Specifications

| Front Disc Brake | Specifications |
|---|---|
| Brake disc normal thickness | 17 mm |
| Brake disc limit thickness | 15 mm |
| Brake pad normal thickness | 15 mm |
| Brake pad limit thickness | 7 mm |
| Brake disc limit offset | 0.15 mm |

**WARNING: When the brake disc limit thickness has been reached, install a new brake disc. Take extra care when performing a polishing treatment on the brake disc that has not reached the limit thickness.**

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Tire nut | 110 ± 5 | - | - |
| Brake caliper retaining bolt | 85 | 63 | - |
| Brake wheel cylinder support retaining bolt | 95 | 70 | - |
| Front brake hose joint | 40 ± 2 | - | - |

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## Description and Operation

# System Overview

The brake caliper of front disc brake is of single piston type, which is installed on the steering knuckle with two mounting bolts. When depressing the brake pedal, the brake caliper moves outward under the hydraulic pressure to push the brake pad press against the brake disc, producing a friction force to reduce the rotating speed of wheel and tire assembly. The vehicle will stop as a result. The piston moves further to compensate the clearance when the brake pad is worn. The piston rubber seal recovers to its original shape to keep the original clearance between brake disc and brake pad when the pressure on the brake pedal and the hydraulic pressure on the piston are released.

# Components Description

### Disc Brake Pad

Applies the mechanical output force from the hydraulic brake caliper to the friction surface of brake disc.

### Disc Brake Pad Guide Plate

Located between disc brake pad and brake pad mounting bracket to keep a smooth movement of the brake pad and eliminate noises.

### Brake Disc

Reduces the rotating speed of tire and wheel assembly to stop the vehicle by using the mechanical output force applied by the disc brake pad to the friction surface of brake disc.

### Brake Caliper

Receives the hydraulic pressure from the brake master cylinder and transforms it into mechanical output force to act on the inner brake pad; when the brake master cylinder returns, the brake caliper piston returns automatically.

### Bracket for Brake Caliper and Brake Pad

Used to secure the disc brake pad and brake caliper in place to keep a correct matching position with the hydraulic brake caliper. The brake pad slides when the mechanical output force is applied to the brake pad.

### Disc Brake Caliper Floating Pin

Used to install the hydraulic brake caliper and secure it in place to keep a correct matching position with the brake caliper bracket. The brake caliper slides relative to the brake pad when the mechanical output force is applied.

### Operation of Front Disc Brake System

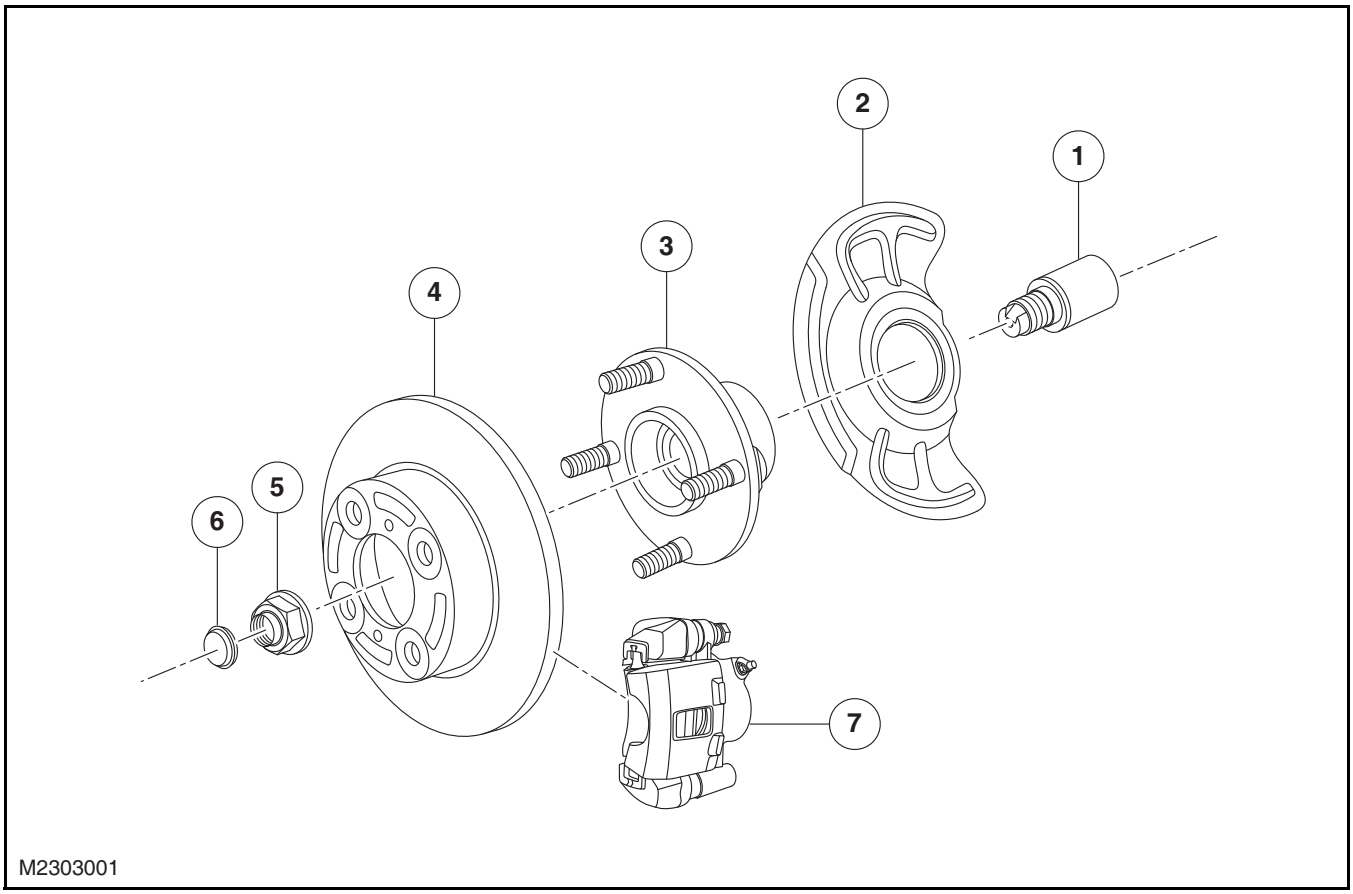
The mechanical output force from the hydraulic brake caliper piston is applied to the inner brake pad. The brake caliper housing pulls the outer brake pad inward to get even distribution of the output force while the piston pushes the inner brake pad outward. The brake pad applies the output force to the both sides of brake disc friction surface to reduce the rotating speed of wheel and tire assembly. It is important for the even distribution of brake force that whether the brake pad guide plate and brake caliper floating pin work normally or not.

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# Exploded View

## Front Disc Brake




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Front hub shaft | 5 | Hub shaft nut |
| 2 | Brake disc dust plate | 6 | Shaft cover |
| 3 | Front hub bearing assembly | 7 | Brake caliper assembly |
| 4 | Front brake disc | | |

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## Removal and Installation

# Brake Pad

### Material

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

## Removal

**1.** Remove the tire.

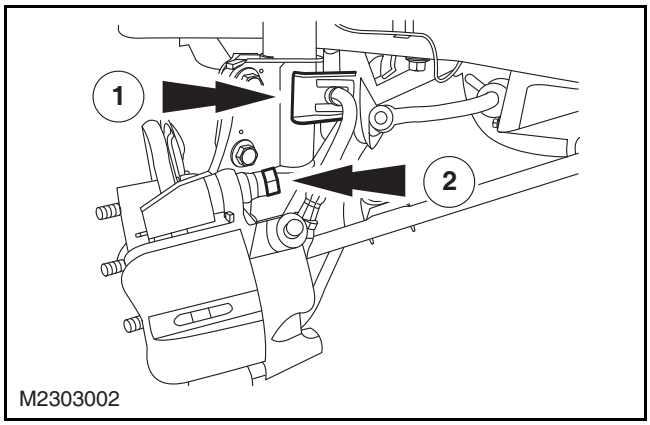
**Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

**2.** Remove the brake caliper.

1 Remove the front brake hose (1).

2 Remove the brake caliper retaining bolt (2).

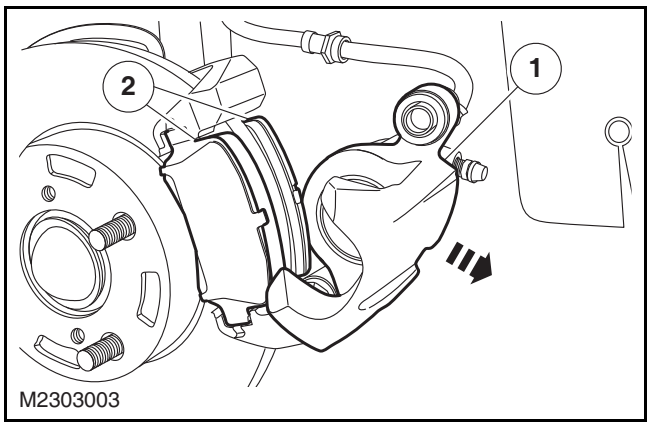
**CAUTION: Before removing the brake caliper, pull the brake caliper forcibly to two sides of wheel cylinder return a little for removal.**




**3.** Remove the brake pad.

1 Turn the brake caliper over.

2 Remove the brake pad.



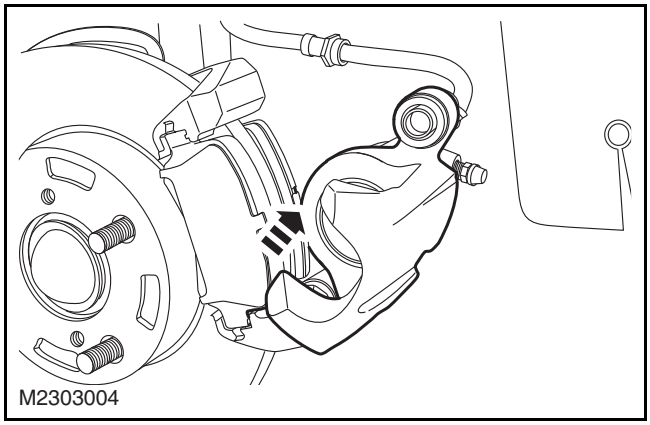
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## Installation

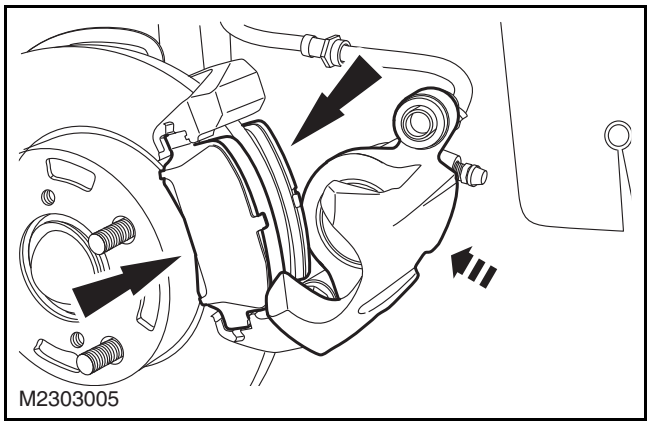
1. Use a suitable tool to compress the brake wheel cylinder piston.

**CAUTION: Brake fluid will spill out from the brake fluid reservoir after the brake wheel cylinder piston is compressed tightly into the piston cylinder.**


M2303004

2. Install the brake pad.

**CAUTION: For installation of brake pad, ensure the circlip is on the brake caliper; Otherwise displacement or falling off may cause unusual sound for braking.**

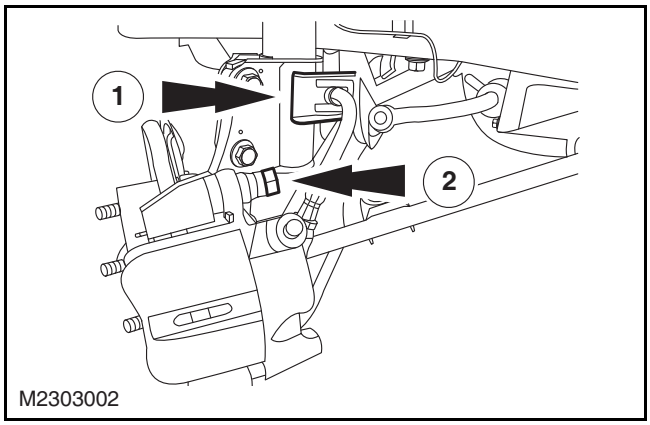

M2303005

3. Install the brake caliper.

   1 Install the brake caliper retaining bolt (2).

   Torque: 85 Nm

   2 Install the front brake hose (1).



M2303002

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4. Depress the brake pedal forcibly for more than 3 times.

**WARNING: After maintenance of brake system, make sure to depress the brake pedal forcibly for more than 3 times to eliminate the clearance generated among wheel cylinder, brake pad and brake disc. Without this step, it would cause the missing of brake force for the first two braking!**

5. Inspect the brake fluid level and fill when necessary.
6. Install the tire.

**Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

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# Brake Caliper

### General Equipment

| |
|---|
| Brake hose clamp |

## Removal

1. Remove the tire.

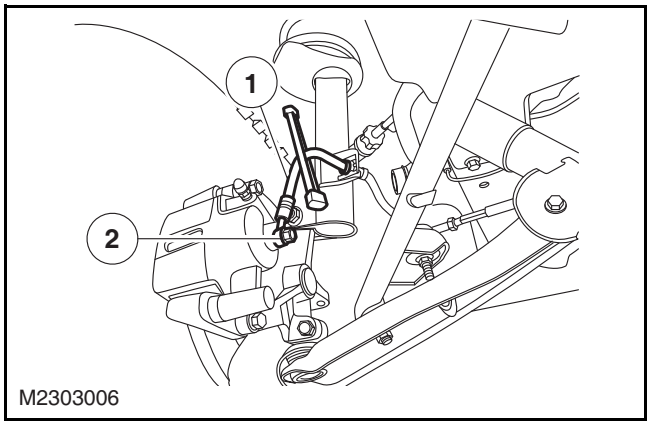
   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Remove the brake hose from the brake caliper.

   1 Clamp the brake hose with a brake hose clamp.

   2 Remove the brake hose joint.

   Torque: 40 ± 2 Nm



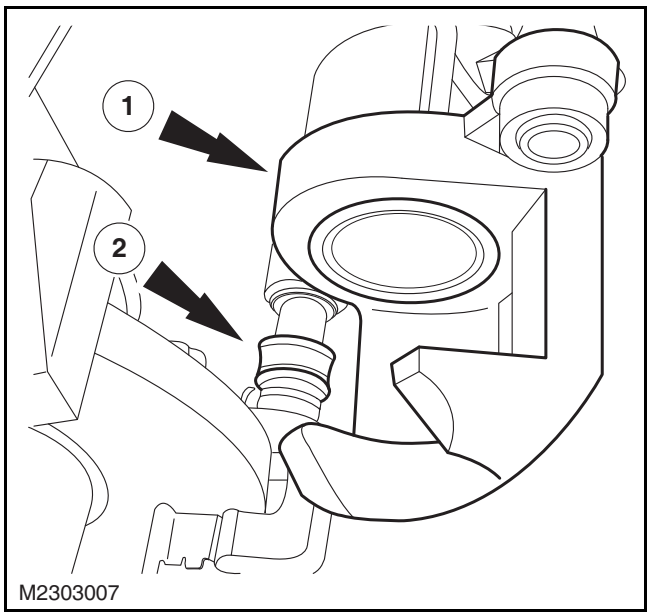

**CAUTION: Seal the brake wheel cylinder oil inlet to prevent oil loss and dirt.**

**CAUTION: If brake fluid is splashed on the paintwork, the affected area must be immediately washed with cold water.**

3. Remove the brake pad.

   **Refer to: Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).**

4. Remove the dust boot (1) from the brake caliper lower slide pin and remove the brake wheel cylinder (2).

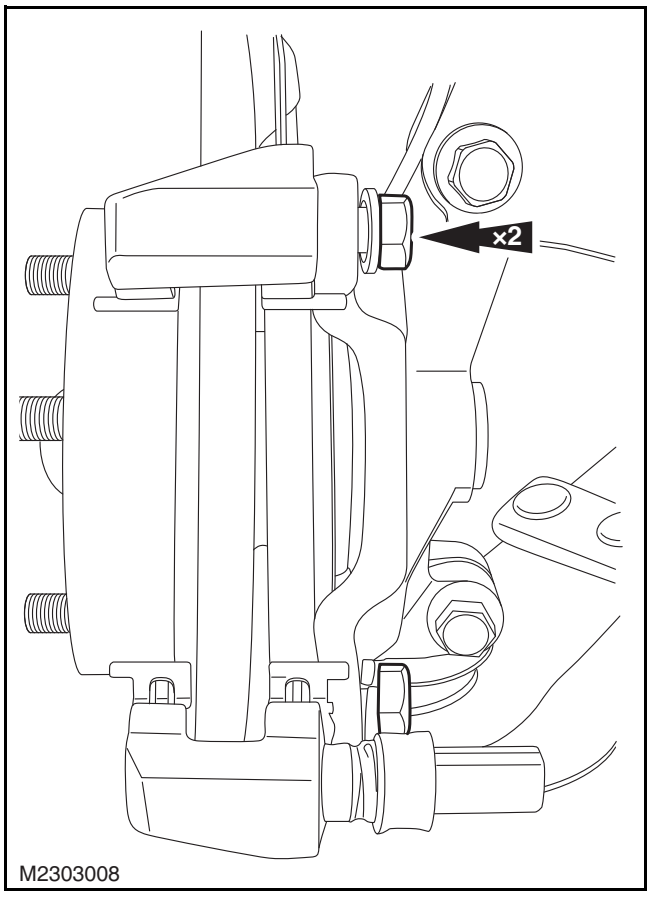


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5. Remove 2 retaining bolts from brake wheel cylinder support of brake caliper, and remove the brake wheel cylinder support.

   Torque: 95 Nm




## Installation

1. Installation is in the reverse order of removal.
2. Bleed air in the brake system.

   **Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

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# Brake Disc

## Removal

1. Remove the brake pad.

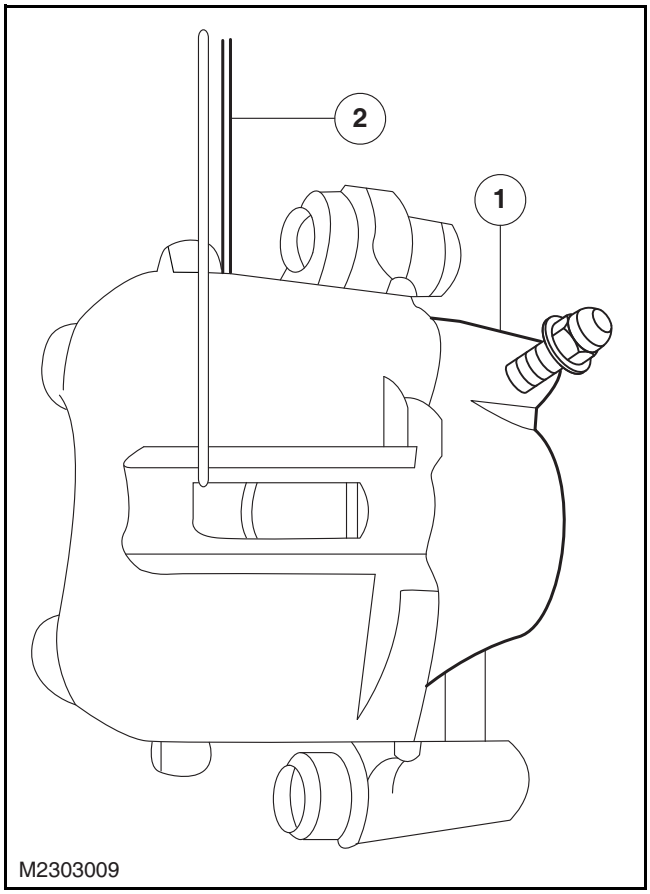
   **Refer to: Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).**

2. Remove the brake caliper.

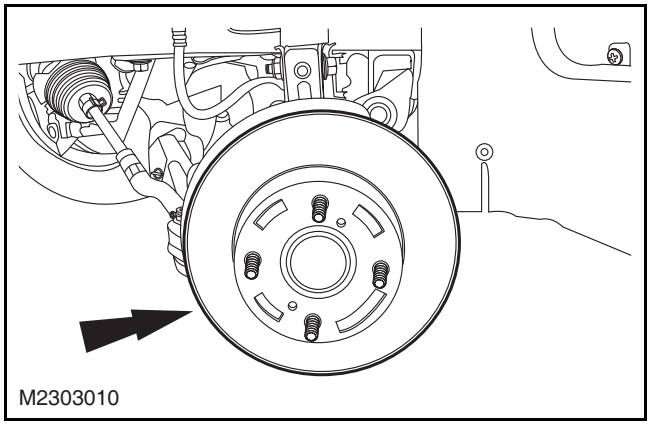
   **Refer to: Brake Caliper (2.3.3 Front Disc Brake, Removal and Installation).**

3. Use an iron wire (2) to hang the brake caliper (1).

**CAUTION: Hang the brake caliper to prevent the brake hose from being stretched.**




4. Remove the brake disc.



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## Installation

1. Installation is in the reverse order of removal.
2. Bleed air in the brake system.

**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

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## Specifications

# Parking Brake Specifications

| Parking Brake | Specifications |
|---|---|
| (Pulled with a force of 20 kg) Parking brake lever tooth number | 5 ~ 10 teeth |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Parking brake cable adjusting/retaining nut | 5 | - | 44 |
| Parking brake lever retaining bolt | 20 ± 2 | - | - |
| Parking brake cable retaining nut | 20 | 15 | - |
| Parking brake cable retaining bolt | 9 | - | 80 |
| Retaining bolt between parking brake cable and brake baseplate | 9 | - | 80 |

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## Description and Operation

# System Overview

The parking braking is actuated by the rear brakes. The parking brake system consists of parking brake, manual brake control mechanism and parking brake cable.

The parking brake system is a mechanical system to control the rear drum brakes through a parking brake lever. The system can be enabled by pulling up the parking brake lever, which controls the rear drum brake shoes to stretch outward through the cables for braking. The parking brake indicator on the instrument cluster will be turned on when the parking brake lever is pulled up and the ignition switch is turned to "ON". Pull up the lever, press the button on it, and lower it down to release the parking brake, and then the parking brake indicator on the instrument cluster will be turned off.

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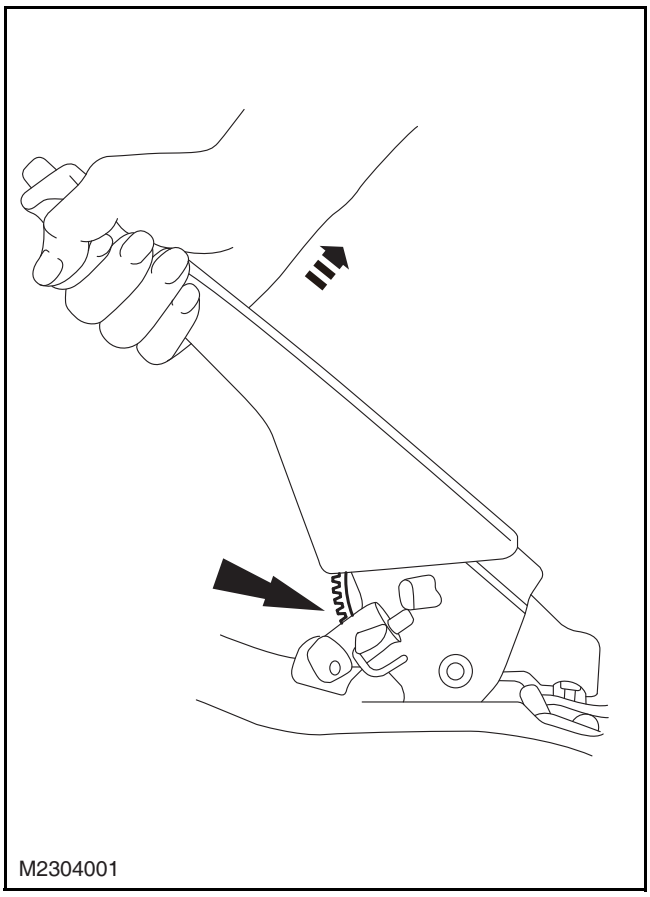


## General Inspection

# Parking Brake Lever Inspection

1. Hold and pull up the parking brake lever with a force of 20 kg.
2. Count the number of teeth indicated by the arrow shown in the figure.

   Standard tooth number: 5 ~ 10 teeth




3. If the number of teeth does not accord with technical requirements, adjust the cable to obtain specified parking brake travel.

**CAUTION: Inspect if the tooth tip is worn or damaged, otherwise replace the parking brake lever.**

# Parking Brake Cable Adjustment

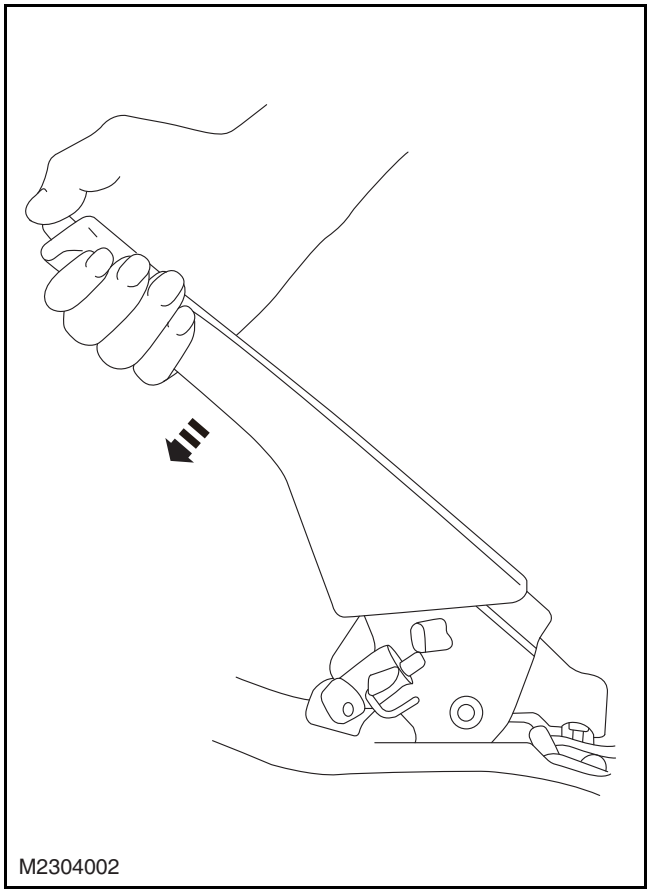
**CAUTION: Before adjustment of cables, ensure the following conditions:**

- **Brake system shall be free of air.**
- **Brake pedal travel is proper.**
- **Pull the parking brake lever several times with a force of about 20 kg.**
- **Abrasion of rear brake shoe shall not exceed limit range.**

1. Remove the console.

   **Refer to: Console (5.1.6 Instrument Panel and Console, Removal and Installation).**

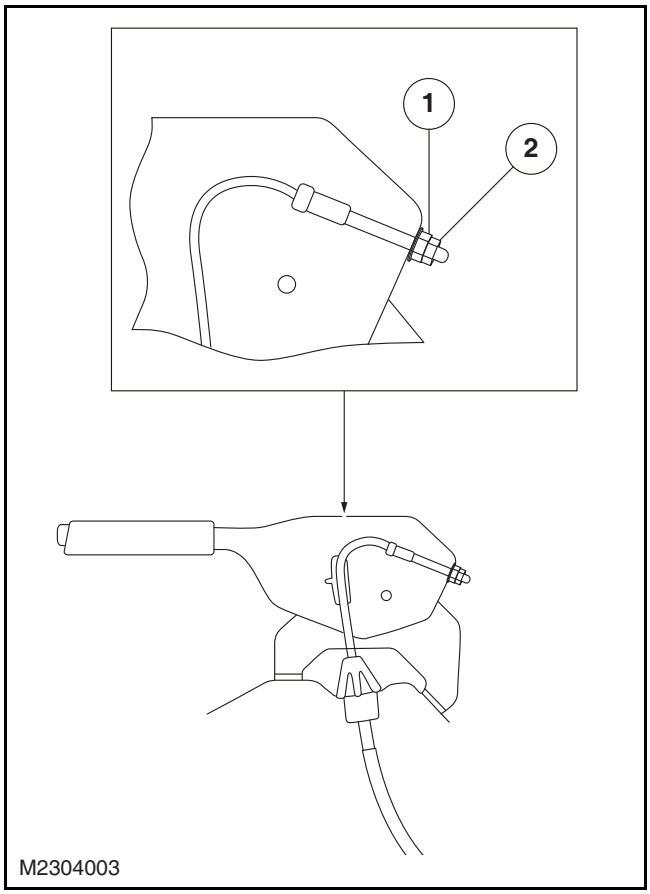
2. Release the parking brake lever.



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3. Loosen the locking nut (2) and adjusting nut (1).




4. Adjust the parking brake lever to the standard tooth number.

   Standard tooth number: 5 ~ 10 teeth

5. Tighten the adjusting nut.

   Torque: 5 Nm

6. Test the parking brake for normal operation.

**CAUTION: After adjustment, inspect if the brake drum is stuck.**

7. Install the console.

   **Refer to: Console (5.1.6 Instrument Panel and Console, Removal and Installation).**

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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical and hydraulic damage.

**Visual Inspection Chart**

| Mechanical |
| --- |
| • Tire pressure(s) |
| • Wheel and tire |
| • Brake fluid level |
| • Brake line leakage |

3. Solve the known problems before proceeding to the next step.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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# Symptom Chart

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Parking brake will not function (failure)/Poor parking brake force | • Excessive parking brake lever travel | • Adjust the parking brake cables.<br>**Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection).** |
| | • Left and right parking brake cables (stuck, broken) | • Repair or replace the parking brake cables.<br>**Refer to: Parking Brake Cable (2.3.4 Parking Brake and Operation, Removal and Installation).** |
| | • Cable equalizer (loosen, cracked, distorted) | • Replace the front part of parking brake cables.<br>**Refer to: Parking Brake Cable (2.3.4 Parking Brake and Operation, Removal and Installation).** |
| | • Rear brake shoes (worn to the limit) | • Replace the brake shoes.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Parking brake cannot be released (drag) | • Insufficient parking brake lever travel | • Adjust the parking brake cables.<br>**Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection).** |
| | • Left and right parking brake cables (stuck) | • Repair or replace the parking brake cables.<br>**Refer to: Parking Brake Cable (2.3.4 Parking Brake and Operation, Removal and Installation).** |
| | • Rear brake shoe (stuck, cracked and distorted) | • Replace the brake shoes.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |
| | • Rear brake return spring (fatigue and cracked) | • Replace the return springs.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |
| Parking brake indicator does not illuminate with ignition switch "ON" and vehicle parked | • Instrument panel fuse | **Refer to: Diagnosis Procedure for Inoperative Parking Brake Indicator with Ignition Switch "ON" and Vehicle Parked (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing).** |
| | • Instrument cluster wiring harness connector | |
| | • Instrument cluster power circuit | |
| | • Instrument cluster grounding circuit | |
| | • Wiring harness between parking brake lamp switch and instrument cluster | |
| | • Parking brake switch | |
| | • Instrument cluster | |

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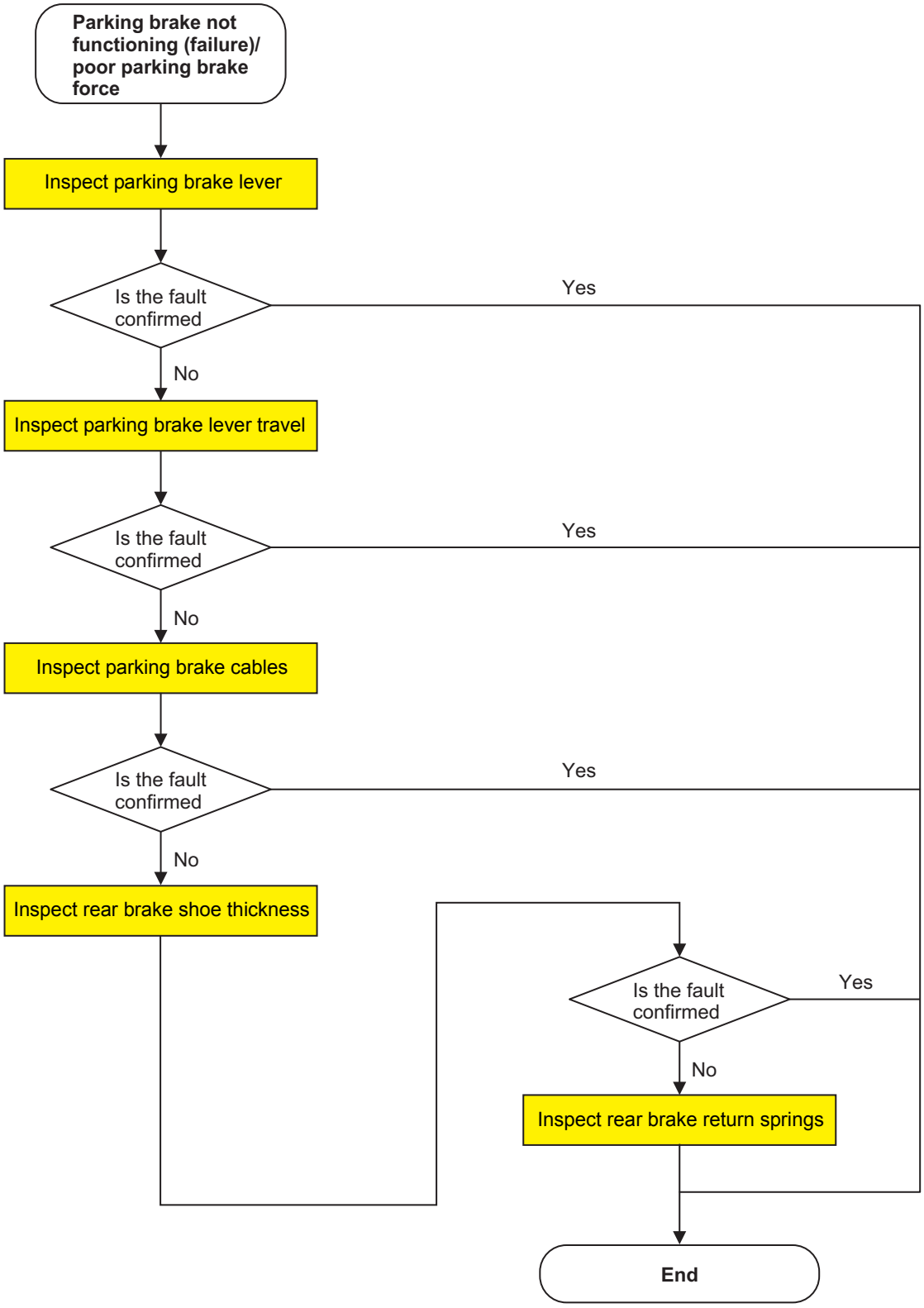


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Parking brake indicator is always on | • Parking brake switch | Refer to: Diagnosis Procedure for Parking Brake Indicator Constant ON (2.3.4 Parking Brake and Operation, Symptom Diagnosis and Testing). |
| | • Wiring harness between parking brake switch and instrument cluster | |
| | • Instrument cluster | |

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# Diagnosis Procedure for Parking Brake not Functioning (Failure)/ Poor Parking Brake Force



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect parking brake lever | |
| | A. Inspect if the parking brake lever is normal.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the parking brake lever.<br>**Refer to: Parking Brake Lever (2.3.4 Parking Brake and Operation, Removal and Installation).** |
| 2. Inspect parking brake lever travel | |
| | A. Inspect if the parking brake lever travel is normal.<br>**Standard travel: 5 ~ 10 teeth**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Adjust the parking brake lever travel.<br>**Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection)** |
| 3. Inspect parking brake cables | |
| | A. Inspect the parking brake cables for damage or sticking.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair or replace the parking brake cables.<br>**Refer to: Parking Brake Cable (2.3.4 Parking Brake and Operation, Removal and Installation).** |

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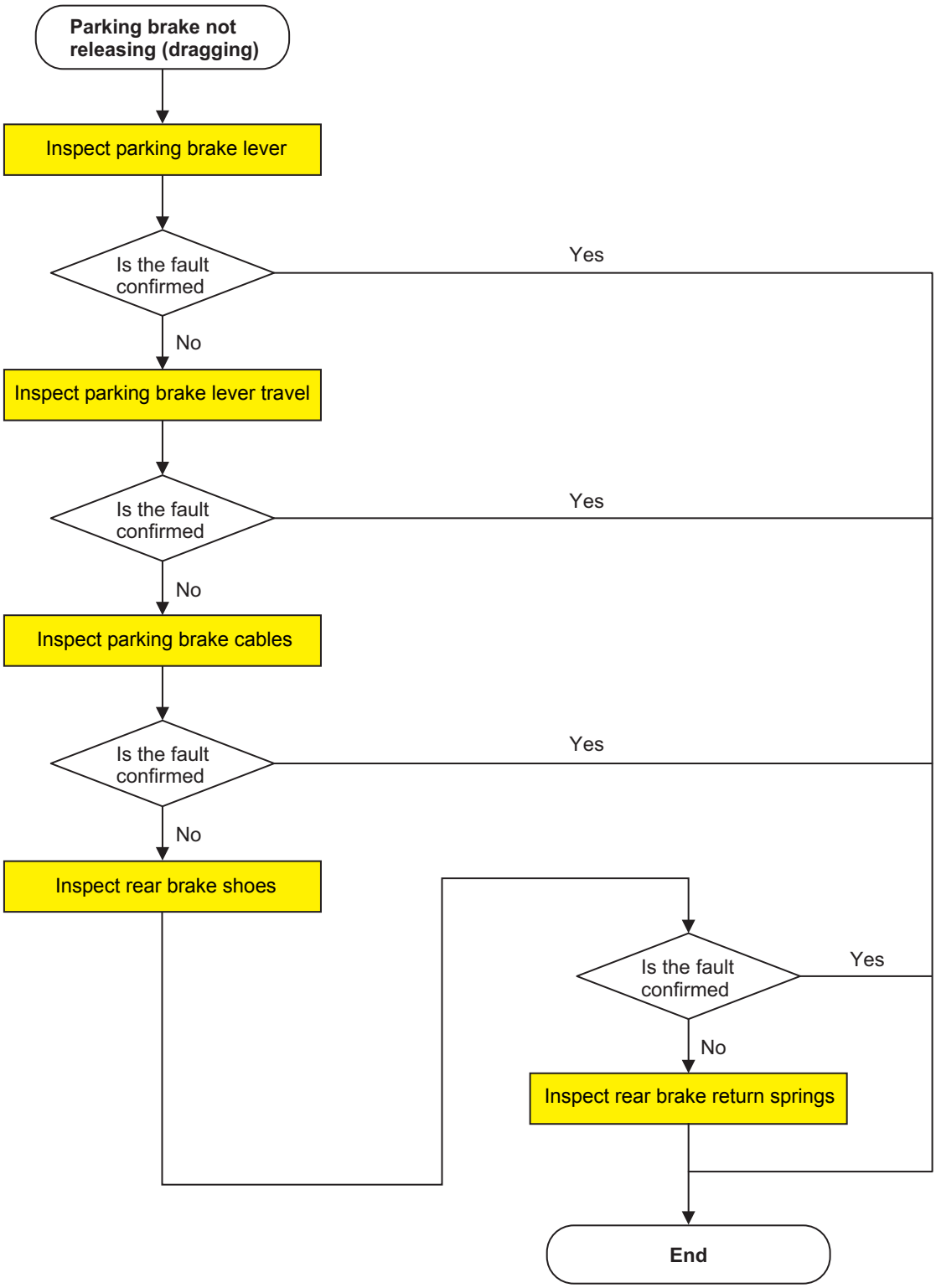


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect rear brake shoe thickness | |
| | A. Inspect if the brake shoe thickness is normal.<br>**Brake shoe limit thickness: 3 mm**<br>Is it normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the brake shoes.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |
| 5. Inspect rear brake return springs | |
| | A. Inspect if the rear drum brake return springs are normal.<br>Is it normal?<br>**Yes**<br>The maintenance is finished.<br>**No**<br>Inspect and repair the rear drum brake. |

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# Diagnosis Procedure for Parking Brake not Releasing (Dragging)



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect parking brake lever | |
| | A. Inspect if the parking brake lever is normal.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the parking brake lever.<br>**Refer to: Parking Brake Lever (2.3.4 Parking Brake and Operation, Removal and Installation).** |
| 2. Inspect parking brake lever travel | |
| | A. Inspect if the parking brake lever travel is normal.<br>**Standard travel: 5 ~ 10 teeth**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Adjust the parking brake lever travel.<br>**Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection).** |
| 3. Inspect parking brake cables | |
| | A. Inspect the parking brake cables for damage or sticking.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair or replace the parking brake cables.<br>**Refer to: Parking Brake Cable (2.3.4 Parking Brake and Operation, Removal and Installation).** |

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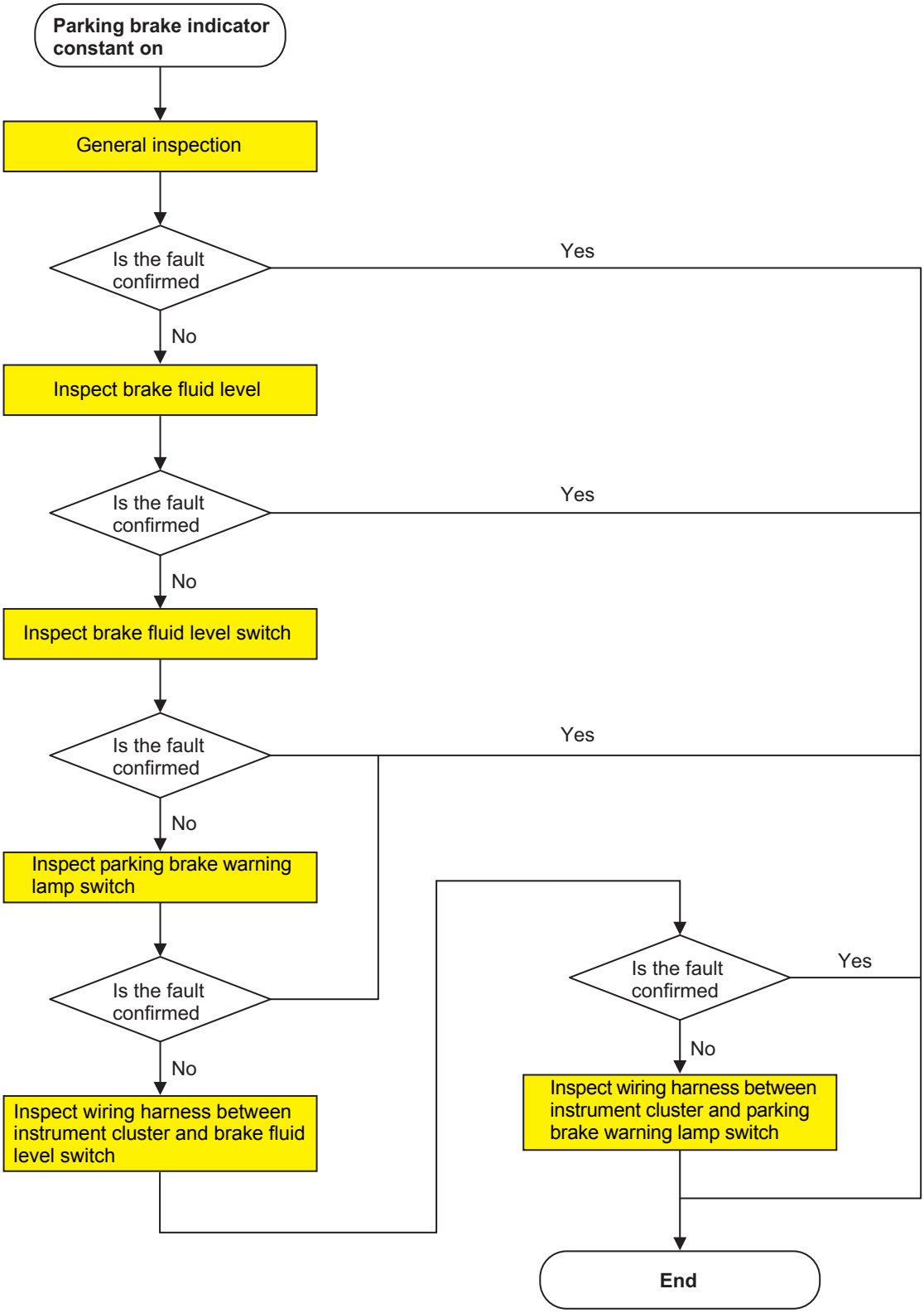


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect rear brake shoes | |
| | A. Inspect the brake shoes for normal movement.<br>Is it normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the brake shoes.<br>**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).** |
| 5. Inspect rear brake return springs | |
| | A. Inspect if the rear drum brake return springs are normal.<br>Is it normal?<br>**Yes**<br>The maintenance is finished.<br>**No**<br>Inspect and repair the rear drum brake. |

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# Diagnosis Procedure for Parking Brake Indicator Constant ON



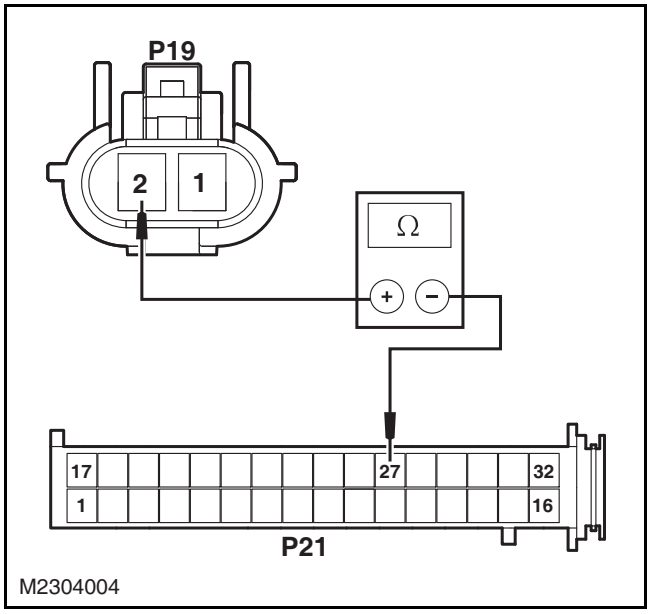
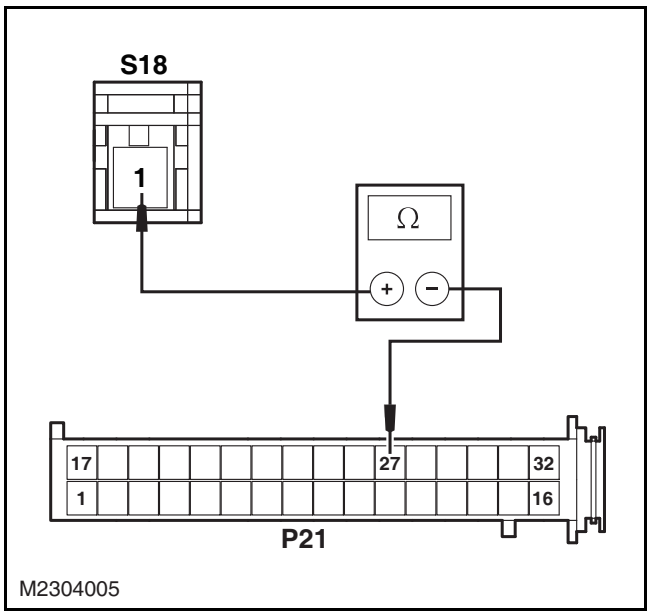
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect brake fluid level | |
| | A. Inspect the brake fluid level.<br>Is the level normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Add brake fluid and inspect the brake system. |
| 3. Inspect brake fluid level switch | |
| | A. Disconnect the brake fluid level switch wiring harness connector P19.<br>B. Inspect if the parking brake indicator turns off.<br>Is it normal?<br>**Yes**<br>Replace the brake fluid reservoir.<br>**No**<br>Go to step 4. |
| 4. Inspect parking brake warning lamp switch | |
| | A. Disconnect the parking brake warning lamp switch wiring harness connector S18.<br>B. Inspect if the parking brake indicator turns off.<br>Is it normal?<br>**Yes**<br>Replace the parking brake warning lamp switch.<br>**Refer to: Parking Brake Warning Lamp Switch (2.3.4 Parking Brake and Operation, Removal and Installation).**<br>**No**<br>Go to step 5. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect wiring harness between instrument cluster and brake fluid level switch | |
|  M2304004 | A. Disconnect the brake fluid level switch wiring harness connector P19.<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 2 of brake fluid level switch wiring harness connector P19 and terminal 27 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of brake fluid level switch wiring harness connector P19 and terminal 27 of instrument cluster wiring harness connector P21. |
| 6. Inspect wiring harness between instrument cluster and parking brake warning lamp switch | |
|  M2304005 | A. Disconnect the parking brake warning lamp wiring harness connector S18.<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 1 of parking brake warning lamp wiring harness connector S18 and terminal 27 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of parking brake warning lamp wiring harness connector S18 and terminal 27 of instrument cluster wiring harness connector P21. |

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## Removal and Installation

# Parking Brake Lever

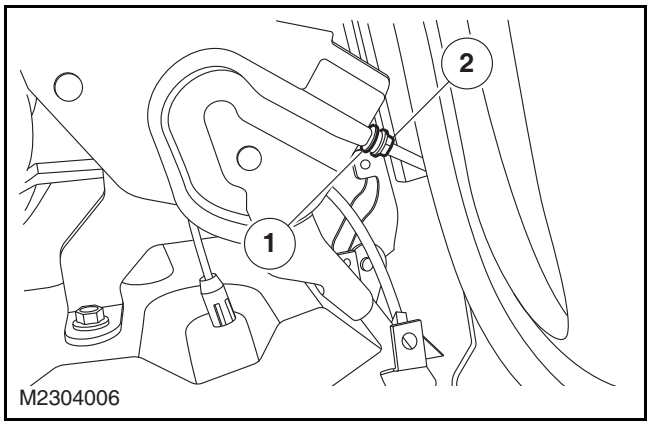
### Removal

1. Remove the console.

   **Refer to: Console (5.1.6 Instrument Panel and Console, Removal and Installation).**

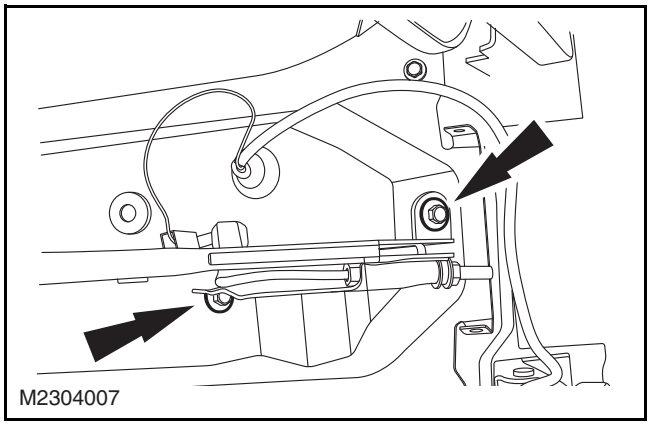
2. Release the parking brake lever.
3. Loosen the tightening nut (2) and adjusting nut (1).

   Torque: 5 Nm

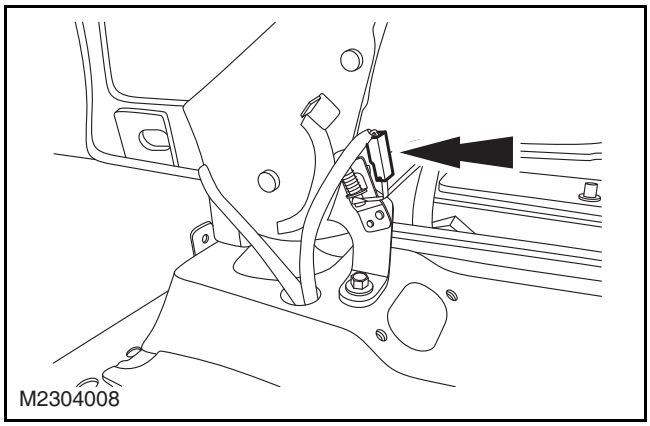



4. Remove 2 retaining bolts from the parking brake lever.

   Torque: 20 ± 2 Nm



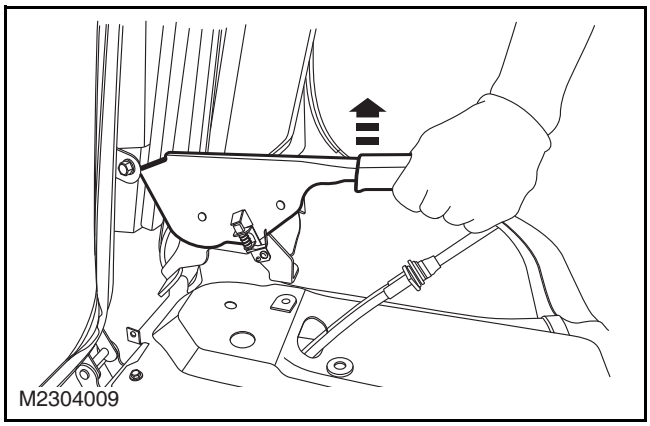

5. Remove the parking brake control cable.
6. Disconnect the parking brake warning indicator switch wiring harness connector.



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7. Remove the parking brake lever.




## Installation

1. Installation is in the reverse order of removal.
2. Adjust the parking brake cable.

**Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection).**

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# Parking Brake Cable

**Material**

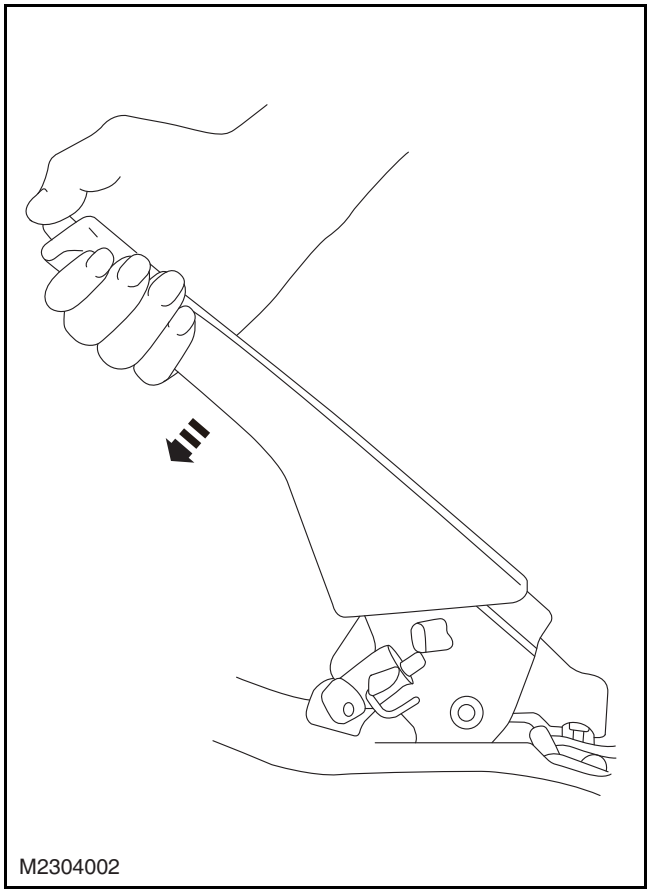
| Item | Type |
|---|---|
| Water-proof sealant | Sealant 366E |

## Removal

1. Remove the console.

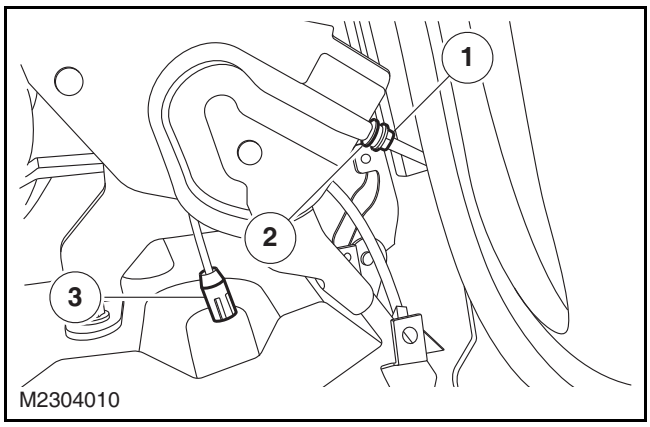
   **Refer to: Instrument Panel (5.1.6 Instrument Panel and Console).**

2. Release the parking brake lever.


M2304002

3. Loosen the tightening nut (1) and adjusting nut (2) and remove the unidirectional clip (3) from the front part of parking brake cable.

   Torque: 5 Nm



M2304010

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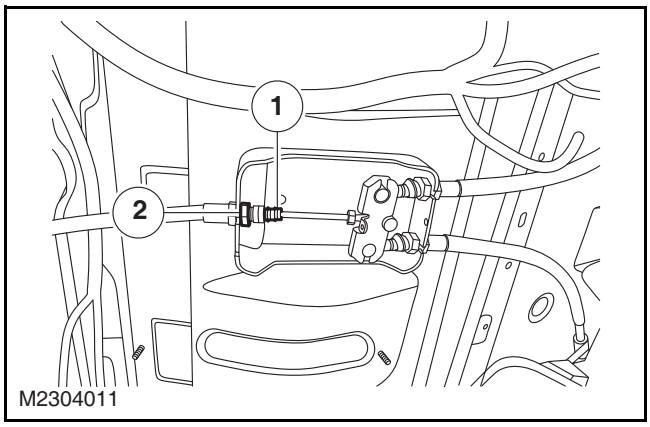


**4.** Remove the front part of parking brake cable.

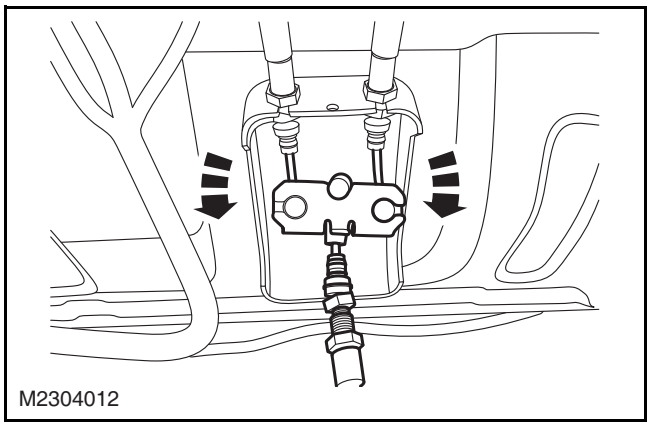
1 Remove the seal sleeve (1) from the front part of parking brake cable.

2 Remove the retaining nut (2) from the front part of parking brake cable.

Torque: 20 Nm




3 As shown in the figure, turn the left and right cables 90 degrees and remove them out from the equalizer.




**5.** Remove the brake shoe.

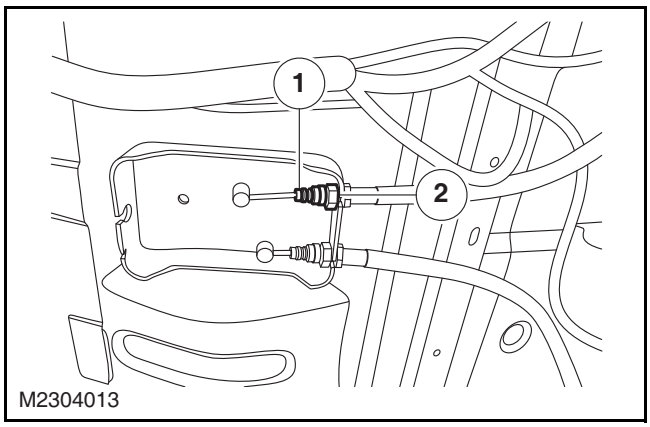
**Refer to: Brake Shoe (2.3.2 Rear Drum Brake, Removal and Installation).**

**6.** Remove the left brake cable.

1 Remove the seal sleeve (1) from the left parking brake cable.

2 Remove the retaining nut (2) from the left parking brake cable.

Torque: 20 Nm

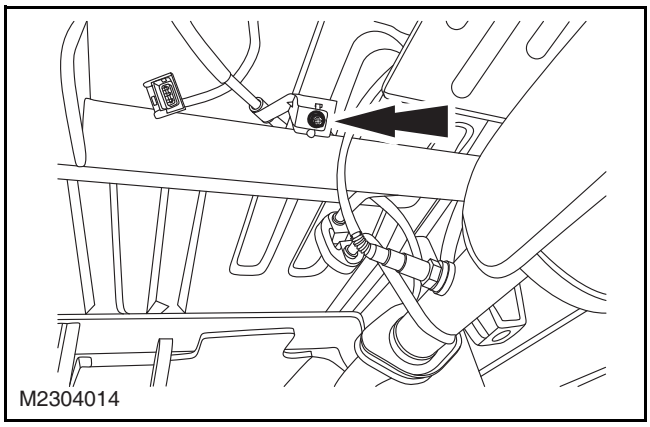


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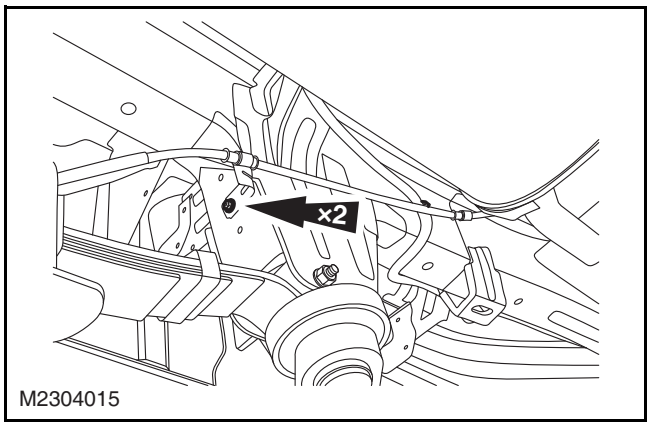
3 Remove the retaining bolt at the front of left brake cable.

Torque: 9 Nm


M2304014

4 Remove 2 retaining bolts at the center of left brake cable.

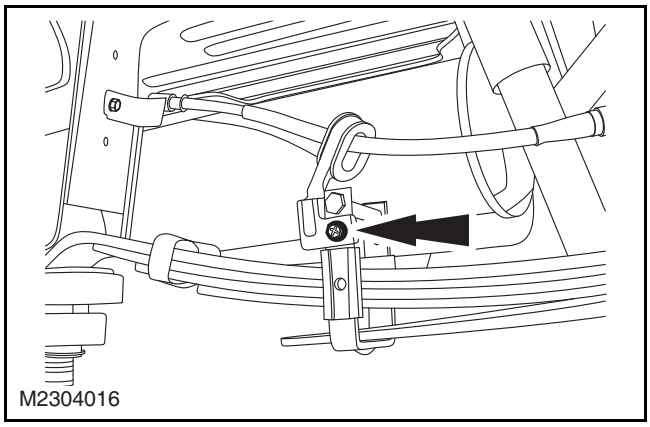
Torque: 9 Nm



M2304015

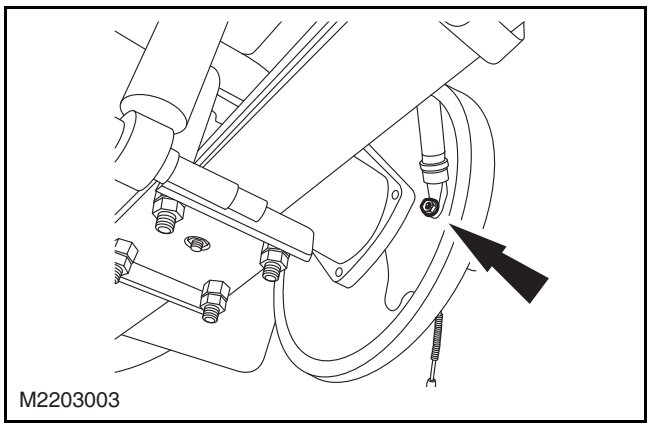
5 Remove the retaining bolt at the rear of left brake cable.

Torque: 9 Nm


M2304016

6 Remove the retaining bolt between left parking brake cable and brake baseplate.

Torque: 9 Nm


M2203003

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7 Remove the left brake cable.

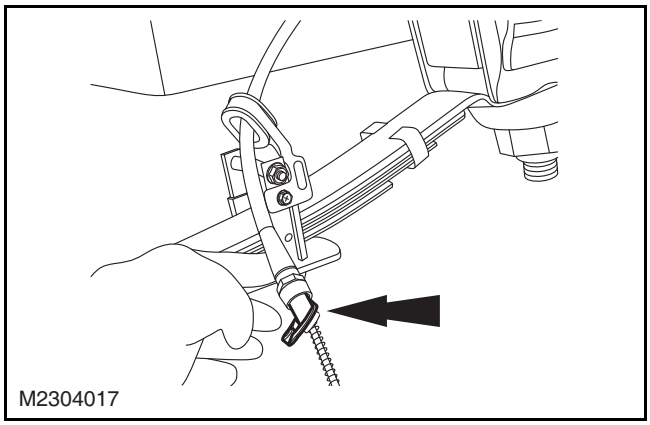
**7.** Remove the right brake cable.

**CAUTION: Removal procedure of right brake cable is the same with that of left one.**

## Installation

**1.** Installation is in the reverse order of removal.

**CAUTION: Apply the sealant to the lip of brake cables during installation.**




**2.** Adjust the parking brake cable.

**Refer to: Parking Brake Cable Adjustment (2.3.4 Parking Brake and Operation, General Inspection).**

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# Parking Brake Warning Lamp Switch

**General Tool**

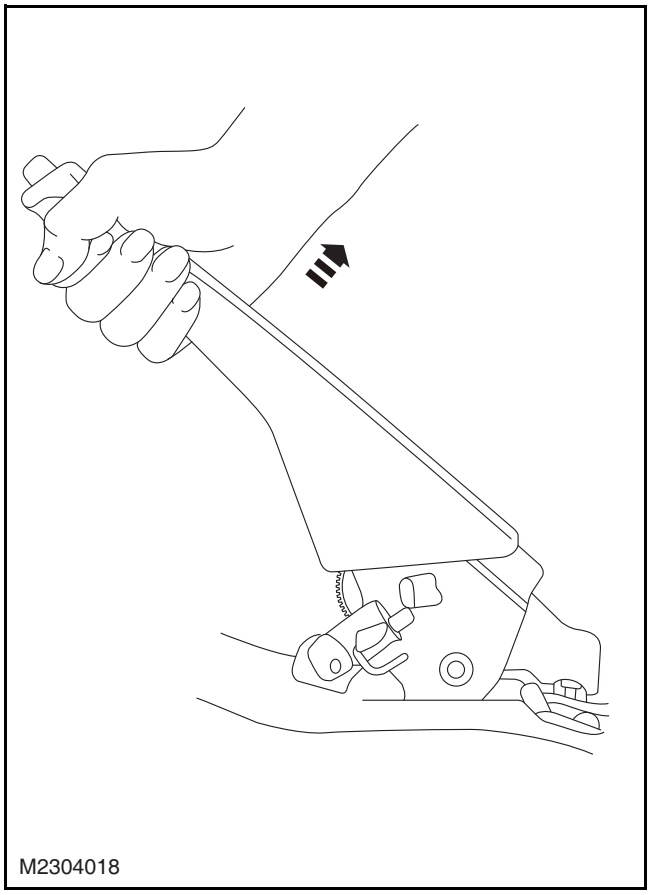
| |
|---|
| Rivet gun |

## Removal

1. Remove the console.

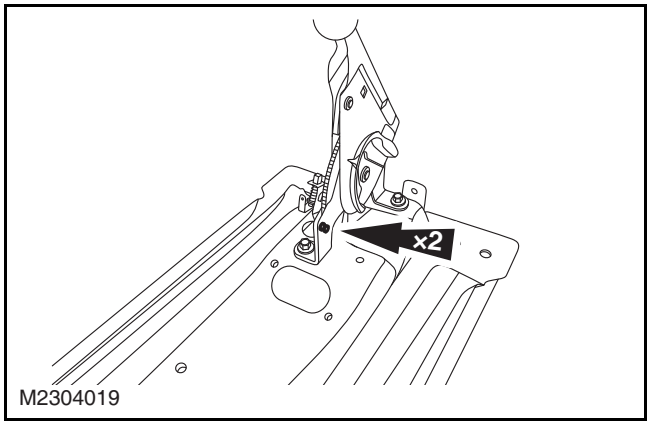
   **Refer to: Instrument Panel (5.1.6 Instrument Panel and Console).**

2. Pull the parking brake lever to the maximum position.




3. Remove the parking brake warning lamp switch.

   1 Use a suitable tool to remove 2 rivets from the switch.




   2 Remove the parking brake warning lamp switch, and disconnect the wiring harness connector.

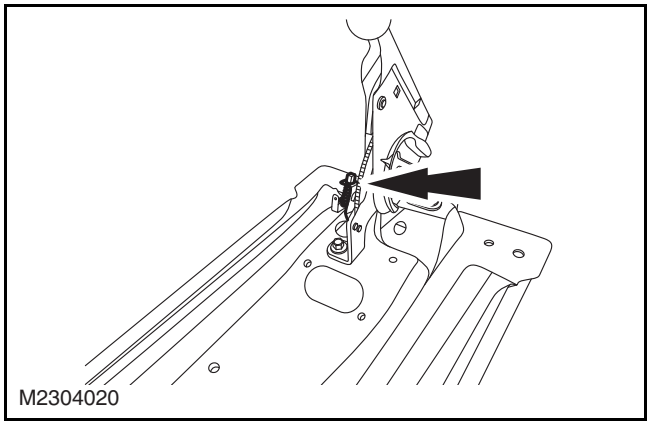
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## Installation

1. Use a suitable tool to install the parking brake warning lamp switch, and connect the wiring harness connector.

   General tool: Rivet gun




2. Install the console.

   **Refer to: Instrument Panel (5.1.6 Instrument Panel and Console).**

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## Specifications

# Material Specifications

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Brake master cylinder oil pipe | 16 | 12 | - |
| Brake master cylinder retaining nut | 13 | 10 | - |
| Retaining bolt of spring connected to load sensing proportioning valve and rear axle | 25 ± 5 | - | - |
| Load sensing proportioning valve brake line | 30 | 22 | - |
| Load sensing proportioning valve retaining bolt | 25 ± 5 | - | - |
| 6-way joint line | 11 | 8 | - |
| 6-way joint retaining bolt | 10 | - | 89 |
| Pedal assembly | 25 | 18 | - |

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## Description and Operation

# System Overview

Mechanical force from brake pedal is converted into hydraulic force via a master cylinder, and then transmitted to front brake caliper and rear brake wheel cylinder via brake pipe and hose (the vehicle without anti-lock system before rear brake wheel cylinder shall be installed with "Loading Sensing Proportional Valve (LSPV)"), and then the brake caliper and wheel cylinder would convert the hydraulic force into mechanical force, thus making the brake pad and brake shoe press against the brake disc and brake drum to brake.

Description and precautions.

**WARNING: To remove the hydraulic components or disconnect the brake pipes, bleed the brake system. Tighten the unlubricated dry fasteners according to specified torque.**

**CAUTION: The fasteners on all brake parts are very important as they would affect the performance of main parts and systems and cause additional maintenance fee. For replacement, use the part with the same number or equivalent one. Do not use fake and inferior parts. For reassembling, tighten all parts according to specified torque. Do not weld as it would cause metal damage or softening with large area.**

# Components Description

### Brake Pedal

Receives, amplifies and transmits the brake system input force from driver.

### Brake Pedal Pushrod

Transmits the amplified brake pedal input force to the vacuum booster.

### Brake Master Cylinder Reservoir

Brake fluid used for the hydraulic brake system is filled inside.

### Booster Assembly

The booster is installed between master cylinder and brake pedal. It can increase mechanical brake force using negative pressure of engine vacuum by depressing the brake pedal.

**WARNING: Never disassemble the brake booster assembly. In case of faults, replace it with a new one.**

**CAUTION: During and after removing the booster, never drop or deform the booster.**

**CAUTION: Tighten the unlubricated fastener according to specified torque. To remove any hydraulic components or disconnect the brake pipes, bleed the brake system.**

### Brake Master Cylinder

Transforms the mechanical input force into hydraulic output pressure, which is distributed to two hydraulic circuits through the master cylinder to provide the brake fluid to the H type brake circuit of RWD vehicle.

**CAUTION: To maintain this master cylinder, replace the part with the genuine one maintenance pack. Apply clean brake fluid to lubricate the rubber parts for assembling. Do not blow the brake parts via the oily compressed air as it would cause damages to rubber parts. To remove the hydraulic components or disconnect the brake pipes, it is necessary to bleed the brake system. Tighten the unlubricated dry fasteners according to specified torque.**

### Brake Pipes and Brake Hoses

Passes brake fluid through each component of hydraulic brake system.

### Disc Brake Caliper Assembly

With only one single piston cylinder, apply force on the brake pedal to generate hydraulic pressure, and deliver the pressure to the brake pad via the caliper to generate friction. Hydraulic pressure is evenly acting on the piston and caliper cylinder bottom to make the piston move

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outward, and then the caliper moves inward (slide) to press the disc, and then it presses the brake pad to apply pressure on the brake disc to generate braking.

**CAUTION: Lubricate parts and components accordingly and do not blow them with oily compressed air, which would damage the rubber parts. To remove parts or pipes, bleed brake system first. Tighten the unlubricated dry fasteners according to specified torque.**

## Rear Drum Brake Assembly

The drum brake assembly adopts a brake shoe clearance self-adjusting unit, which can keep a proper clearance between brake drum and brake shoe. When depressing on the brake pedal, the piston and brake shoe would move toward the brake drum. When the abrasion and clearance of brake shoe increase, the force on the brake arm would also increase. If the force exceeds specified value, the connecting plate hole of brake shoe would move toward drum side along with the arm on the support plate, with movement and abrasion of friction lining being equal. Then brake force would be generated when the brake shoe is pressed against the brake drum. Moving distance of the rod arm is the same as abrasion loss. With the movement of rod arm, the fan rachet would also move. Because they are integrated as a whole, the rod arm and rachet will not move in place to hold unchanged till the clearance between brake shoe and brake drum is larger than the moving distance. Then, when depressing the brake pedal every time, the clearance between brake shoe and drum will be adjusted accordingly.

**CAUTION: To maintain this drum brake, replace with the full set of parts from the maintenance pack. Lubricate parts and components accordingly.**

## Load Sensing Proportioning Valve (LSPV)

Load Sensing Proportioning Valve (LSPV) is located within the brake circuit connecting master cylinder and rear wheel brakes. It can control the hydraulic pressure to rear wheel brakes according to load condition (or load weight) to prevent the real wheels from early locking and also release excessive pressure to rear wheel brakes. If the hydraulic circuit of front wheel brakes fails, the hydraulic pressure generated in the master cylinder will be directly provided to rear wheel brakes for brake control.

**CAUTION: Never disassemble the load sensing proportioning valve, otherwise it will damage original function. In case of any faults, replace it with a new one.**

## LSPV consists of following parts.

1. Sensor part

   Main part of sensor assembly is control lever and spring. When affected by the load, this spring would sense the change on height and convert it to load signal.

2. Hydraulic pressure control part

   This part mainly includes the plunger and valve system to execute proportion control.

3. Fail-safe part

   It mainly includes piston chamber and fail-safe piston. The piston chamber would suck hydraulic pressure via front wheel brakes. If the front wheel brake system fails, the fail-safe piston would release valve system pressure, which is connected to the rear wheel brakes.
   Brake Fluid Low Level Warning Indicator
   The instrument cluster turns on the brake fluid low level warning indicator when it has detected that brake fluid level is over low (the signal circuit is at low potential).

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## Removal and Installation

# Brake Fluid Reservoir

### Material

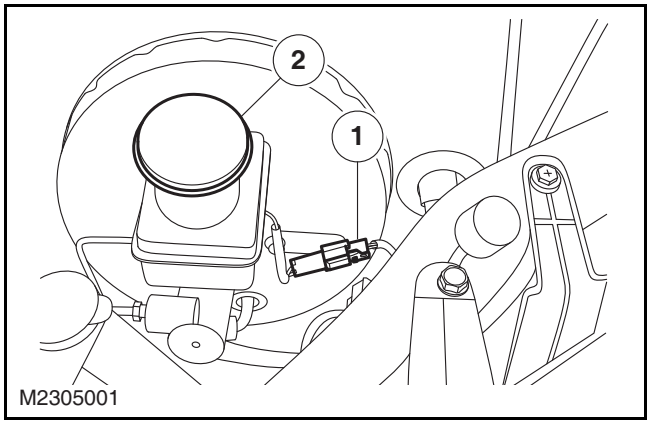
| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

## Removal

**CAUTION: If brake fluid is splashed on the paintwork, wash the affected area immediately with clear water.**

**CAUTION: The reservoir cap must be clean.**

1. Disconnect the brake fluid low level warning indicator switch connector.
2. Remove the reservoir cap.




3. Drain the brake fluid in the reservoir.

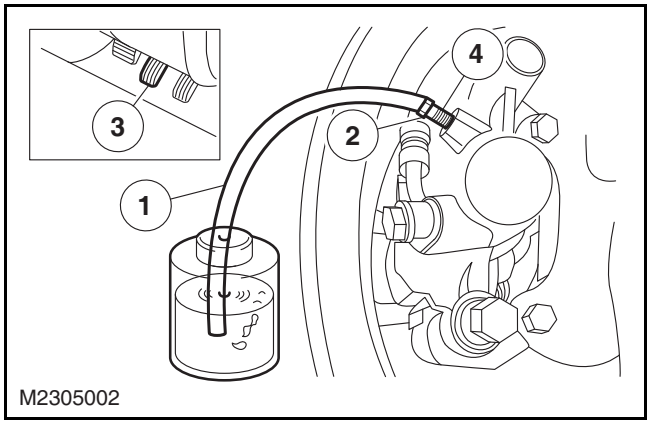
   1 Connect one end of a clear plastic tube to the system bleeding nozzle and place the other end into a suitable container.

   2 Loosen the bleeding nozzle.

   3 Depress the brake pedal repeatedly until all brake fluid is drained from the brake fluid reservoir.

   4 Tighten the bleeding nozzle.

   5 Install the reservoir cap.




**CAUTION: Repeat the drain procedure for both sides to drain the brake fluid in the reservoir.**

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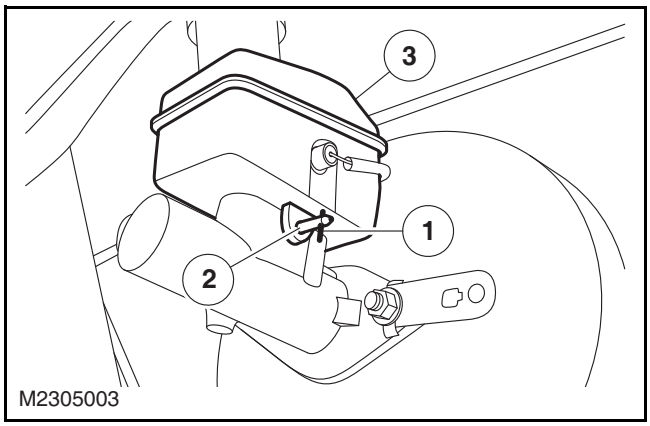


4. Remove the brake fluid reservoir.

   1 Remove the cotter pin.

   2 Remove the retaining pin from the brake fluid reservoir.

   3 Remove the brake fluid reservoir.




## Installation

1. Installation is in the reverse order of removal.
2. Bleed the brake system.

   **Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

**CAUTION: If brake fluid is splashed on the paintwork, wash the affected area immediately with clear water.**

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# Brake Master Cylinder

### Material

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Drain the brake fluid in the reservoir.

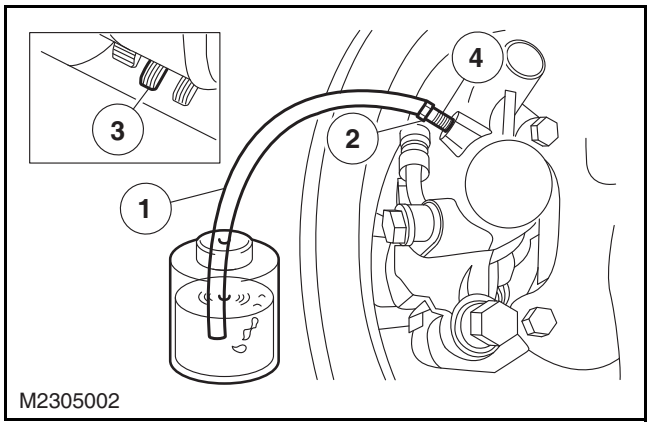
   1 Connect one end of a clear plastic tube to the system bleeding nozzle and place the other end into a suitable container.

   2 Loosen the bleeding nozzle.

   3 Depress the brake pedal repeatedly until all brake fluid is drained from the brake fluid reservoir.

   4 Tighten the bleeding nozzle.

   5 Install the reservoir cap.



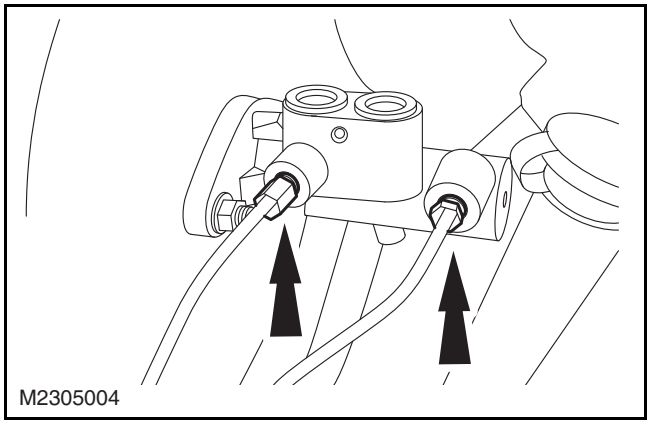

**CAUTION: Repeat the drain procedure for both sides to drain the brake fluid in the reservoir.**

3. Remove the brake fluid reservoir.

   **Refer to: Brake Fluid Reservoir (2.3.5 Hydraulic Brake System, Removal and Installation).**

4. Remove the brake pipe from the brake master cylinder.

   Torque: 16 Nm



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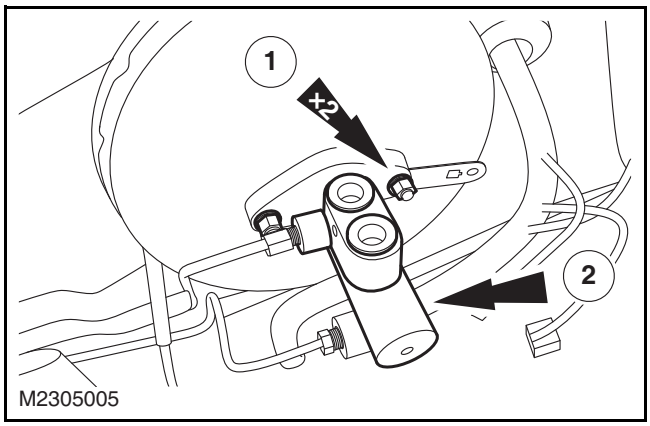


**5.** Remove the brake master cylinder.

1 Remove 2 retaining nuts from the brake master cylinder.

Torque: 13 Nm

2 Remove the brake master cylinder.




## Installation

**1.** Installation is in the reverse order of removal.

**2.** Bleed the brake system.

**Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

**CAUTION: If brake fluid is splashed on the paintwork, wash the affected area immediately with clear water.**

**CAUTION: Make sure that the brake booster pushrod is correctly positioned before installation.**

**CAUTION: Make sure that the brake master cylinder vacuum sealing is correctly positioned.**

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# Load Sensing Proportioning Valve

**Material**

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Drain the brake fluid in the reservoir.

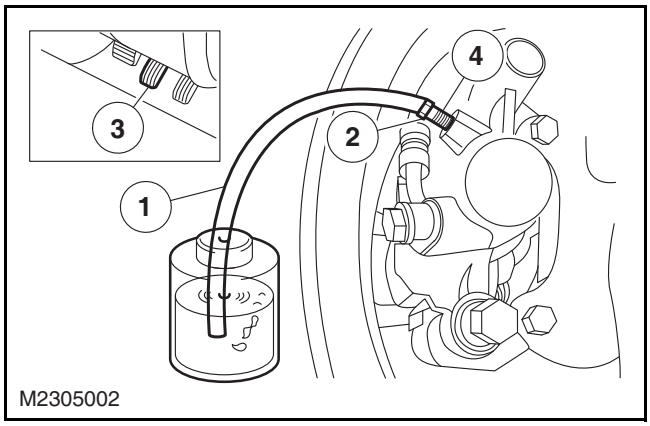
   1 Connect one end of a clear plastic tube to the system bleeding nozzle and place the other end into a suitable container.

   2 Loosen the bleeding nozzle.

   3 Depress the brake pedal repeatedly until all brake fluid is drained from the brake fluid reservoir.

   4 Tighten the bleeding nozzle.

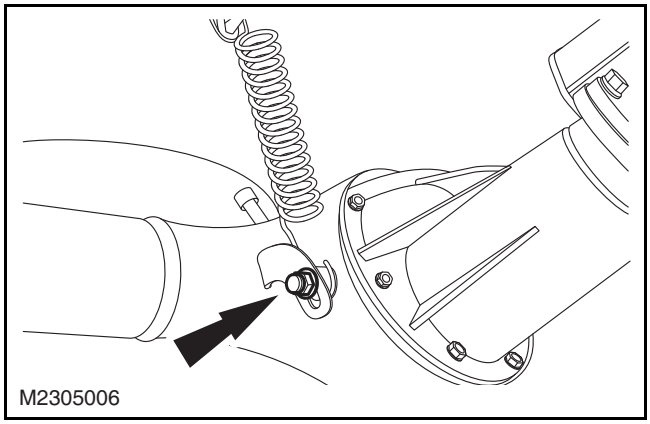
   5 Install the reservoir cap.




**CAUTION: Repeat the draining procedure on the opposite side to drain the brake fluid in the reservoir.**

3. Remove the retaining bolt from the spring connected to load sensing proportioning valve and rear axle.

   Torque: 25 ± 5 Nm

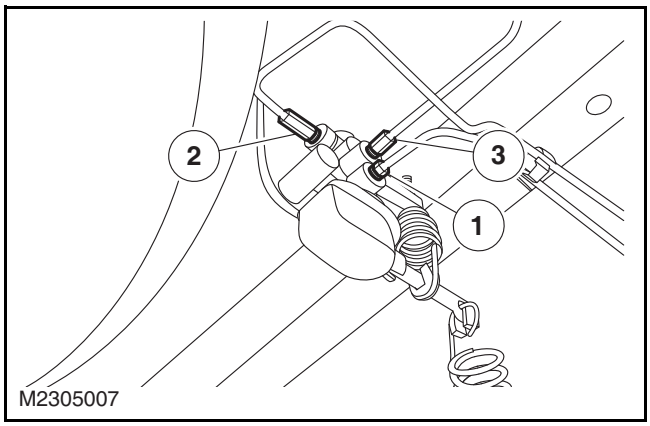


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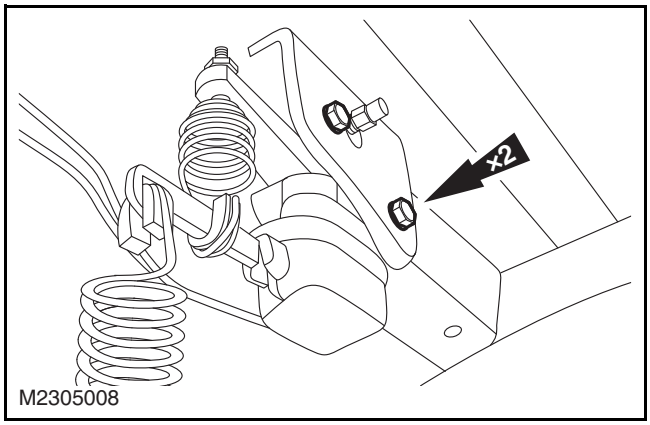
4. Remove the brake pipe (1), (2) from brake master cylinder to load sensing proportioning valve, and brake pipe (3) from load sensing proportioning valve to brake wheel cylinder.

   Torque: 30 Nm




5. Remove 2 retaining bolts from the load sensing proportioning valve, and remove the load sensing proportioning valve.

   Torque: 25 ± 5 Nm




## Installation

1. Installation is in the reverse order of removal.
2. Bleed the brake system.

   **Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

**CAUTION: If brake fluid is splashed on the paintwork, wash the affected area immediately with clear water.**

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# 6-way Joint

**Material**

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

## Removal

1. Drain the brake fluid in the reservoir.

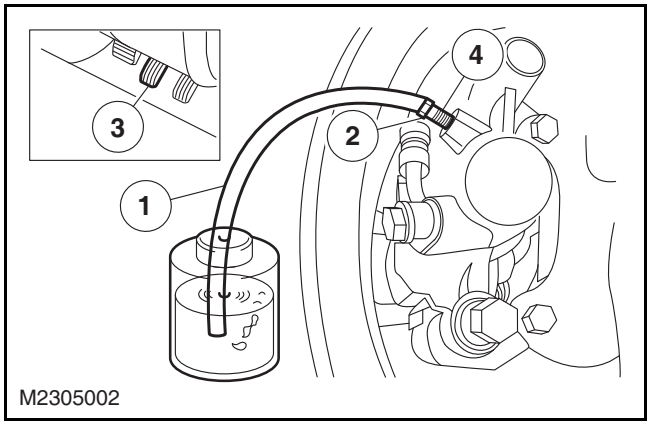
   1 Connect one end of a clear plastic tube to the system bleeding nozzle and place the other end into a suitable container.

   2 Loosen the bleeding nozzle.

   3 Depress the brake pedal repeatedly until all brake fluid is drained from the brake fluid reservoir.

   4 Tighten the bleeding nozzle.

   5 Install the reservoir cap.




**CAUTION: Repeat the drain procedure for both sides to drain the brake fluid in the reservoir.**

2. Remove the 6-way joint.

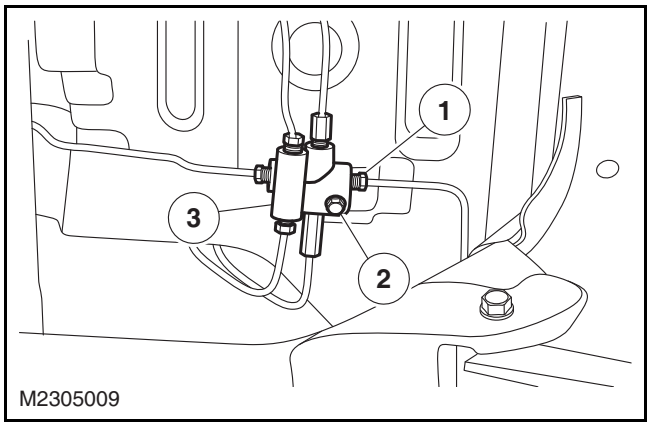
   1 Remove 6 pipes from the 6-way joint.

   Torque: 11 Nm

   2 Remove the retaining bolt from the 6-way joint.

   Torque: 10 Nm

   3 Remove the 6-way joint.




## Installation

1. Installation is in the reverse order of removal.
2. Bleed the brake system.

   **Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

**CAUTION: If brake fluid is splashed on the paintwork, wash the affected area immediately with clear water.**

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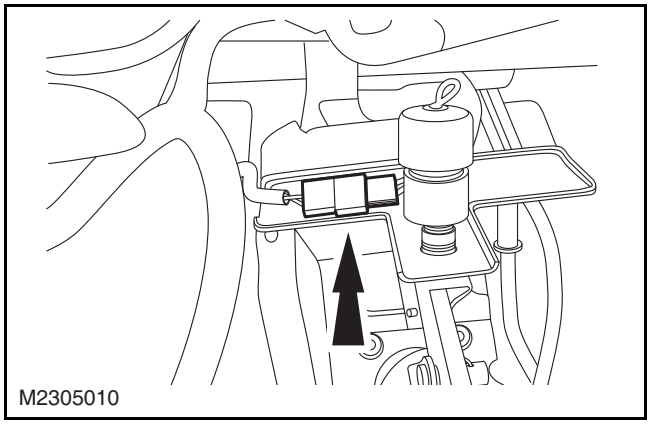
# Pedal Assembly

## Removal

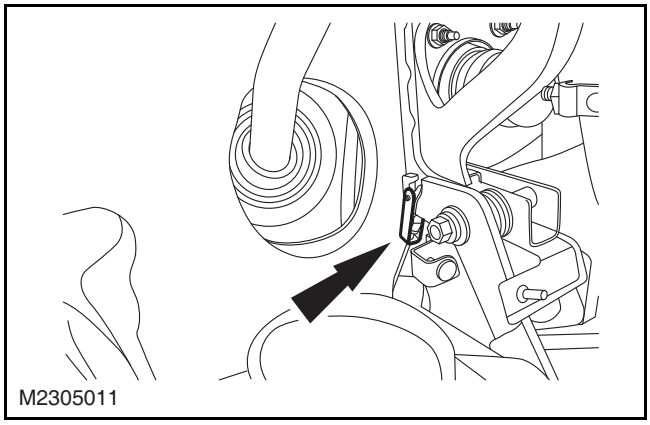
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

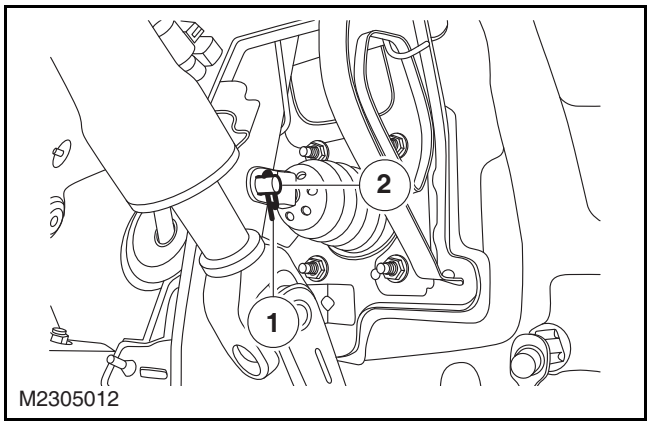
2. Remove the brake lamp switch wiring harness connector.


M2305010

3. Remove the clutch cable.


M2305011

4. Remove the spring pin (1) and remove the brake booster pushrod pin (2).



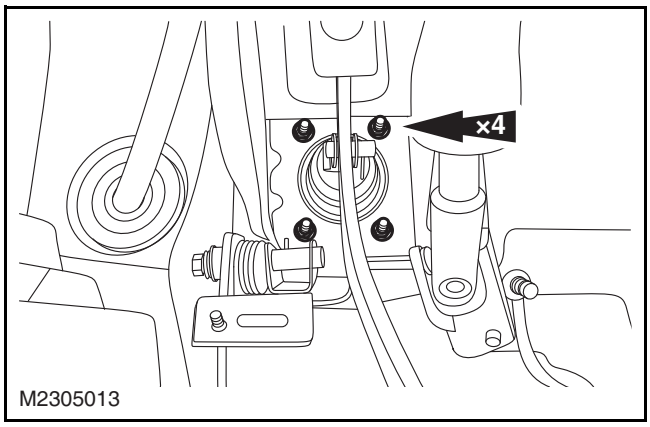
M2305012

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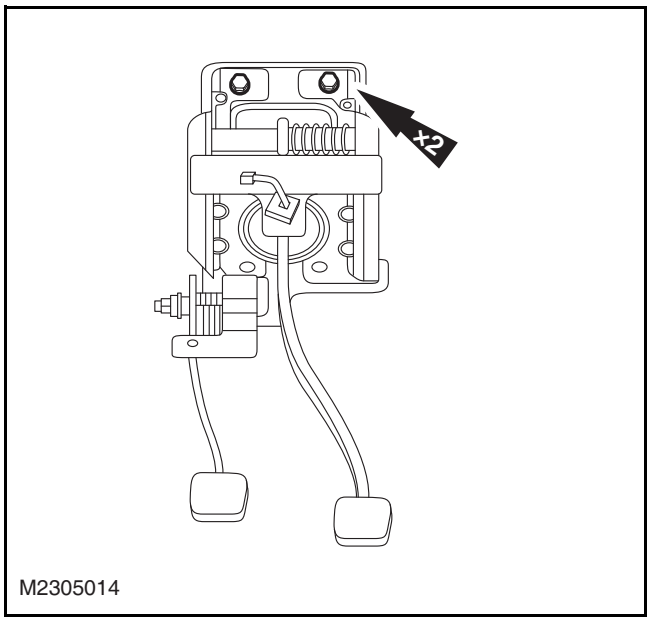
**5.** Remove 4 retaining nuts between pedal assembly and booster.

Torque: 25 ± 5 Nm




**6.** Remove 2 retaining nuts between pedal assembly and body.

Torque: 25 ± 5 Nm




**7.** Remove the pedal assembly.

## Installation

**1.** Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Brake master cylinder | 13 | 10 | - |
| Retaining nut between booster and pedal assembly | 25 ± 5 | - | - |

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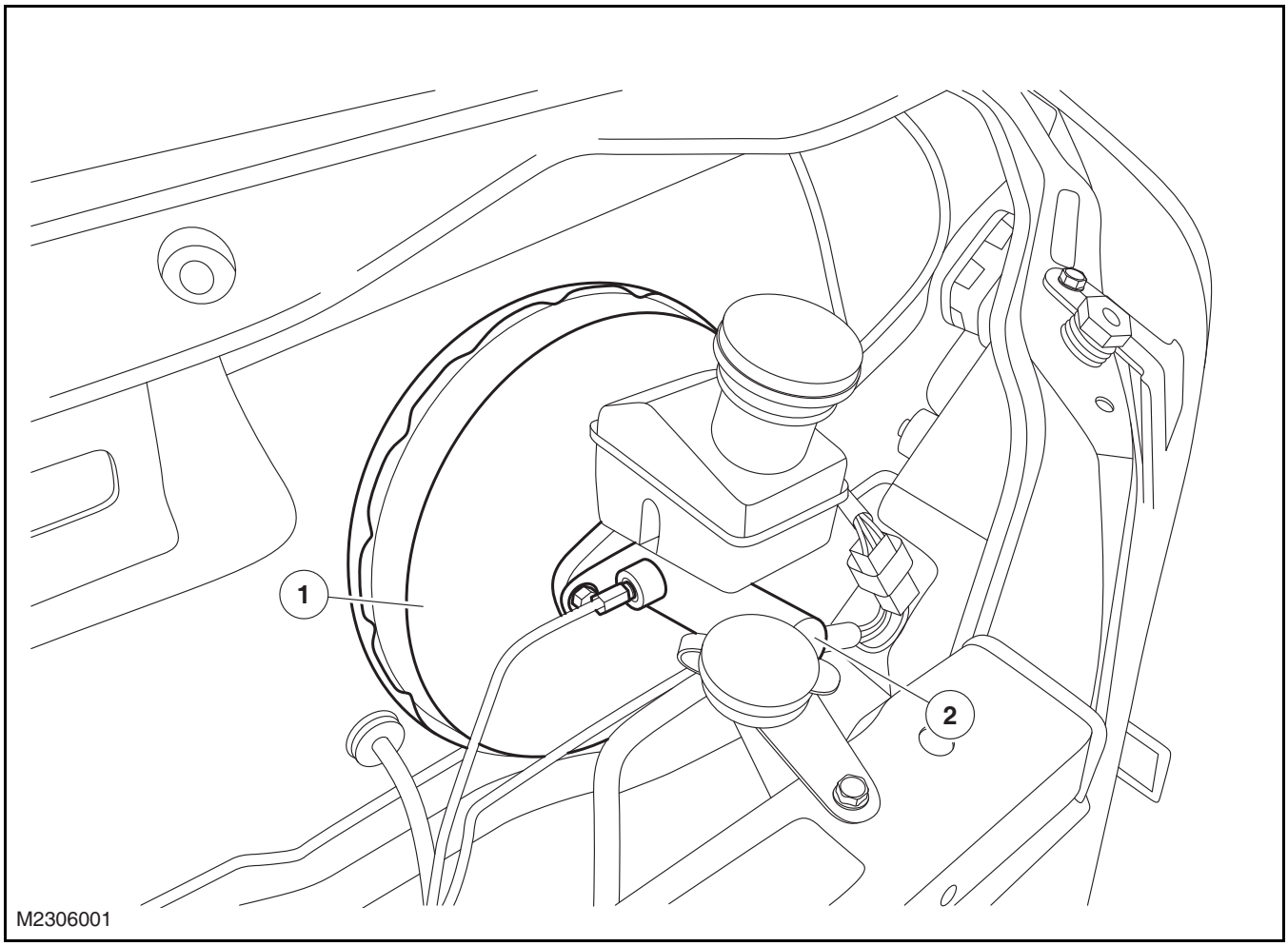


## Description and Operation

# System Overview

The brake system input force is amplified by the brake pedal and transmitted to the vacuum booster by the brake pedal pushrod, and then applied to the hydraulic brake master cylinder. Vacuum booster uses the vacuum source to assist power so as to reduce the pedal effort by the driver during applying the brake.

# Location View




| Item | Description |
|---|---|
| 1 | Brake booster |
| 2 | Brake master cylinder |

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## Removal and Installation

# Brake Booster

### Material

| Item | Type |
|---|---|
| Brake fluid | HZY 3 or HZY 4 |

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Drain the brake fluid in the reservoir.

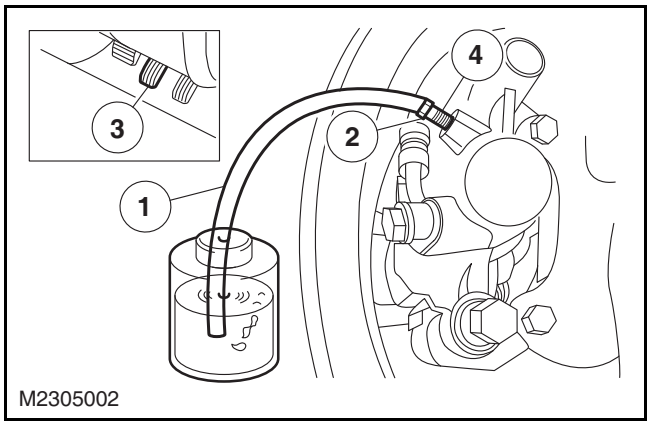
   1 Connect one end of a clear plastic tube to the system bleeding nozzle and place the other end into a suitable container.

   2 Loosen the bleeding nozzle.

   3 Depress the brake pedal repeatedly until all brake fluid is drained from the brake fluid reservoir.

   4 Tighten the bleeding nozzle.

   5 Install the reservoir cap.




**CAUTION: Repeat the drain procedure for both sides to drain the brake fluid in the reservoir.**

**CAUTION: If brake fluid is splashed on the paintwork, wash the affected area immediately with clear water.**

**CAUTION: The reservoir cap must be clean.**

3. Remove the brake fluid reservoir.

   **Refer to: Brake Fluid Reservoir (2.3.5 Hydraulic Brake System, Removal and Installation).**

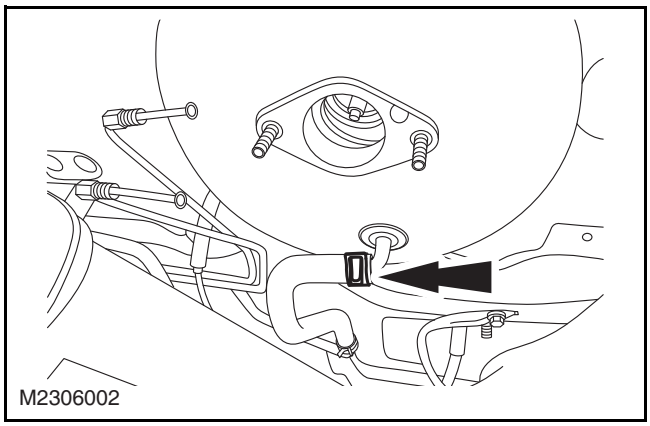
4. Remove the brake master cylinder.

   **Refer to: Brake Master Cylinder (2.3.5 Hydraulic Brake System, Removal and Installation).**

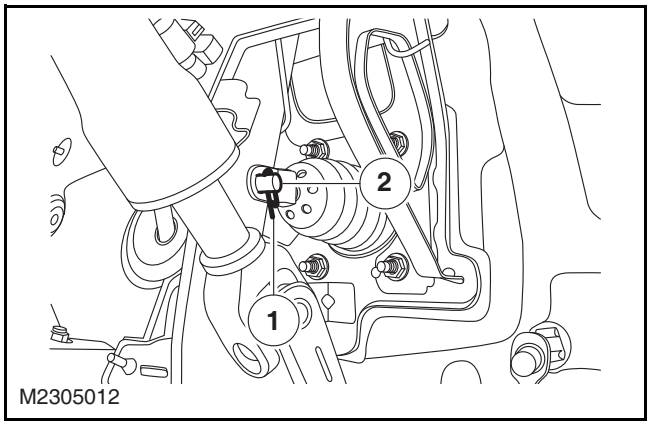
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5. Disconnect the brake booster vacuum tube.

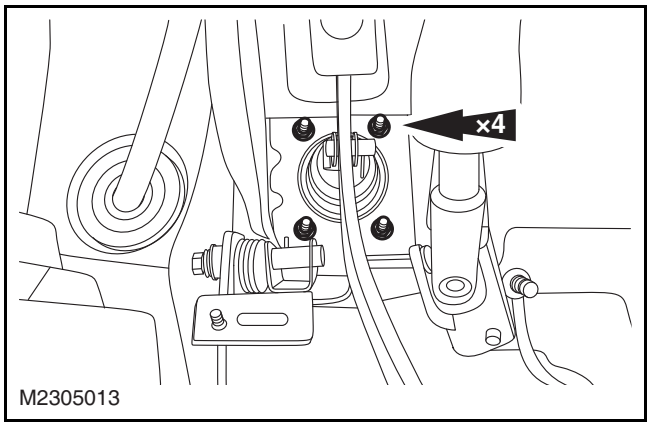



6. Remove the spring pin (1) and remove the brake booster pushrod pin (2).




7. Remove 4 retaining nuts between booster and pedal assembly.

   Torque: 25 ± 5 Nm




8. Remove the brake booster.

## Installation

1. Installation is in the reverse order of removal.
2. Bleed the brake system.

   **Refer to: Brake System Bleeding (2.3.1 Brake System - Overview, General Inspection).**

**CAUTION: If brake fluid is splashed on the paintwork, wash the affected area immediately with clear water.**

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# 2.4 Steering System

## 2014 MD/MS201

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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| Minimum turning diameter | 11 m or less |

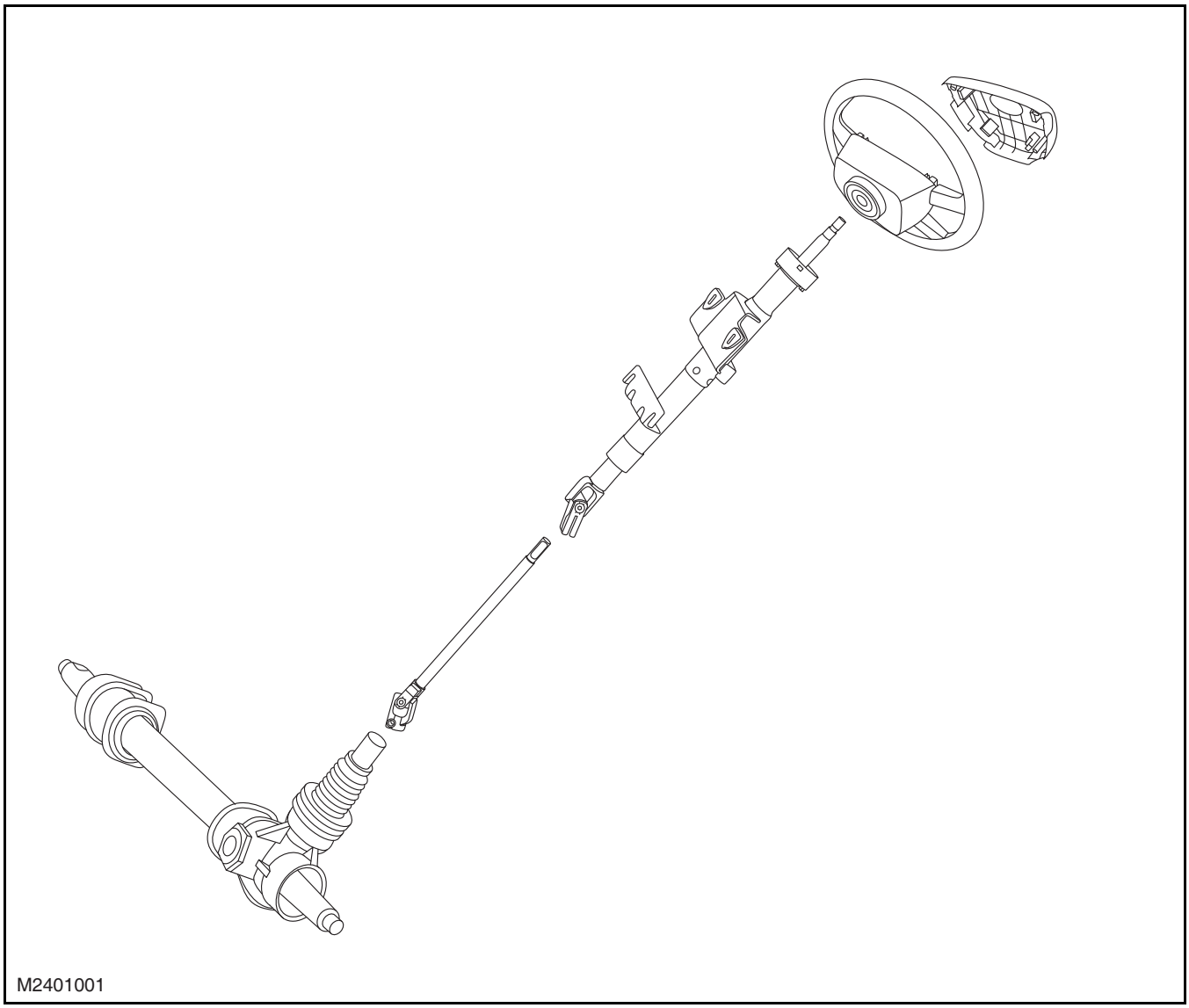
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## Description and Operation

# System Overview

- Mechanical steering system is adopted for both MD201 and MS201.
- The steering system usually consists of steering operation mechanism, steering gear and steering drive mechanism. The force applied on the steering wheel by driver would be transmitted to the steering gear via steering column. The steering gear would convert this rotational motion into linear motion via its internal gear and rack. This linear motion would be transmitted to the steering knuckle via steering tie rod and tie rod outer joint, and then make the steering knuckle and its supported drive wheels deflect, thus changing the running direction of the vehicle.
- When the steering wheel rotates, the power would be transmitted to steering shaft, universal joint and then pinion. The power would be transmitted to the rack, which is meshed with the pinion, making it linear motion. Then this power would be transmitted to the steering knuckle of steering wheel via the steering tie rod.



M2401001

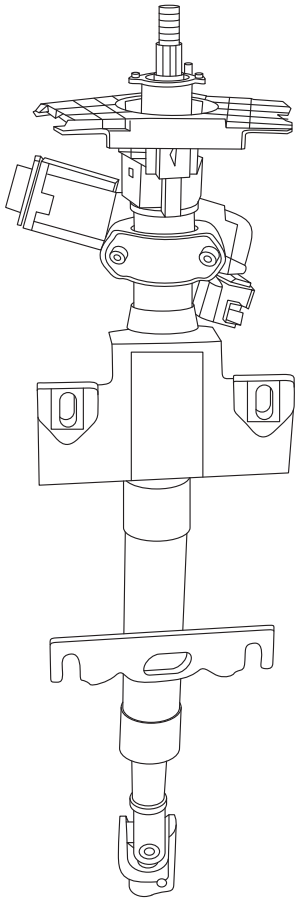
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# Components Description

## Steering Column

- Besides the steering function, the tubular steering column also can absorb energy and weaken the front shock.
- The steering column is equipped with ignition switch and anti-theft lock. Because of the anti-theft lock on steering column, the ignition and steering wheel can be locked to prevent the vehicle from being stolen.
- The steering wheel is fixed on the steering column assembly by retaining nut, and the steering pinion connects with the steering column by the flexible universal joint which is fixed on the pinion by retaining bolts.



A2401003

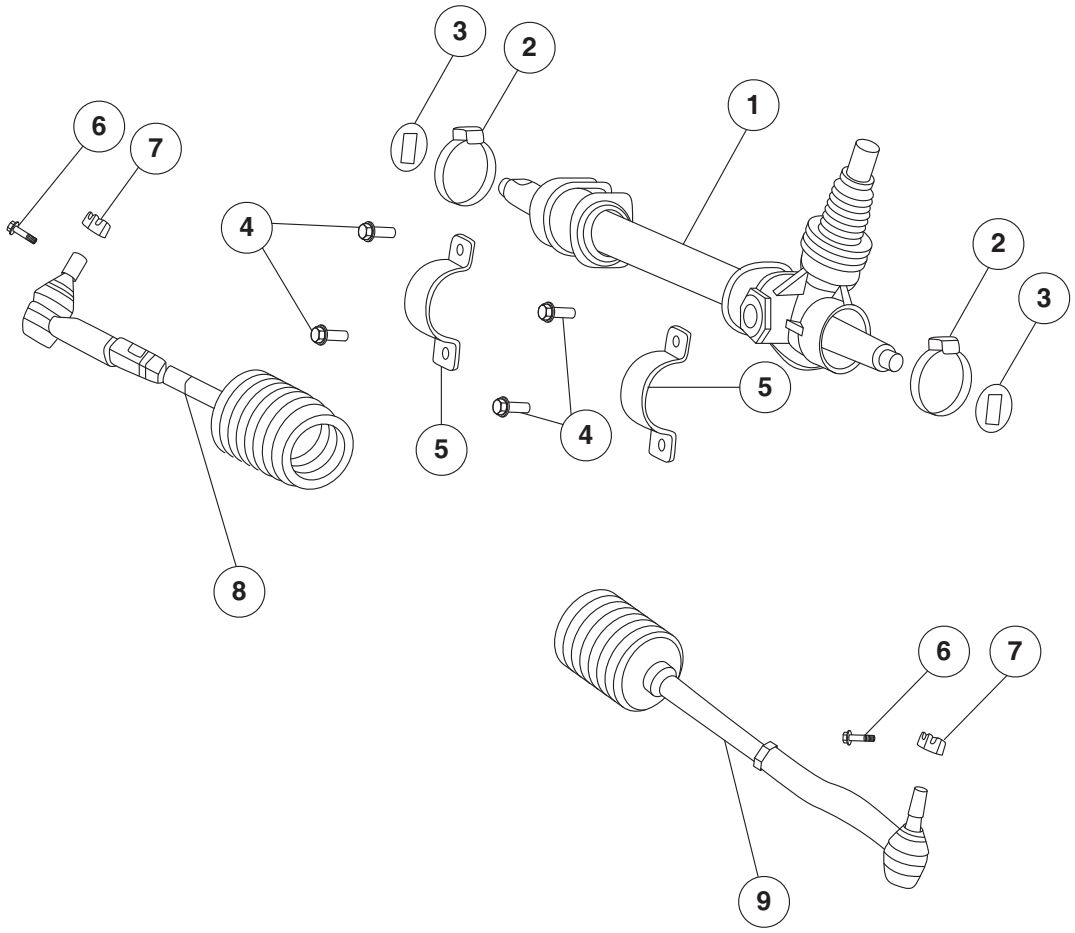
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### Steering Gear

Rack and pinion steering gear is adopted, which mainly consists of rack and pinion. When the steering wheel rotates, the power would be transmitted to steering column, universal joint and then pinion. The power would be transmitted to the rack, which is meshed with the pinion, making it form a linear motion. Then this power would be transmitted to the steering knuckle and drive wheels via the steering tie rod. This type of steering gear features with simple structure, high drive efficiency, low cost, high rigidity and sound operation stability.

## Components Exploded View




M2401005

| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Steering gear assembly | 1 | 6 | Cotter pin | 2 |
| 2 | Clamp | 2 | 7 | Nut | 2 |
| 3 | Steering tie rod retaining washer | 2 | 8 | Steering rod assembly (right) | 1 |
| 4 | Hexagon flange bolt | 4 | 9 | Steering rod assembly (left) | 1 |
| 5 | Steering gear assembly fixing bracket | 2 | | | |

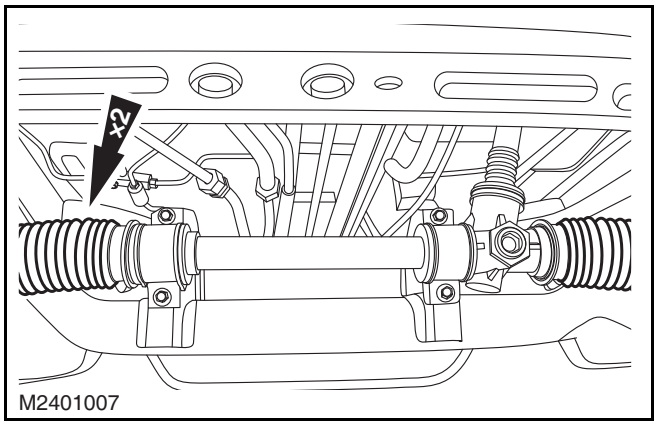
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## General Inspection

## Dust Boot on Steering Rack and Pinion Side Inspection

Inspect each steering gear dust boot for damage. The dust and water will enter damaged dust boot, which may cause the steering rack and pinion wear, rust and noise, resulting in operation fault of steering system. Replace it with a new one (dust boot or clamp), though minor damage is suffered. When lifting the vehicle due to regularly inspection according to specified time interval or other reasons, inspect the dust boot for any damage or wear visually.




## Steering Linkage Inspection

1. Park the vehicle on a dry and flat road, and pull up the parking brake. Turn the steering wheel to the center.
2. Turn off the engine and hold the steering wheel tightly with hands. Shake it forcibly up and down, left and right (do not turn the steering wheel), and inspect if the steering column bearing is worn, and the steering coupling, steering wheel or steering column is loose. If so, inspect the torque of retaining bolts of steering column, coupling and steering wheel. As the steering column is an unrepairable part, replace if necessary.

   **Refer to: Steering Column (2.4.3 Steering Column, Removal and Installation).**

3. If the steering linkage is damaged, replace when necessary.

   **Refer to: Steering Column (2.4.3 Steering Column, Removal and Installation).**

   As the steering column is an unrepairable part, replace when necessary.

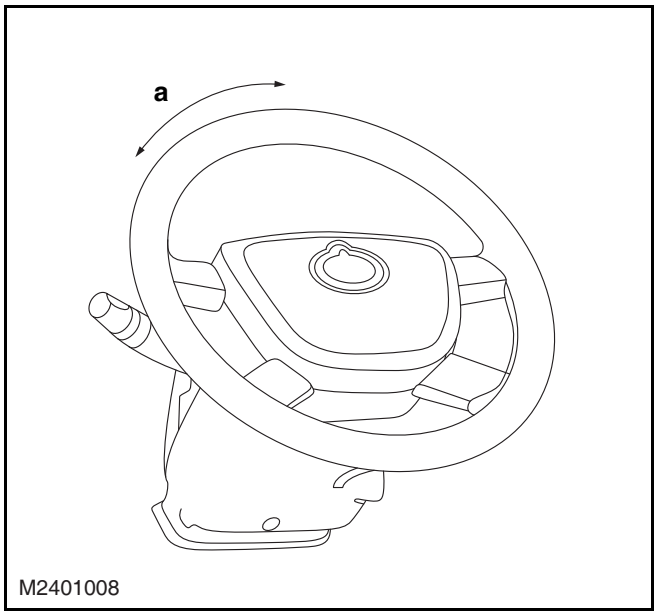
   **Refer to: Steering Column (2.4.3 Steering Column, Removal and Installation).**

   As the clearance of steering gear cannot be adjusted, replace when necessary.

## Steering Wheel Play Inspection

When driving the vehicle straightly forward on the road, inspect the steering wheel play and vibration.

**Steering wheel play "a": 0 ~ 30 mm**




If the steering wheel play is not within the technical range, inspect according to the following steps, and if damaged, replace it.

- Whether the steering tie rod ball joint is worn (when the torque applied is more than 2 kg·cm, the ball joint should be moveable).
- Whether the lower ball joint is worn.
- Whether the steering shaft joint is worn.
- Whether the steering pinion or rack is worn or broken.
- Whether any parts are loose.

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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.

**Visual Inspection Chart**

| Mechanical |
|---|
| • Wheel and tire |
| • Tire pressure |
| • Steering gearbox |
| • Tie rod |
| • Steering tie rod ball joint |
| • Steering column stuck |
| • Universal joint of steering shaft |
| • Front shaft swing arm ball joint and bushing |
| • Wheel bearing |
| • Steering gear pinion and rack |
| • Front strut and spring assembly |

3. If an obvious cause has been found, solve the fault before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom by referring to the symptom chart.

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## Symptom Chart

If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Steering swing or poor steering stability | • Tires do not match or charging pressures are uneven | • Charge the tire to the correct pressure or replace it.<br>**Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).** |
| | • Ball joints of front suspension arm and tie rod loose | • Replace the front shaft swing arm or steering tie rod end.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation) or Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).** |
| | • Shock absorber, strut or fitting parts failure | • Replace the strut or repair the fitting parts. |
| | • Stabilizer bar loose | • Tighten or replace the stabilizer bar or bushing. |
| | • Spring worn or droop | • Replace the spring. |
| | • Improper adjustment for rack and pinion | • Inspect and adjust the torque for rack and pinion. |
| | • Incorrect front wheel alignment | • Inspect and adjust the front wheel alignment.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System - Overview, General Inspection).** |
| | • Stabilizer bar link ball joint loose | • Replace the stabilizer bar link ball joint. |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Steering is unstable when braking | • Wheel bearing worn | • Replace the wheel bearing. |
| | • Spring damaged or droop | • Replace the spring. |
| | • Wheel tire charging insufficient | • Charge the tire to the proper pressure. |
| | • Incorrect front wheel alignment | • Inspect and adjust the front wheel alignment.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System-Overview, General Inspection).** |
| | • Inconsistent work of brakes | • Replace the brakes.<br>**Refer to: Brake (2.3.2 Rear Drum Brake, Removal and Installation or 2.3.3 Front Disc Brake, Removal and Installation).** |
| Steering noise (click or chug) | • Steering gearbox bolt loose | • Retighten. |
| | • Damage or other fault in wheel bearing | • Replace the wheel bearing. |
| | • Steering tie rod end worn or not flexible. | • Replace the steering tie rod ball joint.<br>**Refer to: Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).** |
| | • Improper adjustment for rack and pinion | • Inspect and adjust the torque for rack and pinion. |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Steering return function abnormal | • Steering tie rod ball joint stuck | • Replace the steering tie rod ball joint.<br>**Refer to: Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).** |
| | • Ball joint stuck | • Replace the front shaft swing arm.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).** |
| | • Steering column stuck | • Repair or replace the steering column.<br>**Refer to: Steering Column (2.4.3 Steering Column, Removal and Installation).** |
| | • Poor lubrication for rack and pinion | • Inspect, repair or lubricate the rack and pinion. |
| | • Front wheel misalignment | • Inspect and adjust the front wheel alignment.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System-Overview, General Inspection).** |
| | • Improper adjustment for rack and pinion | • Inspect and adjust the torque for rack and pinion. |
| | • Tire charging pressure improper | • Adjust the tire pressure. |

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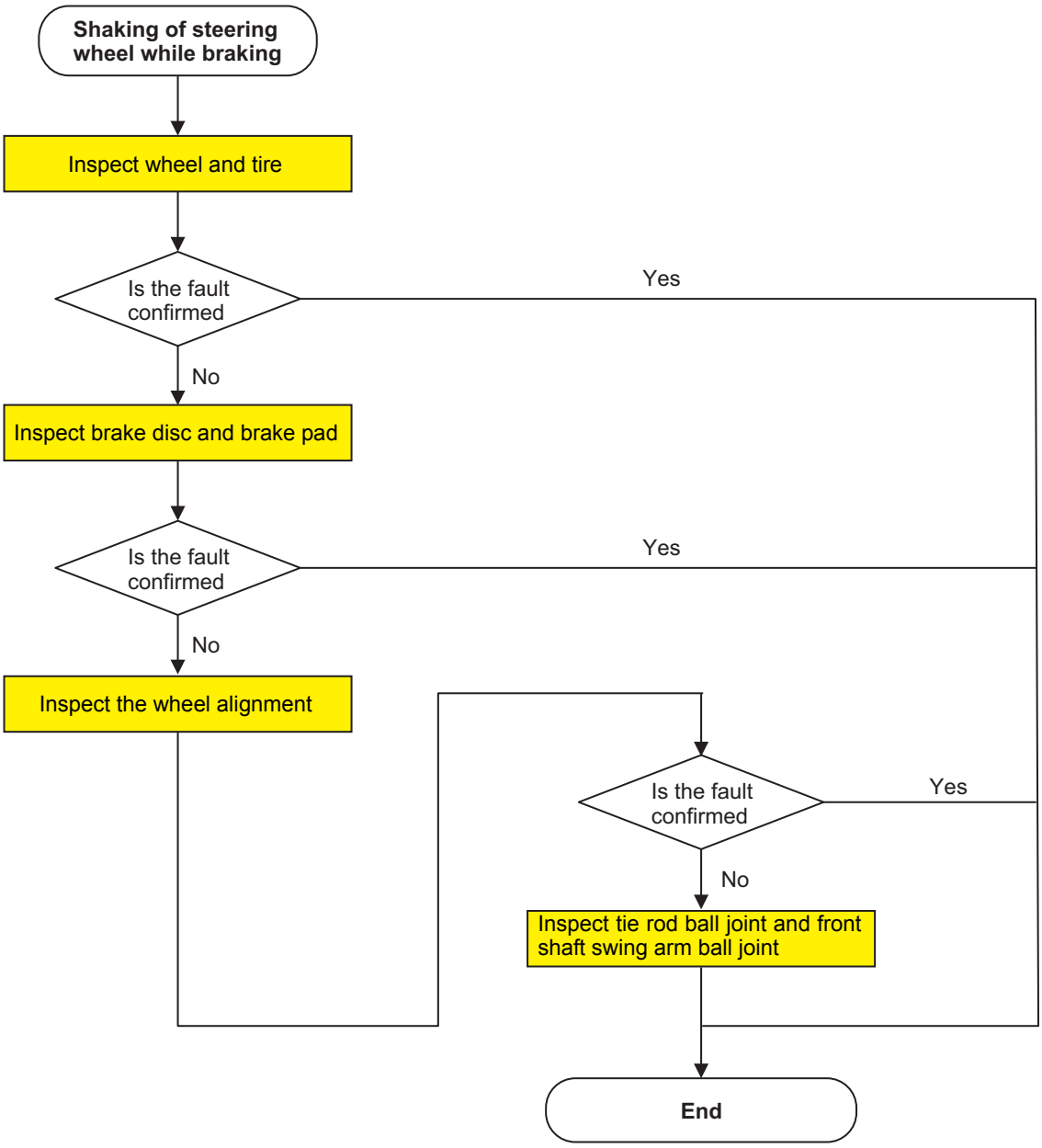


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Steering wheel play is too large | • Wheel bearing worn | • Replace the wheel bearing. |
| | • Steering gearbox bolt loose | • Tighten |
| | • Incorrect adjustment for rack and pinion | • Inspect and adjust the torque for rack and pinion. |
| | • Universal joint of steering shaft worn | • Replace the steering knuckle.<br>**Refer to: Steering Knuckle (2.3.3 Front Disc Brake, Removal and Installation).** |
| | • Steering tie rod ball joint or inner ball joint worn | • Replace the steering tie rod ball joint or steering tie rod.<br>**Refer to: Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).** |
| | • Left and right front shaft swing arm ball joints worn | • Replace the front shaft swing arm.<br>**Refer to: Front Shaft Swing Arm (2.1.2 Front Suspension, Removal and Installation).** |
| Difficult steering | • Tire charging pressure improper | • Charge the tire to the proper pressure. |
| | • Steering tie rod ball joint or left and right ball joints stuck | • Replace the steering tie rod ball joint or front shaft swing arm<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation) or Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).** |
| | • Front wheel misalignment | • Inspect and adjust the front wheel alignment.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System-Overview, General Inspection).** |
| | • Improper adjustment for rack and pinion | • Inspect and adjust the torque for rack and pinion. |
| | • Steering column stuck | • Repair or replace the steering column.<br>**Refer to: Steering Column (2.4.3 Steering Column, Removal and Installation).** |

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# Diagnosis Procedure for Shaking of Steering Wheel While Braking



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect wheel and tire | |
| | A. Inspect if the tire model, pressure, or tread abrasion is close to the limit, and if the tire has eccentric wear.<br>B. Inspect if the wheel is distorted, deformed or damaged.<br>Inspect if tire and wheel are normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Adjust or replace the wheel and tire. |
| 2. Inspect brake disc and brake pad | |
| | A. Inspect the brake disc.<br>**Refer to: Brake Disc Runout and Thickness Inspection (2.3.1 Brake System - Overview, General Inspection).**<br>B. Inspect the brake pad.<br>**Refer to: Brake Pad (2.3.3 Front Disc Brake, Removal and Installation).**<br>Are the brake disc and brake pad normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Adjust or replace the brake disc, brake pad. |
| 3. Inspect the wheel alignment | |
| | A. Inspect the wheel alignment.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System - Overview, General Inspection).**<br>Are the wheel alignment parameters normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Adjust the wheel alignment parameters.<br>**Refer to: Front Wheel Toe-in Inspection and Adjustment (2.1.1 Suspension System - Overview, General Inspection).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect tie rod ball joint and front shaft swing arm ball joint | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the tie rod ball joint and front shaft swing arm ball joint.<br>Are they normal?<br>**Yes**<br>Replace steering gear.<br>**Refer to: Steering Gear (2.4.2 Steering Gear, Removal and Installation).**<br>**No**<br>Replace tie rod ball joint.<br>**Refer to: Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).**<br>Replace front shaft swing arm ball joint.<br>**Refer to: Front Shaft Swing Arm Assembly (2.1.2 Front Suspension, Removal and Installation).** |

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Steering tie rod ball joint retaining nut | 30 ~ 55 | 22 ~ 41 | - |
| Tie rod ball joint locking nut | 30 ~ 55 | 22 ~ 41 | - |
| Steering gear retaining bolt | 50 ± 5 | - | - |
| Wheel nut | 110 ± 5 | - | - |

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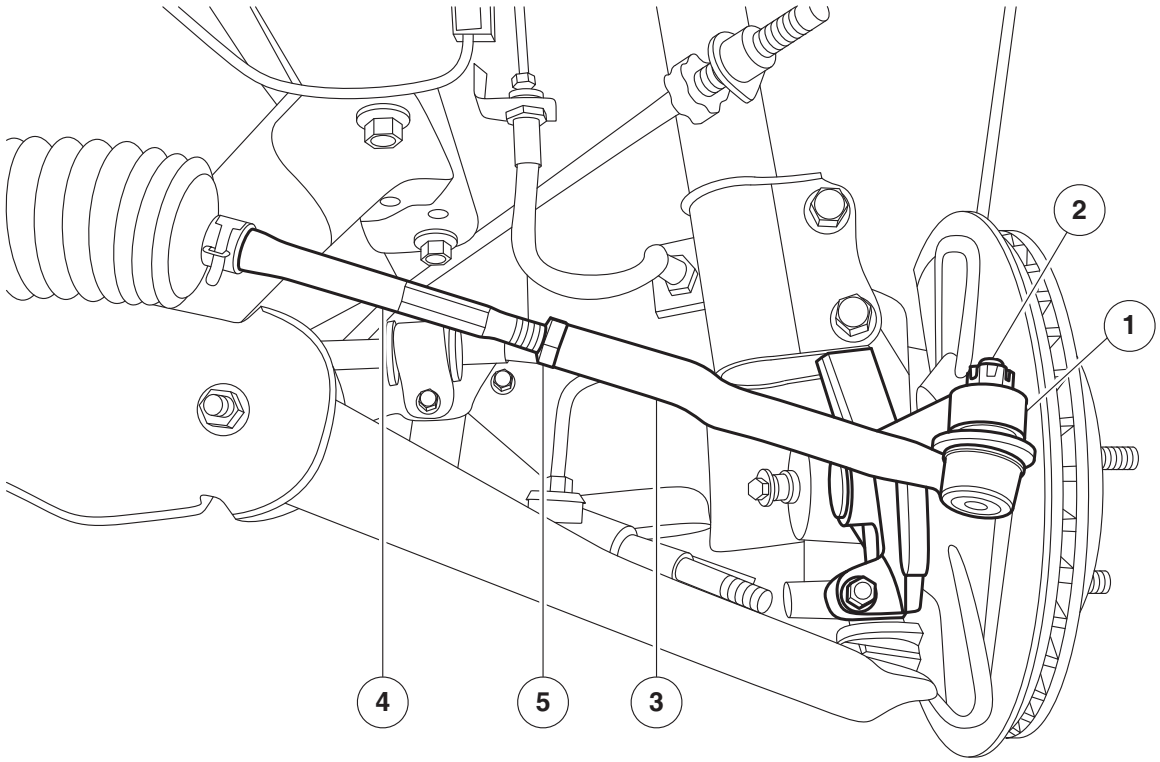
## Description and Operation

# System Overview

The steering tie rod is connected with steering gear, and transmits the motion of steering gear to wheels via the following parts:

- Steering tie rod
- Tie rod ball joint
- Steering knuckle

Steering tie rod ball joint is connected to tie rod closely with a locking nut.




M2402001

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Steering knuckle | 4 | Steering tie rod |
| 2 | Tie rod ball joint retaining nut | 5 | Tie rod ball joint locking nut |
| 3 | Tie rod ball joint | | |

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## Symptom Diagnosis and Testing

Refer to: Symptom Chart (2.4.1 Steering System - Overview, Symptom Diagnosis and Testing).

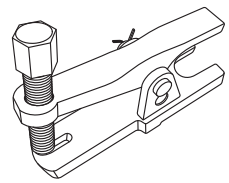
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## Removal and Installation

# Tie Rod Ball Joint

### Special Tool

| | |
|---|---|
|  CA201-001 | Tie Rod Ball Joint Puller CA201-001 |

## Removal

1. Remove the front wheel.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the tie rod ball joint.

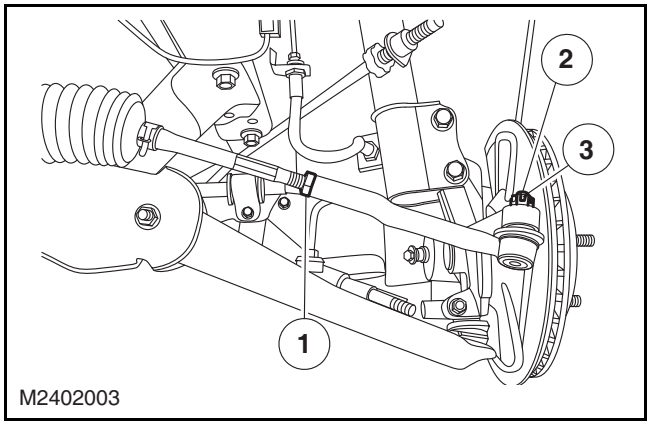
   1 Loosen the locking nut from the tie rod ball joint.

   Torque: 30 ~ 55 Nm

   2 Remove the cotter pin.

   3 Remove the retaining nut from the tie rod ball joint.

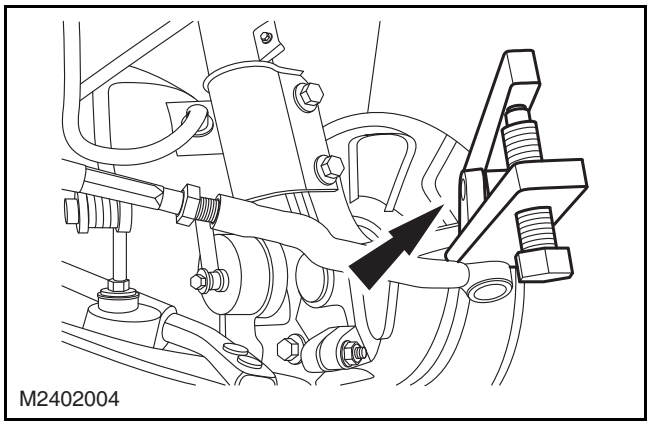
   Torque: 30 ~ 55 Nm



M2402003

4. Use the ball joint puller to remove the tie rod ball joint.

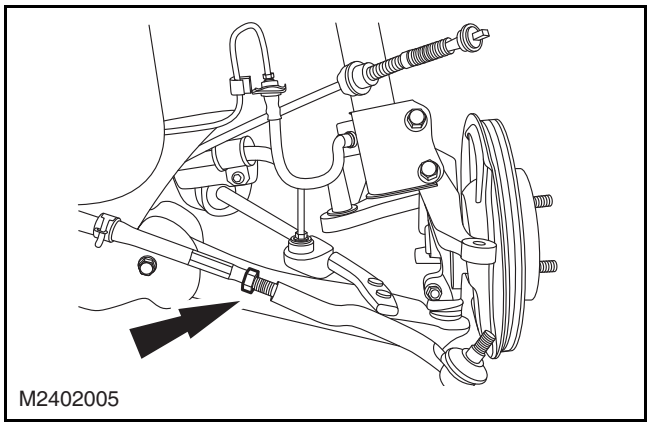
**CAUTION: When the tie rod ball joint is separated from the steering knuckle, pay attention to protect the oil seal.**


M2402004

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5. Remove the locking nut and the tie rod ball joint.


M2402005

**CAUTION: Record the number of turns while removing the tie rod ball joint.**

**CAUTION: Make sure the tightening turn number for tie rod ball joint thread is the same as that recorded while being removed. If the turn number is unknown, the visible thread length on the two sides of tie rod should be same while installing the tie rod.**

**CAUTION: Inspect and adjust toe-in when necessary, and make four-wheel alignment.**

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect and adjust toe-in when necessary, and make four-wheel alignment.**

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# Steering Gear Dust Boot

## Removal

1. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Remove the tie rod ball joint.

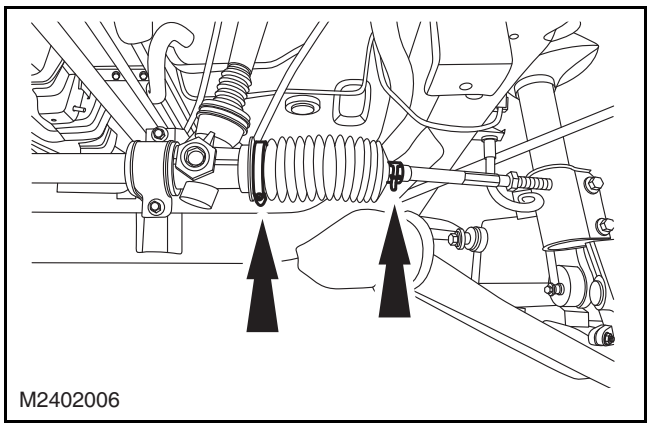
   **Refer to: Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).**

**CAUTION: Make sure the tie rod is clean before removing the dust boot.**

3. Remove the steering gear dust boot.

   1 Remove the metal wire and clamp from the steering gear dust boot.

   2 Remove the dust boot from the steering tie rod.


M2402006

## Installation

1. Installation is in the reverse order of removal.

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# Steering Gear

## Removal

1. Remove 2 front wheels.

   **Refer to: Wheel and Tire (2.1.4 Wheel and Tire, Removal and Installation).**

2. Lift the vehicle.

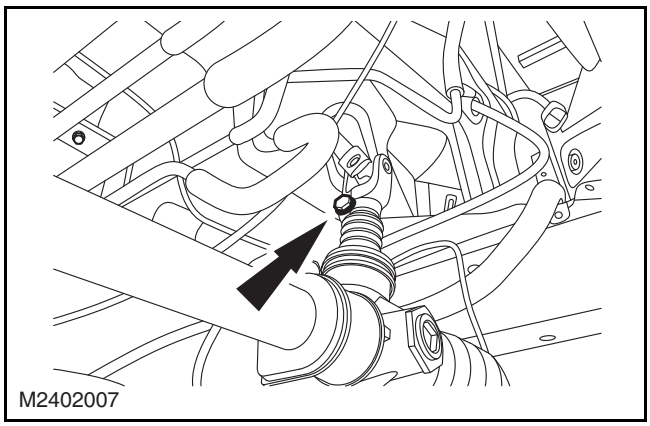
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the tie rod ball joint.

   **Refer to: Tie Rod Ball Joint (2.4.2 Steering Gear, Removal and Installation).**

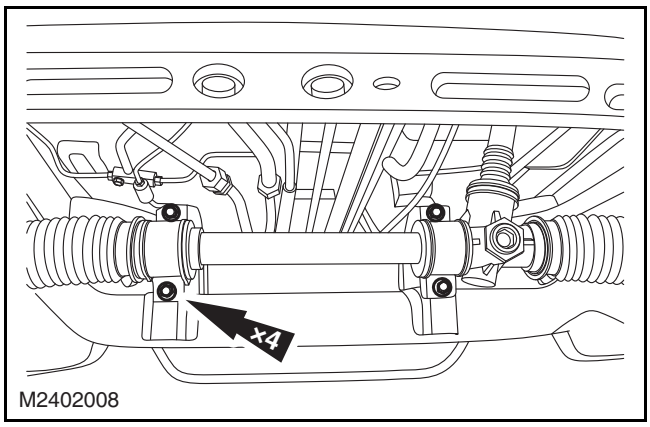
4. Remove the connecting bolt between steering lower shaft and steering gear.

   Torque: 32 ~ 38 Nm


M2402007

5. Remove 4 retaining bolts from the steering gearbox, and remove the steering gear assembly.

   Torque: 50 ± 5 Nm



M2402008

## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Steering wheel retaining nut | 25 ~ 40 | 18 ~ 30 | - |
| Connecting bolt and nut between steering upper shaft and steering support | 21 ~ 27 | 15 ~ 20 | - |
| Connecting bolt between steering upper and lower shafts | 32 ~ 38 | 24 ~ 28 | - |

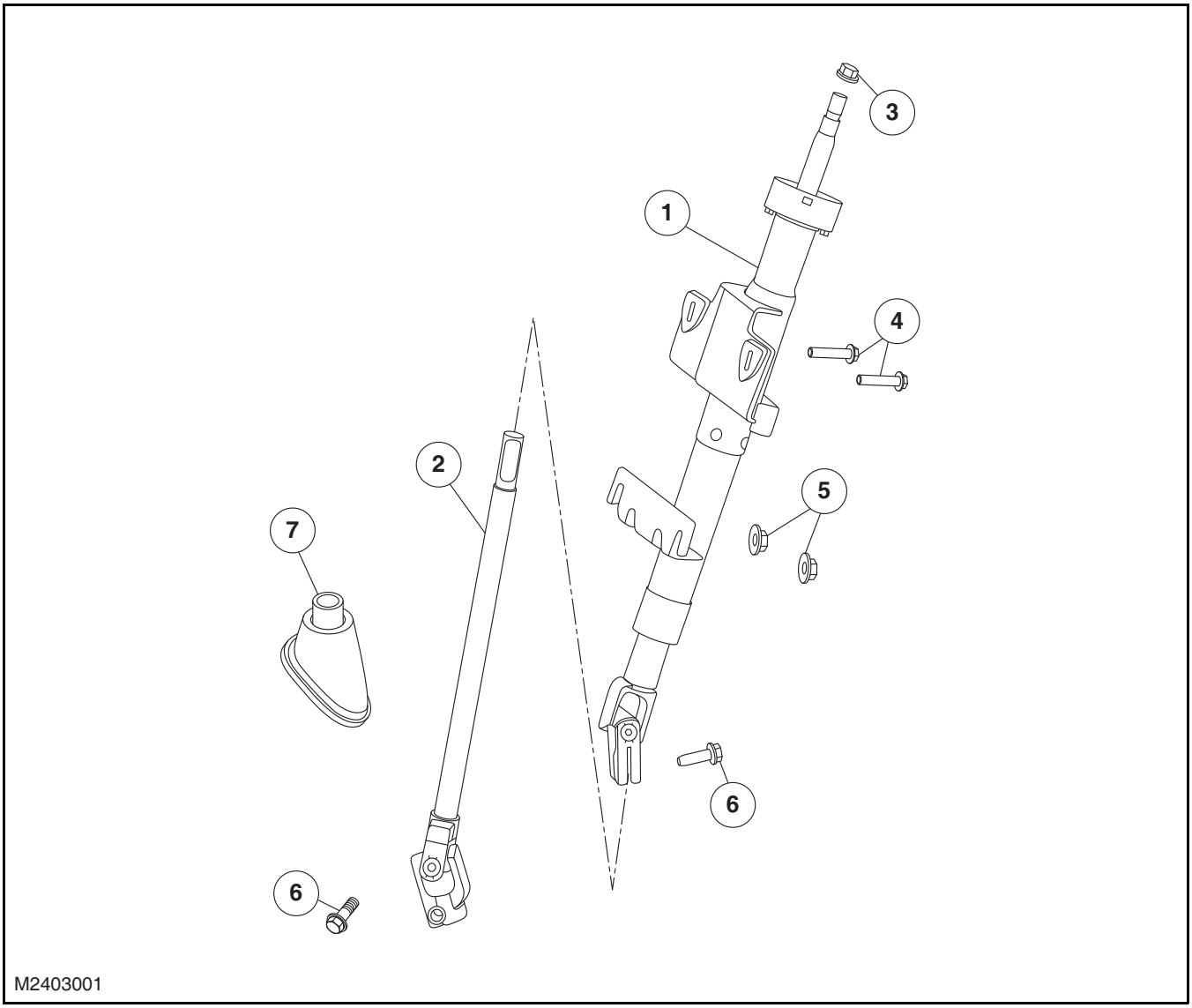
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## Description and Operation

# System Overview

Steering column is a part connected with steering wheel and steering gear for steering system. The steering wheel is fixed on the steering column assembly by the retaining nut, and the steering pinion connects with the steering column by the flexible universal joint, which is fixed on the pinion by a locking bolt and fixed on the steering column with the retaining bolts of shaft locator assembly and retainer.




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Steering upper shaft assembly | 5 | Hexagonal nut with serrated flange |
| 2 | Steering lower shaft assembly | 6 | Bolt and washer |
| 3 | Hexagonal nut with serrated flange | 7 | Steering shaft dust boot assembly |
| 4 | Hexagon flange bolt | | |

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## Symptom Diagnosis and Testing

Refer to: Symptom Chart (2.4.1 Steering System - Overview, Symptom Diagnosis and Testing).

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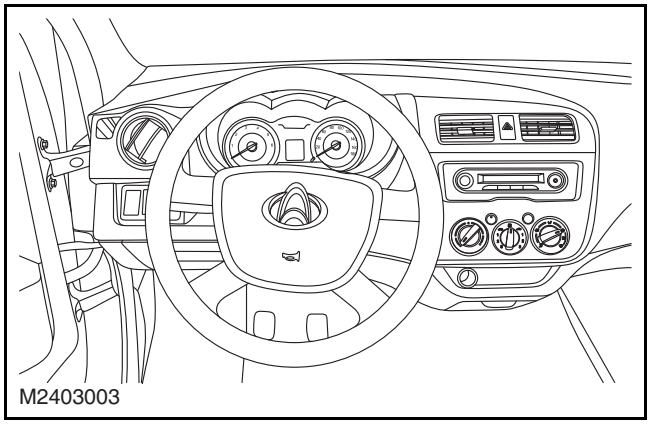
# Removal and Installation

## Steering Wheel

### Removal

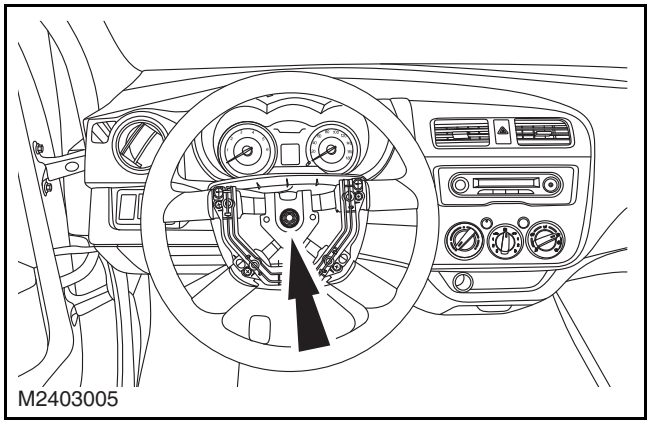
1. Turn the steering wheel to position the front wheels straight ahead.
2. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**
3. Remove the steering wheel upper cover.


M2403003

4. Remove the retaining nut from the steering wheel.

   Torque: 25 ~ 40 Nm


M2403005

5. Remove the steering wheel.

**CAUTION: For easy installation, mark it during removal.**

### Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect if there is enough lubricant on the metal conductive ring of steering wheel bottom before installation.**

**CAUTION: First make the steering wheel and wheels in straight-running state before tightening the steering wheel retaining nut according to specified torque.**

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# Steering Column

## Removal

**CAUTION: Turn the steering wheel to position the front wheels straight ahead.**

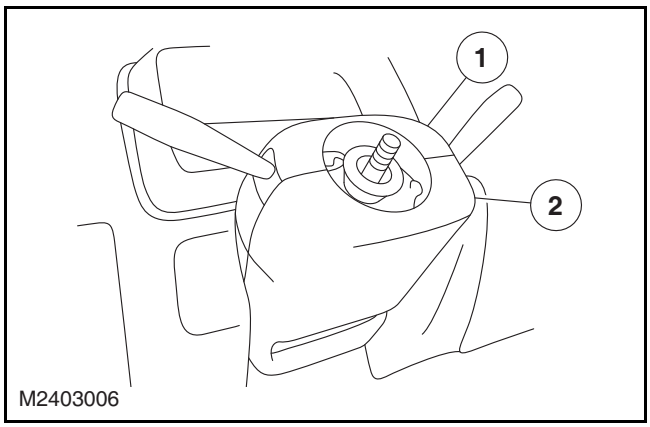
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

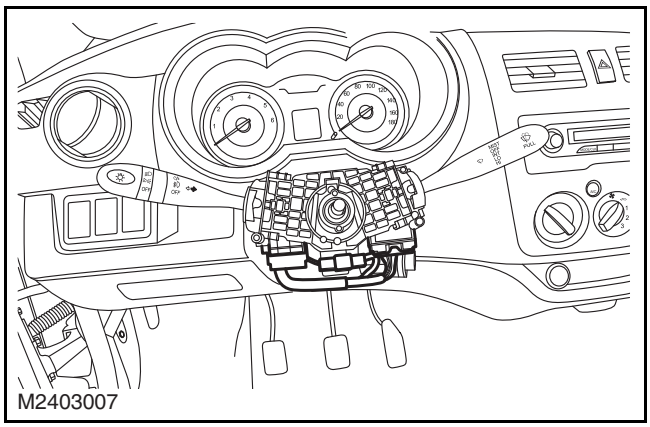
2. Remove the steering wheel.

   **Refer to: Steering Wheel (2.4.3 Steering Column, Removal and Installation).**

3. Remove the steering lock case upper cover (1) and lower cover (2).




4. Disconnect the wiring harness connectors from the combination switches and ignition switch.



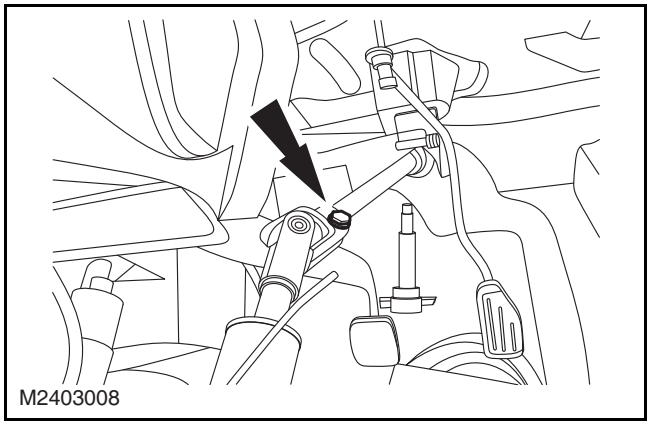

5. Remove 2 screws and the combination switches.

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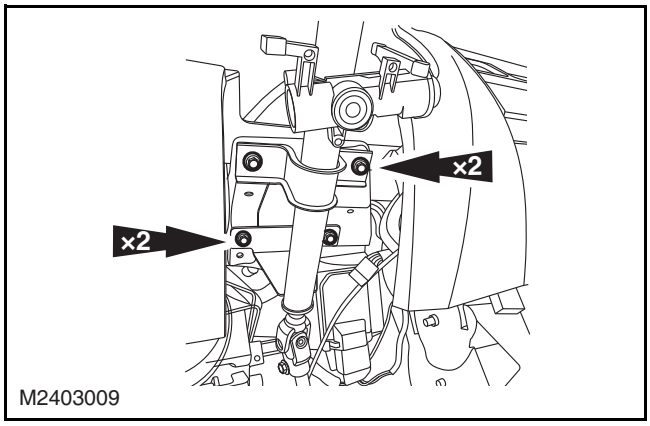
6. Remove the connecting bolt between steering upper and lower shafts.

   Torque: 32 ~ 38 Nm




7. Remove 2 retaining bolts and 2 retaining nuts from the steering column, and remove the steering column.

   Torque: 21 ~ 27 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: For installation of steering column retaining bolts, do not tighten first. After all bolts are ready, tighten them according to specified torque.**

**CAUTION: Ensure the spline is meshed properly when installing the steering gear and connecting the steering column.**

**CAUTION: Inspect and adjust toe-in when necessary, and make four-wheel alignment.**

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# Steering Wheel Anti-theft Lock (Ignition Switch)

## Removal

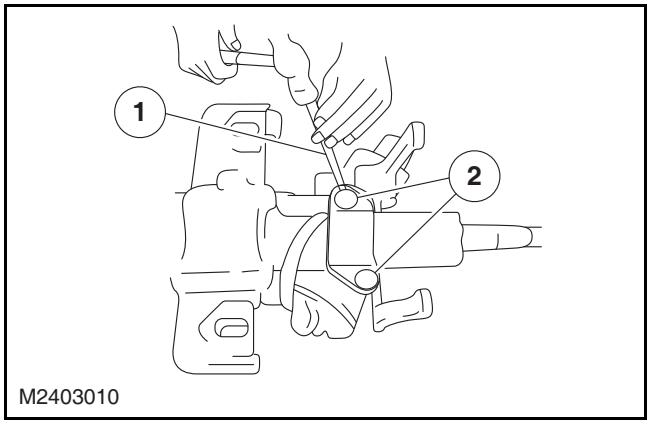
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the steering column.

   **Refer to: Steering Column (2.4.3 Steering Column, Removal and Installation).**

3. Use a center punch (1) to loosen and remove the assembling bolts (2) from the steering wheel anti-theft lock.




**CAUTION: Be careful to use the center punch, and do not damage the aluminum part of steering wheel anti-theft lock.**

4. Turn the ignition key to "ACC" or "ON", and remove the steering wheel anti-theft lock assembly from the steering column.

## Installation

1. Installation is in the reverse order of removal.

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# GROUP 3

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## Overview

C10 engine is a 4-stroke, water-cooling, 1.0 L gasoline engine. The cylinder block is made of casting aluminium alloy with a in-line 4-cylinder arrangement. The crankshaft is made of cast iron using fully balanced structure with five main bearing blocks. Cylinder head is made of casting aluminium alloy. Two camshafts are installed on the top of cylinder head, with design of double over-head camshaft (DOHC), which is fixed by the camshaft cover. Four valves are available for each cylinder (two intake valves and two exhaust valves) using DOHC design with V-type valve. The intake and exhaust valves can be opened and closed correctly at right time with right opening to ensure normal engine operation. DOHC is driven by crankshaft via timing belt.

The engine has the following advantages:

1. Double over-head camshaft (DOHC) with gapless helical gear connecting the two camshafts are adopted, which not only reduces noise and engine parts movement friction but also precisely controls engine valves work. As a result, it realizes less power loss, better high speed movement support of four valves of each cylinder and less fuel consumption loss.
2. The 16V technology uses two intake valves and two exhaust valves per cylinder to increase intake and exhaust capacity and achieve fully burning in each cylinder, thus not only providing greater power but reducing fuel consumption to effectively improve both dynamic performance and economic performance.
3. The engine oil pump is rotor pump, which is fixed on the crankshaft pulley side directly driven by the crankshaft. When the drive gear is rotating, the oil pump driven gear is driven to deliver oil to each engine working part.
4. The cooling system consists of radiator, coolant expansion tank, hose, water pump, cooling fan and thermostat. The radiator is aluminum gilled tube radiator while the cylinder block adopts wavy water jacket. This cooling system has been filled with high quality antifreeze composed of water and glycol in a proportion of 50/50 before delivery.
5. The air intake system consists of intake pipe, air filter, throttle body, plastic intake manifold and others. The air intake amount is calculated by the air intake pressure/ temperature sensor.
6. The engine adopts closed-loop electrically-controlled multi-point fuel injection. The fuel supply system is a non-return fuel supply system. The engine control module controls the opening sequence and duration of the fuel injector in accordance with the engine working condition.
7. Engine adopts DLI distributorless dual-cylinder simultaneous ignition system. Cylinder 1 and 4, cylinder 2 and 3 use the same ignition coil respectively.
8. The engine exhaust emission can be reduced and efficiently improved by evaporative emission (EVAP) control system, positive crankcase ventilation (PCV) system and three-way catalytic converter.
9. The engine spark plug is arranged in the center of each valve improving the ignition efficiency to achieve fully burning, thus further reducing the fuel consumption.
10. The engine adopts a united electronic control system which consists of engine control module (ECM), ECM working circuit, system input and output components. The engine control module also executes system diagnosis function through malfunction indicator lamp (MIL) to remind the driver and meanwhile stores the diagnostic trouble code (DTC) for the failed area in order to offer facility for the serviceman to repair.

**WARNING: Before the removal or installation of any electrical equipment, it is necessary to disconnect the negative battery cable when any tool or equipment has an easy access to any uncovered electrical terminals. Disconnect the wiring harness to prevent any personal injury or damage to the vehicle. It is necessary to turn the ignition switch to "LOCK" if there is no particular description.**

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**CAUTION: The air intake port must be covered to keep any foreign matters from it, each time the air filter is removed. Otherwise, the foreign matters could block the cylinder inlet duct, which will lead to serious damage when starting the engine.**

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## Specifications

# Material Specifications

| Item | Specifications | Capacity |
|---|---|---|
| Sealant | Silicon rubber flat sealant: Loctite 5900 | - |
| Flywheel bolt | 1005014D1 | - |
| Thread locking sealant | Loctite 262 | - |
| Oil | SG 15W-40 | 3.3 ± 0.1 L |

# Component Specifications

| Item | | Specifications |
|---|---|---|
| Camshaft | Air intake cam lift | 40.11 ~ 40.19 mm |
| | Air exhaust cam lift | 37.26 ~ 37.34 mm |
| | Radial runout | 0.10 mm |
| | Camshaft diameter | 23.947 ~ 23.960 mm |
| | Camshaft journal hole diameter | 24.000 ~ 24.025 mm |
| | Camshaft journal clearance | 0.040 ~ 0.078 mm |
| Cylinder head | Flatness limit for cylinder head surface | Top: 0.05 mm<br>Bottom: 0.03 mm<br>Intake: 0.05 mm<br>Exhaust: 0.05 mm |
| | Minimum overall height after machine tooling | 107.23 ~ 107.33 mm |
| | Overall height | 107.23 ~ 107.33 mm |
| | Deformation limit for manifold matching surface | 0.05 mm |
| Valve spring | Valve spring free length | 35.37 mm |
| | Valve spring preload | F1 = (118 ± 9) N<br>F2 = (258 ± 20) N |
| | Valve spring verticality | 1.0 mm |

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| Item | | | Specifications |
|---|---|---|---|
| Valve | Intake valve diameter | | 24.9 ~ 25.1 mm |
| | Exhaust valve diameter | | 21.1 ~ 21.3 mm |
| | Valve stem diameter | Intake | 4.952 ~ 4.966 mm |
| | | Exhaust | 4.926 ~ 4.940 mm |
| | Clearance between valve stem and guide | Intake | 0.046 ~ 0.060 mm |
| | | Exhaust | 0.072 ~ 0.086 mm |
| | Valve stem end offset limit | Intake | 0.14 mm |
| | | Exhaust | 0.18 mm |
| | Valve head thickness | Intake | 2.0 ~ 2.4 mm |
| | | Exhaust | 2.55 ~ 2.85 mm |
| | Valve imprint standard width | Intake | Minimum: 1.25 mm<br>Unevenness: 0.5 mm |
| | Valve clearance | Intake | 0.16 ~ 0.24 mm in cold state (coolant temperature 15~25°C) |
| | | Exhaust | 0.24 ~ 0.32 mm in cold state (coolant temperature 15~25°C) |
| Valve guide | Valve guide inner diameter | Intake | 5.000 ~ 5.012 mm |
| | | Exhaust | |
| | Extended length of valve guide from cylinder head | | 8.95 ~ 9.35 mm |
| | Valve guide overall length | | 35.7 ~ 36.3 mm |
| Piston | Piston standard diameter | | 65.58 ~ 65.82 mm |
| | Enlarged size by 0.25 mm | | 65.83 ~ 66.07 mm |
| | Enlarged size by 0.50 mm | | 66.08 ~ 66.32 mm |
| | Clearance to cylinder liner | | 0.028 ~ 0.052 mm |
| Piston ring groove | Piston ring groove side clearance | First ring | Side clearance:<br>0.04 ~ 0.08 mm |
| | | Second ring | Side clearance:<br>0.03 ~ 0.07 mm |
| Piston ring | End gap | First ring | 0.15 ~ 0.30 mm |
| | | Second ring | 0.30 ~ 0.45 mm |
| Piston pin | Piston pin diameter | | 15.995 ~ 16.000 mm |
| | Clearance between piston pin and piston pin hole | | 0.006 ~ 0.017 mm |
| | Piston pin hole diameter | | 16.006 ~ 16.012 mm |
| | Bending limit | | 480 MPa |
| | Twisting limit | | 245 MPa |

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| Item | | | Specifications |
|---|---|---|---|
| Crankshaft | Connecting rod journal diameter | | 37.982 ~ 38.000 mm |
| | Connecting rod journal diameter (reducing size by 0.25 mm in repair) | | 37.732 ~ 37.750 mm |
| | Connecting rod journal out-of-round limit | | 0.005 mm |
| | Connecting rod bearing shell clearance (oil film thickness) | | 0.02 ~ 0.04 mm |
| | Connecting rod bearing shell thrust clearance | | 0.100 ~ 0.202 mm |
| | Main journal radial runout limit | | 0.06 mm |
| | Main journal thrust clearance | | 0.16 ~ 0.36 mm |
| | Standard thickness for crankshaft thrust plate | | 2.47 ~ 2.52 mm |
| | Thickness for crankshaft thrust plate enlarged size by 0.125 mm | | 2.595 ~ 2.645 mm |
| | Main journal taper and out-of-round | | 0.005 mm |
| | Clearance between main bearing shell and main journal | | 0.02 ~ 0.04 mm |
| | Main journal diameter | 1 | 49.994 ~ 49.000 mm |
| | | 2 | 49.988 ~ 49.994 mm |
| | | 3 | 49.982 ~ 49.988 mm |
| Main bearing cap hole diameter | | Bearing cap A | 54.000 ~ 54.006 mm |
| | | Bearing cap B | 54.006 ~ 54.012 mm |
| | | Bearing cap C | 54.012 ~ 54.018 mm |
| Main bearing thickness | 1 | | 1.998 ~ 2.002 mm |
| | 2 | | 1.995 ~ 1.999 mm |
| | 3 | | 1.992 ~ 1.996 mm |
| | 4 | | 1.989 ~ 1.993 mm |
| | 5 | | 1.986 ~ 1.990 mm |
| Flywheel end face runout limit | | | 0.2 mm |
| Cylinder block | Taper and out-of-round limit | | 0.008 mm |
| | Flatness | | 0.03 mm |
| | Diameter | | 66.00 ~ 66.02 mm |
| | Cylinder diameter limit | | 66.02 mm |

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# General Specifications

| Item | Specifications |
|---|---|
| Engine type | Vertical, in-line, 4-cylinder, water-cooling, four-stroke, DOHC |
| Fuel supply | Sequential multi-point electronic control fuel injection |
| Timing drive mode | Timing chain |
| Cylinder diameter | 66.00 ~ 66.02 mm |
| Piston stroke | 73 mm |
| Displacement | 0.999 L |
| Compression ratio | 10.5:1 |
| Rated power | 51 kW/6000 rpm |
| Max. torque | 91 Nm/4600 rpm |
| Min. fuel consumption | 265 g/ kW·h |
| Idle speed | 760 rpm |
| Cylinder compression pressure | 1250 kPa (300 rpm) or more |
| Ignition sequence | 1 - 3 - 4 - 2 |
| Spark plug type | DK7RTC |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Alternator charging cable retaining nut | 9.5 | - | - |
| Engine wiring harness grounding point | 10 ± 1 | - | - |
| Connecting bolt between A/C high/low pressure pipe and A/C compressor | 14 ~ 17 | - | - |
| Connecting nut between exhaust manifold and three-way catalytic converter | 23 ± 2 | - | - |
| Grounding wire retaining bolt | 10 ± 1 | - | - |
| Engine left mounting bracket bush assembly retaining bolt | 55 ± 10 | - | - |
| Engine right mounting bracket bush assembly retaining bolt | 55 ± 10 | - | - |
| Flywheel retaining bolt | 45 ~ 50 | - | - |
| Clutch pressure plate assembly retaining bolt | 32 ± 2 | - | - |
| Camshaft timing belt retaining bolt | 80 ~ 87 | - | - |
| Driven gear locating bolt | 9 ± 1 | - | - |
| Camshaft cover retaining bolt | 10 ± 1 | - | - |
| Crankshaft pulley retaining bolt | 133 ± 5 | - | - |
| Tensioner pulley retaining bolt | 23 ± 2 | - | - |
| Water pump pulley retaining bolt | 8 ± 1 | - | - |
| Cylinder head retaining bolt | 67 ± 2 | - | - |

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| Item | | Nm | lb-ft | lb-in |
|---|---|---|---|---|
| Piston connecting rod bearing cap retaining bolt | | 35 ± 2 | - | - |
| Main bearing cap retaining bolt | | 63 ± 2 | - | - |
| Connecting rod retaining bolt | | 35 ± 2 | - | - |
| No.1 camshaft bearing cap retaining bolt | | 10 ± 1 | - | - |
| No.2 camshaft bearing cap retaining bolt | | 10 ± 1 | - | - |
| Oil pressure alarm assembly retaining bolt | | 12 ~ 15 | - | - |
| Oil filter assembly | | 14 ± 2 | - | - |
| Drain plug | | 23 ± 5 | - | - |
| Coolant temperature sensor | | 15 ± 2 | - | - |
| Tensioner pulley assembling bolt | | 23 ± 2 | - | - |
| Knock sensor | | 23 ± 2 | - | - |
| Engine trim cover retaining bolt | | 10 ± 1 | - | - |
| Unmarked bolt | M6 × 1.0 | 10 ± 1 | - | - |
| | M8 × 1.25 | 23 ± 2 | - | - |
| | M10 × 1.25 | 50 ± 5 | - | - |
| | M12 × 1.25 | 87 ± 9 | - | - |

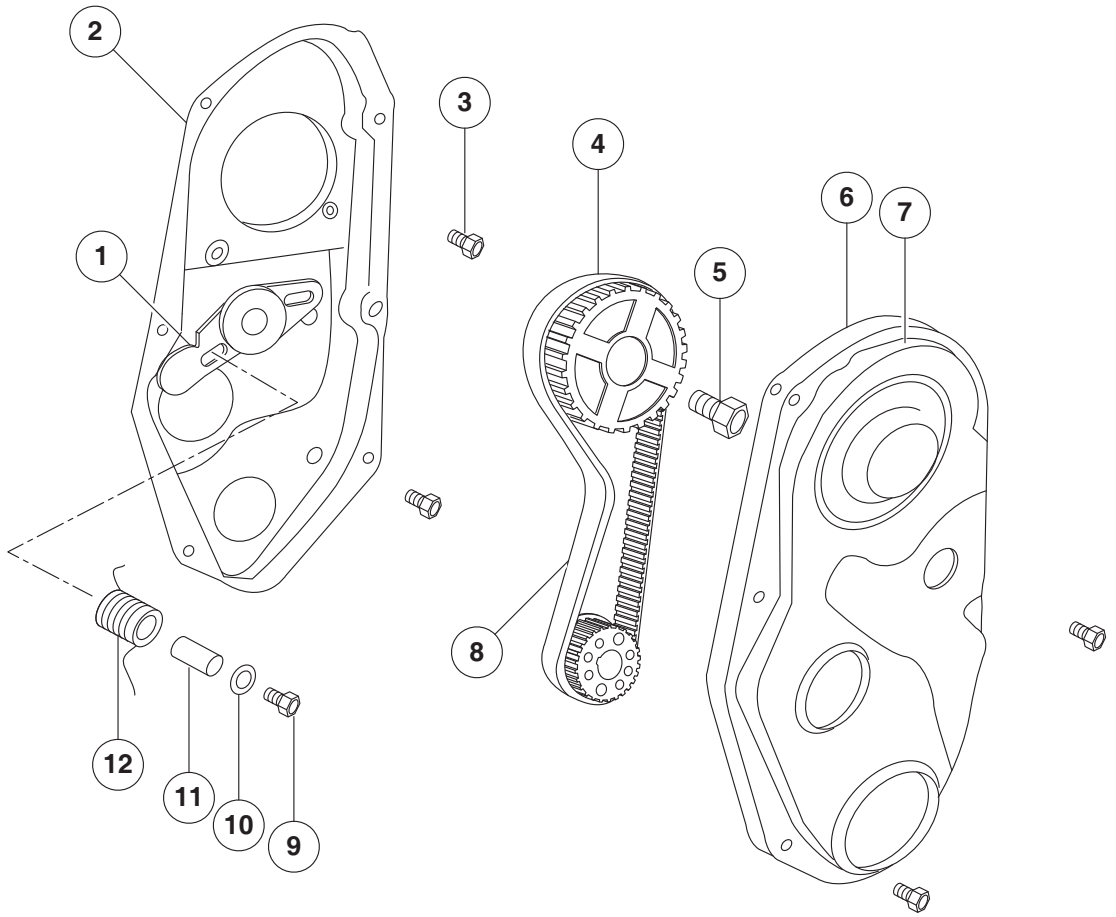
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## Description and Operation

# Components Exploded View

### Timing Wheel Train



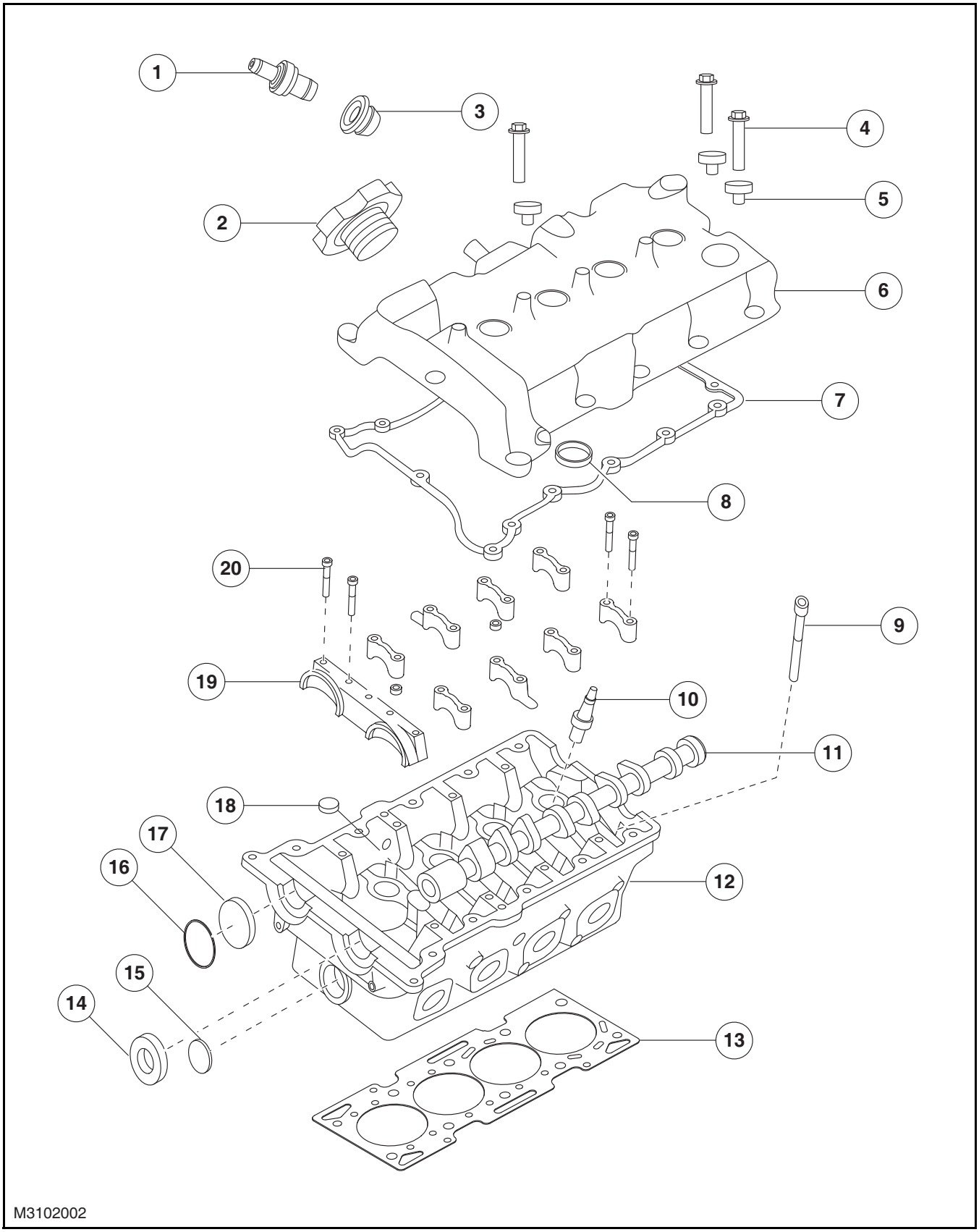

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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Tensioner pulley assembly | 7 | Timing belt outer housing |
| 2 | Timing belt inner housing | 8 | Timing belt |
| 3 | Tensioner pulley retaining bolt | 9 | Tensioner pulley retaining bolt |
| 4 | Camshaft timing belt pulley | 10 | Washer |
| 5 | Camshaft timing belt pulley retaining bolt | 11 | Torsion spring bushing |
| 6 | Gasket of inner and outer housing | 12 | Torsion spring |

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## Cylinder Head



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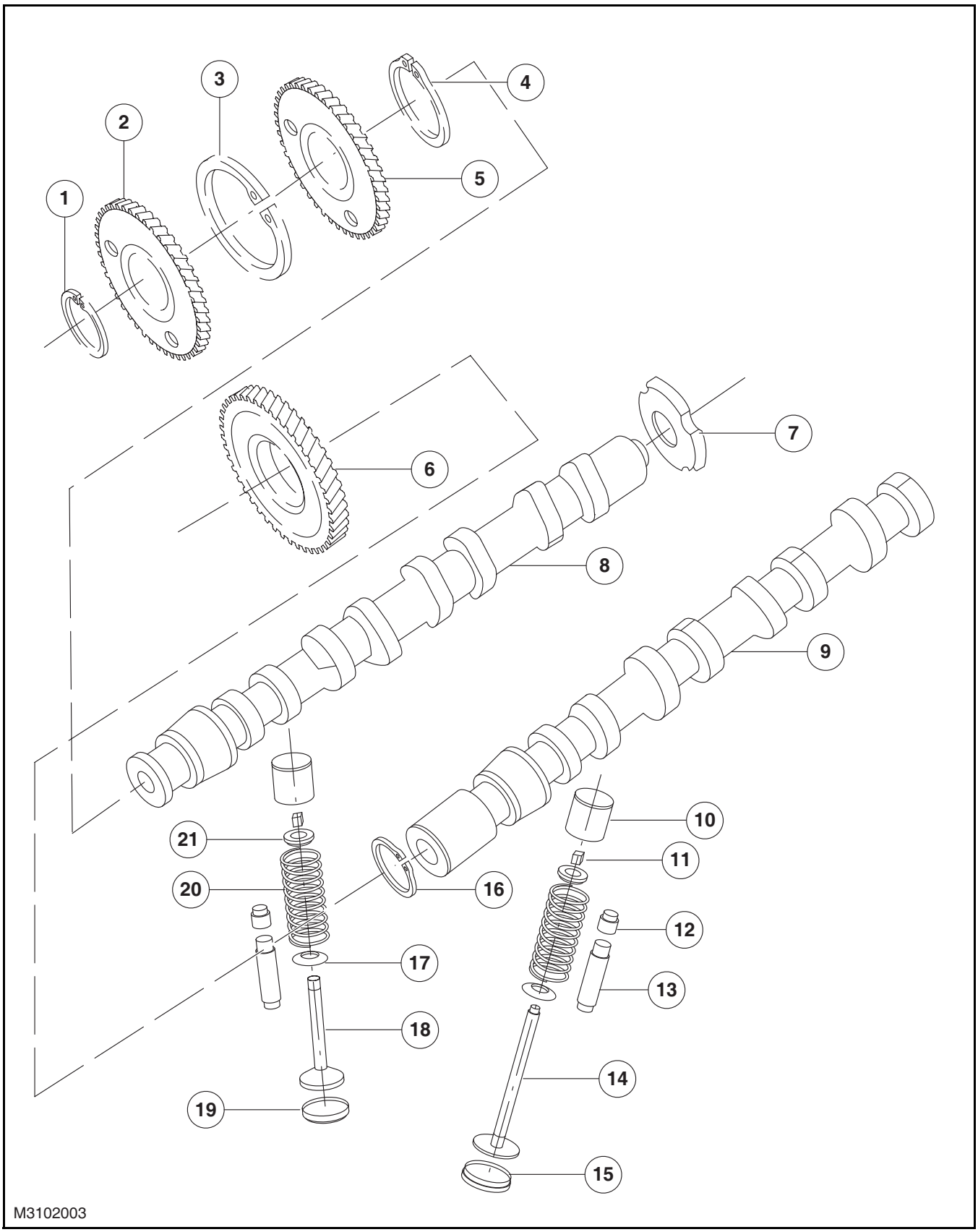


| Item | Description | Item | Description |
|---|---|---|---|
| 1 | PCV valve | 11 | Exhaust camshaft |
| 2 | Oil filter cap assembly | 12 | Cylinder head assembly |
| 3 | PCV valve seal ring | 13 | Cylinder gasket |
| 4 | Hexagon flange bolt | 14 | Camshaft front oil seal |
| 5 | Cylinder head cover bolt washer assembly | 15 | Bowl plug |
| 6 | Cylinder head cover assembly | 16 | Camshaft end cover O-ring |
| 7 | Cylinder head cover gasket | 17 | Camshaft hole front end cover |
| 8 | Spark plug seal ring | 18 | Cylinder head bowl plug |
| 9 | Cylinder head assembling bolt | 19 | No.1 camshaft bearing cap |
| 10 | Spark plug | 20 | No.1 camshaft bearing cap retaining bolt |

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## Valve Mechanism



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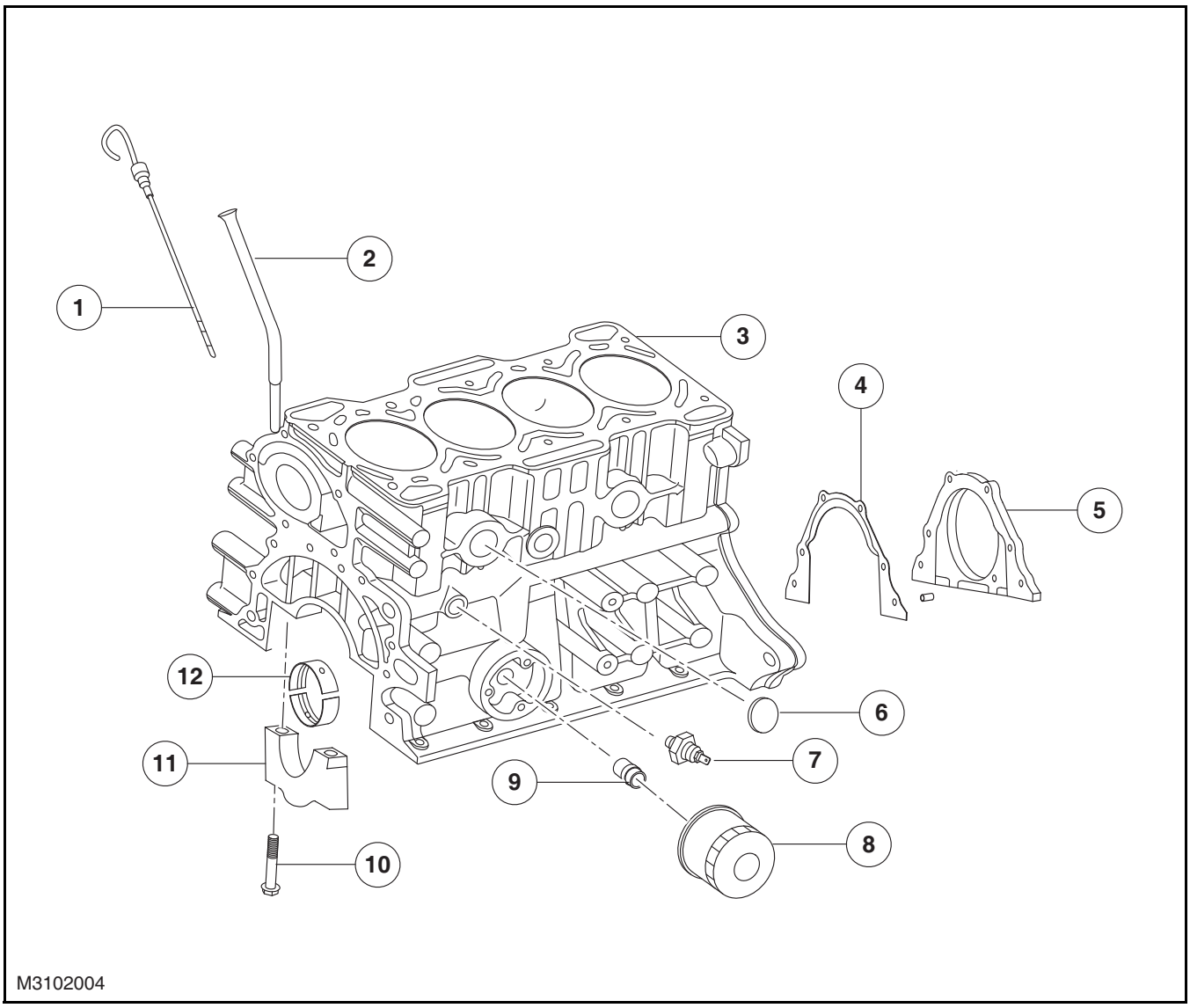


| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Circlip | 12 | Valve oil seal |
| 2 | Driven gear | 13 | Valve guide |
| 3 | Circlip | 14 | Exhaust valve |
| 4 | Circlip for shaft | 15 | Exhaust valve seat |
| 5 | Separation gear | 16 | Small circlip |
| 6 | Drive gear | 17 | Valve spring lower retainer |
| 7 | Phase plate | 18 | Intake valve |
| 8 | Intake camshaft | 19 | Intake valve seat |
| 9 | Exhaust camshaft | 20 | Valve spring |
| 10 | Valve tappet | 21 | Valve spring upper retainer |
| 11 | Valve taper cotter | | |

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## Crankcase

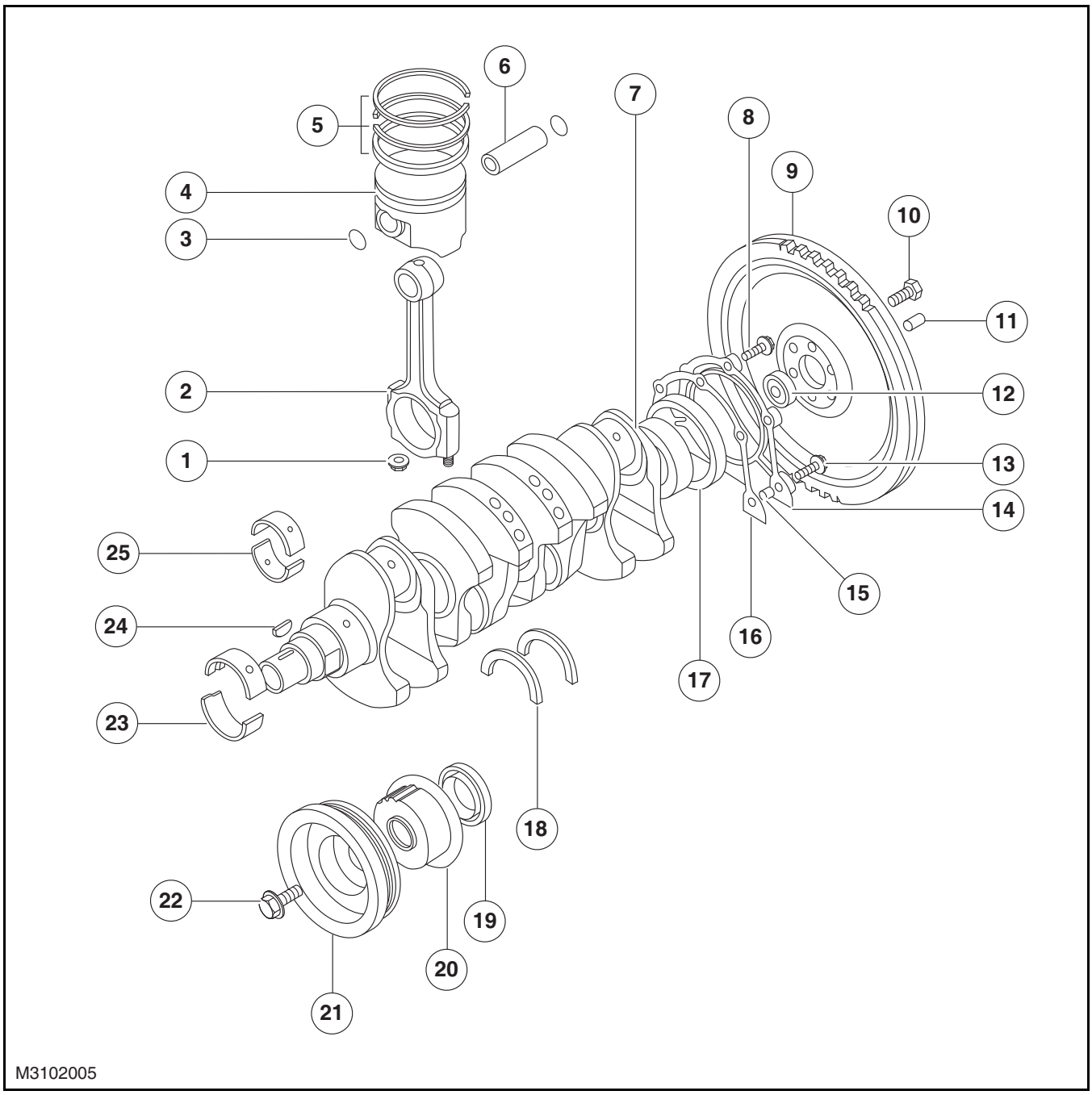



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Oil level gauge | 7 | Oil pressure alarm assembly |
| 2 | Oil level gauge guide | 8 | Oil filter assembly |
| 3 | Crankcase assembly | 9 | Connecting pipe |
| 4 | Crankshaft rear end cover gasket | 10 | Crankshaft main bearing cap bolt |
| 5 | Crankshaft rear end cover | 11 | Crankshaft bearing cap |
| 6 | Bowl plug | 12 | Main bearing |

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## Crankshaft



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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Connecting rod nut | 14 | Crankshaft rear end cover |
| 2 | Connecting rod assembly | 15 | Dowel pin |
| 3 | Piston pin snap ring | 16 | Crankshaft rear end cover gasket |
| 4 | Piston | 17 | Crankshaft rear oil seal |
| 5 | Piston ring | 18 | Crankshaft thrust plate assembly |
| 6 | Piston pin | 19 | Crankshaft front oil seal |
| 7 | Crankshaft assembly | 20 | Crankshaft timing belt pulley |
| 8 | Bolt | 21 | Crankshaft belt pulley |
| 9 | Flywheel gear assembly | 22 | Crankshaft belt pulley bolt |
| 10 | Bolt | 23 | Crankshaft bearing set |
| 11 | Pin | 24 | Woodruff key |
| 12 | Flywheel bearing | 25 | Connecting rod bearing set |
| 13 | Bolt | | |

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## General Inspection

# Cylinder Compression Pressure Inspection

### General Equipment

| |
|---|
| Cylinder compression pressure gauge assembly |
| Spark plug socket |
| Ratchet wheel |
| Connecting rod |

**WARNING: High temperature engine and oil would lead to serious scalding.**

**CAUTION: ECM receives a wrong message when the fuel pump relay or electrical component is removed. The wrong message must be cleared from the trouble memory with the diagnostic tool after the cylinder pressure test is finished.**

**CAUTION: Before compression pressure test, the valve clearance must be adjusted correctly.**

**Refer to: Valve Clearance Inspection and Adjustment (3.1.2 Mechanical System, General Inspection).**

1. Warm up the engine to the normal operation temperature.
2. Turn off the engine after warm up. Also, move the transmission shift lever to "N", apply the parking brake and chock the drive wheels.
3. Remove the fuel pump relay.
4. Disconnect the wiring harness connectors between the fuel injectors and ignition coils.
5. Remove and take off all the spark plugs.
6. Insert the special tool (compression pressure gauge) into the spark plug hole.
7. Depress the clutch pedal (to reduce the starting load of engine) and depress the accelerator pedal to fully open the throttle valve.
8. Use the fully-charged battery to start the engine (at least 5 compression cycles), until the reading on the cylinder pressure gauge stops increasing, then read the highest pressure value and record it.

**CAUTION: To measure the compression pressure, it is necessary to use the fully-charged battery to run the engine at least 250 rpm.**

**CAUTION: When performing the start test, the ignition switch is in "ST" for no more than 15 seconds, or the starting motor may be damaged.**

9. Operate the other 3 cylinders as the step 5 to 8 and record the cylinder compression pressure value.
10. Compare with the specifications in the table below, the condition is as follows:
    - Normal condition: each cylinder pressure increases rapidly and evenly to the specified pressure value.
    - Piston ring fault: pressure is low in the first stroke but increases in the next strokes and never reaches the normal level. The pressure increases considerably after a moderate amount of engine oil has been added to the cylinder. Inspect the piston ring.

      **Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**

    - Valve fault: the pressure is low in the first stroke and cannot increase in the next strokes. If the pressure increases slightly after a moderate amount of engine oil has been added to the cylinder, inspect the valve.

      **Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**

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- The cylinder head gasket may be damaged if the compression pressures of 2 cylinders arranged on the cylinder block "in parallel" are too low.

| Compression Pressure | Specifications |
|---|---|
| Limit | 1250 kPa |
| Max. pressure difference between two cylinders | 100 kPa |

**11.** Install the spark plugs and high voltage cable, and connect the wiring harness connectors to the fuel injectors and ignition coils.

**12.** Install the fuel pump relay and clear the DTC(s) from the ECM with a diagnostic tool.

# Accessory Drive Belt Inspection

**CAUTION: Do not overly wind or bend the drive belt.**

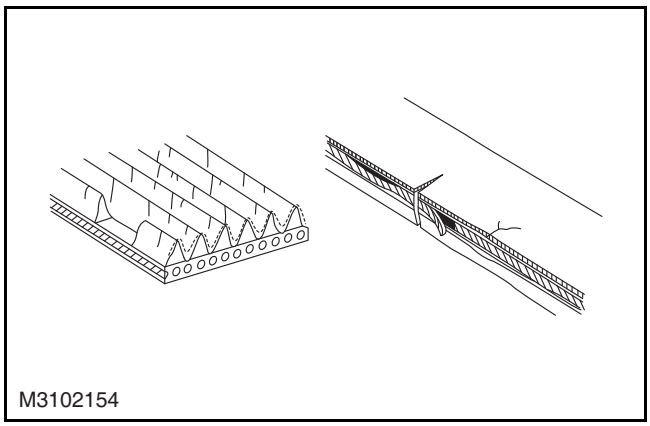
**CAUTION: Do not stick the engine oil or coolant to the drive belt.**

**CAUTION: Accessory drive belt consists of alternator belt, elastic belt and compressor belt.**

**1.** Inspection should be conducted after the engine has cooled down or turned off for 30 minutes.

**2.** Visually inspect the accessory drive belt surface for pilling, oil stain, aging and cracks. If any defect is found, replace the accessory drive belt.

**3.** Visually inspect the interior and margin of drive belt for damages, abrasions, foreign matters and cracks. If so, replace the drive belt with a new one.



M3102154

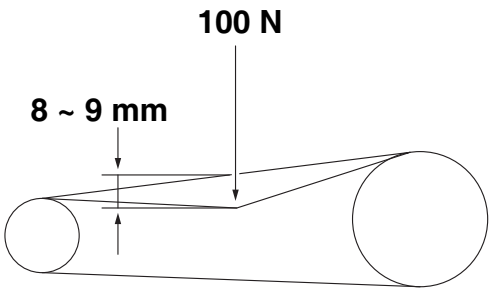
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**4.** Inspect the accessory drive belt tension.

Inspect the compressor belt tension.

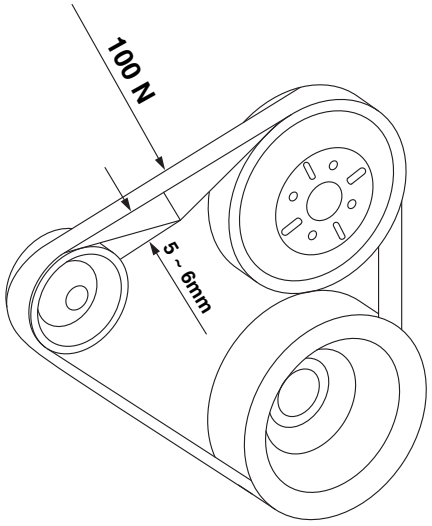
Press down the compressor belt vertically in the middle with a force of 100 N, and its bending deflection should be 8 ~ 9 mm measuring with a straight scale and its tension should be 3800 ± 200 N measuring with a sonic tension meter.




M3102155

Inspect the alternator belt tension.

Press down the alternator belt vertically in the middle with a force of 100 N, and its bending deflection should be 5 ~ 6 mm measuring with a straight scale.

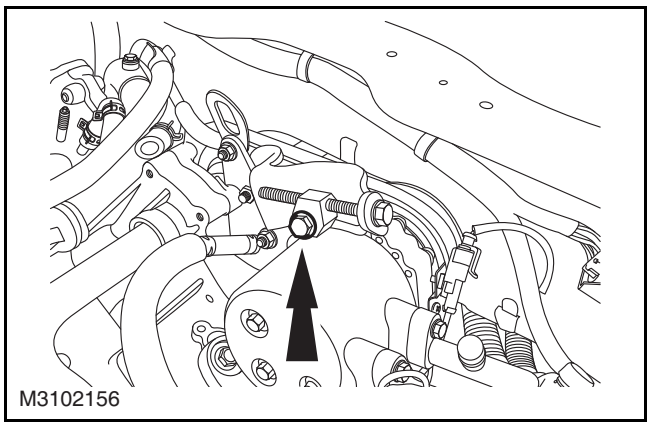



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# Accessory Drive Belt Tension Adjustment

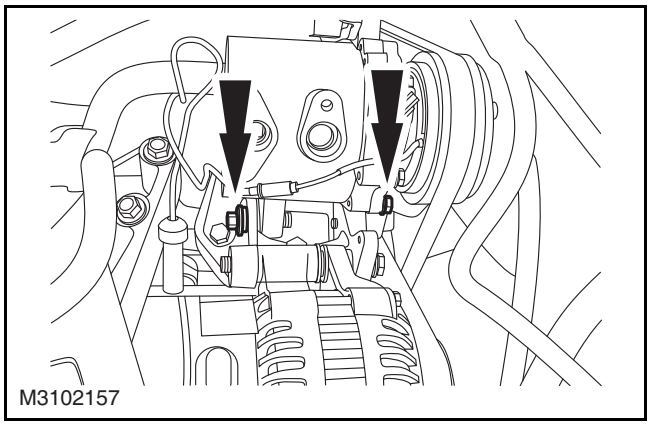
**1.** Compressor Belt Tension Adjustment

1 Loosen the compressor adjusting bolt.



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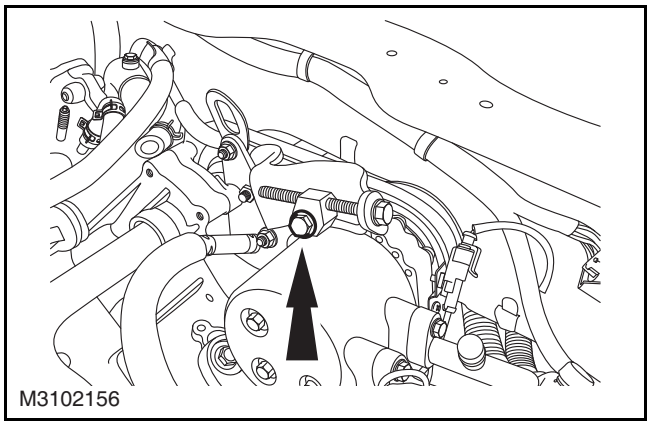
2 Loosen 2 compressor lower retaining bolts.



M3102157

3 Adjust the compressor belt tension.

4 Tighten the compressor adjusting bolt.

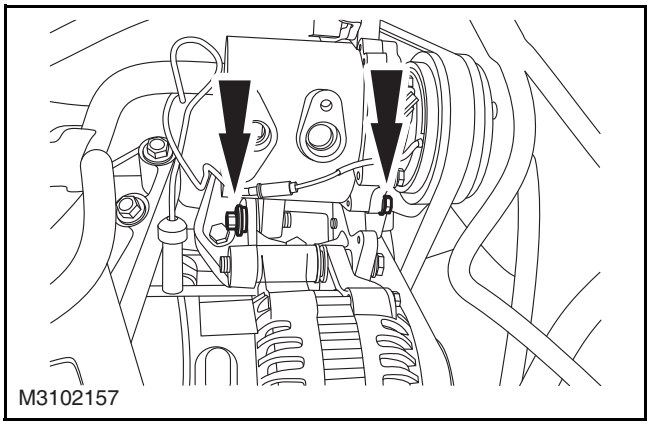


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5 Tighten 2 compressor lower retaining bolts.

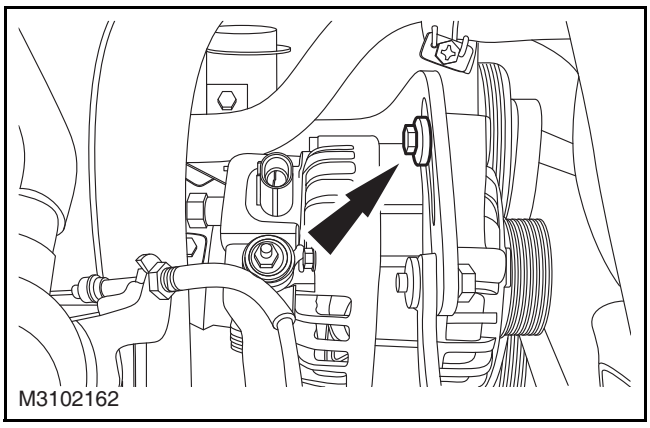



6 Inspect if the compressor belt tension reaches the specified value.

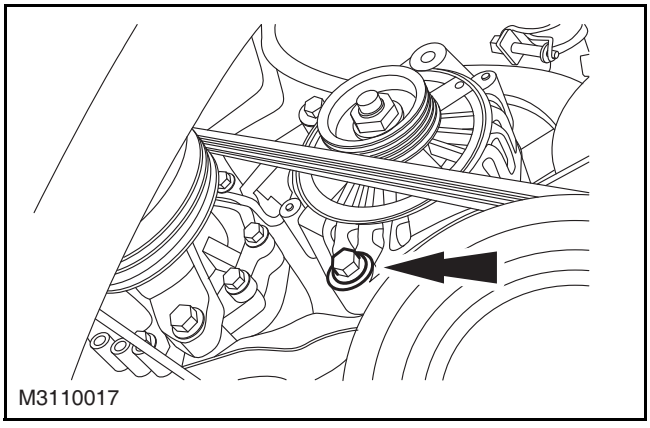
7 If not, repeat the steps 1 ~ 5 until the compressor belt tension reaches the specified value.

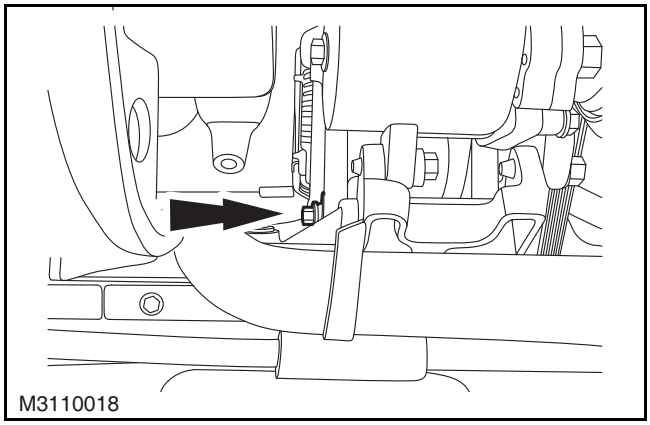
**2.** Alternator Belt Tension Adjustment

1 Loosen the alternator upper adjusting bolt.



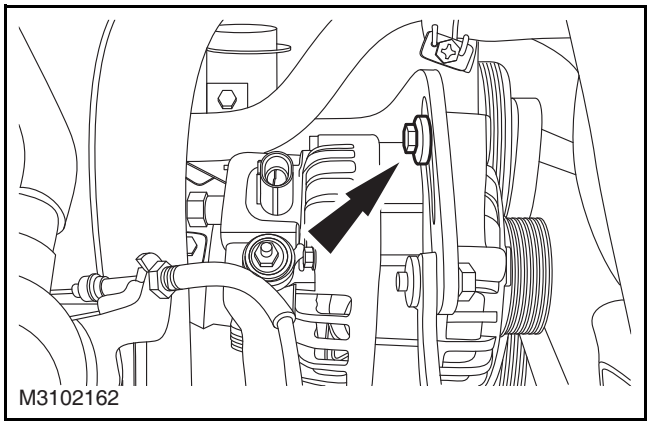

2 Loosen 2 alternator lower retaining bolts.



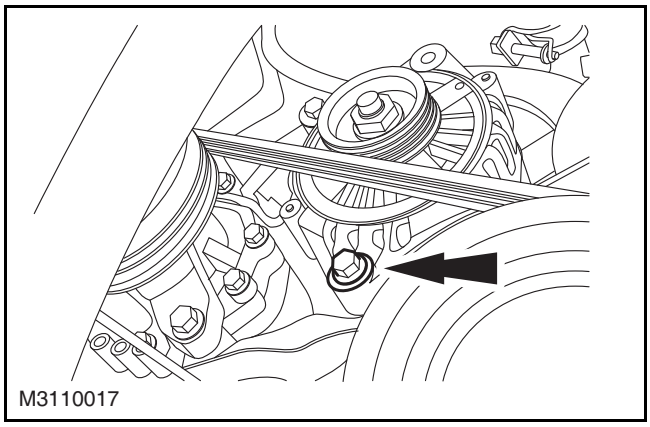




3 Adjust the alternator belt tension.

4 Tighten the alternator upper adjusting bolt.

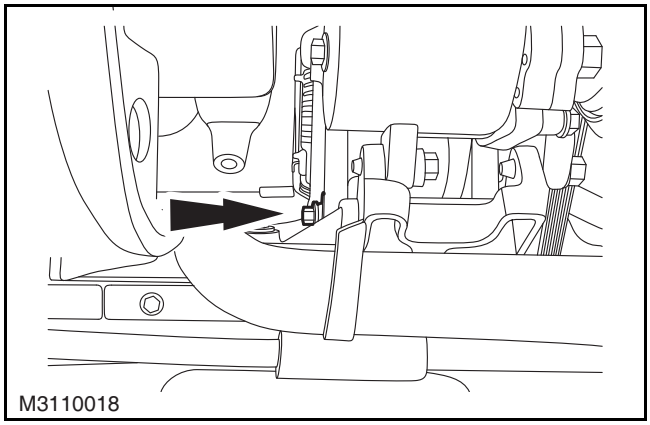



5 Tighten 2 alternator lower retaining bolts.



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6 Inspect if the alternator belt tension reaches the specified value.

7 If not, repeat the steps 1 ~ 5 until the alternator belt tension reaches the specified value.

# Valve Clearance Inspection and Adjustment

**General Tool**

| |
|---|
| Feeler gauge |

1. Disconnect the battery negative cable.
2. Remove the cylinder head cover.

   **Refer to: Cylinder Head Cover (3.1.2 Mechanical System, Removal and Installation).**

3. Rotate the crankshaft clockwise (observed from crankshaft belt pulley side) to make the piston in the No.1 cylinder reach the top dead center while observing the timing mark on the crankshaft belt pulley.
4. Use the feeler gauge to measure the No.1 and No. 2 cylinder intake valve clearance and the No. 1 and No. 3 cylinder exhaust valve clearance in sequence.

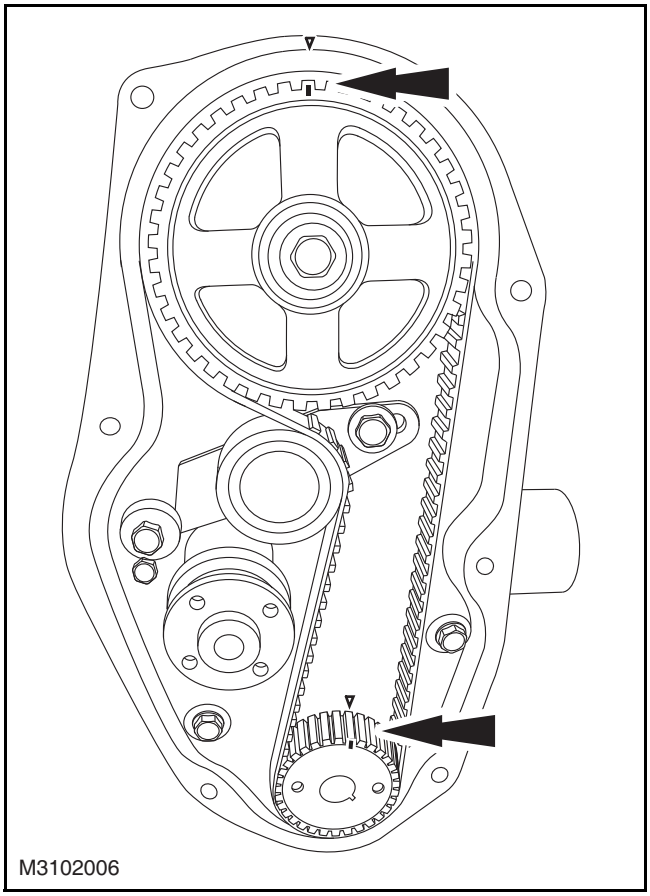
**CAUTION: At this moment, the No.1 piston is at the top dead center in the compression stroke.**

5. Rotate the crankshaft clockwise for 360 degrees and use the feeler gauge to measure the No. 3 and No. 4 cylinder intake valve clearance and the No. 2 and No. 4 cylinder exhaust valve clearance in sequence.

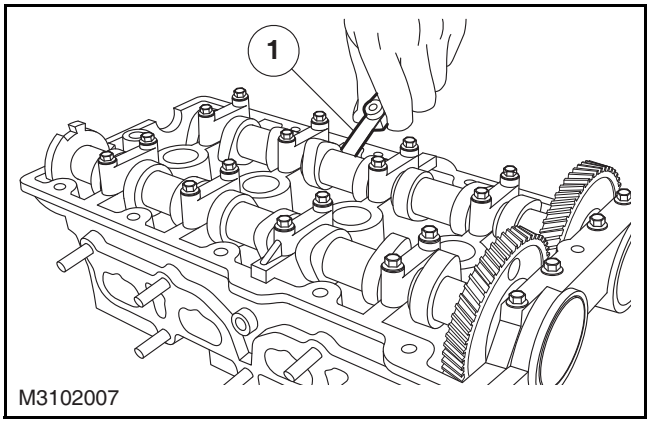
**CAUTION: At this moment, the No.4 piston is at the top dead center in the compression stroke.**

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**6.** Inspect the valve clearance by inserting the feeler gauge between the cam and tappet.



M3102007

| Item | Description |
|---|---|
| 1 | Feeler gauge |

| | | |
|---|---|---|
| Valve clearance | Cold state (coolant temperature 15 ~ 25°C) | |
| | Intake | 0.16 ~ 0.24 mm |
| | Exhaust | 0.24 ~ 0.32 mm |

**7.** If the valve clearance exceeds the specification, replace the corresponding valve tappet with the same thickness according to the following method and the measured valve clearance value, measure again to ensure the valve clearance is within the specified standard.

**The selection method of valve tappet is as follows:**

**1.** Valve tappet grouping chart is as shown below.

| Item | D | T | Item | D | T |
|---|---|---|---|---|---|
| 1 | 6.10 | 0.015 | 26 | 6.72 | 0.010 |
| 2 | 6.13 | 0.015 | 27 | 6.74 | 0.010 |
| 3 | 6.16 | 0.015 | 28 | 6.76 | 0.010 |
| 4 | 6.19 | 0.015 | 29 | 6.78 | 0.010 |
| 5 | 6.22 | 0.015 | 30 | 6.80 | 0.010 |
| 6 | 6.25 | 0.015 | 31 | 6.82 | 0.010 |
| 7 | 6.28 | 0.015 | 32 | 6.84 | 0.010 |
| 8 | 6.31 | 0.015 | 33 | 6.86 | 0.010 |
| 9 | 6.34 | 0.015 | 34 | 6.88 | 0.010 |
| 10 | 6.37 | 0.015 | 35 | 6.90 | 0.010 |
| 11 | 6.40 | 0.015 | 36 | 6.92 | 0.010 |
| 12 | 6.43 | 0.015 | 37 | 6.94 | 0.010 |
| 13 | 6.46 | 0.010 | 38 | 6.97 | 0.015 |
| 14 | 6.48 | 0.010 | 39 | 7.00 | 0.015 |
| 15 | 6.50 | 0.010 | 40 | 7.03 | 0.015 |
| 16 | 6.52 | 0.010 | 41 | 7.06 | 0.015 |
| 17 | 6.54 | 0.010 | 42 | 7.09 | 0.015 |
| 18 | 6.56 | 0.010 | 43 | 7.12 | 0.015 |
| 19 | 6.58 | 0.010 | 44 | 7.15 | 0.015 |
| 20 | 6.60 | 0.010 | 45 | 7.18 | 0.015 |
| 21 | 6.62 | 0.010 | 46 | 7.21 | 0.015 |
| 22 | 6.64 | 0.010 | 47 | 7.24 | 0.015 |
| 23 | 6.66 | 0.010 | 48 | 7.27 | 0.015 |
| 24 | 6.68 | 0.010 | 49 | 7.30 | 0.015 |
| 25 | 6.70 | 0.010 | | | |

**2.** First, select one of the tappet groups as the standard tappet (from 6.31 in the group 8 to 6.48 in the group 14), for example, select 6.40 in the group 11.

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3. Install the selected standard tappet to the cylinder head assembly (valves, camshaft, etc. have been installed in place), then inspect the clearance between each tappet and camshaft base circle separately with a feeler gauge and record it. For example, the measured clearance of No.1 cylinder No.1 valve for intake side is 40.
4. Finally replace with appropriate tappet according to the specified valve clearance in the Valve Clearance Standard Table and the measured clearance above, for example, if selecting the 6.60 in the group 20, the valve clearance is just 20.
5. The mark of valve tappet grouping is D × 100, 6.10 × 100 = 610 which is the first group in the table above.

## Timing Inspection

1. Inspect the ignition timing with a diagnostic tool.
   - Turn the ignition switch to "OFF".
   - Connect the diagnostic tool to the diagnosis testing interface.
   - Start the engine to the normal working temperature.
   - Do not switch on the air conditioner and other electric equipment.
   - Using a diagnostic tool, select in turn: M7 data test/Engine speed and ignition advance angle.

| Idle Speed | Ignition Advance Angle |
|---|---|
| 760 rpm | 3.5° |

2. Use a diagnostic tool to inspect for DTCs.

   Continue with the following inspections if the fault still exists.
3. Inspect the valve timing mechanism.

   **Refer to: Camshaft (3.1.2 Mechanical System, Removal and Installation).**

**CAUTION: Inspect the phase relationship between camshaft timing belt pulley and crankshaft timing belt pulley as well as the relationship between timing belt pulley and shaft. For example: Pay much attention to the cracked belt pulley pin of the camshaft during inspection.**

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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Verify the customer concern and conduct the corresponding inspections.
2. Visually inspect for obvious mechanical damage.
3. Solve the known problems before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

**Visual Inspection Chart**

| Mechanical |
|---|
| • Coolant leaks |
| • Oil leaks |
| • Fuel leaks |
| • Component visibly damaged or worn |
| • Nut or bolt loose, or lost |

# Symptom Chart

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine misfire | • Electronic control system<br>• Fuel system<br>• Ignition system<br>• Mechanical system<br>- Combustion chamber carbon deposit<br>- Intake and exhaust camshaft<br>- Intake and exhaust valve<br>- Piston<br>- Piston ring<br>- Cylinder<br>- Inadequate intake air<br>- Exhaust air blockage | • Engine misfire is a synthetical malfunction.<br>**Refer to: DTC Diagnosis Procedure Index (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).** |
| Abnormal noise in lower part of engine | • Deformed oil pan<br>• Deformed or damaged oil strainer<br>• Low engine oil pressure<br>• Excessive matching clearance between crankshaft and bearing<br>• Excessive crankshaft thrust clearance | • Perform diagnosis for abnormal noise in lower part of engine |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Noise from drive belt | • Accessory drive belt<br>• Related fastener<br>• Tensioner pulley<br>• Tensioner<br>• Idler gear<br>• Crankshaft belt pulley<br>• Related accessory pulley<br>• Related accessory pulley bearing<br>• Alternator<br>• Water pump<br>• A/C compressor | • Perform diagnosis for noise from drive belt |
| Engine backfire<br>**CAUTION: A serious noise of blasting occurs when the fuel in intake manifold is set on fire.** | • Electronic control system malfunction<br>• Engine timing<br>• Lean gas mixture<br>• Intake valve set<br>• Exhaust system blocking<br>• Engine control module | • Perform diagnosis for engine backfire |
| Engine knock<br>**CAUTION: A serious noise of blasting occurs when the fuel in exhaust system is set on fire.** | • Electronic control system malfunction<br>• Engine timing<br>• Late ignition<br>• Rich gas mixture<br>• Exhaust valve set<br>• Exhaust system leak(s)<br>• Engine control module | • Perform diagnosis for engine knock |
| Abnormal exhaust (white smoke) | • Coolant enters combustion chamber | • Perform diagnosis for coolant entering combustion chamber |
| Abnormal exhaust (blue smoke) | • Engine oil burning | • Perform diagnosis for abnormal exhaust (blue smoke) |
| Abnormal exhaust (black smoke) | • Rich gas mixture | • Perform diagnosis for abnormal exhaust (black smoke) |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine knock at cold state occurs and continues for 2 or 3 minutes or increases as engine torque increases | • Electronic control system malfunction | Refer to: DTC Diagnosis Procedure Index (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing). |
| | • Low engine oil viscosity | • Fill engine oil with viscosity meeting the season requirement. |
| | • Excessive clearance between piston and cylinder wall | Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly). |
| | • Alignment of connecting rod (end gap, bend, distortion) | |
| | • Excessive piston pin clearance | |
| Engine knock during idle or engine warm-up | • Electronic control system malfunction | Refer to: DTC Diagnosis Procedure Index (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing). |
| | • Low engine oil viscosity | • Fill engine oil with viscosity meeting the season requirement. |
| | • Fuel quality | • Fuel 93 # and above must be used. |
| | • Engine timing | Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection). |
| | • Excessive clearance between piston and cylinder wall | Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly). |
| | • Alignment of connecting rod (end gap, bend, distortion) | |
| | • Excessive piston pin clearance | |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Main bearing noise<br>**CAUTION: Remove the accessory drive belt to eliminate the noise caused due to accessory device. Determine the position of noise through a stethoscope.**<br>**CAUTION: Main bearing noise can be heard when the engine gets loaded. The noise is loud and toneless, and increases as the load increases.**<br>**CAUTION: Knocking noise is regular and changes with the engine speed.**<br>**CAUTION: Low engine oil pressure occurs with such case.**<br>**CAUTION: Knocking noise from bearing will be heard if there is no or little engine oil on the bearing.** | • Low oil pump pressure | **Refer to: Oil Pressure Inspection (3.1.3 Lubrication System, General Inspection).** |
| | • Excessive crankshaft thrust clearance | **Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).** |
| | • Crankshaft journal out-of-round | |
| | • Excessive clearance between crankshaft and bearing | |
| Noise from connecting rod and rod bearing | • Low oil pump pressure | **Refer to: Diagnosis Procedure for Noise from Connecting Rod and Rod Bearing (3.1.2 Mechanical System, Symptom Diagnosis and Testing).** |
| | • Connecting rod large end side clearance beyonds limit | |
| | • Tightening torque of connecting rod bolt | |
| | • Connecting rod distortion / bend beyonds limit | |
| | • Connecting rod journal out-of-round and taper beyond limit | |
| | • Connecting rod bearing clearance beyonds limit | |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Piston and piston pin noise | • Low oil pump pressure | Refer to: Diagnosis Procedure for Piston and Piston Pin Noise (3.1.2 Mechanical System, Symptom Diagnosis and Testing). |
| | • Incorrect installation of connecting rod and piston | |
| | • Connecting rod distortion / bend beyonds limit | |
| | • Excessive piston pin clearance | |
| | • Excessive clearance between piston and cylinder wall | |
| | • Excessive piston ring groove clearance | |
| Valve train noise | • Excessive valve clearance | Refer to: Diagnosis Procedure for Valve Train Noise (3.1.2 Mechanical System, Symptom Diagnosis and Testing). |
| | • Low oil pump pressure | |
| | • Damaged cam lobe | |
| | • Excessive camshaft journal clearance | |
| | • Excessive camshaft thrust clearance | |
| | • Valve spring too soft | |
| | • Seized valve(s) | |
| | • Excessive clearance between valve stem and valve guide | |
| | • Valve seat loose | |
| Engine cannot start - crankshaft cannot turn | • Accessory drive system components seized | Refer to: Diagnosis Procedure for Engine not Starting - Crankshaft not Turning (3.1.2 Mechanical System, Symptom Diagnosis and Testing). |
| | • Cylinder seized due to hydraulic pressure | |
| | • Seized or cracked camshaft | |
| | • Seized or cracked valve system components | |
| | • Foreign matters in the cylinder(s) | |
| | • Seized crankshaft or connecting rod bearing | |
| | • Bent or cracked connecting rod | |
| | • Cracked crankshaft | |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Coolant enters combustion chamber<br>**CAUTION: White smoke or coolant-flavor gas, which exceeds the acceptable range, are exhausted from the exhaust pipe**<br>**CAUTION: Spark plug is dipped with coolant when removing it.** | • Engine overheating<br>- Low coolant level<br>- Inoperative cooling fan<br>- Thermostat fault | **Refer to: Symptom Chart (3.1.4 Cooling System, Symptom Diagnosis and Testing).** |
| | • Cylinder head gasket fault | • Replace cylinder head gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).** |
| | • Warped cylinder head | • Replace cylinder head and gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).** |
| | • Cracked cylinder head | • Replace cylinder head and gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Coolant enters combustion chamber<br>**CAUTION: White smoke or coolant-flavor gas, which exceeds the acceptable range, are exhausted from the exhaust pipe**<br>**CAUTION: Spark plug is dipped with coolant when removing it.** | • Cracked cylinder liner or cylinder block | • Replace cylinder liner or cylinder block.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).** |
| | • Pore on the cylinder head or cylinder block | • Replace cylinder head or cylinder block.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).** |
| Coolant enters engine oil<br>**CAUTION: Oil is foamed or discolored.**<br>**CAUTION: Engine oil is "excessive".** | • Engine overheating<br>- Low coolant level<br>- Inoperative cooling fan<br>- Thermostat fault | **Refer to: Symptom Chart (3.1.4 Cooling System, Symptom Diagnosis and Testing).** |
| | • Cylinder head gasket fault | • Replace cylinder head gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).** |
| | • Warped cylinder head | • Replace cylinder head and gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).** |

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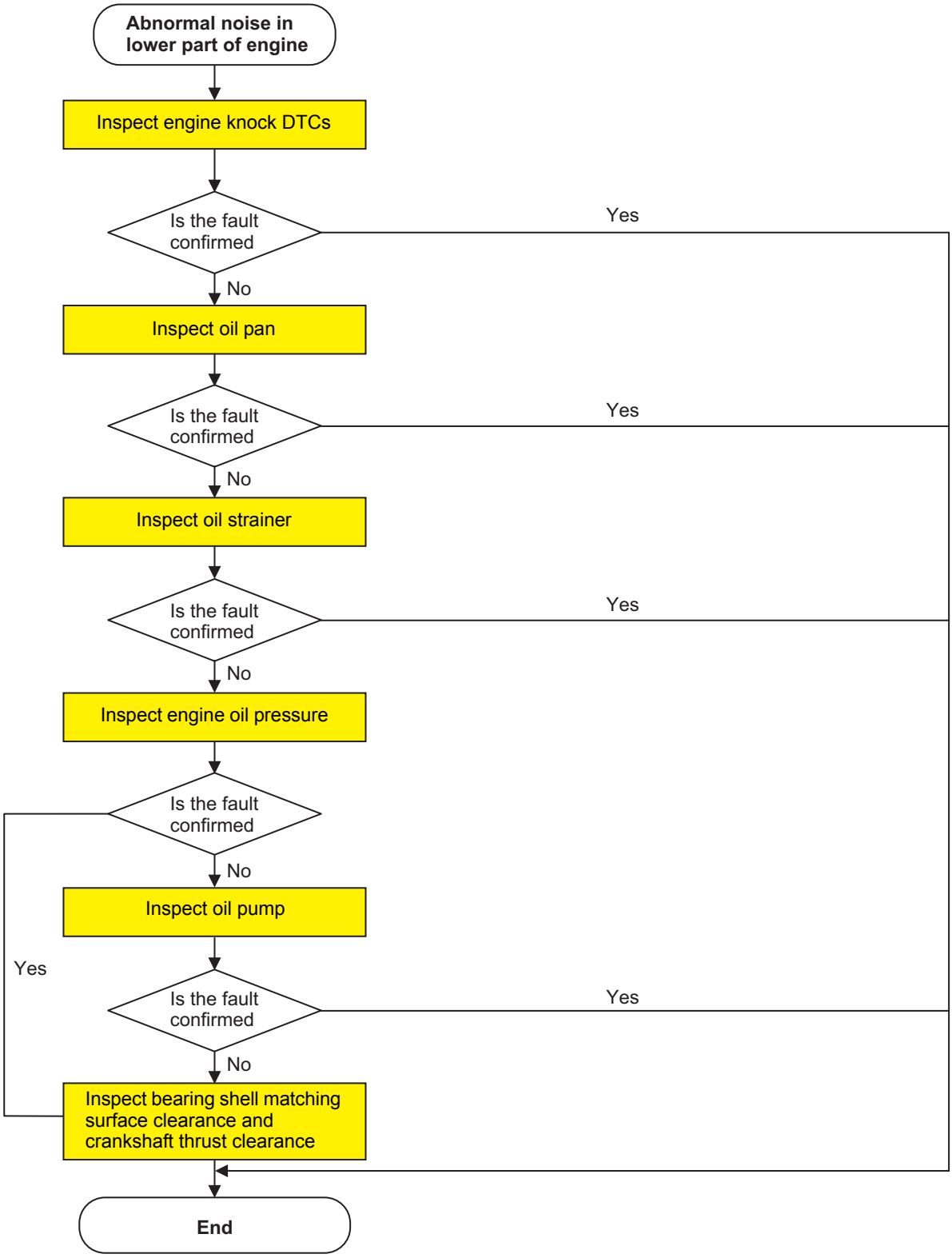


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Coolant enters engine oil<br>**CAUTION: Oil is foamed or discolored.**<br>**CAUTION: Engine oil is "excessive".** | • Cracked cylinder head | • Replace cylinder head and gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).** |
| | • Cracked cylinder liner or cylinder block | • Replace cylinder block.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).** |
| | • Pore on the cylinder head or cylinder block | • Replace cylinder head or cylinder block.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).** |

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# Diagnosis Procedure for Abnormal Noise in Lower Part of Engine



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**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: Remove the accessory drive belt to eliminate the noise caused by these devices.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect engine knock DTCs | |
| | A. Using a diagnostic tool, inspect for knock DTCs.<br>Is there any engine knock?<br>**Yes**<br>**Refer to: DTC P0327, P0328 (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect oil pan | |
| | A. Inspect the oil pan.<br>Is it deformed?<br>**Yes**<br>Go to step 3 after repair or replacement.<br>**No**<br>Go to step 4. |
| 3. Inspect oil strainer | |
| | A. Inspect the oil strainer for deformation or damage?<br>Is it deformed or damaged?<br>**Yes**<br>Repair or replace.<br>**No**<br>Go to step 4. |
| 4. Inspect engine oil pressure | |
| | A. Inspect the engine oil pressure.<br>**Refer to: Oil Pressure Inspection (3.1.3 Lubrication System, General Inspection).**<br>Is the pressure too low?<br>**No**<br>Go to step 6.<br>**Yes**<br>Go to step 5. |

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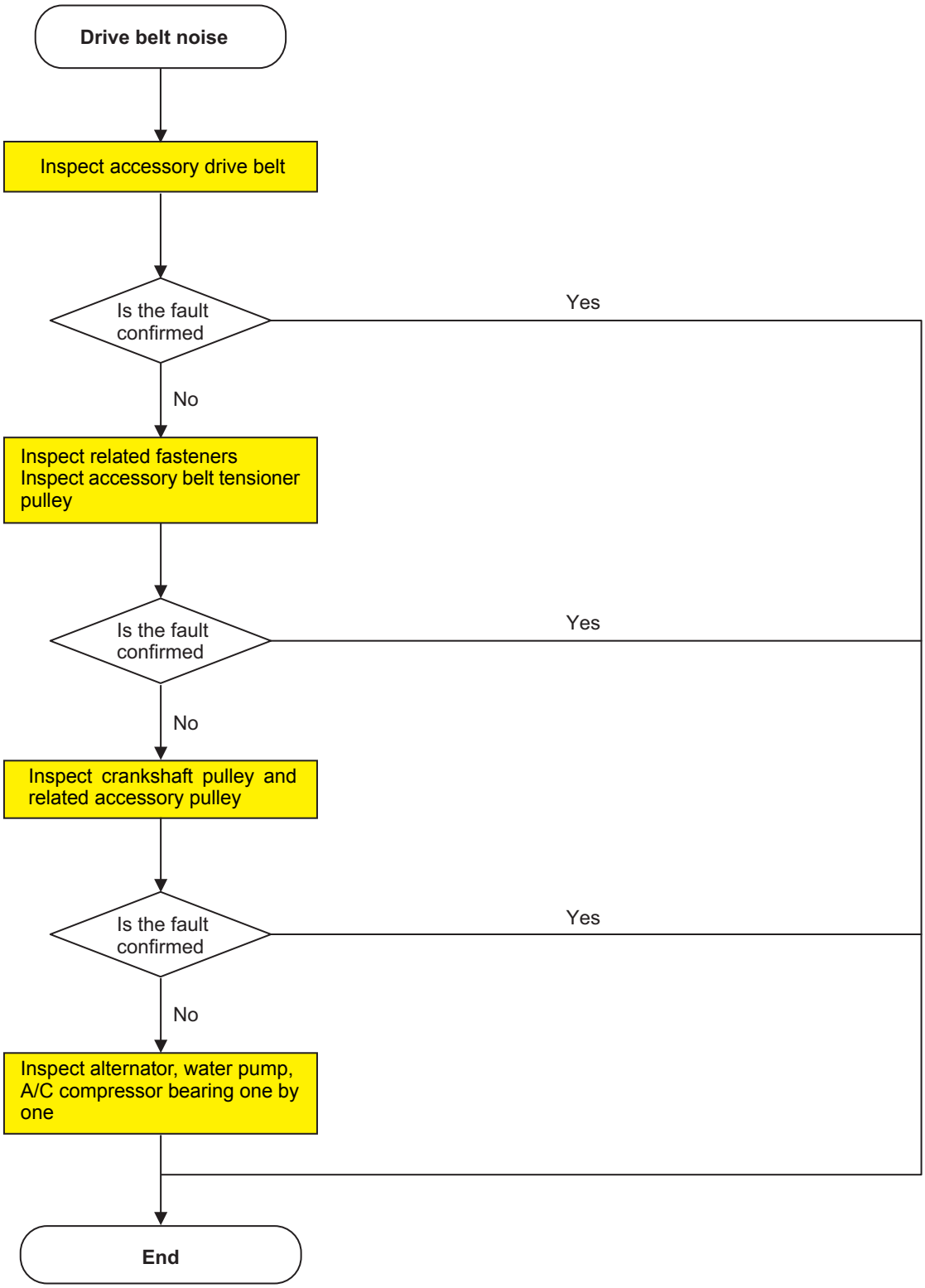


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect oil pump | |
| | A. Remove the oil pump.<br>**Refer to: Oil Pump (3.1.3 Lubrication System, Removal and Installation).**<br>B. Inspect the oil pump.<br>Is it normal?<br>**No**<br>Replace the oil pump.<br>**Yes**<br>Go to step 6. |
| 6. Inspect bearing shell matching surface clearance and crankshaft thrust clearance | |
| | A. Disassemble the main bearing shell and connecting rod bearing shell.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).**<br>B. Inspect the matching clearance of engine main bearing shell and connecting rod bearing shell as well as the crankshaft thrust plate for any wear.<br>Are the matching clearance and crankshaft thrust clearance normal?<br>**No**<br>Adjust the matching clearance of engine main bearing shell and connecting rod bearing shell as well as the crankshaft thrust clearance to normal values.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>The system is normal. |

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# Diagnosis Procedure for Drive Belt Noise



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**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: A proper drive belt must be used.**

**CAUTION: Accessory drive belt consists of compressor belt and water pump belt.**

**CAUTION: Flatness (unevenness of crankshaft pulley and related accessory pulley) may cause the drive belt abnormal wear, noise and fall-off.**

**CAUTION: Suddenly-increased large load may cause the belt to slip and make noises, for example: when the compressor of air conditioning system starts and engine is running, throttle valve rapidly opens.**

**CAUTION: Heavy load may cause the belt abnormal noises, for example: excessive filling into the air conditioning system, clipped hoses of power steering system, excessive power steering fluid.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect accessory drive belt | |
| | A. Inspect the accessory drive belt.<br>**Refer to: Accessory Drive Belt Inspection (3.1.2 Mechanical System, General Inspection).** |
| 2. Inspect related fasteners | |
| | A. Inspect all the fasteners related to the drive belt for looseness or deformation.<br>Are they loosened or deformed?<br>**Yes**<br>Tighten or replace.<br>**No**<br>Go to step 3. |

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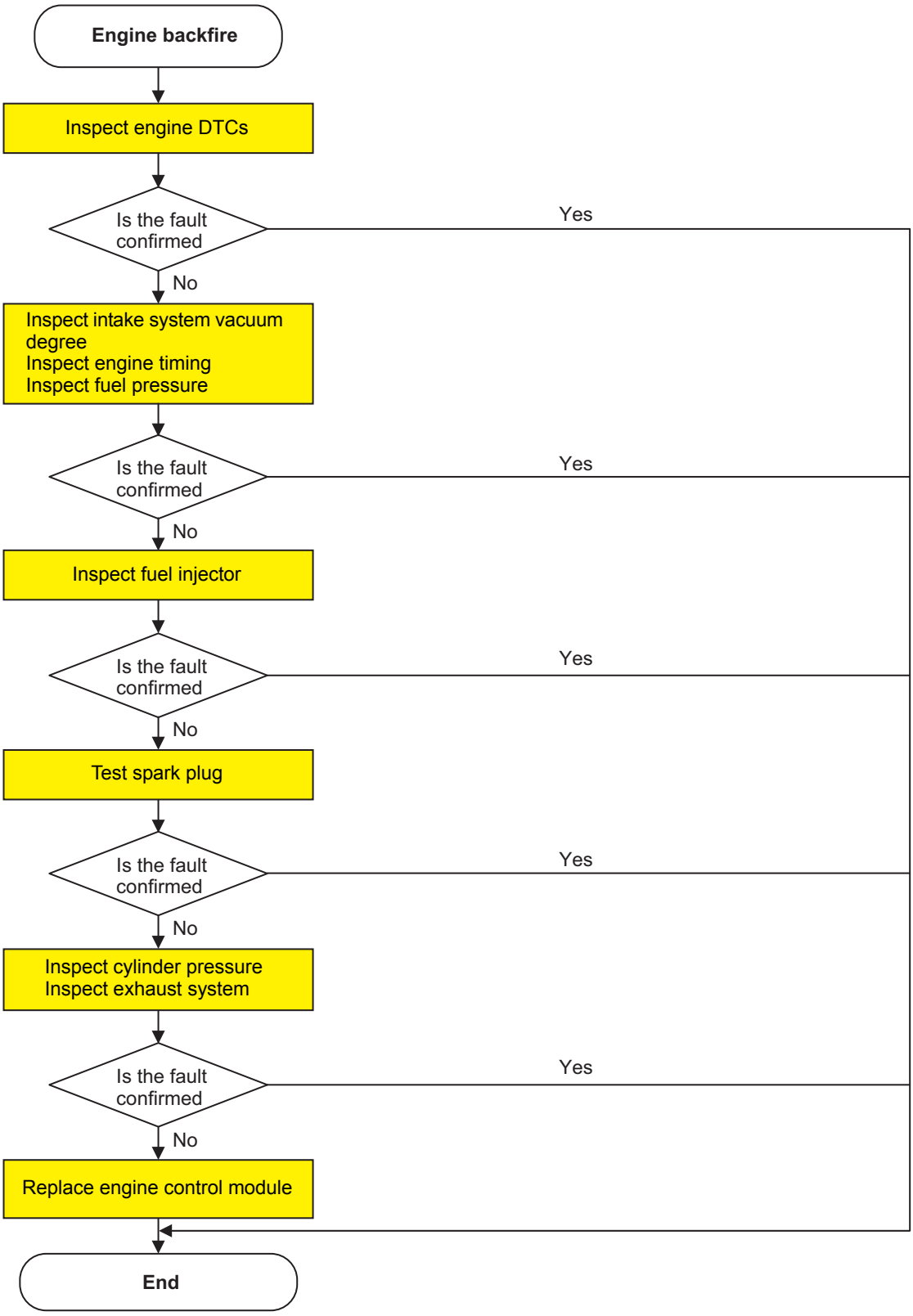


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect accessory belt tensioner pulley | |
| | A. Remove the accessory belt.<br>**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**<br>B. Seizure and looseness are not allowed for tensioner pulley bearing.<br>C. Abnormal noises are not allowed when turning the tensioner pulley bearing.<br>D. Misalignment, bend, distortion, cracks are not allowed for tensioner pulley.<br>E. Abnormal scratches, edges and corners are not allowed on the tensioner pulley surface.<br>Does it conform to above requirements?<br>**No**<br>Tighten or replace.<br>**Yes**<br>Go to step 4. |
| 4. Inspect crankshaft pulley and related accessory pulley | |
| | A. Misalignment, bend, distortion, cracks and looseness are not allowed for pulley.<br>B. Abnormal scratches, edges and corners are not allowed on the pulley surface.<br>C. Foreign matters are not allowed in the pulley groove.<br>Does it conform to above requirements?<br>**No**<br>Clear, tighten or replace.<br>**Yes**<br>Go to step 5. |
| 5. Inspect alternator, water pump, A/C compressor bearing one by one | |
| | A. Seizure and looseness are not allowed for bearing.<br>B. Abnormal noise is not allowed when rotating the bearing.<br>Does it conform to above requirements?<br>**No**<br>Tighten or replace.<br>**Yes**<br>The system is normal. |

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# Diagnosis Procedure for Engine Backfire



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect engine DTCs | |
| | A. Using a diagnostic tool, inspect the DTCs.<br>Are there any DTCs?<br>**Yes**<br>**Refer to: DTC Diagnosis Procedure Index (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect intake system vacuum degree | |
| | A. Inspect the intake system vacuum degree to judge the intake system for air leakage.<br>**Refer to: Vacuum Degree of Intake System Inspection (3.1.5 Air Intake System, General Inspection).**<br>Are there any leaks?<br>**Yes**<br>Repair.<br>**Refer to: Diagnosis Procedure for Intake Air Leak(s) (3.1.5 Air Intake System, Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Inspect engine timing | |
| | A. Inspect whether the engine timing is correct.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the system normal?<br>**No**<br>Repair.<br>**Yes**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuel pressure | |
| | A. Inspect whether the fuel pressure is too low.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the pressure too low?<br>**Yes**<br>Take the symptom actions.<br>**Refer to: Symptom Chart (3.1.7 Fuel System, Symptom Diagnosis and testing).**<br>**No**<br>Go to step 5. |
| 5. Inspect fuel injector | |
| | A. Inspect the fuel injector.<br>Is it blocked?<br>**Yes**<br>Clean or replace.<br>**No**<br>Go to step 6. |
| 6. Test spark plug | |
| | A. Inspect if the spark plug is within the specification.<br>**Refer to: Ignition Spark Test (3.1.8 Ignition System, General Inspection).**<br>Is it within the specification?<br>**No**<br>Clear or replace.<br>**Yes**<br>Go to step 7. |
| 7. Inspect cylinder pressure | |
| | A. Carry out the cylinder pressure inspection.<br>**Refer to: Cylinder Compression Pressure Inspection (3.1.2 Mechanical System, General Inspection).** |

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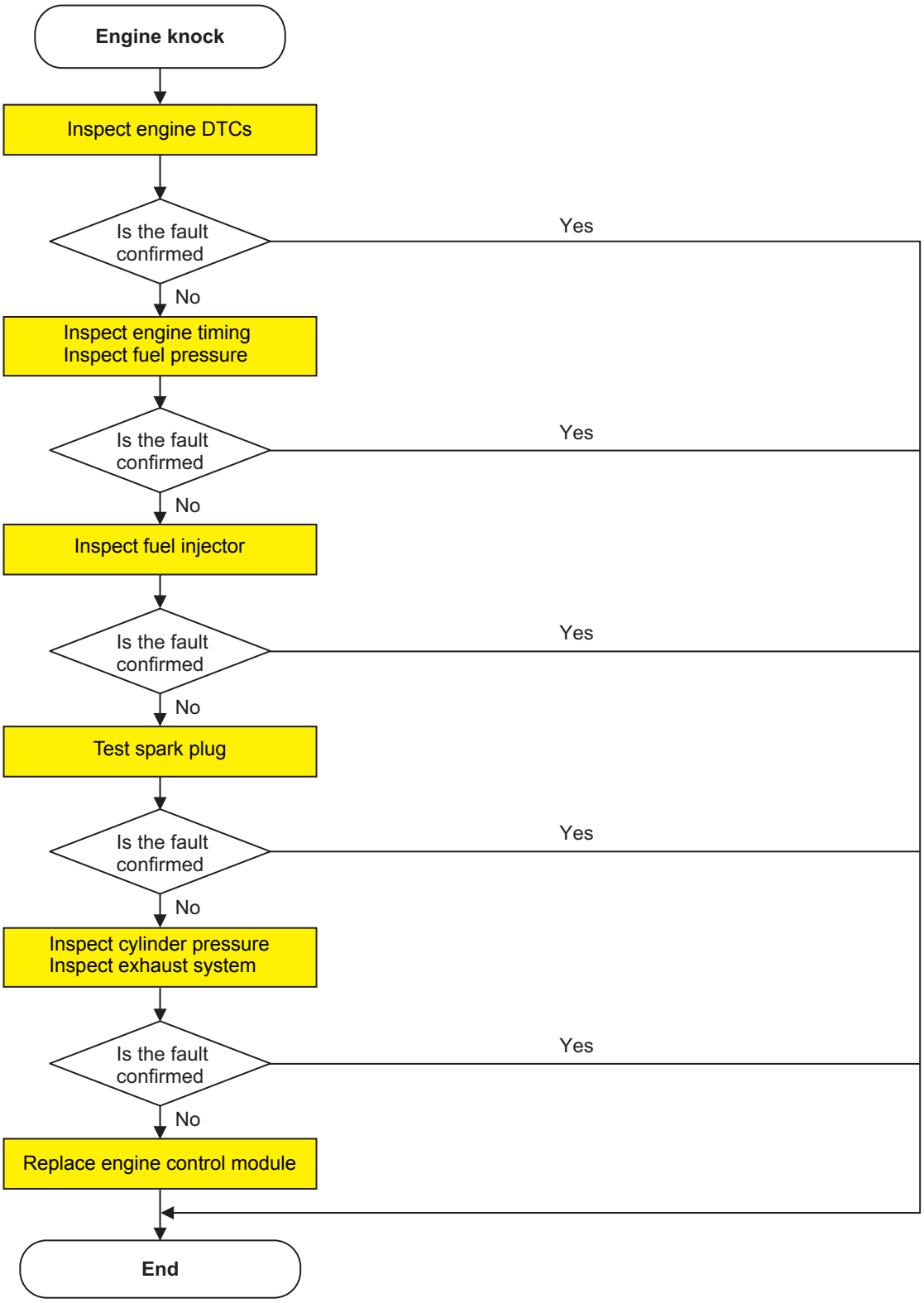


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect exhaust system | |
| | A. Carry out an exhaust backpressure test to inspect if the exhaust system has been blocked.<br>**Refer to: Exhaust Backpressure Test (3.1.6 Exhaust System, General Inspection).**<br>Is it blocked?<br>**Yes**<br>Carry out the diagnostic procedure for exhaust system blockage.<br>**Refer to: Diagnosis Procedure for Exhaust System Blockage (3.1.6 Exhaust System, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 9. |
| 9. Replace engine control module | |
| | A. Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>The system is normal. |

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# Diagnosis Procedure for Engine Knock



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect engine DTCs | |
| | A. Using a diagnostic tool, inspect the engine DTCs.<br>Are there any DTCs?<br>**Yes**<br>**Refer to: DTC Diagnosis Procedure Index (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect engine timing | |
| | A. Inspect the engine timing.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the timing normal?<br>**No**<br>Repair.<br>**Yes**<br>Go to step 3. |
| 3. Inspect fuel pressure | |
| | A. Inspect the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the pressure too high?<br>**Yes**<br>Repair the fuel line that is blocked.<br>**Yes**<br>Go to step 4. |
| 4. Inspect fuel injector | |
| | A. Inspect the fuel injector for leakage.<br>Are there any leaks?<br>**Yes**<br>Replace.<br>**No**<br>Go to step 5. |

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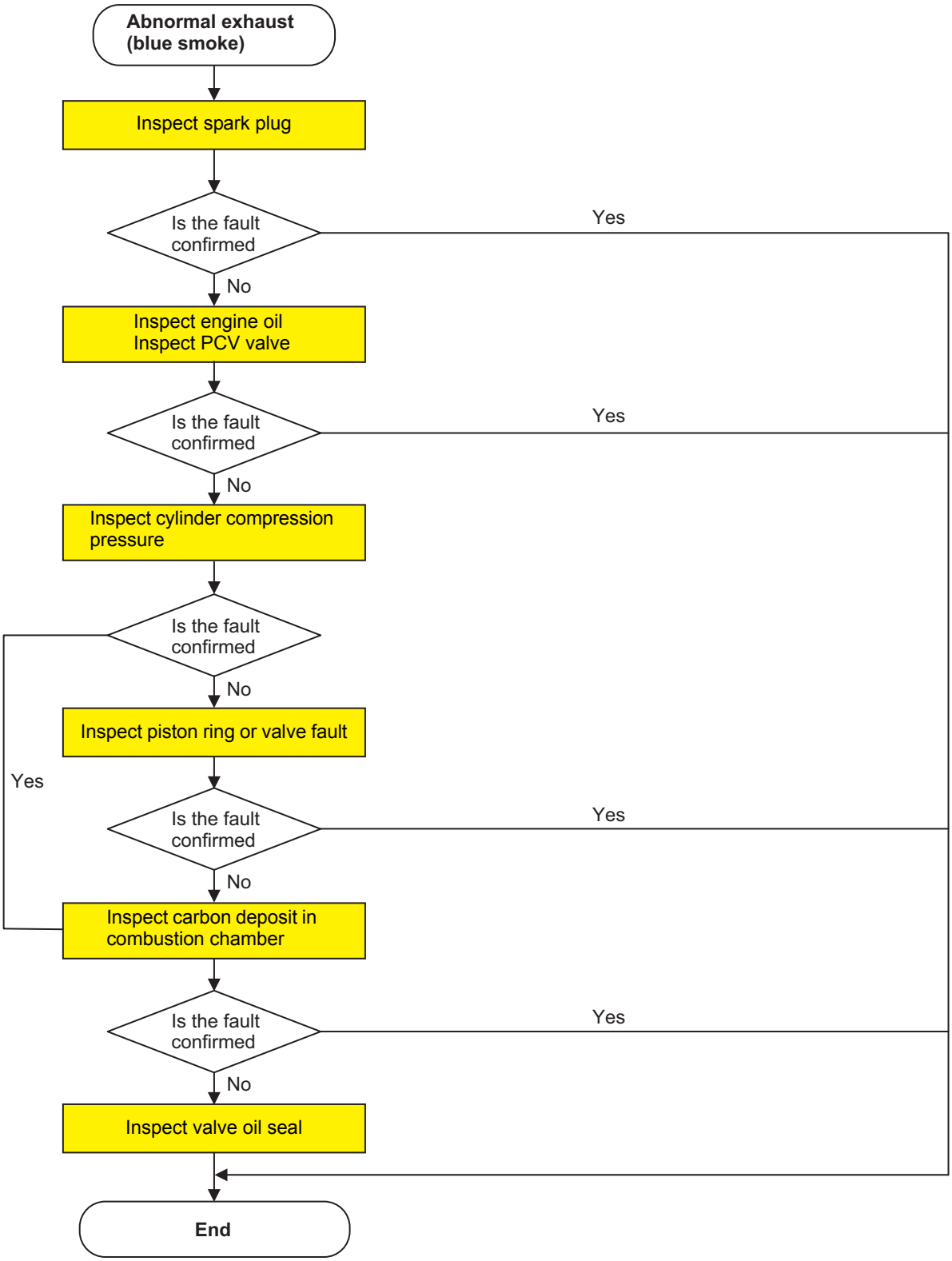


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Test spark plug | |
| | A. Inspect if the spark plug is within the specification.<br>**Refer to: Ignition Spark Test (3.1.8 Ignition System, General Inspection).**<br>Is it within the specification?<br>**No**<br>Clear or replace.<br>**Yes**<br>Go to step 6. |
| 6. Inspect cylinder pressure | |
| | A. Carry out the cylinder pressure inspection.<br>**Refer to: Cylinder Compression Pressure Inspection (3.1.2 Mechanical System, General Inspection).** |
| 7. Inspect exhaust system | |
| | A. Carry out an exhaust backpressure test.<br>**Refer to: Exhaust Backpressure Test (3.1.6 Exhaust System, General Inspection).**<br>Is the exhaust system leaking?<br>**Yes**<br>Carry out the diagnosis procedure for exhaust system leakage and noise.<br>**Refer to: Symptom Chart (3.1.6 Exhaust System, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 8. |
| 8. Replace engine control module | |
| | A. Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>The system is normal. |

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# Diagnosis Procedure for Abnormal Exhaust (Blue Smoke)



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**CAUTION: Usually, it is accompanied with spark plug carbon deposit.**

**CAUTION: Use engine oil meeting the specification.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect spark plug | |
| | A. Inspect the spark plug.<br>Is there any carbon deposit?<br>**Yes**<br>Clean or replace.<br>**No**<br>Go to step 2. |
| 2. Inspect engine oil | |
| | A. Inspect the engine oil level.<br>Is the level too high?<br>**Yes**<br>Return to normal level.<br>**No**<br>Go to step 3. |
| 3. Inspect PCV valve | |
| | A. Inspect the PCV valve.<br>Is it normal?<br>**No**<br>Replace the PCV valve.<br>**Yes**<br>Go to step 4. |
| 4. Inspect cylinder compression pressure | |
| | A. Inspect the cylinder compression pressure.<br>**Refer to: Cylinder Compression Pressure Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is it lower than the specification?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 6. |

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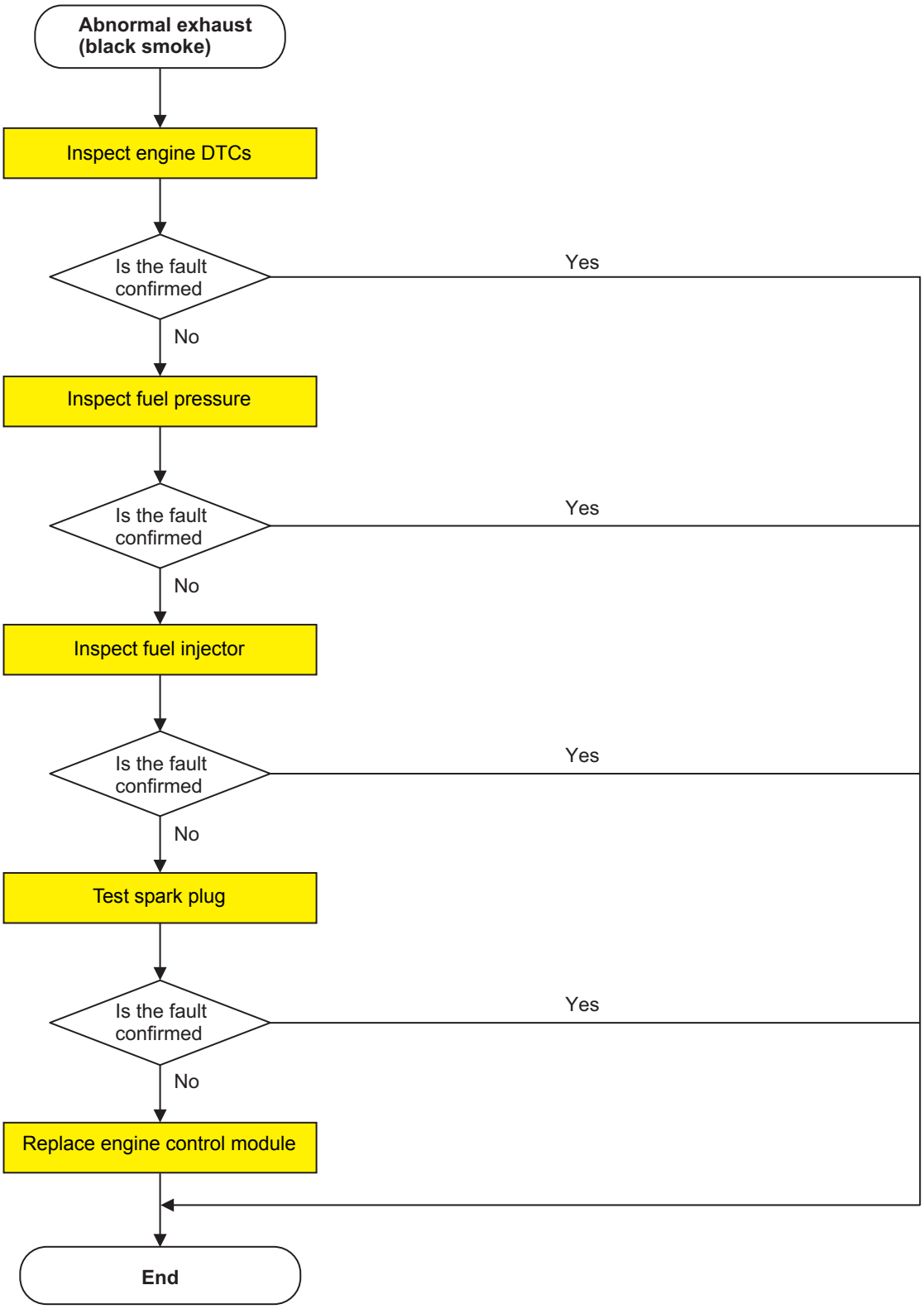


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect piston ring or valve fault | |
| | A. Add an appropriate amount of engine oil to the cylinder block.<br>**Pressure increases remarkably and inspect the piston ring.**<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Pressure increases a little and inspect the valve.**<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).** |
| 6. Inspect carbon deposit in combustion chamber | |
| | A. Inspect the combustion chamber.<br>Is there any carbon deposit?<br>**Yes**<br>Clean.<br>**No**<br>Go to step 7. |
| 7. Inspect valve oil seal | |
| | A. Inspect the valve oil seal.<br>Are there any leaks?<br>**Yes**<br>Replace.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>The system is normal. |

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# Diagnosis Procedure for Abnormal Exhaust (Black Smoke)



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect engine DTCs | |
| | A. Using a diagnostic tool, inspect the engine DTCs.<br>Are there any DTCs?<br>**Yes**<br>**Refer to: DTC Diagnosis Procedure Index (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect fuel pressure | |
| | A. Inspect the fuel pressure.<br>Is the pressure too high?<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>**Yes**<br>Repair the fuel line that is blocked.<br>**Yes**<br>Go to step 3. |
| 3. Inspect fuel injector | |
| | A. Inspect the fuel injector.<br>Are there any leaks?<br>**Yes**<br>Replace.<br>**No**<br>Go to step 4. |
| 4. Test spark plug | |
| | A. Inspect if the spark plug is within the specification.<br>**Refer to: Ignition Spark Test (3.1.8 Ignition System, General Inspection).**<br>Is it within the specification?<br>**No**<br>Clear or replace.<br>**Yes**<br>Go to step 5. |

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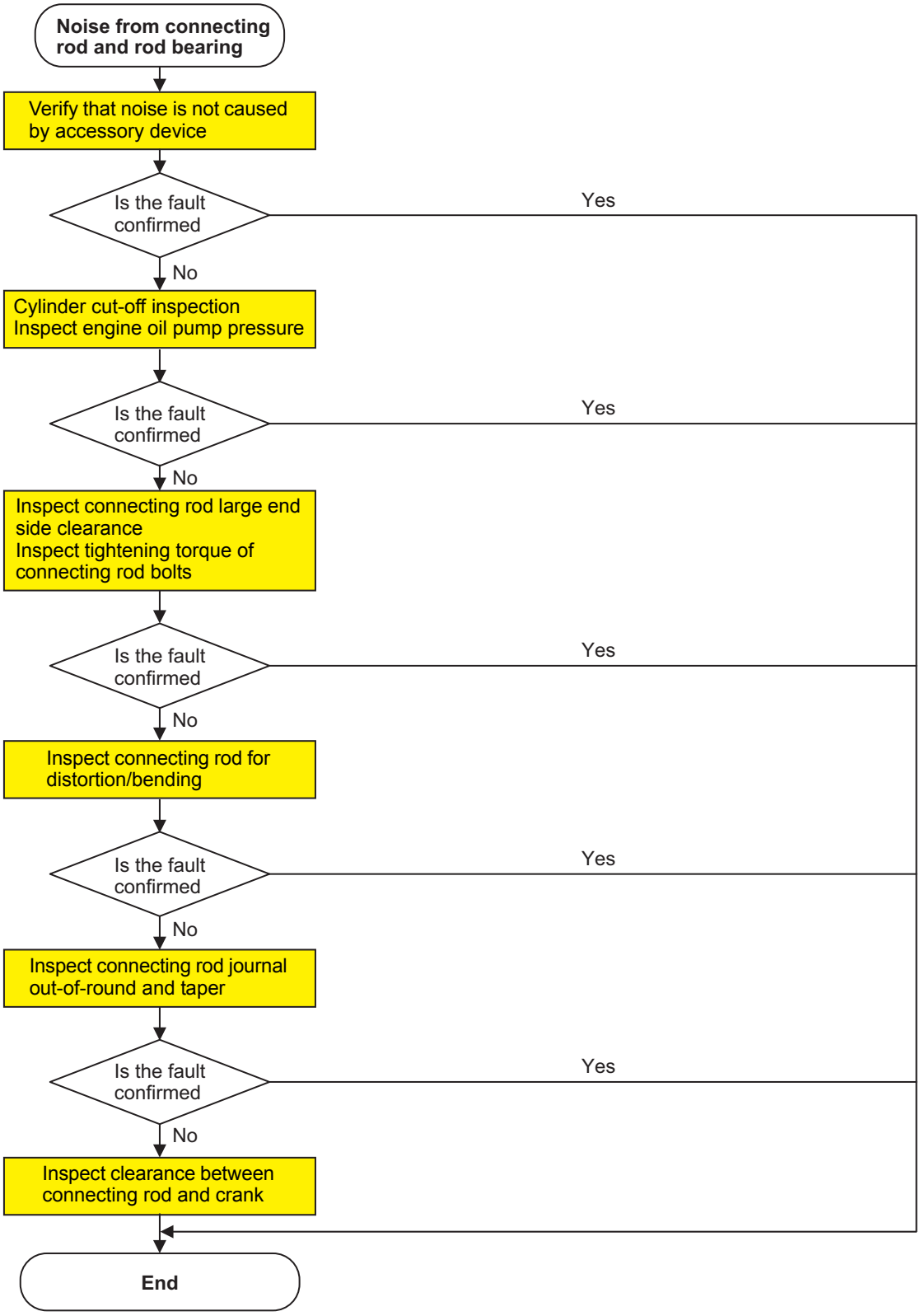


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Replace engine control module | |
| | A. Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>The system is normal. |

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# Diagnosis Procedure for Noise from Connecting Rod and Rod Bearing



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**CAUTION: Remove the accessory drive belt and have a strict limit to the engine running time. Otherwise, the engine may reach high temperature and be damaged.**

**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: Remove the accessory drive belt to eliminate the noise caused by these devices.**

**CAUTION: Such noise sometimes can be isolated by removing one fuel injector wiring harness connector at a time. If the noise volume decreases or disappears, such noise is related to the cylinder, from which the connector is just cut off.**

**CAUTION: Excessive connecting rod clearance can lead to knock noises at each engine speed. Low engine oil pressure also results in such case.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify that noise is not caused by accessory device | |
| | A. Remove the accessory drive belt.<br>**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**<br>Does the noise exist?<br>**No**<br>Noise is caused by the accessory and replace the accessory drive belt.<br>**Yes**<br>Go to step 2. |
| 2. Cylinder cut-off inspection | |
| | A. Carry out the cylinder cut-off test by removing the fuel injector wiring harness connectors to verify which cylinder is related to the noise. |
| 3. Inspect engine oil pump pressure | |
| | A. Inspect the engine oil pump pressure.<br>**Refer to: Oil Pressure Inspection (3.1.3 Lubrication System, General Inspection).**<br>Is oil pump pressure too low?<br>**Yes**<br>Repair.<br>**Refer to: Symptom Chart (3.1.3 Lubrication System, Symptom Diagnosis and testing).**<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect connecting rod large end side clearance | |
| | A. Inspect the connecting rod large end side clearance.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Replace the connecting rod.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 5. |
| 5. Inspect tightening torque of connecting rod bolts | |
| | A. Inspect the tightening torque of connecting rod bolts.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Record the torques, and replace the bolts and nuts.<br>**Yes**<br>Go to step 6. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect connecting rod for distortion/bending | |
| | A. Inspect if the distortion/bending of connecting rod is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Replace the connecting rod.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 7. |
| 7. Inspect connecting rod journal out-of-round and taper | |
| | A. Inspect connecting rod journal out-of-round and taper<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair or replace crankshaft.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 8. |

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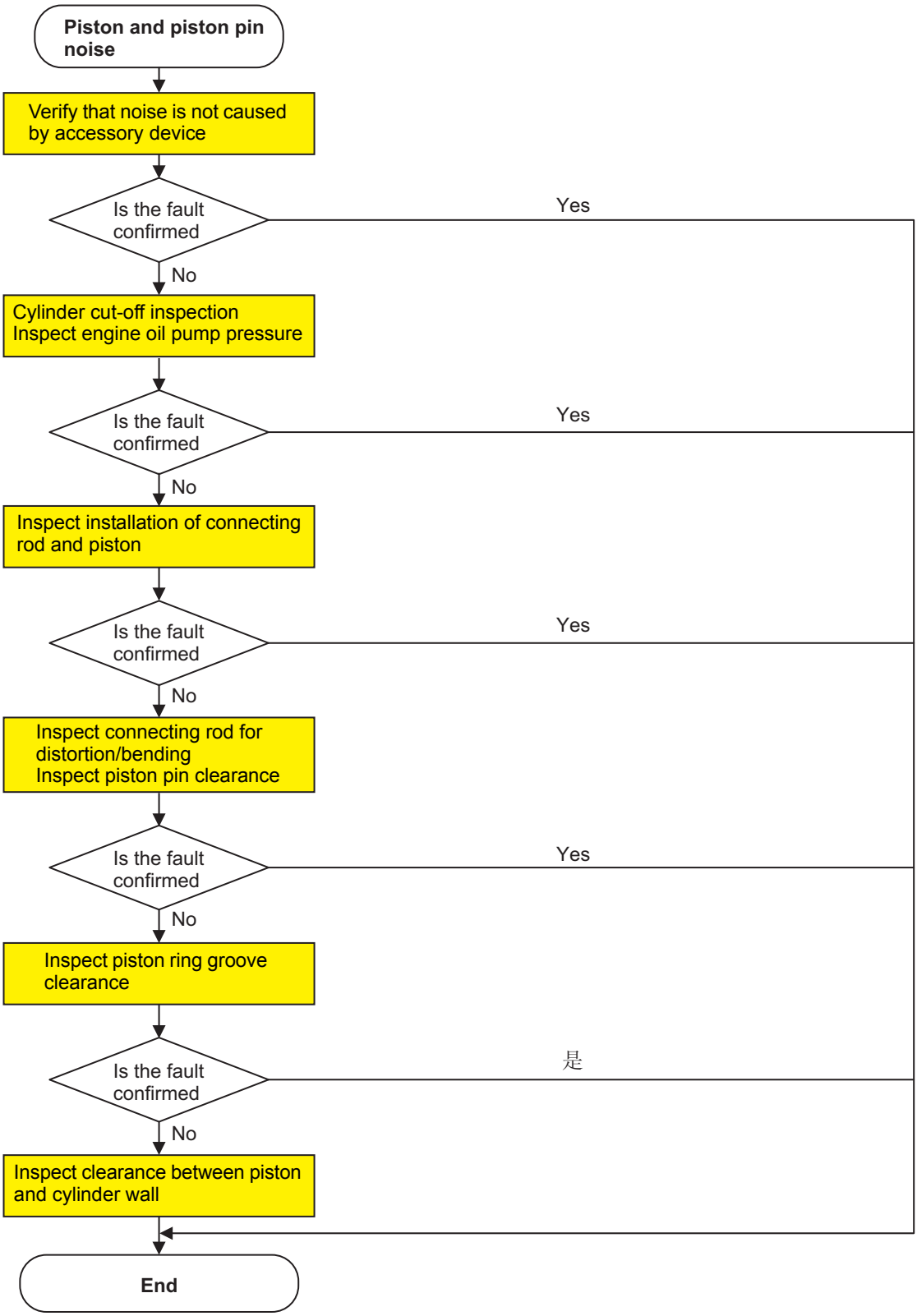


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect clearance between connecting rod and crank | |
| | A. Inspect the clearance between the connecting rod and crank.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair it to the specification.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>The system is normal. |

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# Diagnosis Procedure for Piston and Piston Pin Noise



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**CAUTION: Remove the accessory drive belt and strictly limit to the engine running time, otherwise, the engine may be damaged owing to high temperature.**

**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: Remove the accessory drive belt to eliminate the noise caused by these devices.**

**CAUTION: The knock noise caused by the excessive clearance between the piston and cylinder wall can usually be heard when the engine is running at idle speed. The knock noise will change obviously when the cylinder fuel injector wiring harness connector is removed.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify that noise is not caused by accessory device | |
| | A. Remove the accessory drive belt.<br>**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**<br>Does the noise exist?<br>**No**<br>Noise is caused by the accessory.<br>**Yes**<br>Go to step 2. |
| 2. Cylinder cut-off inspection | |
| | A. Carry out the cylinder cut-off test by removing the fuel injector wiring harness connectors to verify which cylinder is related to the noise. |
| 3. Inspect engine oil pump pressure | |
| | A. Inspect the engine oil pump pressure.<br>**Refer to: Oil Pressure Inspection (3.1.3 Lubrication System, General Inspection).**<br>Is oil pump pressure too low?<br>**Yes**<br>Repair.<br>**Refer to: Symptom Chart (3.1.3 Lubrication System, Symptom Diagnosis and testing).**<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect installation of connecting rod and piston | |
| | A. Inspect the installation positions of connecting rod and piston.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Reinstall.<br>**Yes**<br>Go to step 5. |
| 5. Inspect connecting rod for distortion/bending | |
| | A. Inspect if the distortion/bending of connecting rod is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Replace the connecting rod.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 6. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect piston pin clearance | |
| | A. Inspect if the piston pin clearance is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair it to the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 7. |
| 7. Inspect piston ring groove clearance | |
| | A. Inspect if the piston ring groove clearance is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair it to the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 8. |

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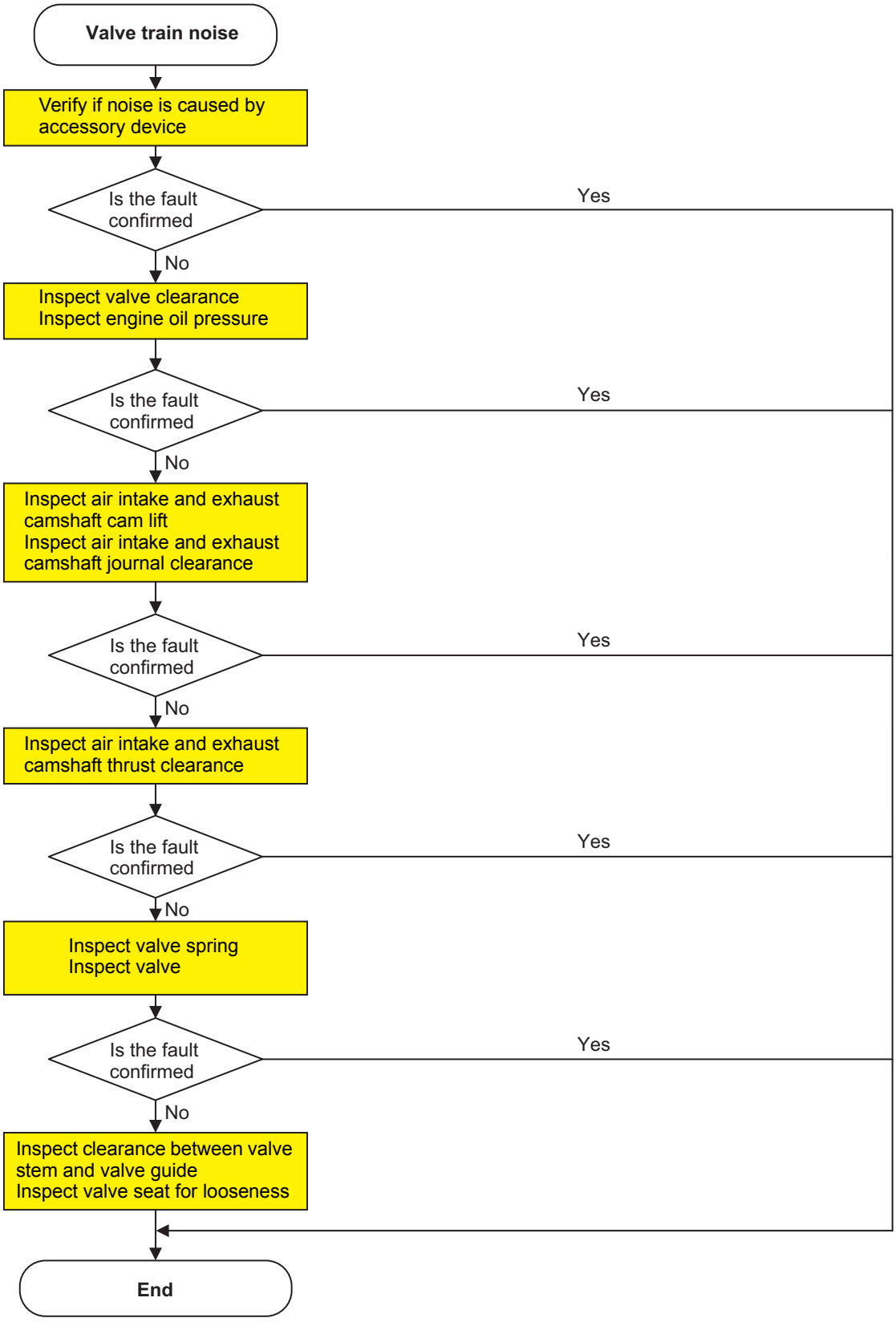


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect clearance between piston and cylinder wall | |
| | A. Inspect if the clearance between piston and cylinder wall is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair it to the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>The system is normal. |

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# Diagnosis Procedure for Valve Train Noise



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**CAUTION: Remove the accessory drive belt and have a strict limit to the engine running time. Otherwise, the engine may reach high temperature and be damaged.**

**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: Remove the accessory drive belt to eliminate the noise caused by these devices.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify if noise is caused by accessory device | |
| | A. Remove the accessory drive belt.<br>**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**<br>Does the noise exist?<br>**No**<br>Noise is caused by the accessory.<br>**Yes**<br>Go to step 2. |
| 2. Inspect valve clearance | |
| | A. Inspect if the valve clearance is within the specification.<br>**Refer to: Valve Clearance Inspection and Adjustment (3.1.2 Mechanical System, General Inspection).**<br>Is it within the specification?<br>**No**<br>Readjust to the specification.<br>**Refer to: Valve Clearance Inspection and Adjustment (3.1.2 Mechanical System, General Inspection).**<br>**Yes**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect engine oil pressure | |
| | A. Inspect the engine oil pump pressure.<br>**Refer to: Oil Pressure Inspection (3.1.3 Lubrication System, General Inspection).**<br>Is the pressure too low?<br>**Yes**<br>Repair.<br>**Refer to: Symptom Chart (3.1.3 Lubrication System, Symptom Diagnosis and testing).**<br>**No**<br>Go to step 4. |
| 4. Inspect air intake and exhaust camshaft cam lift | |
| | A. Inspect the air intake and exhaust camshaft cam lift.<br>**Refer to: Camshaft (3.1.2 Mechanical System, Removal and Installation).**<br>Is it within the specification?<br>**No**<br>Replace.<br>**Refer to: Camshaft (3.1.2 Mechanical System, Removal and Installation).**<br>**Yes**<br>Go to step 5. |
| 5. Inspect air intake and exhaust camshaft journal clearance | |
| | A. Inspect the air intake and exhaust camshaft journal clearance.<br>**Refer to: Camshaft (3.1.2 Mechanical System, Removal and Installation).**<br>Is it within the specification?<br>**No**<br>Repair.<br>**Refer to: Camshaft (3.1.2 Mechanical System, Removal and Installation).**<br>**Yes**<br>Go to step 6. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect air intake and exhaust camshaft thrust clearance | |
| | A. Inspect the air intake and exhaust camshaft thrust clearance.<br>**Refer to: Camshaft (3.1.2 Mechanical System, Removal and Installation).**<br>Is it within the specification?<br>**No**<br>Repair.<br>**Refer to: Camshaft (3.1.2 Mechanical System, Removal and Installation).**<br>**Yes**<br>Go to step 7. |
| 7. Inspect valve spring | |
| | A. Inspect if the valve spring is within the specification.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Replace.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 8. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect valve | |
| | A. Inspect if the valve is stuck.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it stuck?<br>**Yes**<br>Repair.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>Go to step 9. |
| 9. Inspect clearance between valve stem and valve guide | |
| | A. Inspect the clearance between valve stem and valve guide.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 10. |

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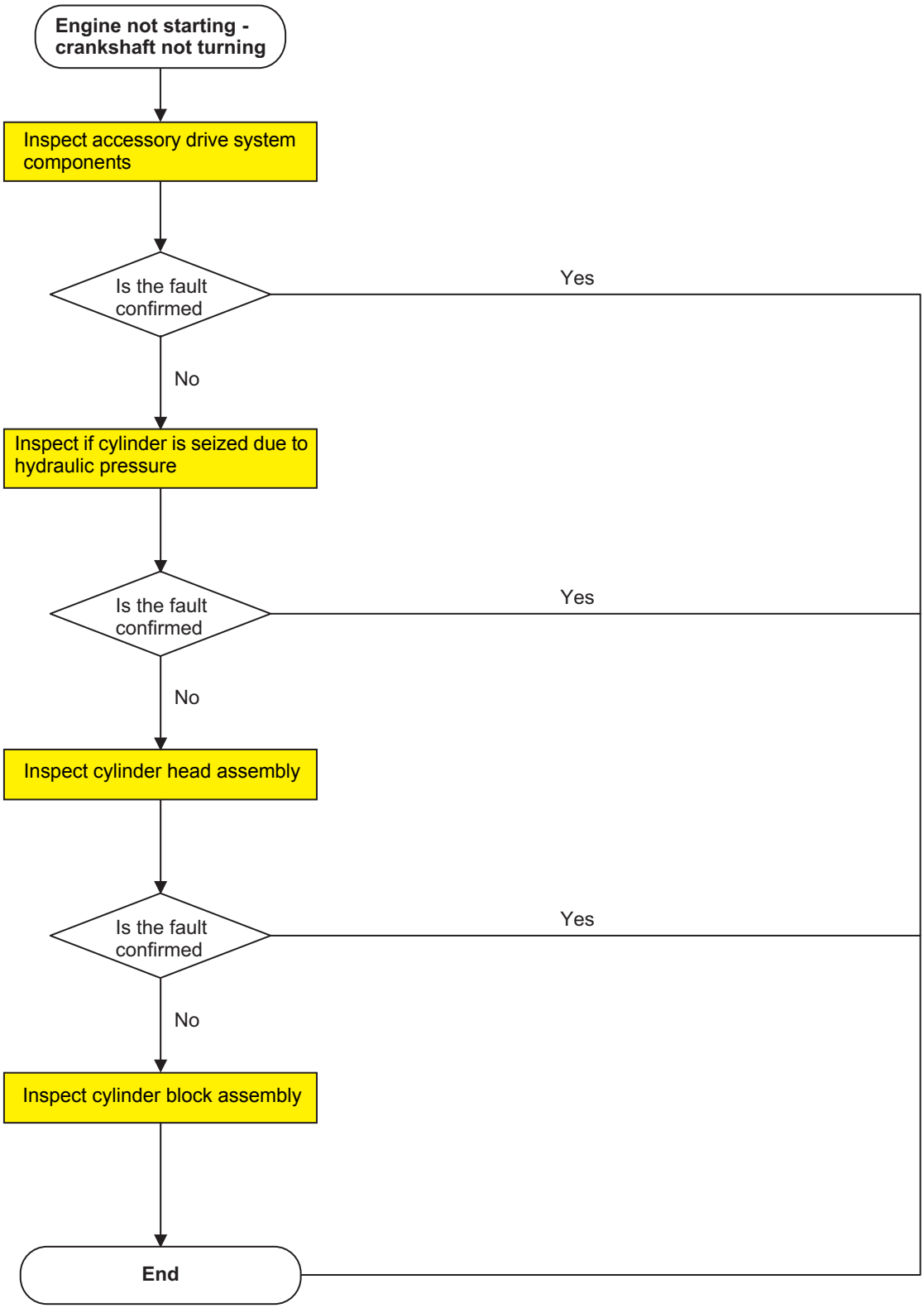


| Test Conditions | Details/Results/Actions |
|---|---|
| 10.Inspect valve seat for looseness | |
| | A. Inspect if the valve seat is loose.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**Yes**<br>Repair.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>The system is normal. |

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# Diagnosis Procedure for Engine not Starting - Crankshaft not Turning



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect accessory drive system components | |
| | A. Remove the accessory drive belt and try to rotate the crankshaft with a wrench.<br>**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**<br>Does the crankshaft rotate freely?<br>**Yes**<br>Repair or replace accessory drive system components.<br>**No**<br>Go to step 2. |
| 2. Inspect if cylinder is seized due to hydraulic pressure | |
| | A. Remove all the spark plugs and inspect if any water, engine oil or antifreeze is attached to them.<br>Is it within the specification?<br>**Yes**<br>Inspect the cylinder block, cylinder head and gasket for cracks. Repair if necessary.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect cylinder head assembly | |
| | A. Remove the timing belt.<br>**Refer to: Timing System (3.1.2 Mechanical System, Removal and Installation).**<br>B. Inspect the cylinder head.<br>**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**<br>• Seized or cracked camshaft<br>• Valve tappet severe seized<br>• Valve or valve spring stuck or broken<br>Do the conditions above exist?<br>**Yes**<br>Repair or replace.<br>**No**<br>Go to step 4. |
| 4. Inspect cylinder block assembly | |
| | A. Inspect the cylinder block assembly.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).**<br>• Cracked piston<br>• Foreign matters in the cylinder<br>• Cracked crankshaft<br>• Bent or cracked connecting rod<br>Do the conditions above exist?<br>**Yes**<br>Repair or replace.<br>**No**<br>The system is normal. |

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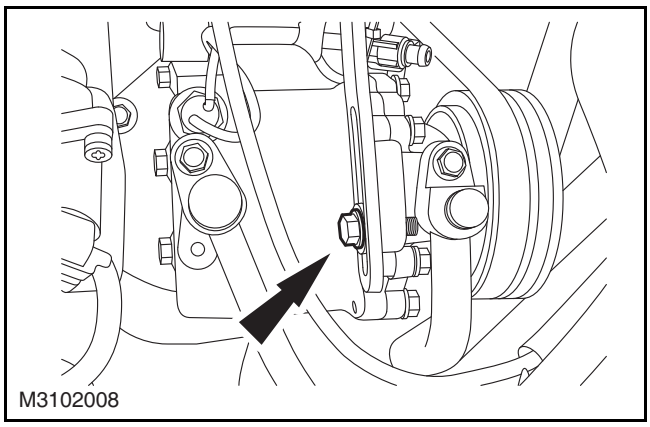
## Removal and Installation

# Accessory Drive Belt

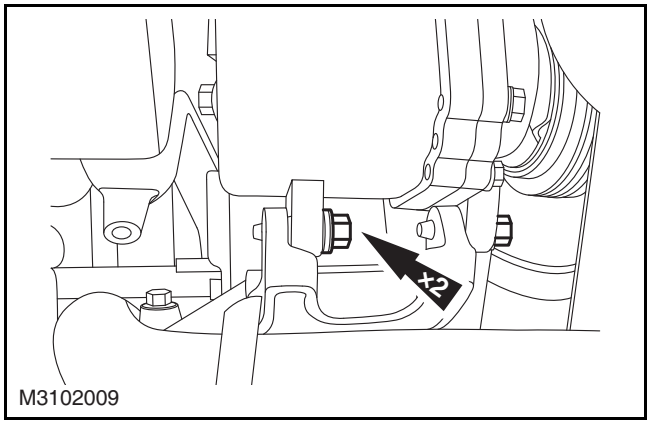
### Removal

**CAUTION: Accessory drive belt consists of compressor belt and alternator belt.**

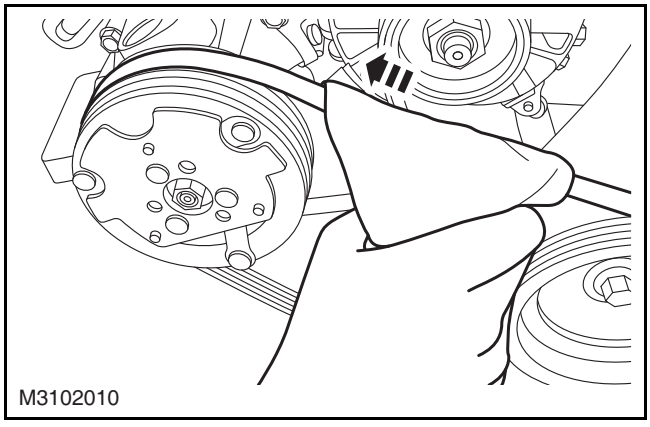
1. Fold the front passenger seat.
2. Loosen the compressor adjusting bolt.




3. Loosen 2 retaining bolts from the lower part of compressor.



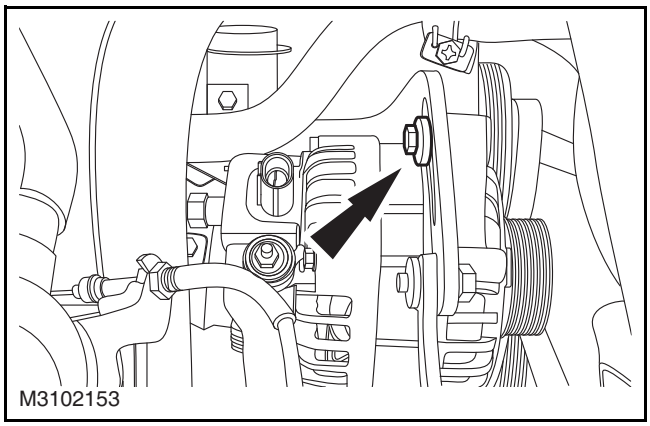

4. Turn the compressor belt to engine side until it can be removed.



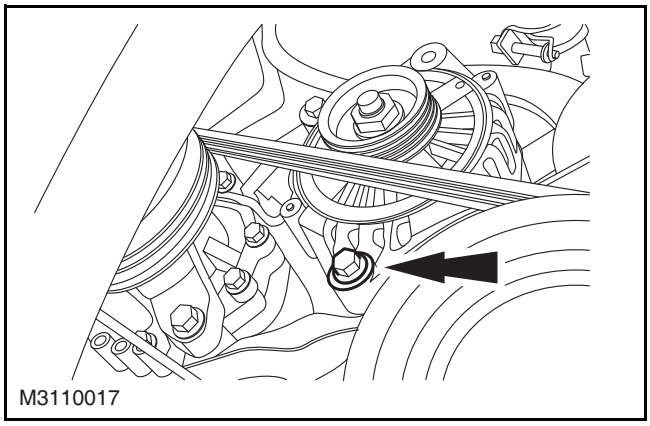
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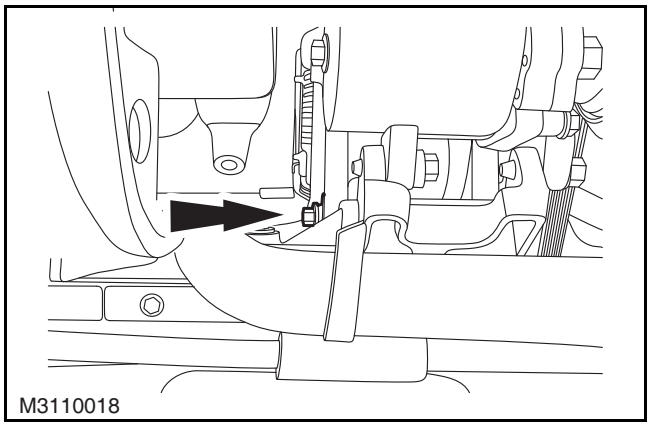


**5.** Loosen the alternator upper adjusting bolt.

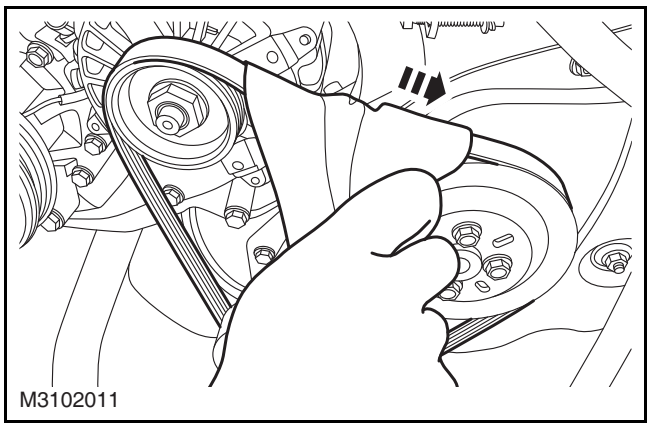

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**6.** Loosen 2 retaining bolts from the lower part of alternator.


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**7.** Turn the water pump pulley to engine side until the alternator belt can be removed.


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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect the accessory drive belt tension.**

**Refer to: Accessory Drive Belt Inspection (3.1.2 Mechanical System, General Inspection).**

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# Engine Assembly

## Removal

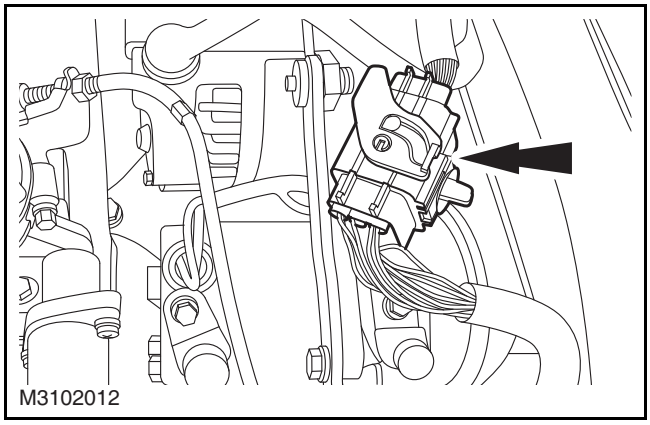
1. Release the fuel pressure.

   **Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**

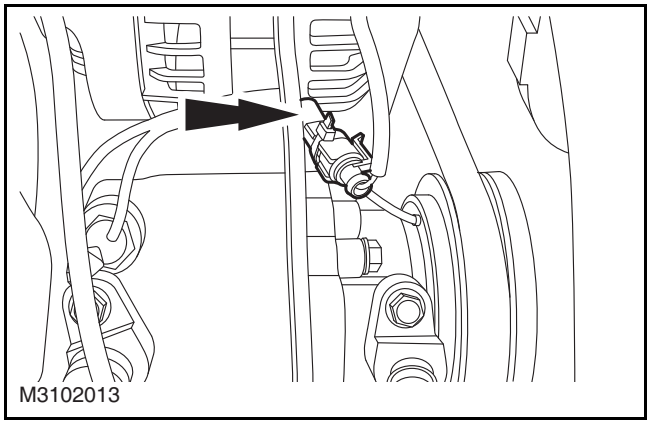
2. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

3. Disconnect the engine wiring harness connector.


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4. Disconnect the A/C compressor magnetic clutch wiring harness connector.

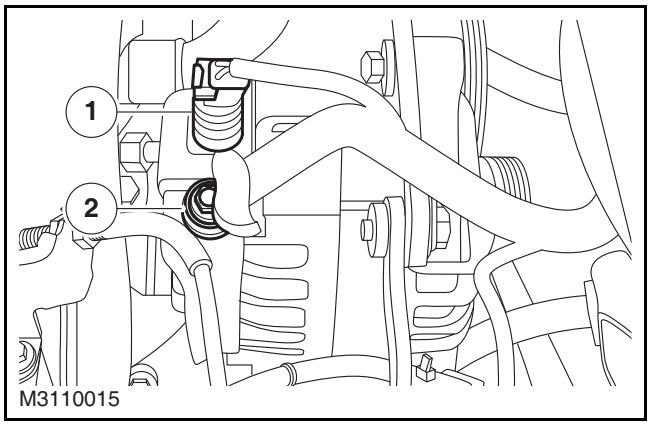

M3102013

5. Disconnect the alternator wiring harness.

   1 Disconnect the alternator regulator wiring harness connector (1).

   2 Remove the alternator charging cable retaining nut (2).

   Torque: 9.5 Nm

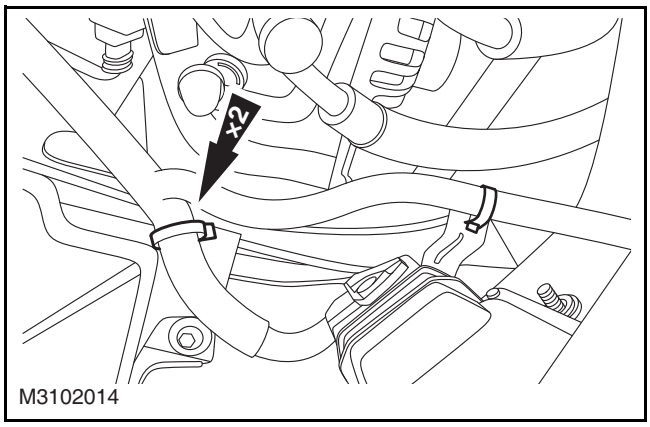


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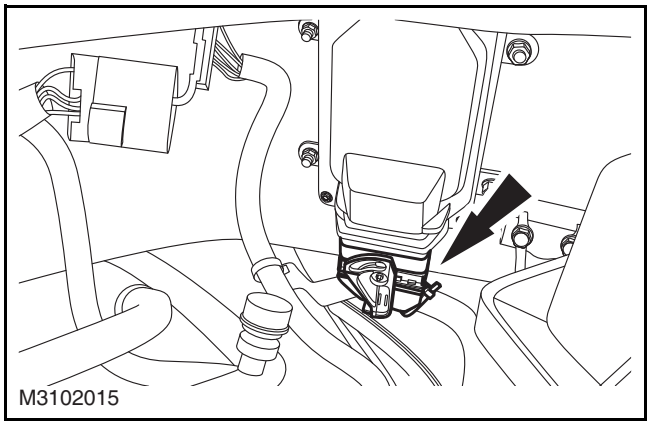
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**6.** Disengage 2 engine wiring harness retaining clamps.

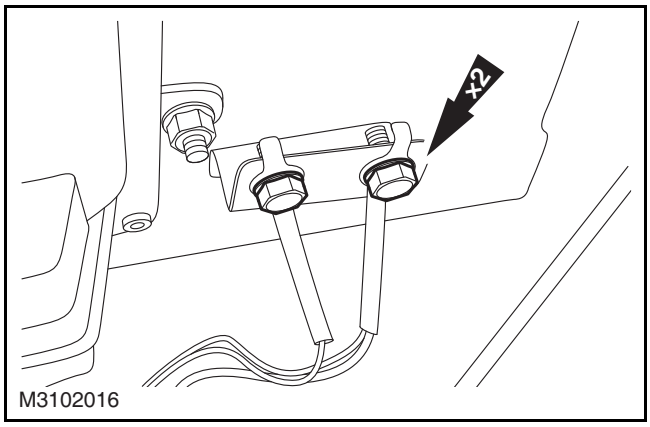



**7.** Disconnect the ECM wiring harness connector.

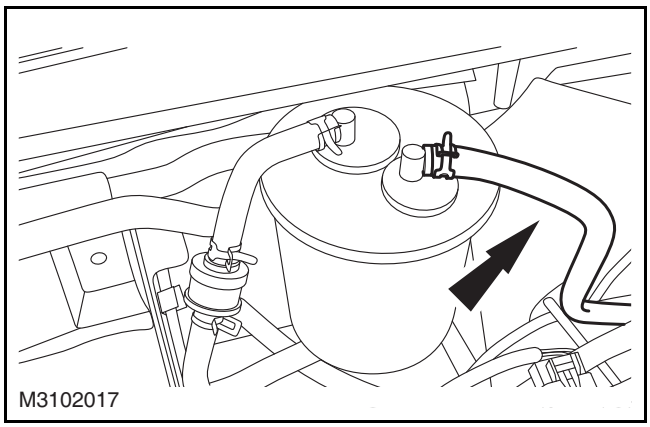



**8.** Disconnect 2 engine wiring harness grounding points.

Torque: 10 ± 1 Nm



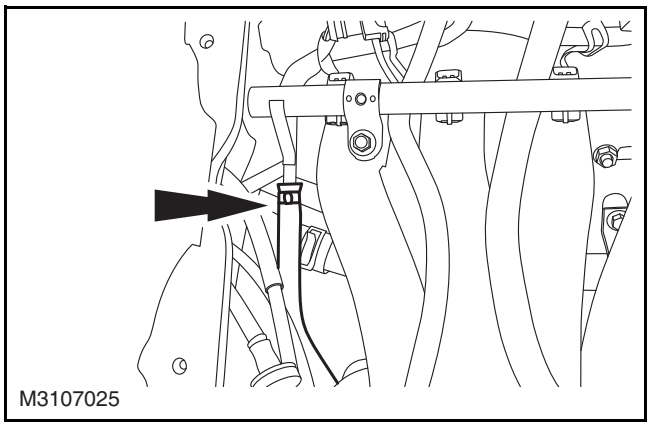

**9.** Loosen the hoop and disconnect the connecting hose between carbon canister and carbon canister control valve.



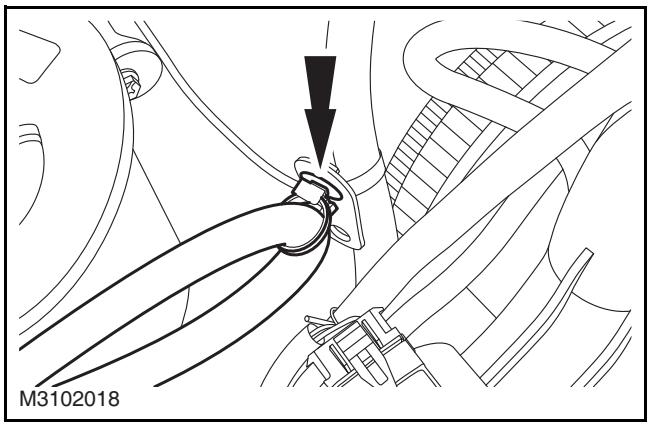
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**10.** Disconnect the connection between fuel main pipe and delivery pipe.




**11.** Separate the delivery pipe clamp from the bracket.




**12.** Remove the throttle body.

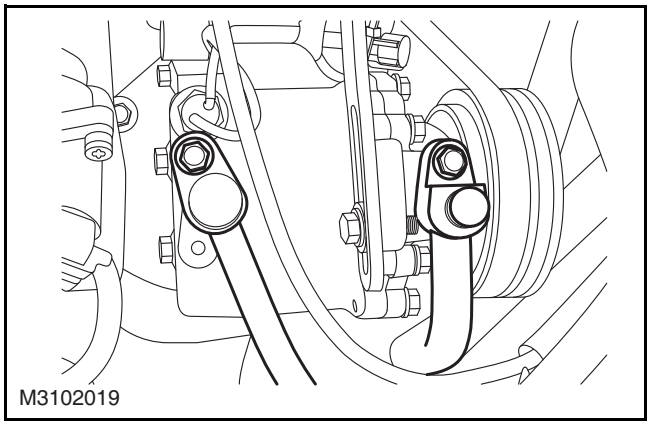
**Refer to: Throttle Body (3.1.5 Air intake System, Removal and Installation).**

**13.** Recover the A/C refrigerant.

**Refer to: A/C Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

**14.** Disconnect the connecting bolts between A/C high/low pressure pipe and A/C compressor.

Torque: 14 ~ 17 Nm



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**15.** Lift the vehicle.

**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

**16.** Drain the engine oil.

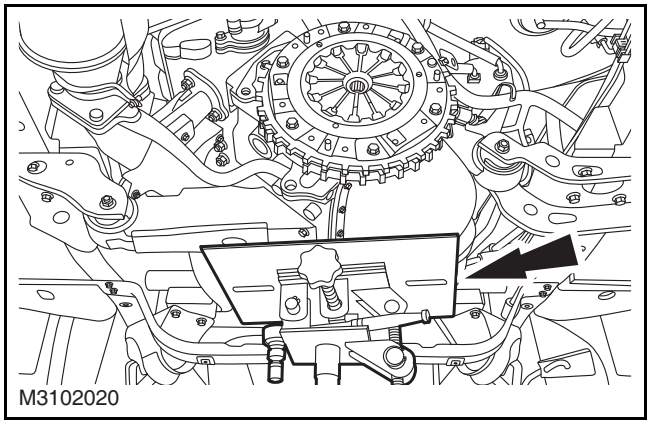
**Refer to: Engine Oil Change (3.1.3 Lubrication System, General Inspection).**

**17.** Remove the manual transmission.

**Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**

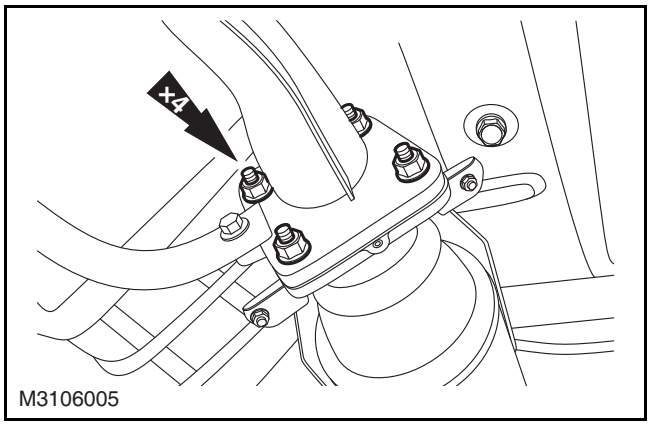
**18.** Support the engine assembly with the flat jack.

**WARNING: Make sure that the contact between jack worktable and engine assembly is secure, or it may cause personal injury.**


M3102020

**19.** Remove 4 connecting nuts between exhaust manifold and three-way catalytic converter.

Torque: 23 ± 2 Nm



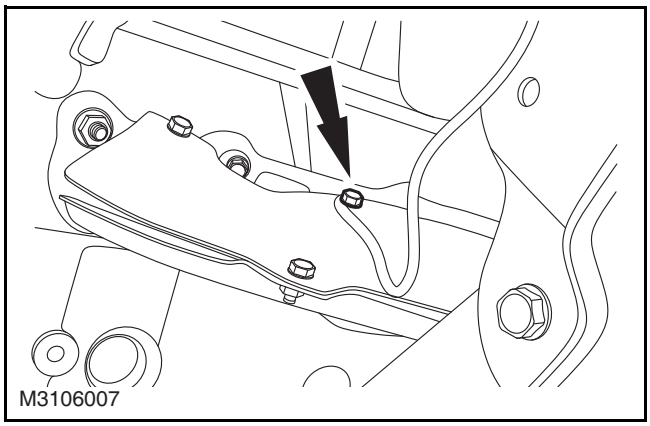
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**20.** Remove the grounding cable retaining bolt.

Torque: 10 ± 1 Nm




**21.** Drain the engine coolant.

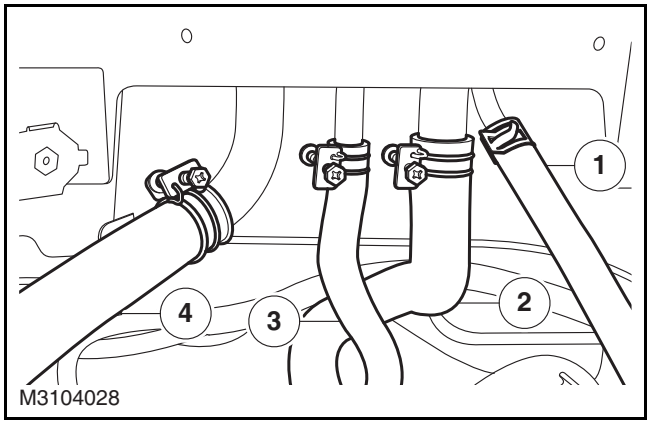
**Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).**

**22.** Loosen the clamp, and disconnect the connecting hose (1) between rear end of floor water pipe and vacuum booster.

**23.** Loosen the clamp, and disconnect the connecting hose (2) between rear end of floor water pipe and engine water outlet pipe.

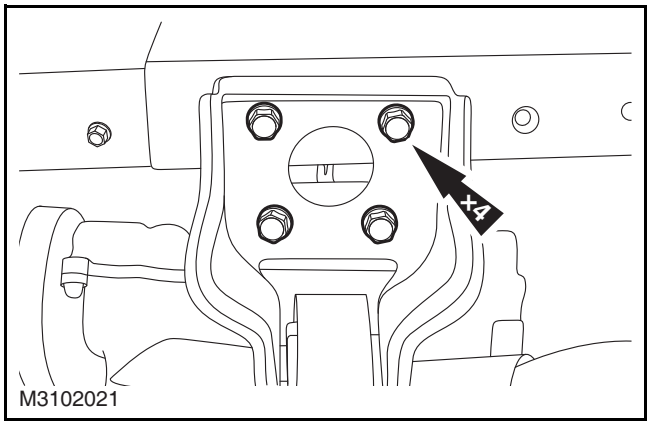
**24.** Disconnect the connecting hose (3) between rear end of floor water pipe and A/C heater core.

**25.** Loosen the clamp, and disconnect the connecting hose (4) between rear end of floor water pipe and engine water inlet pipe.




**26.** Remove 4 retaining bolts from the engine left mounting bracket bush assembly.

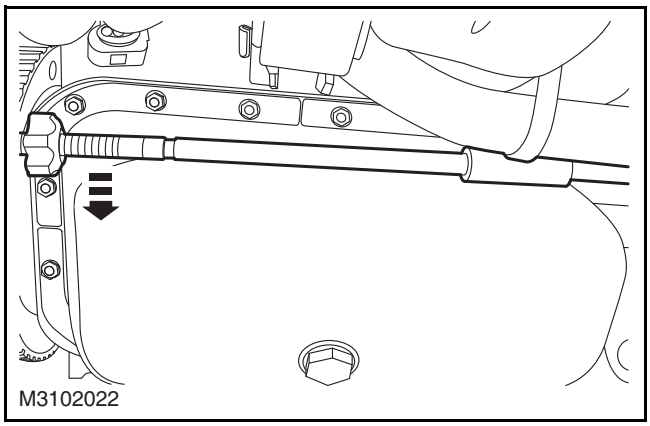
Torque: 55 ± 10 Nm



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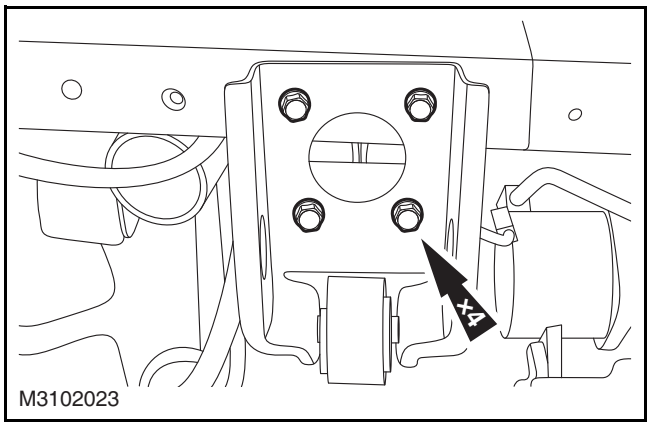


**27.** Move the clutch cable out of the way.




**28.** Remove 4 retaining bolts from engine right mounting bracket bush assembly.

Torque: 55 ± 10 Nm




**29.** Lift the vehicle slowly to separate the engine assembly from the frame.

**CAUTION: During lifting, be aware of preventing the engine assembly from inclining on the jack worktable and any interference of joints connecting the engine assembly and frame.**

## Installation

**1.** Installation is in the reverse order of removal.

**CAUTION: Adjust the clutch pedal stroke after installation. Be sure to adjust it to a proper position as specified, as excessive pedal free play may cause gear shifting noise or disengagement failure and insufficient free play may cause severe wear of friction disc, lack of power, and even burnout of friction disc.**

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# Flywheel

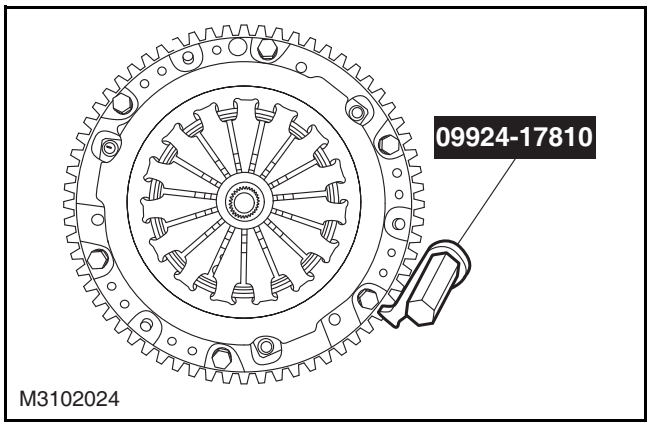
## Removal

1. Remove the manual transmission.

   **Refer to: Manual Transmission (3.4.3 Manual Transmission, Removal and Installation).**

2. Use a suitable tool to lock the flywheel.

   Special tool: 09924-17810

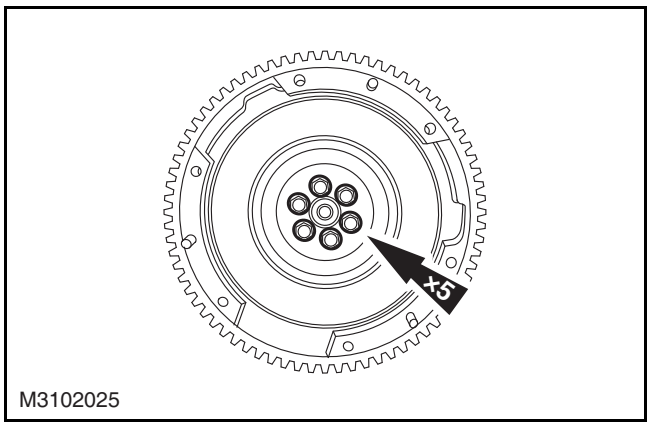



3. Remove the clutch pressure plate and clutch driven disc assembly.

   **Refer to: Clutch Pressure Plate Assembly, Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**

4. Remove 6 flywheel retaining bolts.

   Torque: 45 ~ 50 Nm



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## Installation

**CAUTION: Make sure the flywheel and pressure plate surfaces are clean and completely dry before assembly.**

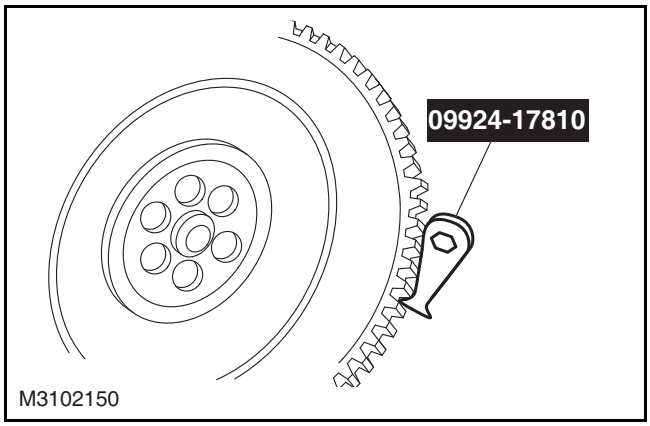
**CAUTION: The flywheel bolt has sealant with itself, and make sure the sealant is continuous with no cracks before assembly.**

**CAUTION: As the flywheel is a non-reusable part, clean the installation hole and replace the flywheel with a new one after removal.**

1. Use the special tool to install the flywheel to crankshaft and tighten it to the specified torque.

   Special tool: 09924-17810

   Torque: 45 ~ 50 Nm

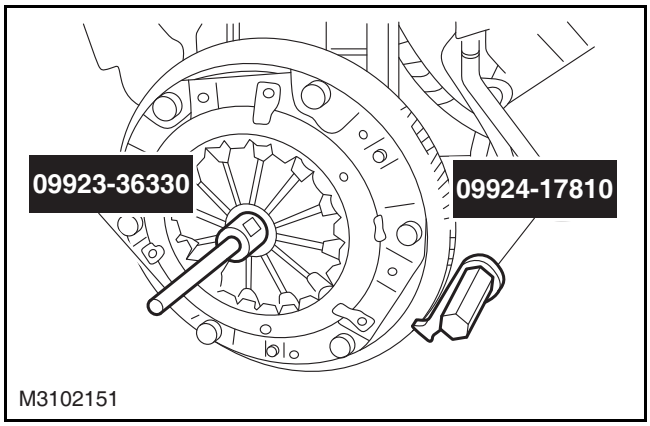



2. Use the special tool to align the clutch driven disc with the center of flywheel, install the clutch pressure plate assembly and bolts, then tighten them to the specified torque.

   Torque: 32 ± 2 Nm

**CAUTION: When tightening the clutch pressure plate retaining bolts, use the special tool to press the clutch driven disc tightly, so that the clutch driven disc assembly is aligned with the center of flywheel.**

**CAUTION: Tighten the clutch pressure plate retaining bolts evenly in the diagonal order.**




Special Tool

(A): 09924-17810

(C): 09923-36330

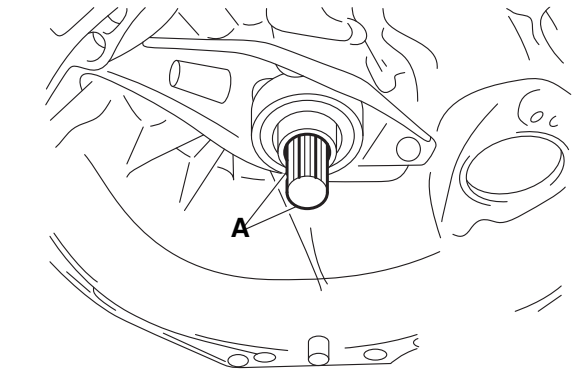
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3. Apply a small amount of grease to input shaft and then connect the transmission assembly and engine.

   "A": Grease 99000-25210

**CAUTION: While inserting the transmission input shaft into the clutch driven disc assembly, use a wrench to turn the crankshaft from the front side until the splines are engaged.**



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# Cylinder Head Cover

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

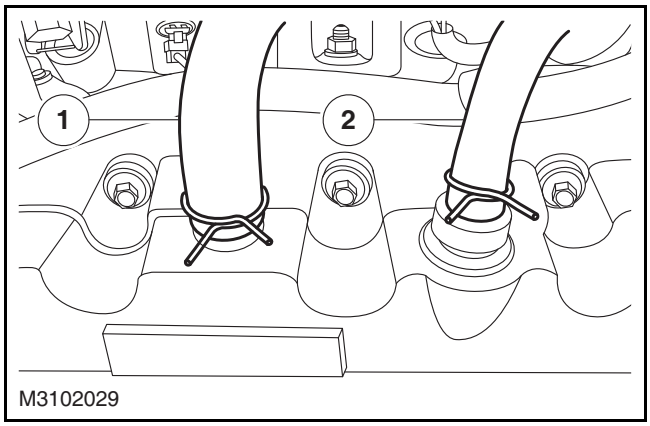
2. Remove the ignition coil and high-voltage damping line.

   **Refer to: Ignition Coil (3.1.8 Ignition System, Removal and Installation).**

   **Refer to: High-voltage Damping Line (3.1.8 Ignition System, Removal and Installation).**

3. Loosen the hoop and disconnect the crankcase vent hose (1).

4. Loosen the hoop and disconnect the PCV valve hose (2).

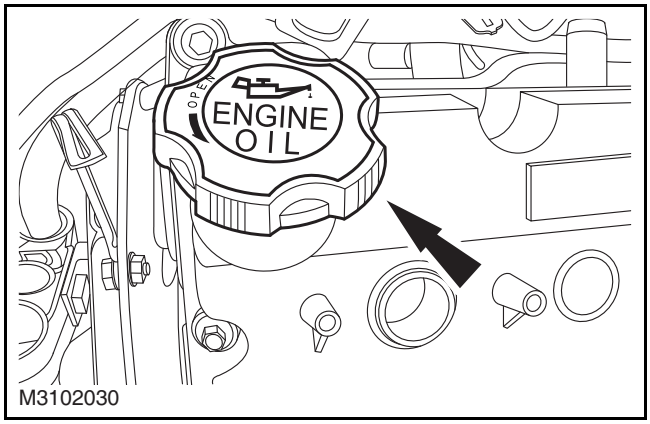


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5. Remove the PCV valve.

   **Refer to: PCV Valve (3.1.11 Emission Control System, Removal and Installation).**

6. Remove the engine oil filler cap.



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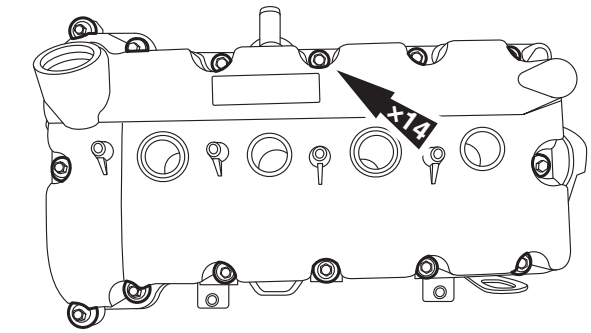
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**7.** Remove the cylinder head cover.

1 Remove 14 retaining bolts from the cylinder head cover.

Torque: 10 Nm




M3102031

2 Remove the gasket and O-ring from the cylinder head cover.

## Installation

**1.** Installation is in the reverse order of removal.

**2.** Install the gasket and O-ring to the cylinder head cover correctly.

**CAUTION: Before installation, inspect each part for defects or damages, and replace immediately if found.**

**CAUTION: When installing the cylinder head cover, prevent the gasket and O-ring from misplacing and dropping.**

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# Camshaft

## General Equipment

| |
|---|
| Dial indicator |
| Micrometer |
| Plastic feeler gauge |
| Plastic straight scale |
| Caliper gauge |

## Material

| | Item | Specifications |
|---|---|---|
| Material | Sealant | Loctite 5900 |
| | Thread locking sealant | Loctite 262 |

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the ignition coil and high-voltage damping line.

   **Refer to: Ignition Coil (3.1.8 Ignition System, Removal and Installation).**

   **Refer to: High-voltage Damping Line (3.1.8 Ignition System, Removal and Installation).**

3. Remove the engine accessory drive belt.

   **Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

4. Remove the engine timing belt.

   **Refer to: Timing Mechanism (3.1.2 Mechanical System, Removal and Installation).**

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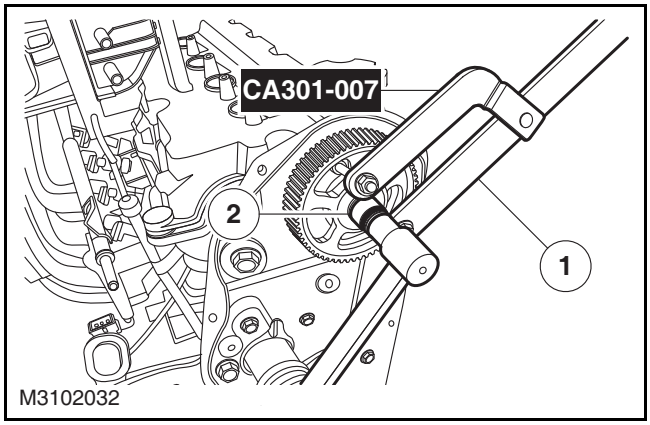
**5.** Remove the camshaft timing pulley.

1 Use the special tool (1) to secure the camshaft timing pulley.

Special tool: CA301-007

2 Remove the camshaft timing pulley retaining bolt (2), and remove the camshaft timing pulley.

Torque: 80 ~ 87 Nm

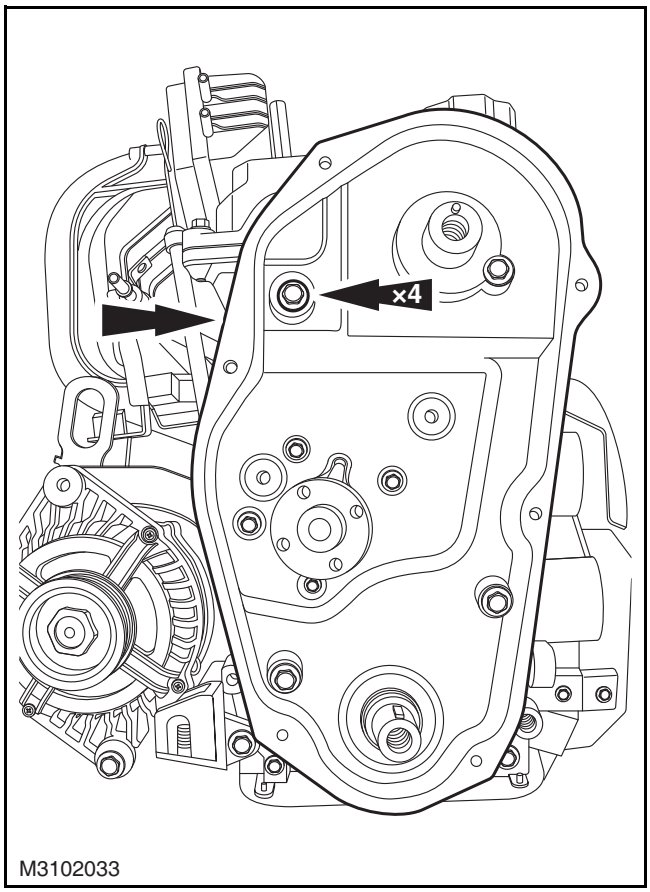


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**6.** Remove the retaining bolt from timing belt inner housing, and remove the timing belt inner housing.

**7.** Remove the cylinder head cover.

**Refer to: Cylinder Head Cover (3.1.2 Mechanical System, Removal and Installation).**



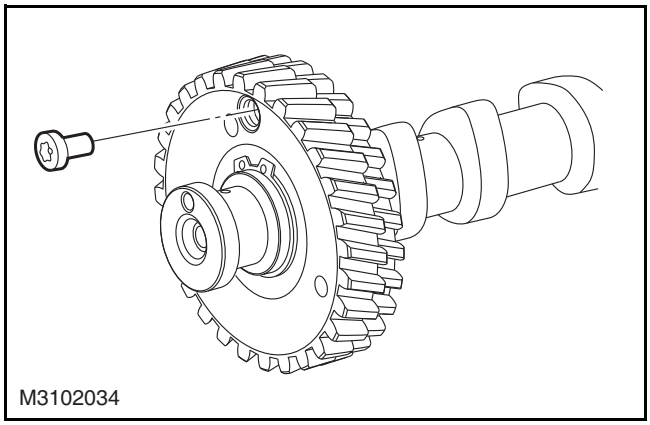
M3102033

**8.** Connect the driven gear and separate gear of intake camshaft firmly with retaining bolt.

Part number for bolt: 10060406E

Torque: 9 ± 1 Nm

**CAUTION: Before removing the camshaft bearing cap bolt, be sure to use special bolt to secure the driven gear and separate gear for easier installation.**


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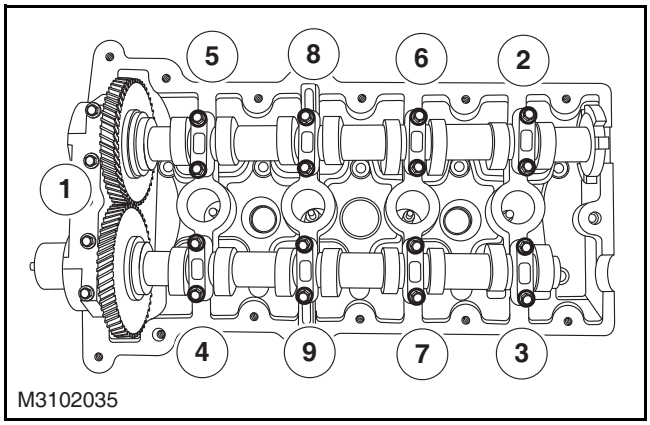
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**9.** Remove the camshaft bearing cap retaining bolt.

Torque: 9 ~ 11 Nm

**CAUTION: When removing the camshaft bearing cap bolts, follow the order from both ends to center as shown in the figure, and loosen them in sequence.**



M3102035

**10.** Remove the camshaft, camshaft hole front end cover and camshaft oil seal.

**CAUTION: After removing the camshaft hole front end cover, replace with a new front end cover gasket.**

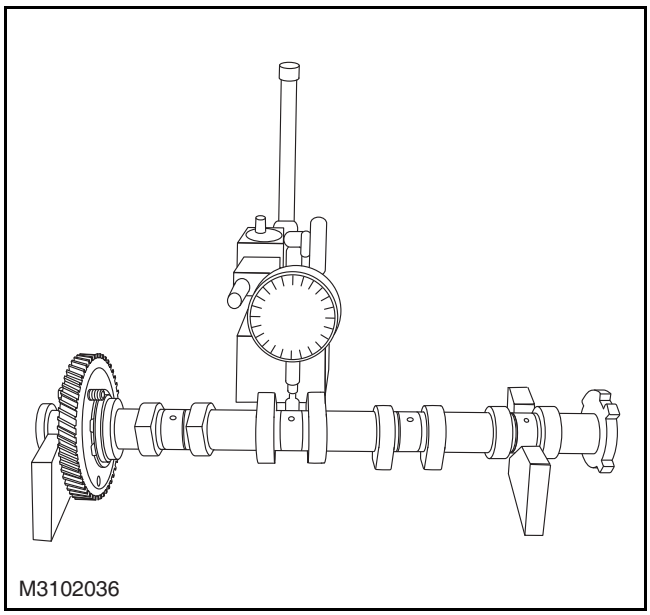
**CAUTION: After removing the camshaft oil seal, replace it with a new one.**

## Inspection

**1.** Use the V block and dial indicator to inspect the camshaft radial runout. If the radial runout is more than the limit, replace the camshaft.

Radial runout limit: 0.10 mm

General equipment: Dial indicator


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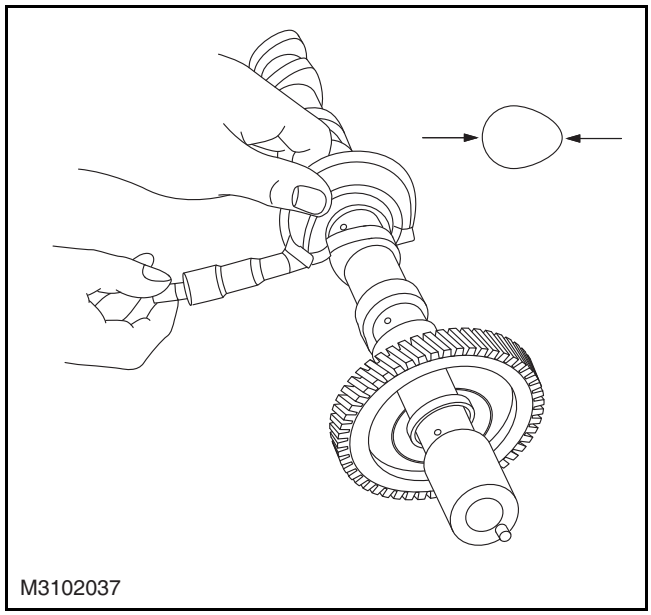


2. Use the micrometer to measure the cam lift, and inspect the cam for wear.

   General equipment: Micrometer

**CAUTION: If the measured lift is less than the limit, replace the camshaft.**

| Cam Lift | Standard | Limit |
|---|---|---|
| Intake cam | 40.11 ~ 40.19 mm | 40.102 mm |
| Exhaust cam | 37.26 ~ 37.34 mm | 37.252 mm |

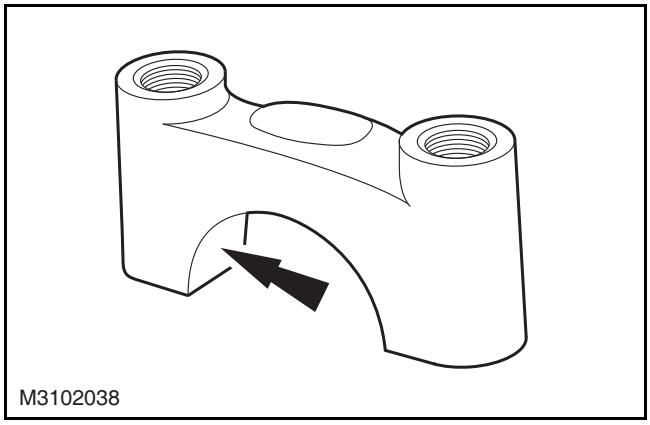


M3102037

3. Inspect the camshaft journal and camshaft bearing cap for rust, scratches, abrasions or damages.

**CAUTION: If any defect is found, replace the camshaft or cylinder head and camshaft bearing cap.**

**CAUTION: Never replace the cylinder head without replacing the camshaft bearing cap.**



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**4.** Inspect the camshaft journal clearance.

1 Clean the camshaft bearing caps and journals.

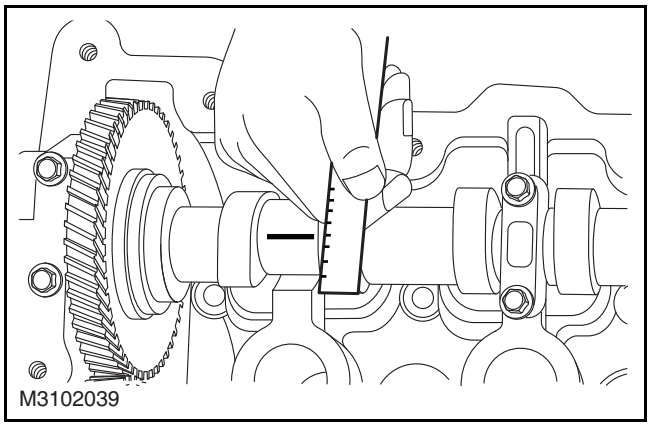
2 Install the camshaft to the cylinder head.

3 Place a piece of plastic feeler gauge with the same width as the camshaft journal (parallel to the camshaft).

4 Install the camshaft bearing caps.

5 Tighten the camshaft bearing cap bolts in sequence in the reverse order of removal, until tighten them to the specified torque.

Torque: 10 ± 1 Nm


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**CAUTION: When installing the plastic feeler gauge, do not rotate the camshaft. Remove the camshaft bearing caps and measure the width of plastic feeler gauge at its widest point with a plastic straight scale.**

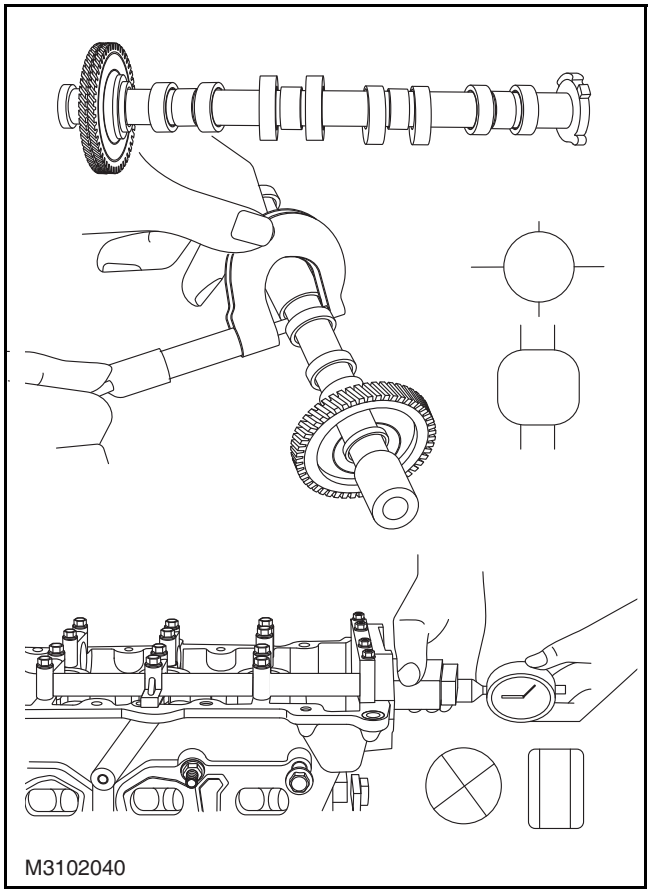
| Item | Standard | Limit |
|---|---|---|
| Journal clearance | 0.040 ~ 0.078 mm | 0.12 mm |

**CAUTION: If the actually measured camshaft journal clearance is more than the limit, measure the camshaft journal (camshaft bearing cap) bore diameter and outer diameter. If the difference from specifications is large, replace the camshaft or cylinder head assembly.**

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| Item | Standard |
|---|---|
| Cylinder head camshaft bore diameter | 24.000 ~ 24.025 mm |
| Camshaft journal outer diameter | 23.947 ~ 23.960 mm |



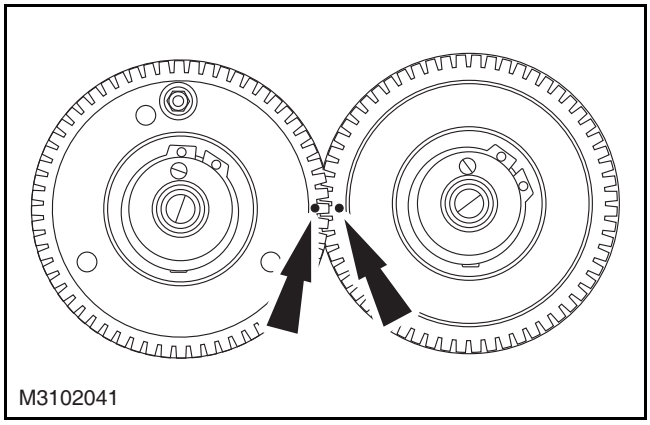
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## Installation

1. Apply a proper amount of engine oil to the cams and journals of camshafts.
2. As shown in the figure, align the timing marks on drive gears of intake and exhaust camshafts, and place the intake and exhaust camshafts on the cylinder head.

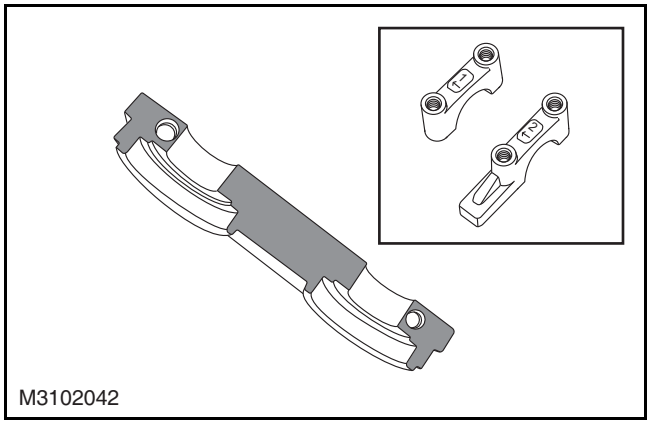

M3102041

3. Install the camshaft bearing caps.

**CAUTION: Follow the number and " → ", and " → " points the engine timing belt side.**

**CAUTION: As the camshaft bearing caps 2# and 6# have oil ways, and differ from other caps, pay attention to distinguish them.**

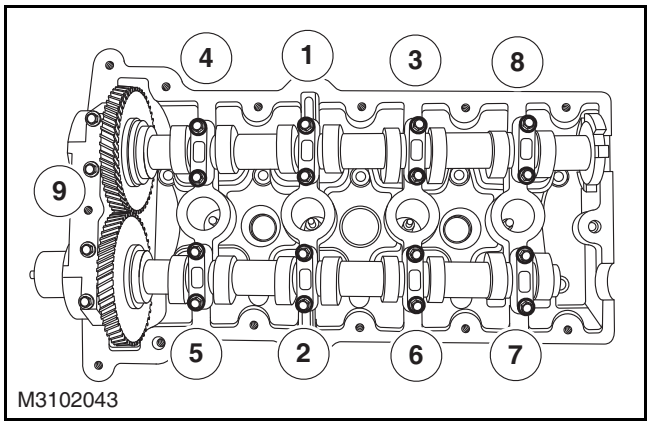
**CAUTION: Apply a light coat of oil-resistant sealant to the joint surface of camshaft bearing cap 1# and cylinder head before installation, and make sure that the sealant does not adhere to the camshaft or camshaft oil seal contact surface.**


M3102042

4. Install the camshaft bearing caps in the order indicated by the numbers as shown in the figure, and tighten the camshaft bearing cap bolts in the same order.

   Torque: 10 ± 1 Nm

**CAUTION: When installing the camshaft bearing cap bolts, follow the order from center to both ends as shown in the right figure, and tighten them in three or four steps.**

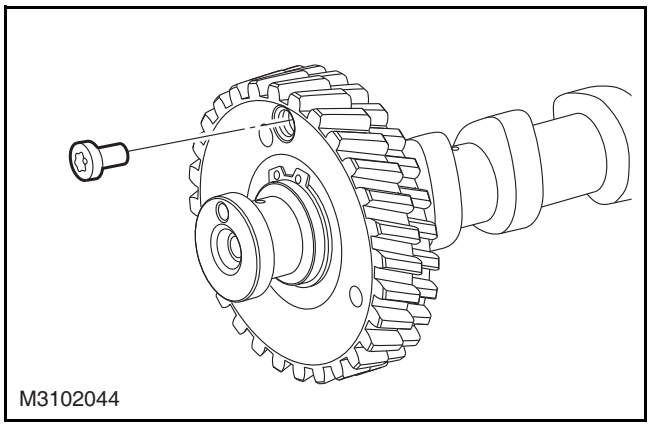


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**5.** Remove the retaining bolt from the driven gear and separate gear on the intake camshaft.

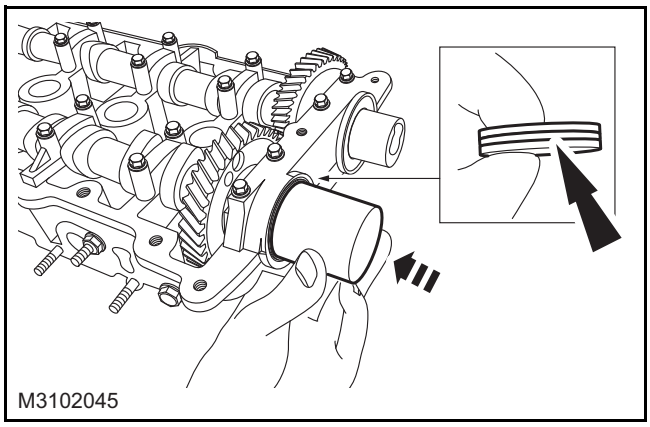

M3102044

**6.** Install the camshaft hole front end cover.

1 Replace with a new gasket.

2 Use the suitable tool to install the camshaft hole front end cover.

**CAUTION: When installing the front end cover, it should be flush with camshaft bearing cap 1#.**


M3102045

**7.** Use the special tool to install the camshaft gasket.

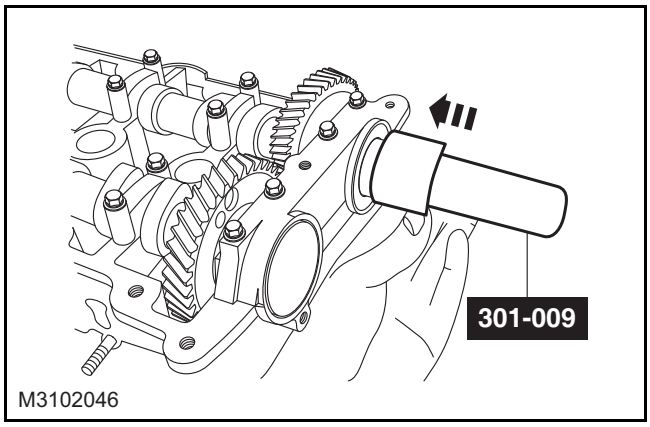
1 Apply a proper amount of engine oil to the lip of camshaft oil seal.

2 Use the suitable tool to press the camshaft oil seal to install.

Special tool: CA301-009

**CAUTION: Replace with a new one when installing the gasket.**

**CAUTION: Press the camshaft oil seal until its surface is flush with camshaft bearing cap surface.**



M3102046

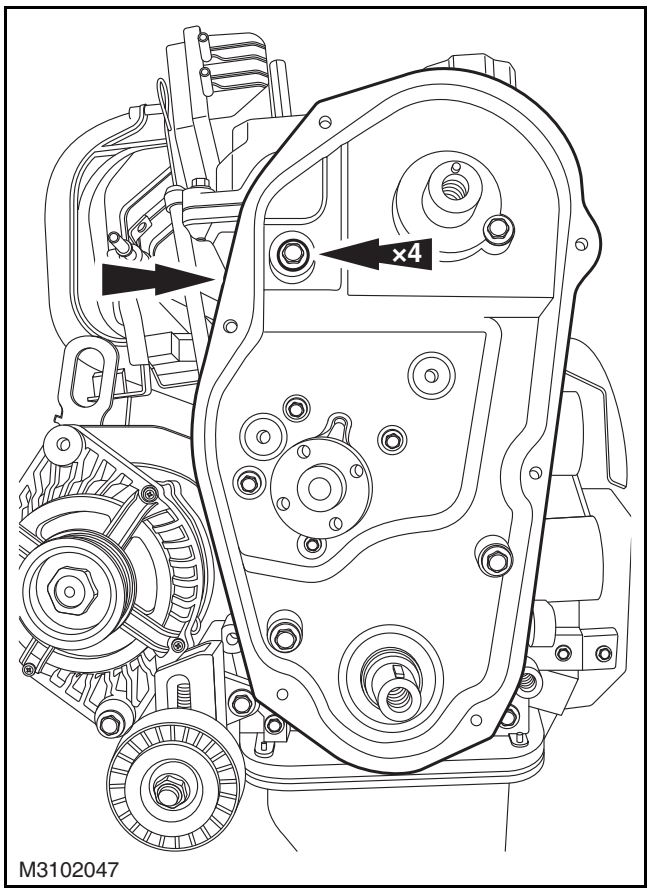
**8.** Install the cylinder head cover and tighten the retaining bolts.

**Refer to: Cylinder Head Cover (3.1.2 Mechanical System, Removal and Installation).**

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**9.** Install the timing belt inner housing and tighten the retaining bolts.

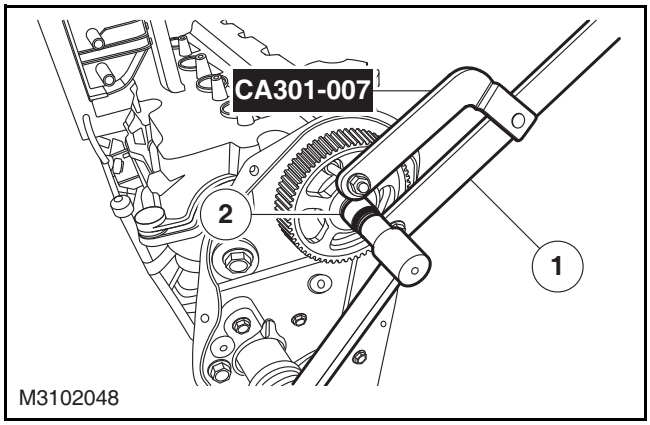



**10.** Install the camshaft timing pulley.

1 Use the special tool (1) to secure the camshaft timing pulley.

2 Tighten the camshaft timing pulley retaining bolt (2) to the specified torque.

Torque: 80 ~ 87 Nm




**11.** Install the engine timing belt.

**Refer to: Timing Mechanism (3.1.2 Mechanical System, Removal and Installation).**

**12.** Install the engine accessory drive belt.

**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

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13. Install the ignition coil and high-voltage damping line.

    **Refer to: Ignition Coil (3.1.8 Ignition System, Removal and Installation).**

    **Refer to: High-voltage Damping Line (3.1.8 Ignition System, Removal and Installation).**

14. Connect the negative battery cable.

15. Adjust the accessory drive belt tension.

    **Refer to: Accessory Drive Belt Inspection (3.1.2 Mechanical System, General Inspection).**

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# Timing Mechanism

## Removal

1. Disconnect the negative battery cable.

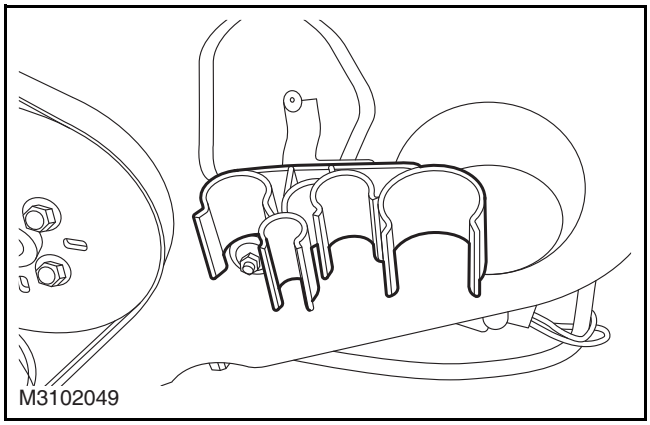
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Move the vacuum booster hose out of the way.

3. Remove the rear wind guiding cover.

   **Refer to: Rear Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

4. Remove the hose bracket.

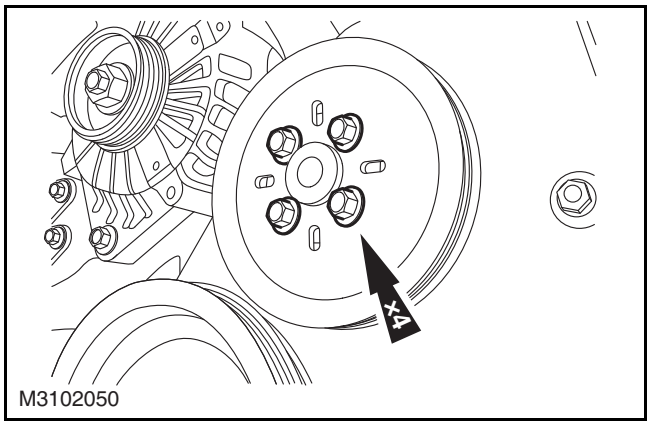



5. Remove the accessory drive belt.

   **Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

6. Remove the water pump pulley.

   1 Remove 4 retaining bolts from the water pump pulley.




   2 Remove the water pump pulley.

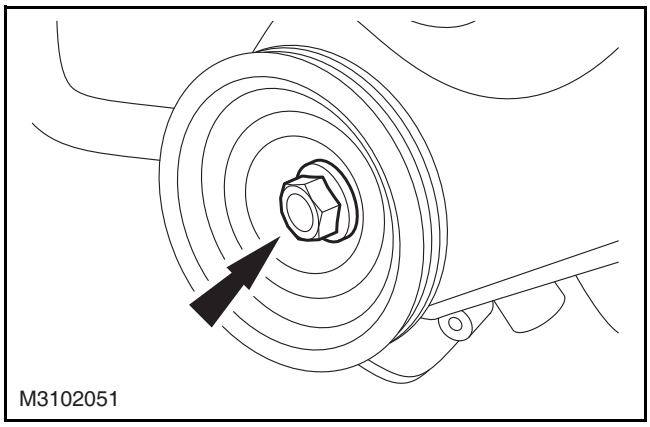
https://truckmanualshub.com/



**7.** Remove the crankshaft pulley.

1 Remove the crankshaft pulley bolt.

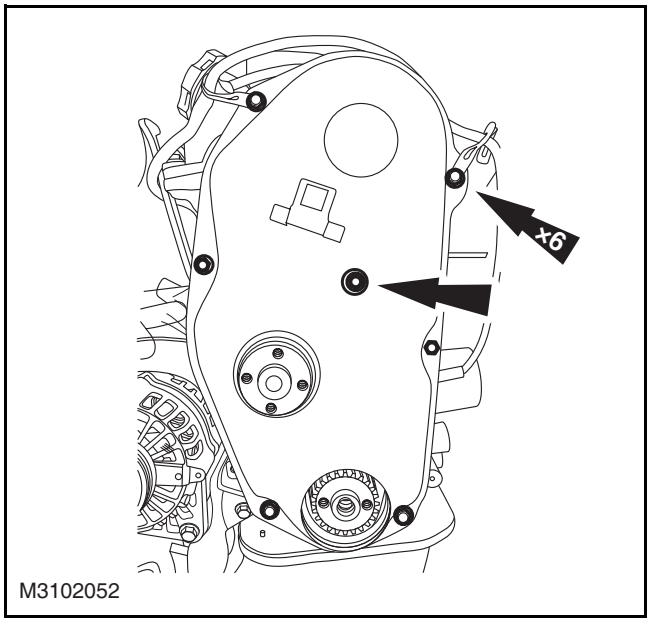
Torque: 133 ± 5 Nm


M3102051

2 Remove the crankshaft pulley.

**8.** Remove the timing belt front housing assembly.

1 Remove 6 retaining bolts and 1 retaining nut from the timing belt front housing assembly.



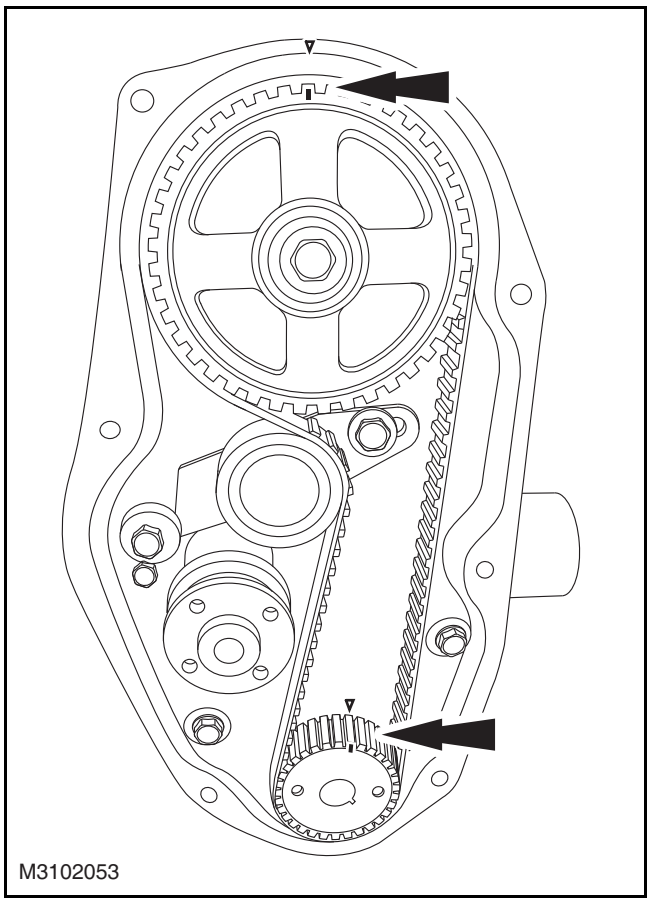
M3102052

2 Remove the timing belt front housing assembly.

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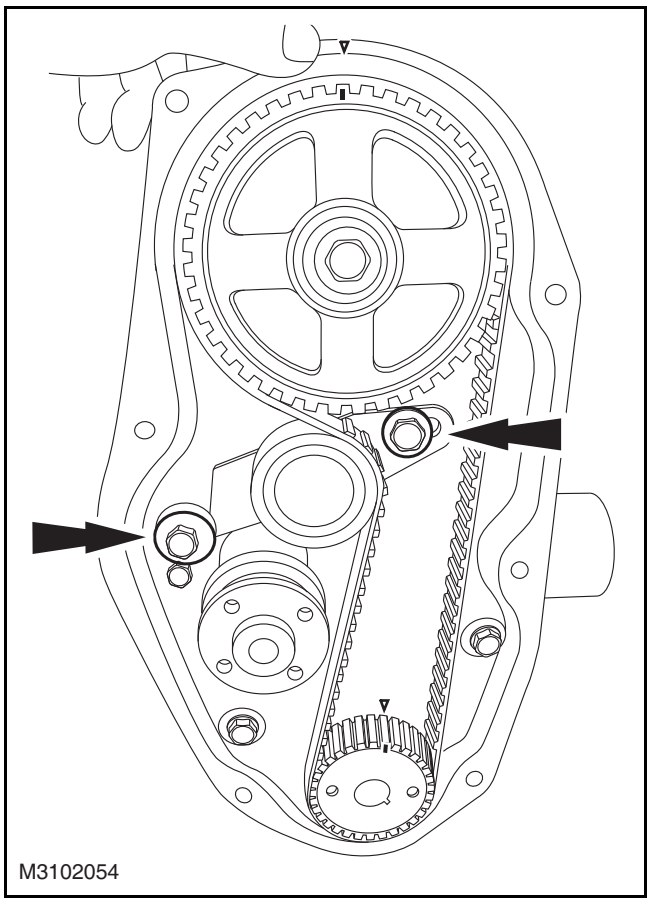
9. Rotate the crankshaft to align the timing marks as shown in the figure.


M3102053

10. Remove the retaining bolt from the timing belt tensioner pulley, and remove the timing belt tensioner pulley and timing belt.

**WARNING: After removing the timing belt, do not rotate the crankshaft and camshafts for over 45 degrees to both the left and right with the timing mark as the benchmark. Otherwise, the piston, valve and other related components will be damaged.**

**CAUTION: Do not bend the timing belt.**


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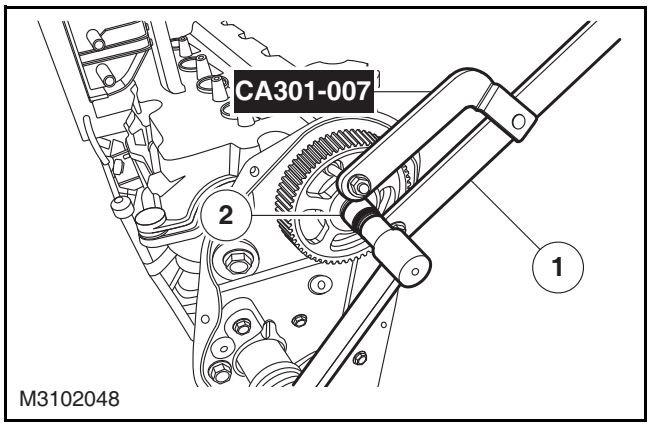
**11.** Remove the camshaft timing pulley.

1 Use the special tool (1) to secure the camshaft timing pulley.

Special tool: CA301-007

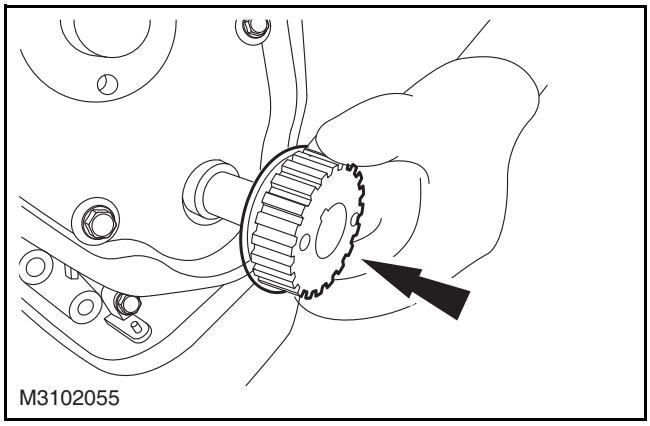
2 Remove the camshaft timing pulley retaining bolt (2), and remove the camshaft timing pulley.

Torque: 80 ~ 87 Nm



M3102048

**12.** Remove the crankshaft timing pulley.

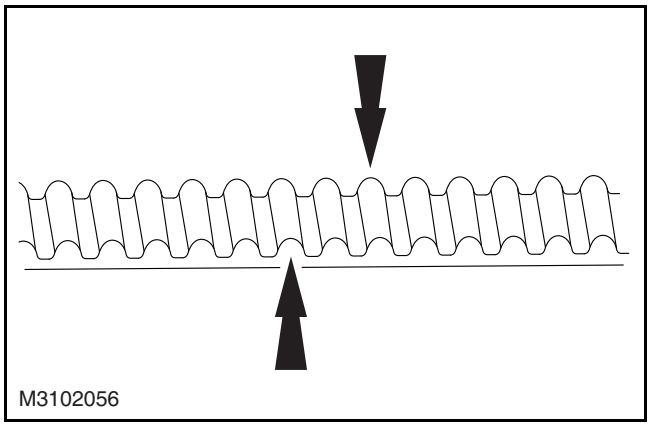

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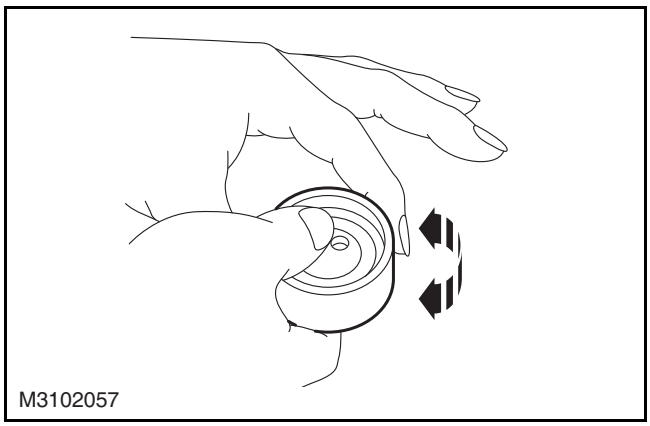


## Inspection

1. Inspect the timing belt for wear or cracks, replace it when necessary.


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2. Inspect if the tensioner pulley rotates smoothly.


M3102057

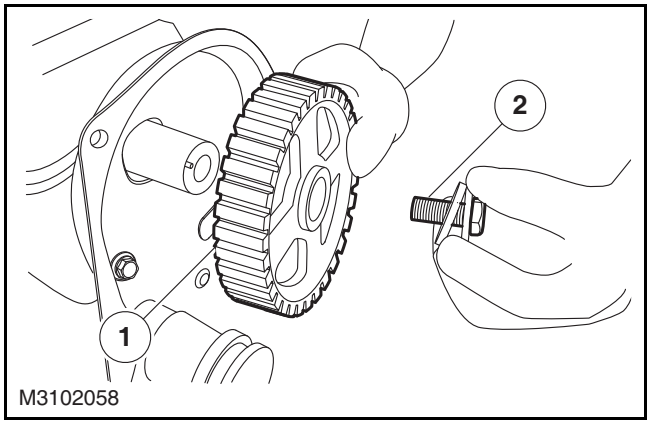
## Installation

1. Install the camshaft timing pulley.

   1 Install the camshaft timing pulley (1) to the camshaft.

   2 Pre-tighten the camshaft timing pulley retaining bolt (2).

**CAUTION: Confirm that the woodruff key at the front end of camshaft for positioning camshaft timing pulley has not dropped off.**



M3102058

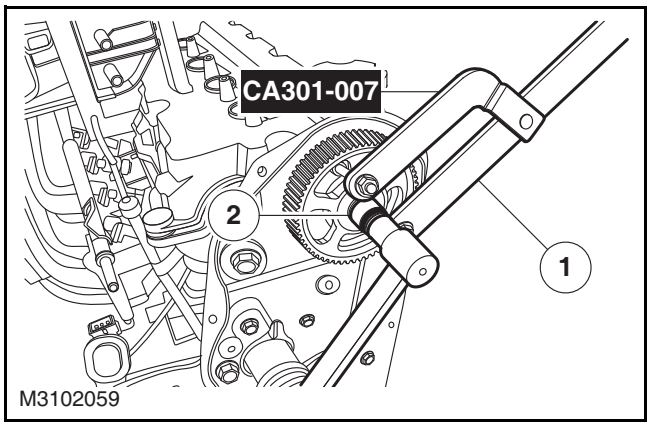
https://truckmanualshub.com/



3 Tighten the camshaft timing pulley retaining bolt (2).

Use the special tool (1) to secure the camshaft timing pulley.

Special tool: CA301-007




2. Tighten the camshaft timing pulley retaining bolt.

   Torque: 80 ~ 87 Nm

3. Install the crankshaft timing pulley.
4. Install the timing belt tensioner pulley.

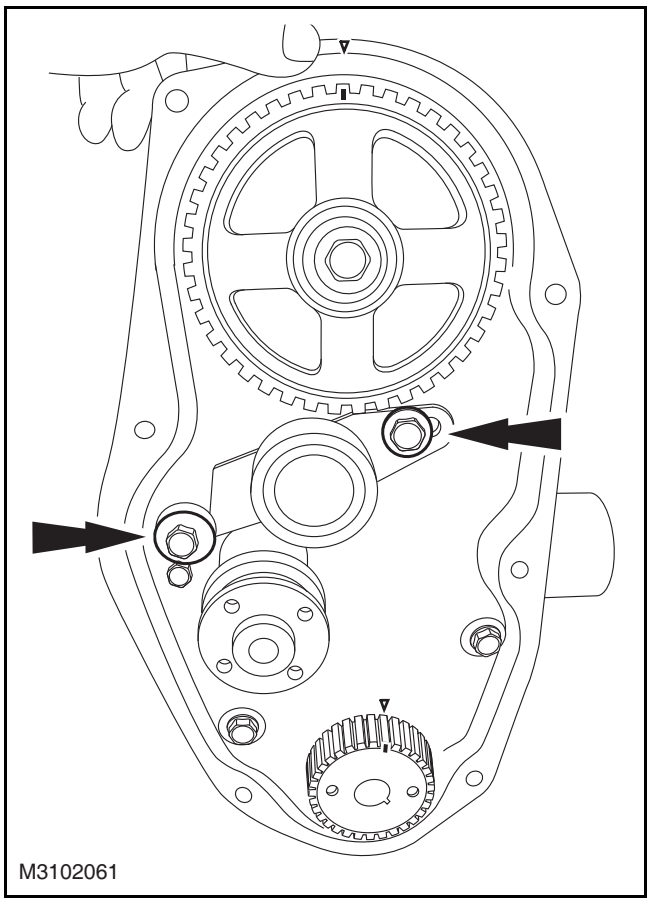
**CAUTION: Do not tighten the tensioner pulley bolt, and just pre-tighten it by hand.**

5. Inspect the timing mark on the camshaft timing pulley, and the mark should align with the "∇" mark on the timing belt inner housing. If not, make two marks align by rotating the camshaft, but note that the rotation should not exceed the allowed range.

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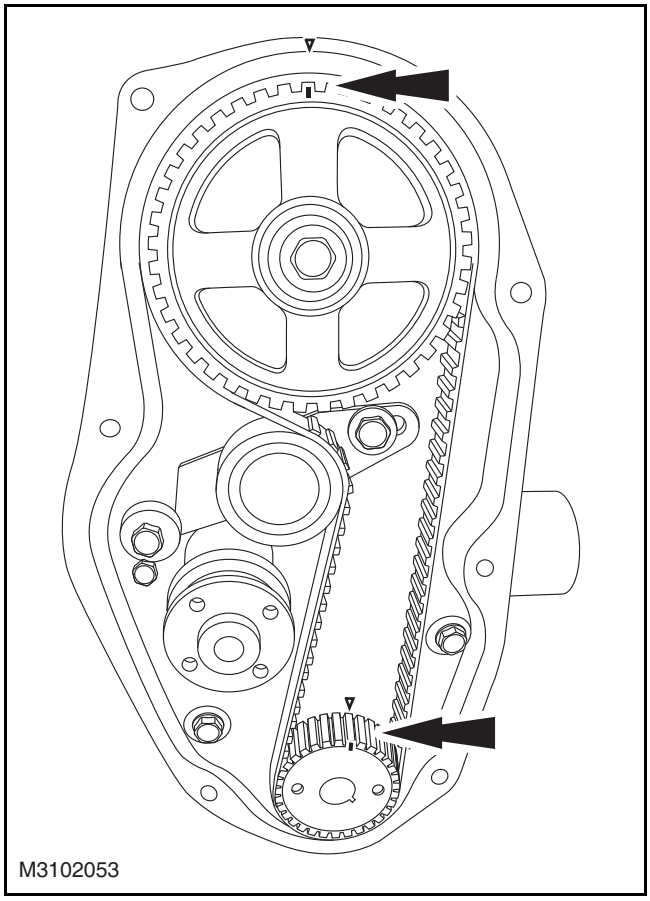


6. Inspect the imprint mark on the crankshaft pulley, and the mark should align with the "∇" mark on the timing belt inner housing. If not, make two marks align by rotating the crankshaft, but note that the rotation should not exceed the allowed range.


M3102061

7. Install the timing belt clockwise from the camshaft belt pulley through the crankshaft belt pulley and the timing belt tensioner pulley assembly to align the two sets of marks, and inspect the camshaft timing belt pulley and crankshaft timing belt pulley for alignment and the gear teeth and belt teeth for correct engagement.

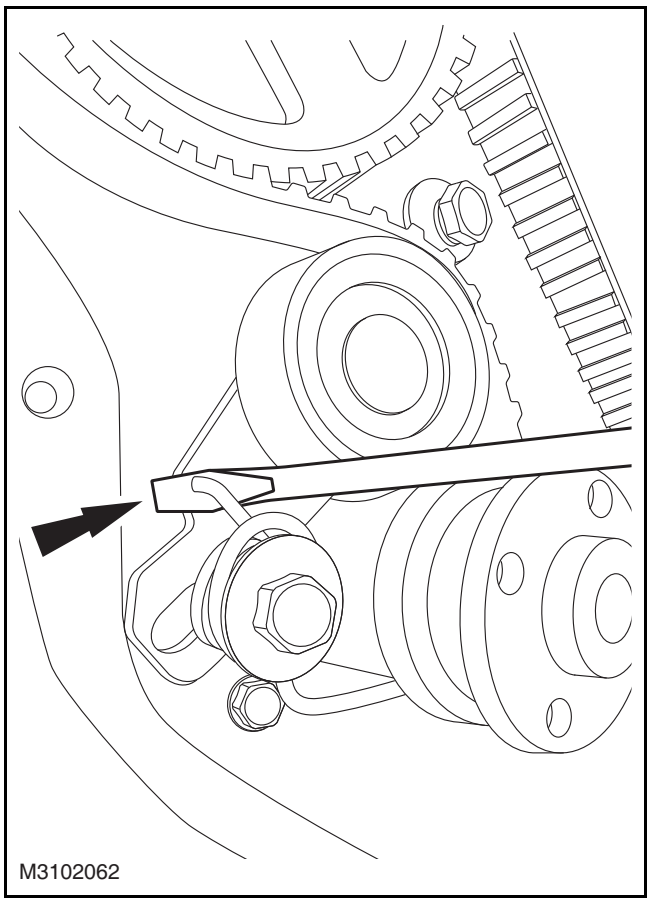
**CAUTION: When installing the timing belt, make the arrow mark on the belt in the same direction as the crankshaft rotates.**


M3102053

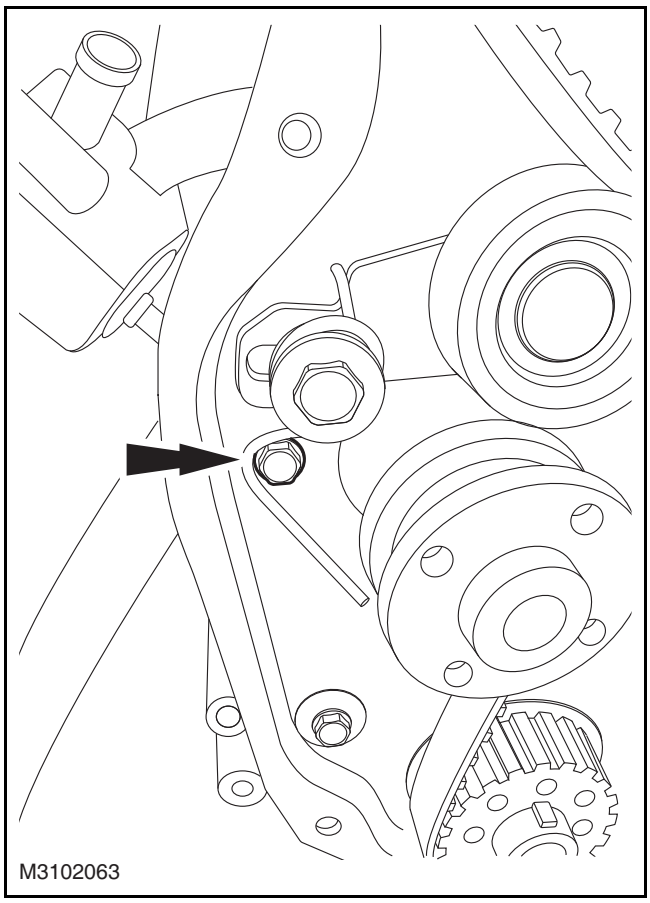
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**8.** Use the suitable tool to insert one end of torsion spring to the tensioner pulley bracket.


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**9.** Use the same method to insert the other end of torsion spring to the lower bolt.


M3102063

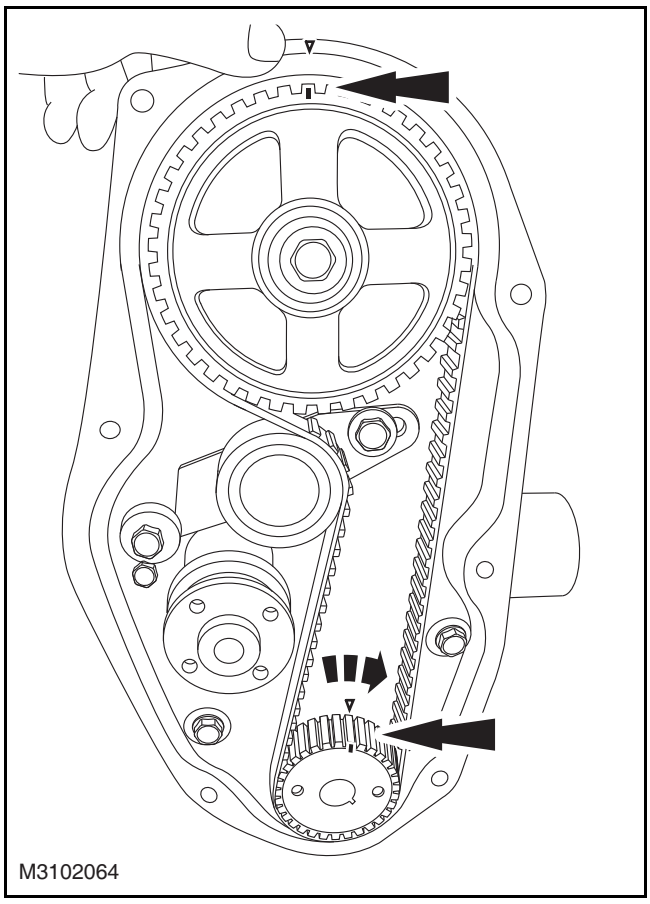
https://truckmanualshub.com/



**10.** In order to tension the loose timing belt, rotate the crankshaft 2 turns clockwise. After confirming the belt is tension, tighten the tensioner pulley retaining bolt.

Torque: 23 ± 2 Nm

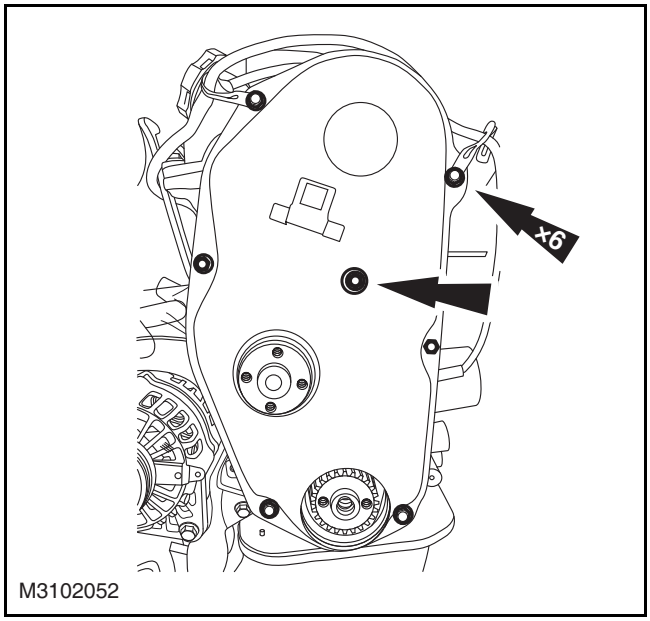
**CAUTION: After rotating the crankshaft 2 turns, inspect if the engine timing marks align once again. if not, reinstall the timing belt and tensioner pulley.**



M3102064

**11.** Install the timing belt front housing assembly, and tighten the timing belt front housing assembly retaining bolts and nut.

Torque: 10 Nm



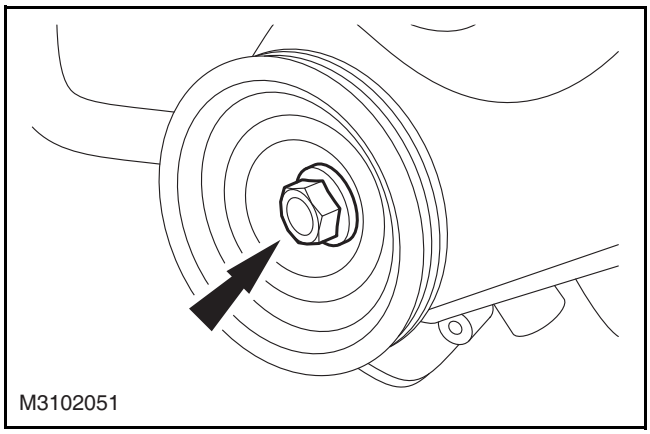

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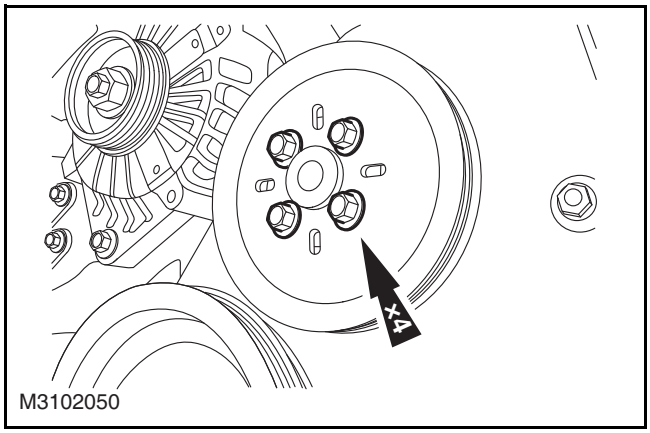
12. Install the crankshaft pulley, and tighten the crankshaft pulley retaining bolt.

    Torque: 133 ± 5 Nm


M3102051

13. Install the water pump pulley, and tighten 4 retaining bolts to the water pump pulley.

    Torque: 8 ± 1 Nm



M3102050

14. Install the accessory drive belt.

**CAUTION: Inspect the accessory drive belt tension.**

**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

15. Install the hose bracket.
16. Return the vacuum booster hose to the original position.
17. Install the rear wind guiding cover.

**Refer to: Rear Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

18. Connect the vacuum booster hose and intake manifold.
19. Connect the negative battery cable.

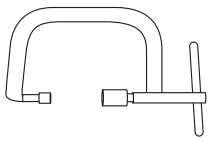
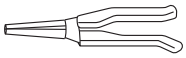
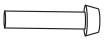
https://truckmanualshub.com/



## Disassembly and Assembly

# Cylinder Head Subassembly and Valve

### Special Equipment

| | |
|---|---|
|  CA301-011 | Valve spring cotter replacer CA301-011 |
|  CA301-012 | Valve oil seal plier CA301-012 |
|  CA301-013 | Valve oil seal installer CA301-013 |

### General Equipment

| |
|---|
| Tweezer |
| Dial indicator |
| Micrometer |
| Plastic feeler gauge |
| Straight scale |
| Caliper gauge |
| Vernier caliper |
| Reamer |

### Material

| Item | Specifications |
|---|---|
| Sealant | Loctite 5900 |
| Thread locking sealant | Loctite 262 |

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## Disassembly

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the ignition coil and high-voltage damping line.

   **Refer to: Ignition Coil (3.1.8 Ignition System, Removal and Installation).**

   **Refer to: High-voltage Damping Line (3.1.8 Ignition System, Removal and Installation).**

3. Remove the cylinder head cover.

   **Refer to: Cylinder Head Cover (3.1.2 Mechanical System, Removal and Installation).**

4. Remove the engine accessory drive belt.

   **Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

5. Remove the engine timing belt.

   **Refer to: Timing Mechanism (3.1.2 Mechanical System, Removal and Installation).**

6. Remove the intake manifold.

   **Refer to: Intake Manifold (3.1.5 Intake System, Removal and Installation).**

7. Remove the exhaust manifold.

   **Refer to: Exhaust manifold (3.1.6 Exhaust System, Removal and Installation).**

8. Remove the thermostat.

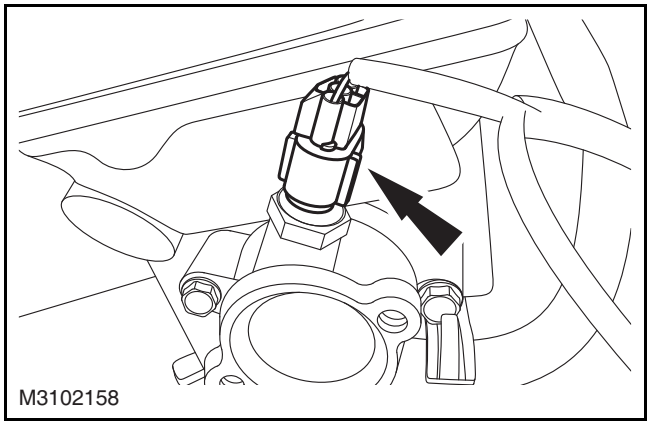
   **Refer to: Thermostat (3.1.4 Cooling System, Removal and Installation).**

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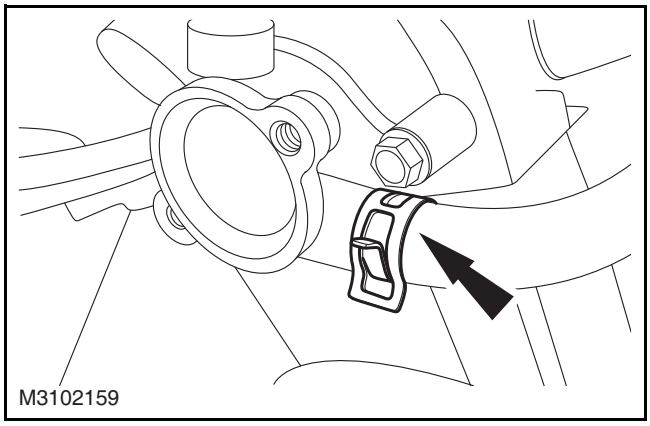


**9.** Remove the thermostat holder assembly.

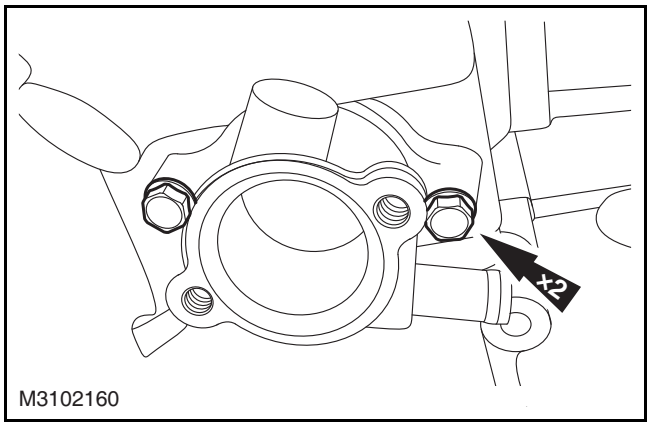
1 Disconnect the coolant temperature sensor wiring harness connector.




2 Loosen the hoop and disconnect 1# water outlet pipe.




3 Remove 2 retaining bolts from the thermostat holder.




4. Remove the thermostat holder assembly.

**10.** Remove the camshaft.

**Refer to: Camshaft (3.1.2 Mechanical System, Removal and Installation).**

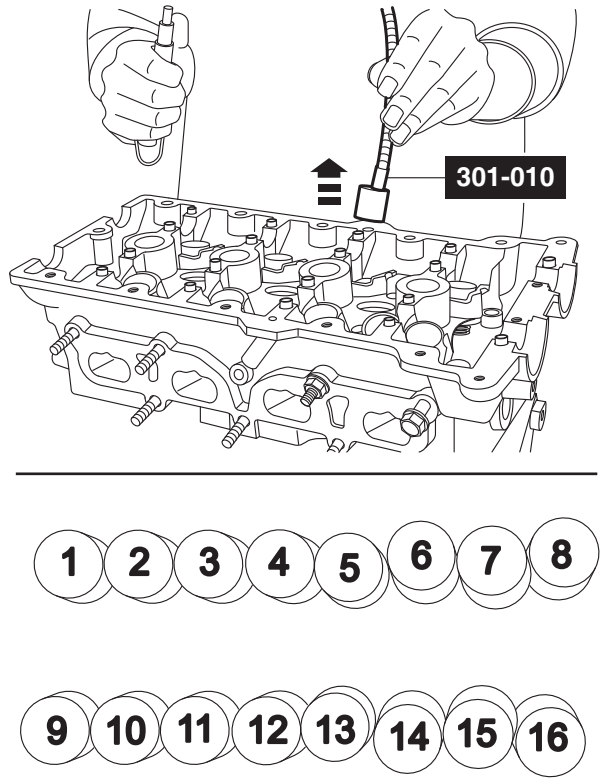
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**11.** Use the special tool to take the valve tappet out, and mark on the valve tappet with quick drying paint.

Special tool: CA301-010

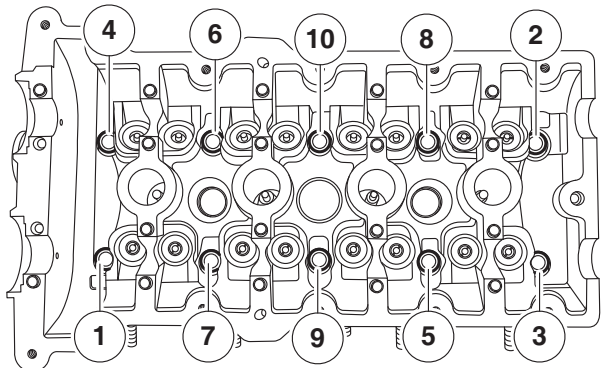
**CAUTION: If the original valve tappet is used, it has fixed position and cannot be changed.**




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**12.** Remove the cylinder head bolts in the order shown in figure.

**13.** Remove the cylinder head from vehicle.



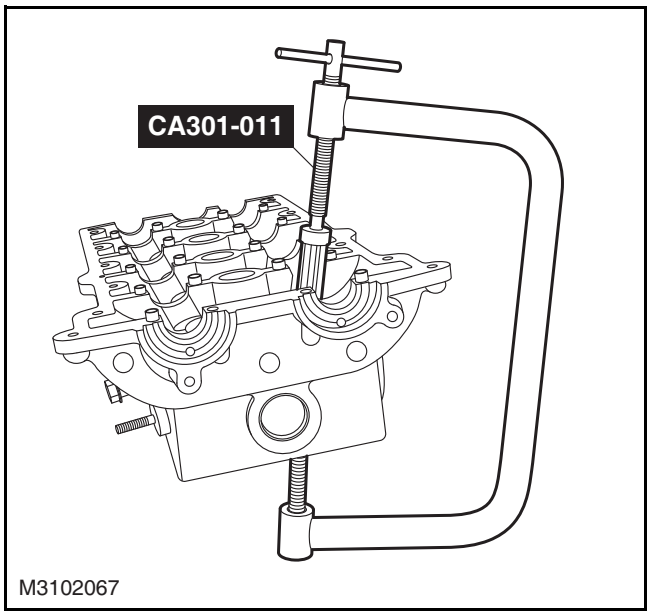

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**14.** Use the special tool to squeeze the valve spring.

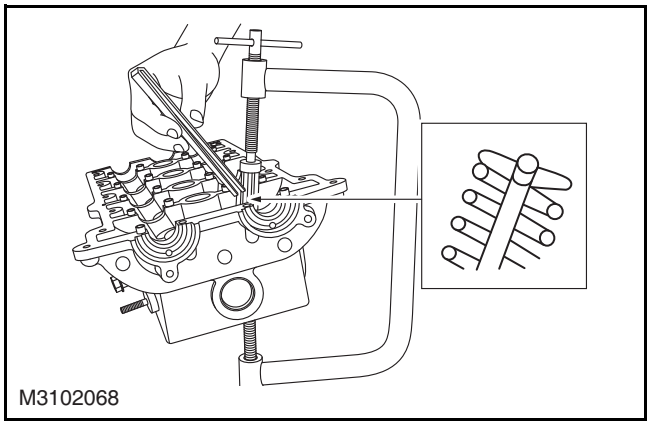
Special tool: CA301-011




**15.** Use the tweezer to remove the valve cotter.

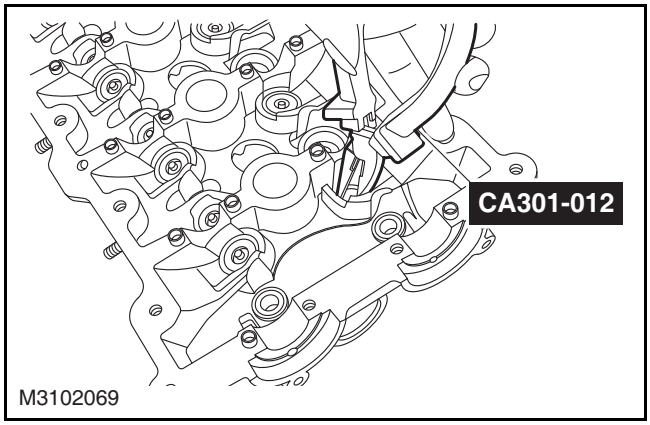
General equipment: Tweezer

**16.** Remove the valve from combustion chamber side.




**17.** Use the special tool to remove the valve oil seal from valve guide side.

Special tool: CA301-012



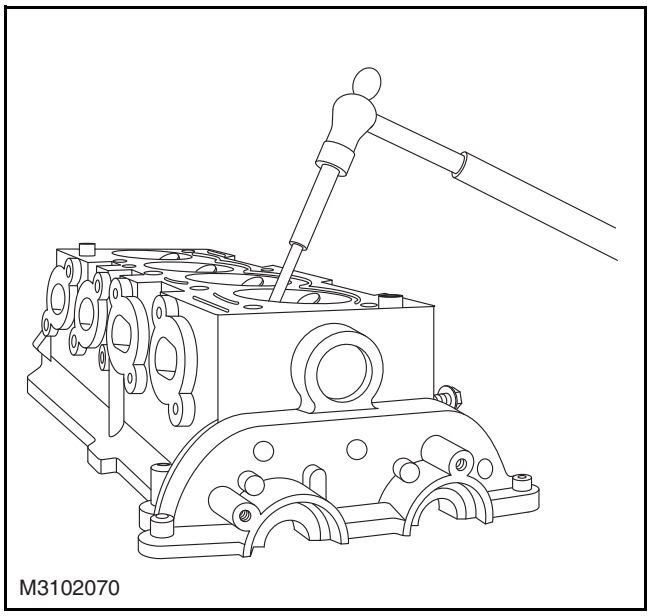
https://truckmanualshub.com/



**18.** Use a proper tool to push the valve guide from combustion chamber side to valve spring side.

**CAUTION: The valve guide will not be reusable if removed. Be sure to use a new (oversized) valve guide when assembling.**

**CAUTION: Except for the valve oil seal and valve guide, arrange the removed components in order so that they can be reassembled to their original positions.**



M3102070

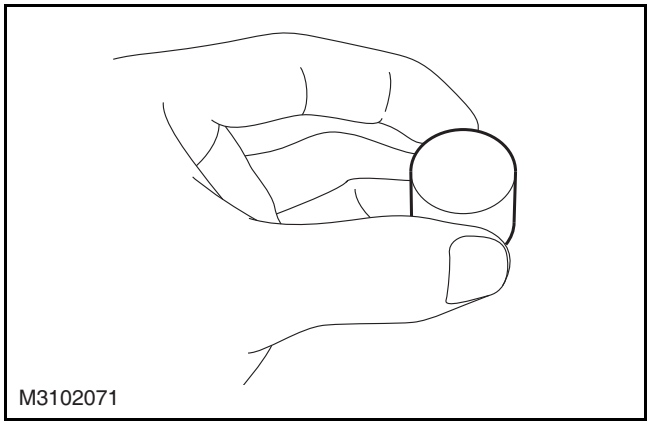
https://truckmanualshub.com/



## Inspection

1. Inspect the valve tappet surface for scrape, and the top for wear. Replace the valve tappet with a new one according to the valve clearance match table if exist.

**CAUTION: Each valve tappet has its fixed position and cannot be changed.**

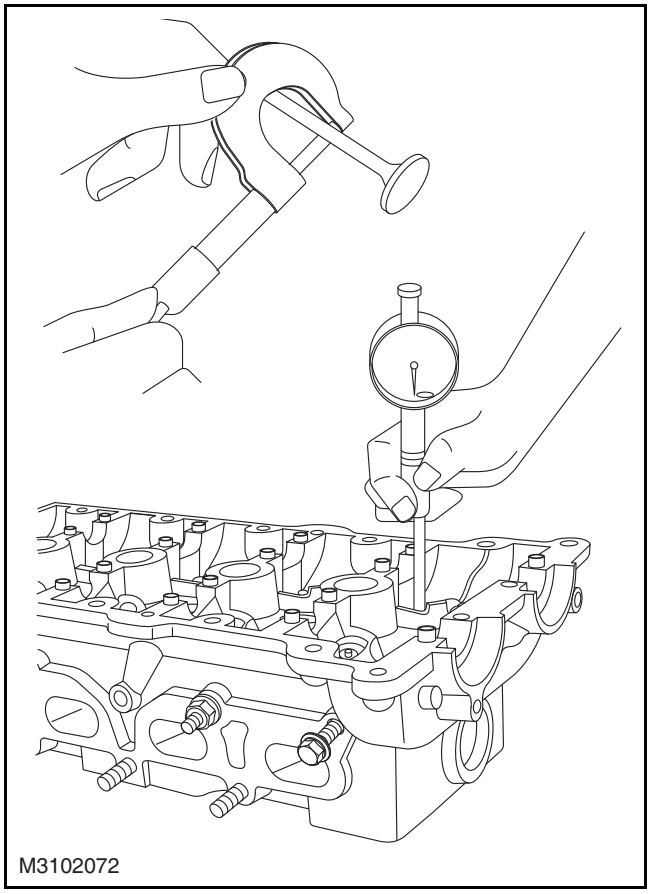

M3102071

2. Use the micrometer to measure the valve stem diameter, and inspect the valve stem for wear.

   General equipment: Micrometer

**CAUTION: The valve and valve guide must be replaced if the data is lower than limit.**

| Item | | Standard | Limit |
|---|---|---|---|
| Valve stem diameter | Intake | 4.952 ~ 4.966 mm | 4.947 mm |
| | Exhaust | 4.926 ~ 4.940 mm | 4.921 mm |
| Valve guide inner diameter | Intake | 5.00 ~ 5.012 mm | 5.020 mm |
| | Exhaust | | |
| Clearance between valve stem and guide | Intake | 0.046 ~ 0.060 mm | 0.073 mm |
| | Exhaust | 0.072 ~ 0.086 mm | 0.099 mm |

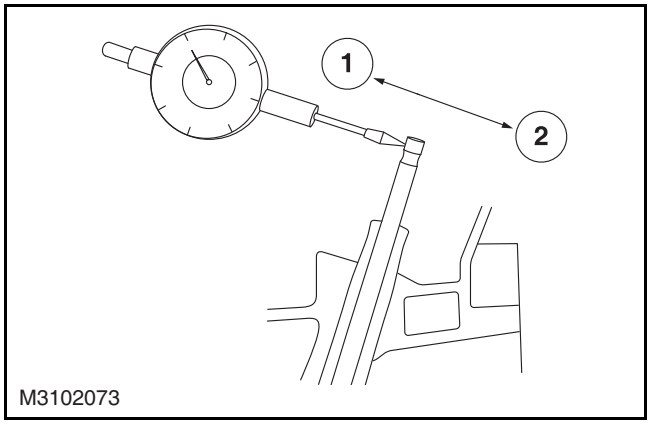

M3102072

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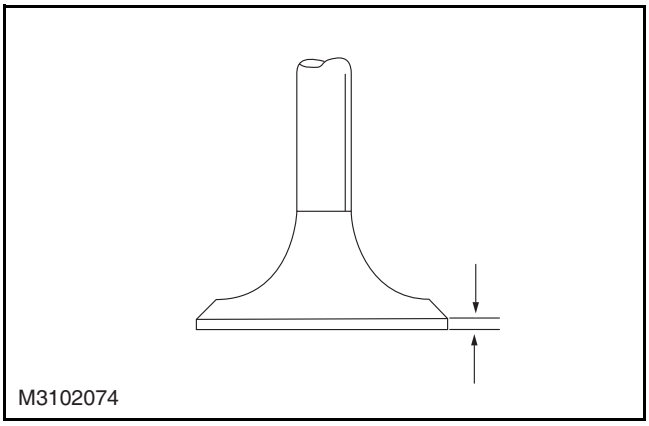
3. If a caliper gauge is not available, inspect the end offset of valve stem with the dial indicator instead. Move the valve stem end in both 1 and 2 directions to inspect the end offset. If the offset is more than the limit, replace the valve stem and valve guide.

| | | |
|---|---|---|
| valve stem end offset limit | Intake | 0.14 mm |
| | Exhaust | 0.18 mm |



M3102073

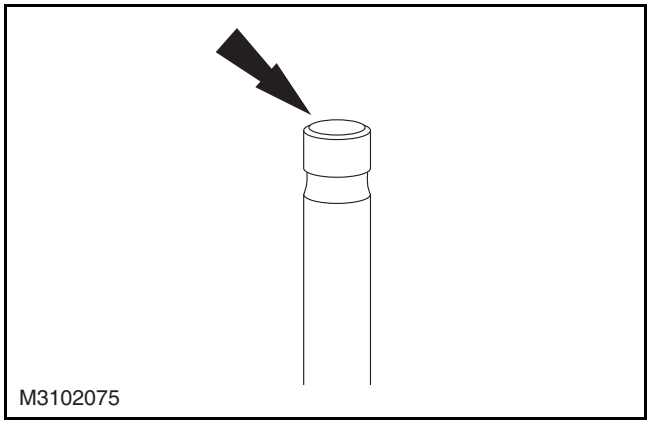
4. Clean all the carbon deposit from the valve.
5. Inspect the working surfaces of valve and the valve stem for abrasions, burns or deformations, and replace the valve when necessary.
6. Measure the valve head thickness. If the measured thickness exceeds limit, replace the valve.


M3102074

| Valve Head Thickness | | |
|---|---|---|
| **Item** | **Standard** | **Limit** |
| Intake | 0.85 ~ 1.15 mm | 0.6 mm |
| Exhaust | | 0.7 mm |

7. Inspect the valve stem end for any possible dent or wear.

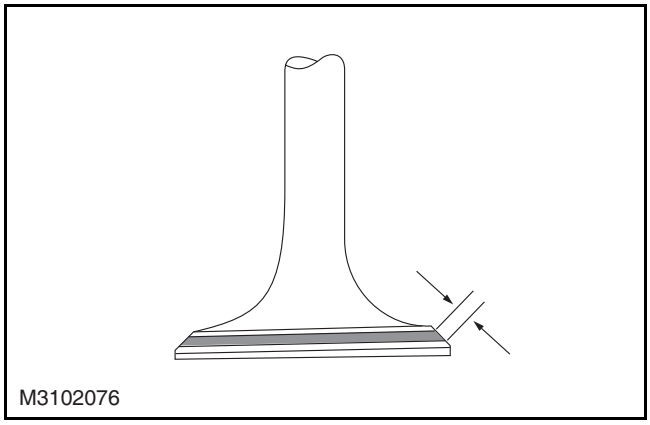
**CAUTION: Trim the valve stem if there is dent or abrasion. Do not trim too much to polish the chamfer. Replace the valve if the chamfer has been polished.**


M3102075

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8. Inspect the valve-face width by observing the contacting imprint left on the valve matching surface.


M3102076

**CAUTION: Uniformly apply a coat of membrane on the valve seat and then inspect the valve-face width by turning the valve seat and valve head. Valve grinder must be used (the tool is used to grind the valve).**

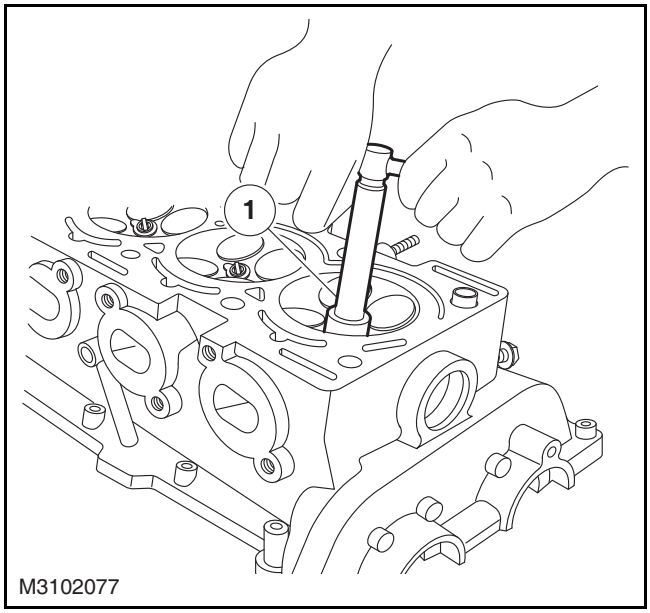
**CAUTION: The imprint left on the valve matching surface must be a continuous circle, the width of which must be within the specification.**

| Valve Imprint Standard Width | |
|---|---|
| | **Standard** |
| Intake | 1.25 mm in minimum, 0.5 mm in unevenness |

9. Repair the valve seat.

**CAUTION: The valve seat must be dressed, turned, grinded and polished, if the imprint made by the contact between valve seat and valve is not even or the width is not within the specification.**

1 Use a valve reamer to repair twice as shown in the figure.



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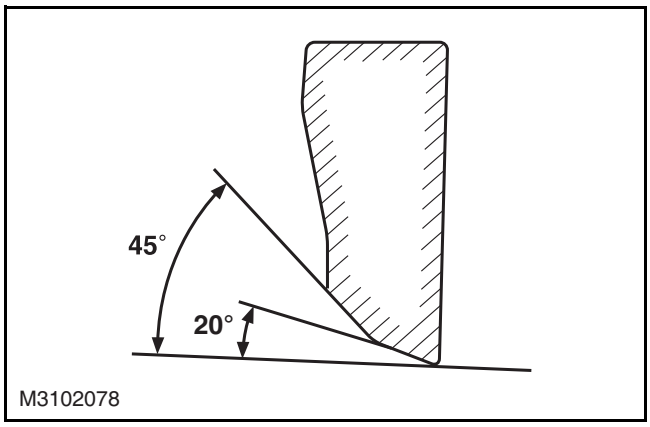
**CAUTION: Two reamers must be used for repair. Use the first one at an angle of 20° and the second one at an angle of 45°. The width required must be reached at the second repair.**

Exhaust valve seat width: 1.2 ~ 1.45 mm

Intake valve seat width: 1.3 ~ 1.55 mm

2 Grind the end face by spreading rough grinding paste on it.

3 Grind the end face with fine grinding paste.



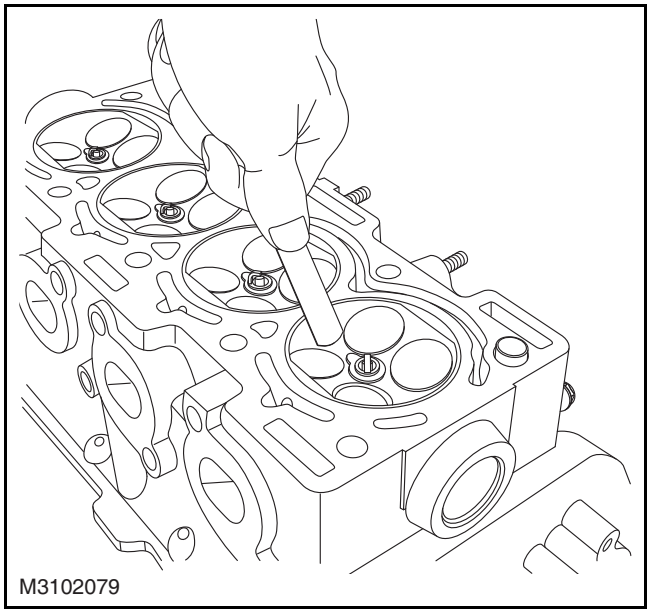
M3102078

**CAUTION: Use the common methods to grind the end face with valve grinding tools in each step.**

**10.** Remove the combustion chamber carbon deposit.

**CAUTION: Do not use any sharp tools to scrape the carbon deposit. Be careful not to damage or scrape the metal surface when clearing carbon deposit. It is also applicable to the valve(s) and valve seat(s).**

**11.** Inspect the cylinder head intake and exhaust ports, combustion chamber and cylinder head surface for any possible scratches.


M3102079

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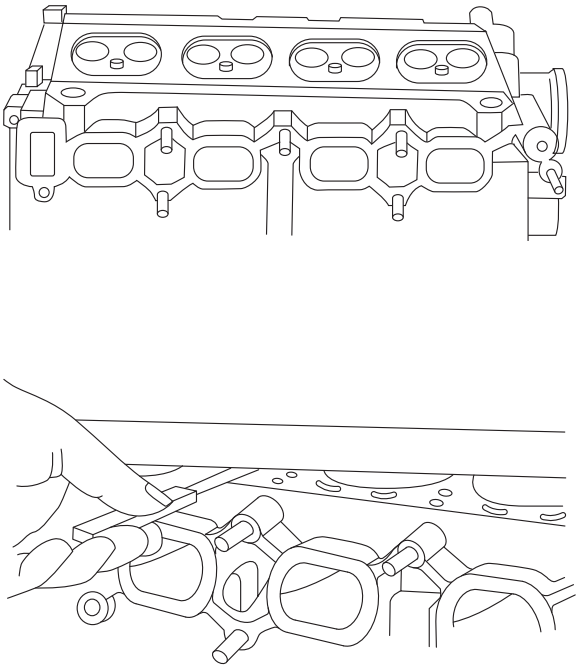
**12.** Inspect the cylinder head for flatness.

General equipment: Plastic feeler gauge, straight scale

**CAUTION: Use the straight scale and feeler gauge to inspect the cylinder head surface at 6 positions. Use a flat and a 400# sand paper to level the cylinder head if the deformation of cylinder head exceeds the limit below.**

**CAUTION: Install a new cylinder head if the reading on the feeler gauge remains beyond the limit.**

Deformation limit: 0.05 mm



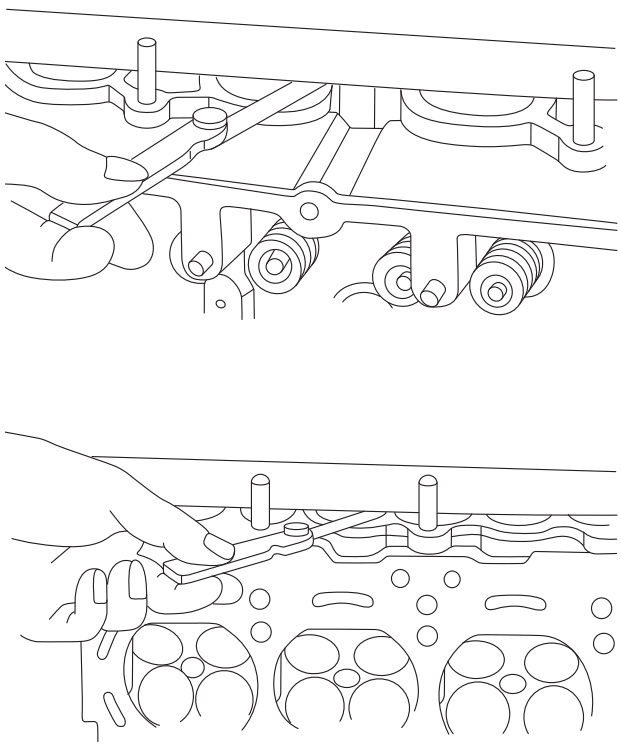
M3102080

**13.** Inspect the manifold matching surface for deformation.

General equipment: Plastic feeler gauge, straight scale

**CAUTION: Inspect the cylinder head manifold matching face with a straight scale and a feeler gauge to see if these surfaces need to be leveled or the cylinder head need to be replaced.**

Deformation limit: 0.05 mm



M3102081

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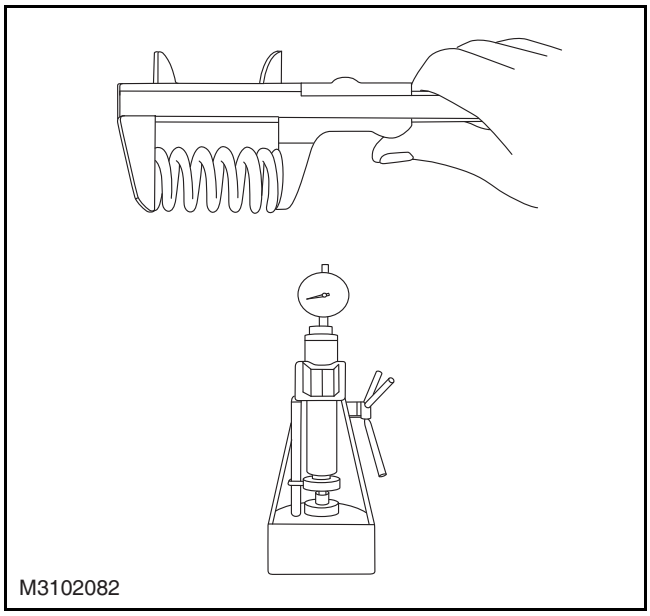


**14.** Inspect the valve spring length and load.

General equipment: Vernier caliper

**CAUTION: Inspect if each spring is still functioning or not damaged or weakening referring to the following table. Valve spring(s) with poor elasticity results in vibration and the reduced valve seat pressure results in the occurrence of gas leak, which leads to the reduction of output power.**

| Item | Standard | Limit |
|---|---|---|
| Valve spring free length | 35.37 mm | 35.14 mm |
| Valve spring preload length | 27.9 mm at 109 ~ 127 N | |

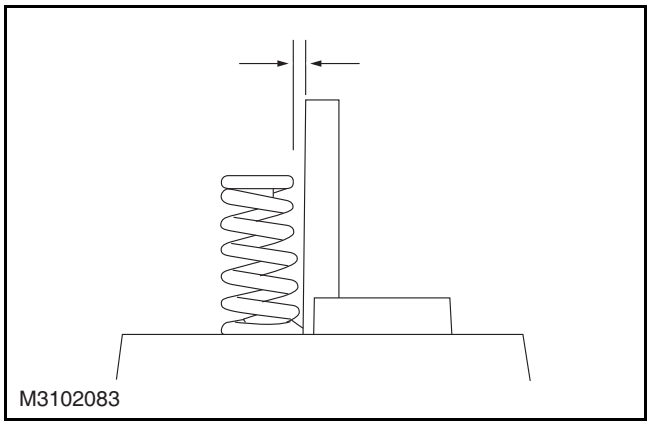

M3102082

**15.** Inspect the valve spring for uprightness.

General equipment: Straight scale

**CAUTION: Use a straight scale and a flat to inspect the uprightness of each spring in accordance with the clearance between valve spring end and straight scale. Install a new valve spring if the clearance exceeds the limit values shown below.**

Valve spring uprightness limit: 1.0 mm


M3102083

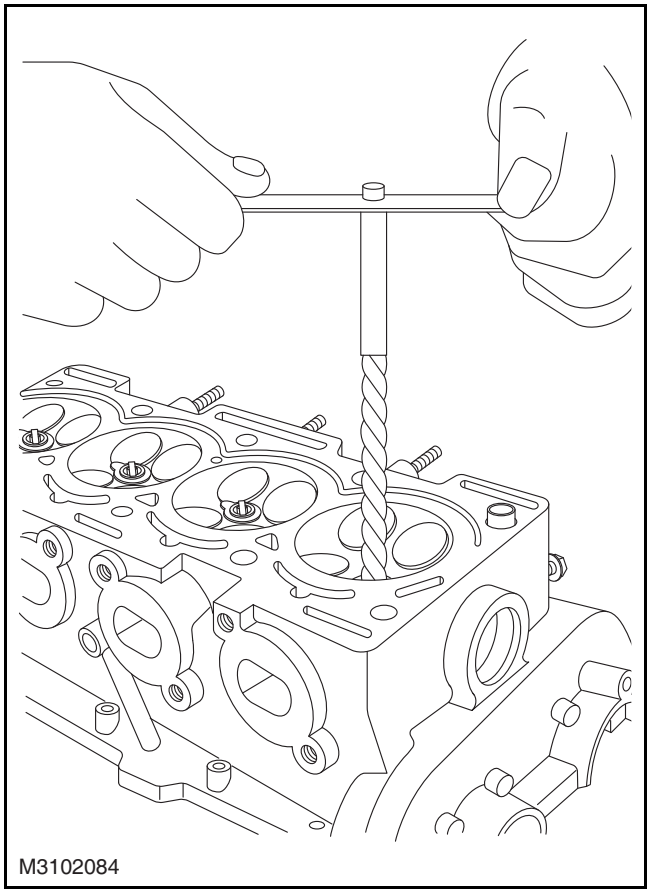
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## Assembly

1. Use 9 mm reamer to remove the raw edges around the valve guide bore.

   General equipment: 9 mm reamer

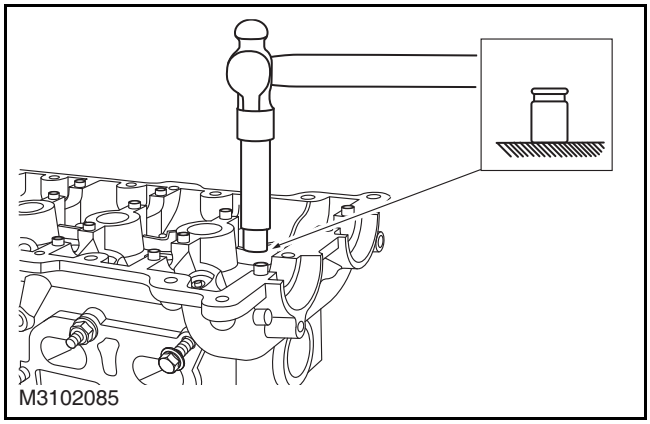

M3102084

2. Install the valve guide(s) in the cylinder head.

   1 Heat the cylinder head evenly.

**CAUTION: Evenly heat the cylinder head to 80°C ~ 100°C, thus, the cylinder head will not be deformed.**

   2 Use the special tool to press the new valve guide into the bore until the special tool contacts with the cylinder head.


M3102085

**CAUTION: After installing, make sure that the valve guide stretches a distance of 9.15 ± 0.2 mm from the cylinder head.**

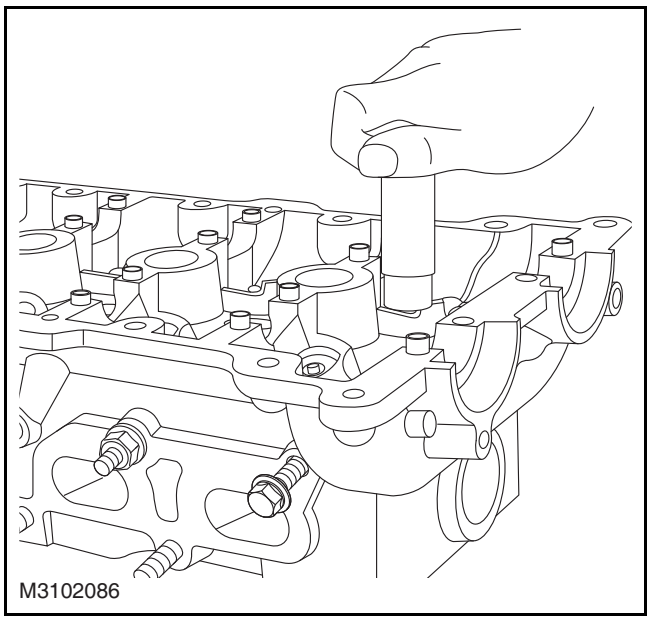
**CAUTION: The installations of both the intake and exhaust valve guides are the same.**

**CAUTION: Valve guide oversized (intake and exhaust): 0.028 mm.**

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3. Use 5.0 mm reamer to ream the valve guide bore diameter.
4. Clean the valve guide bore.


M3102086

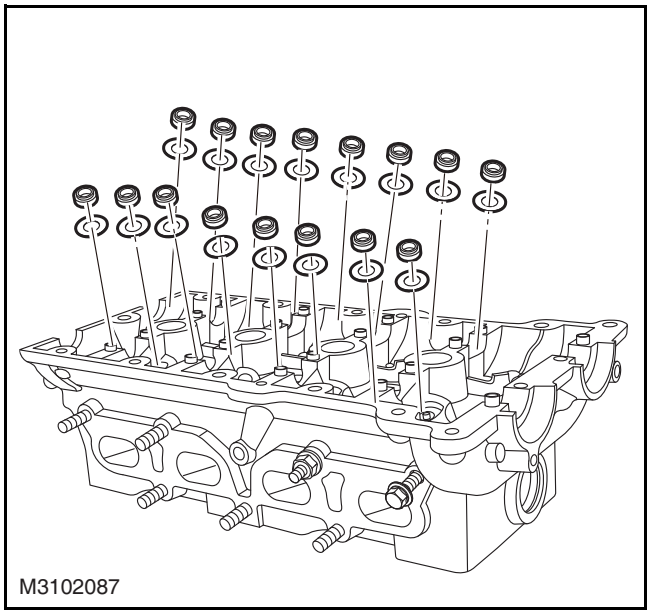
5. Use the special tool to install a new valve stem oil seal to the valve guide.

   Special tool: CA301-013

**CAUTION: Apply engine oil to the valve stem oil seal surface and then install the oil seal on valve guide with special tool.**

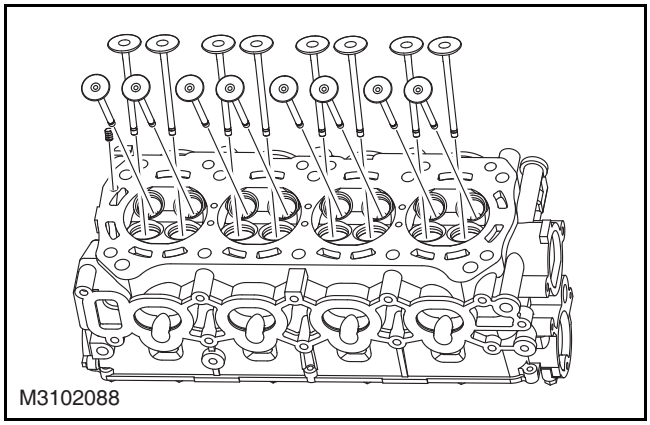
**CAUTION: Once the oil seal is removed, it cannot be reused.**

**CAUTION: During the installation, do not knock on the special tools with a hammer or other tools. Install the oil seal on the valve guide by pushing and pressing the special tool with hands. Knocking on the special tool may result in the damage of oil seal.**


M3102087

6. Install the valve spring to cylinder head.
7. Install the valve to valve guide.

**CAUTION: Apply engine oil to the valve oil seal, valve guide bore and valve stem when installing the valve to valve guide.**

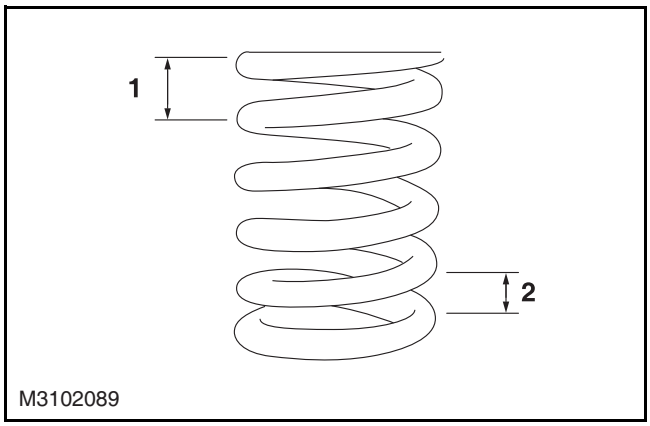

M3102088

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8. Install the valve spring and spring retainer.

**CAUTION: Each valve spring has a top (big pitch end (1)) and a bottom (small pitch end (2)). When installing the spring, its bottom end (small pitch end (2)) must point to the bottom (valve spring lower retainer).**



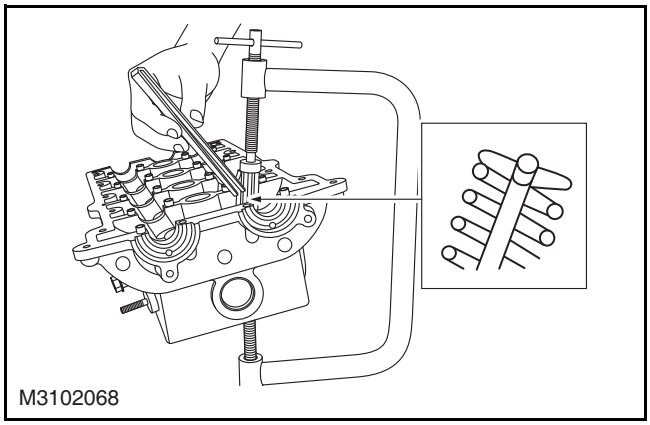

9. Use the special tool to compress the valve spring and install the valve cotter to valve stem groove.

   Special tool: CA301-011

   General equipment: Tweezer

10. Install the valve tappet after applying oil to it.

**CAUTION: Each valve tappet has its fixed position and cannot be changed.**

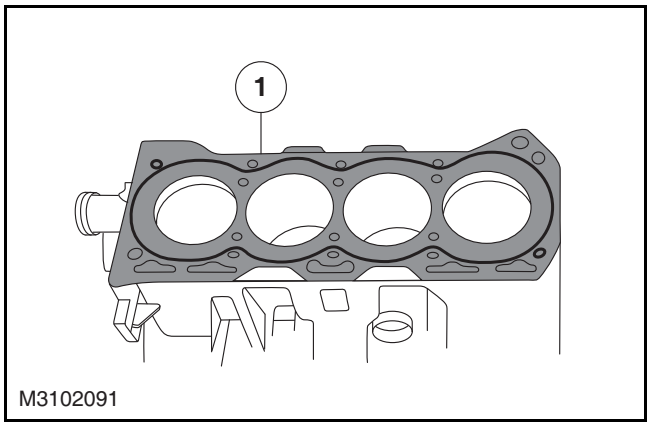



11. Install a new cylinder head gasket.

    1 Remove the used cylinder head gasket (1).

    2 Apply an appropriate amount of engine oil to the matching surface.

    3 Install the cylinder head gasket onto the cylinder block with "TOP" on the gasket facing upside, and connected with crankshaft belt pulley side.



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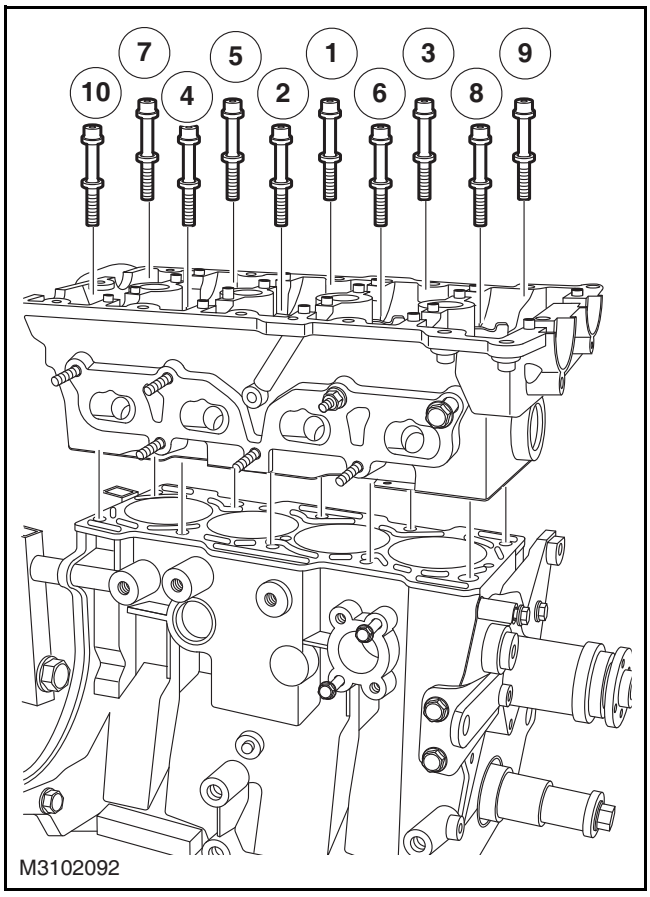


**12.** Install and tighten the cylinder head bolts.

1 Tighten all the bolts to 45 Nm in order as shown in figure.

2 Tighten all the bolts to the specificied torque in order as shown in figure.

Torque: 67 ± 2 Nm



M3102092

**13.** Install the camshaft.

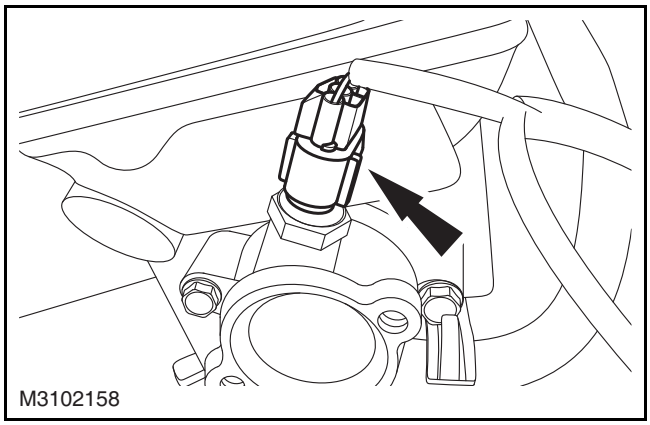
**Refer to: Camshaft (3.1.2 Mechanical System, Removal and Installation).**

**14.** Inspect the valve clearance, replace the valve tappet when necessary.

**Refer to: Valve Clearance Inspection and Adjustment (3.1.2 Mechanical System, General Inspection).**

**15.** Install the thermostat holder assembly.

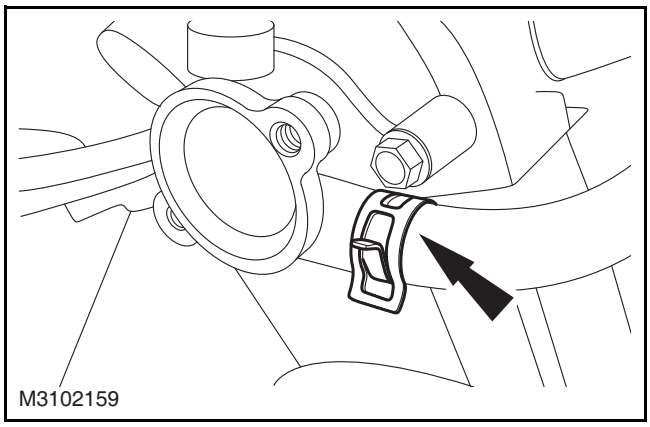
1 Install 2 retaining bolts to the thermostat holder.


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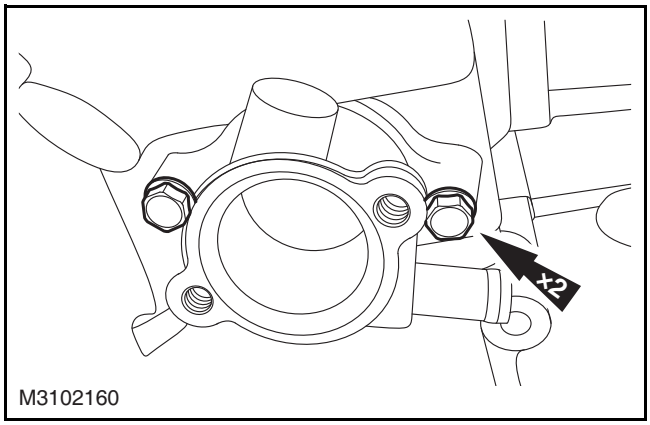
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2 Connect the 1# water outlet pipe.




3 Connect the coolant temperature sensor wiring harness connector.




**16.** Install the thermostat.

**Refer to: Thermostat (3.1.4 Cooling System, Removal and Installation).**

**17.** Install the exhaust manifold.

**Refer to: Exhaust manifold and three-way catalytic (3.1.6 Exhaust System, Removal and Installation).**

**18.** Install the intake manifold.

**Refer to: Intake Manifold (3.1.5 Intake System, Removal and Installation).**

**19.** Install the engine timing belt.

**Refer to: Timing Mechanism (3.1.2 Mechanical System, Removal and Installation).**

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20. Install the accessory belt, and adjust the belt tension.

    **Refer to: Accessory Drive Belt Inspection (3.1.2 Mechanical System, General Inspection).**

21. Install the cylinder head cover.

    **Refer to: Cylinder Head Cover (3.1.2 Mechanical System, Removal and Installation).**

22. Install the ignition coil and high-voltage damping line.

    **Refer to: Ignition Coil (3.1.8 Ignition System, Removal and Installation).**

    **Refer to: High-voltage Damping Line (3.1.8 Ignition System, Removal and Installation).**

23. Connect the negative battery cable.

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# Piston, Piston Ring, Connecting Rod and Cylinder

### General Equipment

| |
|---|
| Cylinder bore gauge |
| Micrometer |
| Plastic feeler gauge |
| Straight scale |
| Piston ring expander |
| Piston ring compressor |

### Material

| Item | Specifications |
|---|---|
| Sealant | Loctite 5900 |
| Thread locking sealant | Loctite 262 |

## Disassembly

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Drain the engine coolant.

   **Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).**

3. Drain the engine oil.
4. Remove the engine assembly.

   **Refer to: Engine Assembly (3.1.2 Mechanical System, Removal and Installation).**

5. Remove the cylinder head.

   **Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**

6. Remove the oil pan and oil strainer.

   **Refer to: Oil Pan and Oil Strainer (3.1.3 Lubrication System, Removal and Installation).**

7. Remove the oil pump.

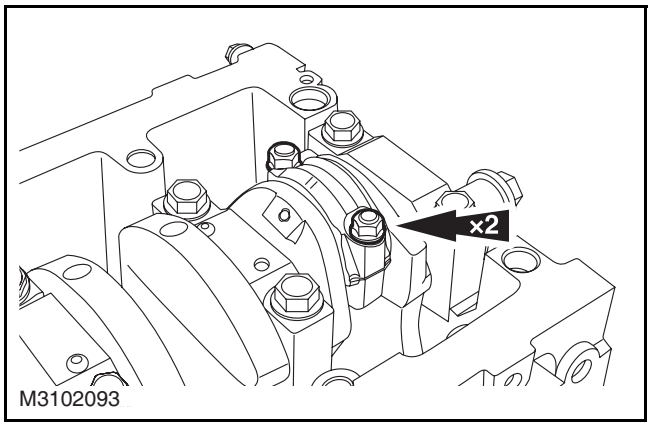
   **Refer to: Oil Pump (3.1.3 Lubrication System, Removal and Installation).**

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8. Mark on the piston, connecting rod and connecting rod bearing cap with quick drying paint.
9. Remove the piston connecting rod bearing cap retaining bolts.

   Torque: 35 ± 2 Nm

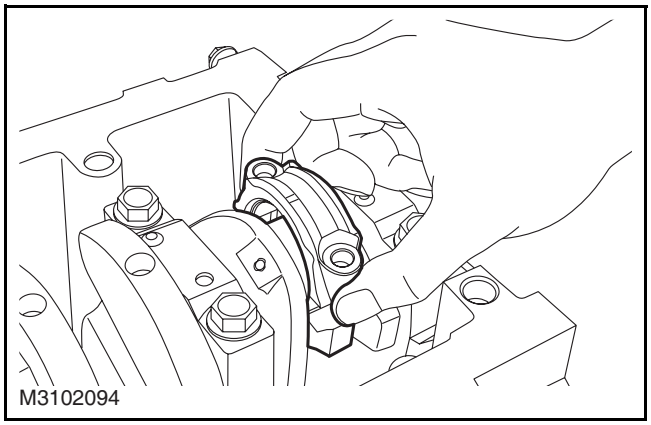


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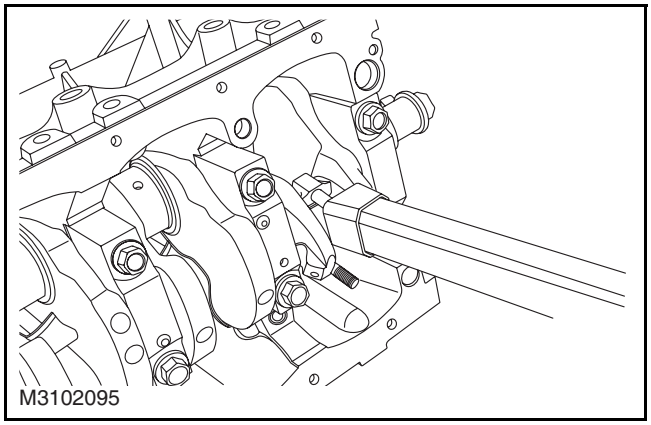
10. Remove the piston connecting rod bearing cap.

**CAUTION: Install the rubber boot over the thread of connecting rod bolts to avoid damaging the crankshaft journal and cylinder inner wall when removing the connecting rod.**

11. Remove the carbon deposit from cylinder upper part.


M3102094

12. Push out the piston and connecting rod from the engine block.


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**13.** Use the piston ring expander to remove the piston ring.

**Refer to: The first and second rings are gas ring, the third one is oil ring.**

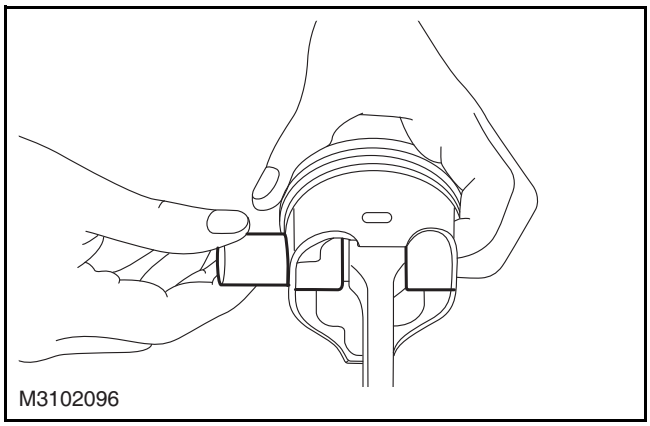
**14.** Separate the piston from the connecting rod.

1 Remove the piston pin circlip.

2 Press out the piston pin.

3 Separate the piston from the connecting rod.

**15.** Use a suitable tool to remove the carbon deposit from the piston top and piston ring groove.


M3102096

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## Inspection

1. Visually inspect the cylinder walls for evident scratch, roughness or swell. If the cylinder wall is very rough or has some deep scratches, sags and crests, hone out the cylinder block again or replace the crankcase.
2. Measure the cylinder bore at three positions in two directions with a cylinder bore gauge as shown in the figure. Hone out the cylinder block again or install a new crankcase if any of the following cases exists.

   1 The cylinder bore exceeds the tolerance.

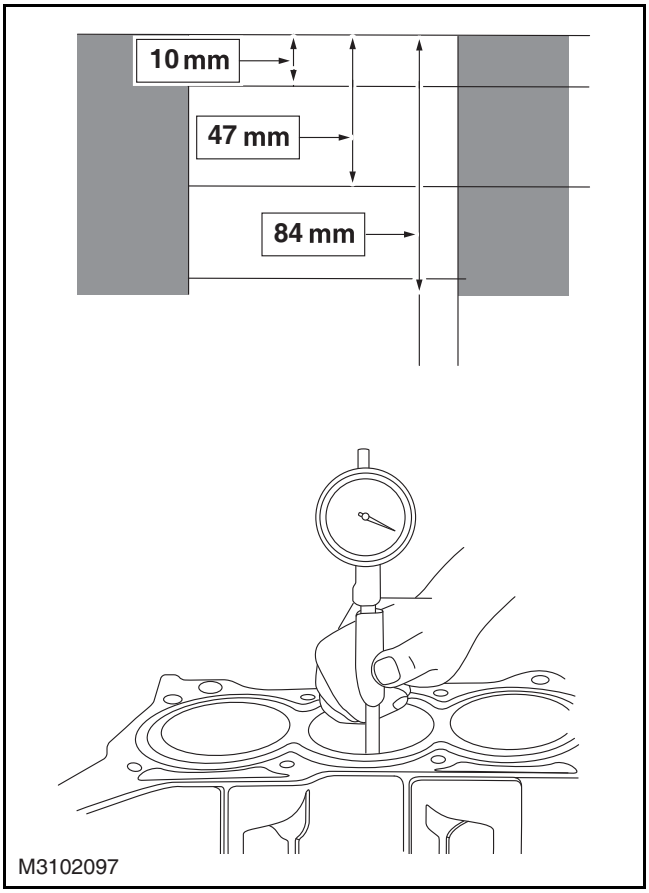
   2 The difference value of tapers at the two positions exceeds the tolerance.

   3 The measured thrust and axial difference value exceeds the out-of-round range.

   Cylinder diameter limit: 66.02 mm

   Cylindricity limit: 0.008 mm

   Out-of-round limit: 0.008 mm




**CAUTION: Hone out the four cylinder blocks at an uniform increased scale if any of them needs to be honed out again. This is necessary to keep the uniformity and equilibrium of cylinder blocks.**

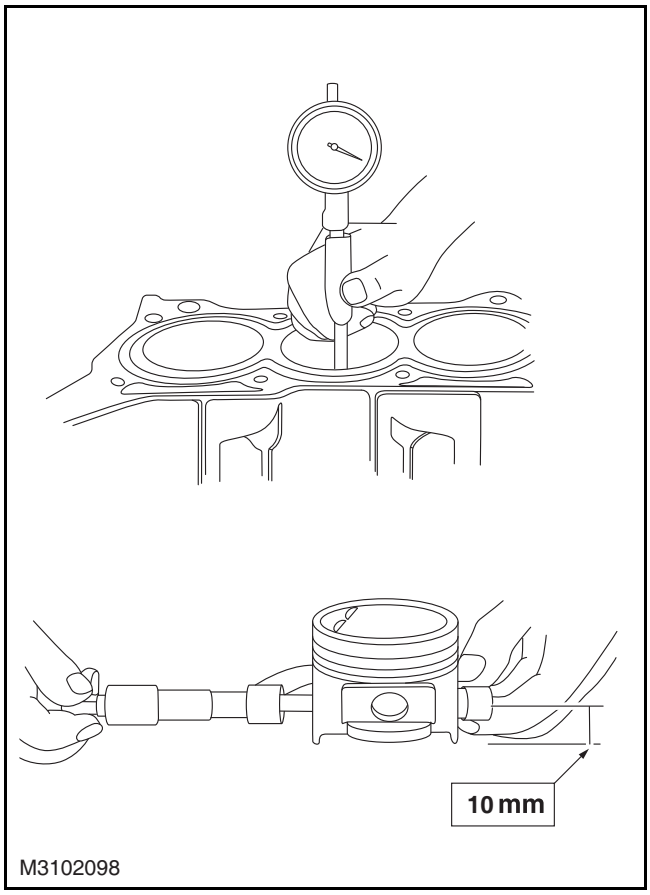
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3. Inspect the pistons for abrasions, cracks or other damages, and replace if damage is found.

4. Measure the piston diameter (from the piston skirt bottom to vertical position, with 10 mm away from piston pin (no printed graphite)) as shown in the figure.

| | | |
|---|---|---|
| Piston diameter | Standard | 65.58 ~ 65.82 mm |
| | Oversize by 0.25 mm | 65.83 ~ 66.07 mm |
| | Oversize by 0.50 mm | 66.08 ~ 66.32 mm |



M3102098

5. Inspect the clearance between piston and cylinder. If the clearance exceeds the specified range, hone out the cylinder block again with an oversized piston or install a new crankcase.

   Piston clearance: 0.028 ~ 0.052 mm (after the piston skirt is printed graphite)

**CAUTION: The cylinder bore in this step is measured at two positions in two directions.**

6. Inspect the piston ring groove clearance.

   1 Clean and dry the piston ring groove.

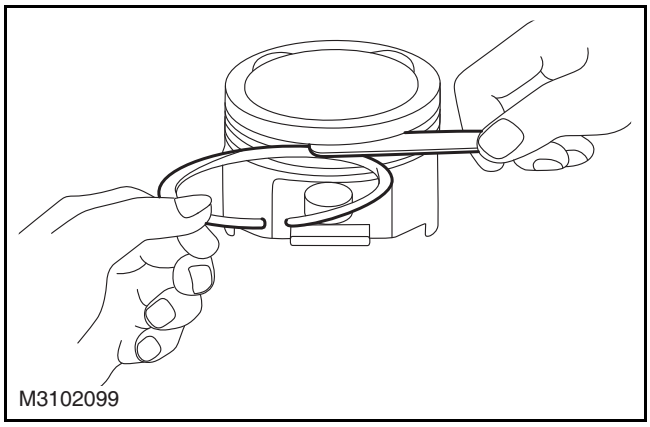
   2 Install the piston ring in the groove.

   3 Use the plastic feeler gauge to measure the piston ring groove clearance. If it exceeds the standard range, install a new piston.

   Piston ring groove clearance:

   The first ring: 0.04 ~ 0.08 mm

   The second ring: 0.03 ~ 0.07 mm


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7. Inspect the piston pins, connecting rod small end holes and piston holes for abrasions or damages.

**CAUTION: If severe abrasion or damage is found, replace the pins, connecting rods or pistons.**

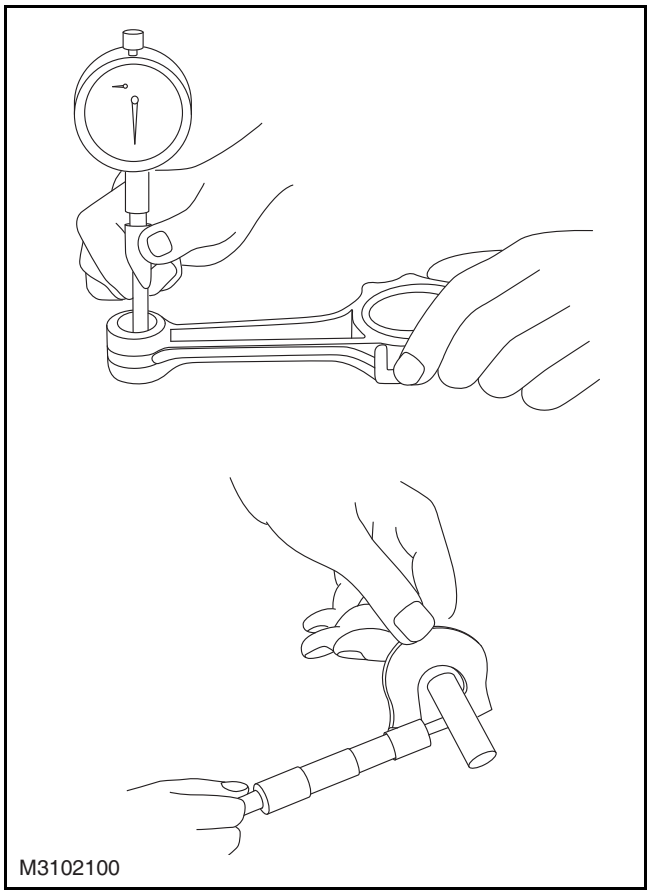
8. Inspect the piston pin clearance.

**CAUTION: Measure the piston pin clearance at small end. If severe abrasion or damage is found or clearance is out of the standard range, replace the connecting rods.**

| Item | Standard | Limit |
|---|---|---|
| Connecting rod small end clearance | 0.006 ~ 0.017 mm | 0.05 mm |

Small end hole: 16.006 ~ 16.012 mm

Piston pin diameter: 15.995 ~ 16.000 mm

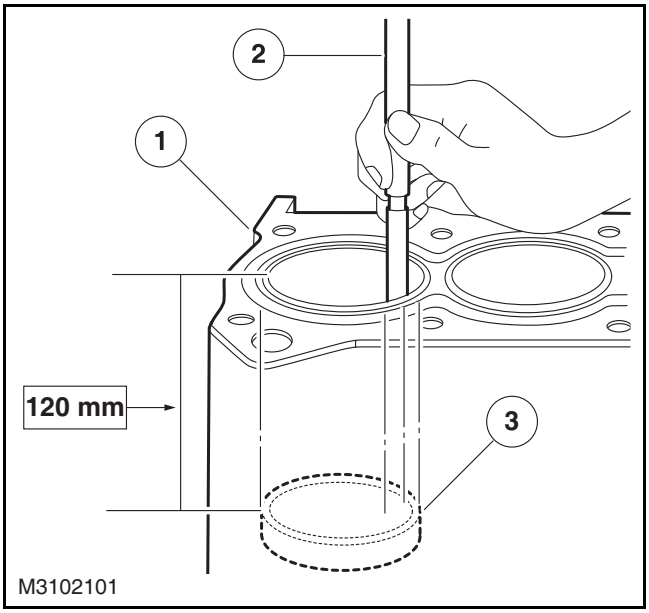

M3102100

9. Insert the piston rings into the cylinders and measure the clearance with a feeler gauge.

**CAUTION: Clean the carbon deposit from the top of cylinder before inserting the piston ring.**

General equipment: Plastic feeler gauge

| Item | | Standard | Limit |
|---|---|---|---|
| Piston ring end gap | First ring | 0.15 ~ 0.30 mm | 0.5 mm |
| | Second ring | 0.30 ~ 0.45 mm | 0.5 mm |



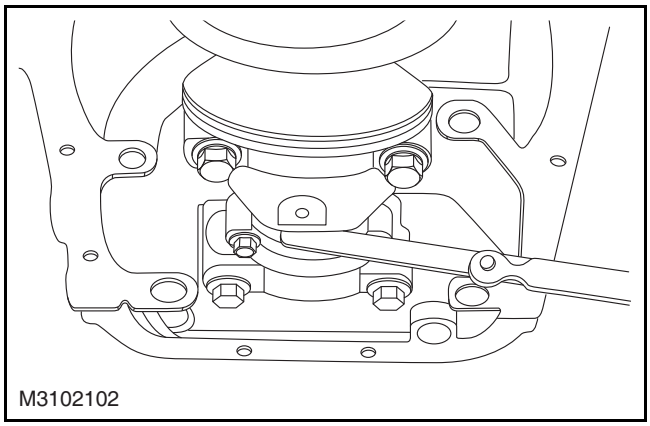
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**10.** Connect the crankshaft and connecting rod and inspect the connecting rod large end side clearance. Install a new connecting rod if the clearance exceeds the standard range.

| Item | Standard | Limit |
|---|---|---|
| Connecting rod large end side clearance | 0.10 ~ 0.20 mm | 0.36 mm |


M3102102

**11.** Install the connecting rod on the straightener and inspect if the connecting rod is bent or distorted. If the bend and distortion are out of limits, replace the piston connecting rod.

Bend limit: 0.05 mm

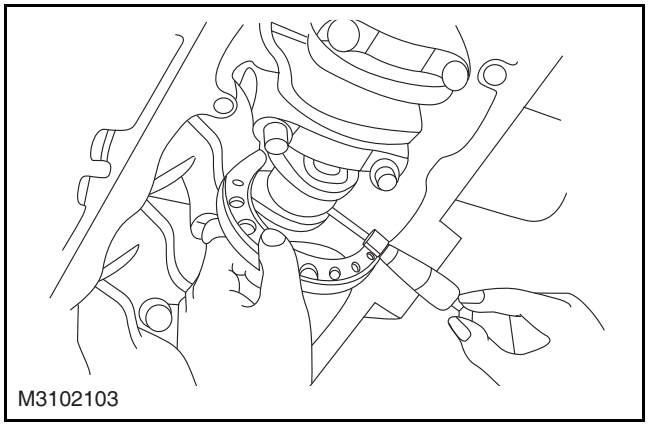
Distortion limit: 0.10 mm

**12.** Use a micrometer to inspect the journal for any possible irregular wear or damages.

| Connecting Rod Bearing Shell Model | Journal Diameter |
|---|---|
| Standard size | 37.982 ~ 38.000 mm |
| Reduce the size by 0.25 mm | 37.732 ~ 37.750 mm |

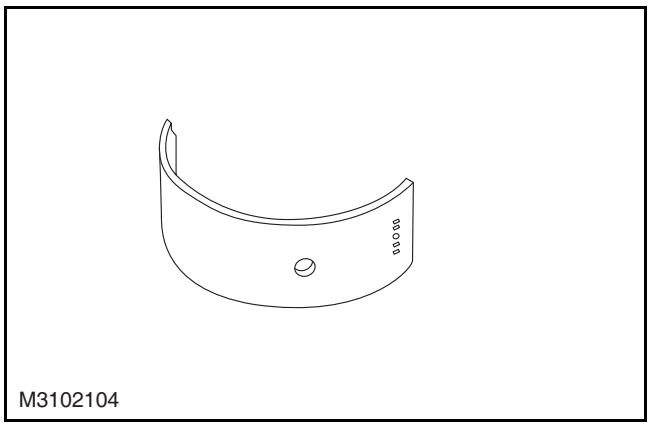
Journal out-of-round and taper limit: 0.005 mm

General equipment: Micrometer


M3102103

**13.** Inspect the bearing shell for dissolution, drop pits, ablation or surface peeling off as well as contacting pattern. If there are any obvious signs as described above, replace the shell.

**CAUTION: Distinguish the standard bearing shell from the reduced by 0.25 mm through observing the mark on the back of the bearing shell.**


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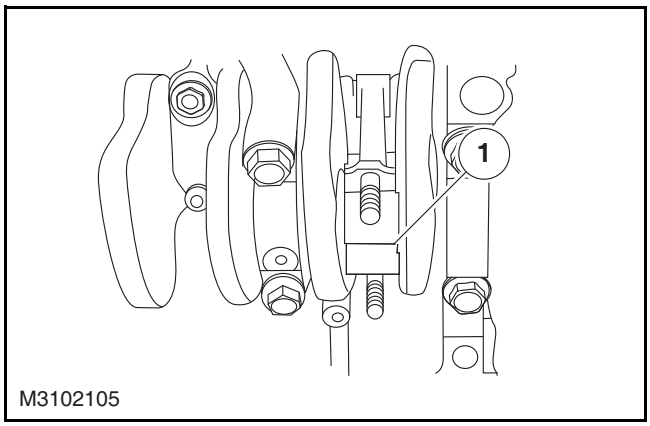
**14.** Inspect the connecting rod bearing shell clearance.

1 Clean the connecting rod bearing shells and cranks.

2 Install the bearing shells to the connecting rod and bearing cap.

3 Parallel to the crankshaft axis, place a piece of feeler gauge on the crank while away from the oil hole.

General equipment: Plastic feeler gauge

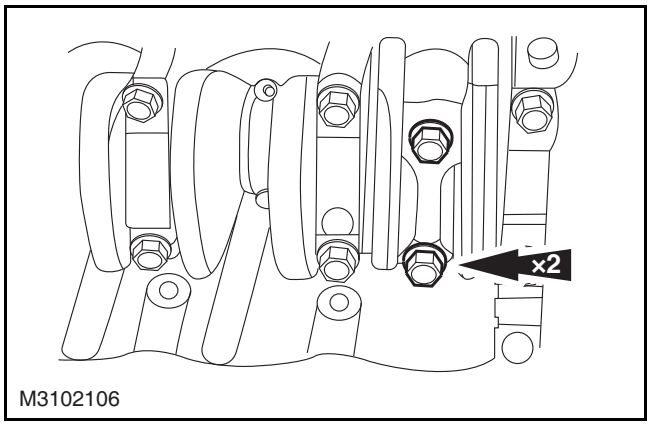


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**15.** Install the connecting rod bearing cap.

**CAUTION: When installing the connecting rod bearing cap, confirm that dowel pins on the bearing cap face toward the flywheel side. After applying oil to the bolts on both sides, tighten the retaining nuts of connecting rod bearing cap to the specified torque as shown in the figure. Do not rotate the crankshaft with feeler gauge.**

Torque: 35 ± 2 Nm

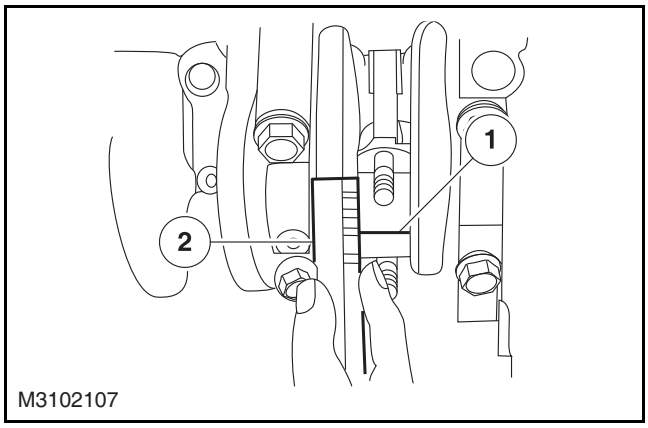


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**16.** Remove the bearing cap and place a gauge (1) on the plastic feeler gauge (2), then measure the feeler gauge width at its widest point.




**CAUTION: If the clearance is out of the standard range, install a new bearing shell of standard size and measure clearance again.**

| Item | Standard | Limit |
|---|---|---|
| Bearing shell clearance | 0.020 ~ 0.040 mm | 0.026 ~ 0.046 mm |

**17.** If the clearance is still out of standard after replacing with a new standard bearing shell, replace the crankshaft or grind the crank.

1 Install the bearing shell reduced by 0.25 mm in size to the connecting rod large end.

2 Measure the connecting rod large end bore diameter.

3 Grind the crank again to reach the final diameter below.

| |
|---|
| Final crankshaft diameter = Measured large end bore diameter (including the sized-reduced bearing) - 0.035 mm |

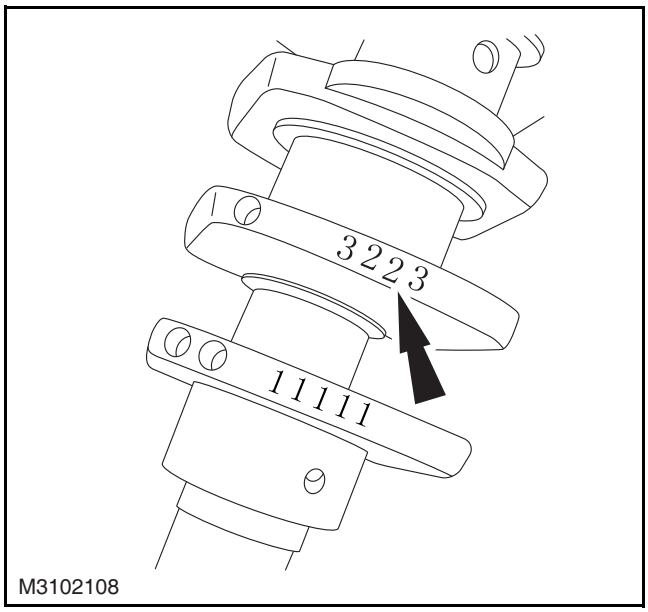
4 Verify the bearing shell clearance is within the standard range.

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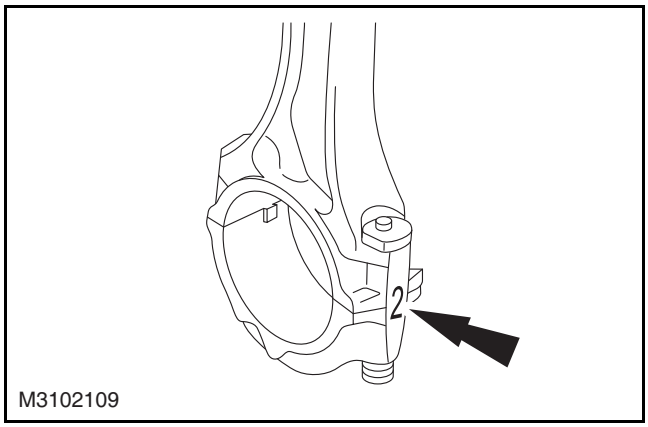
**18.** Selection of connecting rod bearing shell:

1 Verify the crank with 4 numbers on the crankshaft. The 4 numbers stand for the model of connecting rod journal diameter and installation sequence of 4 connecting rods.



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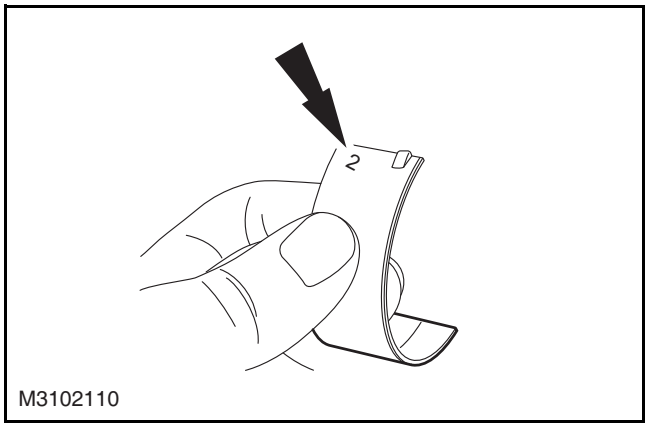
2 Then verify the number on the joint surface of connecting rod bearing caps. The number represents the model of connecting rod large end hole diameter.



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3 Selection of connecting rod bearing.

Bearing shell = 7 - Number printed on the crankshaft - Number on the connecting rod bearing cap side



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## Assembly

1. Match the piston to the corresponding cylinder by following number on the top of piston and the cylinder inside diameter mark on the cylinder block.

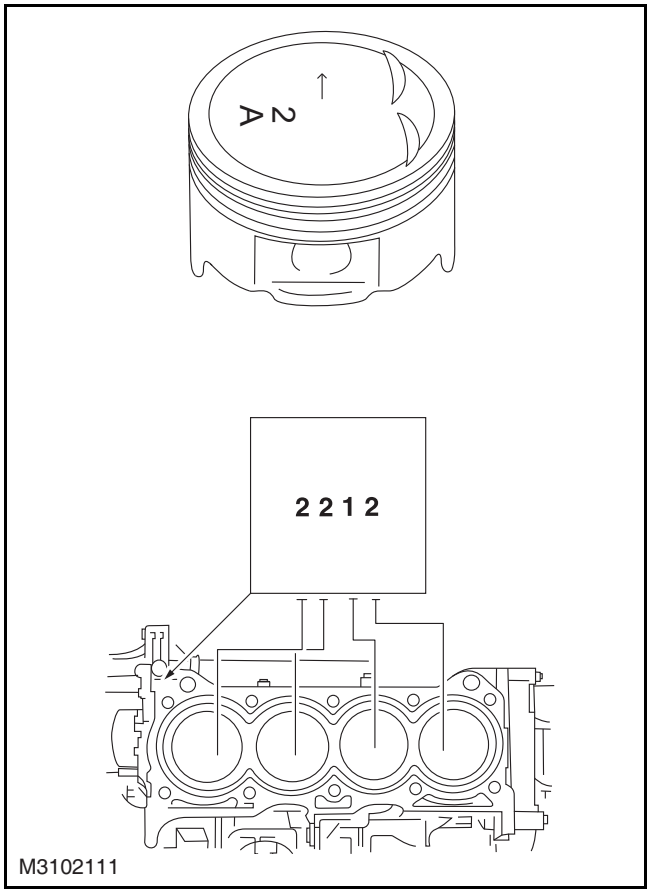
**CAUTION: Two models of piston are standard spare parts. The piston can be used only if it guarantees a correct piston and cylinder clearance. When installing the standard piston, match the piston to the cylinder as the following description.**

**CAUTION: Each piston has the number as shown in the figure, which represents the outside diameter of piston.**

**CAUTION: There are also numbers mark 1 or 2 on the engine block as shown in the figure. The first number represents the inside diameter of No.1 cylinder. The second number represents the inside diameter of No.2 cylinder. The third number represents the inside diameter of No.3 cylinder. The fourth number represents the inside diameter of No.4 cylinder.**

**CAUTION: Match the piston to the corresponding cylinder by following the cylinder inside diameter mark on the cylinder block.**

**CAUTION: There is a quality grouping letter A and B stamped on each piston top. When assembling, all the pistons should belong to the same quality group.**



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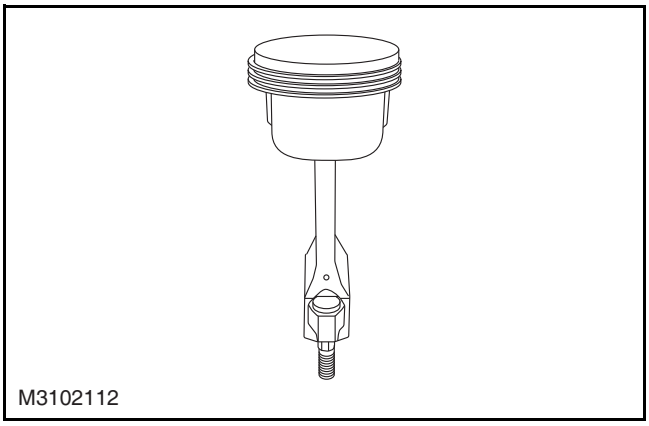
**2.** Install the piston ring to the piston and connecting rod.

1 Apply an appropriate amount of engine oil to the piston pin and piston pin hole.

2 Install the piston connecting rod to the piston.

3 Insert the piston pin into the piston and connecting rod.

4 Install the piston pin circlip.

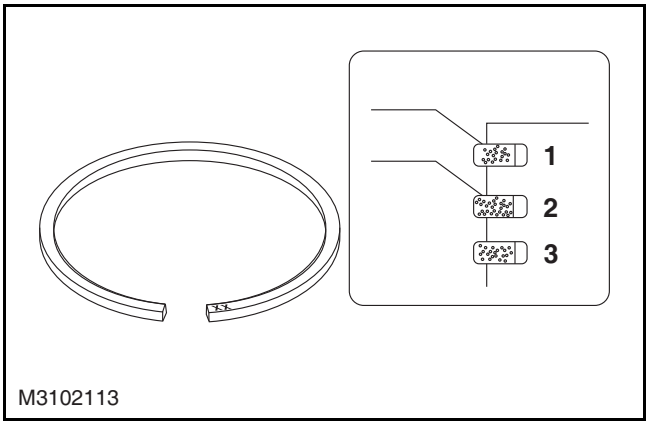

M3102112

**CAUTION: As shown in the figure, install the piston pin circlip with its mouth facing upwards or downwards.**

**CAUTION: The engine oil hole should be on the intake side.**

**3.** Install the piston ring to the piston.

1 There are letter marks on the No.1 and No.2 piston rings as shown in the figure. Install the piston rings into the corresponding piston ring groove with the marked side facing the piston top.



M3102113

**CAUTION: There are differences between No.1 and No.2 rings in terms with thickness, shape and contacting way to cylinder.**

2 Install the coil spring.

3 Install the oil control ring.

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4. Arrange the end gap of three piston rings as shown in the figure.

   1 Upper oil control ring clearance.

   2 Intake side.

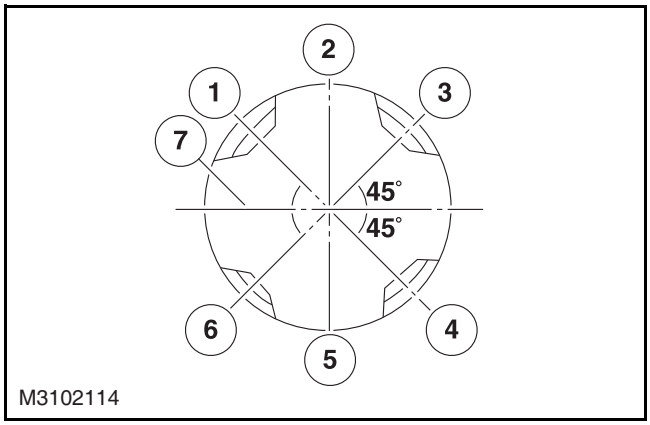
   3 No.1 piston ring end gap.

   4 Lower oil control ring clearance.

   5 Exhaust side.

   6 No.2 piston ring end gap and coil spring clearance.

   7 Assembly direction mark



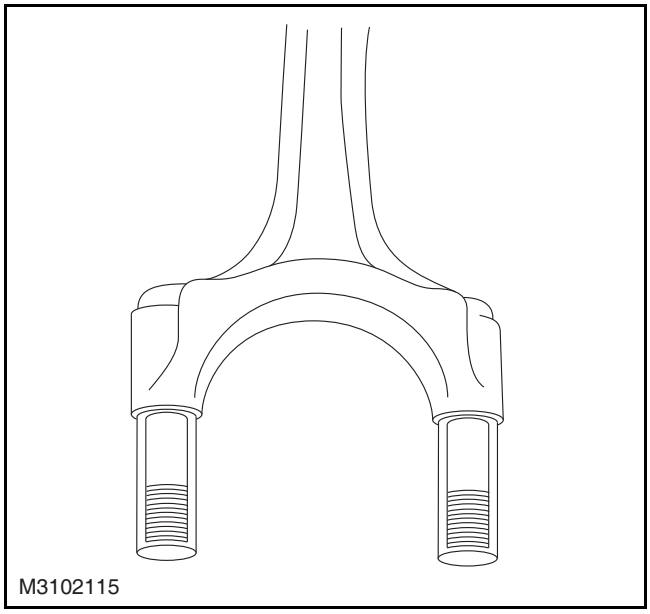
M3102114

5. Apply an appropriate amount of engine oil to the piston, piston ring, cylinder wall, connecting rod bearing and crank.

**CAUTION: Do not apply engine oil between the connecting rod and bearing or bearing cap and bearing.**

6. Install rubber boot to the connecting rod bolts.

**CAUTION: The rubber boot can prevent the crankshaft journal and cylinder inner wall from being damaged when installing the connecting rod and assembling the piston.**


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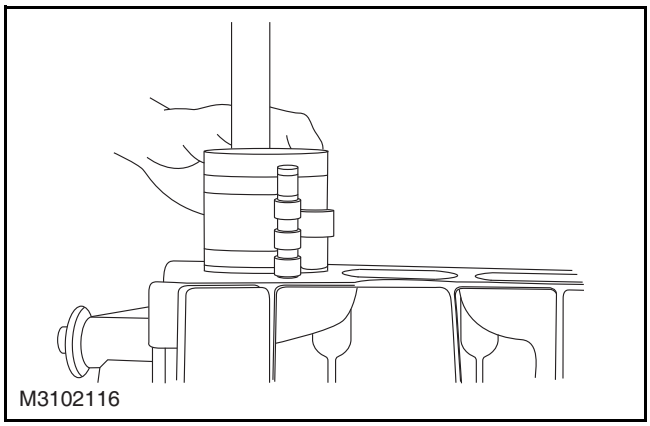
**7.** Assembly the piston and connecting rod into the cylinder.

1 Use a piston ring compressor to compress the piston ring.

2 Place the connecting rod on the cylinder block.

3 Use hammer handle to tap the piston and install it to cylinder.

General equipment: Piston ring compressor


M3102116

**CAUTION: Hold the piston ring compressor closely against the cylinder block until all piston rings enter the cylinder.**

**CAUTION: When assembling the piston and connecting rod into the cylinder, make the mark on top of piston " ← " against the crankshaft pulley.**

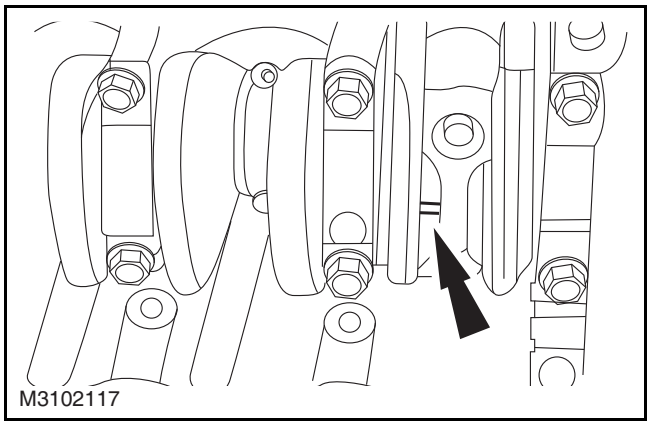
**8.** Install the connecting rod bearing cap.

1 Install the bearing shell to the connecting rod bearing cap.

2 Install the bearing cap with the stiffener on it facing the flywheel side.

3 Tighten the connecting rod bearing cap retaining nuts.

Torque: 35 ± 2 Nm


M3102117

**CAUTION: Confirm the connecting rod bearing cap position according to the quick drying paint mark. And the joint area of connecting rod bearing upper and lower cap is a complete number of "2".**

**9.** Install the oil pump.

**Refer to: Oil Pump (3.1.3 Lubrication System, Removal and Installation).**

**10.** Install the oil pan and oil strainer.

**Refer to: Oil Pan and Oil Strainer (3.1.3 Lubrication System, Removal and Installation).**

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11. Install the cylinder head.

    **Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**

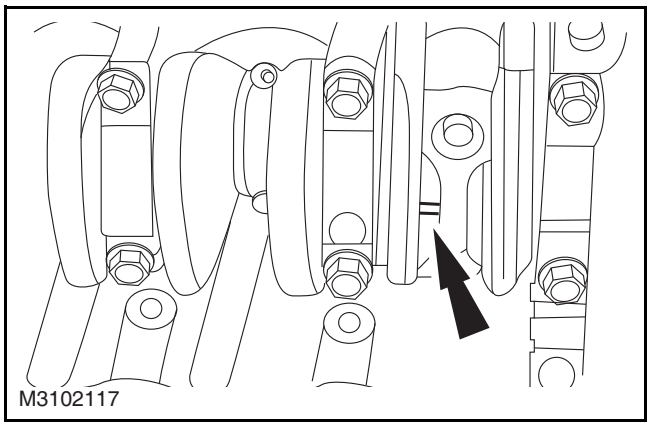
12. Install the engine assembly.

    **Refer to: Engine Assembly (3.1.2 Mechanical System, Removal and Installation).**

13. Fill oil as specified.

14. Fill engine coolant.

15. Connect the negative battery cable.


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# Main Bearing, Crankshaft and Cylinder Block

### General Equipment

| |
|---|
| Micrometer |
| Plastic feeler gauge |
| Straight scale |

### Material

| Item | Specifications |
|---|---|
| Sealant | Loctite 5900 |
| Thread locking sealant | Loctite 262 |

## Disassembly

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Separate the manual transmission.

   **Refer to: Manual Transmission (3.3.3 Manual Transmission-MR510L02, Removal and Installation).**

3. Drain the engine coolant.

   **Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).**

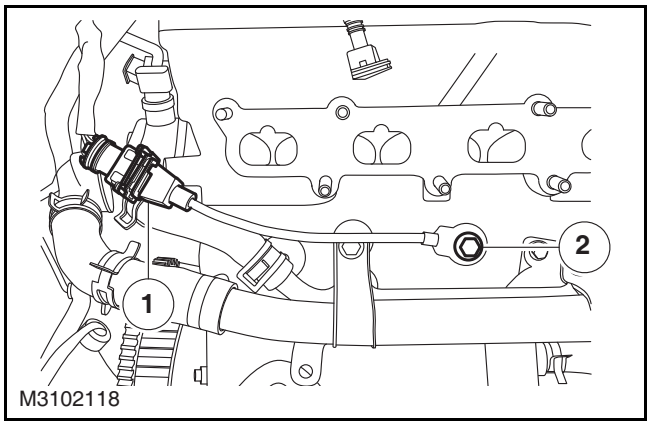
4. Drain the engine oil.
5. Remove the engine assembly.

   **Refer to: Engine Assembly (3.1.2 Mechanical System, Removal and Installation).**

6. Remove the knock sensor.

   1 Disconnect the knock sensor wiring harness connector (1).

   2 Remove the knock sensor retaining bolt (2).



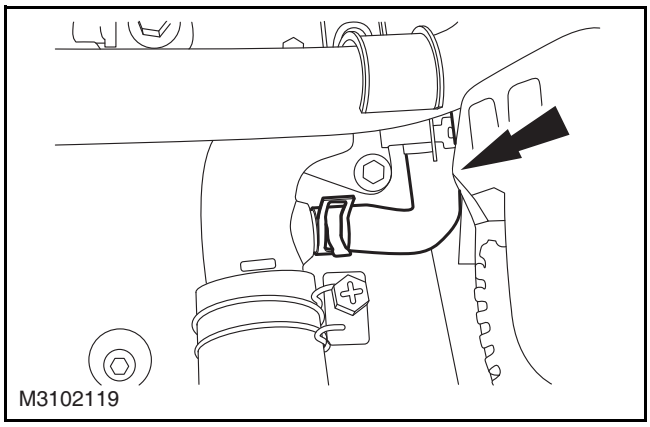

   3 Remove the knock sensor carefully.

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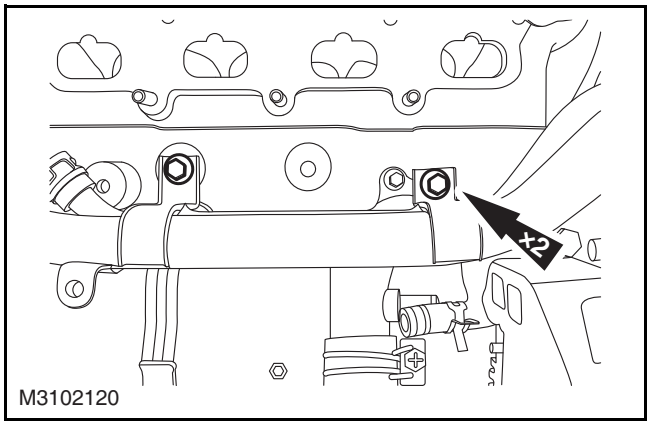


**7.** Remove the water outlet pipe assembly.

1 Loosen the hoop, disconnect the connecting hose between water inlet pipe assembly and water outlet pipe assembly.


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2 Remove 2 retaining bolts from the water outlet pipe assembly.

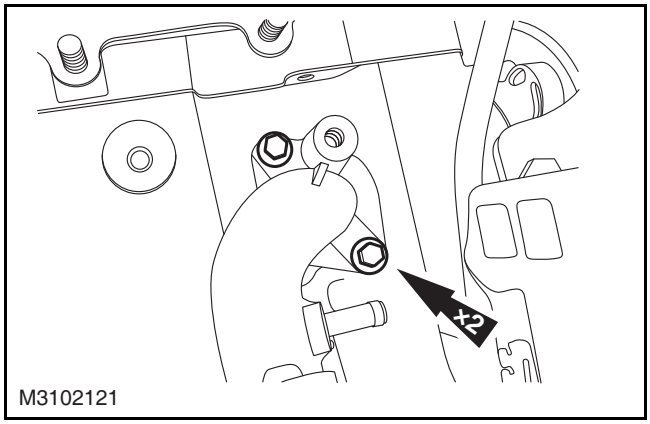


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3 Remove the water outlet pipe assembly.

**8.** Remove the water inlet pipe assembly.

1 Remove 2 retaining bolts from the water inlet pipe assembly.



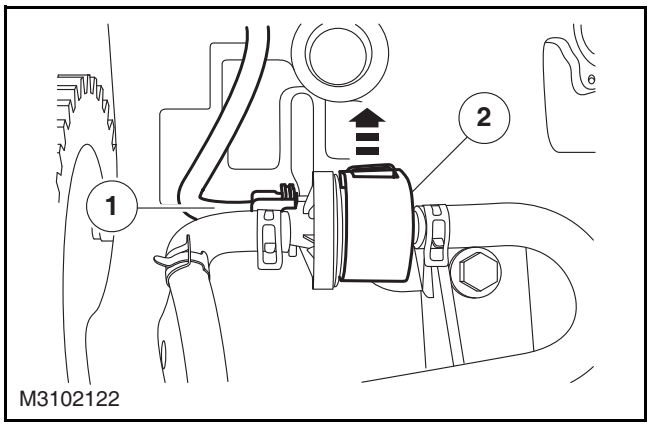
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2 Remove the water inlet pipe assembly.

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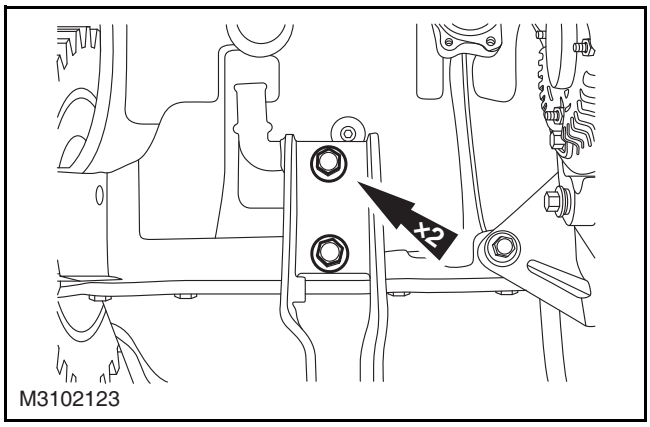
9. Disconnect the carbon canister control valve wiring harness connector (1).
10. Move the carbon canister control valve and carbon canister control valve boot (2) upward and remove them.



M3102122

11. Remove the left mounting bracket bush assembly and left bracket assembly.

    1 Remove 2 retaining bolts from the left mounting bracket bush assembly.



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    2 Remove the left mounting bracket bush assembly and left bracket assembly.

12. Remove the A/C compressor.

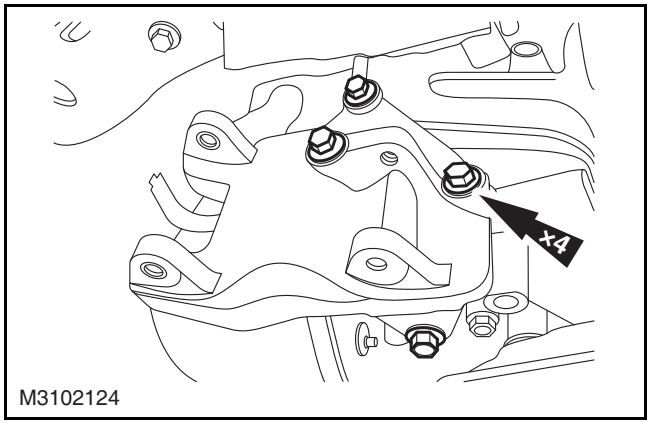
    **Refer to: Compressor (4.1.1 Air Conditioning System, Removal and Installation).**

13. Remove the alternator.

    **Refer to: Alternator (3.1.10 Charging System, Removal and Installation).**

14. Remove the engine bracket.

    1 Remove 4 retaining bolts from the engine bracket.



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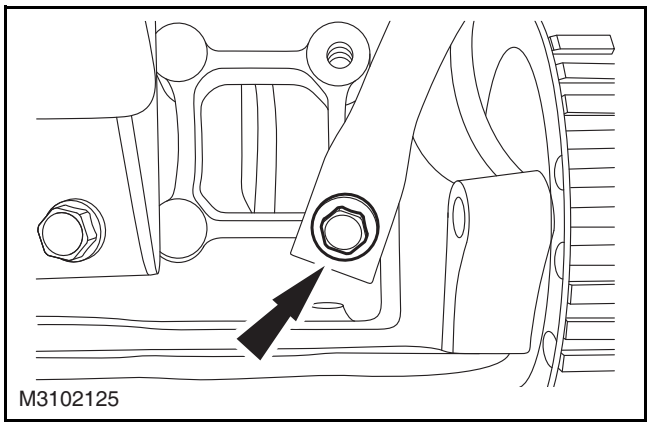
    2 Remove the engine bracket.

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**15.** Remove the exhaust manifold bracket.

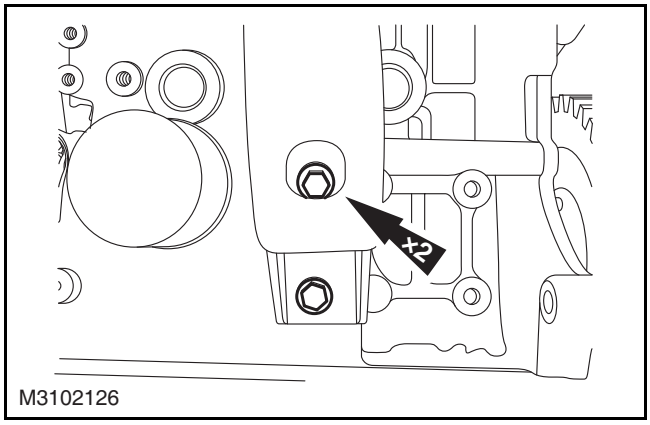
1 Remove the retaining bolt from the exhaust manifold bracket.


M3102125

2 Remove the exhaust manifold bracket.

**16.** Remove the right mounting bracket bush assembly and right bracket assembly.

1 Remove 2 retaining bolts from the right mounting bracket bush assembly.

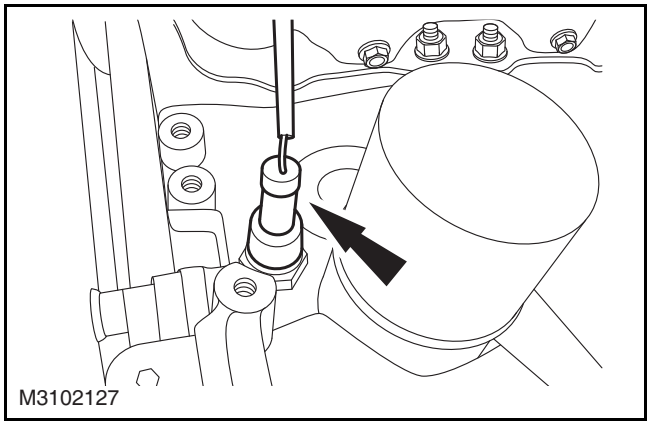


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2 Remove the right mounting bracket bush assembly and right bracket assembly.

**17.** Remove the oil pressure alarm.

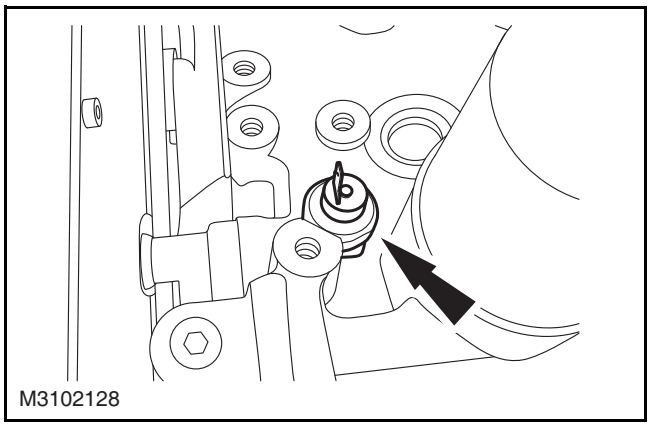
1 Disconnect the oil pressure alarm wiring harness connector.


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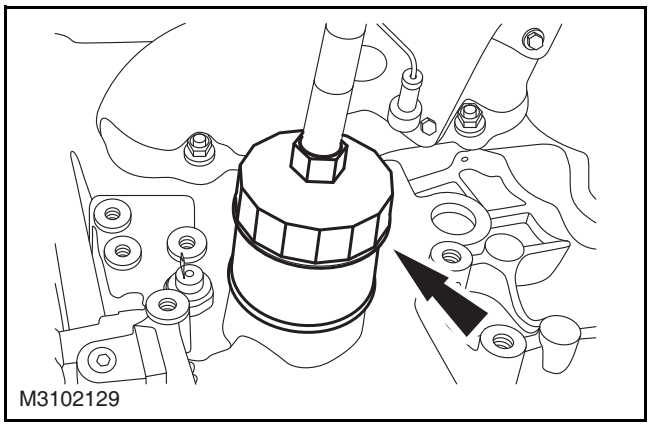
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2 Remove the oil pressure alarm.


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**18.** Use a suitable tool to remove the oil filter.


M3102129

**19.** Remove the cylinder head.

**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**

**20.** Use a suitable tool to remove the flywheel assembly.

**21.** Remove the engine oil pan and oil strainer.

**Refer to: Oil Pan and Oil Strainer (3.1.3 Lubrication System, Removal and Installation).**

**22.** Remove the oil pump.

**Refer to: Oil Pump (3.1.3 Lubrication System, Removal and Installation).**

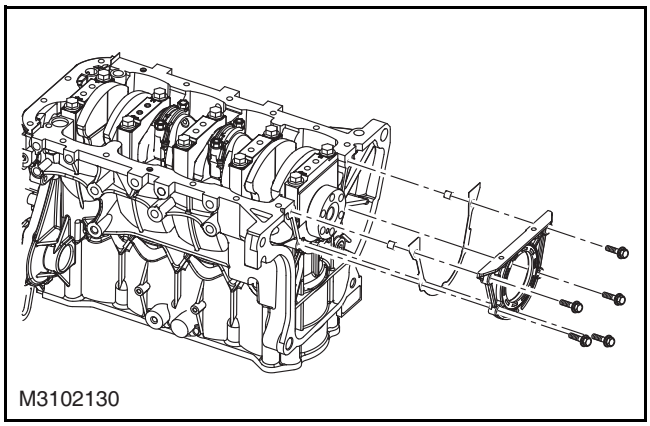
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**23.** Remove the crankshaft rear end cover and crankshaft rear oil seal.

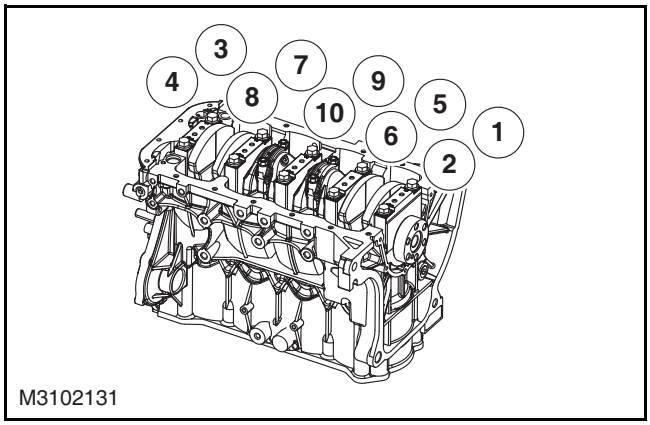
**24.** Remove the piston connecting rod bearing cap.

**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**



M3102130

**25.** Remove the crankshaft main bearing cap bolts in the order shown in the figure.




M3102131

**26.** Remove the crankshaft from the cylinder block.

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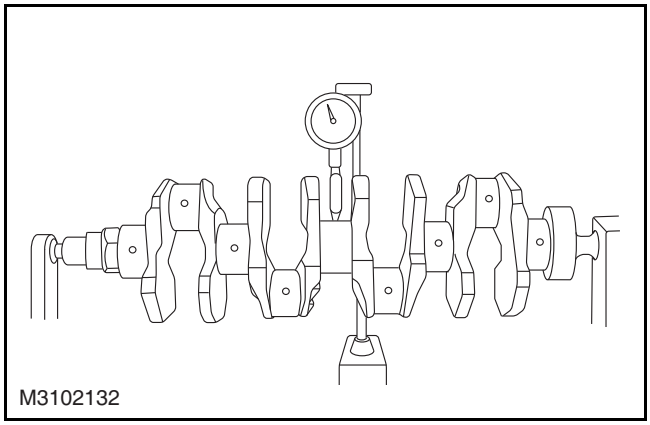


## Inspection

**1.** Inspect the crankshaft.

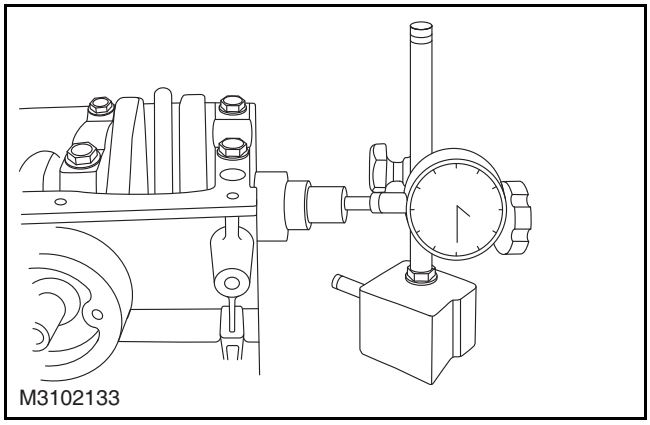
1 Inspect the crankshaft radial runout and measure the radial runout at the center journal with a dial indicator while slowly turning the crankshaft. If the radial runout exceeds the limit, install a new crankshaft.

Radial runout limit: 0.06 mm


M3102132

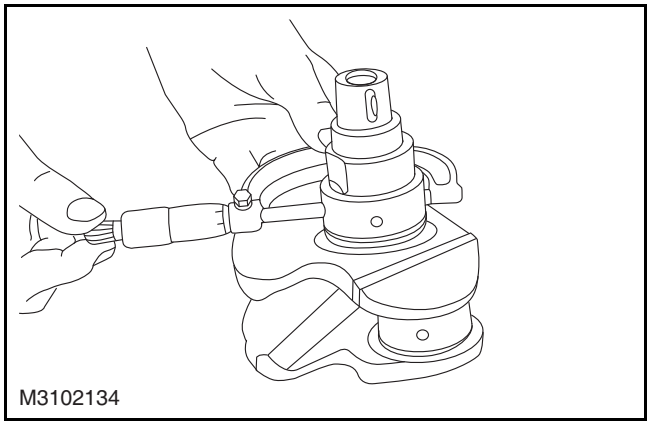
2 Inspect the thrust clearance and read the offset in the axial thrust direction with a dial indicator. Install a new thrust plate if the measurement exceeds the limit.

| Item | Standard | Limit |
|---|---|---|
| Crankshaft thrust clearance | 0.16 ~ 0.36 mm | 0.36 mm |
| Thickness of crankshaft thrust plate | Standard | 2.470 ~ 2.520 mm |
| | Oversize: 0.125 mm | 2.595 ~ 2.645 mm |


M3102133

3 Inspect the crankshaft for uneven wear (out-of-round and taper) and measure it with a micrometer. Grind the crankshaft or install a new one if any of the bearing journals has been seriously worn or the uneven wear exceeds the limit.

Out-of-round and taper limit: 0.005 mm


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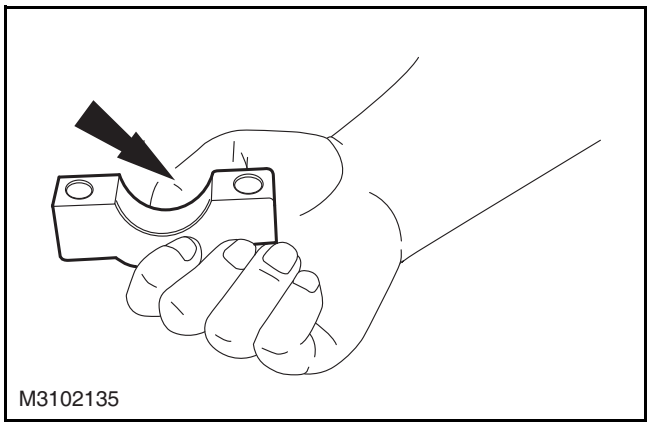
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**2.** Inspect the main bearing shell.

1 Inspect the main bearing shell for any corrosive pitting, scratches, abrasions or damages. If any defect is found, replace upper and lower main bearing shell instead of replacing one alone.

Radial runout limit: 0.06 mm

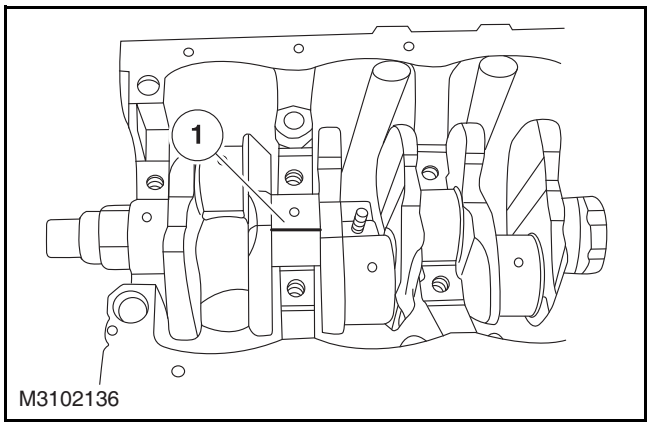

M3102135

**3.** Inspect the main bearing shell clearance.

1 Remove the main bearing cap.

2 Clean the main bearing and main journal.

3 Place a piece of plastic feeler gauge (parallel to the crankshaft) with the same width as the bearing while away from the old hole.



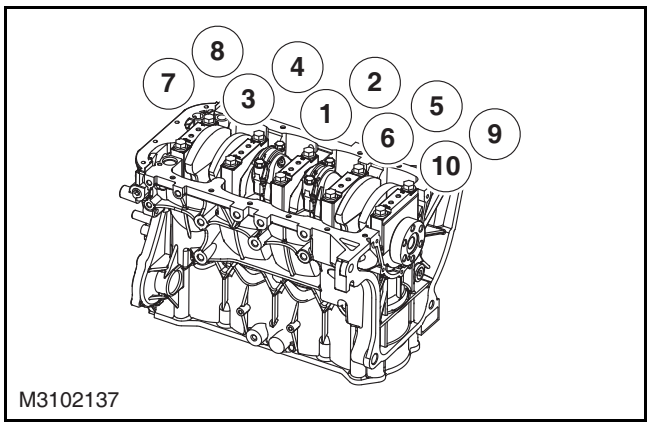
M3102136

4 Install the main bearing caps in the order shown in the figure and evenly tighten the bolts to the specified torque in three or four steps.

Torque: 61 ~ 65 Nm

**CAUTION: When installing, the arrow on the main bearing cap must point to the engine front. The main bearing cap marked with "1" is installed at the engine front while one marked with "5" is installed on the flywheel side.**

**CAUTION: Do not rotate the crankshaft after installing the main bearing caps.**

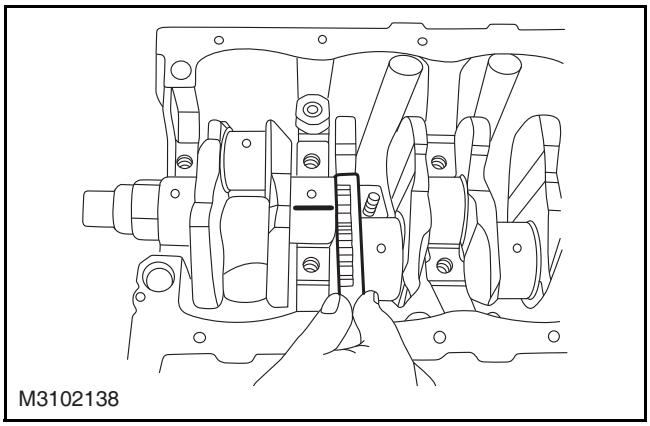


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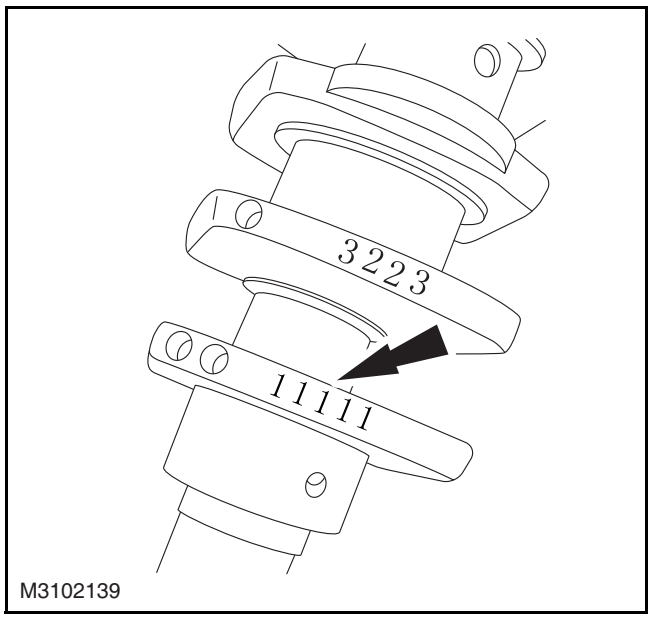
5 Remove the main bearing cap, measure its width by placing the gauge (2) at the widest point of the plastic feeler gauge (1). If the clearance exceeds the limit, replace the main bearing shell. Both the upper and lower bearing shells must be replaced as a whole. If the clearance for standard bearing shell is not as specified, use the oversize 0.25 mm bearing shells to grind the crankshaft journal again. Inspect the bearing clearance again after installing a new bearing.


M3102138

| Bearing shell clearance | Standard | Limit |
|---|---|---|
| | 0.020 ~ 0.040 mm | 2.595 ~ 2.645 mm |

**4.** The selection of main bearing: Select a new standard bearing as the following sequence if the main bearing is not correct or the bearing clearance exceeds the technical requirement.

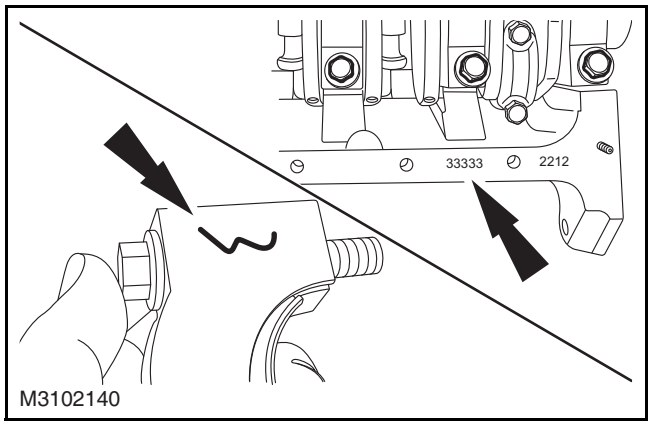
1 Inspect the diameter of crankshaft journal and there are 5 printed numbers on the crank. The numbers stand for the model of crankshaft main journal diameter and meanwhile stand for the installation order of 5 crankshaft main bearings.



M3102139

2 Inspect crankshaft bearing cap hole diameter and there is one number on the crankshaft bearing cap side (as shown in the figure). Number stands for the model of bearing cap hole diameter.

Also, the five numbers on the joint area of cylinder block and oil pan stand for the model of crankshaft bearing cap hole diameter, and meanwhile stand for the installation order of five crankshaft bearing caps.



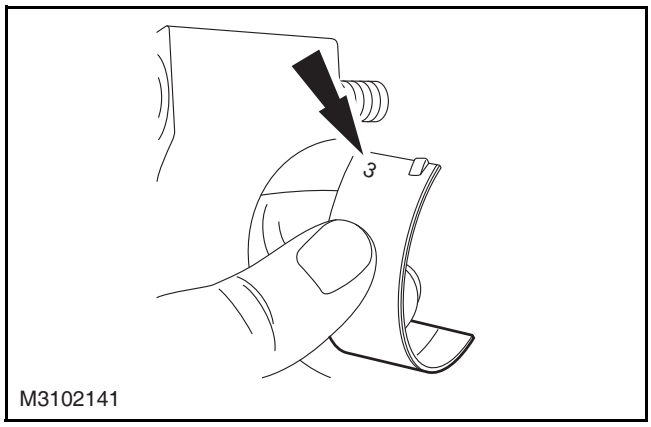
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3 The crankshaft bearing shell should be selected by 7 minus the number printed on the crankshaft minus number on the crankshaft bearing cap side.

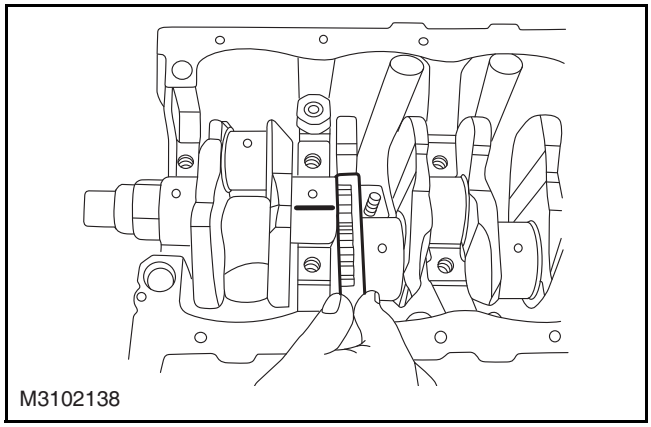
For example, the first number on the crankshaft is 1, the first crankshaft main bearing cap is 3 and the first crankshaft main bearing is 7 - 1 (first number on the crankshaft) - 3 (the first crankshaft main bearing cap) = 3 (on the back of crankshaft bearing shell).



M3102141

4 Use a plastic gauge to inspect the reselected crankshaft bearing shell clearance. Use a thicker bearing and inspect the clearance again if the clearance remains beyond the limit value.

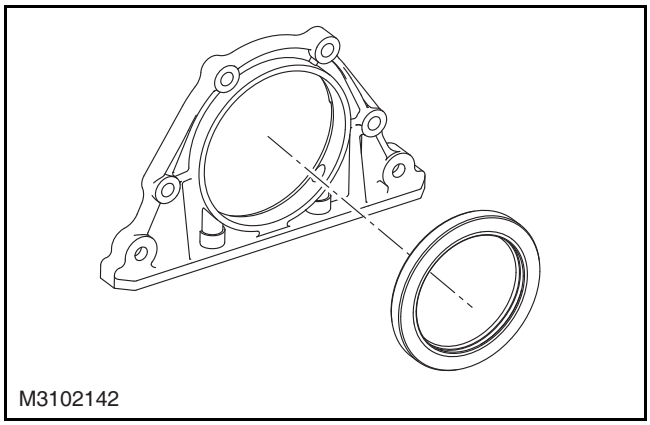
5 Refer to the numbers printed on the new crankshaft or the letters printed on the new cylinders to select a new standard crankshaft bearing when installing a new crankshaft or cylinder block.


M3102138

**5.** Inspect the crankshaft rear oil seal.

1 Inspect the oil seal for abrasions, and if oil seal lip is worn or damaged, replace it with a new one.

2 When installing the oil seal, clean the oil seal retainer and press it in steadily to keep the oil seal face 0.5 mm below the oil seal housing face.


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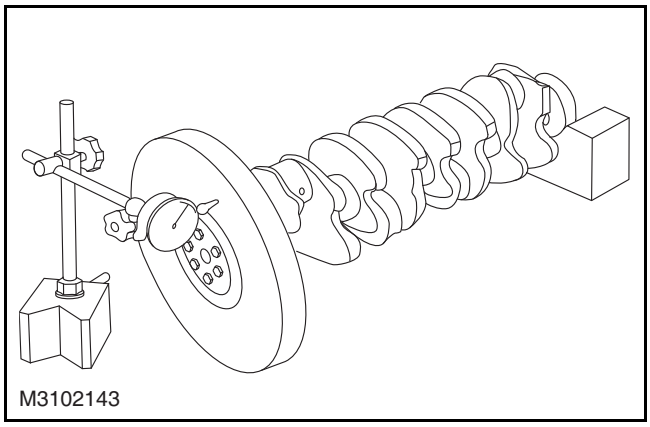
**6.** Inspect the flywheel.

1 Inspect the flywheel gear ring, and if it is damaged, cracked or worn, replace the flywheel.

2 Inspect the clutch driven disc junction surface, and if it is damaged or worn excessively, replace the flywheel.

3 Measure the flywheel end face runout with a dial indicator, and if it exceeds the limit, replace the flywheel.

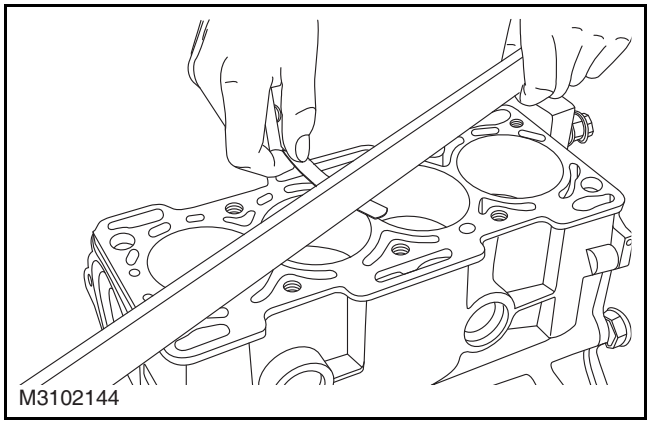
End face runout limit: 0.2 mm


M3102143

**7.** Inspect the cylinder block.

1 Use the straight scale and feeler gauge to inspect the cylinder block and cylinder head sealing surface for deformation. If the flatness exceeds the limit, trim the surface.

| Item | Standard | Limit |
|---|---|---|
| Flatness | 0.03 mm | 0.10 mm |


M3102144

**8.** Hone out the cylinder.

1 All other cylinders need to be honed out again if any of the cylinders needs to be honed out again.

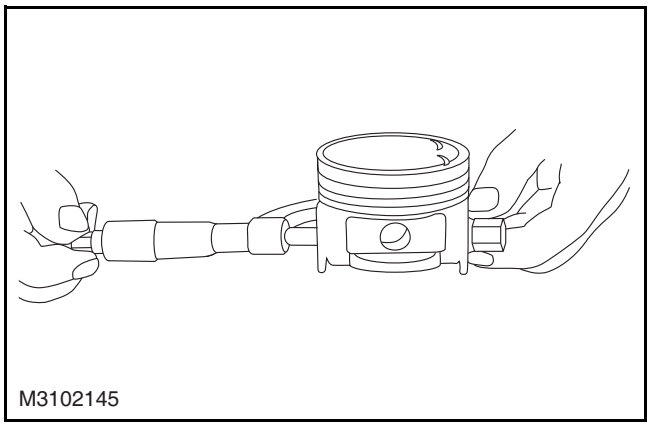
2 Select oversized piston according to the extent that the cylinder has been honed.

| Oversize | Piston diameter |
|---|---|
| 0.25 mm | 66.25 ~ 66.27 mm |
| 0.50 mm | 66.50 ~ 66.52 mm |

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3 Measure the piston diameter with a micrometer.


M3102145

4 Calculate the diameter of cylinder bore to be honed out.

D = A + B - C

D: The diameter of cylinder bore to be honed out

A: Measured piston diameter

B: Piston Clearance = 0.02 ~ 0.04 mm

C: Honing excess = 0.02 mm

5 Hone out the cylinder to the calculated size.

**CAUTION: Before honing the cylinder, install all the main bearing caps and tighten them to the specified torque while preventing the bearing bore deformation.**

6 Measure the piston clearance after the cylinder has been honed.

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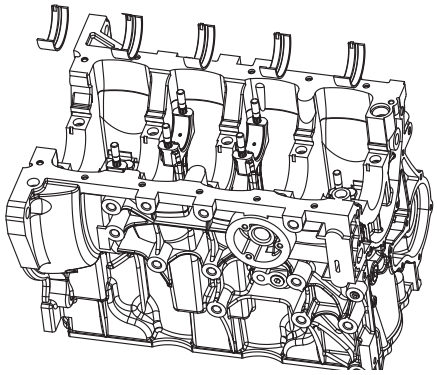
## Installation

**CAUTION: Clean all the components to be installed thoroughly.**

**CAUTION: Apply an appropriate amount of engine oil to the crankshaft journals, crankshaft bearings, thrust plates, connecting rod journals, connecting rod bearings, pistons, piston rings and cylinder bores.**

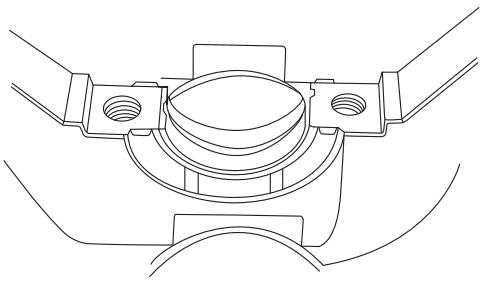
**CAUTION: Make sure that the crankshaft bearing, bearing cap, connecting rod, connecting rod bearing, connecting bearing cap, piston and piston ring are all assembled into a combination. Do not mess the combination and make sure that each component return to the original position.**

1. Install the crankshaft bearing to the cylinder block. The bearing shell with oil groove is installed on the cylinder block while the other one without oil groove is installed on the bearing cap. Verify the two bearing shells are of the same size.



M3102146

2. Install the crankshaft thrust plate (1) to the cylinder block between No.2 and No.3 cylinders and make sure that the side with oil groove faces the crank.
3. Install the crankshaft to the cylinder block.

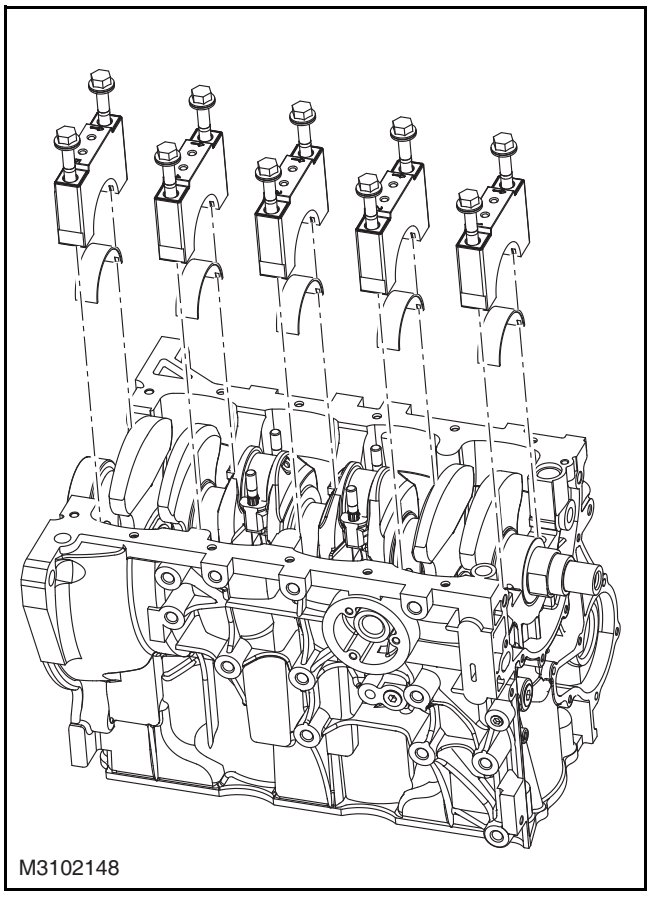


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4. Install the crankshaft bearing caps, and make sure that the arrow on each bearing cap points to the crankshaft pulley side. Install the caps marked with "1" to the side near the crankshaft belt pulley in sequence and install the caps marked with "5" to the side near the flywheel.



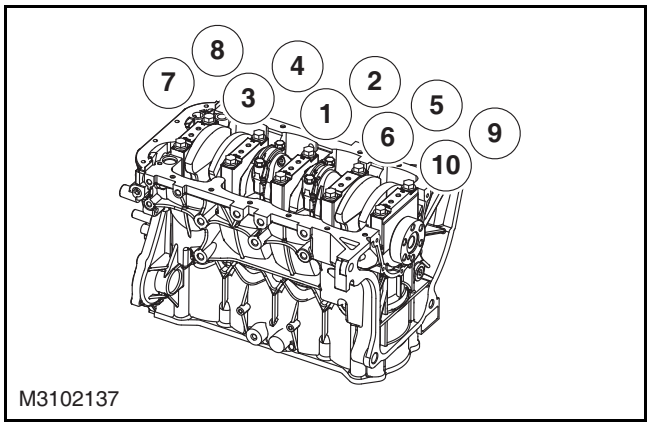
M3102148

5. Tighten the crankshaft bearing cap bolts to the specified torque in the order shown in the figure.

   Torque: 63 ± 2 Nm

**CAUTION: Do not tighten the bolts to the specified torque in one step during installation. The correct procedure is to tighten them in several steps before tightening them to the specified torque.**

**CAUTION: After tightening the crankshaft bearing cap bolts, make sure that the crankshaft rotates smoothly when rotating it with a force of 8 Nm or less.**



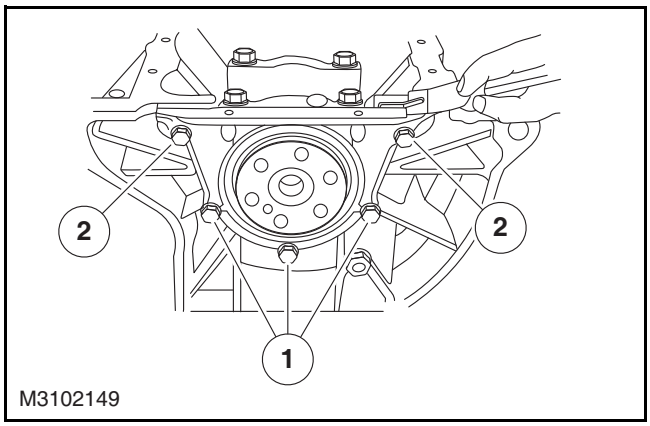

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6. After installing a new crankshaft rear oil seal housing gasket and oil seal housing, tighten the shorter retaining bolt (1) and the longer retaining bolt (2) to the specified torque.

   Torque: 9 ~ 10 Nm



M3102149

**CAUTION: It is not allowed to use the oil seal housing gasket removed from the crankshaft. Apply engine oil to the seal lip before the installation.**

**CAUTION: Since there are two types of oil seal housing bolts, do not install them at a wrong position. After installing the oil seal housing, the protrusion on edge of seal gasket should be cut off if it exists and clean the cylinder block and oil seal housing.**

7. Install the oil pump.

   **Refer to: Oil Pump (3.1.3 Lubrication System, Removal and Installation).**

8. Install the oil pan and oil strainer.

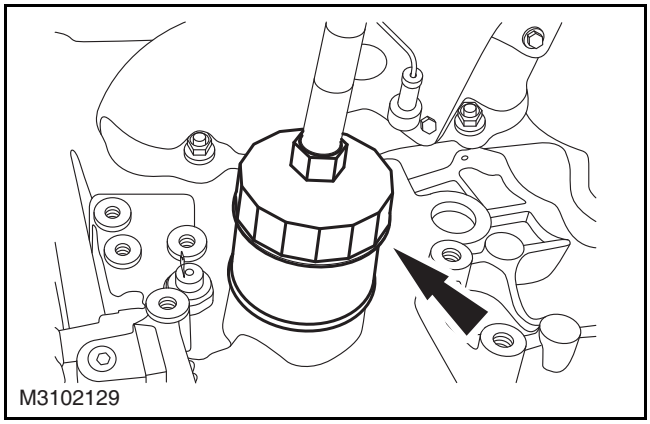
   **Refer to: Oil Pan and Oil Strainer (3.1.3 Lubrication System, Removal and Installation).**

9. Install the flywheel.

   **Refer to: Flywheel (3.1.2 Mechanical System, Removal and Installation).**

10. Use a suitable tool to install the oil filter.

    Torque: 14 ± 2 Nm


M3102129

11. Install the oil pressure alarm.

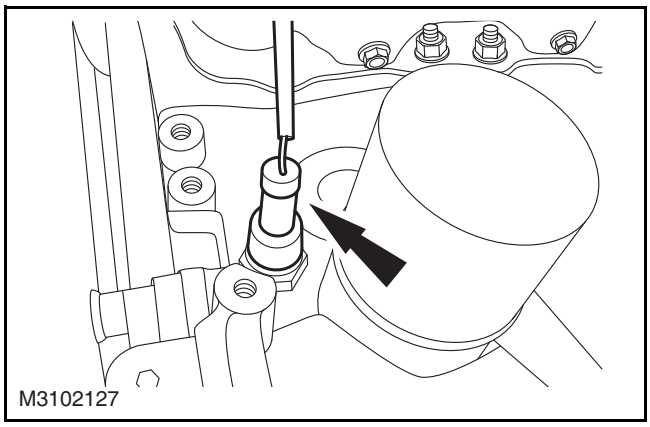
    1 Install the oil pressure alarm.

    Torque: 12 ~ 15 Nm

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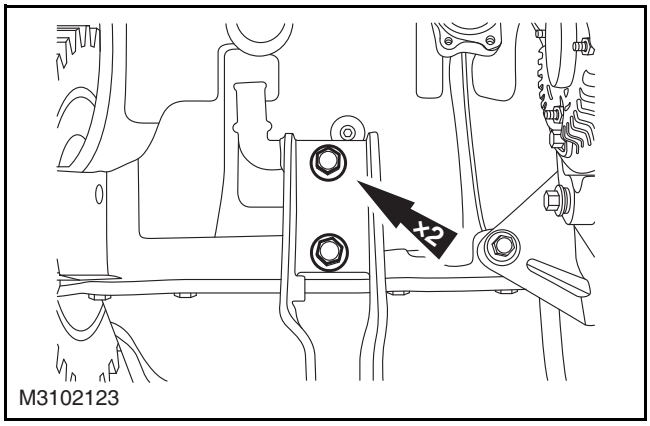
2 Connect the oil pressure alarm wiring harness connector.




**12.** Install the right mounting bracket bush assembly and right bracket assembly.

1 Tighten 2 retaining bolts of the right mounting bracket bush assembly.

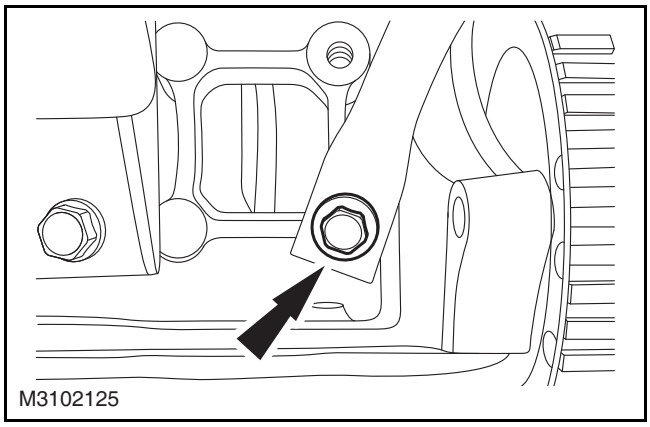
Torque: 51 ± 5 Nm




**13.** Install the exhaust manifold bracket.

1 Tighten the retaining bolt of exhaust manifold bracket.

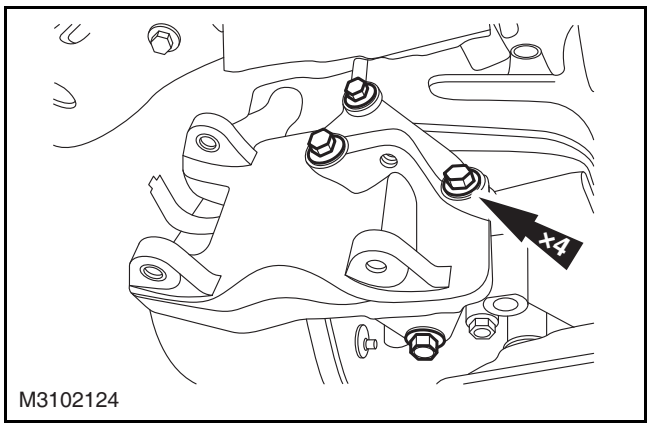
Torque: 23 ± 2 Nm




**14.** Install the engine bracket.

1 Tighten 4 retaining bolts of the engine bracket.

Torque: 23 ± 2 Nm



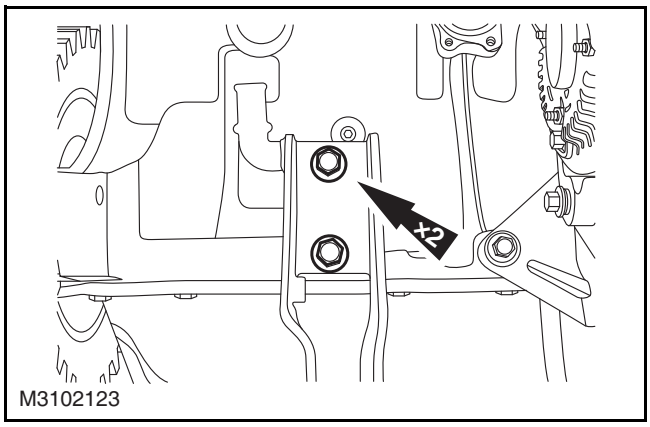
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**15.** Install the left mounting bracket bush assembly and left bracket assembly.

1 Tighten 2 retaining bolts of the left mounting bracket bush assembly.

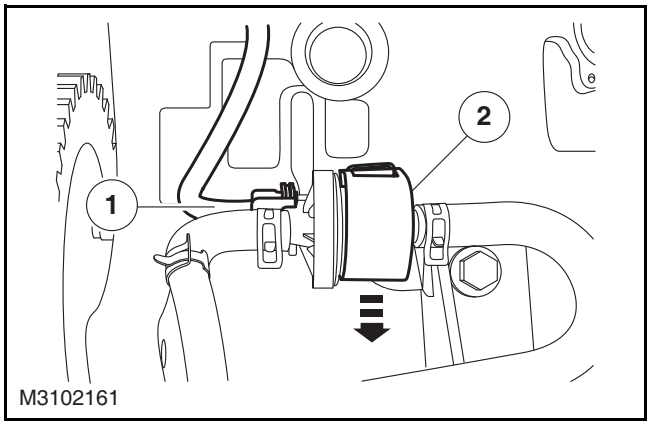
Torque: 51 ± 5 Nm



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**16.** Return the carbon canister control valve and carbon canister control valve boot (2).

**17.** Connect the carbon canister control valve wiring harness connector (1).

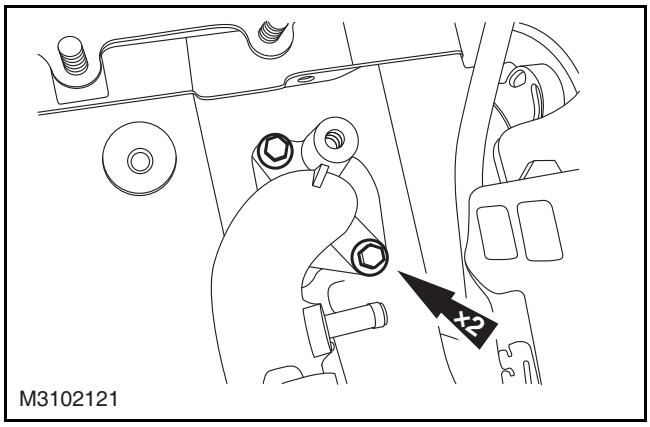


M3102161

**18.** Install the water inlet pipe assembly.

1 Install 2 retaining bolts of the water inlet pipe assembly.

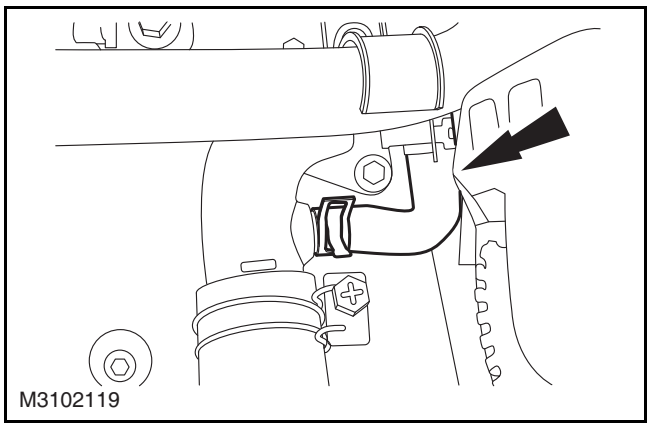
Torque: 10 ± 1 Nm



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**19.** Install the water outlet pipe assembly.

1 Connect the connecting hose between water inlet pipe assembly and water outlet pipe assembly.

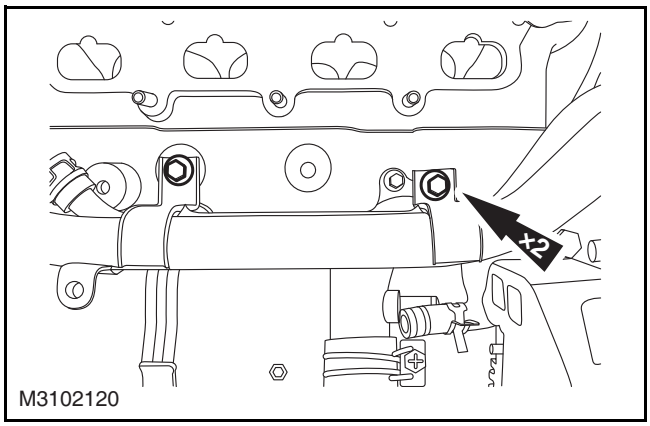

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2 Tighten 2 retaining bolts of the water outlet pipe assembly.

Torque: 23 ± 2 Nm

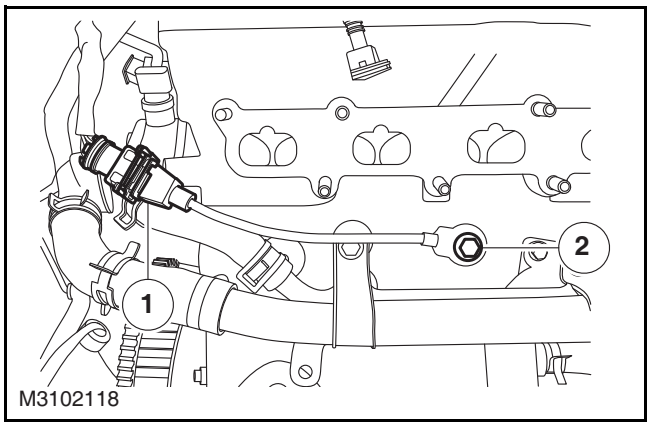



**20.** Install the knock sensor.

1 Tighten the knock sensor retaining bolt (2).

Torque: 23 ± 2 Nm

2 Connect the knock sensor wiring harness connector (1).




**21.** Install the cylinder head.

**Refer to: Cylinder Head Subassembly and Valve (3.1.2 Mechanical System, Disassembly and Assembly).**

**22.** Install the timing mechanism.

**Refer to: Timing Mechanism (3.1.2 Mechanical System, Removal and Installation).**

**23.** Install the accessory drive belt.

**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

**24.** Install the manual transmission.

**Refer to: Manual Transmission (3.1.2 Mechanical System, Removal and Installation).**

**25.** Install the engine assembly.

**Refer to: Engine Assembly (3.1.2 Mechanical System, Removal and Installation).**

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**26.** Fill engine oil as specified.

**27.** Fill coolant.

**28.** Connect the negative battery cable.

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## Specifications

# Material Specifications

| Item | Specifications | Area |
|---|---|---|
| Sealant | Silicone rubber flat sealant: Loctite 5900 | Gluing surface between cylinder block and oil pan |
| Thread locking sealant | Loctite 262 | Thread surface of oil pressure alarm |

# Component Specifications

| Item | Specifications | | |
|---|---|---|---|
| Oil pump type | Rotor pump | | |
| Oil pressure | Engine speed | Iding | 3000 rpm |
| | Oil pressure | 130 ~ 250 kPa | 300 ~ 480 kPa |

# General Specifications

### Lubricant Specifications

| Item | Specifications |
|---|---|
| Viscosity | SG or higher |
| Grade | SAE 15W-40 |
| Capacity | 3.3 ± 0.1 L |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Oil pan drain plug | 23 ± 5 | - | - |
| Oil pan retaining bolt and nut | 7 | - | 62 |
| Oil pump retaining bolt | 11 | 8 | - |
| Oil filter tightening torque | 14 ± 2 | - | - |
| Oil pressure switch tightening torque | 12 ~ 15 | - | - |
| Oil pump strainer retaining bolt | 10 | - | 89 |
| Oil pump rotor plate screw | 11 | 8 | - |
| Oil pump casing bolt | 10 | - | 89 |

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## Description and Operation

# System Overview

Oil pump is rotor type, which is installed on one side of crankshaft pulley. Oil enters the filter through oil pump mesh. The filtered oil falls into two oil ways in the cylinder. One way leads oil to the crankshaft journal bearing. Oil flowing out of the crankshaft journal bearing goes to the connecting rod bearing through an inclined passage drilled on the crankshaft, and spurts out of the hole on the connecting rod large end to lubricate the piston, piston ring and cylinder wall. The other oil way leads oil to the cylinder head, and lubricates the valve tappet, camshaft journal, camshaft etc. through an oil way of the cylinder head. The relief valve is installed on the oil pump, which discharges the pressure when the pressure is over 400 kPa. The oil flows back to the oil pan after the pressure has been discharged.

## Components Description

### Oil Pump

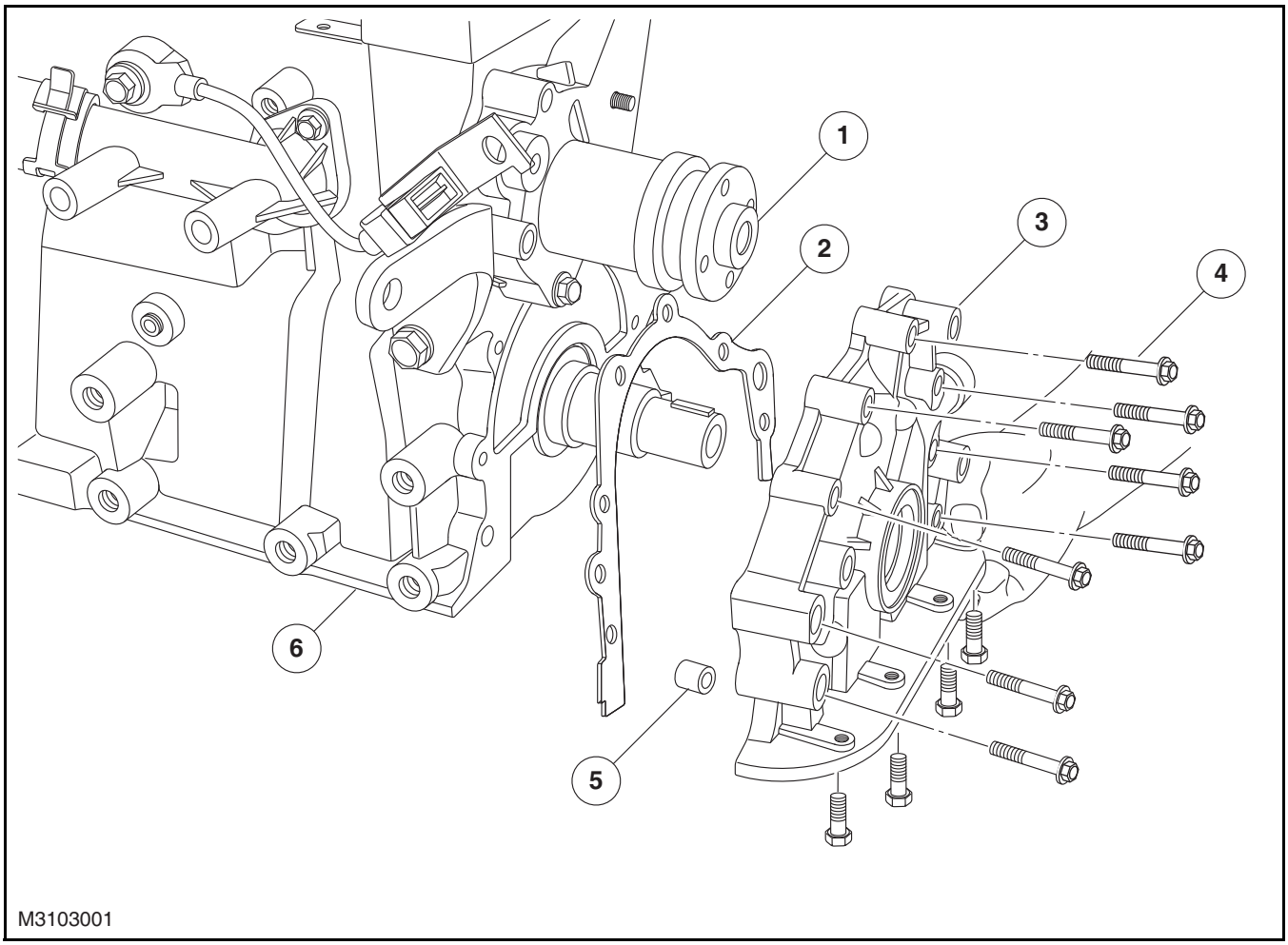
The oil pump is rotor pump which is fixed on the crankshaft and driven directly by the crankshaft. There is a relief valve in the oil pump. The relief valve opens to keep the system under a moderate pressure when the pressure is over 400 kPa.

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# Components Location View

## Oil Pump

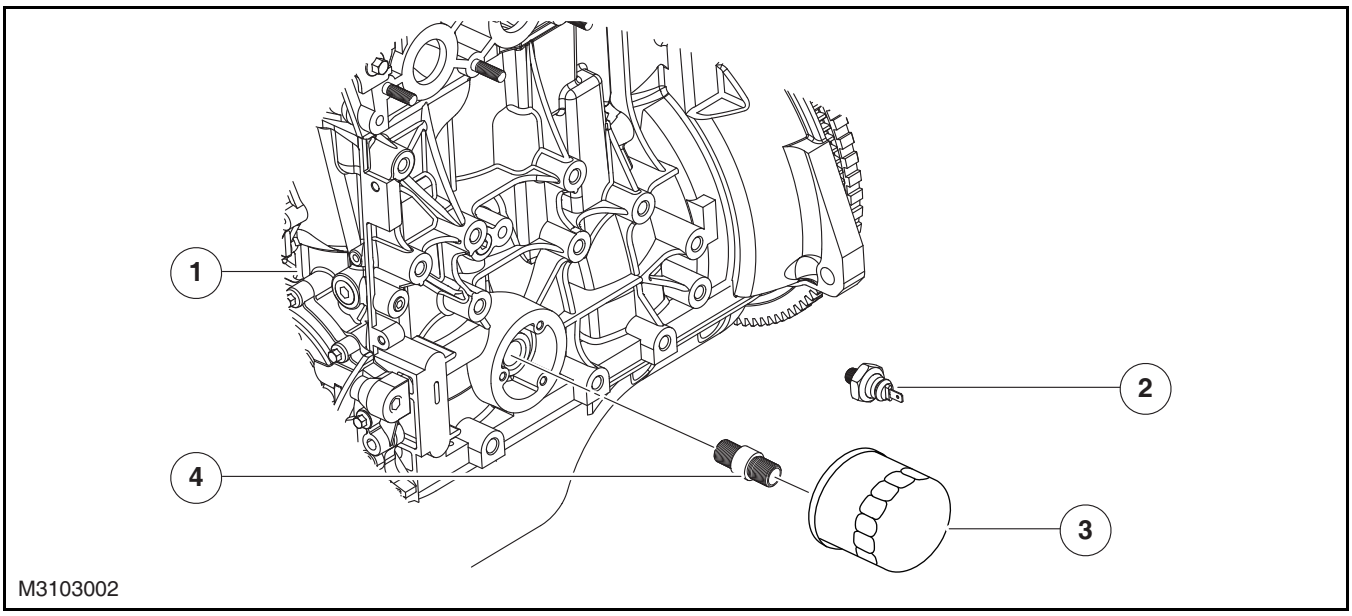



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Water pump | 4 | Retaining bolt |
| 2 | Oil pump gasket | 5 | Oil pump dowel pin |
| 3 | Oil pump assembly | 6 | Cylinder block |

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## Oil Filter Element and Accessory



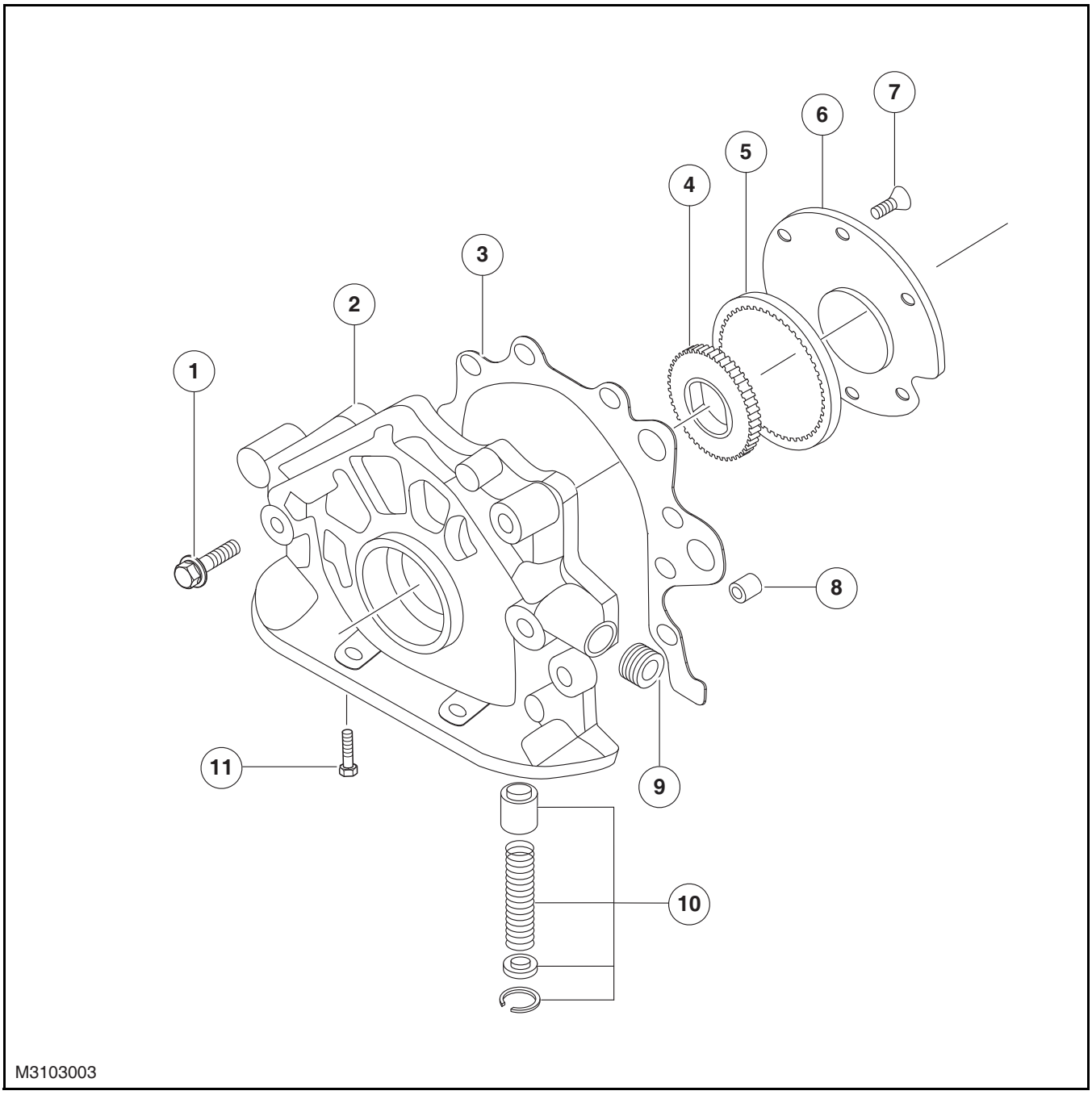

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Cylinder block | 3 | Oil filter |
| 2 | Oil pressure alarm | 4 | Oil filter connecting pipe |

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# Components Exploded View

## Oil Pump




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Bolt | 7 | Screw |
| 2 | Oil pump housing | 8 | Dowel pin |
| 3 | Oil pump gasket | 9 | Plug |
| 4 | Oil pump inner rotor | 10 | Oil pump relief valve |
| 5 | Oil pump outer rotor | 11 | Bolt |
| 6 | Oil pump rear end cover | | |

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## General Inspection

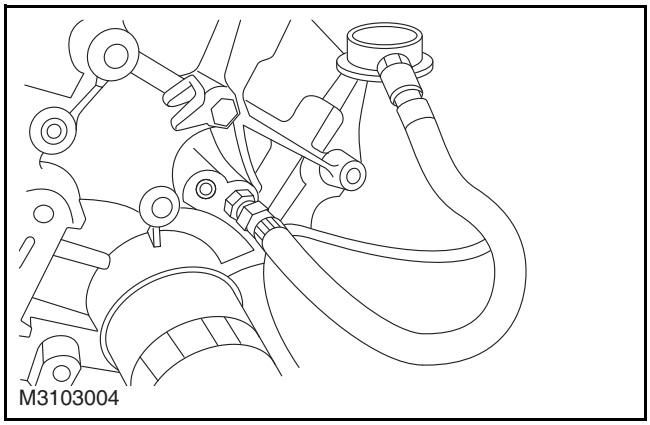
# Oil Pressure Inspection

**WARNING: The rats in lab suffers from skin cancer due to a long-term contact with the used oil. Wash your hands with soap and water to protect your skin immediately after contacting with oil.**

**WARNING: High temperature engine and oil will lead to serious scalding. Turn off engine to wait until the engine and oil cools down.**

1. Remove the oil pressure alarm.

Install the oil pressure gauge testing joint to the bolt hole of oil pressure alarm and tighten it.


M3103004

2. Park the vehicle on level ground.
3. Turn off the ignition switch and inspect the engine oil level and viscosity. Fill or replace if necessary.
4. Start the engine and measure the engine oil pressure when the engine reaches the normal working temperature at 80 °C.

   **Standard oil pressure:**

   **260 ~ 380 kPa when engine speed is 3000 rpm.**
5. Turn off the ignition switch and remove the oil pressure gauge after the engine cools down.
6. Install the oil pressure alarm. Before reinstalling the oil pressure switch, remember to wind a sealing tape at the thread and tighten it by specified torque.

   Torque: 12 ~ 15 Nm

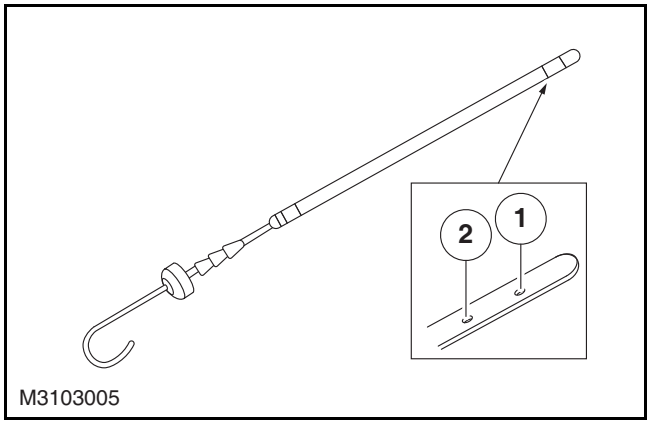
**CAUTION: If the edge of sealing tape is rough, cut it even from the switch thread.**

7. Start the engine to check if there is oil leakage in the oil pressure alarm.

Turn off the engine, connect the terminal and the pressure sensor terminal and cover the oil pressure alarm with a shield.

# Oil Level Inspection

1. Park the vehicle on level ground.
2. Verify that the vehicle is at a cold state.
3. Remove the oil level gauge and inspect if the oil level is between MAX and MIN marks.



M3103005

1. Low oil level mark
2. High oil level mark

Add engine oil if the oil level is below the MIN mark.

# Oil Change

**WARNING: Disassemble or assemble all components after the engine cools down, otherwise, the components may lead to serious burn or personal injury.**

**WARNING: A vehicle which is jacked up by a jack but not securely supported on the bracket is very dangerous. It may slip or fall off, which leads to death or serious injury. Do not work near a vehicle which is jacked up by a jack but not securely supported on the bracket.**

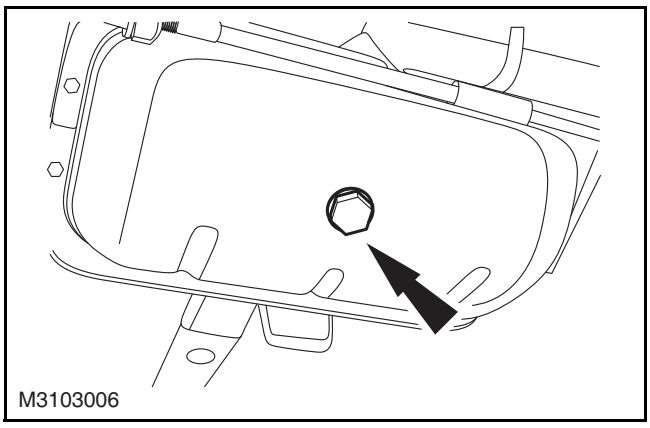
**WARNING: The rats in lab suffers from skin cancer due to a long-term contact with used oil. After you use oil, immediately wash the skin with soap and water for protection.**

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**CAUTION: Wipe the oil off completely in case you spread it over the exhaust system. If the splashed oil is not wiped off completely, it would cause smog due to high temperature.**

1. Park the vehicle on level ground.
2. Remove the oil filler cap.
3. Remove the oil pan drain plug.


M3103006

4. Drain the oil into a container.
5. Install the oil pan drain plug and gasket, and tighten it to the specified torque immediately.

   Torque: 23 ± 5 Nm
6. Fill engine oil with specified type and amount in the table.

**CAUTION: The amount of residual oil in engine varies with change methods and oil temperature etc. Verify the oil level after oil change.**

7. Install the oil filler cap.
8. Start the engine and verify that there is no oil leak.
   - Find the reasons and repair or replace the related components if any oil leak occurs.
9. Inspect the oil level.

**Refer to: Oil Level Inspection (3.1.3 Lubrication System, General Inspection).**

## Oil Filter Replacement

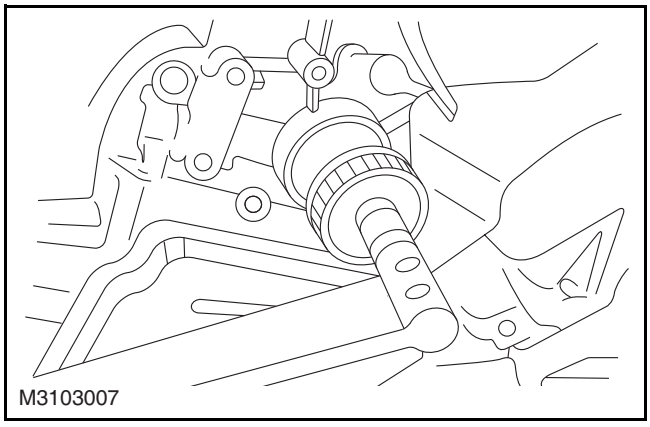
**WARNING: Disassemble or assemble all components after the engine cools down, otherwise, the components may lead to serious burn or personal injury.**

**WARNING: A vehicle which is jacked up by a jack but not securely supported on the bracket is very dangerous. It may slip or fall off, which leads to death or serious injury. Do not work near a vehicle which is jacked up but not securely supported on the bracket.**

**WARNING: The rats in lab suffers from skin cancer due to a long-term contact with used oil. After you use oil, immediately wash the skin with soap and water for protection.**

**CAUTION: Wipe the oil off completely in case you spread it over the exhaust system. If the splashed oil is not wiped off completely, it would cause smog due to high temperature.**

1. Remove the rear wind guiding cover.
2. Use a suitable tool to remove the oil filter.


M3103007

3. Use a clean rag to clean the installation surface.
4. Apply clean oil to the gasket of new oil filter.
5. Use a suitable tool to tighten the oil filter in accordance with the indication on the side or package.

   Tightening torque (reference value):

   14 ± 2 Nm

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6. Start the engine and verify that oil leaks do not exist.
   - Repair or replace the related components if any oil leaks occur.
7. Inspect the oil level.

   **Refer to: Oil Level Inspection (3.1.3 Lubrication System, General Inspection).**
8. Install the floor.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Oil gauge |
| Multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern has been found, solve the fault (if possible) before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Oil pan<br>• Oil pan gasket<br>• Oil filter | • Oil pressure alarm<br>• Oil pressure alarm circuit<br>• Instrument cluster |

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

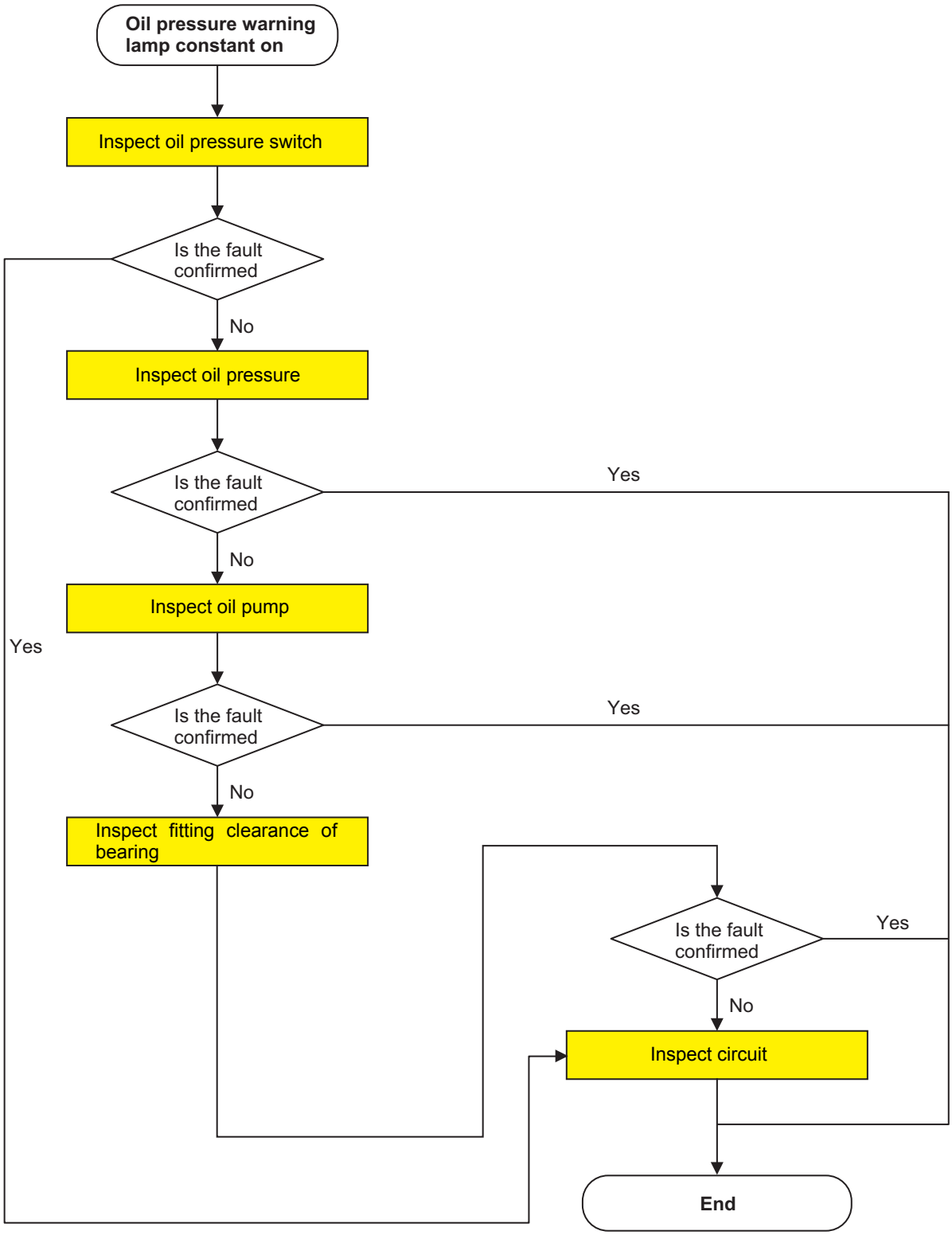
| Symptom | Possible Causes | Solutions |
|---|---|---|
| Oil pressure warning lamp constant on | • Oil<br>• Oil Pump<br>• Oil filter<br>• Oil pressure switch<br>• Engine main bearing<br>• Connecting rod bearing<br>• Electrical | **Refer to: Diagnosis Procedure for Oil Pressure Warning Lamp Constant ON (3.1.3 Lubricating System, Symptom Diagnosis and Testing).** |
| Oil pressure warning lamp not on | • Oil pressure switch<br>• Circuit<br>• Oil pressure warning lamp LED<br>• Instrument cluster | **Refer to: Diagnosis Procedure for Oil Pressure Warning Lamp not on (3.1.3 Lubricating System, Symptom Diagnosis and Testing).** |
| Abnormal oil consumption | • Leak<br>• PCV gas leakage consumption<br>• Burning consumption in the combustion chamber | **Refer to: Diagnosis Procedure for Abnormal Oil Consumption (3.1.3 Lubricating System, Symptom Diagnosis and Testing).** |

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# Diagnosis Procedure for Oil Pressure Warning Lamp Constant ON

**CAUTION: Make sure that the oil level, viscosity and quality are normal before diagnosis. Replace or add oil if necessary.**



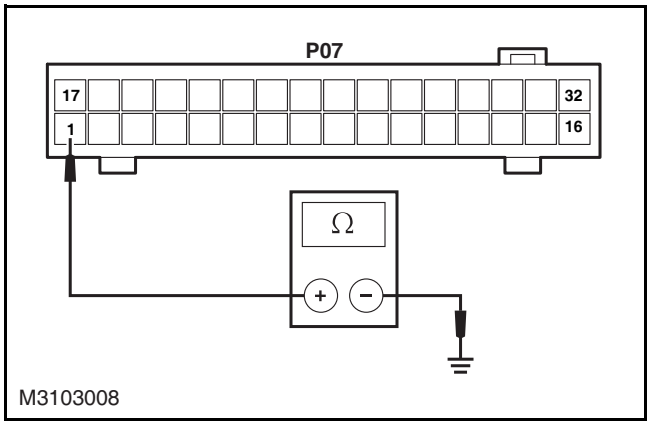
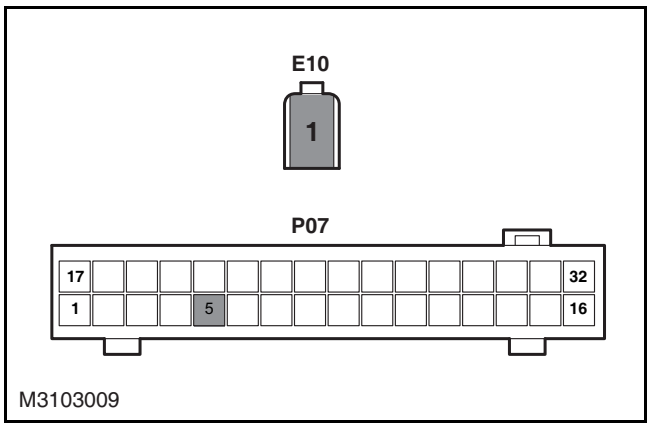
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect oil pressure switch | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the oil pressure alarm wiring harness connector E10.<br>C. Turn the ignition switch to "ST", and start the engine.<br>Is the oil pressure warning lamp constant on?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 2. |
| 2. Inspect oil pressure | |
| | A. Perform the inspection procedures for the oil pressure.<br>**Refer to: Oil Pressure Inspection (3.1.3 Lubrication System, General Inspection).**<br>Is the oil pressure normal?<br>**Yes**<br>Replace the oil pressure alarm.<br>**No**<br>Go to step 3. |
| 3. Inspect oil pump | |
| | A. Remove the oil pump.<br>**Refer to: Oil Pump (3.1.3 Lubrication System, Removal and Installation).**<br>B. Inspect the oil pump.<br>Is the oil pump normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the oil pump. |

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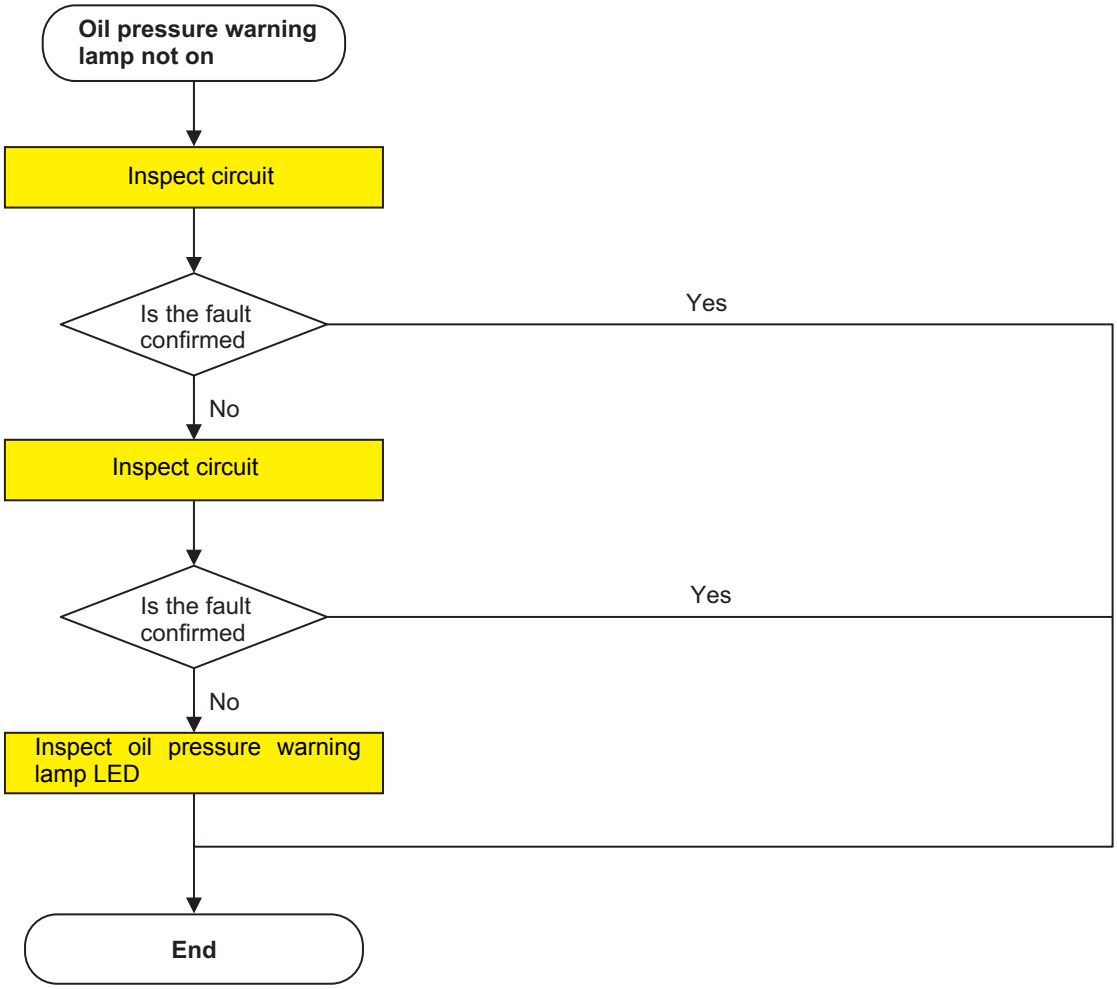


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fitting clearance of bearing | |
| | A. Disassemble the main bearing and connecting rod bearing.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).**<br>B. Inspect the fitting clearances of engine main bearing and connecting rod bearing.<br>Is the fitting clearance normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Adjust the fitting clearances of engine main bearing and connecting rod bearing until they return to normal.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).** |
| 5. Inspect circuit | |
|  M3103008<br>  M3103009 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the oil pressure switch wiring harness connector E10. Keep the terminal 1 of E10 insulated from the grounding.<br>C. Disconnect the instrument cluster wiring harness connector P07, and measure the resistance between terminal 1 of connector P07 and reliable grounding with a multimeter.<br>**Standard resistance: 10 MΩ or higher**<br>Is the resistance value normal?<br>**Yes**<br>Replace the instrument cluster.<br>**No**<br>Repair the short circuit fault between terminal 1 of oil pressure switch connector E10 and terminal 1 of instrument cluster wiring harness connector P07. Test the system to make sure it is normal. |

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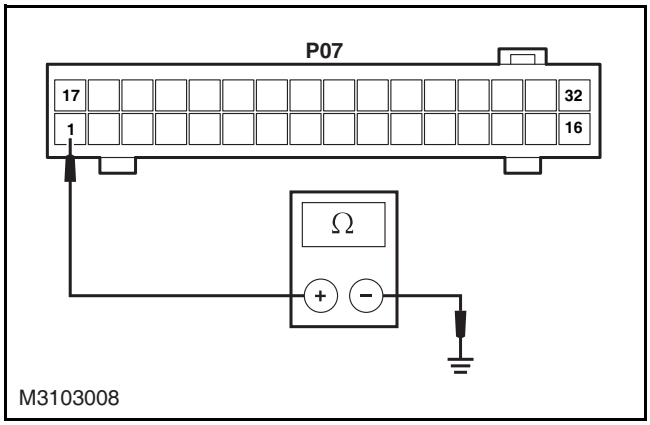
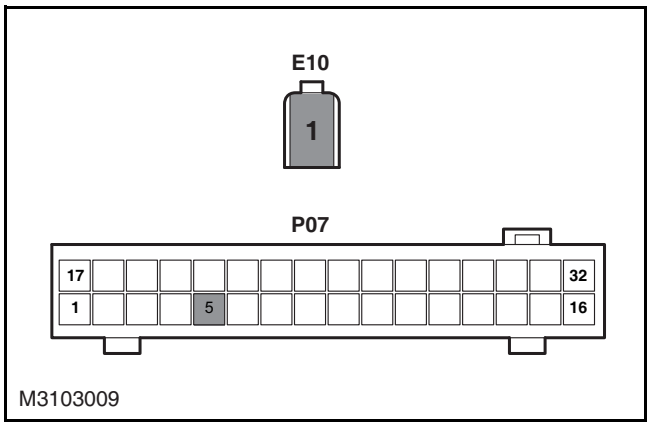


# Diagnosis Procedure for Oil Pressure Warning Lamp not on



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the oil pressure alarm wiring harness connector E10.<br>C. Use jumper wire to connect the terminal 1 of oil pressure alarm wiring harness connector E10 to reliable grounding.<br>D. Turn the ignition switch to "ON".<br>Does the oil pressure warning lamp turns on?<br>**Yes**<br>Replace the oil pressure alarm.<br>**No**<br>Go to step 2. |
| 2. Inspect circuit | |
|  M3103008<br>  M3103009 | A. Keep the terminal 1 of oil pressure alarm wiring harness connector E10 grounded.<br>B. Disconnect the instrument cluster wiring harness connector P07.<br>C. Measure resistance between terminal 1of instrument cluster wiring harness connector P07 and reliable grounding with a multimeter. Test if the system is normal.<br>**Standard resistance: less than 1 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the open circuit fault between terminal 1 of oil pressure switch wiring harness connector E10 and terminal 1 of instrument cluster wiring harness connector P07. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect oil pressure warning lamp LED | |
| | A. Remove the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>B. Replace the oil pressure warning lamp LED.<br>C. Inspect the LED with a multimeter.<br>Is the LED normal?<br>**Yes**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>**No**<br>Replace the LED. |

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# Diagnosis Procedure for Abnormal Oil Consumption

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect for leaks | |
| | A. Inspect each sealing portion of engine.<br>Does any oil leak exist?<br>**Yes**<br>Repair the leak point. Test the system to make sure that it is normal.<br>**No**<br>Go to step 2. |
| 2. Inspect amount of PCV gas leakage | |
| | A. Disconnect the PCV connecting pipe from the inlet pipe.<br>B. Start the engine and increase the speed to 4000 rpm.<br>Does the PCV connecting pipe exhaust excessive amount of exhaust gas?<br>**Yes**<br>Repair the engine piston and the sealing of cylinder.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.1.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>The system is normal. |

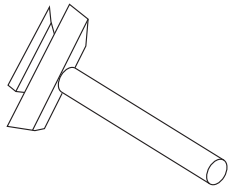
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## Removal and Installation

# Oil Pan and Oil Strainer

### Special Tool

| | |
|---|---|
|  CA301-027 | Oil pan remover CA301-027 |

### Material

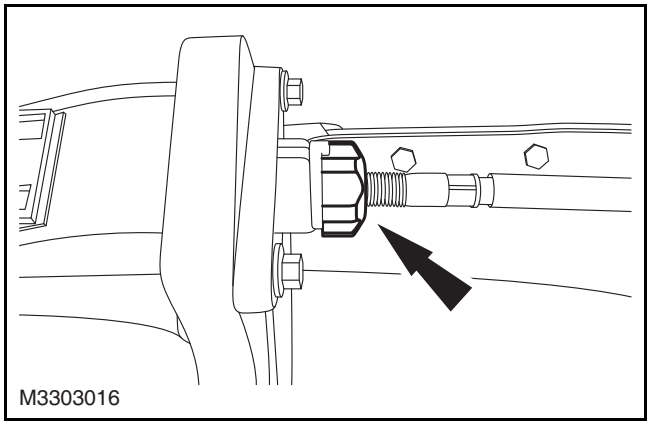
| Item | Specifications |
|---|---|
| Sealant | TianShan 587 or TianShan 1596 |

## Removal

1. Lift the vehicle.

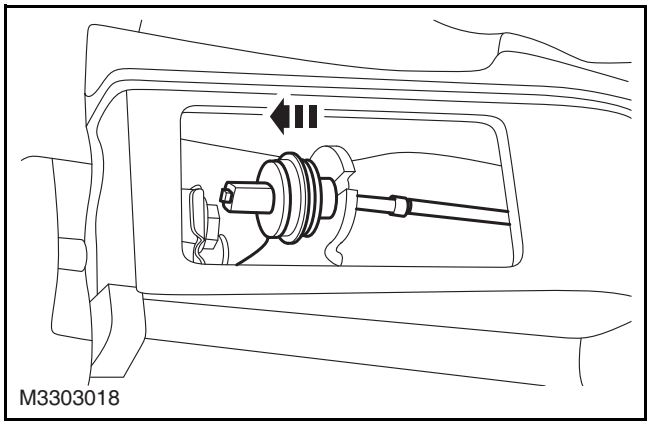
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Loosen the clutch cable retaining nut.


M3303016

3. Remove the clutch cable cover.

4. Disconnect the connection between clutch cable and clutch fork.


M3303018

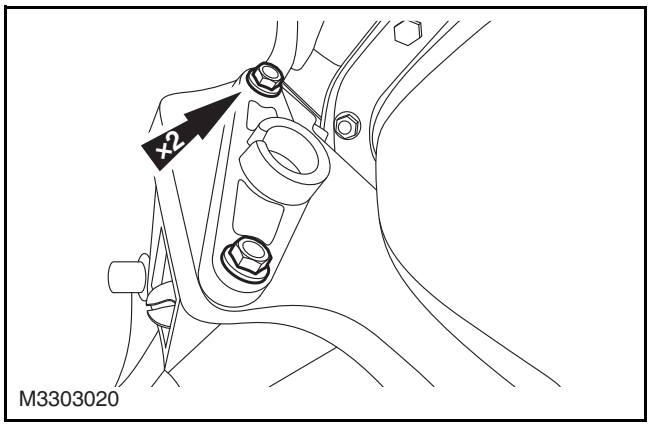
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**5.** Remove the locating plate of clutch cable retaining nut.

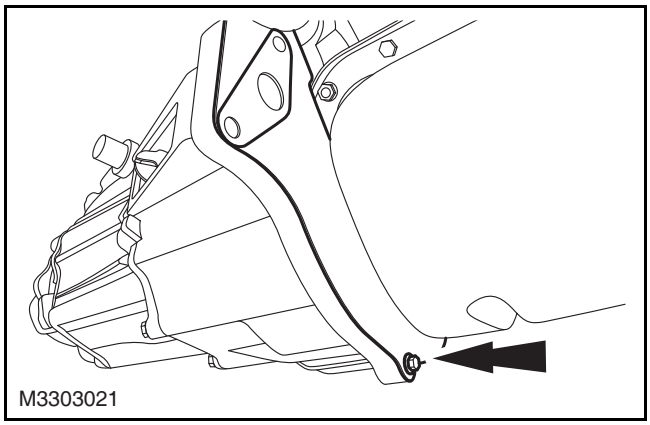
1 Remove 2 retaining bolts from the locating plate.

Torque: 23 ± 2 Nm




2 Remove the locating plate of clutch cable retaining nut.

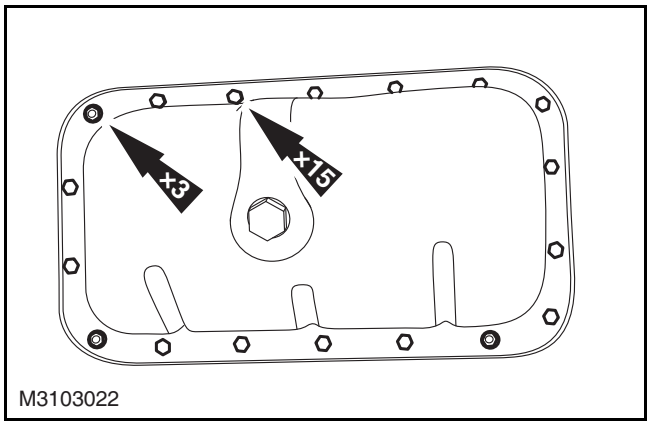
**6.** Remove the retaining bolt from clutch baffle plate, and remove it.




**7.** Remove the oil pan.

1 Remove 15 retaining bolts and 3 retaining nuts from the oil pan.

Torque: 7 Nm



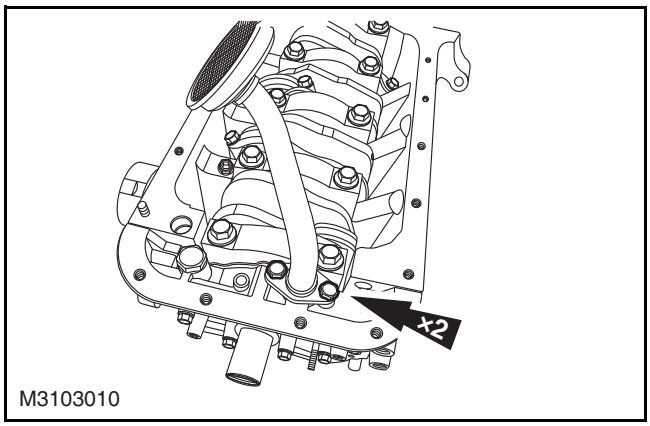

2 Separate the oil pan and cylinder block.

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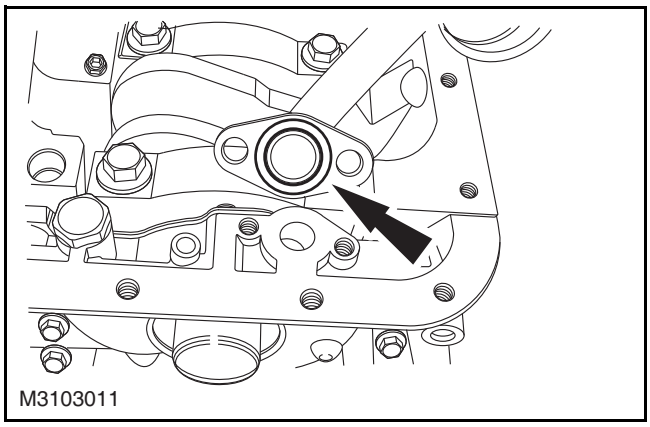
8. Remove 2 retaining bolts from the strainer.

   Torque: 10 Nm



M3103010

9. Remove the strainer and throw away the O-ring.


M3103011

10. Clean the fitting surface between oil pan and cylinder block, remove the oil and dirt from the fitting surface and clean the inside of oil pan.
11. Clean the oil pump strainer mesh.

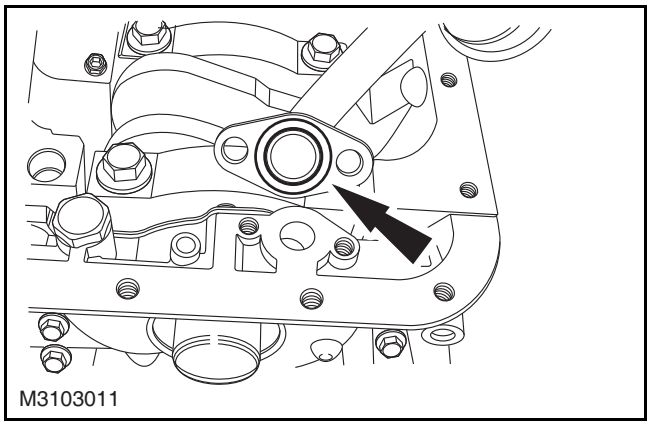
## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Clean the joint surface between oil pan and cylinder block.**

**CAUTION: The side with words should face toward oil pan during installation.**

**CAUTION: Apply sealant to the joint gaps between oil pump, crankshaft rear oil seal and cylinder block.**


M3103011

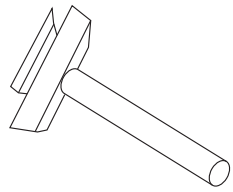
2. Fill lubricant for engine as specified.
3. Inspect that each connection has no oil leak.

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# Oil Pump

### Special Tool

| | |
|---|---|
|  CA301-027 | Oil pan remover CA301-027 |

### Material

| Item | Specifications |
|---|---|
| Sealant | Loctite 5900 |

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the accessory drive belt.

   **Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

4. Remove the A/C compressor.

   **Refer to: Compressor (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**

5. Remove the alternator.

   **Refer to: Alternator (3.1.10 Charging System, Removal and Installation).**

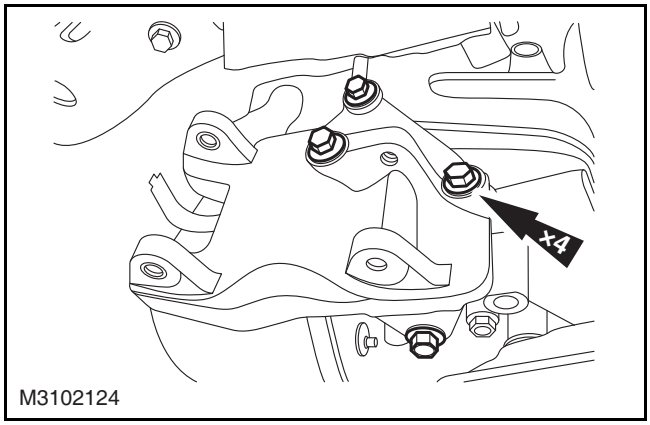
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**6.** Remove the alternator bracket.

1 Remove 4 retaining bolts from the alternator bracket.

Torque: 23 ± 2 Nm

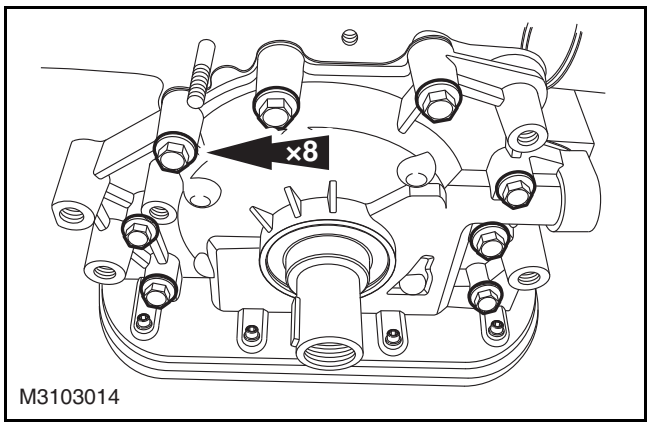



2 Remove the alternator bracket.

**7.** Remove the water pump pulley.

1 Remove 8 retaining bolts from the water pump pulley.

Torque: 10 ± 1 Nm




2 Remove the water pump pulley.

**8.** Remove the timing mechanism.

**Refer to: Timing Mechanism (3.1.2 Mechanical System, Removal and Installation).**

**9.** Remove the oil pan and oil pump strainer.

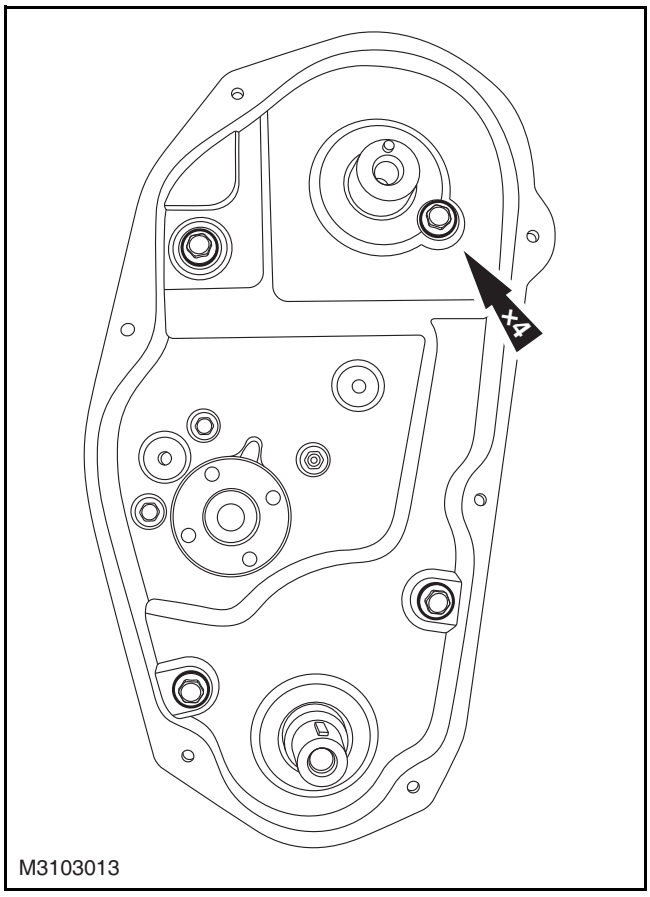
**Refer to: Oil Pan and Oil Pump Strainer (3.1.3 Lubrication System, Removal and Installation).**

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**10.** Remove 4 retaining bolts from the timing belt rear cover.

Torque: 10 Nm



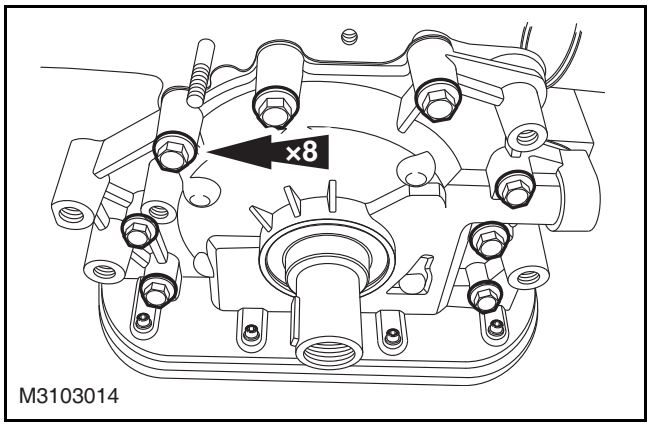
M3103013

**11.** Remove the water pump pulley.

Torque: 11 Nm

**CAUTION: Note that the length of retaining bolts is different when installing the oil pump.**

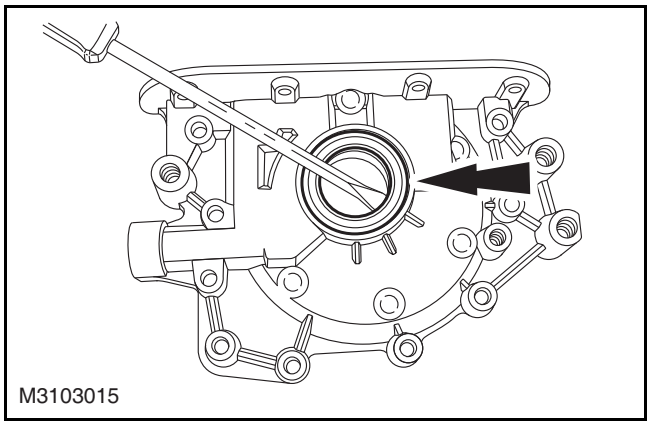
**CAUTION: It is necessary to replace with a new one after removing the oil pump gasket.**



M3103014

**12.** Remove the crankshaft front seal ring.

**CAUTION: It is necessary to replace a new crankshaft front seal ring after removing the oil pump.**


M3103015

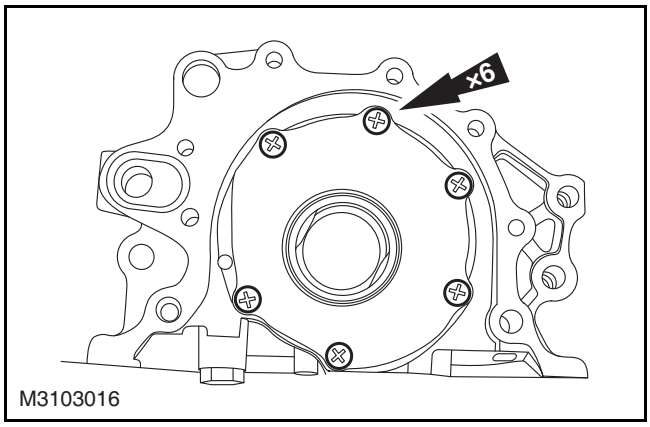
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## Inspection

1. Remove 6 retaining screws from the rotor cover.

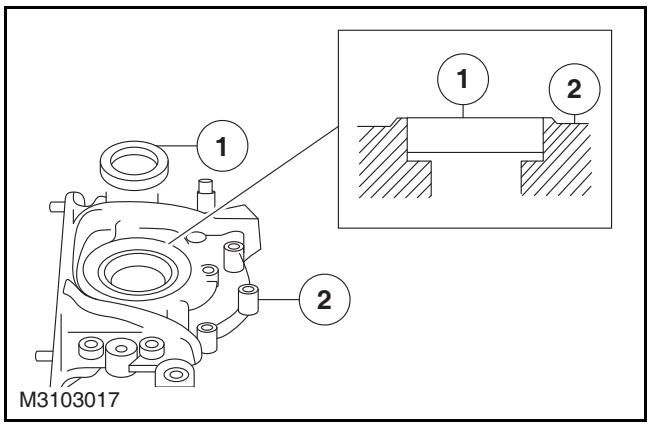
   Torque: 11 Nm




**CAUTION: Replace the oil pump timing chain housing assembly if the oil pump is damaged.**

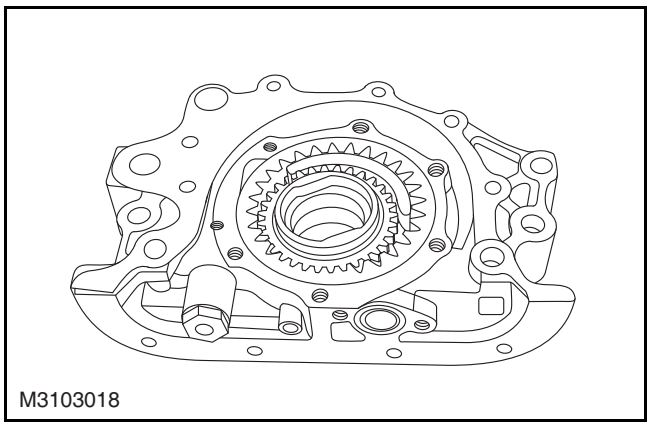
2. Inspect the oil seal lip for defect and damage.

   Replace it as necessary. Apply engine oil to oil seal lip before installation.




**CAUTION: When installing the oil seal, press it so as to assemble and make the end surface of oil seal (1) lower 0.5 mm than the end surface of oil pump housing (2).**

3. Inspect the inner and outer rotor, rotor cover and oil pump housing for excessive wear or damage.

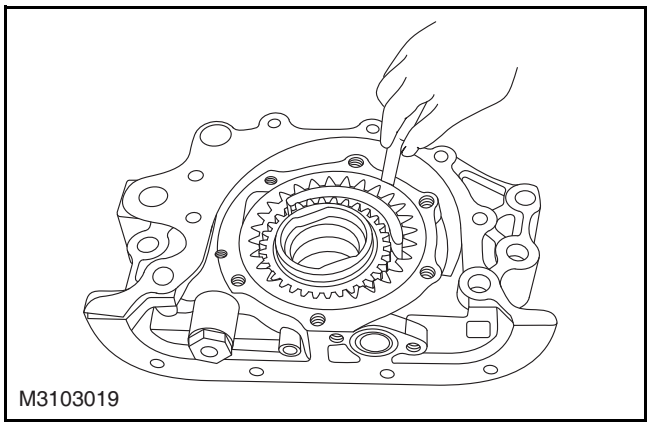


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4. Measure the radial clearance.

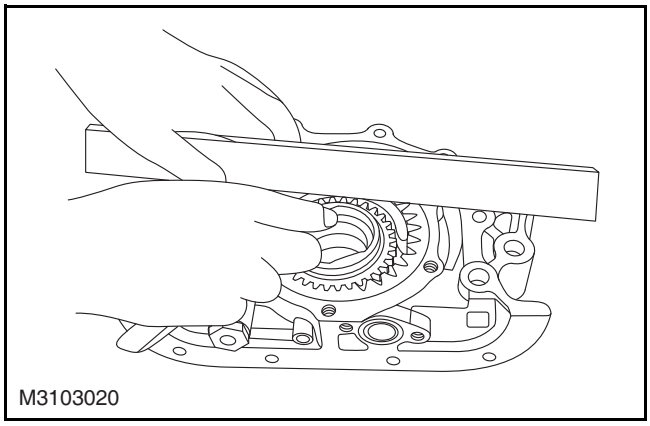
   Use a feeler gauge to inspect the radial clearance between outer rotor and housing. If the clearance exceeds limit, replace the outer rotor and housing.
   Radial clearance limit between outer rotor and housing:
   0.310 mm


M3103019

5. Measure the side clearance.

   Use a straight ruler and feeler gauge to measure the side clearance.

   Side clearance limit: 0.15 mm


M3103020

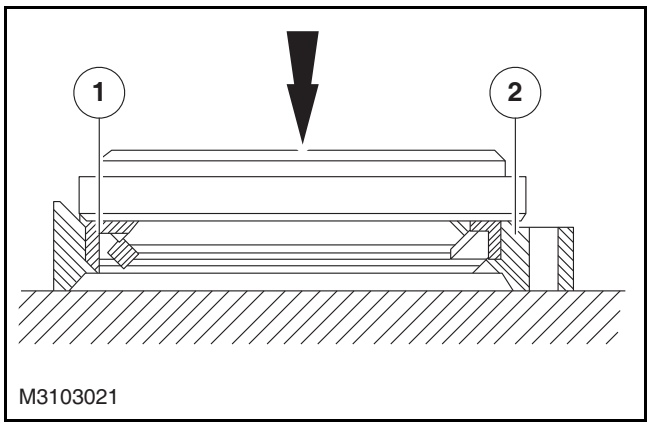
## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Note that the new crankshaft front seal ring should be installed into position.**

**CAUTION: Start the engine and inspect for coolant and oil leaks.**

**CAUTION: Inspect if the engine oil pressure is normal.**



M3103021

| Item | Description |
|---|---|
| 1 | Oil seal |
| 2 | Oil seal housing |

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## Specifications

# Component Specifications

| Item | Specifications |
|---|---|
| Thermostat type | Paraffin type |
| Water pump type | Centrifugal impeller pump |
| Number of water pump vanes | 7 |

# General Specifications

| Application | Specifications |
|---|---|
| Cooling type | Water cooling |
| Coolant capacity (including the water reservoir) | 5.0 ± 0.2 L |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Water pump pulley retaining bolt | 10 ± 1 | - | - |
| Water pump retaining bolt | 10 ± 1 | - | - |
| Thermostat cap retaining bolt | 15 ± 2 | - | - |
| Radiator fan retaining bolt | 10 ± 1 | - | - |

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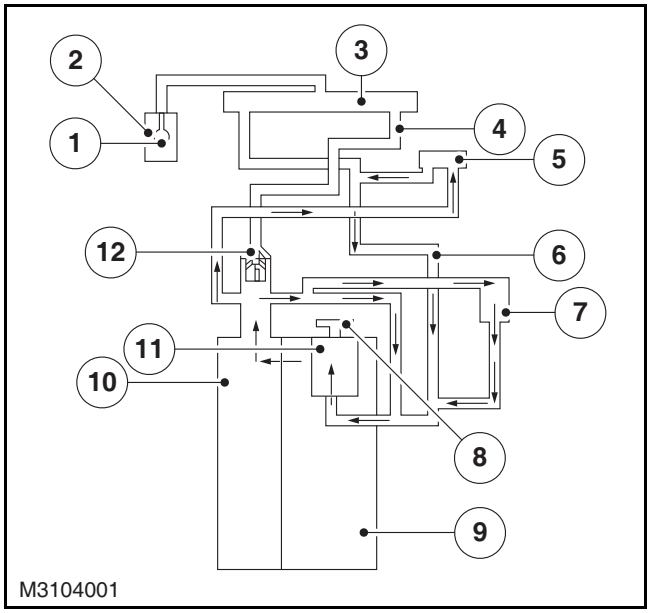


## Description and Operation

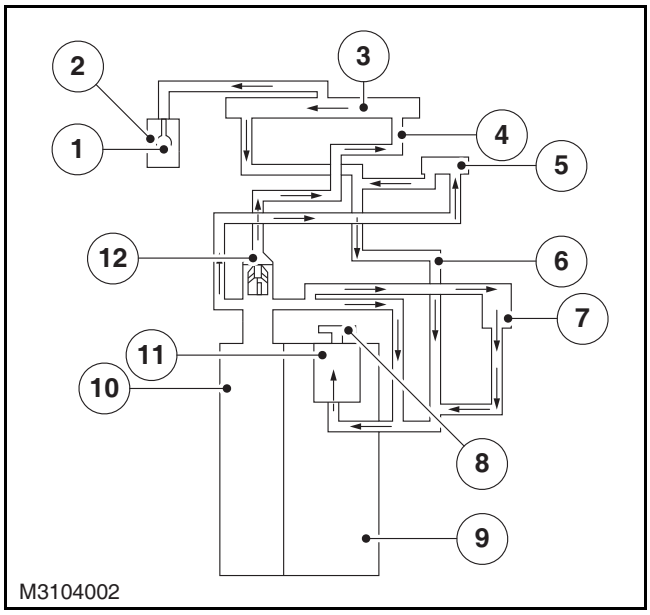
# System Overview

Cooling system consists of radiator filler cap, radiator, water reservoir, hose, water pump, cooling fan and thermostat. The radiator is a flat pipe structure. When the engine is cold: the normal working temperature of engine is around 95°C (203°F), and within this range, all engine components work in optimal state. It will increase the mechanical wear if the ideal working temperature cannot be reached for a long time. Due to low temperature, the mixed gas burns inadequately in the combustion chamber, which leads to serious carbon deposit. Therefore, the engine is required to run at low temperature.

The normal working temperature should be reached as soon as possible and the heat produced by engine should be kept away from exchanging with the outside as much as possible. At this moment, the thermostat controls the coolant in the engine to circulate in the engine only. The heat produced around engine wall is brought to other components of engine to heat them rapidly. The water pump circulates the engine coolant and then the coolant circulates through water jacket, throttle body assembly and cylinder head. Such state is called "minor cycle".




When the temperature is 88°C (190.4°F), the coolant is pumped by the water pump to the engine water jacket, intake manifold, cylinder head and radiator. Such state is called "major cycle".




| Item | Description |
|---|---|
| 1 | Water reservoir cap |
| 2 | Water reservoir |
| 3 | Radiator |
| 4 | Radiator inlet hose |
| 5 | Heater water tank |
| 6 | Radiator water outlet hose |
| 7 | Throttle body |
| 8 | Water pump pulley |
| 9 | Cylinder block |
| 10 | Cylinder head |
| 11 | Water pump |
| 12 | Thermostat |

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# Components Description

## Coolant

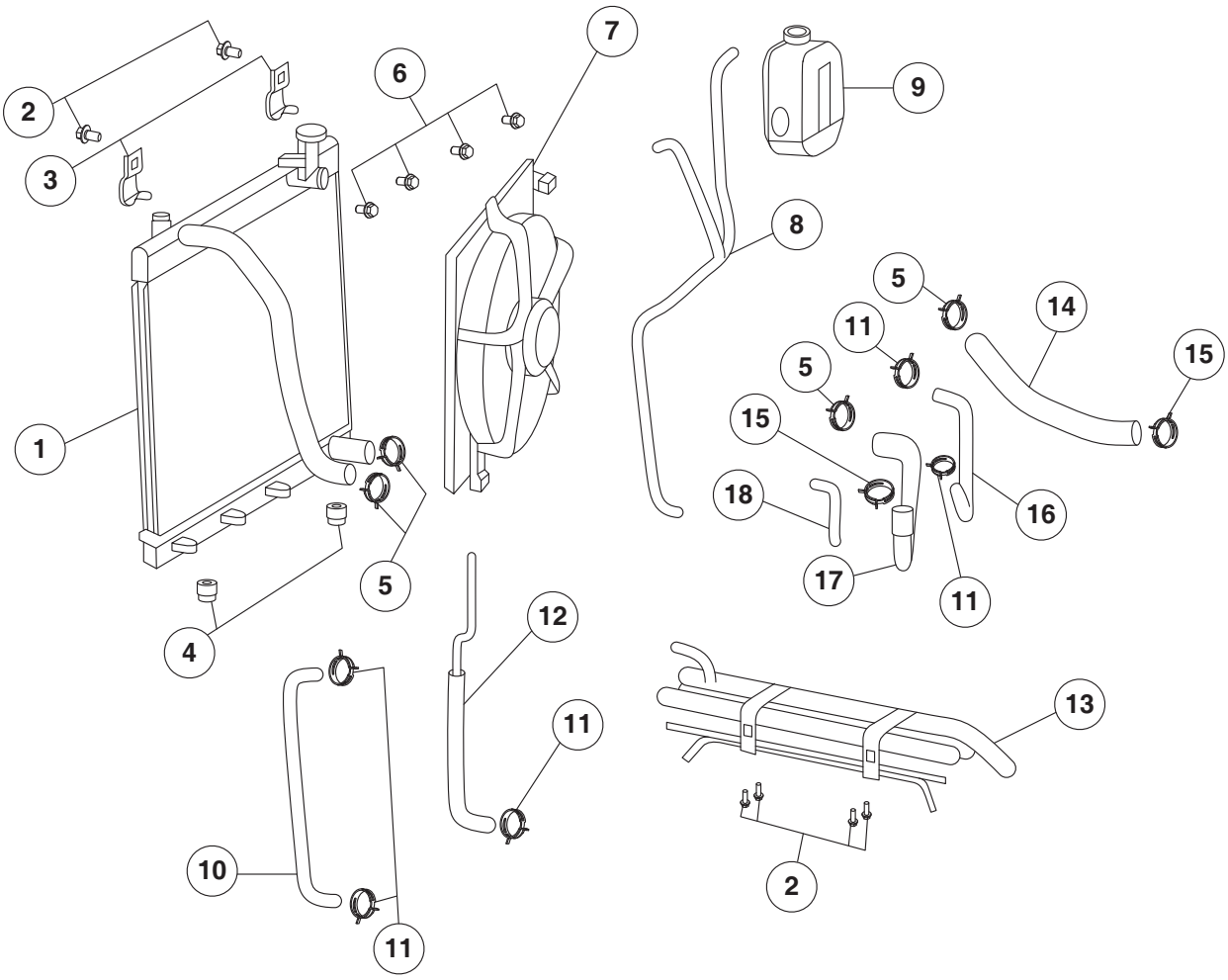
When engine reaches a normal working temperature: coolant in engine gets warm rapidly with engine running. The cooling system works normally when it reaches the thermostat cooling cycle standard (major cycle starts operating). The coolant in radiator will swell when it is heated and overflow to the water reservoir. The coolant flows back to the radiator when system cools down.

**CAUTION: Coolant such as alcohol, methanol or water alone cannot be used for the cooling system, which may cause system malfunction.**

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# Components Location View



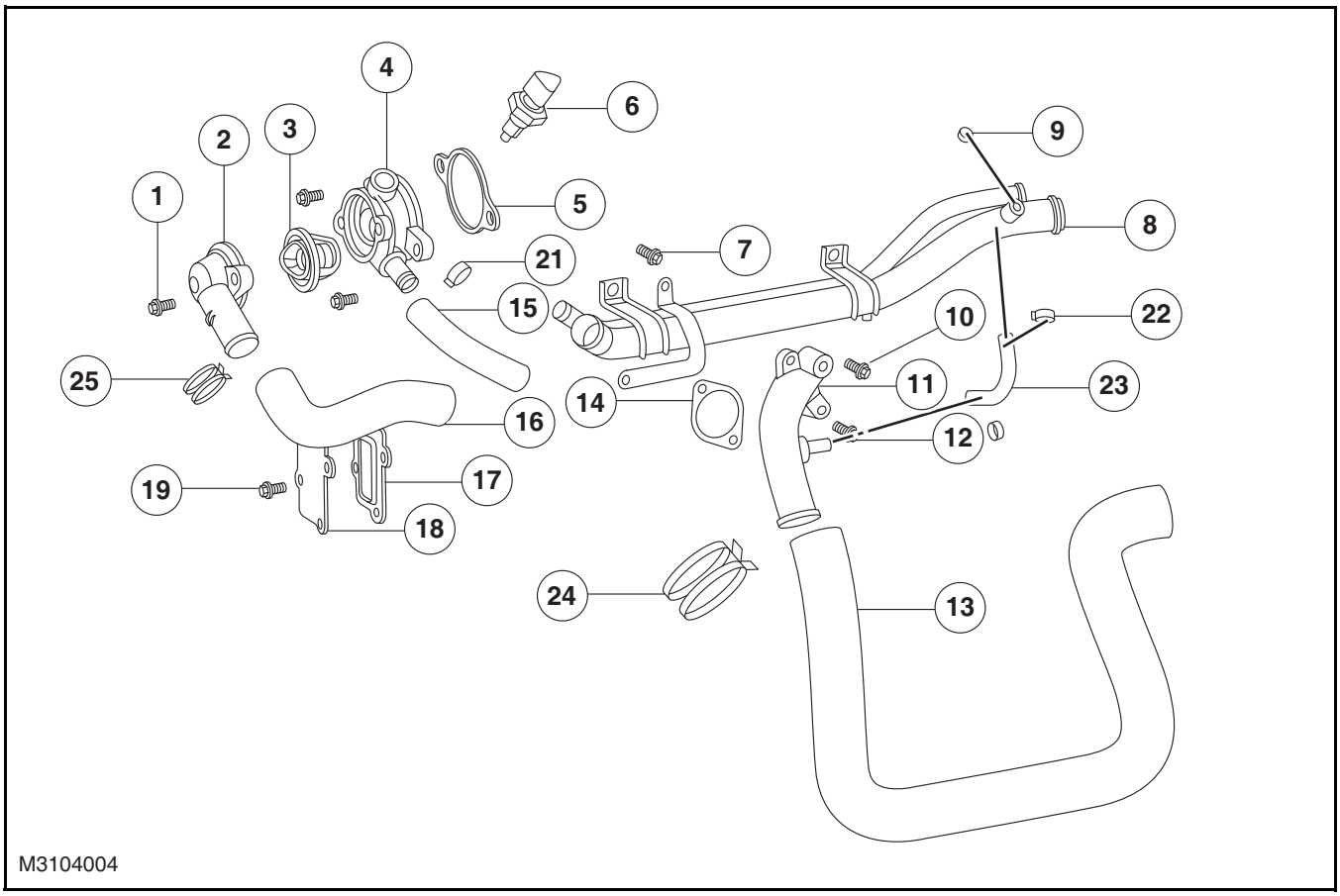

M3104003

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Radiator assembly | 10 | Heater outlet hose |
| 2 | Screw | 11 | Clamp |
| 3 | Radiator upper bracket | 12 | Heater joint with hose assembly |
| 4 | Radiator mounting bracket | 13 | Floor water pipe accessory assembly |
| 5 | Clamp | 14 | Engine inlet hose |
| 6 | Screw | 15 | Clamp |
| 7 | Radiator fan | 16 | Engine to heater hose |
| 8 | 3-way with accessory assembly | 17 | Engine outlet hose |
| 9 | Water reservoir assembly | 18 | Engine reservoir hose |

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# Components Exploded View




| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Hexagon flange bolt | 1 | 11 | Water inlet pipe assembly | 1 |
| 2 | Thermostat cap | 1 | 12 | Hexagon flange bolt | 2 |
| 3 | Thermostat assembly | 1 | 13 | Inlet hose | 1 |
| 4 | Thermostat seat assembly | 1 | 14 | Inlet hose gasket | 1 |
| 5 | Thermostat seat gasket | 1 | 15 | No.1 outlet hose | 1 |
| 6 | Coolant temperature sensor assembly | 1 | 16 | No.2 outlet hose | 1 |
| 7 | Hexagon flange bolt | 1 | 17 | Sealing end cover gasket | 1 |
| 8 | Water outlet hose assembly | 1 | 18 | Sealing end cover | 1 |
| 9 | Cooling system vent plug | 1 | 19 | Exhaust manifold cover bolt | 4 |
| 10 | Hexagon flange bolt | 2 | 20 | Hexagon flange bolt | 2 |

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## General Inspection

**CAUTION: Coolant such as alcohol, methanol or water alone cannot be used for the cooling system, which may cause system malfunction.**

**CAUTION: Even though the ambient temperature cannot be expected to reach the freezing point, an antifreeze (antifreezing and rust prevention coolant) mixed with water and glycol in a proportion of 70% and 30% should be used as the coolant.**

**WARNING: Disassemble or assemble all components when the engine cools down, otherwise, the components may lead to serious burn or personal injury.**

**WARNING: Turn off engine and wait until it cools down. Be very careful when removing the reservoir cap even if the engine has cooled down. Cover the cap with a thick cloth, and turn it 2.5 turns counterclockwise slowly. Step back while pressure is releasing.**

**WARNING: After confirming that all pressure has been released, turn the cap with cloth and remove it.**

**WARNING: Use coolant with concentration suitable for the driving ambient conditions. Otherwise, the engine may be damaged.**

**WARNING: The engine has some components made of aluminium which must need the protection from ethylene glycol based coolant to prevent erosion and freeze.**

**WARNING: Only use soft water (demineralized) in the coolant mixture. Water containing mineral reduces the effectiveness of the coolant.**

**WARNING: Engine coolant will damage the paintwork. Wash the engine coolant immediately if it adheres to any painted surfaces.**

## Coolant Level Inspection

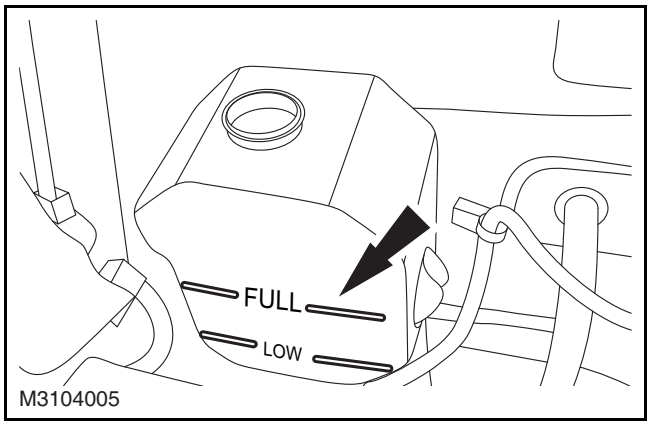
**WARNING: To avoid the danger of being scalded, do not open the water reservoir cap and radiator filler cap when the coolant is "boiling".**

**WARNING: To avoid the danger of being scalded, do not open the water reservoir cap and radiator filler cap when engine and radiator still hot.**

**WARNING: The boiling liquid and steam may spurt out under the pressure since the water reservoir cap opens earlier.**

Inspect the coolant level in the water reservoir when the engine cools down. The normal coolant level should be between "FULL" and "LOW" marks on the water reservoir.

When the coolant level is below "LOW" mark, open the water reservoir cap and add an appropriate amount of coolant to the "FULL" mark, and then close the cap again.

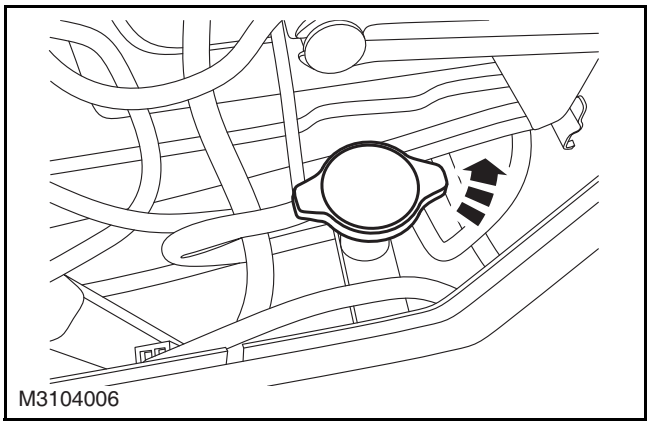


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## Coolant Leak(s) Inspection

1. Inspect engine coolant level.
2. When the engine is cooling, remove the radiator filler cap, and clean the filler cap and filler port with clean water.


M3104006

3. Install the tester to the water reservoir filler port.
4. Apply pressure with a tester, and make the pressure reach 110 kPa.

**CAUTION: Be aware that the pressure in radiator must not more than 110 kPa, or it may cause damage.**

5. Observe the tester for pressure changes.

Standard: hold pressure for 2 minutes when it reaches 110 kPa.

It shows that there may be leaks if the pressure indicated by pressure gauge needle begins to drop. Repair or replace the related components.

## Drive Belt Tension Inspection

**WARNING: Disconnect the negative wiring harness before inspecting and adjusting the belt tension.**

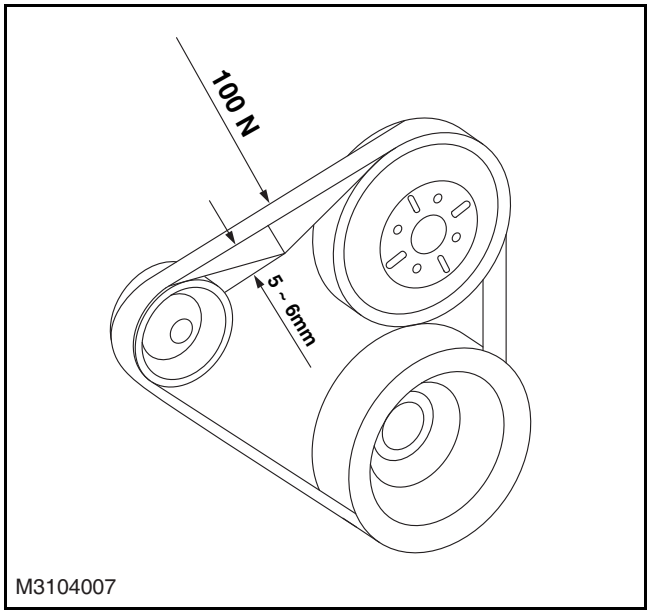
**WARNING: Read the "WARNING" content of 3.1.4 Cooling System.**

1. Inspect the belt for any cracks, cuts, deformation, wear and dirty. Replace the belt with a new one if necessary.

   **Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

2. Inspect the belt tension. (Method 1)

   If pressing the belt with thumb (about 100 N) and it sags 5 ~ 6 mm, this indicates that the belt tension is proper.



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## Thermostat Test

1. Remove the thermostat.

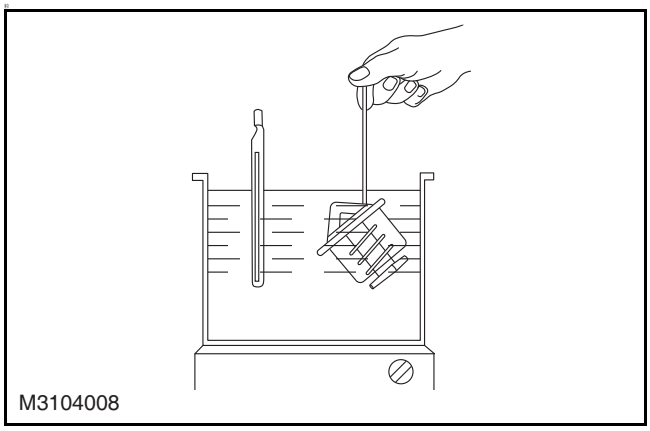
   **Refer to: Thermostat (3.1.4 Cooling System, Removal and Installation).**

2. Soak the thermostat in the heatable water.
3. Place a thermometer in the water.
4. Observe if the thermostat state is normal or not while warming up the water.

   Thermostat opening temperature is 88 ± 2°C.

   Thermostat maximum lift is more than 8 mm.

   Thermostat full opening temperature is 95°C.


M3104008

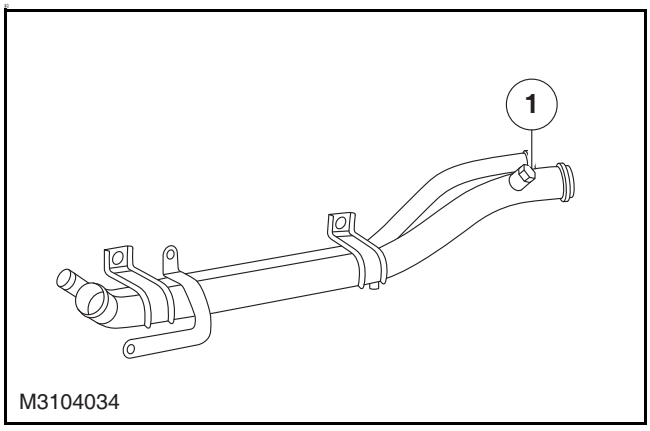
## Coolant Draining and Filling

1. Remove the water reservoir cap after the engine cools down. And turn the cap counterclockwise slowly until the pressure has been released, then press it down and continue to turn it counterclockwise.

**WARNING: To avoid the danger of being scalded, do not open the water reservoir cap when the engine and radiator still hot. The boiling liquid and steam may spurt out under the pressure since the water reservoir cap opens earlier.**

2. After opening the water reservoir cap, run the engine until the radiator upper hose gets warm (which shows that the thermostat has been opened and the coolant has begun to flow through the system).
3. Stop the engine and drain the coolant.
4. Tighten the drain plug. Fill the cooling system full with water and run the engine, until the radiator upper hose gets warm again.
5. Repeat steps (3) and (4) several times until the liquid drained is almost colorless.
6. Drain the cooling system, and tighten the radiator drain plug.
7. Remove the water reservoir and open its cap, then remove the water reservoir and pour out the liquid. Use soap water to clean the inside and flush it with clean water and drain the water, then install the water reservoir and hoses again.
8. A coolant mixed with high-quality glycol and water in a proportion of 50/50 should be added to the maximum level of radiator and water reservoir.
9. Run the engine for a while, and observe the coolant level. Add coolant until it reaches at the full level if there is no coolant at the radiator filler port.
10. During repair or maintenance, if the vacuuming filling coolant method is not available, pay attention to loosen the drain plug (1) on the water outlet hose assembly (as shown in the figure below) when filling coolant, and run the engine after filling, until water overflows, then tighten the drain plug as required (torque: 6 ± 1 Nm).

**CAUTION: If water leakage occurs on the drain plug, it is necessary to replace the drain plug washer.**



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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |
| Diagnostic tool |

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical damage or electrical damage.
3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Coolant leaks<br>• Washer or sealing<br>• Hose or hose joint<br>• Water reservoir cap and sealing<br>• Water reservoir<br>• Radiator<br>• Water pump<br>• Thermostat cap<br>• Thermostat chamber lock<br>• Heater radiator<br>• Compressor belt<br>• Coolant output connector | • Fuse<br>• Wiring harness<br>• Electrical connector<br>• Coolant temperature sensor<br>• Radiator fan<br>• Engine control module (ECM) |

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Loss of coolant | • Hose or hose joint | • Inspect each connecting hose and its joint for aging or leaks. Repair or replace if necessary. |
| | • Radiator | • Inspect the heater radiator for any leaks. |
| | • Water pump | • Inspect the water pump for any leaks. Perform the pressure test in 3.1.4 Cooling System. Install a new set of water pump and water pump washer if necessary. **Refer to: Water Pump (3.1.4 Cooling System, Removal and Installation).** |
| | • Thermostat cap | • Inspect the thermostat cap for any leaks. Perform the pressure test in 3.1.4 Cooling System. Install a new set of thermostat cap and cap washer if necessary. **Refer to: Thermostat (3.1.4 Cooling System, Removal and Installation).** |
| | • Thermostat chamber lock | • Inspect if the thermostat chamber lock is always locked or damaged. Install a new set of thermostat chamber lock if necessary. |
| | • Radiator filler cap or sealing | • Inspect if the radiator filler cap is always locked or damaged. Install a new set of radiator filler cap if necessary. |
| | • Water reservoir | • Inspect the water reservoir for any damage. Install a new set of coolant tank if necessary. |
| | • Heater radiator | • Inspect the heater radiator for any leaks. |
| | • Engine | • Inspect the engine, cylinder head, cylinder block and cylinder head gasket. |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine cannot reach the normal working temperature | • Radiator fan | **Refer to: Diagnosis Procedure for Radiator Fan Constantly Runing (3.1.4 Cooling System, Symptom Diagnosis and Testing).** |
| | • Thermostat | • Perform the thermostat testing in 3.1.4 Cooling System. Install a new set of thermostat cap and cap washer if necessary.<br>**Refer to: Thermostat (3.1.4 Cooling System, Removal and Installation).** |
| Engine overheating (signs of boiling coolant) | • Cooling system cannot maintain the pressure | • Inspect the water reservoir for any damage. Install a new set of radiator filler cap if necessary.<br>• Inspect the water pump or water pump washer for any damage. Install a new set of water pump and water pump washer if necessary.<br>**Refer to: Water Pump (3.1.4 Cooling System, Removal and Installation).**<br>• Inspect the engine, cylinder head, cylinder block and cylinder head gasket.<br>• Inspect each connecting hose and its joint for aging or leaks. Repair or replace if necessary. |
| | • Air in the cooling system | • Bleed the cooling system. |
| | • Radiator filler cap or sealing | • Inspect if the radiator filler cap is locked or damaged. Install a new set of radiator filler cap if necessary. |
| | • Water reservoir | • Inspect the water reservoir for any damage. Install a new set of water reservoir if necessary. |

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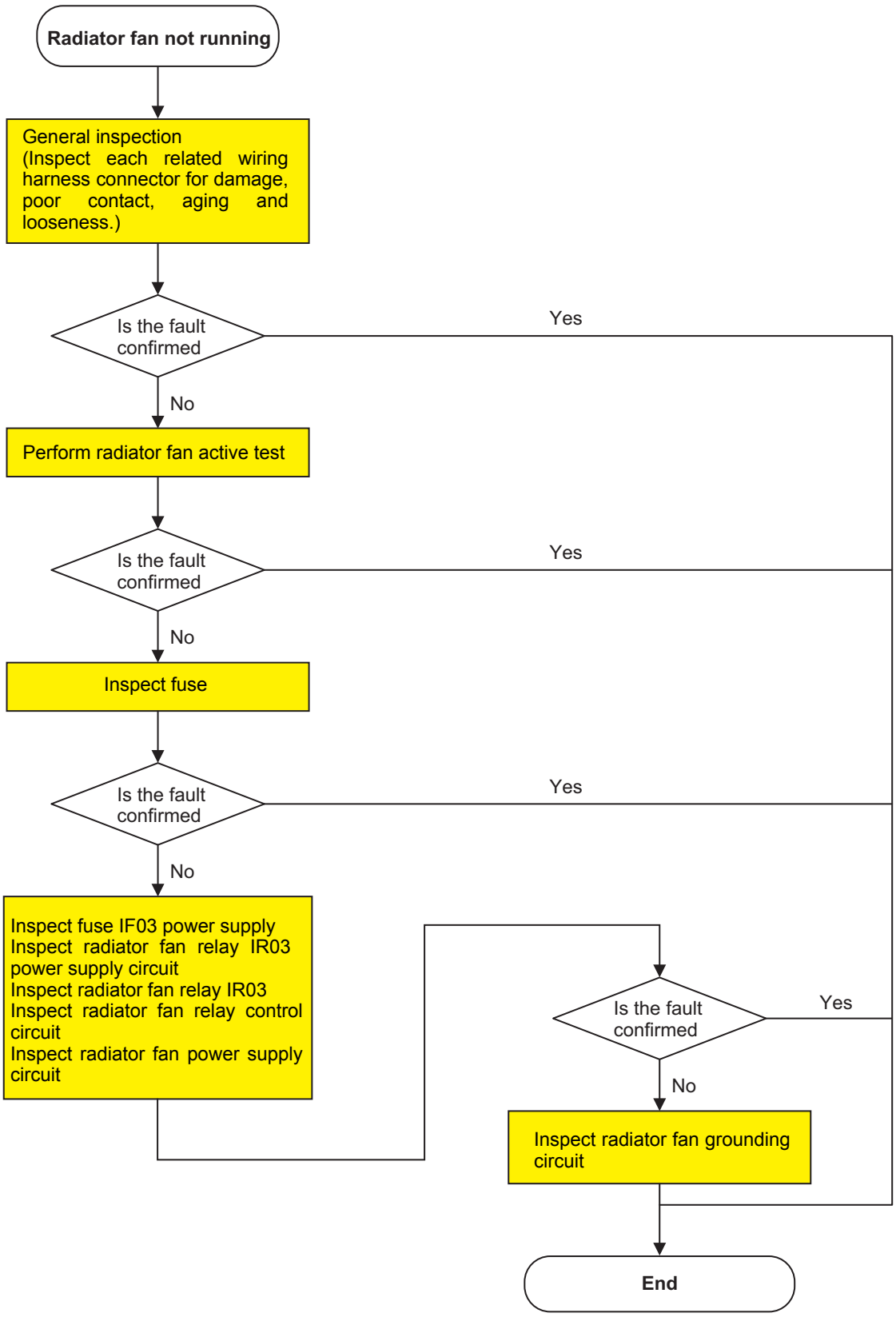
| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine overheating (signs of boiling coolant) | • Coolant level or condition | • Inspect the coolant level. Refill the coolant if necessary.<br>**Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).**<br>• Inspect the coolant condition. Drain the old coolant and add new coolant if the old coolant is abnormal.<br>**Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).** |
| | • Contaminated coolant | • Replace the coolant. |
| | • Radiator grille | • Inspect the radiator grille for any blockage or damage. Repair or replace if necessary. |
| | • Water pump | • Perform the pressure test in 3.1.4 Cooling System. Inspect the water pump for any leaks. Install a new set of water pump and water pump washer if necessary.<br>**Refer to: Water Pump (3.1.4 Cooling System, Removal and Installation).** |
| | • Thermostat | • Perform the thermostat testing in 3.1.4 Cooling System. Install a new set of thermostat cap and cap washer if necessary.<br>**Refer to: Thermostat (3.1.4 Cooling System, Removal and Installation).** |
| | • Compressor belt | • Inspect the compressor belt condition.<br>**Refer to: Accessory Drive Belt Inspection (3.1.2 Mechanical System, General Inspection).** |
| | • Radiator fan | **Refer to: Diagnosis Procedure for Radiator Fan Not Running (3.1.4 Cooling System, Symptom Diagnosis and Testing).** |
| | • Engine | • Inspect the engine, cylinder head, cylinder block and cylinder head gasket. |

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# Diagnosis Procedure for Radiator Fan Not Running

**CAUTION: The radiator fan works is based on the premise that the main relay IR05 of engine control module is working normally. Therefore, make sure the main relay IR05 of engine control module is working normally before inspection. If the vehicle can start normally, this indicates that the main relay IR05 is normal.**



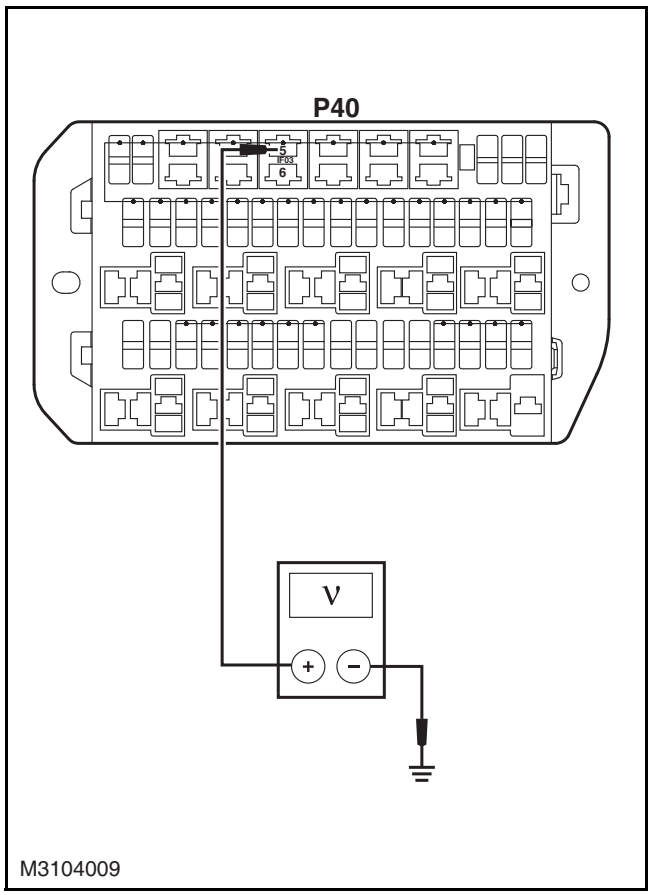
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect each related wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault point. |
| 2. Perform radiator fan active test | |
| | A. Connect diagnostic tool.<br>B. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>Does the fan rotate?<br>**Yes**<br>Inspect the coolant temperature sensor.<br>**Refer to: DTCs P0116, P0117, P0118 (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Inspect fuse | |
| | A. Inspect the radiator fan fuse IF03.<br>Fuse rated capacity: 30 A<br>Is the fuse normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

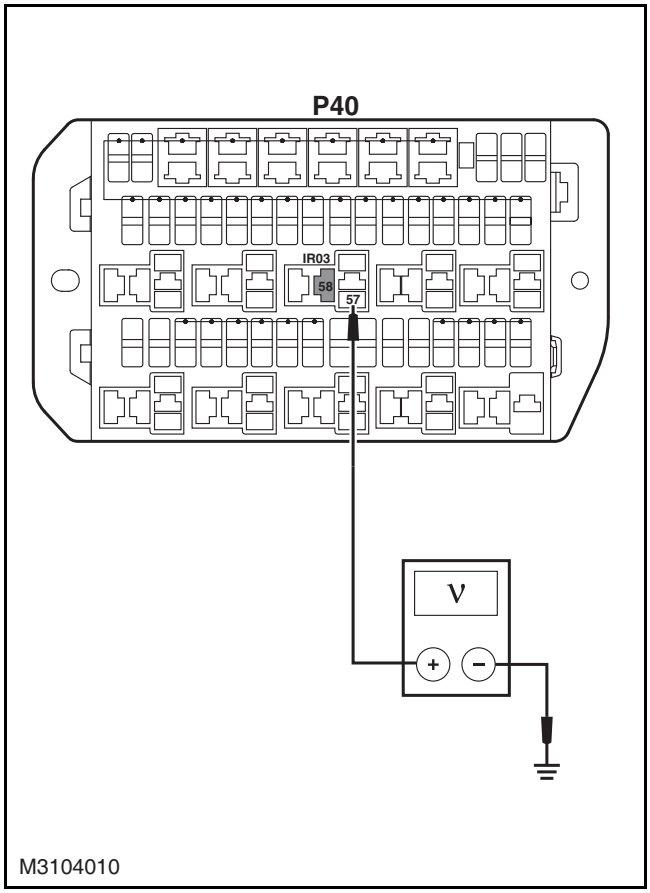
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuse IF03 power supply | |
|  <br>M3104009 | • Measure the voltage between terminal 5 of instrument panel fuse box P40 fuse IF03 and reliable grounding.<br>**Standard voltage value: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of instrument panel fuse box P40 and battery. |

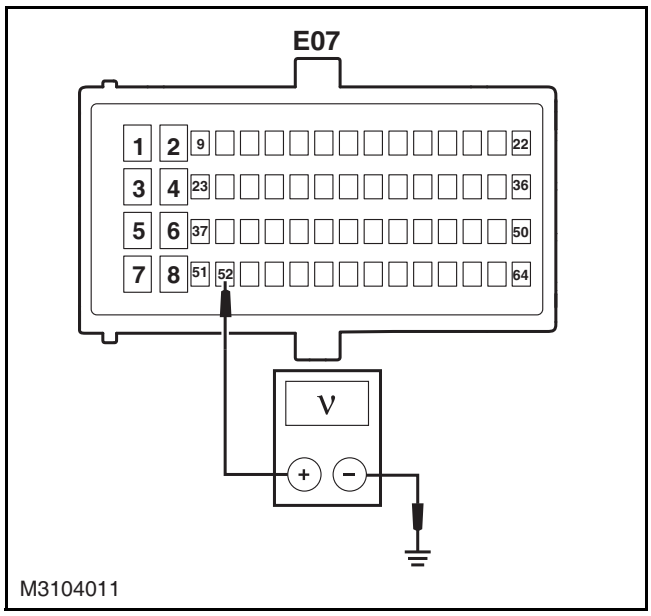
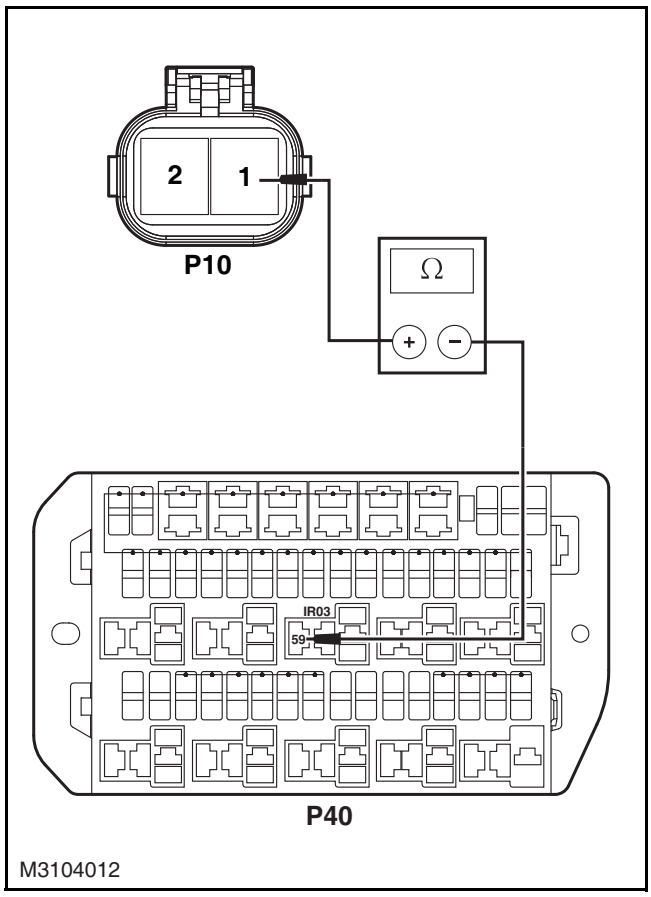
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect radiator fan relay IR03 power supply circuit | |
|  | A. Remove the radiator fan relay.<br>B. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>C. At the same time, measure the voltage between terminals 57, 58 of radiator fan relay IR03 and reliable grounding with a multimeter.<br>**Standard voltage value: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 58 of radiator fan relay IR03 and terminal 6 of instrument panel fuse box.<br>Inspect and repair the open circuit fault between terminal 57 of radiator fan relay IR03 and terminal 69 of main relay IR05. |
| 6. Inspect radiator fan relay IR03 | |
| | A. Remove the radiator fan relay.<br>B. Replace it with a normal one of same type.<br>Is the system normal?<br>**Yes**<br>Replace the radiator fan relay.<br>**No**<br>Go to step 7. |

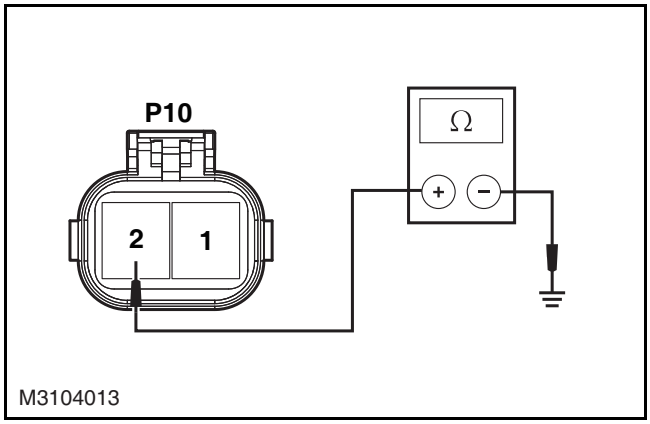
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect radiator fan relay control circuit | |
|  M3104011 | A. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>B. At the same time, measure the voltage between terminal 52 of engine control module wiring harness connector E07 and reliable grounding with a multimeter.<br>**Standard voltage value: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 52 of engine control module wiring harness connector E07 and terminal 85 of radiator fan relay IR03. |
| 8. Inspect radiator fan power supply circuit | |
|  M3104012 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radiator fan wiring harness connector P10.<br>C. Remove the radiator fan relay IR03.<br>D. Measure the resistance between terminal 1 of radiator fan wiring harness connector P10 and terminal 59 of radiator fan relay IR03.<br>**Standard resistance value: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of radiator fan wiring harness connector P10 and terminal 59 of radiator fan relay IR03. |

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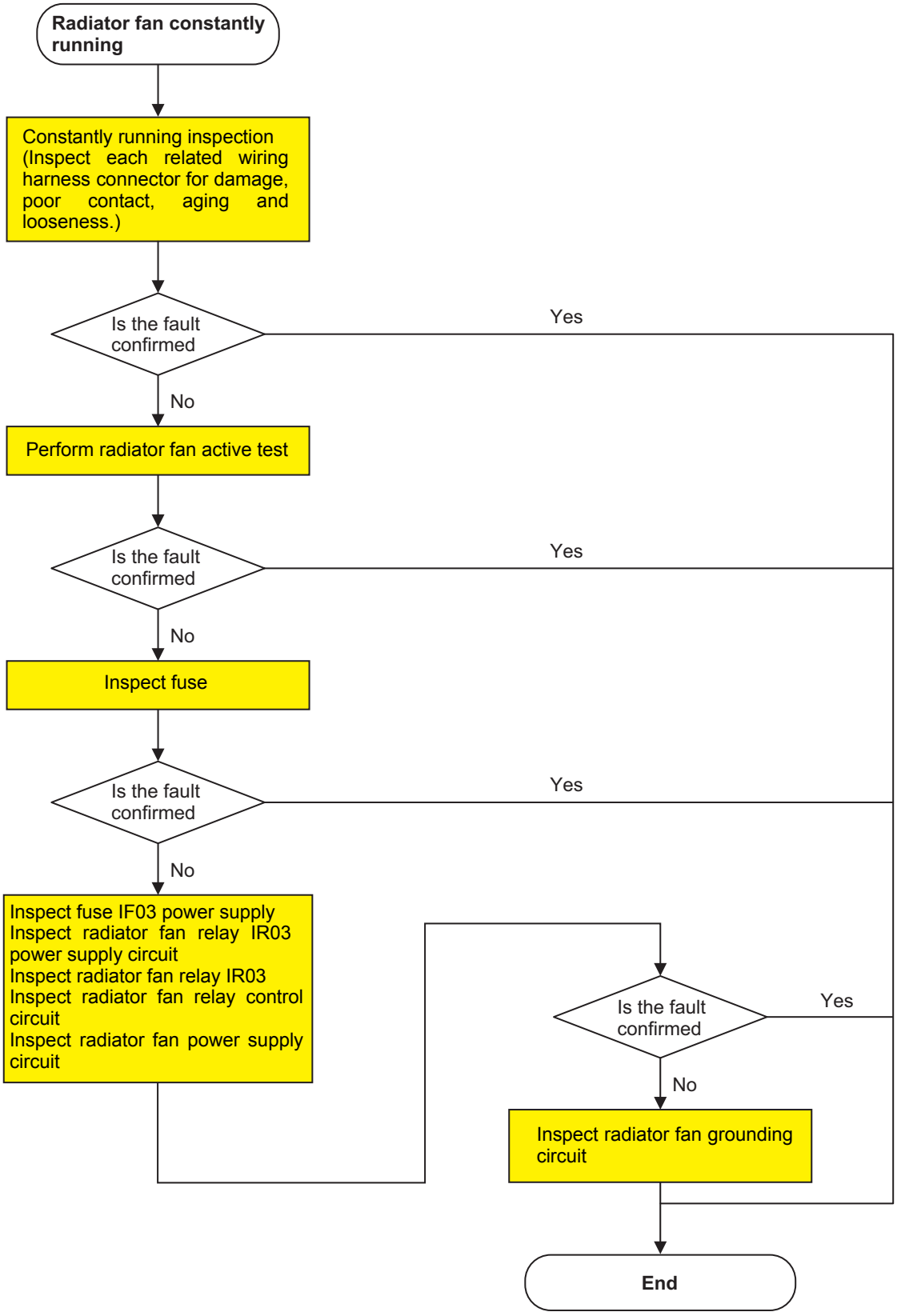


| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect radiator fan grounding circuit | |
|  M3104013 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radiator fan wiring harness connector P10.<br>C. Measure the resistance between terminal 2 of radiator fan wiring harness connector P10 and reliable grounding.<br>**Standard resistance value: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the radiator fan.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of radiator fan wiring harness connector P10 and reliable grounding. |

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# Diagnosis Procedure for Radiator Fan Constantly Running



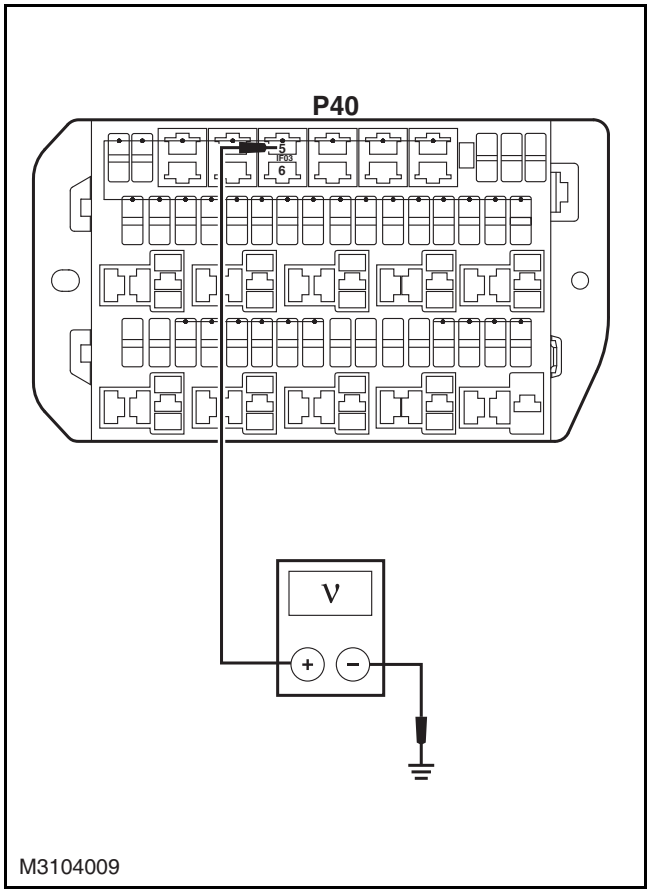
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Constantly running inspection | |
| | A. Inspect each related wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault point. |
| 2. Perform radiator fan active test | |
| | A. Connect diagnostic tool.<br>B. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>Does the fan rotate?<br>**Yes**<br>Inspect the coolant temperature sensor.<br>**Refer to: DTCs P0116, P0117, P0118 (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Inspect fuse | |
| | A. Inspect the radiator fan fuse IF03.<br>**Fuse rated capacity: 30 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

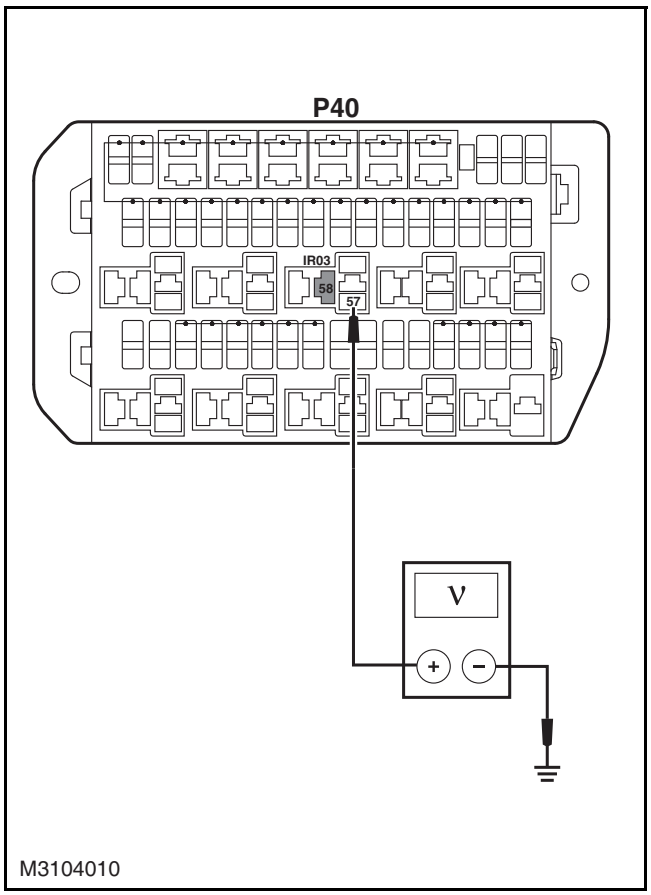
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuse IF03 power supply | |
|  M3104009 | • Measure the voltage between terminal 5 of instrument panel fuse box P40 fuse IF03 and reliable grounding.<br>**Standard voltage value: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of instrument panel fuse box P40 and battery. |

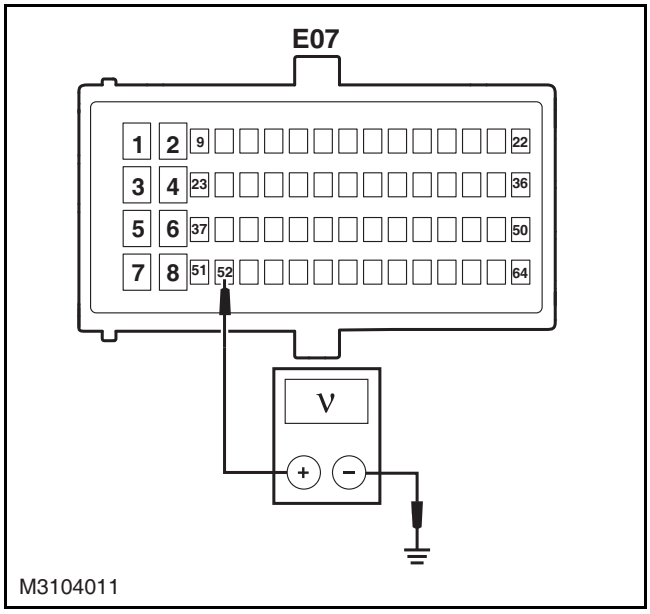
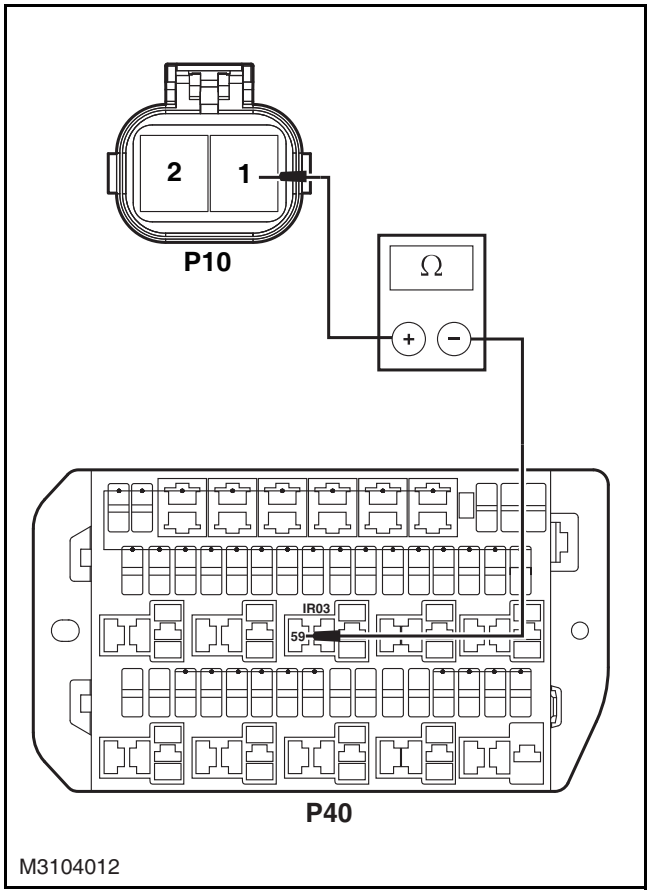
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect radiator fan relay IR03 power supply circuit | |
|  | A. Remove the radiator fan relay.<br>B. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>C. At the same time, measure the voltage between terminals 57, 58 of radiator fan relay IR03 and reliable grounding with a multimeter.<br>**Standard voltage value: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 58 of radiator fan relay IR03 and terminal 6 of instrument panel fuse box.<br>Inspect and repair the open circuit fault between terminal 57 of radiator fan relay IR03 and terminal 69 of main relay IR05. |
| 6. Inspect radiator fan relay IR03 | |
| | A. Remove the radiator fan relay.<br>B. Replace it with a normal one of same type.<br>Is the system normal?<br>**Yes**<br>Replace the radiator fan relay.<br>**No**<br>Go to step 7. |

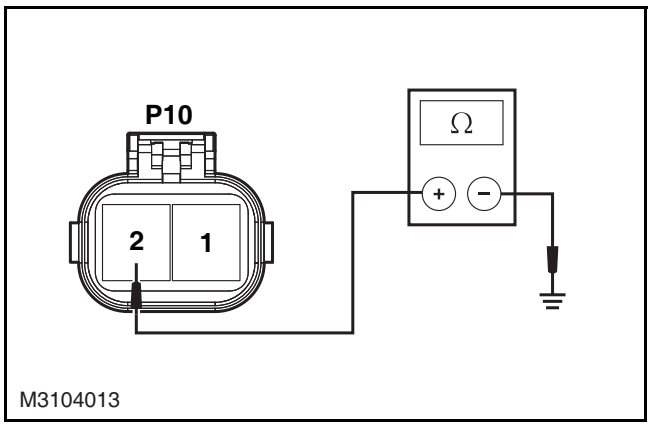
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect radiator fan relay control circuit | |
|  M3104011 | A. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>B. At the same time, measure the voltage between terminal 52 of engine control module wiring harness connector E07 and reliable grounding with a multimeter.<br>**Standard voltage value: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 52 of engine control module wiring harness connector E07 and terminal 85 of radiator fan relay IR03. |
| 8. Inspect radiator fan power supply circuit | |
|  M3104012 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radiator fan wiring harness connector P10.<br>C. Remove the radiator fan relay IR03.<br>D. Measure the resistance between terminal 1 of radiator fan wiring harness connector P10 and terminal 59 of radiator fan relay IR03.<br>**Standard resistance value: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of radiator fan wiring harness connector P10 and terminal 59 of radiator fan relay IR03. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect radiator fan grounding circuit | |
|  M3104013 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radiator fan wiring harness connector P10.<br>C. Measure the resistance between terminal 2 of radiator fan wiring harness connector P10 and reliable grounding.<br>**Standard resistance value: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the radiator fan.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of radiator fan wiring harness connector P10 and reliable grounding. |

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## Removal and Installation

# Radiator Fan

### Removal

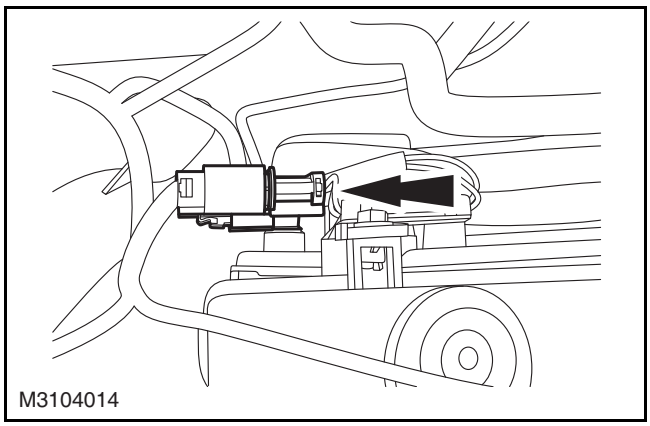
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the front bumper upper grille.

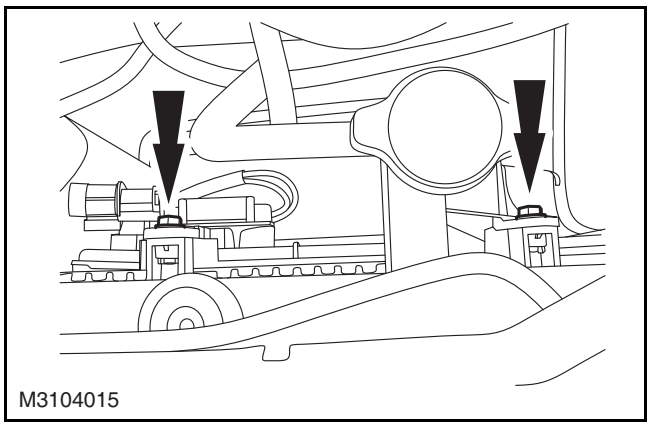
   **Refer to: Front Bumper (5.1.7 Bumper, Removal and Installation).**

3. Disconnect the radiator fan wiring harness connector.


M3104014

4. Remove 2 retaining bolts from the radiator fan.

   Torque: 10 Nm


M3104015

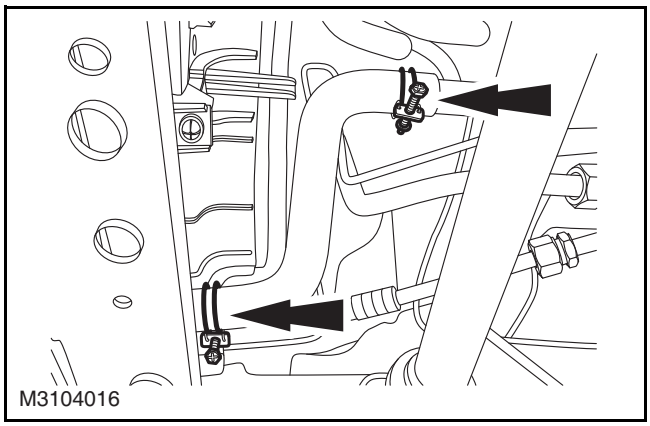
5. Remove the front wind guiding cover.

   **Refer to: Front Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

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6. Loosen 2 clamps, and disconnect the radiator lower water pipe.




7. Remove the radiator fan.

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Be aware that the clip at the lower part of radiator fan must be seized in the holder at the lower part of radiator when installing the radiator fan.**

**CAUTION: Start engine to inspect cooling system for any leaks.**

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# Radiator

## Removal

1. Disconnect the negative battery cable.

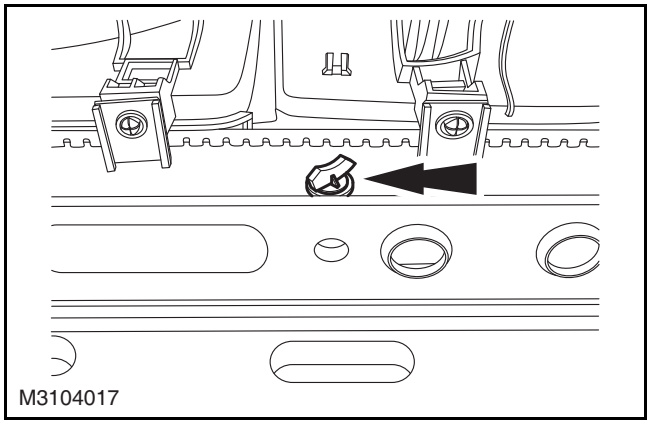
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the front wind guiding cover.

   **Refer to: Front Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

3. Loosen the radiator drain plug to drain the cooling system.

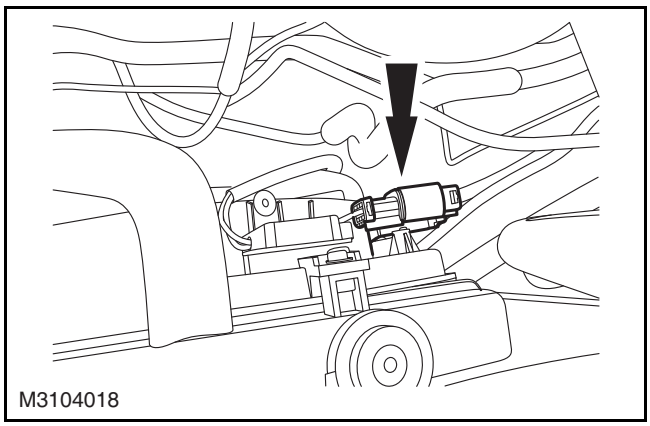
**WARNING: To avoid the danger of being scalded, do not drain the cooling system when engine and radiator still hot. The boiling liquid and steam may spurt out under the pressure since the reservoir cap opens earlier.**


M3104017

4. Remove the radiator fan.

   **Refer to: Radiator Fan (3.1.4 Cooling System, Removal and Installation).**

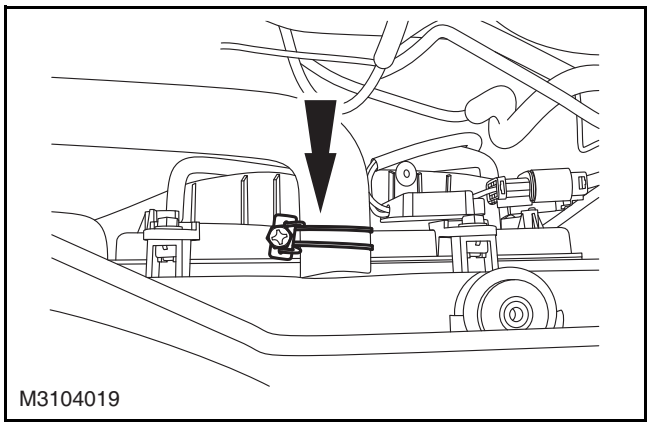
5. Disconnect the condenser fan wiring harness connector.


M3104018

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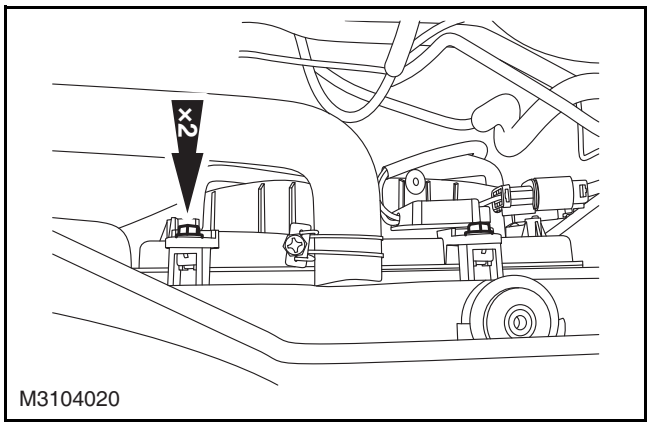


**6.** Loosen the clamp, and separate the radiator upper water pipe from the radiator.


M3104019

**7.** Remove 2 retaining bolts from the condenser fan.

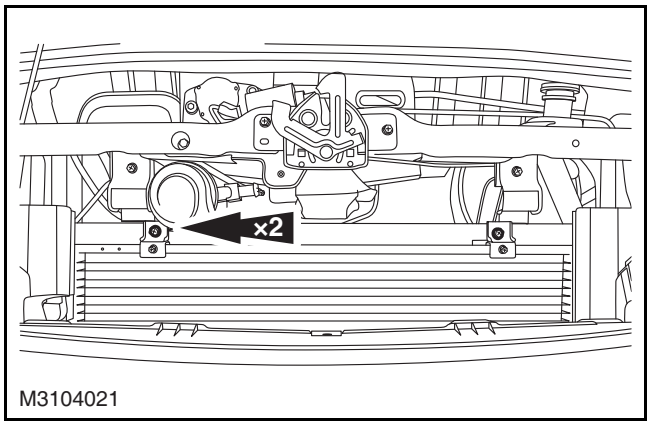
Torque: 10 Nm



M3104020

**8.** Lift the vehicle, and remove the condenser fan from below of vehicle.

**9.** Remove 2 connecting screws between condenser and radiator.



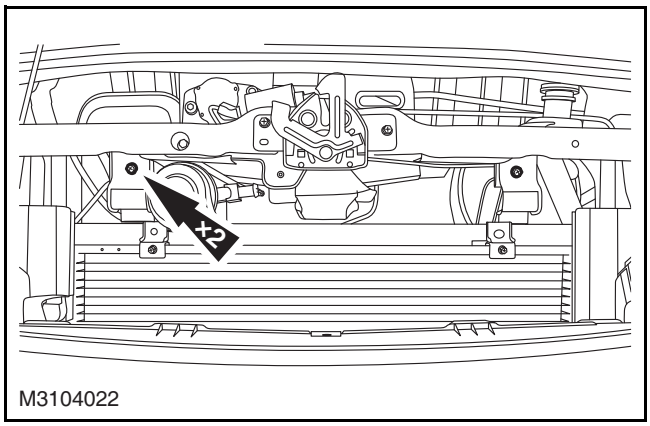
M3104021

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**10.** Remove 2 retaining bolts from the radiator upper bracket.

Torque: 9 Nm

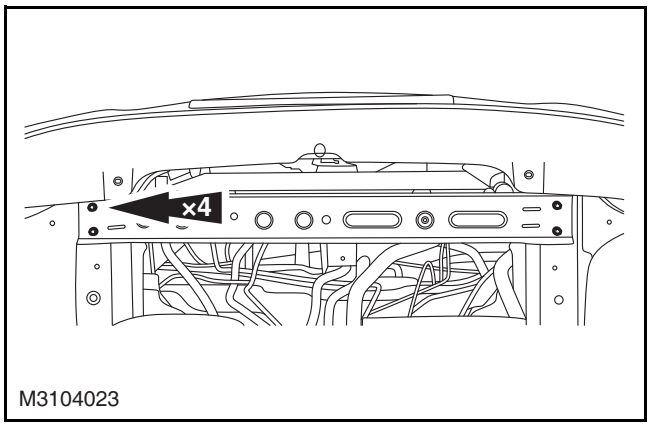



M3104022

**11.** Remove 4 retaining bolts from the radiator bracket assembly.

Torque: 20 Nm

**CAUTION: Secure the condenser to the body before removing the radiator bracket assembly to prevent damaging the A/C pipe.**




M3104023

**12.** Remove the radiator.

## Installation

**1.** Installation is in the reverse order of removal.

**CAUTION: Be aware that the clip at the lower part of radiator must be seized in the holder of radiator bracket assembly when installing the radiator.**

**CAUTION: Start engine to inspect cooling system for any leaks.**

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# Thermostat

## Removal

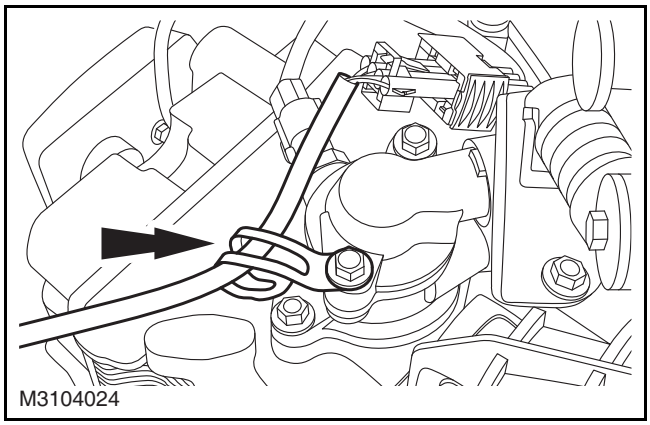
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

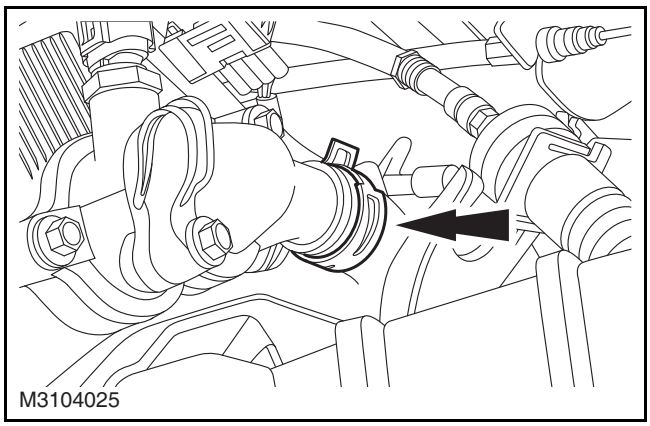
2. Loosen the radiator drain plug to drain the cooling system.

   **Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).**

3. Move the front oxygen sensor wiring harness from the wire harness bracket.

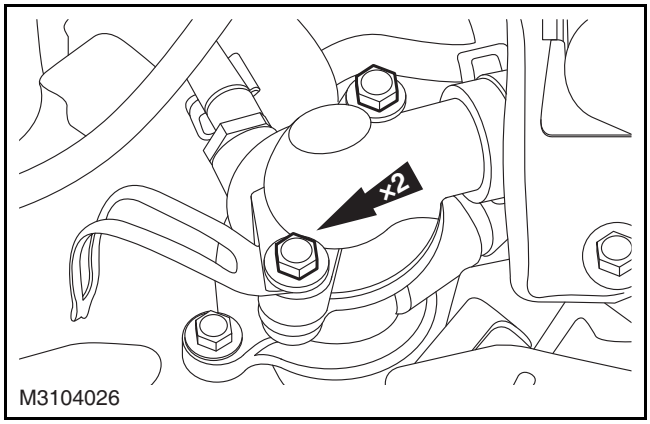



4. Loosen the hoop, and disconnect the connection between No.2 outlet hose and thermostat cap.




5. Remove 2 thermostat cap retaining bolts, and remove the thermostat cap.

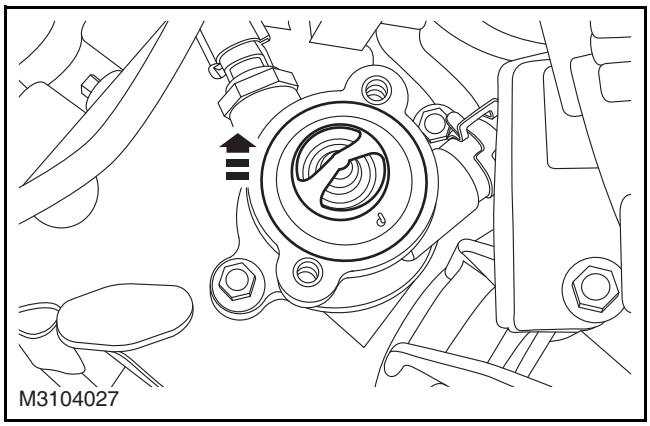
   Torque: 15 ± 2 Nm



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6. Remove the thermostat.




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: The thermostat paraffin inductor should face toward the engine side.**

**CAUTION: Falling out of thermostat seal ring is not allowed.**

**CAUTION: Fully turn the thermostat cap.**

**CAUTION: Start engine to inspect cooling system for any leaks.**

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# Water Pump

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Loosen the radiator drain plug to drain the cooling system.

   **Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).**

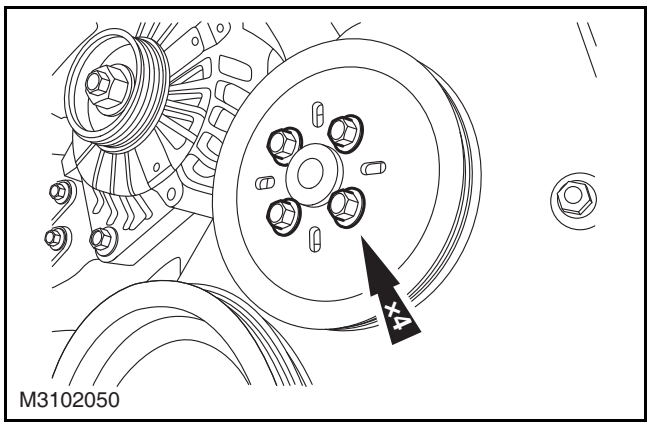
4. Remove the accessory drive belt.

   **Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

5. Remove the water pump pulley.

   1 Remove 4 retaining bolts from the water pump pulley.

   Torque: 10 ± 1 Nm



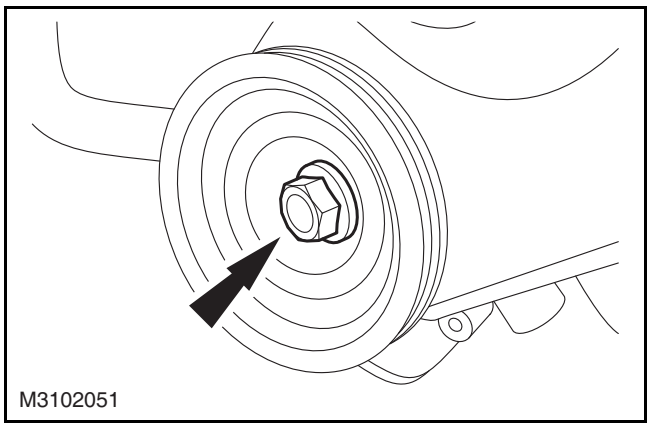
M3102050

   2 Remove the water pump pulley.

6. Remove the crankshaft pulley.

   1 Remove the crankshaft pulley retaining bolt.

   Torque: 133 ± 5 Nm


M3102051

   2 Remove the crankshaft pulley.

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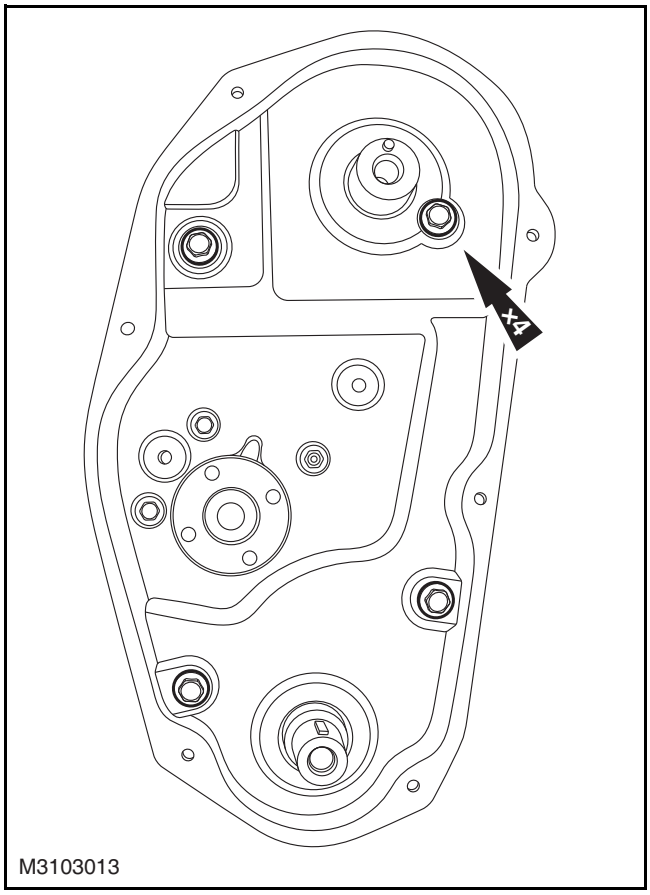


7. Remove the timing mechanism.

   **Refer to: Timing Mechanism (3.1.2 Mechanical System, Removal and Installation).**

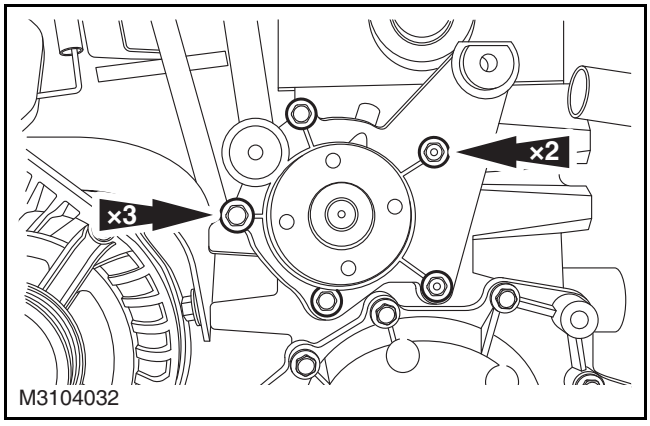
8. Remove 4 retaining bolts from the timing belt rear housing.

   Torque: 10 Nm




9. Remove the water pump retaining bolts and nuts.

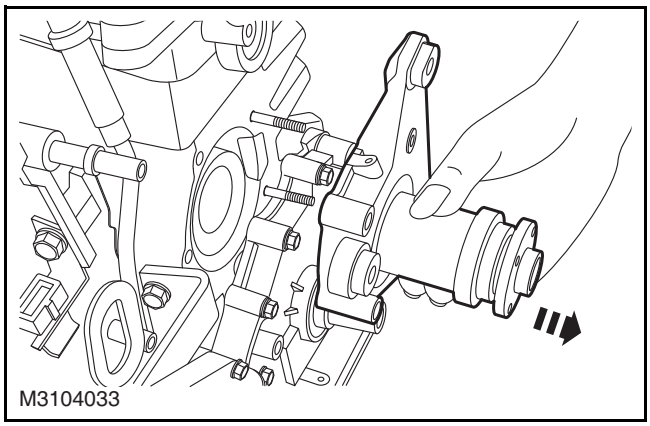
   Torque: 10 ± 1 Nm



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10. Remove the water pump, and clean the joint surface between engine cylinder block and water pump.


M3104033

11. Inspect the water pump gasket for damage. If damaged, replace it.

## Installation

1. Install a new water pump gasket.
2. Installation is in the reverse order of removal.

**CAUTION: Refill coolant.**

**CAUTION: Start engine to inspect cooling system for any leaks.**

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# Floor Water Pipe

## Removal

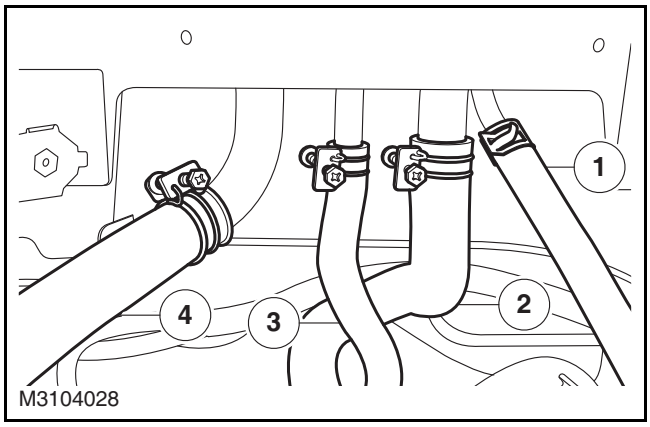
1. Loosen the radiator drain plug to drain the cooling system.

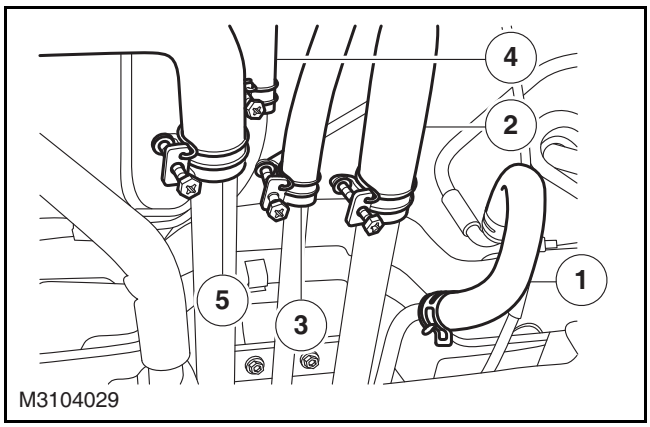
**WARNING: To avoid the danger of being scalded, do not drain the cooling system when engine and radiator still hot. The boiling liquid and steam may spurt out under the pressure since the reservoir cap opens earlier.**

2. Remove the wind guiding cover.

**Refer to: Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

3. Loosen the clamp, and disconnect the connecting hose (1) between floor water pipe rear end and vacuum booster.
4. Loosen the clamp, and disconnect the connection between floor water pipe rear end and engine outlet hose (2).
5. Disconnect the connecting hose (3) from the floor water pipe rear end and A/C heater core.
6. Loosen the clamp, and disconnect the connection between floor water pipe rear end and engine inlet hose (4).
7. Loosen the clamp, and disconnect the connecting hose (1) between floor water pipe front end and vacuum booster.
8. Loosen the clamp, and disconnect the connection between floor water pipe front end and radiator inlet hose (2).
9. Loosen the clamp, and disconnect the connection between floor water pipe front end and A/C heater core inlet hose (3).
10. Disconnect the connection between floor water pipe front end and A/C heater core outlet hose (4).
11. Loosen the clamp, and disconnect the connection between floor water pipe front end and radiator outlet hose (5).



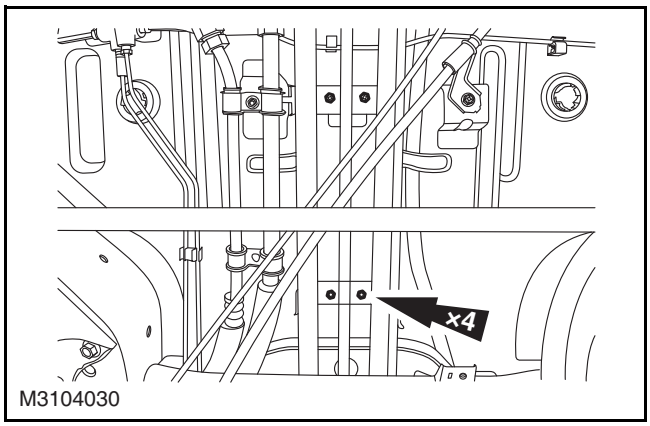



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**12.** Remove 4 retaining screws from the floor water pipe and remove the floor water pipe.

Torque: 10 ± 1 Nm




## Installation

**1.** Installation is in the reverse order of removal.

**CAUTION: Start engine to inspect cooling system for any leaks.**

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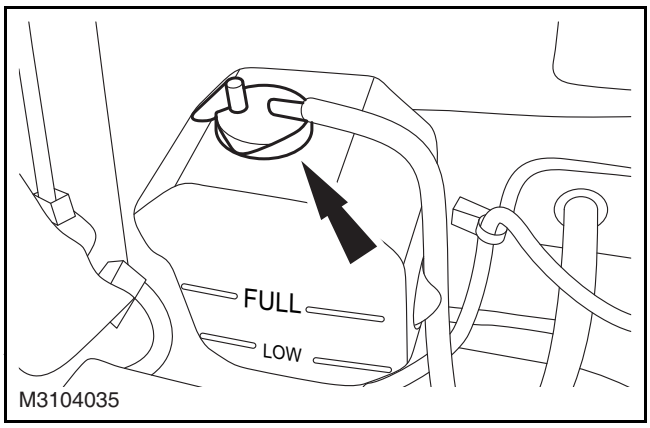


# Water Reservoir

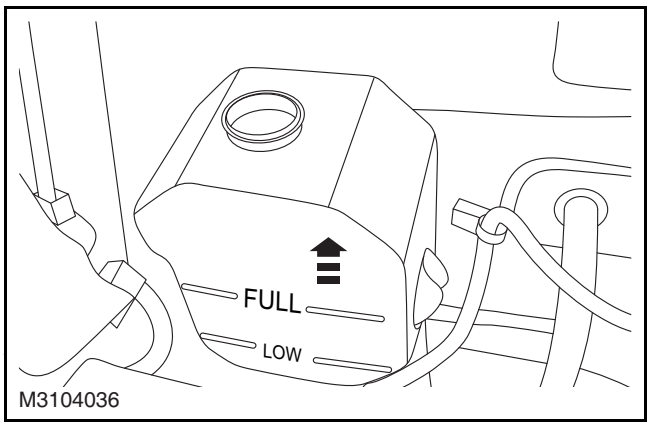
## Removal

1. Remove the water pipe and water reservoir cap.

**WARNING: To avoid the danger of being scalded, do not drain the cooling system when engine and radiator still hot. The boiling liquid and steam may spurt out under the pressure since the reservoir cap opens earlier.**




2. Pull up the water reservoir to remove it.




## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| Vacuum degree of intake manifold under engine idling | 350 mbar |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Air filter retaining bolt | 10 ± 1 | - | - |
| Throttle body retaining bolt | 10 | - | 89 |
| Intake manifold retaining nut and retaining bolt | 23 | 17 | - |
| Air intake pressure/temperature sensor | 9.5 | - | - |
| Intake manifold bracket retaining bolt | 23 | 17 | - |

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## Description and Operation

# System Overview

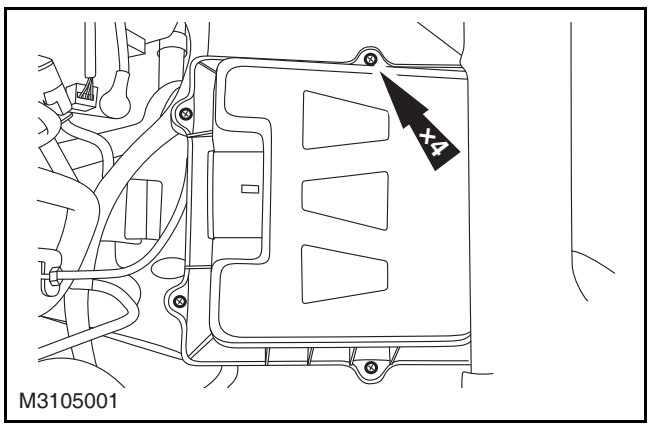
Ambient air enters the air filter first and then the cylinder through the intake pipe, throttle body and intake manifold after it has been filtered by air filter element. The intake pipe is connected with a crankcase vent pipe through which the exhaust gas from the crankcase enters the cylinder with fresh air.

# Components Description

Air filter

The air filter consists of the following items:

- Air filter lower case
- Air cleaner element
- Air filter upper case

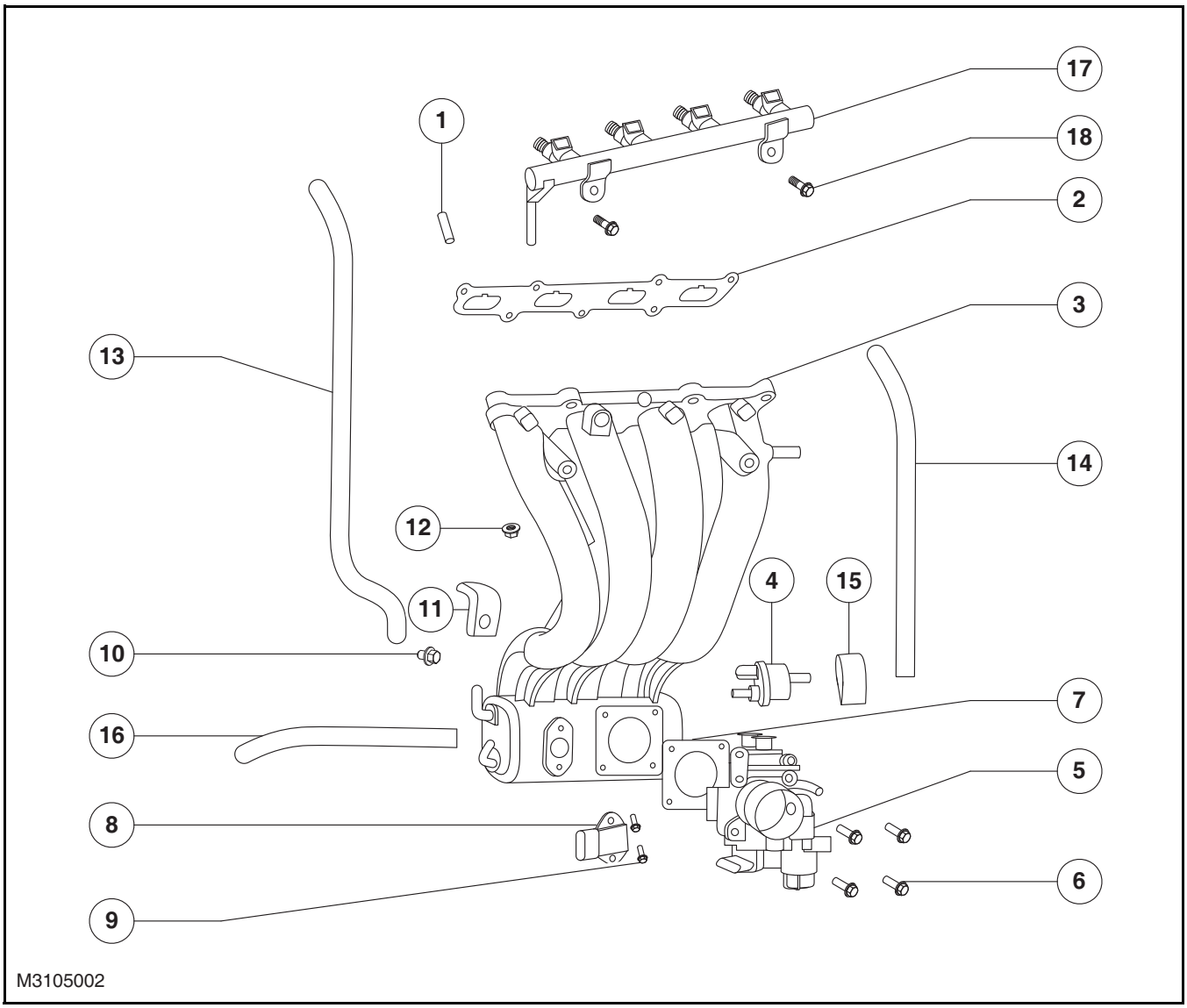



The dry air comes from the intake pipe into the air filter lower case and goes through the air filter element. And then, the filtered air comes out of the air filter upper case.

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# Components Exploded View



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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Exhaust manifold retaining stud bolt | 10 | Hexagon flange bolt |
| 2 | Intake manifold gasket | 11 | Intake manifold bracket |
| 3 | Intake manifold assembly | 12 | Hexagon flange nut |
| 4 | Carbon canister control valve assembly | 13 | PCV valve pipe |
| 5 | Throttle body assembly | 14 | Carbon canister control valve emission outlet hose |
| 6 | Hexagon flange bolt | 15 | Carbon canister control valve sheath |
| 7 | Throttle body paper gasket | 16 | Carbon canister control valve inlet hose |
| 8 | Air intake pressure/temperature sensor assembly | 17 | Fuel main pipe assembly |
| 9 | Hexagon flange bolt | 18 | Hexagon flange bolt |

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## General Inspection

### General Equipment

| |
|---|
| Vacuum gauge |

**WARNING: The components of engine are at high temperature when the engine is running. Do not touch the components at high temperature during removal. Otherwise, serious scalding will be caused.**

## Vacuum Degree of Air Intake System Inspection

1. Stop the engine and turn off the ignition switch.
2. Detach the carbon canister solenoid vacuum hose from the intake manifold.
3. Connect 3-way connector, hose and special tool (vacuum gauge and connector) between intake manifold and detached vacuum hose.
4. Start the engine and measure the vacuum degree of air intake system under engine idling.

   **Standard value: 350 mbar**
5. Remove the vacuum gauge and reconnect the vacuum hose.

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## Symptom Diagnosis and Testing

**General Equipment**

| |
|---|
| Vacuum gauge |

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical or electrical damage.

**Visual Inspection Chart**

| Mechanical |
|---|
| • Air filter set |
| • Air filter inlet pipe |
| • Air filter outlet pipe |
| • Throttle body |
| • Intake manifold |

3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

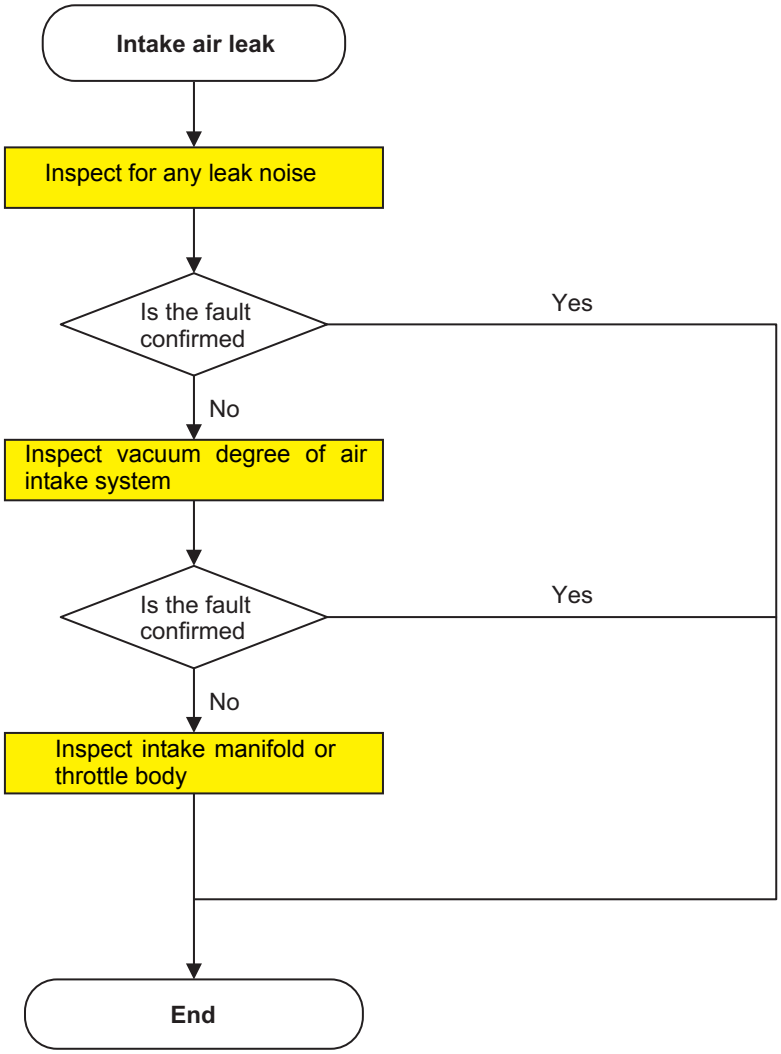
If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order listed in the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Intake air leak | • Air filter<br>• Intake manifold<br>• Throttle body<br>• Crankcase vent pipe<br>• Component connections | • Diagnosis Procedure for Intake Air Leak<br>**Refer to: Diagnosis Procedure for Intake Air Leak (3.1.5 Air Intake System, Symptom Diagnosis and Testing).** |
| Intake blocking | • Air cleaner element | • Inspect the air filter and replace when necessary.<br>**Refer to: Air Filter Element (3.1.5 Air Intake System, Removal and Installation).** |
| | • Foreign matters in the intake pipe | • Disassemble the air filter box and inspect the air filter and intake pipe for any possible foreign matters and remove.<br>**Refer to: Air Filter Element (3.1.5 Air Intake System, Removal and Installation).** |

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# Diagnosis Procedure for Intake Air Leak



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect for any leak noise | |
| | A. Start the engine.<br>B. Inspect for any leak noise by listening.<br>Is there any leak noise like hiss?<br>**Yes**<br>Inspect the leaking point(s) and repair the leaked component(s).<br>**No**<br>Go to step 2. |
| 2. Inspect vacuum degree of air intake system | |
| | A. Carry out the inspection procedures for vacuum degree of air intake system.<br>Is the vacuum degree normal?<br>**Standard vacuum degree: 350 mbar**<br>**Refer to: General Specifications (3.1.5 Air Intake System, Specifications).**<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 3. |
| 3. Inspect intake manifold or throttle body | |
| | A. Inspect the intake manifold or throttle body for leak tightness.<br>Does the intake manifold or throttle body leak?<br>**Yes**<br>Repair the seal of intake manifold or throttle body.<br>**No**<br>Inspect the engine valve train.<br>**Refer to: Timing Mechanism (3.1.2 Mechanical System, Removal and Installation).** |

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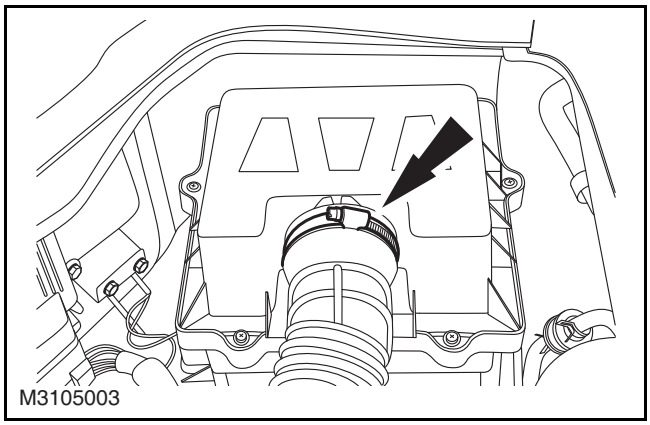


## Removal and Installation

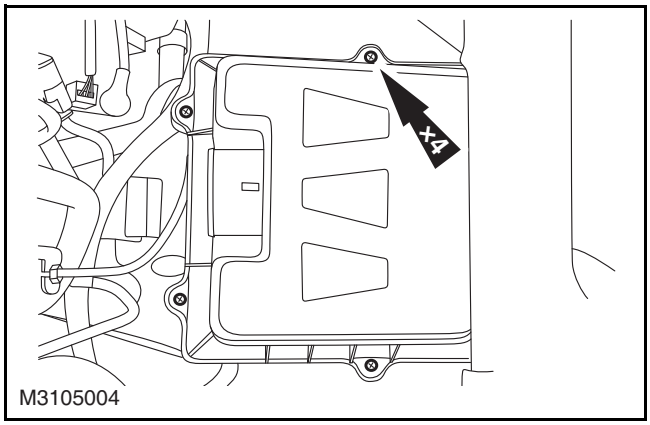
# Air Filter Element

### Removal

**1.** Loosen the clamp, and disconnect the air filter outlet pipe from the air filter.

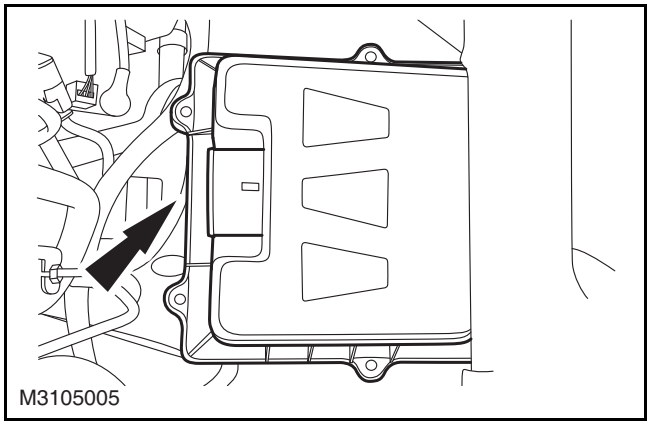

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**2.** Remove 4 retaining screws from the air filter upper case.



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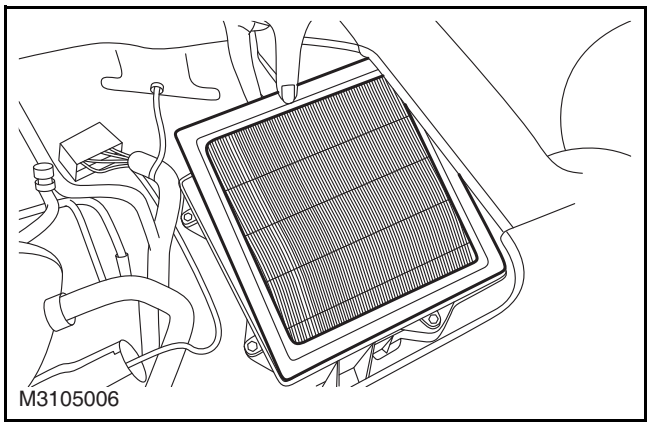
**3.** Remove the air filter upper case.


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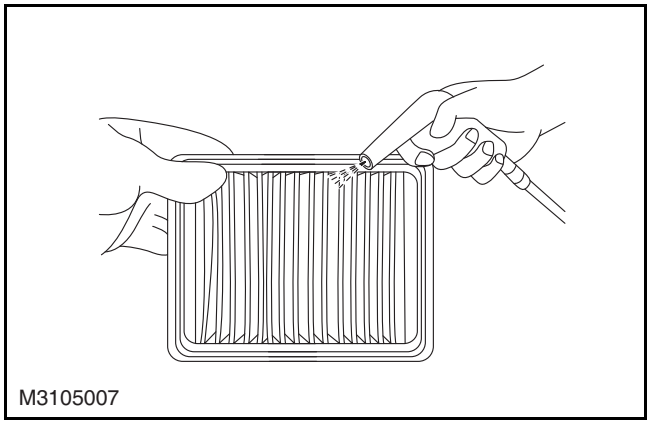


4. Remove the air filter element from the lower case.


M3105006

5. Inspect the air filter element for any dirt.

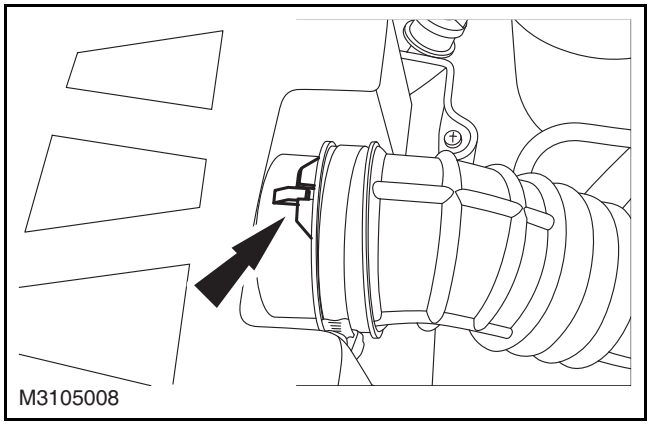
6. Blow away the dirt from the air outlet of element with compressed air if necessary. If excessively dirty, replace the element.


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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Align the bulge of air filter case with the groove of air filter outlet pipe.**


M3105008

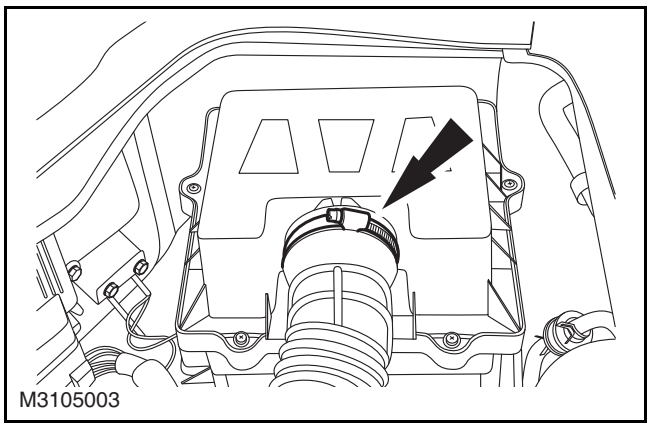
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# Air Filter

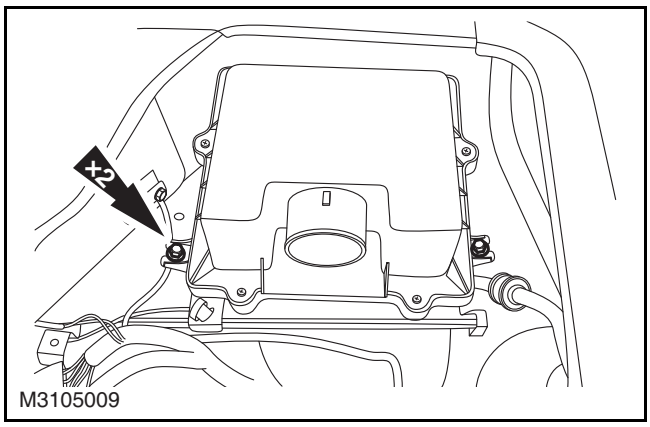
## Removal

1. Loosen the clamp, and disconnect the air filter outlet pipe from the air filter.




2. Remove 2 retaining bolts from the air filter.

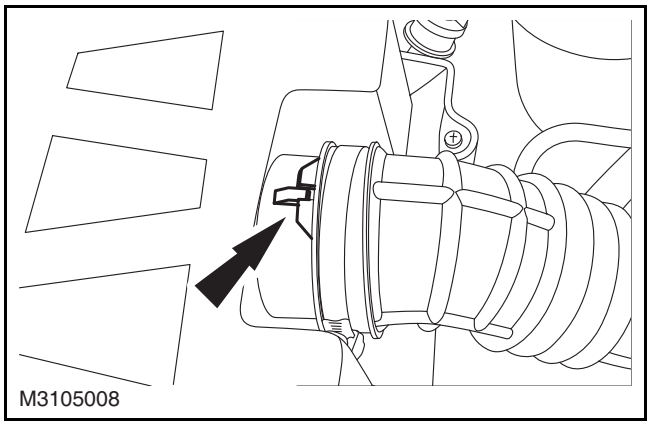
   Torque: 10 ± 1 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Align the bulge of air filter case with the groove of air filter outlet pipe.**



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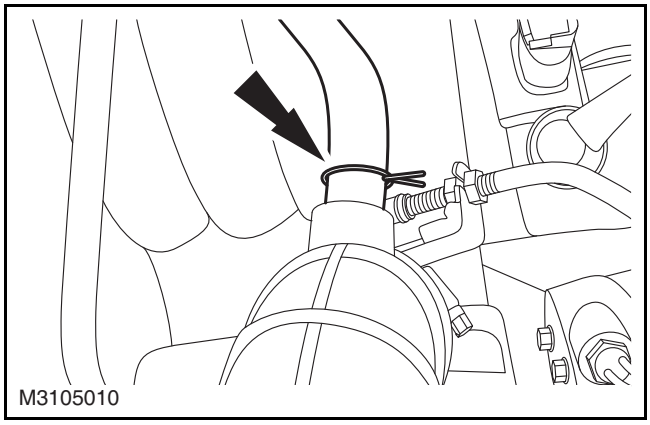
# Throttle Body

## Removal

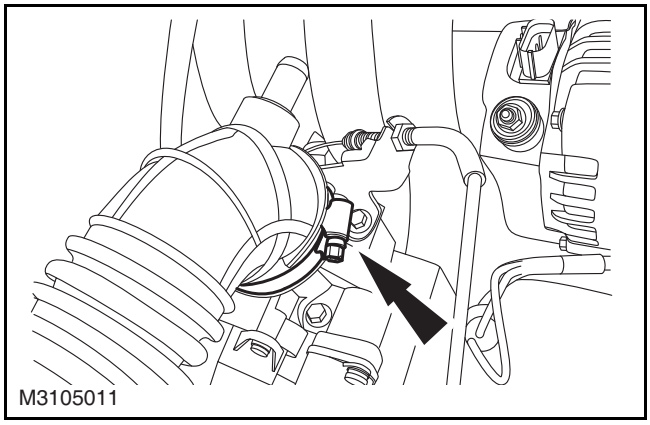
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

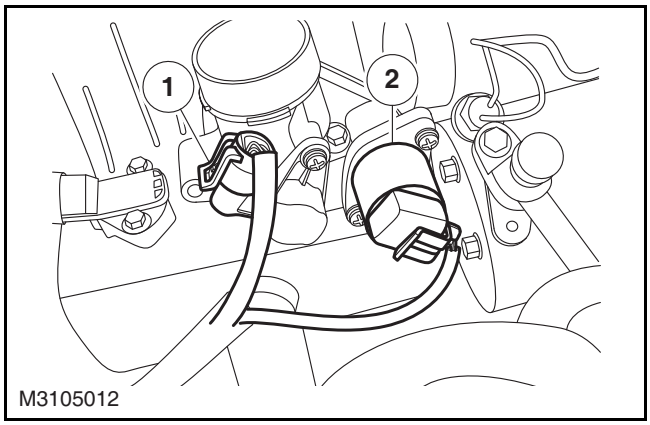
2. Loosen the clamp, and disconnect the crankcase vent hose from the inlet pipe.




3. Loosen the clamp, and disconnect the throttle body from the inlet pipe.



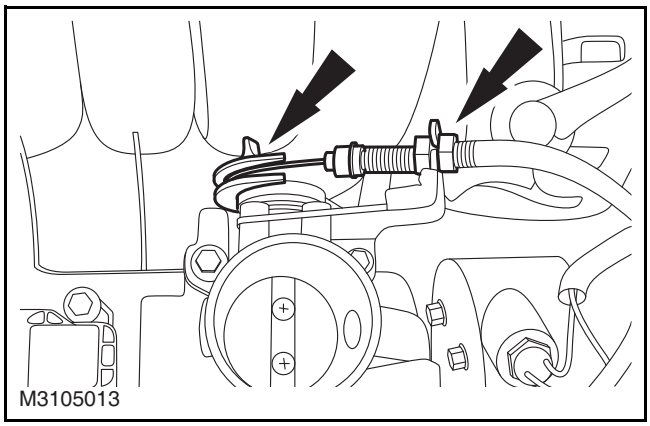

4. Disconnect the throttle position sensor wiring harness connector (1) and the idling stepper motor wiring harness connector (2).



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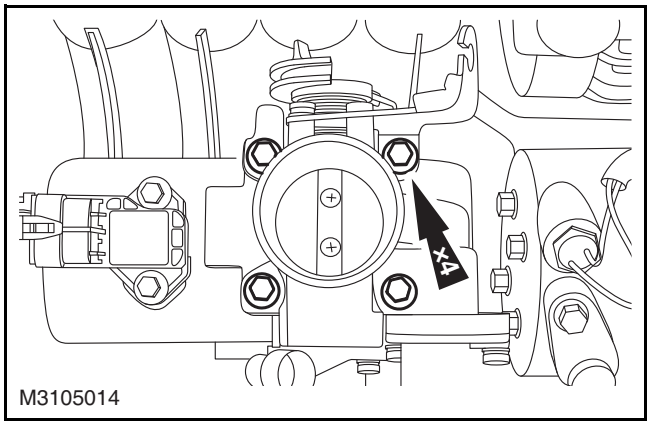


5. Disconnect the throttle cable.




6. Remove 4 retaining bolts from the throttle body.

   Torque: 10 Nm

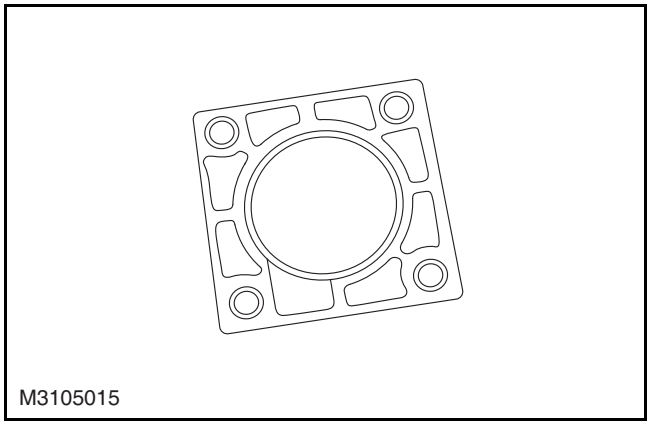



7. Remove the throttle body and gasket.

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect the throttle body gasket for damage, otherwise replace with a new one.**



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# Intake Manifold

## Removal

1. Release the fuel pressure.

   **Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**

2. Drain the engine coolant.

   **Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).**

3. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

4. Remove the gearshift mechanism.

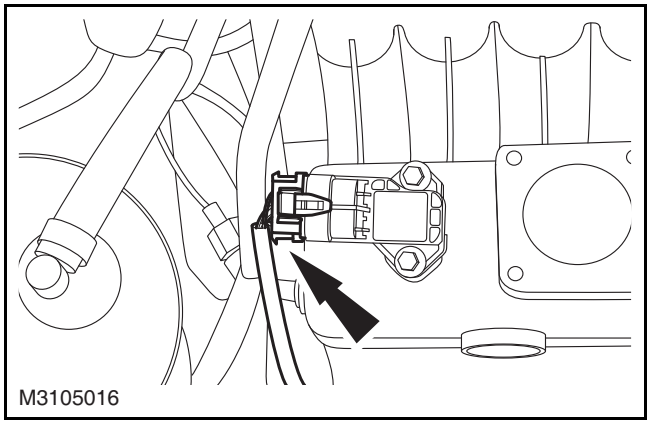
   **Refer to: Gearshift Mechanism (3.3.4 Manual Transmission External Control, Removal and Installation).**

5. Remove the throttle body.

   **Refer to: Throttle Body (3.1.5 Air Intake System, Removal and Installation).**

6. Remove air intake pressure/temperature sensor.

   1 Disconnect the air intake pressure/temperature sensor wiring harness connector.

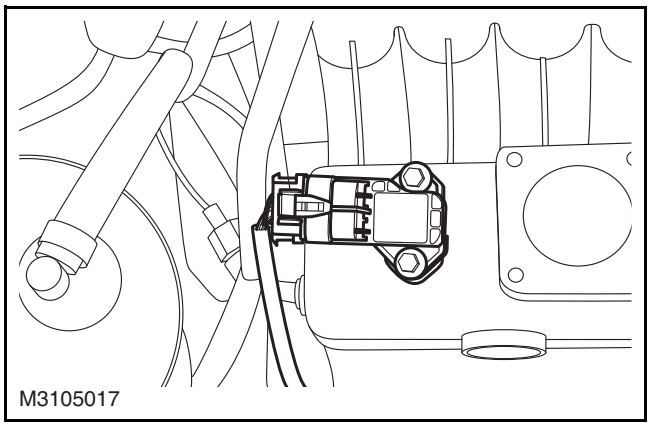


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2 Remove 2 retaining bolts from the air intake pressure/temperature sensor.

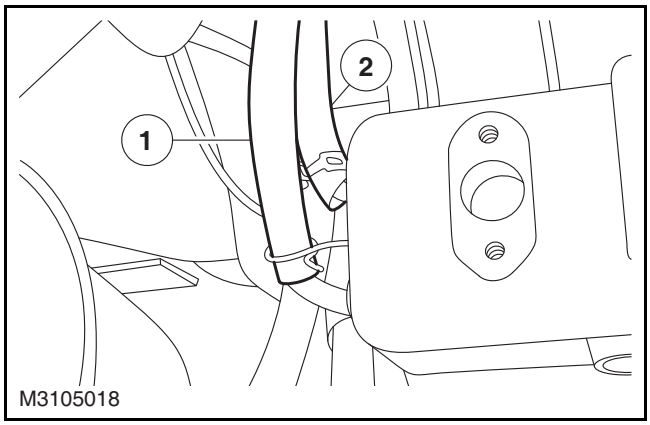
Torque: 9.5 Nm



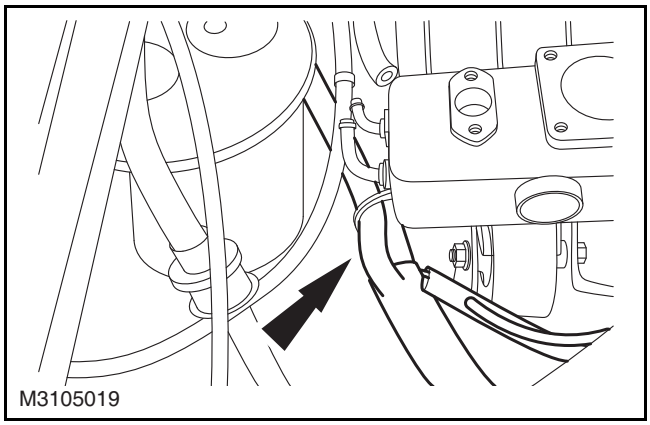

3 Remove the air intake pressure/temperature sensor from the intake manifold.

**7.** Loosen the clamp, and disconnect the PCV valve hose (1) from the intake manifold.

**8.** Loosen the clamp, and disconnect the carbon canister control valve hose (2) from the intake manifold.



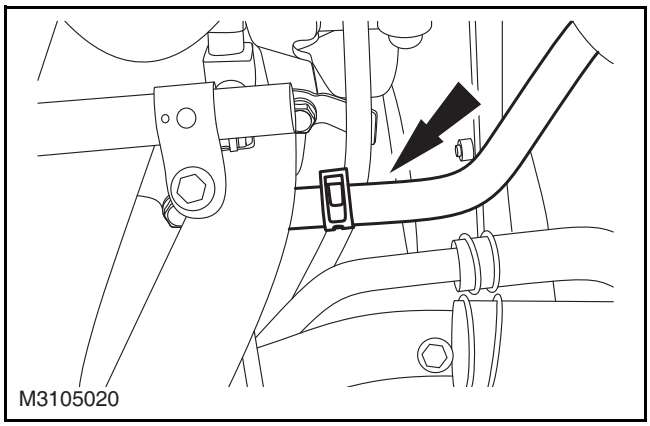

**9.** Disconnect the engine wiring harness from the bracket.



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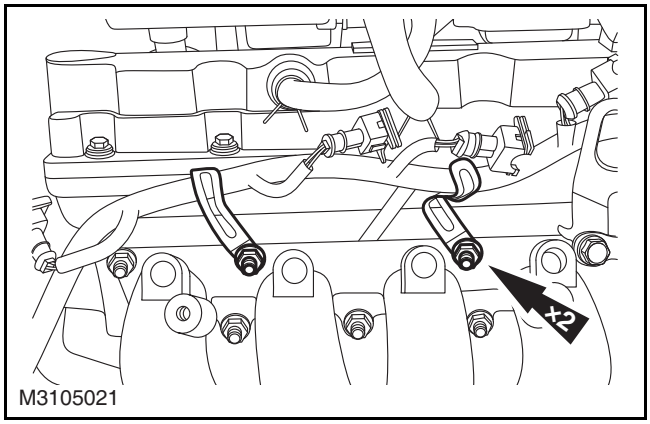
**10.** Disconnect the vacuum booster hose from the intake manifold.




**11.** Remove the fuel main pipe.

**Refer to: Fuel Main Pipe (3.1.7 Fuel System, Removal and Installation).**

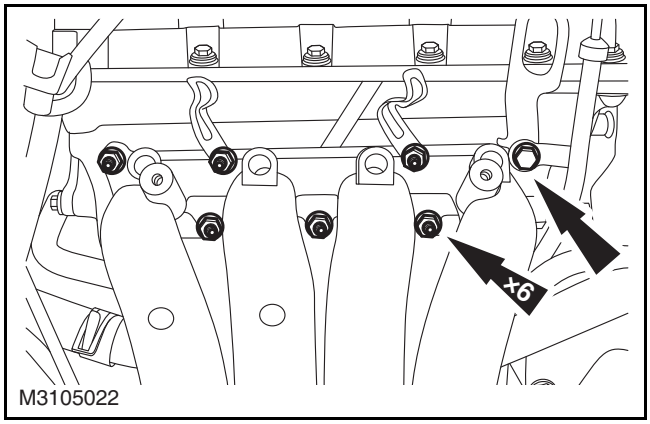
**12.** Disconnect the fuel injector wiring harness from the bracket.




**13.** Remove the intake manifold.

1 Remove the retaining bolt and 6 retaining nuts from the intake manifold.

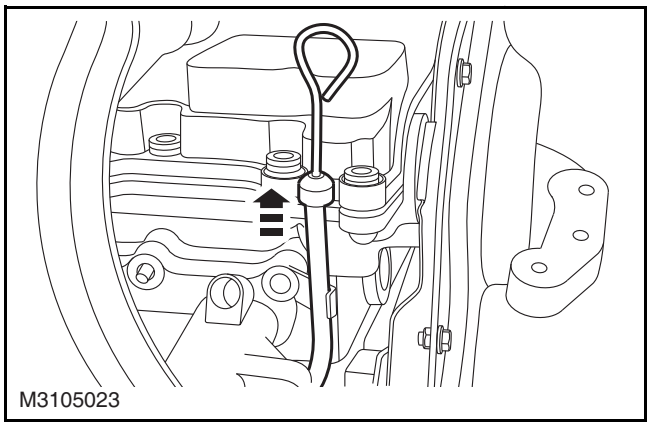
Torque: 23 Nm



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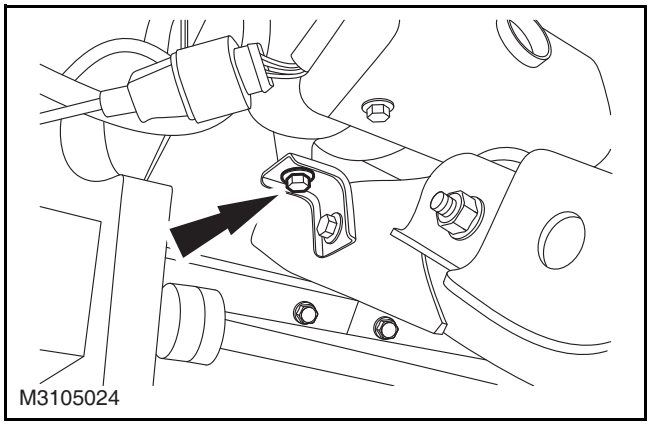


2 Pull out the oil dipstick.




3 Remove the connecting bolt between intake manifold bracket and intake manifold.

Torque: 23 Nm



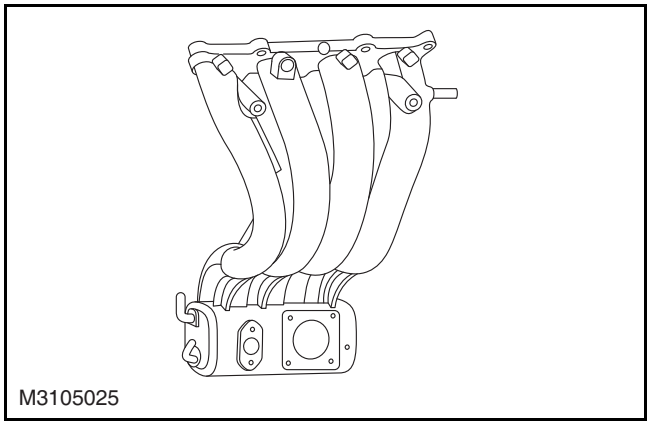

4 Remove the intake manifold.

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## Inspection

1. Inspect the intake manifold for damage and leak.


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2. Inspect the intake manifold gasket for aging, deformation and cracks, and replace when necessary.
3. Inspect and clean the installation surface between intake manifold and cylinder head.

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect the intake manifold for any possible leak after installation.**

**Refer to: Diagnosis Procedure for Intake Air Leak (3.1.5 Air Intake System, Symptom Diagnosis and Testing).**

**CAUTION: Inspect the fuel for any possible leaks after installation.**

**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**

**CAUTION: Inspect the coolant for any possible leaks after installation.**

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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| Exhaust backpressure with engine full load speed (engine speed 6000 r/min, throttle full open) | 36 kPa or less |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Exhaust manifold retaining bolt | 23 ± 2 | - | - |
| Exhaust manifold heat insulator | 10 ± 1 | - | - |
| Connecting bolt between three-way catalytic converter and exhaust manifold | 55 ± 5 | - | - |
| Connecting bolt between muffler and three-way catalytic converter | 55 ± 5 | - | - |
| Oxygen sensor tightening torque | 50 ± 10 | - | - |
| Retaining bolt between engine left mounting and engine | 45 | 33 | - |
| Retaining nut between engine left mounting and engine bracket | 45 | 33 | - |

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## Description and Operation

# System Overview

### Three-Way Catalytic Converter Poisoning

If fuel contains 5 mg or more lead per liter, it will lead to the catalytic converter poisoning. Therefore, strictly forbid using leaded gas for vehicle equipped with a three-way catalytic converter.

The zinc and phosphorus in the engine oil will lead to catalytic converter poisoning if the engine oil consumption is too high. $H_2S$ exhausted from the three-way catalytic converter can be perceived easily. It smells like a rotten egg. Such problem can be solved by using other brands of fuel. To reduce $H_2S$ emission, make sure that CO emission at idle speed meets the standard and the engine exhaust system works normally.

**WARNING: The catalyst carrier will melt if the temperature exceeds 900°C. The fault should be fully analyzed and repaired to prevent such fault occurrence.**

Due to excessive backpressure, the melting of the catalyst often comes along with the power reduction.

# Components Description

### Three-way Catalytic Converter

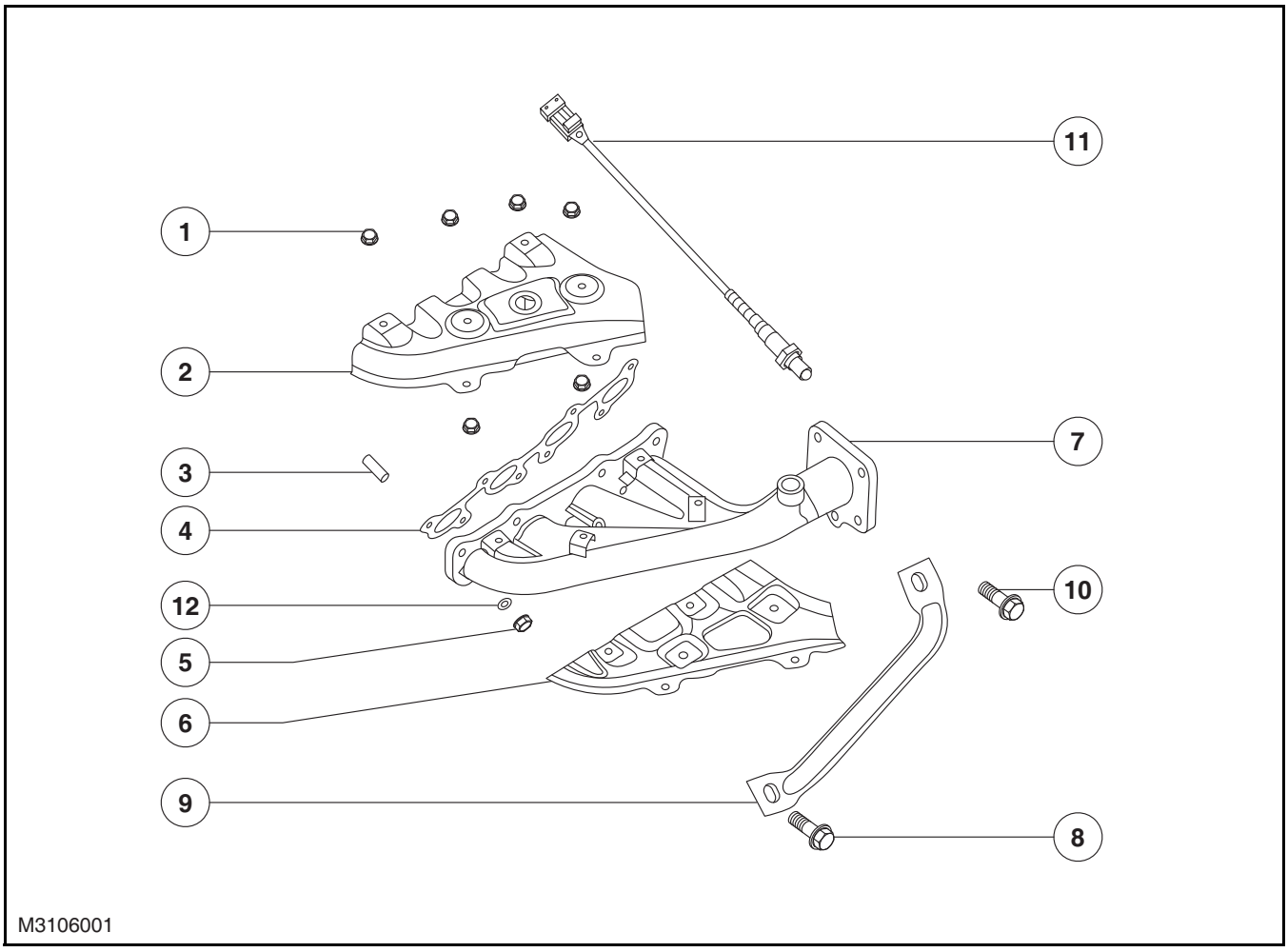
The three-way catalytic converter is shaped like a small muffler. Due to the high working temperature, the bodywork near the three-way catalytic converter has been protected with heat insulated panel. The three-way catalytic converter controls three emissions: HC, CO and NOx.

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# Components Exploded View

## Exhaust manifold

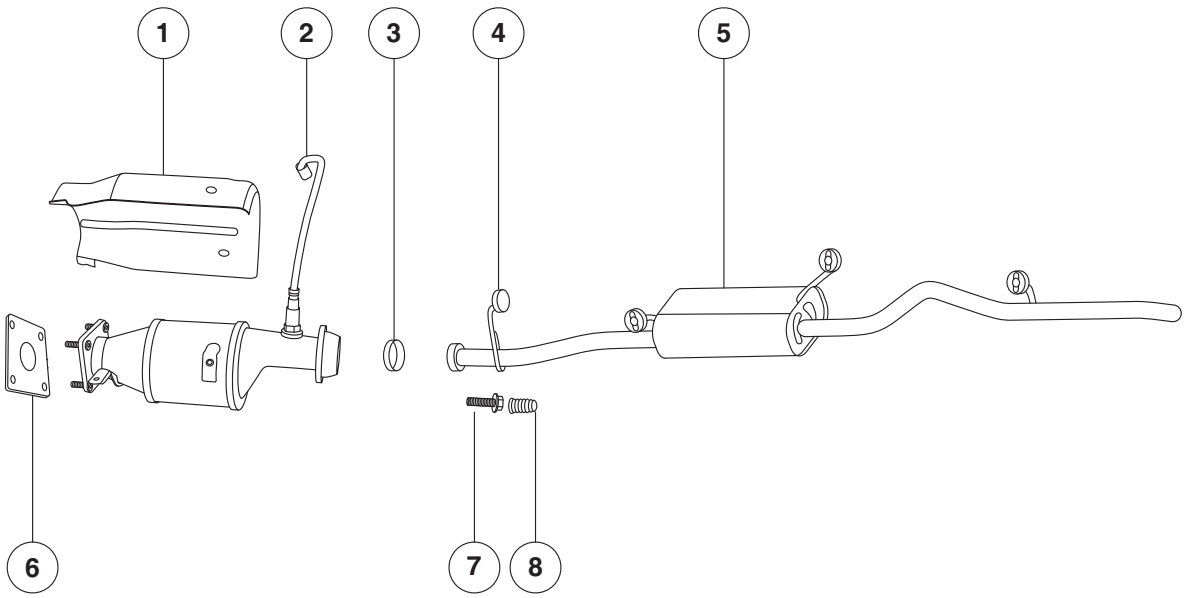



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Exhaust manifold cover bolt | 7 | Exhaust manifold assembly |
| 2 | Exhaust manifold upper cover assembly | 8 | Hexagon flange bolt |
| 3 | Exhaust manifold retaining stud bolt | 9 | Exhaust manifold bracket |
| 4 | Exhaust manifold gasket assembly | 10 | Hexagon flange bolt |
| 5 | Hexagon flange nut | 11 | Front oxygen sensor assembly |
| 6 | Exhaust manifold lower cover assembly | 12 | Plate washer |

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## Three-way Catalytic Converter and Muffler




M3106002

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Exhaust manifold upper cover | 5 | Muffler welding assembly |
| 2 | Front oxygen sensor assembly | 6 | Throttle body gasket |
| 3 | Charcoal ring (cermet coating) | 7 | Pressure spring bolt |
| 4 | Rubber shackle | 8 | Pressure spring |

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## General Inspection

### General Equipment

| |
|---|
| Exhaust backpressure gauge |

# Exhaust Backpressure Inspection

1. Remove the front oxygen sensor.
2. Install the exhaust backpressure gauge.
3. Start the engine.
4. Measure the exhaust backpressure when engine is idling.
5. Measure the exhaust backpressure with engine full load speed (engine speed 6000 r/min, throttle full open).

### Exhaust backpressure standard

| Engine Speed (rpm) | Exhaust Backpressure (kPa) |
|---|---|
| 6000 | 36 kPa or less |

6. Turn the ignition switch off and the engine stops.
7. Remove the exhaust backpressure gauge and install the oxygen sensor.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Exhaust backpressure gauge |

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, solve the fault before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Damage or leakage of exhaust system pipe<br>• Damage of three-way catalytic converter<br>• Looseness of exhaust pipe bolt<br>• Aging or damage of exhaust pipe gasket | • Oxygen sensor circuit fault<br>• Oxygen sensor fault |

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## Symptom Chart

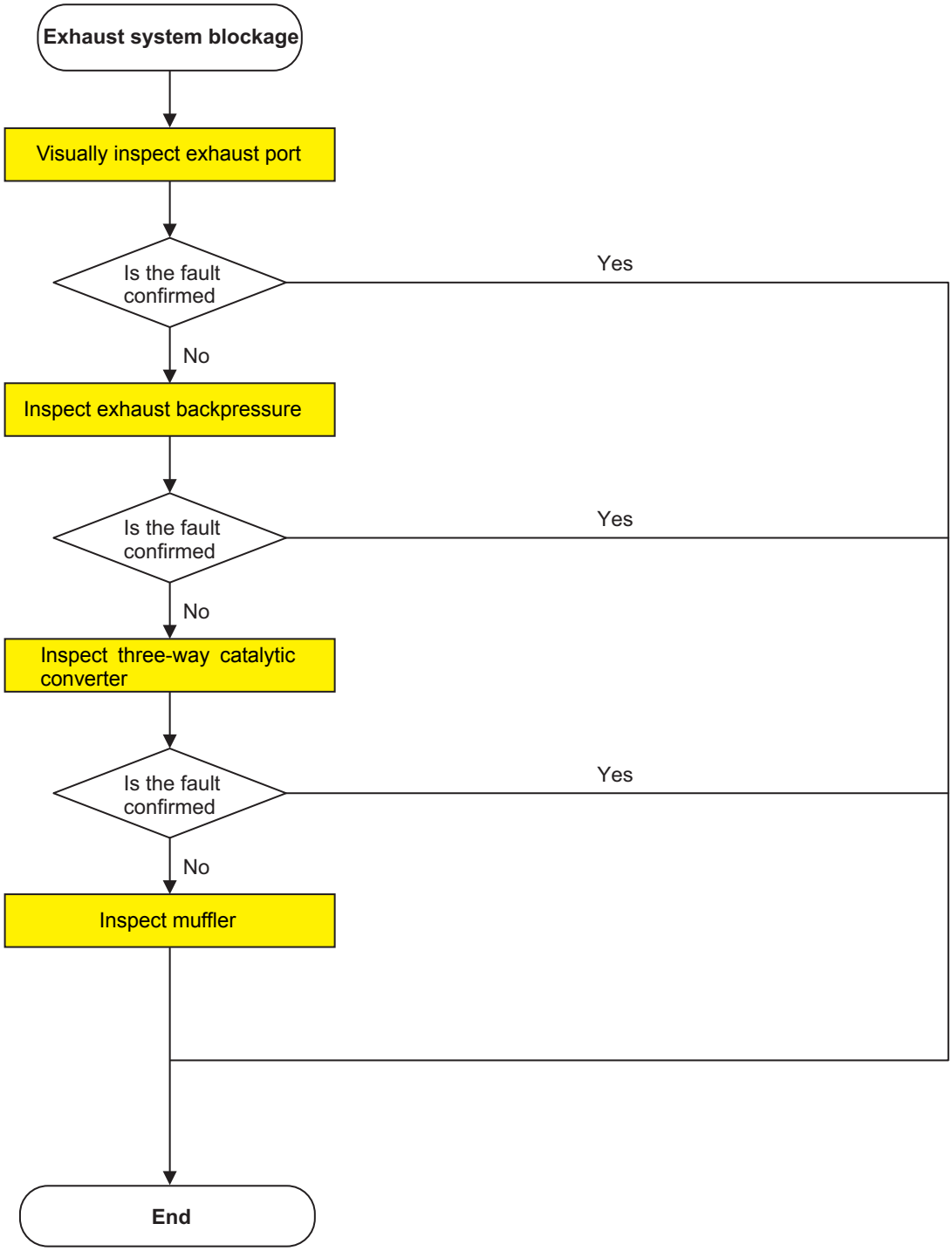
If the fault occurs, but there is no DTC stored in ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Exhaust system blockage | • Exhaust pipe<br>• Three-way Catalytic Converter<br>• Muffler<br>• Exhaust port is blocked as rust heavy inside exhaust pipe<br>• Exhaust system component connections | **Refer to: Diagnosis Procedure for Exhaust System Blockage (3.1.6 Exhaust System, Symptom Diagnosis and Testing).** |
| Exhaust system leak(s) | • Component misalignment or wrong installation of the exhaust system<br>• Sealing or gasket leak(s)<br>1. Exhaust manifold and cylinder head<br>2. Exhaust manifold and three-way catalytic converter assembly<br>3. Three-way catalytic converter assembly and muffler assembly<br>• Irregular junction surface of flange joint connection<br>• Cracked or disconnected exhaust manifold<br>• Welded joint of exhaust system component leak(s) | • Position and tighten each exhaust system component to the specified torques.<br>**Refer to: Torque specifications (3.1.6 Exhaust system, Specification).**<br>• Make sure that the exhaust pipe shackle is located correctly and tightly.<br>• Replace the leaking sealing or gaskets with new ones.<br>• Repair or replace the related components when necessary.<br>• Replace the exhaust manifold.<br>**Refer to: Exhaust manifold (3.1.6 Exhaust System, Removal and Installation).**<br>• Replace the leaking parts. |

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# Diagnosis Procedure for Exhaust System Blockage



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Visually inspect exhaust port | |
| | A. Inspect exhaust port for any foreign matters.<br>Is the exhaust port normal?<br>**Yes**<br>Clear foreign matters.<br>**No**<br>Go to step 2. |
| 2. Inspect exhaust backpressure | |
| | A. Execute the inspection of exhaust backpressure.<br>**Refer to: Exhaust Backpressure Inspection (3.1.6 Exhaust System, General inspection).**<br>Is the exhaust backpressure normal?<br>**Yes**<br>Normal.<br>**No**<br>Go to step 3. |
| 3. Inspect three-way catalytic converter | |
| | A. Remove the three-way catalytic converter.<br>**Refer to: Three-way Catalytic Converter (3.1.6 Exhaust System, Removal and Installation).**<br>B. Inspect the three-way catalytic converter.<br>Is the three-way catalytic converter normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the three-way catalytic converter.<br>**Refer to: Three-way Catalytic Converter (3.1.6 Exhaust System, Removal and Installation).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect muffler | |
| | A. Remove the muffler.<br>B. Inspect the muffler.<br>Is the muffler normal?<br>**Yes**<br>Inspect the exhaust system component joints and test the system for normal operation.<br>**No**<br>Replace the muffler. |

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## Removal and Installation

# Exhaust Manifold

### Removal

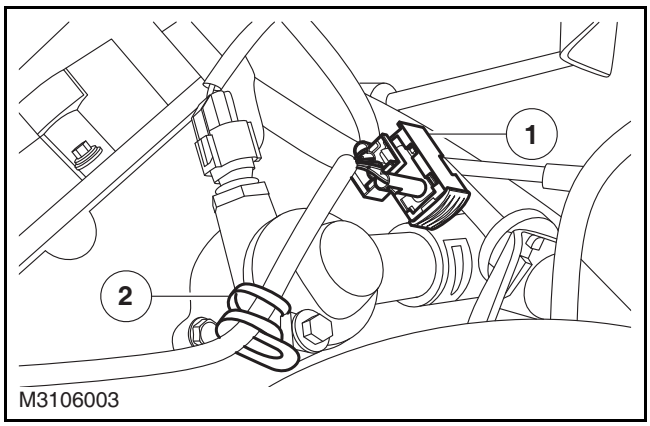
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

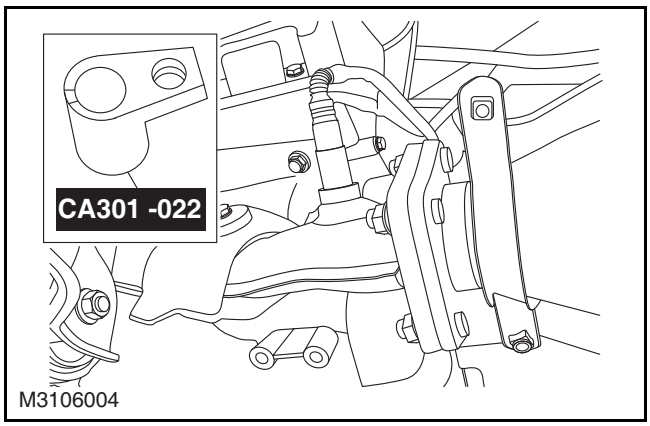
3. Disconnect the front oxygen sensor wiring harness connector (1).
4. Disconnect the front oxygen sensor wiring harness from the bracket (2).




5. Use special tool to remove the front oxygen sensor.

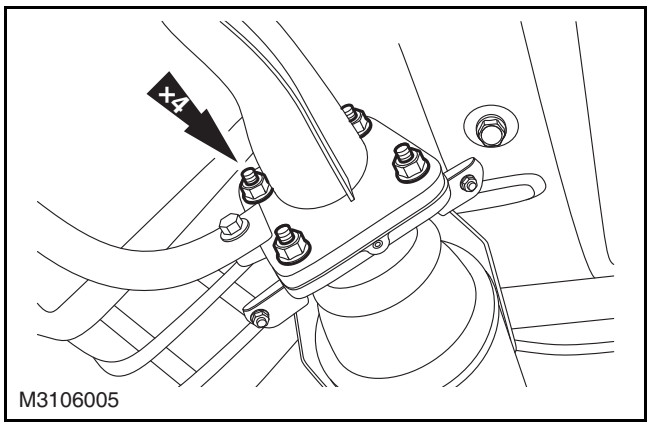
   Torque: 50 ± 10 Nm

   Special tool: Oxygen sensor sleeve CA301-022




6. Remove 4 connecting nuts between exhaust manifold and three-way catalytic converter.

   Torque: 23 ± 2 Nm

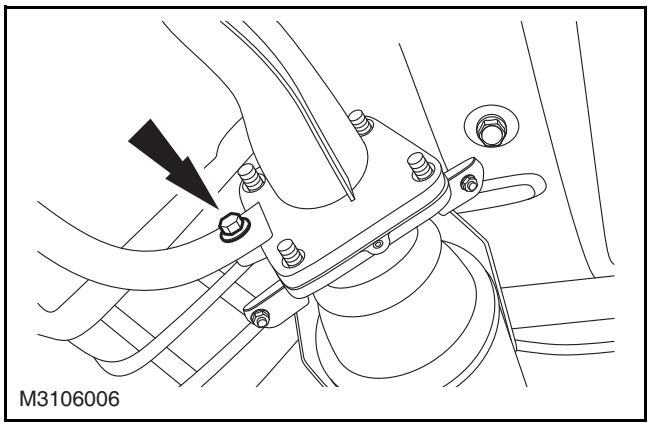


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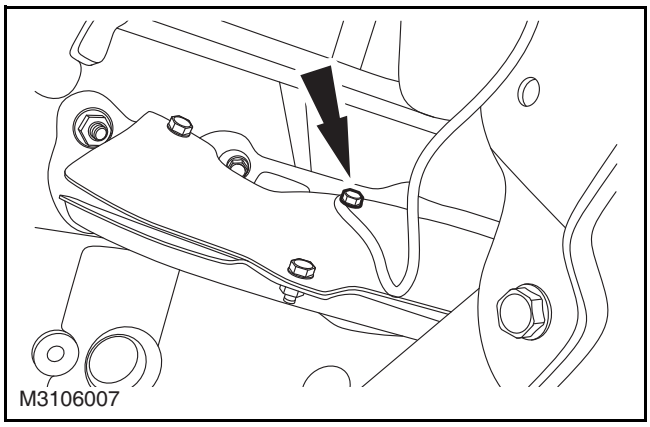
**7.** Remove the connecting bolt between exhaust pipe and exhaust pipe bracket.

Torque: 23 ± 2 Nm


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**8.** Remove the grounding retaining bolt.

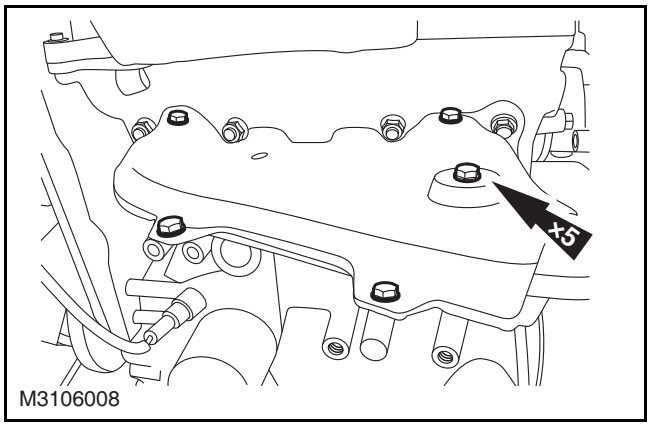
Torque: 10 ± 1 Nm


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**9.** Remove the exhaust manifold upper cover.

1 Remove 5 retaining bolts from the exhaust manifold upper cover.

Torque: 10 ± 1 Nm



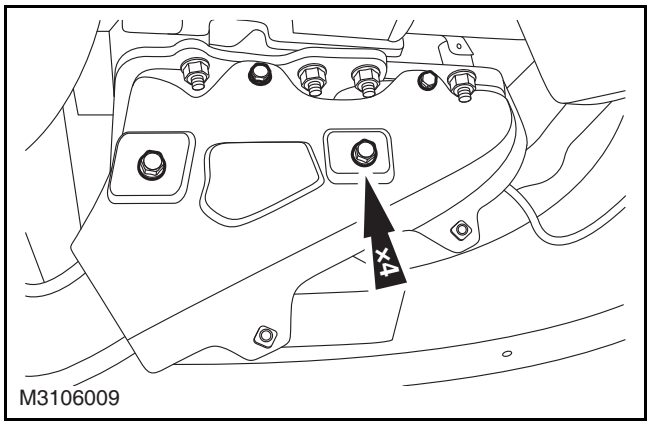
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2 Remove the exhaust manifold upper cover.

**10.** Remove the exhaust manifold lower cover.

1 Remove 4 retaining bolts from the exhaust manifold lower cover.

Torque: 10 ± 1 Nm



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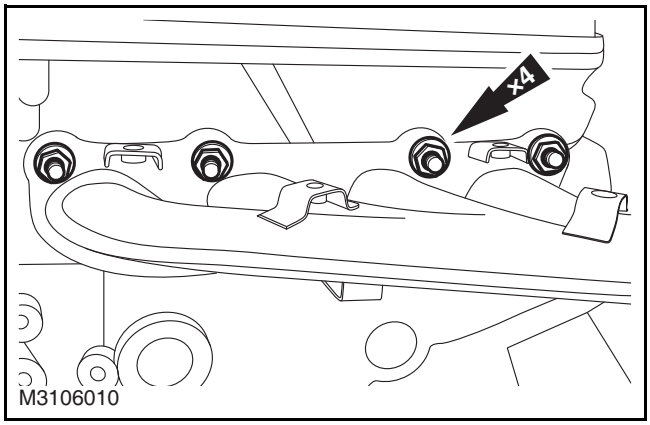


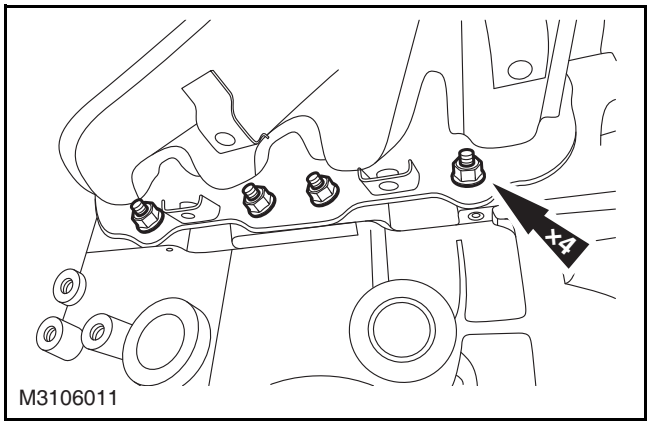
2 Remove the exhaust manifold lower cover.

**11.** Remove the exhaust manifold.

1 Remove 8 retaining nuts from the exhaust manifold.

Torque: 23 ± 2 Nm




2 Remove the exhaust manifold and its gasket in order.

## Installation

**1.** Installation is in the reverse order of removal.

**CAUTION: Inspect for exhaust gas leakage, and tighten the trouble part to prevent leakage if leakage is present. Replace the damaged components when necessary.**

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# Three-way Catalytic Converter

## Removal

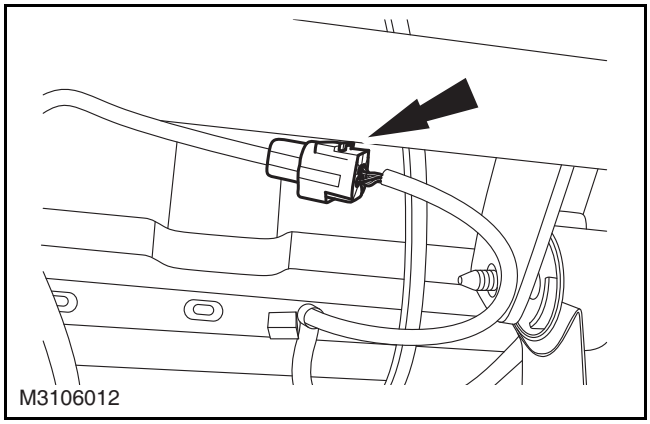
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

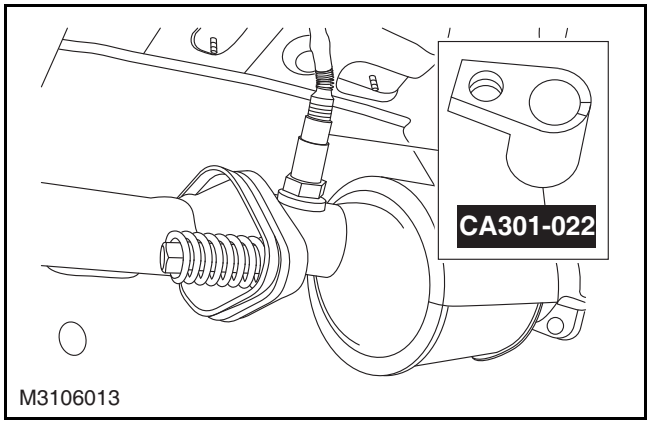
3. Disconnect the rear oxygen sensor wiring harness connector.


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4. Use special tool to remove the rear oxygen sensor.

   Torque: 50 ± 10 Nm

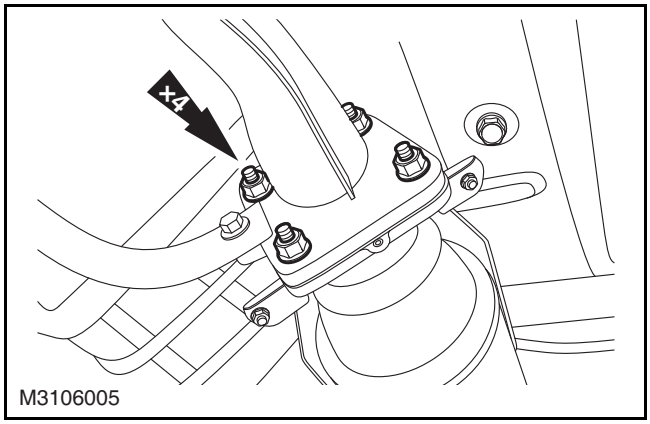
   Special tool: Oxygen sensor sleeve CA301-022



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5. Remove 4 connecting nuts between exhaust manifold and three-way catalytic converter.

   Torque: 23 ± 2 Nm



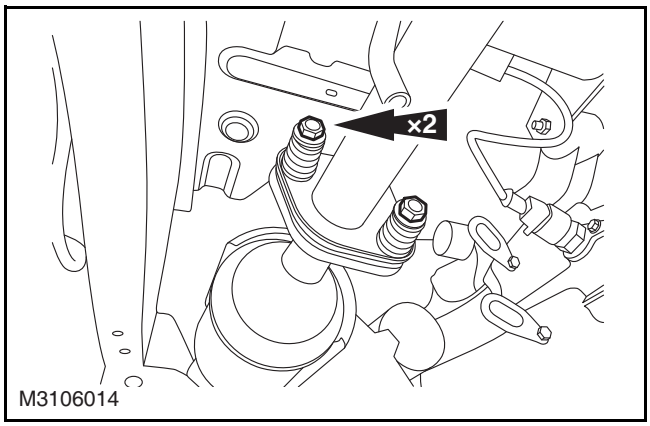
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6. Remove 2 connecting bolts between three-way catalytic converter and muffler.

   Torque: 55 ± 5 Nm




7. Remove the three-way catalytic converter and its gasket.

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: The new three-way catalytic converter gasket is needed.**

**CAUTION: Inspect for exhaust gas leakage, and tighten the trouble part to prevent leakage if leakage is present. Replace the damaged components when necessary.**

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# Muffler

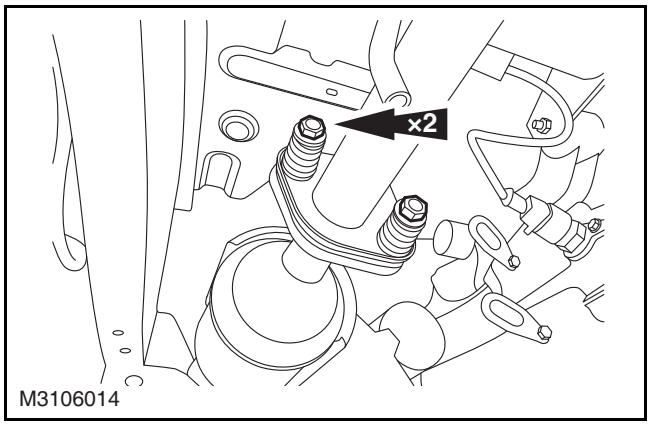
## Removal

1. Lift the vehicle.

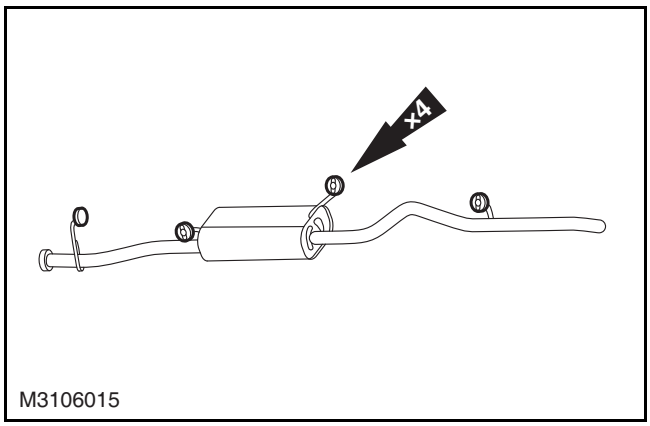
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Remove 2 connecting bolts between three-way catalytic converter and muffler.

   Torque: 55 ± 5 Nm




3. Remove 4 rubber hangers between muffler and vehicle body.




4. Remove the muffler.

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect for exhaust gas leakage, and tighten the trouble part to prevent leakage if leakage is present. Replace the damaged components when necessary.**

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## Specifications

# Component Specifications

| Item | Specifications |
|---|---|
| Fuel injector resistance | 11.4 ~ 12.6 Ω |

# General Specifications

| Item | Specifications |
|---|---|
| Fuel pipe pressure | 3.5 bar |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Fuel tank retaining bolt | 25 | 18 | - |
| Fuel filter bracket bolt | 10 | - | 89 |
| Fuel pump flange bolt | 10 | - | 89 |
| Fuel main pipe retaining bolt | 23 ± 2 | - | - |
| Accelerator pedal retaining bolt | 10 ± 1 | - | - |

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## Description and Operation

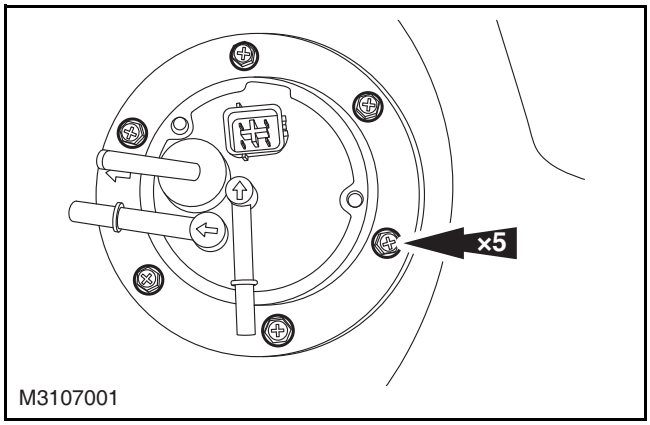
# System Overview

Fuel supply system with fuel pressure regulator adopts the pressure differential adjusting method. The fuel pump is installed in the fuel tank, and forms an assembly together with the fuel pump level sensor. The engine control module controls the fuel pump through the fuel pump relay. After the fuel pump starts working, it supplies the fuel injector rail with fuel of specified pressure. The fuel system maintains a certain pressure when the fuel pump stops working, to ensure that the engine can start normally. Fuel supply system is composed of fuel pump, fuel pipe, fuel filter, fuel pressure regulator, fuel injector rail, fuel pump relay and so on.

# Components Description

### Fuel Pump

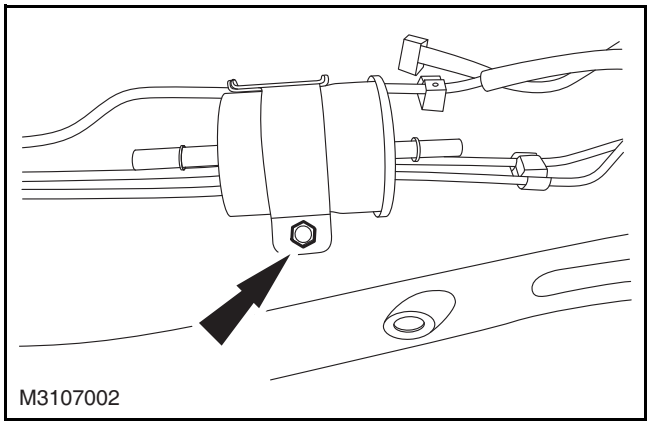
The fuel pump is installed in the fuel tank, and forms an assembly together with the fuel level sensor. It is installed through plastic locking ring and sealed by rubber washer.



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### Fuel Filter

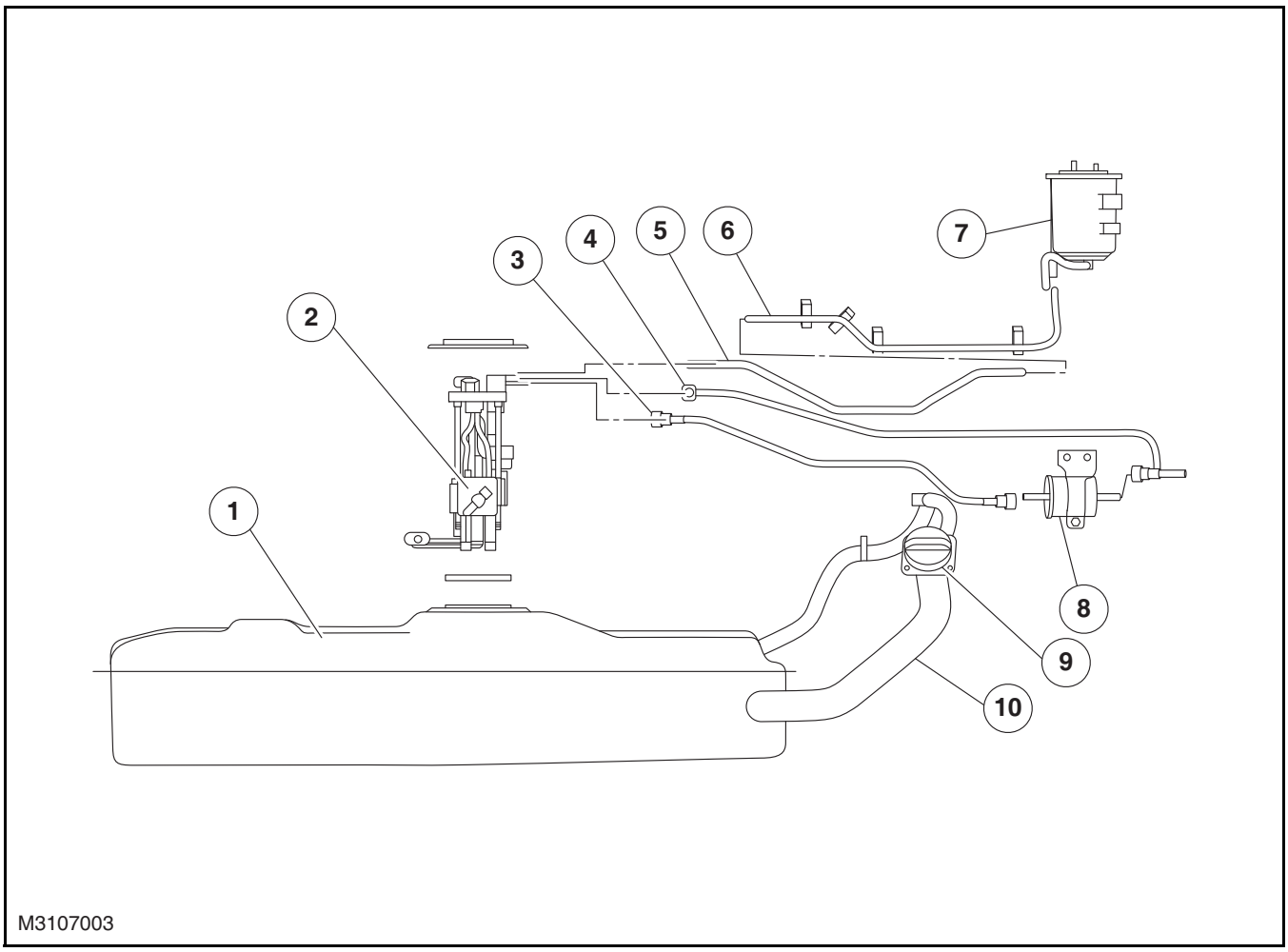
The fuel filter adopts a tank structure, and is installed on the frame of engine side with bolts.


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# Components Location View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Fuel tank | 7 | Fuel vapor pipe |
| 2 | Fuel pump assembly | 8 | Carbon canister with accessory assembly |
| 3 | Nylon fuel pipe assembly | 9 | Fuel filter assembly |
| 4 | Nylon return pipe assembly | 10 | Fuel filler cap assembly |
| 5 | Fuel vapor hose | | |

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## General inspection

### General Equipment

| |
|---|
| Diagnostic tester |
| Fuel pressure gauge |

**WARNING: Gasoline or gasoline vapors is highly flammable. In order to avoid fire or explosion, please keep away from fire. During this procedure, operation staffs are prohibited to use mobile phones. Never drain or store gasoline in open container. Please prepare a dry chemical fire extinguisher nearby during this procedure.**

## Fuel System Pressure Testing

**WARNING: Fuel pipe overflowing and fuel system leakage are extremely dangerous. Fuel will catch fire, which leads to serious injury and damage. To avoid this situation, carry out the following inspection when the engine stops.**

1. Remove the fuel pump relay, start and run the engine until the engine stalls.
2. Install the fuel pump relay.
3. Disconnect the negative battery cable.
4. Connect the fuel pressure gauge to the fuel pipe.

**WARNING: Wrap the joint between fuel pressure gauge and fuel distribution pipe with a cleaning cloth to absorb the leaking fuel as connecting the pressure gauge, so as to reduce the risk of fire and personal injury. Place the cleaning cloth into the specified container after test is completed. Clean the fuel pipe joint before removing the fuel pipe.**

5. Connect the negative battery cable.
6. Connect a diagnostic tester to the diagnosis connector.
7. Turn the ignition switch to "ON".
8. Select the Active Test function of the engine menu on the diagnostic tool, and then select "Fuel pump relay" to run the fuel pump and keep it running for 10 s.
9. Measure the fuel pipe pressure.

   **Standard fuel pressure: 3.5 bar**
10. Stop the fuel pump.
11. Measure the fuel holding pressure after 5 minutes.

    **Standard fuel holding pressure: 3.5 bar**
12. Remove the fuel pressure tester from the fuel system.
13. Reconnect the fuel pipe, inspect the fuel pipe for reliable connection.

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## Symptom Diagnosis and Testing

### General Equipment

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Fuel pipe damage<br>• Fuel leakage<br>• Fuel tank filler cap damage<br>• Fuel tank filler pipe damage<br>• Fuel line joint damage<br>• Fuel pressure regulator damage<br>• Fuel filter incorrect installation | • Fuel pump circuit<br>• Fuel pump relay<br>• Fuel pump |

3. If an observed or reported problem is obvious and the cause has been found, solve the fault before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Fuel pump fault | • Fuel pump relay<br>• Fuel Pump<br>• Circuit<br>• Engine control module (ECM) | **Refer to: Diagnosis Procedure for Fuel Pump Fault (3.1.7 Fuel System, Symptom Diagnosis and Testing).** |
| Low pressure in fuel system | • Fuel pump<br>• Line leakage | • Replace the fuel pump.<br>• Repair the fuel line. |
| Low holding pressure in fuel system | • Fuel pump<br>• Fuel line leakage | • Replace the fuel pump.<br>• Repair the fuel line. |
| High pressure in fuel system | • Fuel line clogging<br>• Fuel pressure regulator | • Repair the fuel line.<br>• Replace the fuel pressure regulator. |
| Heavy fuel smell | • Filler cap<br>• Fuel Filter<br>• Fuel tank vent hole<br>• Purge solenoid<br>• Carbon canister<br>• Fuel system leakage<br>• Fuel pressure | **Refer to: Diagnosis Procedure for Heavy Fuel Smell (3.1.7 Fuel System, Symptom Diagnosis and Testing).** |

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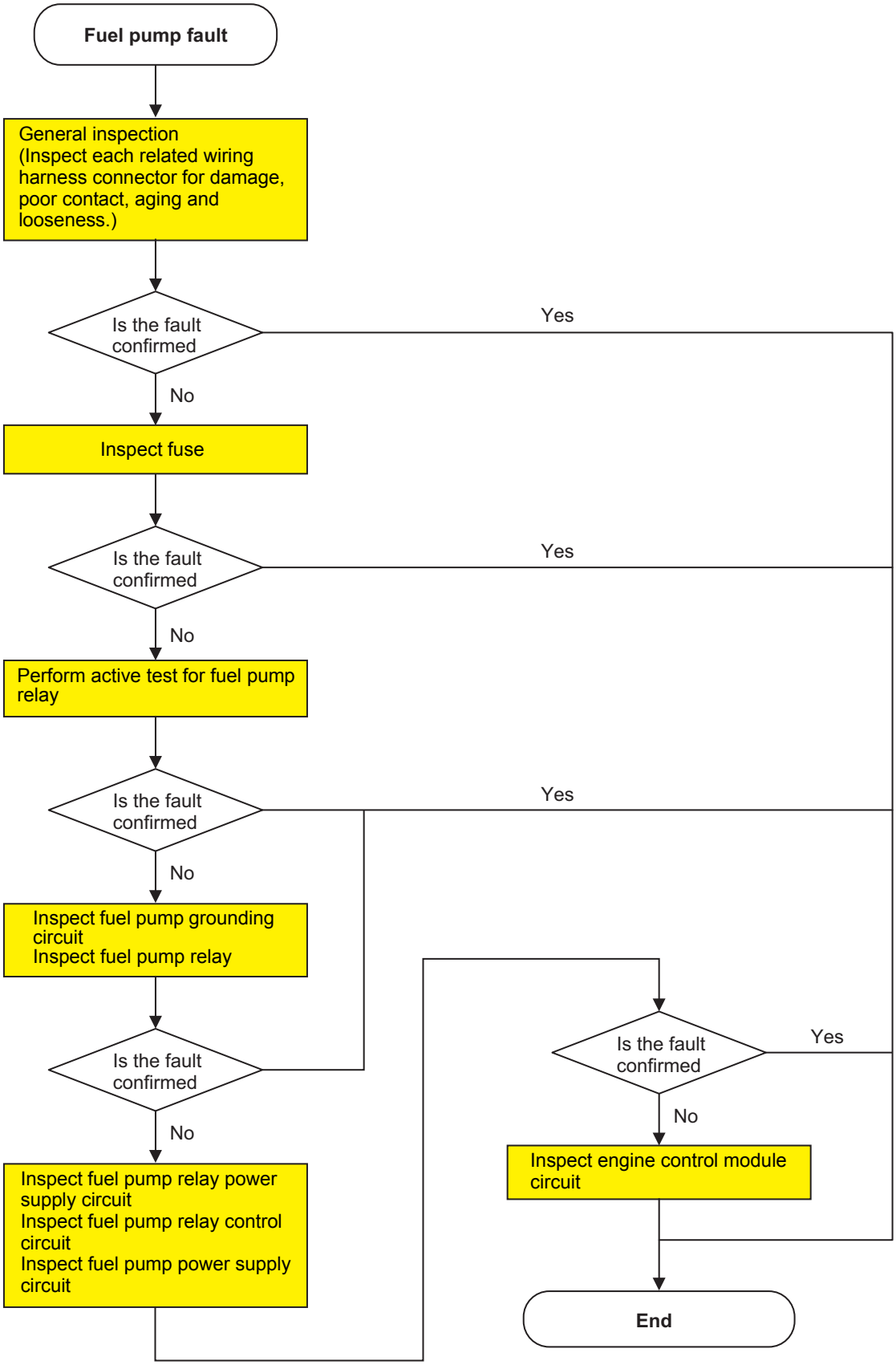


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Surging during driving | • MAP intake pressure sensor<br>• Incorrect A/C system operation<br>• Air intake system component leakage<br>• Purge solenoid fault<br>• Unstable signal from CKP sensor<br>• Vacuum leakage<br>• Poor fuel quality<br>• Intermittent fault of main relay and fuel pump relay<br>• Throttle body fault<br>• Engine overheating<br>• Spark plug fault<br>• Ignition timing<br>• Exhaust system restrictions<br>• Inadequate fuel pressure<br>• Fuel pump mechanical fault<br>• Fuel injector<br>• Unstable signal from TP sensor | **Refer to: Diagnosis Procedure for Emergency during Driving (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |

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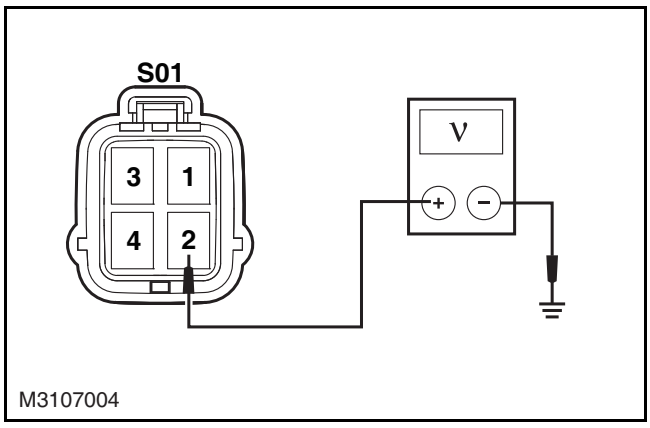


# Diagnosis Procedure for Fuel Pump Fault



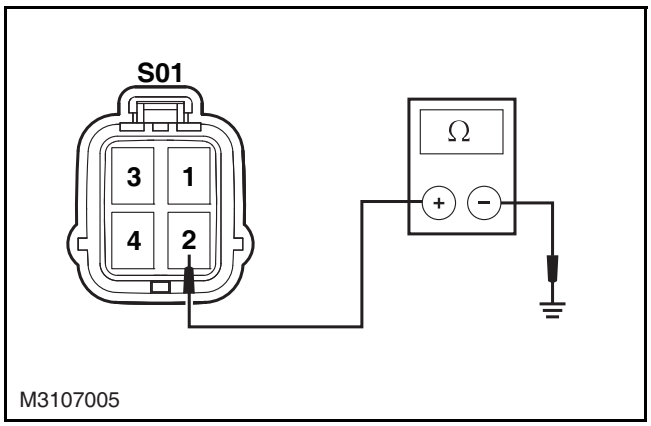
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the related wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the faulty area. |
| 2. Inspect fuse | |
| | A. Inspect the fuse IF19 in the instrument panel fuse box P40.<br>**Fuse rated capacity: 15 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, replace the fuse. |
| 3. Perform active test for fuel pump relay | |
|  <br>M3107004 | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON".<br>C. Select the engine system on the diagnostic tool to perform "Executor test" - "Fuel pump".<br>D. Measure the voltage between terminal 2 of fuel pump wiring harness connector S01 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 5. |

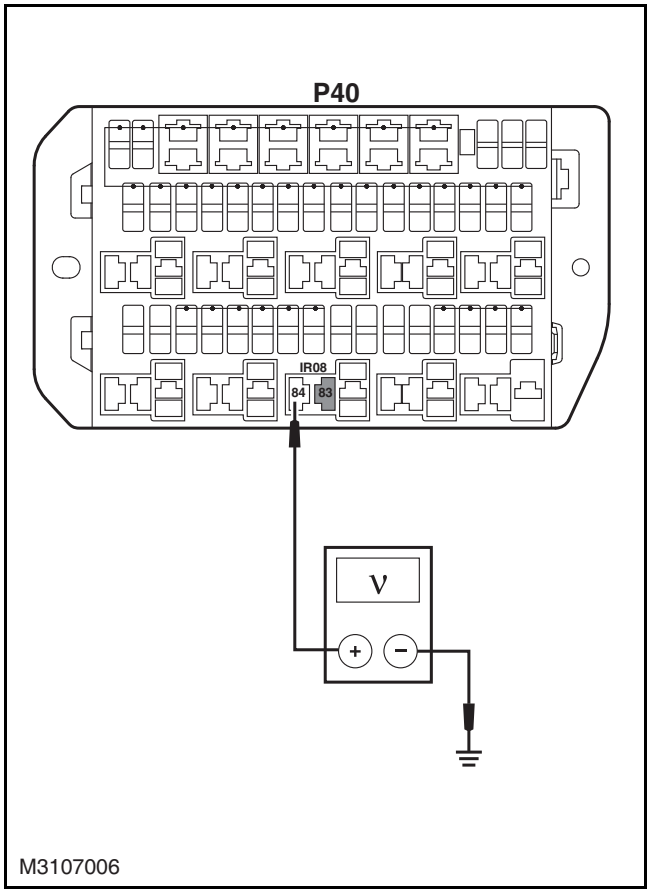
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuel pump grounding circuit | |
|  M3107005 | A. Measure the resistance between terminal 2 of fuel pump wiring harness connector S01 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the fuel pump.<br>**Refer to: Fuel Pump (3.1.7 Fuel System, Removal and Installation).**<br>**No**<br>Repair the wiring harness between terminal 2 of fuel pump wiring harness connector S01 and grounding. |
| 5. Inspect fuel pump relay | |
| | A. Replace the fuel pump relay with a normal one.<br>Is the fuel pump normal?<br>**Yes**<br>Replace the relay.<br>**No**<br>Go to step 6. |

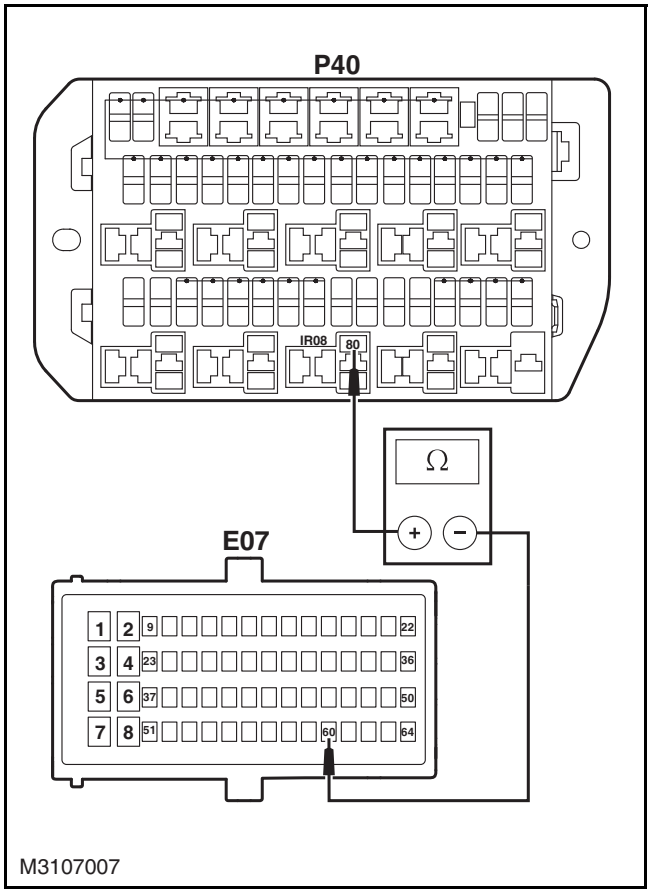
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect fuel pump relay power supply circuit | |
|  M3107006 | A. Turn the ignition switch to "ON".<br>B. Measure the voltage between terminals 83, 84 of fuel pump relay IR08 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the faulty circuit between terminal 82 of fuel pump relay IR08 and terminal 69 of main relay IR05.<br>Inspect and repair the faulty circuit between terminal 83 of fuel pump relay IR08 and battery. |

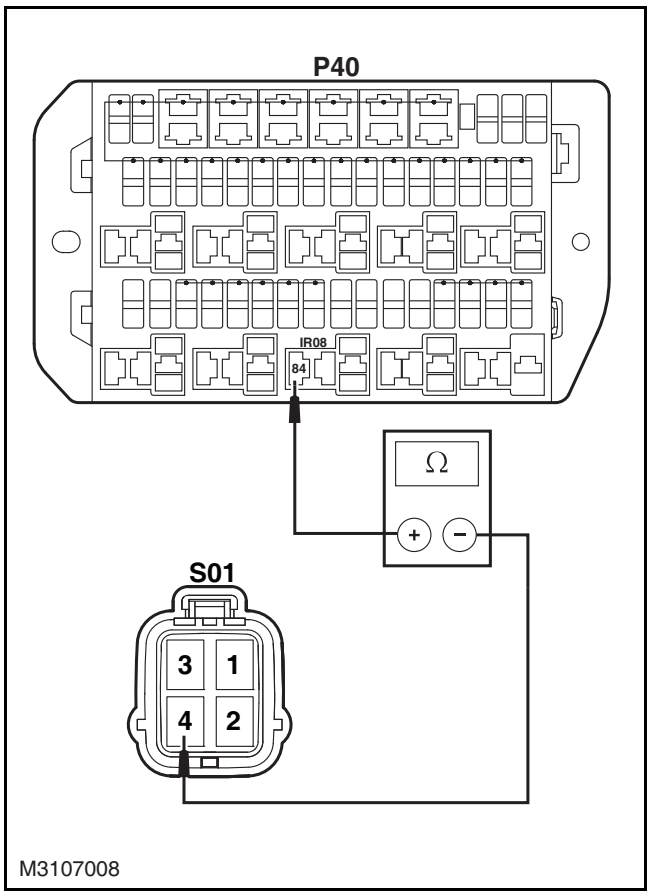
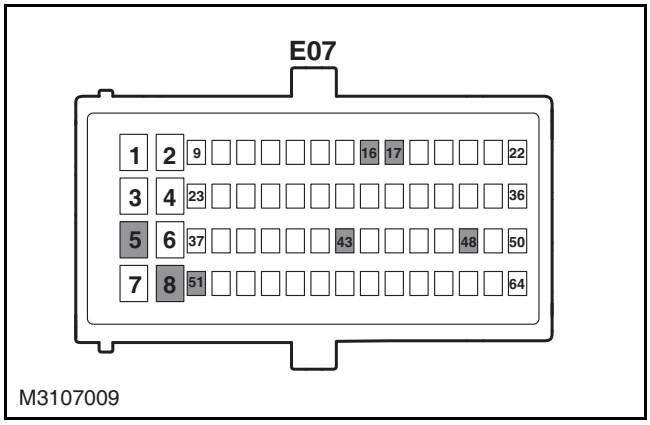
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect fuel pump relay control circuit | |
|  <br>M3107007 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the engine control module wiring harness connector E07.<br>C. Remove the fuel pump relay.<br>D. Measure the circuit resistance between terminal 60 of ECM wiring harness connector E07 and terminal 80 of fuel pump relay IR08.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the faulty circuit. |

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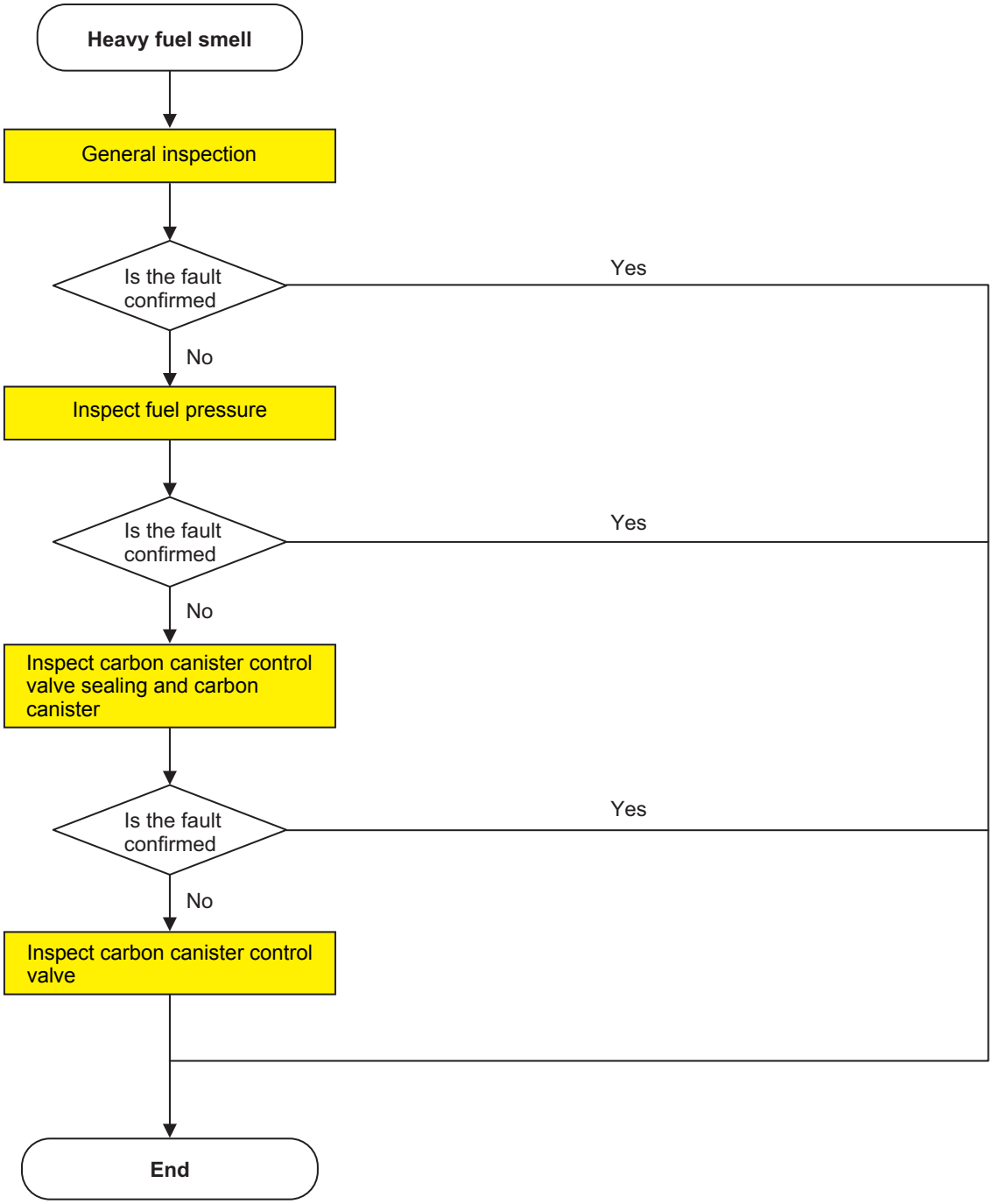
| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect fuel pump power supply circuit | |
|  M3107008 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the fuel pump wiring harness connector S01.<br>C. Remove the fuel pump relay.<br>D. Measure the circuit resistance between terminal 4 of fuel pump wiring harness connector S01 and terminal 84 of fuel pump relay IR08.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the faulty circuit. |
| 9. Inspect engine control module circuit | |
|  M3107009 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the ECM wiring harness connector E07.<br>C. Turn the ignition switch to "ON", inspect whether the power supply at terminals 8, 16, 17 and 51 is normal.<br>D. Turn the ignition switch to "LOCK", inspect whether grounding of terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Heavy Fuel Smell

**WARNING: The following fault inspection flow chart includes the diagnosis and repair procedures for fuel system. Read the following precautions before repairing the fuel system: fuel vapor is very dangerous. It is highly inflammable and can easily cause serious injury and damage. Please always keep fuel far away from fire.**



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Visually inspect the fuel injector, O-ring and fuel pipe for oil leaks.<br>B. Inspect the fuel filter sealing area and filter pipe connecting area for leakage.<br>C. Inspect if the O-ring is fitted with the filler pipe assembly correctly after the filler cap is properly installed.<br>Is the inspection normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the faulty part. |
| 2. Inspect fuel pressure | |
| | A. Perform fuel system pressure inspection.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the fuel pressure too high?<br>**Yes**<br>Repair the clogged fuel pipe, repair or replace the fuel pressure regulator.<br>**No**<br>Go to step 3. |
| 3. Inspect carbon canister control valve sealing and carbon canister | |
| | A. Check if the pipe connected with the carbon canister control valve leaks.<br>B. Inspect if the carbon canister leaks.<br>Is inspection normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the leaking part, repair or replace the carbon canister. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect carbon canister control valve | |
| | A. Inspect the carbon canister control valve.<br>**Refer to: DTC P0444, P0458, P0459 (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>Is the carbon canister control valve normal?<br>**Yes**<br>Repair the fuel tank breather hole.<br>**No**<br>Repair or replace the carbon canister control valve and the circuit. |

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## Removal and Installation

# Fuel Filter

### Removal

**WARNING: During operation of fuel components, all types of open fire are prohibited. High-flammable gas mixture generated during the operation may be ignited. Improper operation may cause personal injury accident.**

1. Release the fuel pressure.

   **Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**

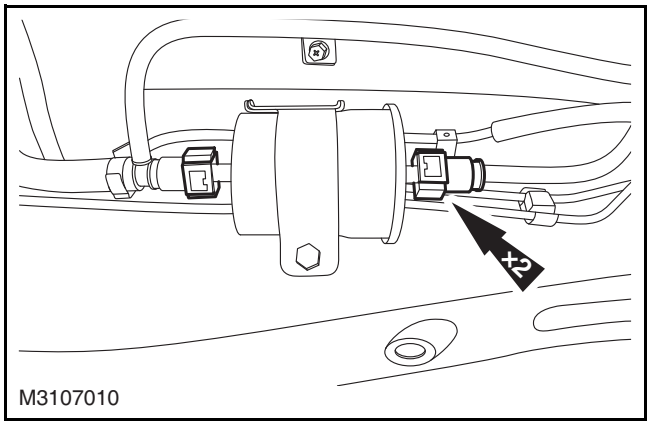
2. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

3. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

4. Disconnect the fuel pipe wiring harness connectors on both sides of fuel filter in sequence.

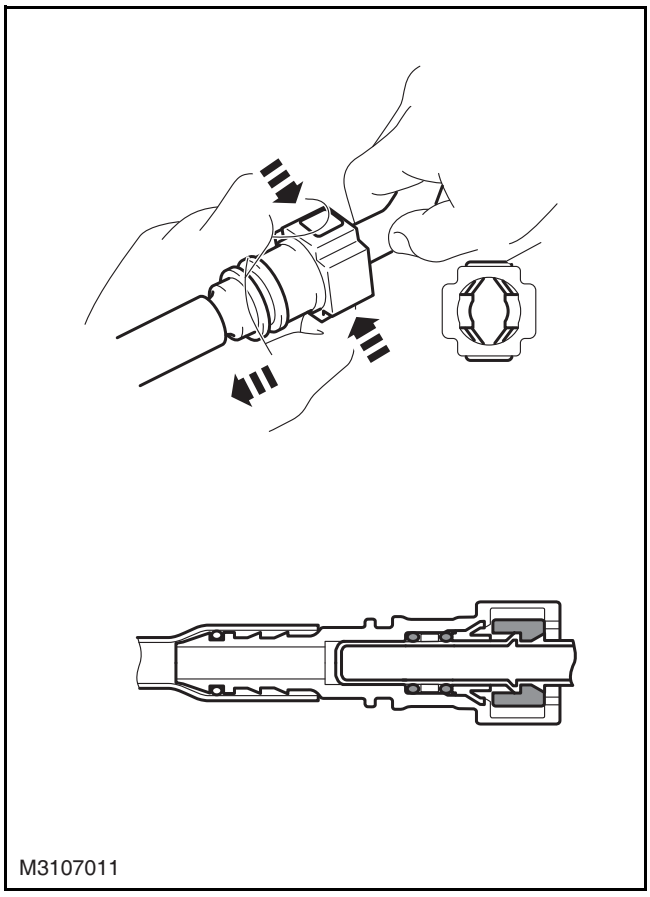


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1 Before disconnecting, inspect and confirm that there is no dirt or other foreign matter around the fuel pipe and wiring harness connectors. Clean if necessary.

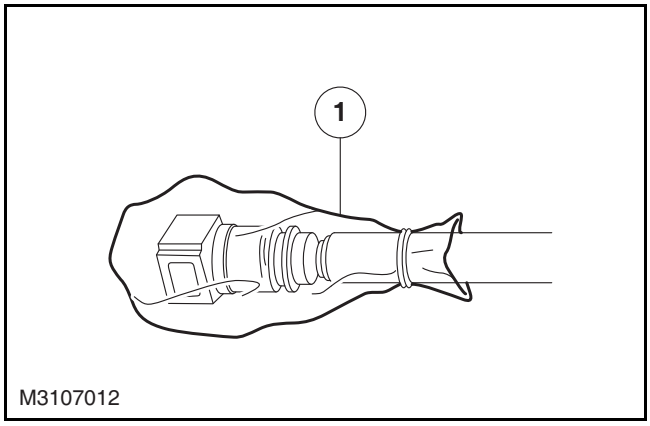
2 Remove the fuel connecting hose.



M3107011

3 Inspect and confirm that there is no dirt or other foreign matter on the sealing surface of disconnected fuel pipe. Clean if necessary.

4 Do not damage the disconnected fuel pipe or wiring harness connectors, wrap them with plastic bag (1) to prevent the entry of foreign matter.



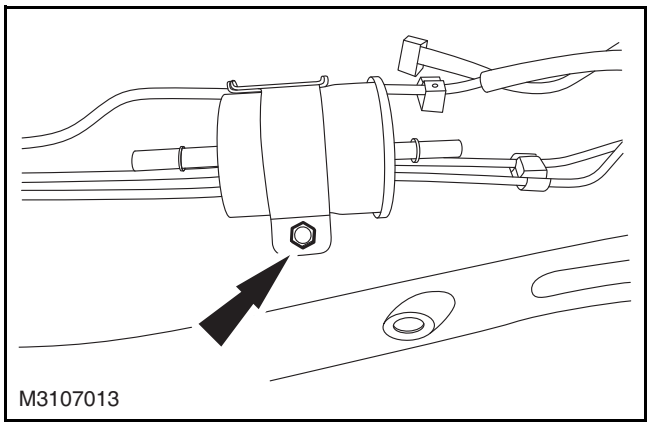

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5. Remove the fuel filter retaining bolt and then remove the fuel filter.

   Torque: 10 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Do not reverse the installation direction of fuel filter.**

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# Fuel Tank

### General Equipment

| |
|---|
| Flat jack |

## Removal

**WARNING: This working process includes fuel disposal. At any time, be aware of fuel overflowing and follow the fuel disposal precautions, or it may cause personal injury.**

**WARNING: During operation of fuel components, all types of open fire are prohibited. High-flammable gas mixture generated during the operation may be ignited. Improper operation may cause personal injury accident.**

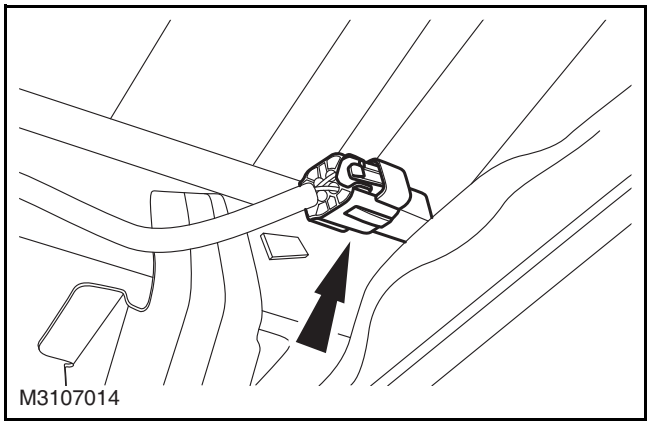
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Drain the fuel tank.
3. Lift the vehicle.

   **Refer to: Lifting Vehicle (1.1.3 Traction and Lifting).**

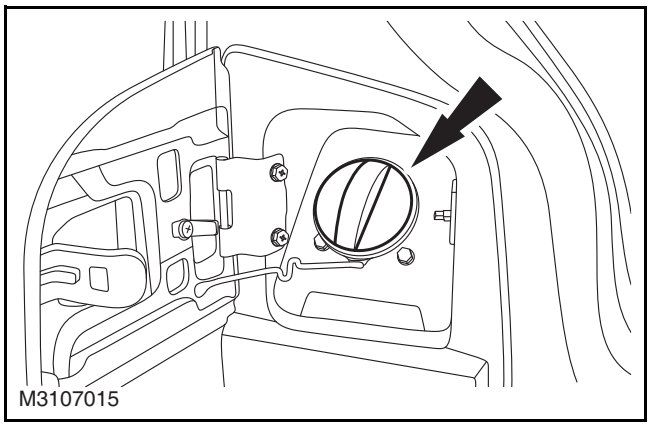
4. Disconnect the fuel pump wiring harness connector.



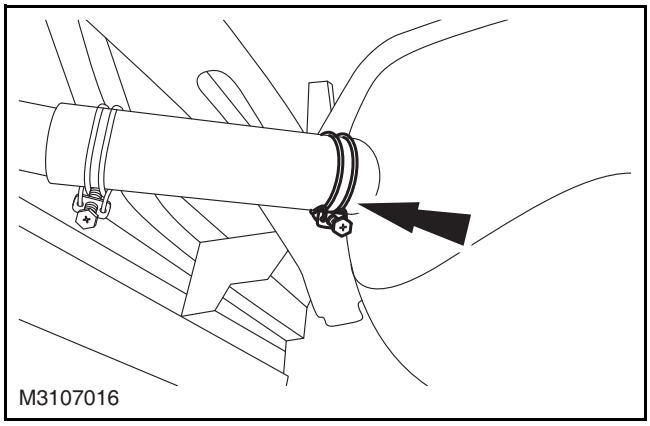
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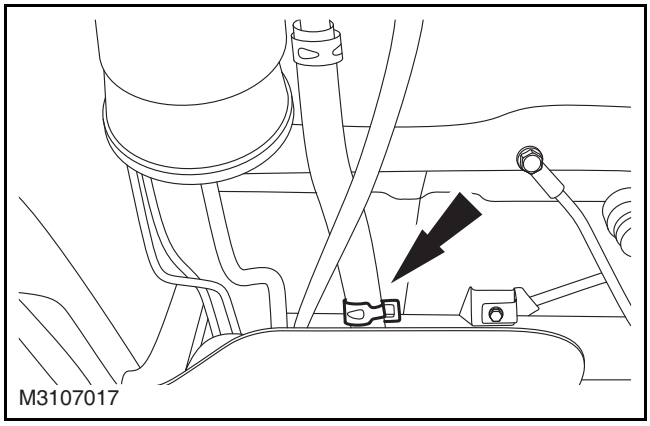
**5.** Open the fuel tank cap and release the air in fuel tank.



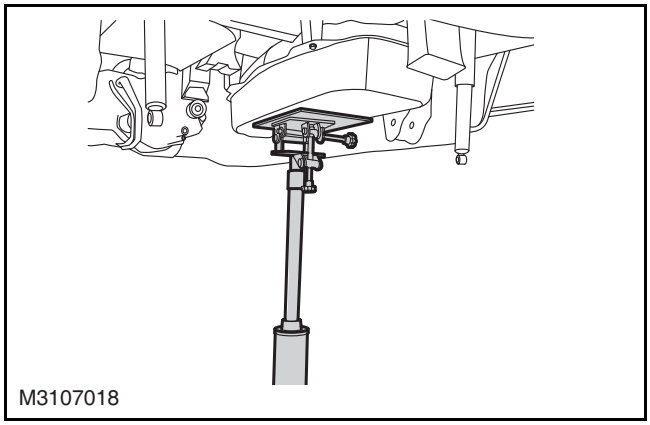

**6.** Loosen the clamp and remove the fuel tank filler hose.




**7.** Loosen the hoop and disconnect the fuel tank vent hose.




**8.** Use a flat jack to support the fuel tank.



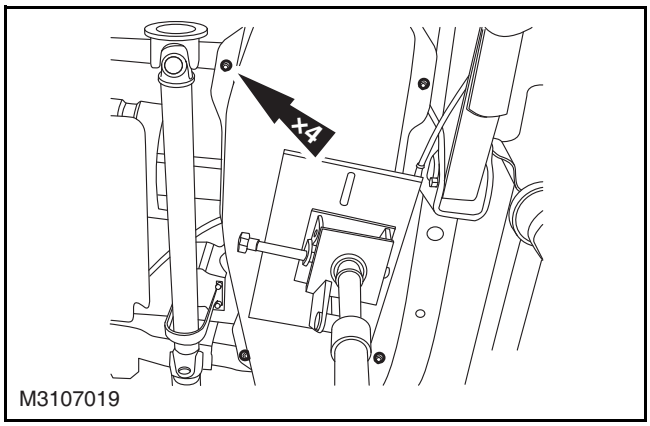
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**9.** Remove 4 retaining bolts from the fuel tank.

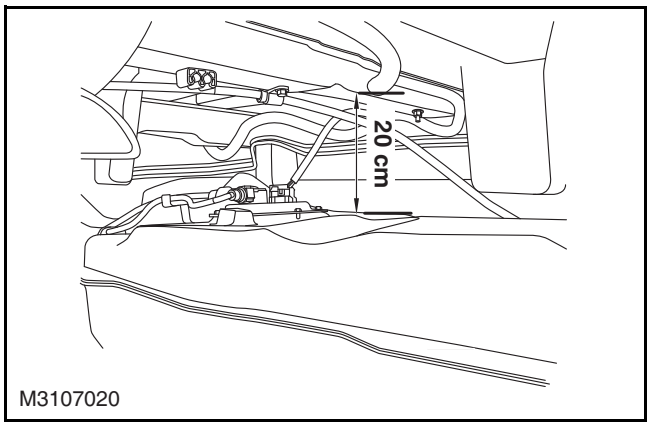
Torque: 25 Nm

**WARNING: When removing the fuel tank, do not apply excessive strain force on the fuel line and wiring harness.**



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**10.** Slowly lower the fuel tank about 20 cm to expose the joints of fuel pump, fuel outlet and return pipe on the top of fuel tank.

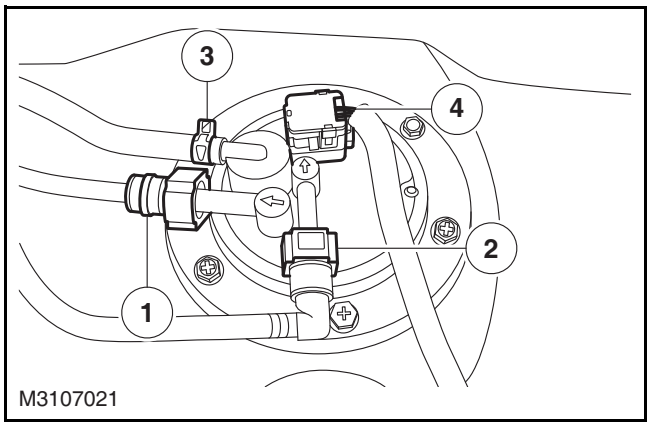


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11. Disconnect the joint (1) connecting fuel outlet pipe and fuel pump.
12. Disconnect the joint (2) connecting fuel return pipe and fuel pump.
13. Disconnect the joint (3) connecting carbon canister and fuel pump end cap.
14. Disconnect the fuel pump wiring harness connector (4).




**WARNING: There maybe a little fuel flowing out after disconnecting the fuel pipe. In order to reduce the possibility of personal injury, wrap the nylon pipe with cloth. After completing the disconnection, be sure to put the cloth into a safe container.**

**CAUTION: Before disconnecting the joint, clear all dirt and foreign matters on the retainer.**

**CAUTION: Do not apply excessive force to bend or twist the fuel pipe.**

**CAUTION: Use plastic bags to wrap the joint ends to avoid damage and contamination.**

15. Slowly lower the bracket to remove the fuel tank.

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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Reinstall the fuel pipe and fuel tank vent hose to original position. Otherwise, the friction caused by vehicle vibration will damage fuel pipes and lead to fuel leak.**

**CAUTION: Inspect if fuel pipes are connected securely after installing the fuel tank.**

**CAUTION: During installation, push fuel pipe wiring harness connector until a "click" sound is heard, and then inspect and confirm that the fuel pipe joint clips are located in fuel pipe joint collar. After installing the fuel pipe joint clips, inspect and confirm that the fuel pipe joint cannot be pulled out. Be care not to damage the joint. Replace with new ones if the clips are damaged.**

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# Fuel Pump

## Removal

**WARNING: Please release the pressure of fuel supply system before repairing fuel supply system components. When repairing the vehicle or components related to fuel supply system in a location with well ventilation, smoking and carrying lighted cigarette or open fire are prohibited. High-flammable gas mixture may appear anytime, any violation of rules may lead to serious personal injury or death. When operating related components or working around the fuel supply system, please do not carry personal electrical devices (such as mobile phones, BP or audio devices). High-flammable gas mixture may appear anytime, any violation of rules may lead to serious personal injury or death.**

**WARNING: Operation precautions for fuel supply system should be observed when operating the fuel supply system. Make preparation for accidental fuel leakage. The leaking fuel may be ignited by hot vehicle components or other fire sources. Violating above descriptions may cause serious personal injury or death.**

**CAUTION: Because the fuel pump assembly is cooled through fuel, the low fuel level in fuel tank will directly shorten the service life of fuel pump.**

**CAUTION: When replacing the fuel pump assembly, please keep fuel pump assembly and working area clean, otherwise, fuel pump filter element will be blocked.**

**CAUTION: The new components of fuel pump must have the same part number with that of original fuel pump.**

**CAUTION: Do not operate the fuel pump when it is free of fuel or in water, otherwise, fuel pump will be damaged.**

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**CAUTION: Keep fuel tank and line clean; if the fuel pump has been replaced, replace the fuel filter at the same time.**

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Release the fuel system pressure.

   **Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**

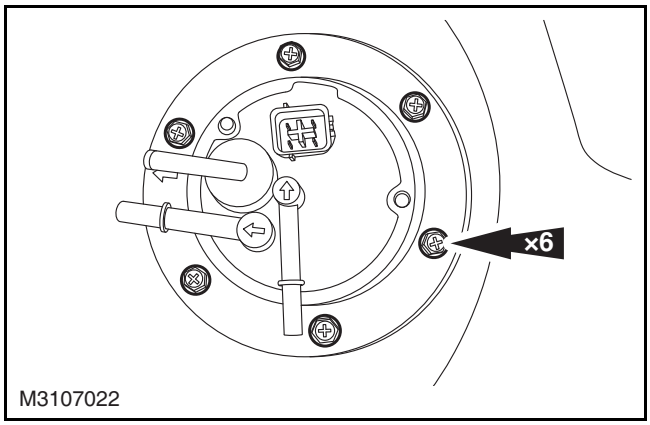
3. Remove the fuel tank.

   **Refer to: Fuel Tank (3.1.7 Fuel System, Removal and Installation).**

4. Remove the fuel pump.

   1 Remove 6 retaining bolts from the fuel pump pressure cover.

   Torque: 10 Nm




   2 Pull upward the fuel pump to pull out the fuel tank.

## Inspection

1. Inspect the operating condition of fuel pump.

   1 Remove the fuel pump.

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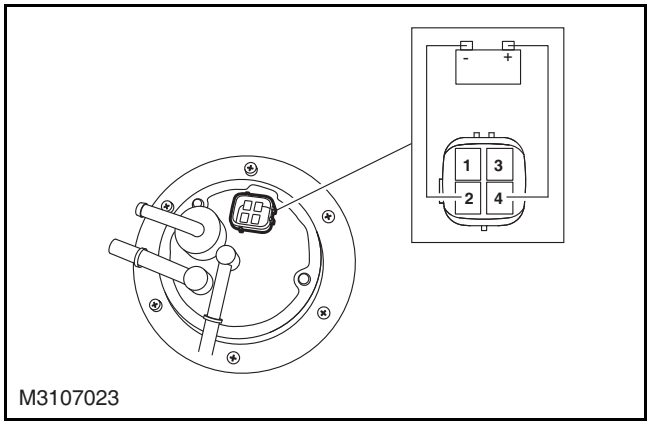


2 Apply battery voltage to terminal 2 and 4. Inspect if the fuel pump works within 10s.

**Note: The test must be finished within 10 s to avoid burning coils.**

**Note: Keep fuel pump away from battery as far as possible.**

**Note: Always turned on and off battery voltage from the battery side (not on the fuel pump side).**



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| Test Conditions | Specifications |
|---|---|
| Battery positive (+) to terminal 4<br>Battery negative (-) to terminal 2 | Fuel pump operates |

Replace the fuel pump if it does not operate.

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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect and confirm that there is no scratch or foreign matter on connecting components.**

**CAUTION: Inspect and confirm that fuel pipe joint is securely inserted into the pipe.**

**CAUTION: Turn the ignition switch to "ON" (do not start engine) to apply fuel pressure to fuel supply system, and then inspect the connecting part for leakage.**

**CAUTION: During installation, push fuel pipe wiring harness connector until a "click" sound is heard, and then inspect and confirm that the fuel pipe joint clips are located in fuel pipe joint collar. After installing the fuel pipe joint clips, inspect and confirm that the fuel pipe joint cannot be pulled out. Be care not to damage the joint. Replace with new ones if the clips are damaged.**

**CAUTION: Install new sealing to the fuel pump sealing surface.**

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# Fuel Main Pipe

## Removal

**WARNING: Please release the pressure of fuel supply system before repairing fuel supply system components.**

**WARNING: After releasing the fuel system pressure, some pressure still remains in fuel line. When disconnecting the fuel line, use a piece of cloth or equivalent to wrap the joint so as to prevent fuel spilling out.**

**WARNING: Repair the vehicle in a location with well ventilation and avoid fire source.**

**WARNING: No smoking when repairing vehicle, otherwise, personal injury or death may be caused.**

**CAUTION: Fuel injector is a high precision component with good anti-blocking, anti-contamination and anti-fogging performance.**

1. Disconnect the negative battery cable.

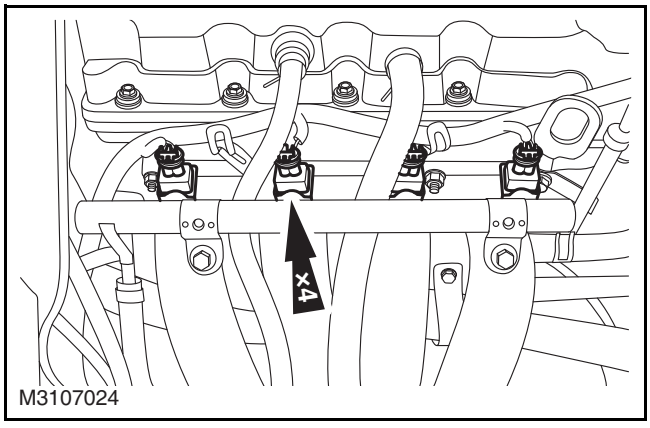
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Release the fuel system pressure.

   **Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**

3. Turn over the driver side seat.
4. Remove the fuel main pipe.

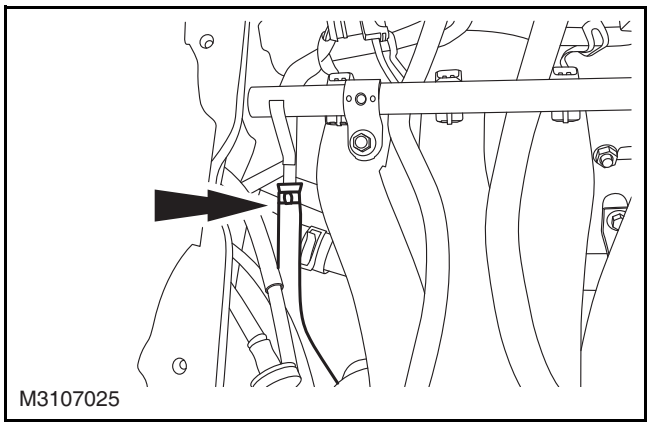
   1 Disconnect 4 fuel injector wiring harness connectors in sequence.



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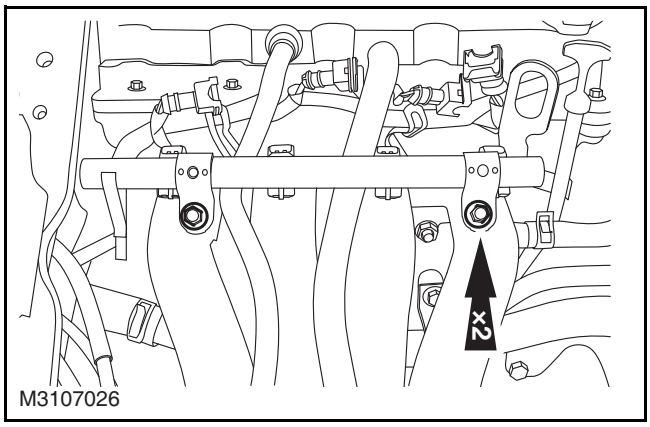


2 Loosen the hoop, disconnect fuel pipe joint.




3 Remove the fuel main pipe retaining bolts and then remove the fuel main pipe.

Torque: 23 ± 2 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect and confirm that fuel pipe joint is securely inserted into the pipe.**

**CAUTION: Turn the ignition switch to "ON" (do not start engine) to apply fuel pressure to fuel supply system, and then inspect the connecting part for leakage.**

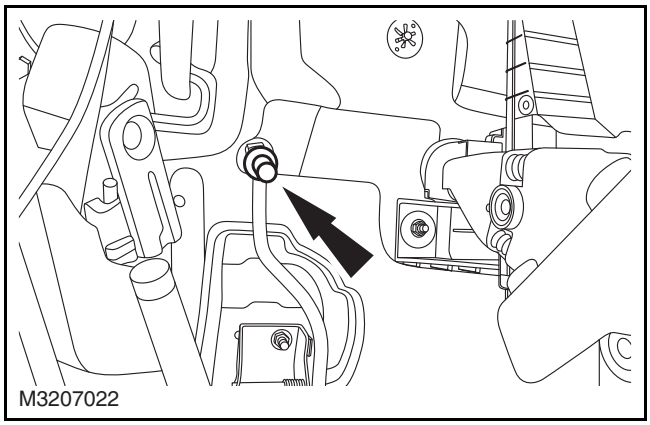
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# Accelerator Pedal Assembly

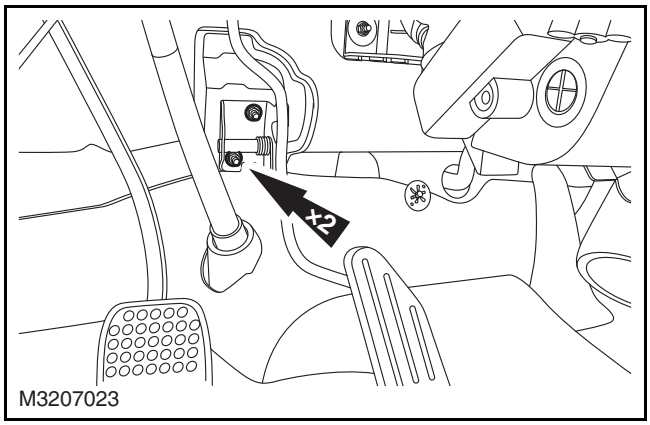
## Removal

1. Pull the accelerator cable, and then separate accelerator cable and accelerator pedal assembly.


M3207022

2. Remove 2 retaining bolts from accelerator pedal assembly and then remove the accelerator pedal assembly.

   Torque: 10 ± 1 Nm



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## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Component Specifications

| Item | Specifications |
|---|---|
| Spark plug type | DK7RTC |
| Spark plug clearance | 0.7 ~ 0.8 mm |
| Ignition coil primary resistance | 0.756 ~ 0.924 Ω at 20°C |
| Ignition coil secondary resistance | 8.01 ~ 9.79 KΩ at 20°C |

# General Specifications

| Item | Specifications |
|---|---|
| Ignition type | Double-cylinder simultaneously ignition |
| Ignition sequence | 1 - 3 - 4 - 2 |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Spark plug | 20 ~ 25 | 15 ~ 18 | - |

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## Description and Operation

# System Overview

Engine adopts DLI distributorless double-cylinder ignition system, and 1-4 cylinder and 2-3 cylinder share a ignition coil respectively. System components mainly include the ECM (M7 Electronic Control System), two ignition coils, high-voltage damping line, spark plug, crankshaft position sensor, camshaft position sensor, knock sensor, etc.

When ECM controls the ignition coil to start igniting, the two cylinders are ignited simultaneously, and one is in compression stroke while the other is in exhaust stroke. The cylinder in exhaust stroke requires very little energy to breakdown the spark plug clearance due to its low cylinder pressure and high temperature. The cylinder in compression stroke requires more energy to breakdown the spark plug clearance due to its high cylinder pressure, high density mixture and low temperature. The cylinder in compression stroke will consume most of the ignition energy if the 2 cylinders are ignited simultaneously.

# Components Description

## Crankshaft Position Sensor

Crankshaft position sensor is electromagnetic induction type.

**Refer to: (3.1.12 Electronic Control System - M7, Description and Operation).**

## Knock Sensor

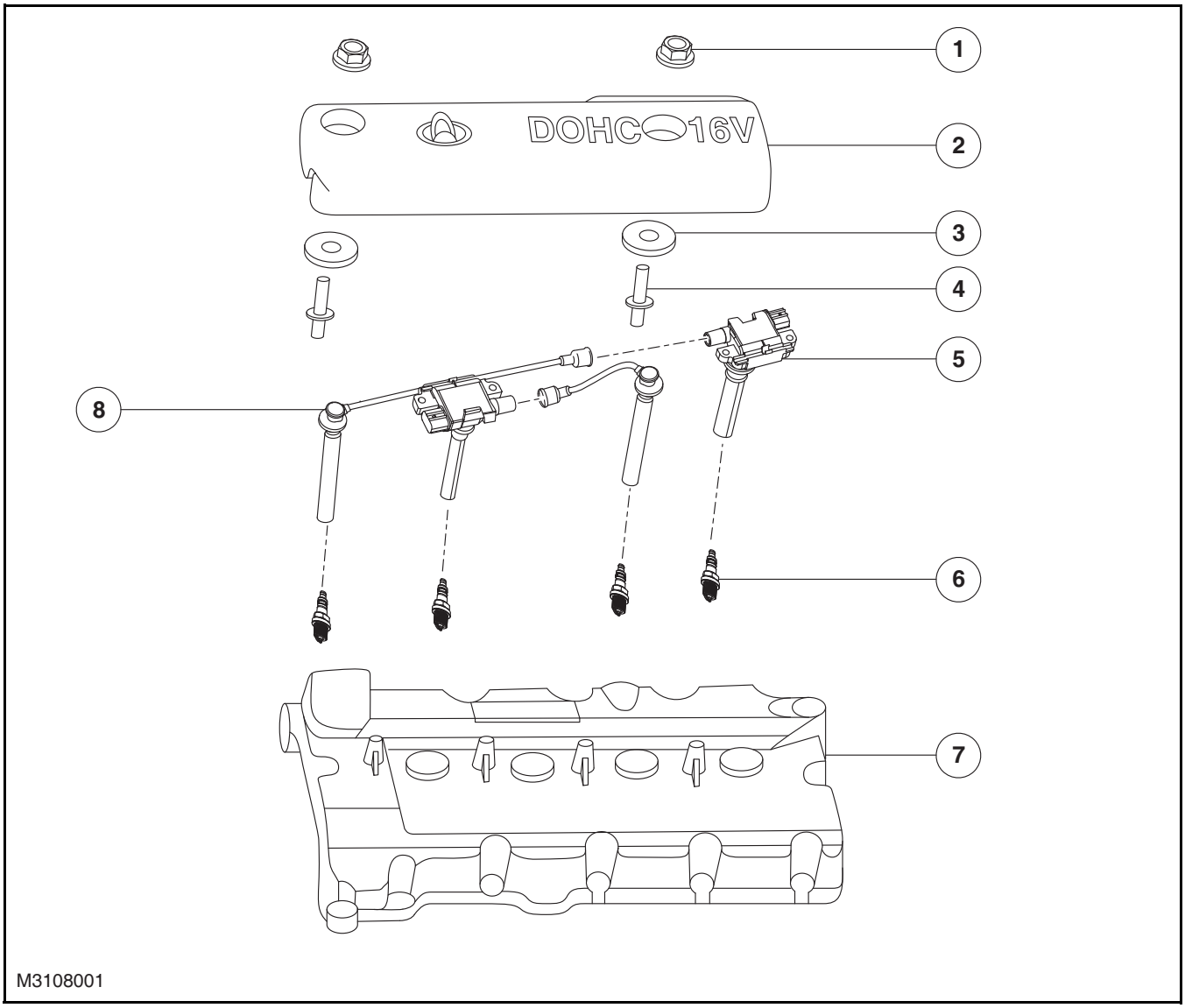
Knock sensor is piezoelectric type. Voltage signal will be generated and sent to ECM in case of knock.

**Refer to: (3.1.12 Electronic Control System - M7, Description and Operation).**

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# Components Exploded View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Hexagon flange nut | 5 | Ignition coil assembly |
| 2 | Engine trim cover | 6 | Spark plug assembly |
| 3 | Washer | 7 | Cylinder head cover assembly |
| 4 | Trim cover stud bolt | 8 | 4-cylinder high-voltage damping line |

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## General Inspection

### General Equipment

| |
|---|
| Multimeter |
| Feeler gauge |

## Ignition Spark Test

**WARNING: Directly use the high-voltage cable to test flash over may result in personal injury and module damage. Do not use high-voltage cable directly to test the ignition spark.**

**WARNING: The temperature of a working engine is very high. When operating on an engine that stops for a short while, pay attention to avoid scalding.**

1. When the transmission shift lever is at "Neutral", apply hand brake.
2. Turn the ignition switch to "LOCK", and disconnect the fuel injector wiring harness connector.

**WARNING: Fire may be caused without disconnecting the fuel injector.**

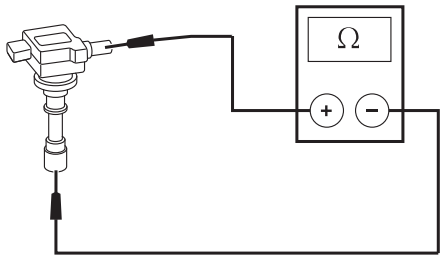
3. Disconnect the high-voltage cable and remove the spark plug.
4. Connect the high-voltage cable to spark plug, and ground the spark plug at reliable ground point of engine.
5. Start the engine and observe the spark state of spark plug.
6. Stop the engine, and turn the ignition switch to "LOCK".
7. Install the spark plug and high-voltage damping line.
8. Connect the fuel injector wiring harness connector.

## Ignition Coil Test

1. Turn the ignition switch to "LOCK".
2. Disconnect the ignition coil wiring harness connector.
3. Use a digital multimeter to measure the resistance between each terminal of ignition coil.

| Multimeter Probe | | |
|---|---|---|
| Positive terminal | Negative terminal | **8.01 ~ 9.79 kΩ** |

4. Connect the ignition coil connector.




M3108002

## High-voltage Cable Test

1. Turn the ignition switch to "LOCK".
2. Disconnect the high-voltage damping line.
3. Use a multimeter to measure the high-voltage cable resistance.

| High-voltage Cable | Length (mm) | Resistance (kΩ) |
|---|---|---|
| 1st cylinder | 30 | 0.65 ~ 1.7 |
| 3rd cylinder | 265 | 1.3 ~ 3.35 |

4. Install the high-voltage cable.

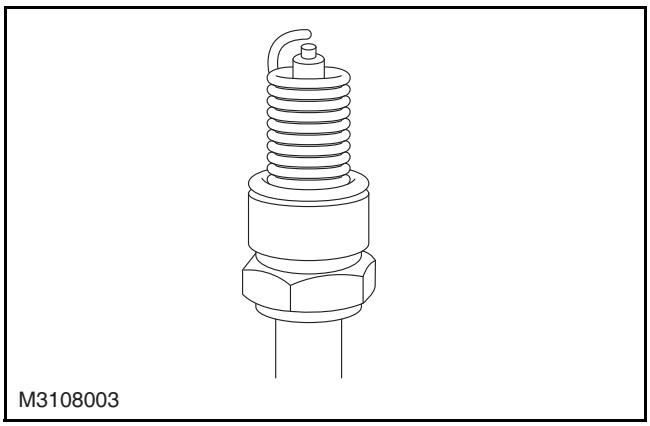
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# Spark Plug Test

1. Inspect the appearance of the spark plug.
   - Electrode wear
   - Carbon deposit
   - Electrode damage
   - Insulator damage
2. Measure the spark plug electrode clearance.

   **Standard: 0.7 ~ 0.8 mm**


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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |
| Feeler gauge |
| Ignition timing lamp |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, solve the fault before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Electrical |
|---|
| • Circuit |
| • Wiring harness |
| • Electrical connector |
| • Spark plug |
| • Ignition coil |
| • Engine control module (ECM) |

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## Symptom Chart

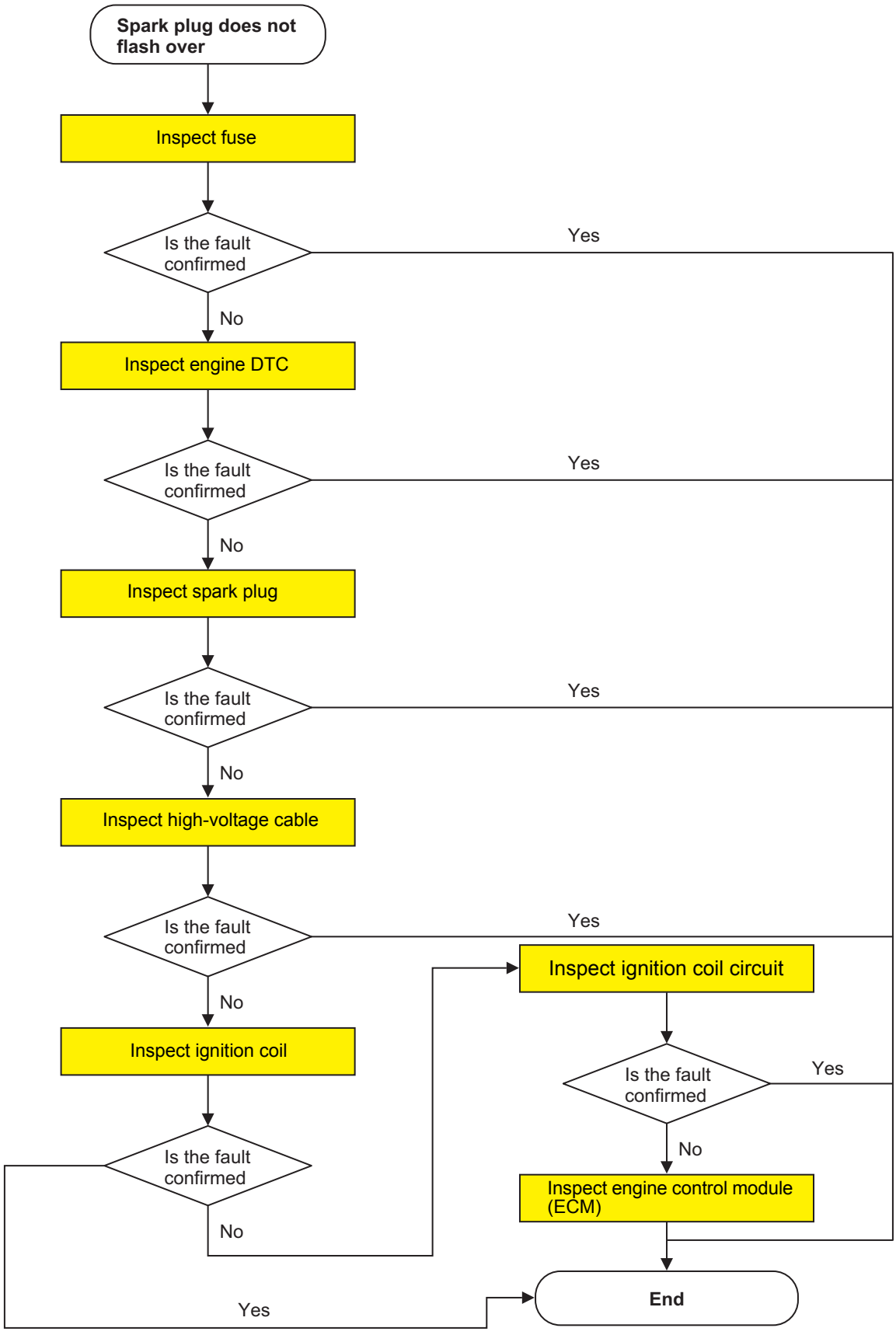
If the fault occurs, but there is no DTC stored in the ECM for this fault, and cannot confirm the cause by basic inspection, diagnose and repair it in order listed in the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Spark plug does not flash over | • Crankshaft position sensor spark plug<br>• Spark plug<br>• High-voltage cable<br>• Ignition coil<br>• ECM<br>• Circuit | • Diagnosis Procedure for Spark Plug does not Flash Over<br>**Refer to: Diagnosis Procedure for Spark Plug does not Flash Over (3.1.8 Ignition System, Symptom Diagnosis and Testing).** |
| Engine stumbling | • Spark plug<br>• High-voltage cable<br>• Ignition coil<br>• Engine | • Perform spark plug test procedure<br>**Refer to: Spark Plug Test (3.1.8 Ignition System, General Inspection).**<br>• Perform high-voltage cable test procedure<br>**Refer to: High-voltage Cable Test (3.1.8 Ignition System, General Inspection).**<br>• Perform ignition coil test procedure<br>**Refer to: Ignition Coil Test (3.1.8 Ignition System, General Inspection).** |
| Insufficient engine power | • Spark plug<br>• High-voltage cable<br>• Ignition coil<br>• Engine | **Refer to: Diagnosis Procedure for Insufficient Engine Power (3.1.8 Ignition System, Symptom Diagnosis and Testing).** |

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# Diagnosis Procedure for Spark Plug does not Flash Over



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect fuse | |
| | A. Inspect the fuse of fuse box IF15.<br>Is the fuse normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Inspect and repair the fuse circuit, replace the fuse. |
| 2. Inspect engine DTC | |
| | A. Connect the diagnostic tool.<br>B. Diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>**Refer to: (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Perform spark plug test procedure.<br>**Refer to: Spark Plug Test (3.1.8 Ignition System, General Inspection).**<br>Is the spark plug normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the spark plug. |
| 4. Inspect high-voltage cable | |
| | A. Remove the high-voltage cable.<br>B. Perform high-voltage cable test procedure.<br>**Refer to: High-voltage Cable Test (3.1.8 Ignition System, General Inspection).**<br>Is the high-voltage cable normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the high-voltage cable. |

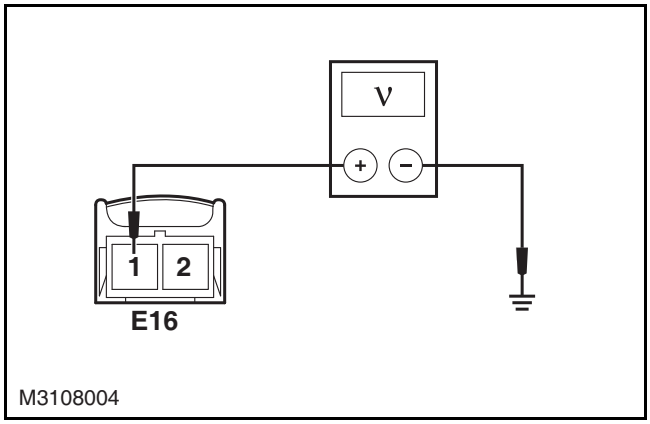
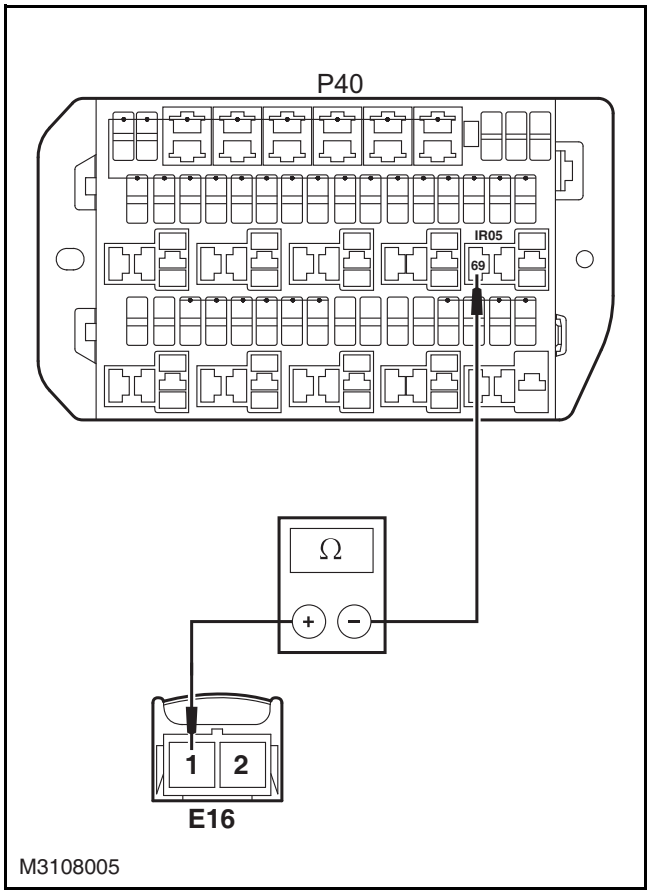
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect ignition coil | |
| | A. Perform ignition coil test procedure.<br>**Refer to: Ignition Coil Test (3.1.8 Ignition System, General Inspection).**<br>Is the ignition coil normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the ignition coil. |

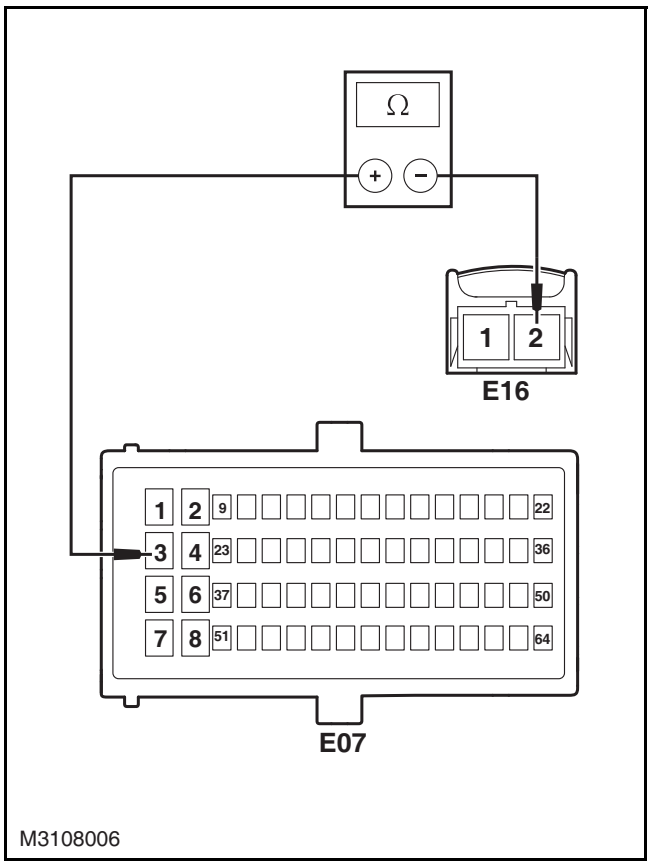
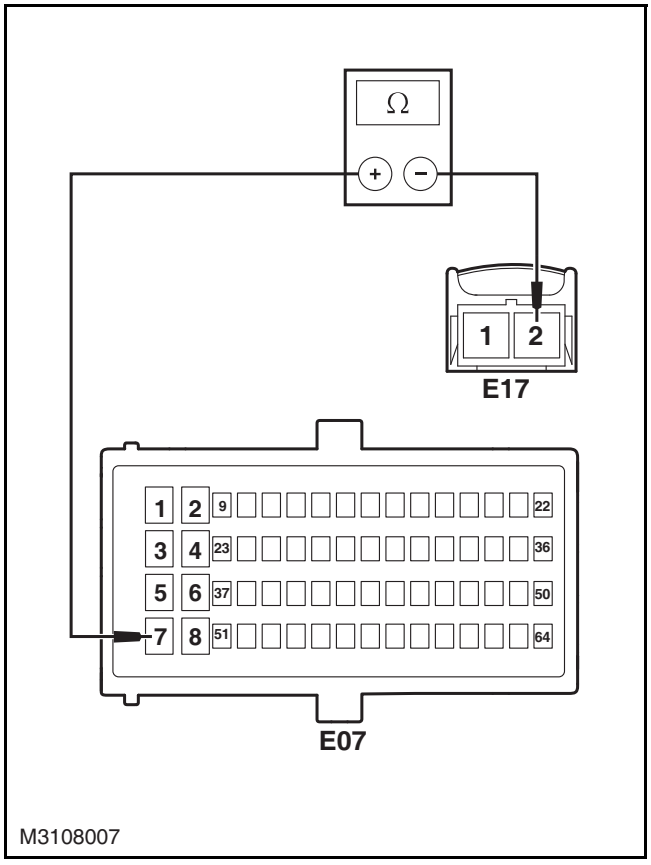
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect ignition coil circuit | |
|  M3108004 | A. Disconnect the ignition circuit wiring harness connector.<br>B. Turn the ignition switch to "ON".<br>C. Use a multimeter to measure the voltage between terminal 1 of ignition coil wiring harness connector E16 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>D. Turn the ignition switch to "LOCK".<br>E. Disconnect the ignition coil wiring harness connector E16, and E17.<br>F. Measure the resistance between terminal 1 of ignition coil wiring harness connector E16 and terminal 69 of the fuse IR05 in instrument panel fuse box P40.<br>Measure the resistance between terminal 1 of ignition coil wiring harness connector E17 and terminal 69 of the fuse IR05 in instrument panel fuse box P40.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Repair the circuit between terminal 1 of ignition coil wiring harness connector E16 and terminal 69 of the fuse IR05 in instrument panel fuse box P40, and the circuit between terminal 1 of ignition coil wiring harness connector E17 and terminal 69 of the fuse IF05 in instrument panel fuse box P40, and test if the system works normally. |
|  M3108005 | |

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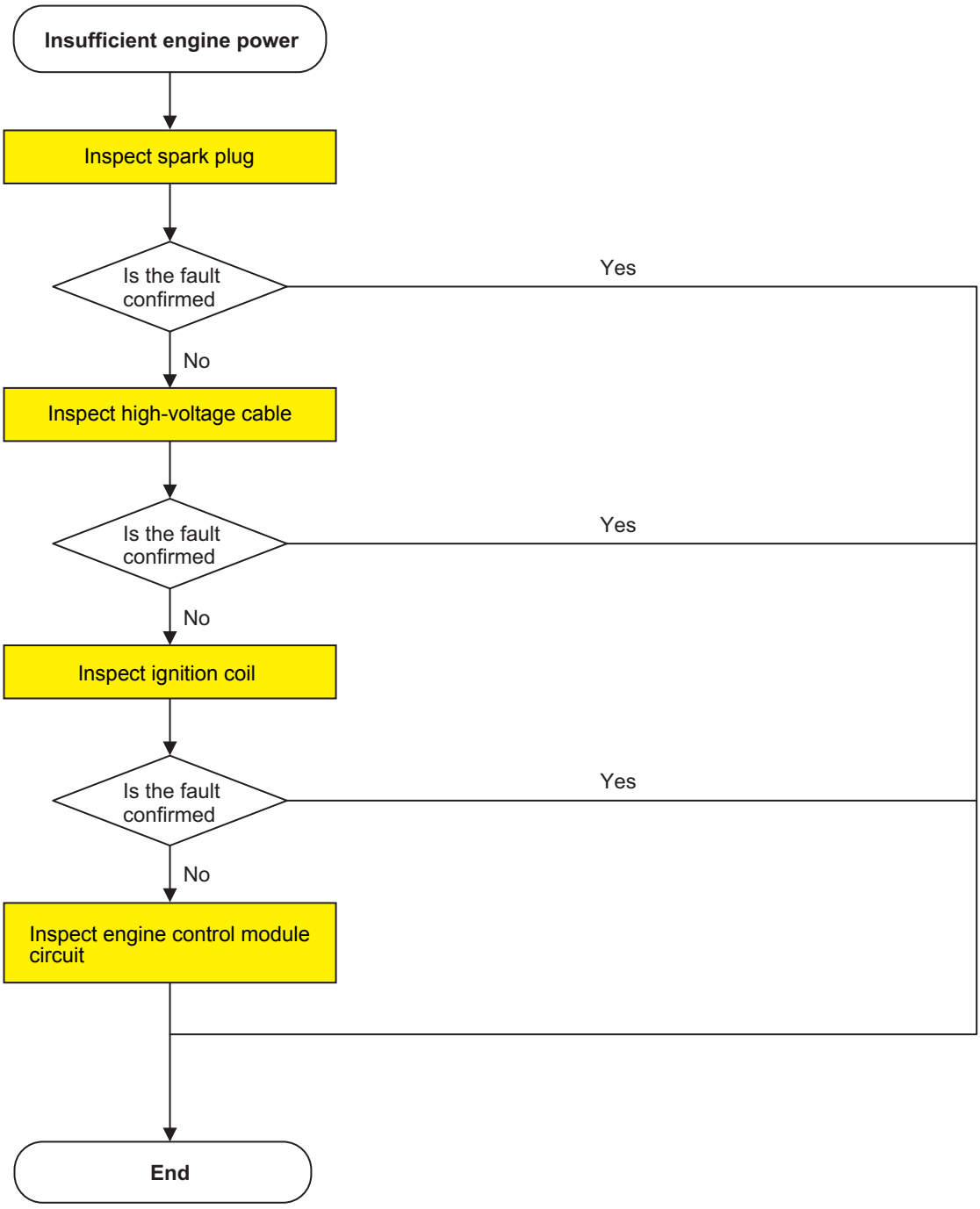
| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module (ECM) | |
|  <br>M3108006 | A. Install the engine control module (ECM) on faulty vehicle to a normal vehicle.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>Does the vehicle start normally?<br>**Yes**<br>Repair the circuit between terminal 2 of ignition coil wiring harness connector E16 and terminal 3 of engine control module wiring harness connector E07, and the circuit between terminal 2 of ignition coil wiring harness connector E17 and terminal 7 of the engine control module wiring harness connector E07, and test if the system works normally.<br>**No**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).** |
|  <br>M3108007 | |

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# Diagnosis Procedure for Insufficient Engine Power

Verify that the engine cylinder pressure is normal, ignition timing mark is correct, and no mechanical damages of engine. Otherwise, repair the fault part first.



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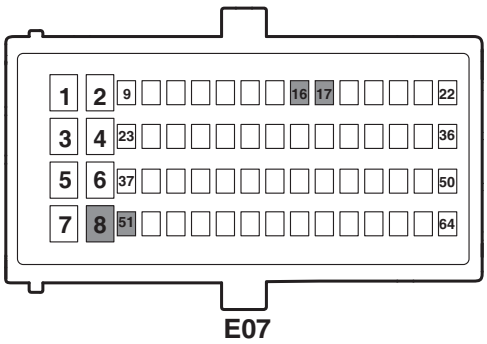


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect spark plug | |
| | A. Perform spark plug test procedure.<br>**Refer to: Spark Plug Test (3.1.8 Ignition System, General Inspection).**<br>Is the spark plug normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the spark plug. |
| 2. Inspect high-voltage cable | |
| | A. Remove the high-voltage cable.<br>B. Perform high-voltage cable test procedure.<br>**Refer to: High-voltage Cable Test (3.1.8 Ignition System, General Inspection).**<br>Is the high-voltage cable normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the high-voltage damping line. |
| 3. Inspect ignition coil | |
| | A. Perform ignition coil test procedure.<br>**Refer to: Ignition Coil Test (3.1.8 Ignition System, General Inspection).**<br>Is the ignition coil normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the ignition coil.<br>**Refer to: Ignition Coil (3.1.8 Ignition System, Removal and Installation).** |

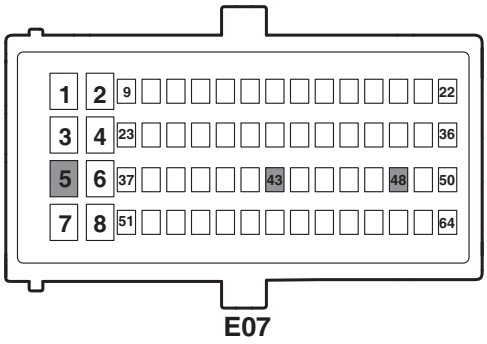
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4. Inspect engine control module circuit




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M3108009

A. Turn the ignition switch to "LOCK".

B. Disconnect the ECM wiring harness connector E07.

C. Connect the terminal 32 of ECM wiring harness connector E07 and grounding securely.

D. Turn the ignition switch to "ON", inspect if power supply of terminal 8, 16, 17 and 51 is normal.

E. Turn the ignition switch to "LOCK", inspect if grounding of engine control module terminal 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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## Removal and Installation

# Ignition Coil

### Removal

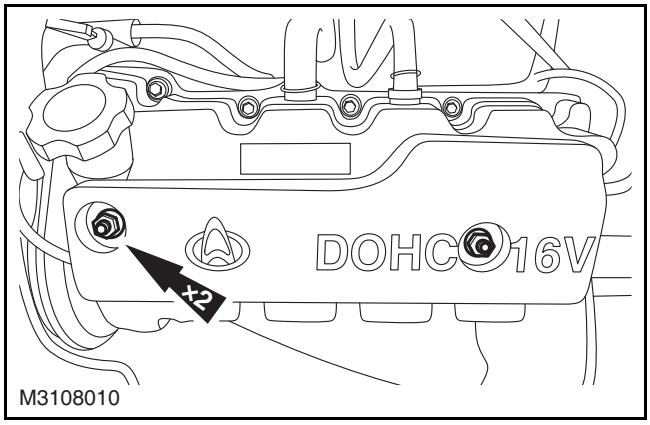
1. Disconnect the negative battery cable.

   **Refer to: Battery Inspection (3.1.10 Charging System, General Inspection).**

2. Remove the engine trim cover.

   1 Remove 2 retaining nuts from the engine trim cover.

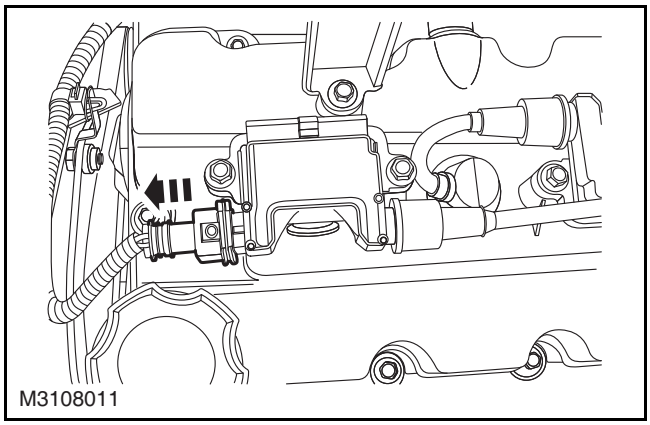
   Torque: 10 ± 1 Nm



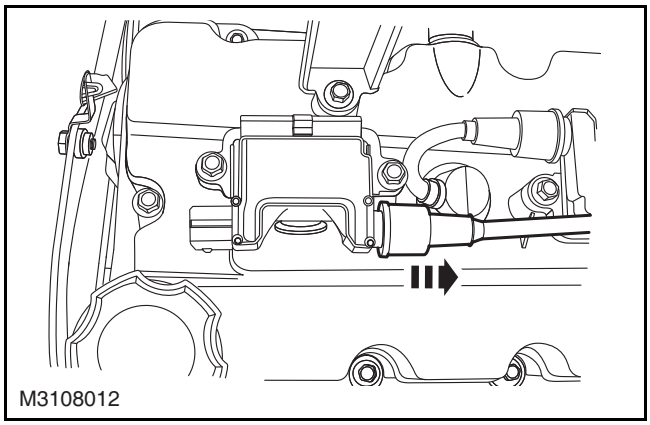
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   2 Remove the engine trim cover and washer.

3. Disconnect the ignition coil wiring harness connector.


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4. Disconnect the high-voltage damping line from the ignition coil.

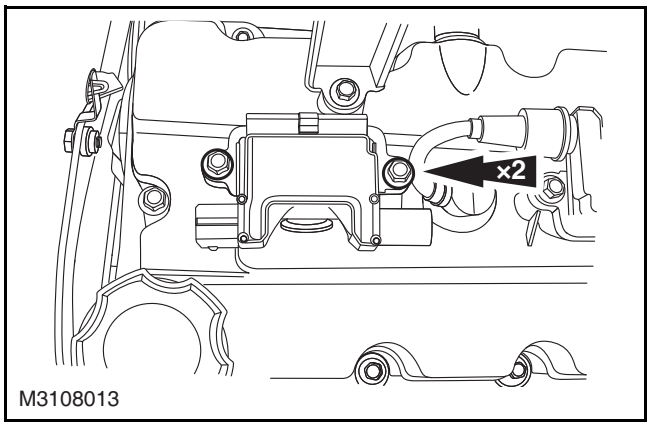

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**5.** Remove the ignition coil retaining bolts.

Torque: 10 ± 1 Nm




**6.** Pull out the ignition coil.

## Installation

**1.** Installation is in the reverse order of removal.

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# High-voltage Damping Line

## Removal

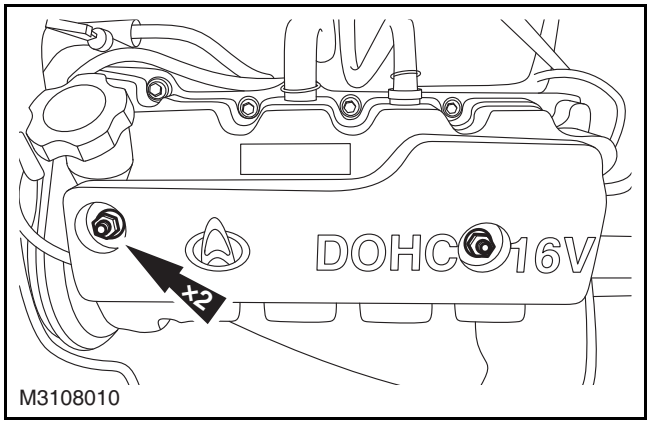
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect the ignition coil wiring harness connector.

   1 Remove 2 retaining nuts from the engine trim cover.

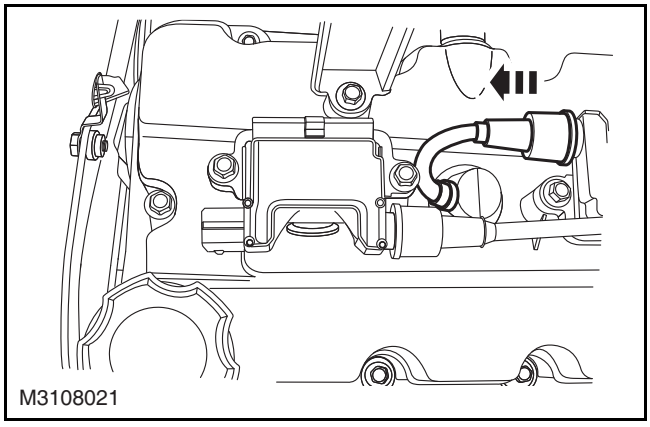
   Torque: 10 ± 1 Nm



M3108010

   2 Remove the engine trim cover and washer.

3. Disconnect the ignition coil wiring harness connector.
4. Disconnect the high-voltage damping line from the ignition coil.
5. Pull out the high-voltage damping line.


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## Installation

1. Installation is in the reverse order of removal.

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# Spark Plug

## Removal

1. Remove the ignition coil.

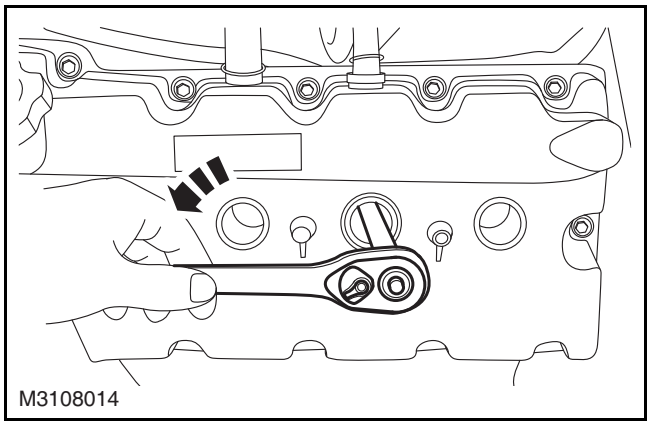
   **Refer to: Ignition Coil (3.1.8 Ignition System, Removal and Installation).**

2. Remove the high-voltage damping line.

   **Refer to: High-voltage Damping Line (3.1.8 Ignition System, Removal and Installation).**

3. Use spark plug remover to remove 4 spark plugs in sequence.

   Torque: 20 ~ 25 Nm


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## Installation

**CAUTION: The joint surface of spark plug and mounting hole must be absolutely free of foreign matter.**

1. Installation is in the reverse order of removal.

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# Ignition Switch

## Removal

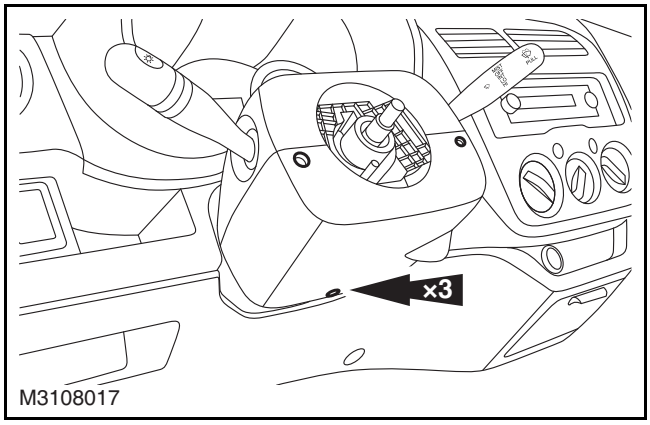
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the steering wheel.

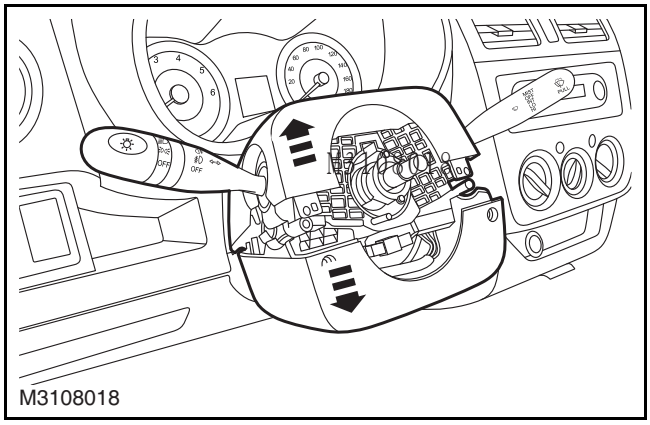
   **Refer to: Steering Wheel (2.4.3 Steering Column, Removal and Installation).**

3. Remove 3 retaining screws from the steering lock upper and lower housings.

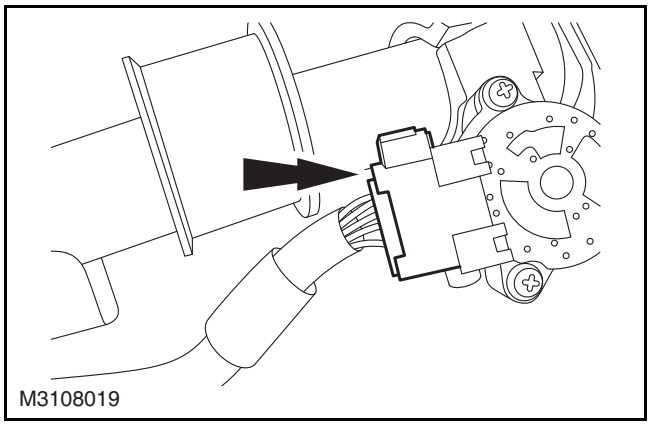


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4. Separate the upper and lower housings of steering lock.


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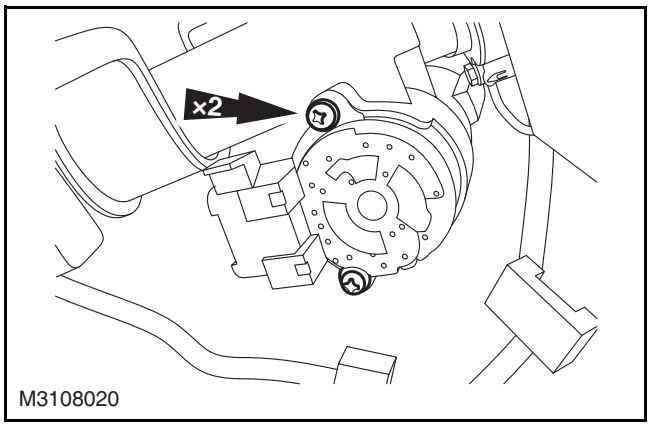
5. Disconnect the ignition switch wiring harness connector.


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6. Remove 2 retaining screws from the ignition switch.




## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Starter motor retaining bolt | 32 ± 2 | - | - |
| Heat insulator retaining bolt | 10 ± 1 | - | - |
| Starting motor magnetic switch wiring harness retaining nut | 7 ± 1 | - | - |

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## Description and Operation

# System Overview

Starting system mainly includes battery, ignition switch, starting motor, starting relay and related circuit, and all the components are connected by wiring harness. When the ignition switch is at "ST", power is supplied to starting motor magnetic switch, and magnetic switch coil generates a magnetic field to move the plunger and the gear drive lever to engage the engine flywheel ring gear with pinion gear. Magnetic switch contact is closed to start the engine.

When the engine starts, the pinion gear overdrive clutch protects the armature to avoid that flywheel drives the pinion gear and armature until the switch is off, then the return spring to disengage the pinion.

# Components Description

## Starting Motor

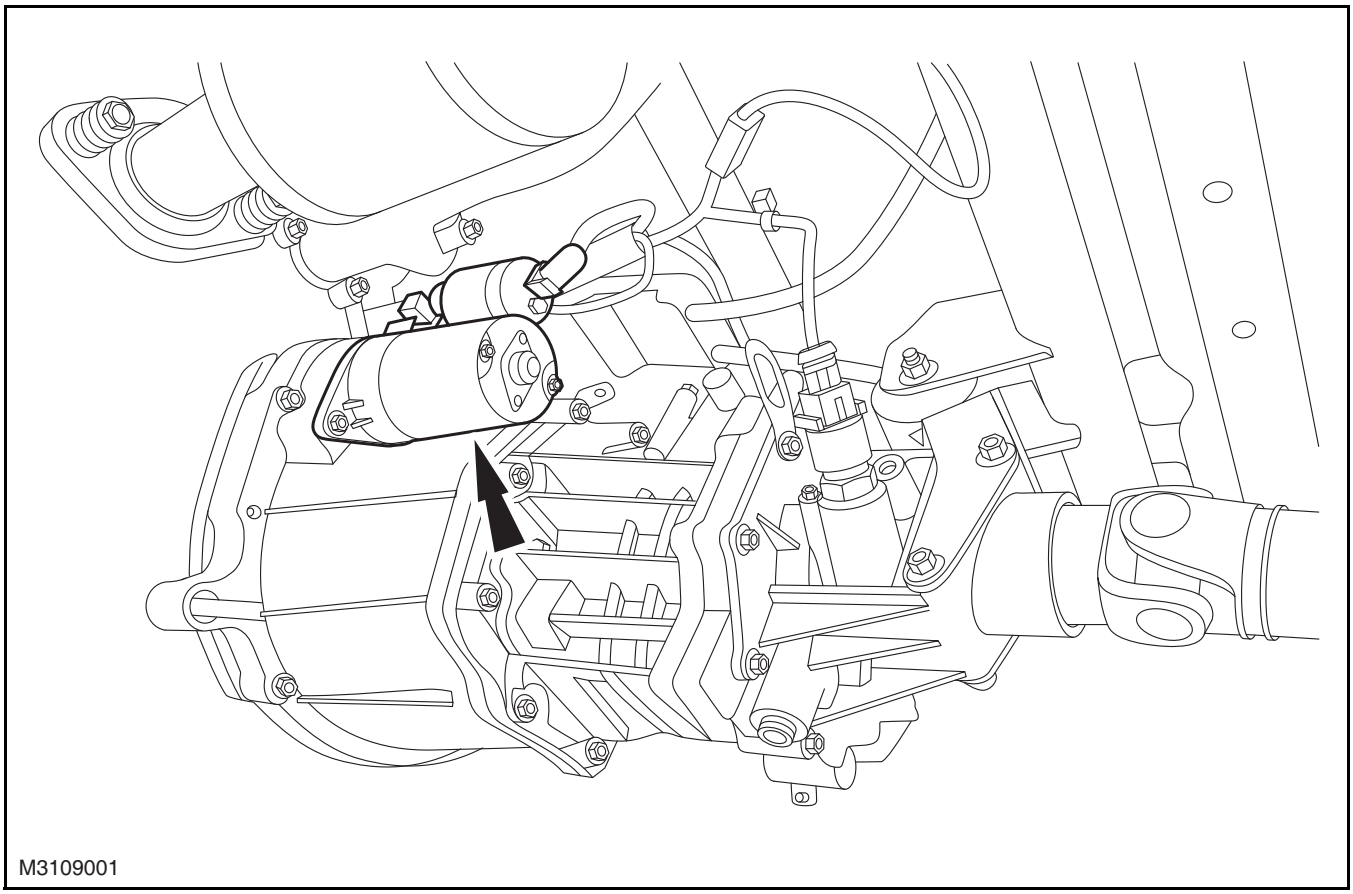
Starter motor includes the stator assembly, armature assembly, overdrive clutch assembly, magnetic switch assembly, front/rear cover, brush holder and drive lever. The starting motor is a direct drive type, which use the armature shaft pinion gear to transmit power to the flywheel directly.

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# Components Location View

## Starting Motor

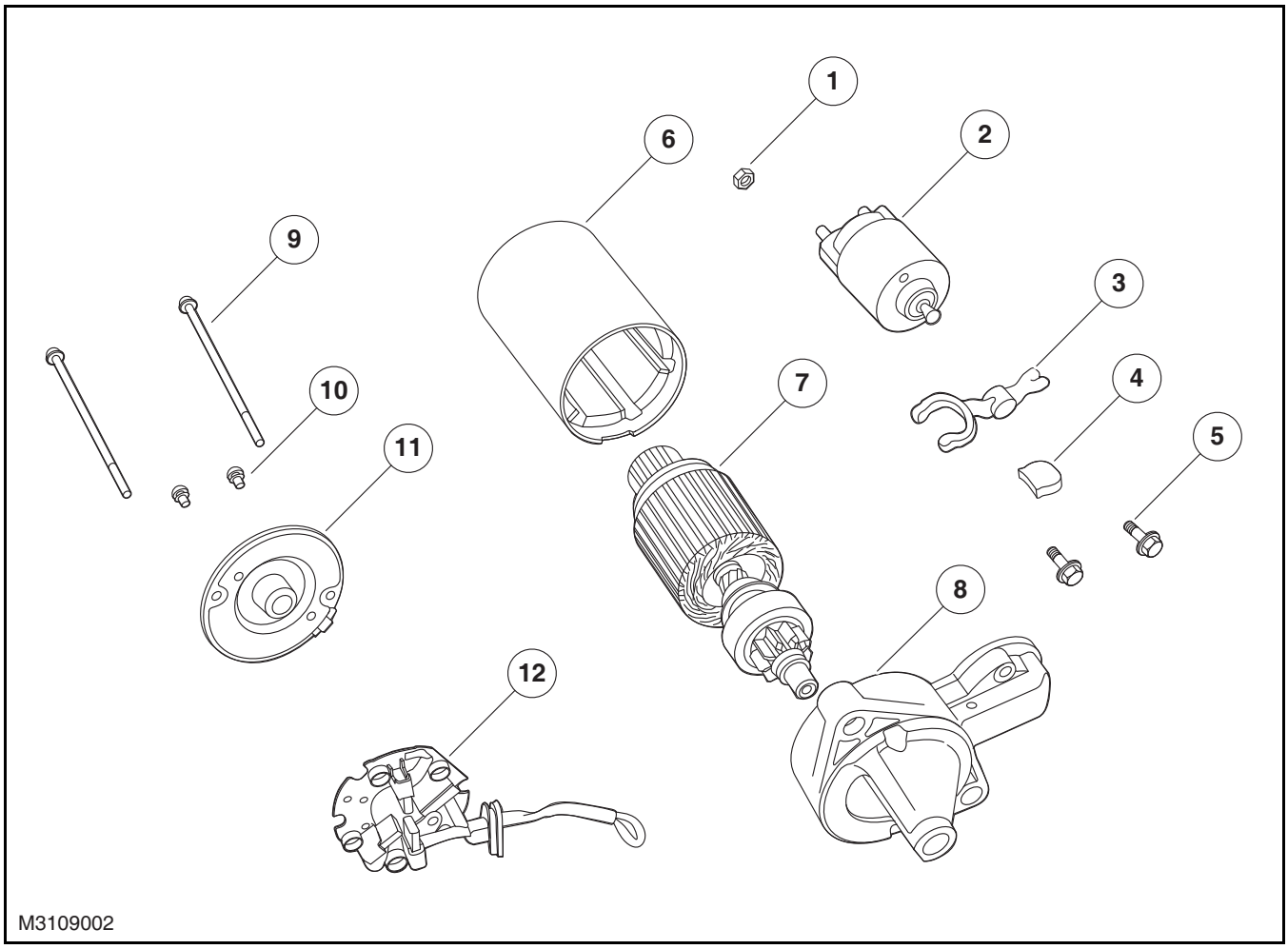


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# Components Exploded View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Nut | 7 | Armature |
| 2 | Magnetic switch | 8 | Housing |
| 3 | Fork | 9 | Bolt |
| 4 | Separation blade | 10 | Screw |
| 5 | Screw | 11 | Rear cover |
| 6 | Stator | 12 | Electrical brake assembly |

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## General Inspection

### General Equipment

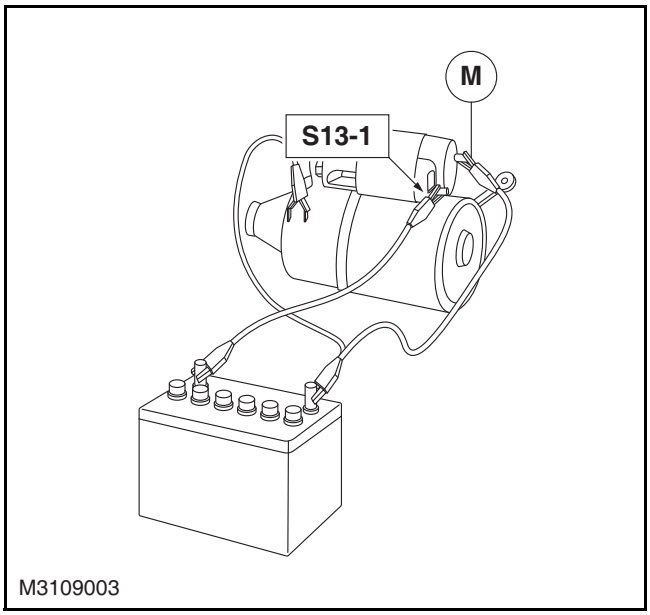
| |
|---|
| Multimeter |

**WARNING: Each test must be completed within 3 ~ 5 s to avoid coil burnout.**

## Magnetic Switch Testing

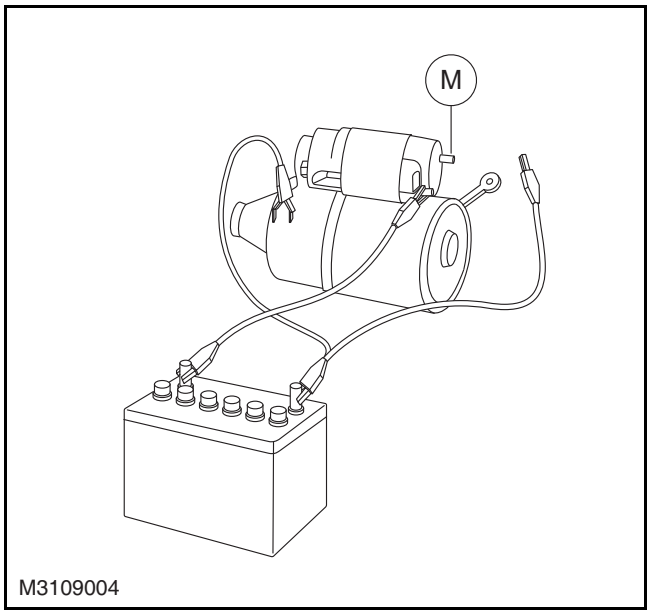
**CAUTION: Before testing, disconnect the field coils from terminal "M".**

1. Remove the starting motor armature wiring harness from the magnetic switch.
2. Use a jumper wire to connect the starting motor housing and magnetic switch housing to the battery negative reliably.
3. Connect one end of another jumper wire to the battery positive and the other end to the terminal 1 of starting motor wiring harness connector S13.
4. Starting motor pinion should move out.
5. Remove the "M" terminal negative cable, and starting motor pinion should not return to the original place.



M3109003

6. As mentioned above, connect the cable and pinion moves outward, then remove the "M" terminal negative wire, inspect whether the pinion moves outward, otherwise, replace the magnetic switch.



M3109004

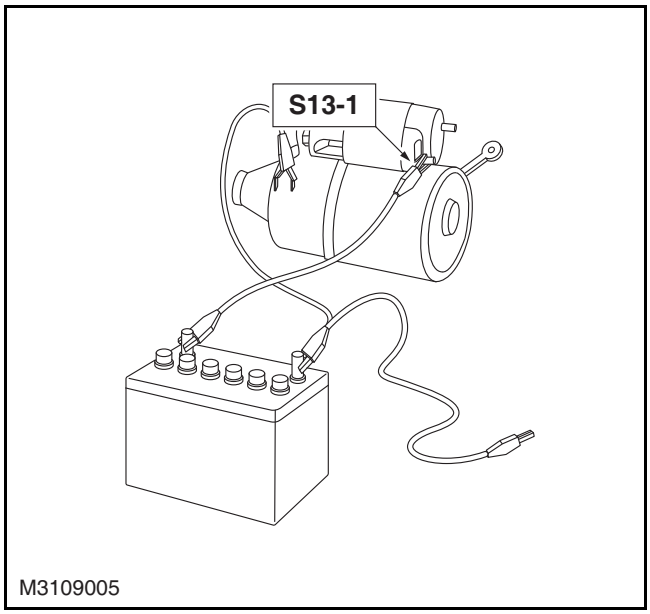
## Pinion Return Test

1. Use a jumper wire to connect the starting motor housing and magnetic switch housing to the battery negative reliably.
2. Connect one end of another jumper wire to the battery positive and the other end to the terminal 1 of starting motor wiring harness connector S13.
3. Starting motor pinion should move out.

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4. Disconnect the jumper wire from the positive battery, and the pinion should quickly return.



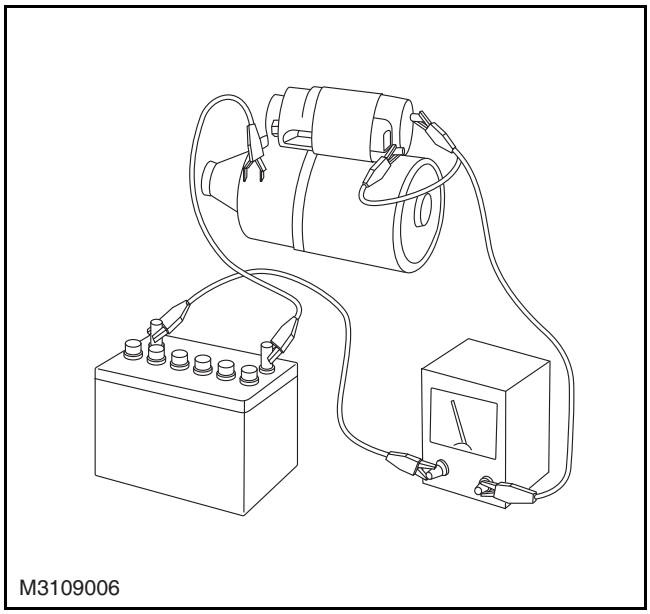
M3109005

## Test without Load

1. Ensure the battery is fully charged.
2. Connect the starting motor, battery and tester as shown in the figure.
3. Start the starting motor and confirm that it is rotates smoothly.

If the starting motor does not rotate smoothly, inspect starting motor device.

4. When the starting motor operates, measure voltage and current.
5. If either of them is not within the specified range, replace the starting motor.


M3109006

| Item | Specifications |
|---|---|
| Current without load | A |
| Voltage drop without load | V |

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Starting motor | • Fuse<br>• Battery<br>• Wiring harness<br>• Connectors loose or corroded |

3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

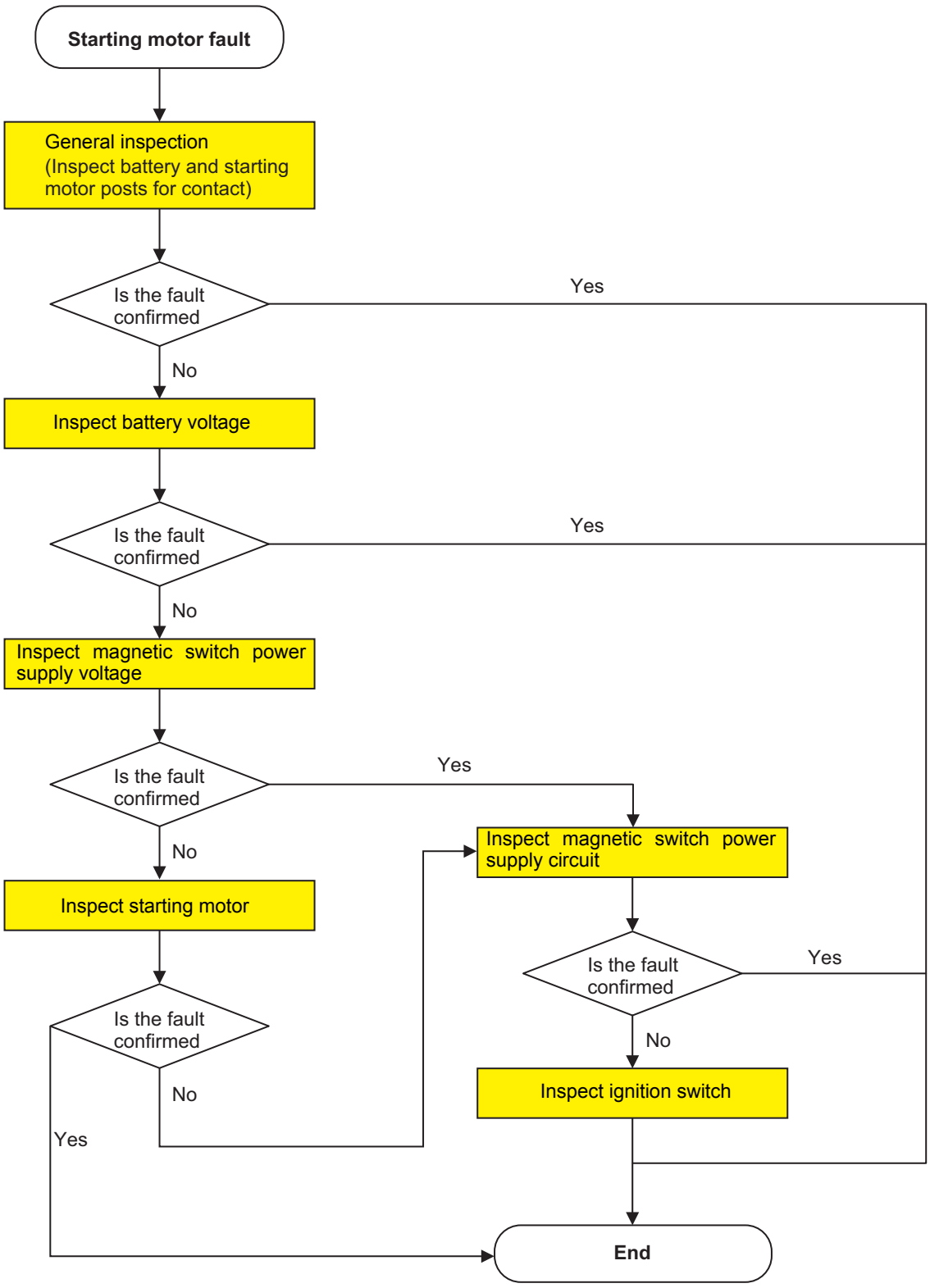
If the fault occurs, but there is no DTC stored in ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Starting motor does not operate | • Battery<br>• Return circuit<br>• Starting motor<br>• Ignition switch | • Diagnosis procedure for starting motor fault.<br>**Refer to: Diagnosis Procedure for Starting Motor Fault (3.1.9 Starting System, Symptom Diagnosis and Testing).** |
| Starting motor fails to stop | • Ignition switch<br>• Starting motor | • Diagnosis procedure for starting motor fails to stop.<br>**Refer to: Diagnosis Procedure for Starting Motor Fails to Stop (3.1.9 Starting System, Symptom Diagnosis and Testing).** |
| Starting motor runs slowly | • Battery<br>• Return circuit<br>• Starting motor | • Diagnosis procedure for starting motor slow run.<br>**Refer to: Diagnosis Procedure for Starting Motor Slow Run (3.1.9 Starting System, Symptom Diagnosis and Testing).** |
| Starting motor rotates but engine does not run | • Starting motor<br>• Flywheel ring gear | • Inspect flywheel ring gear for tooth missing.<br>• Inspect whether the starting motor is correctly secured. If the problem continues, install a new starting motor.<br>**Refer to: Starting Motor (3.1.9 Starting System, Removal and Installation).** |
| Starting motor abnormal noise | • Starting motor<br>• Flywheel ring gear | • Inspect the flywheel ring gear.<br>• Inspect whether the starting motor is properly aligned or the housing is cracked. Ensure all the retaining bolts are well locked. If necessary, replace new starting motor or retaining bolts. |

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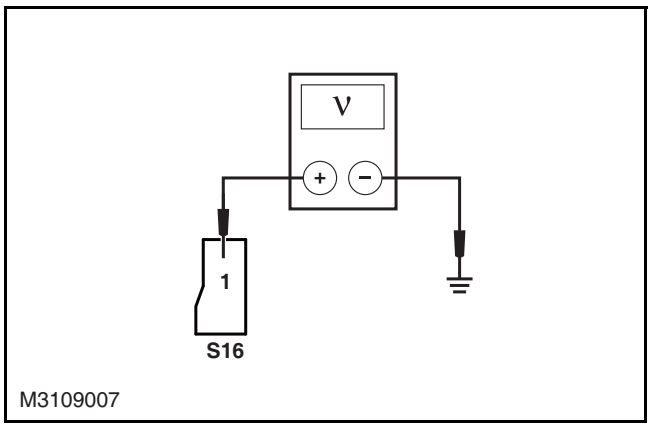


# Diagnosis Procedure for Starting Motor Fault



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect whether the battery positive & negative wiring harness connectors and positive & negative cables are damaged, oxidized, poorly contacted or loose.<br>B. Inspect whether the starting motor wiring harness connector and starting motor positive cable are damaged, oxidized, poorly contacted or loosen.<br>Is the inspection result normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect battery voltage | |
| | A. Inspect the battery starting voltage.<br>Is the starting voltage higher than 10.5 V?<br>**Yes**<br>Go to step 3.<br>**No**<br>Charge the battery.<br>**Refer to: Battery Charging (3.1.10 Charging System, General Inspection).**<br>Or replace with new battery.<br>**Refer to: Battery (3.1.10 Charging System, Removal and Installation).** |
| 3. Inspect magnetic switch power supply voltage | |
|  | A. Turn the ignition switch to "ST".<br>B. Measure the grounding voltage of terminal 1 of starting motor magnetic switch wiring harness connector S16.<br>Is the voltage higher than 10 V?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 5. |

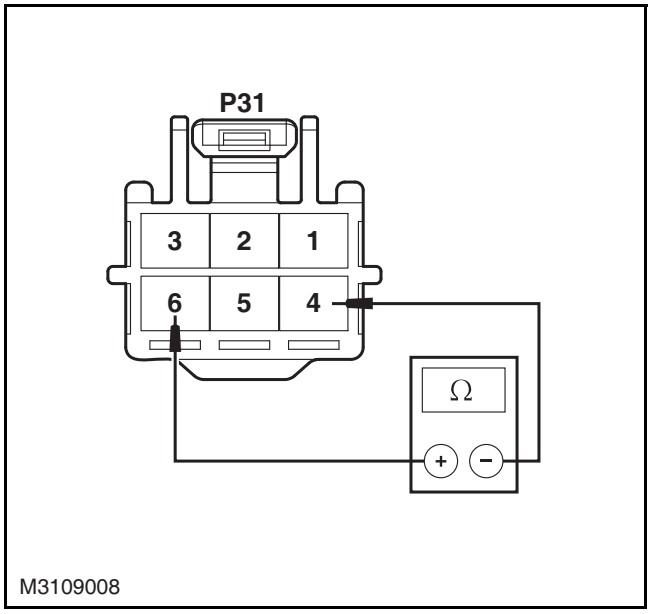
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect starting motor | |
| | A. Test the magnetic switch.<br>**Refer to: Magnetic Switch Testing (3.1.9 Starting System, General inspection).**<br>Is the starting motor testing normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the starting motor.<br>**Refer to: Starting Motor (3.1.9 Starting System, Removal and Installation).** |
| 5. Inspect magnetic switch power supply circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the ignition switch wiring harness connector P31.<br>C. Create a short circuit between terminal 6 of ignition switch wiring harness connector P31 and reliable power supply.<br>Is the starting motor normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of wiring harness connector P31 and terminal 1 of starting motor wiring harness connector S16. |

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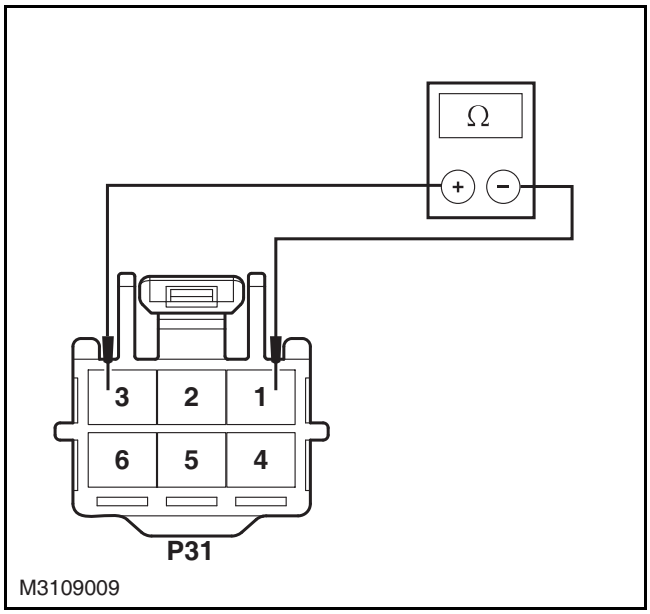
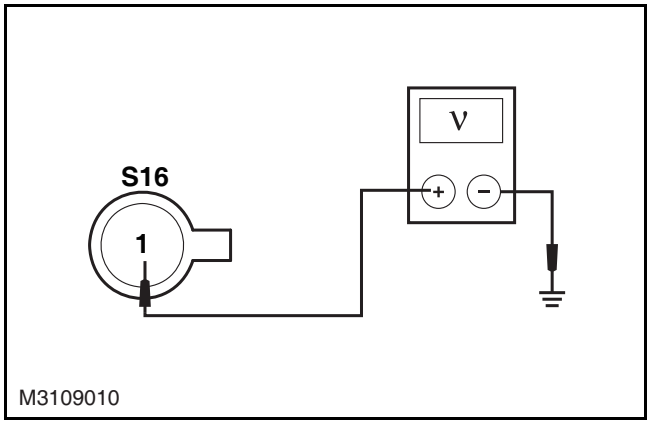


| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect ignition switch | |
|  <br>M3109008 | A. Disconnect the ignition switch connector.<br>B. Turn the ignition switch to "ST".<br>C. Measure the resistance between terminal 4 and terminal 6 of the ignition switch wiring harness connector P31.<br>Is the resistance value lower than 1 Ω?<br>**Yes**<br>Repair the high resistance faults in the following circuits.<br>• Circuit between terminal 1 of starting motor wiring harness connector S17 and terminal 1 of battery wiring harness connector S19.<br>• Circuit between terminal 1 of battery wiring harness connector S20 and grounding.<br>**No**<br>Replace the ignition switch. |

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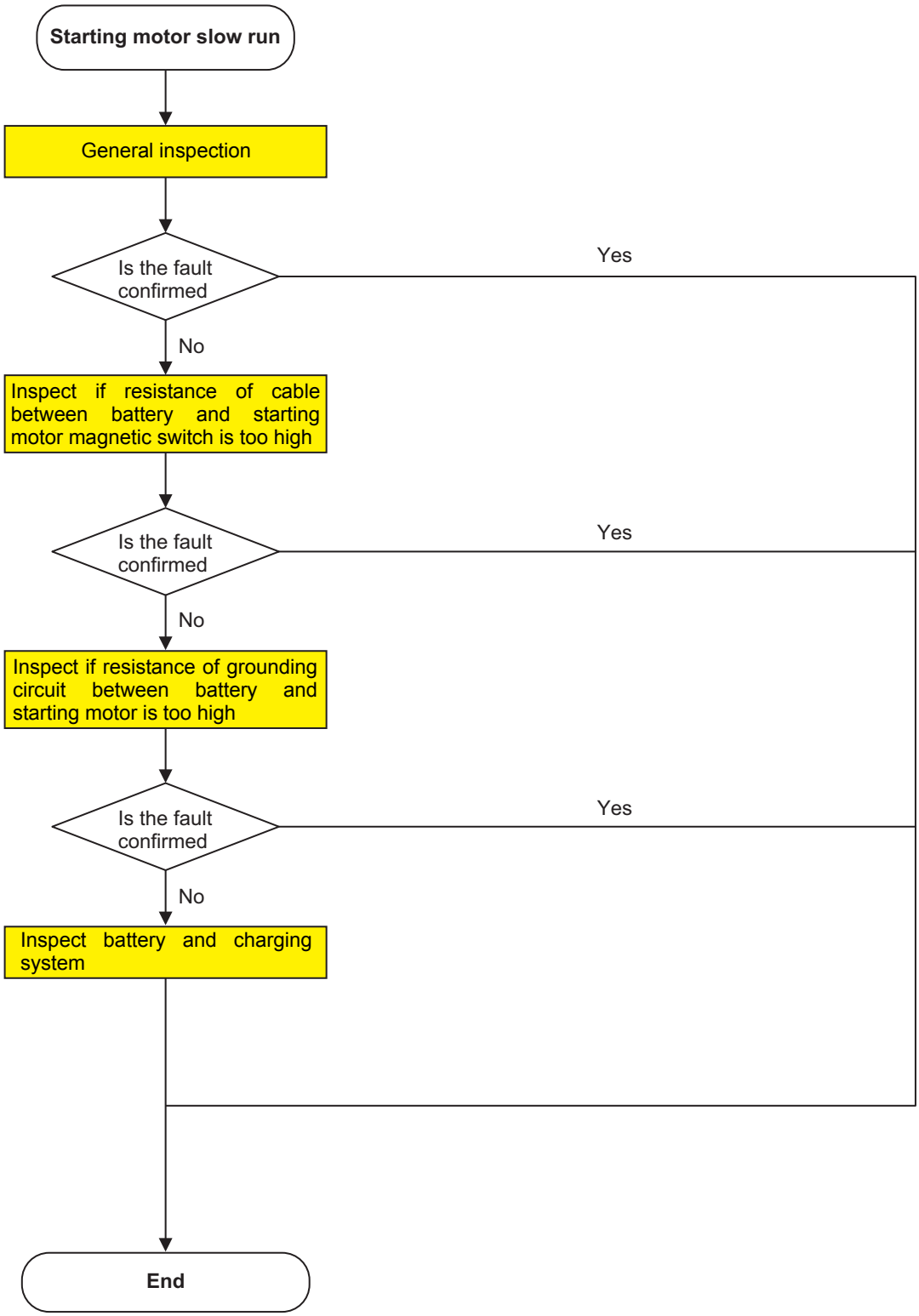
# Diagnosis Procedure for Starting Motor Fails to Stop

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect ignition switch | |
|  M3109009 | A. Disconnect the ignition switch connector.<br>B. Turn the ignition switch to "ACC".<br>C. Measure the resistance between terminal 1 and terminal 3 of the ignition switch wiring harness connector P31.<br>Is the resistance value lower than 1 Ω?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the ignition switch. |
| 2. Inspect if there is short to power supply in magnetic switch circuit | |
|  M3109010 | A. Disconnect the starting motor wiring harness connector S16.<br>B. Use multimeter to measure the voltage between terminal 1 of starting motor magnetic switch wiring harness connector S16 and reliable grounding.<br>**Standard voltage value: 0 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the starting motor.<br>**Refer to: Starting Motor (3.1.9 Starting System, Removal and Installation).**<br>**No**<br>Repair the power supply short circuit between terminal 6 of ignition switch wiring harness connector P31 and terminal 1 of starting motor wiring harness connector S16. |

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# Diagnosis Procedure for Starting Motor Slow Run



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect whether the battery positive & negative wiring harness connectors and positive & negative cables are damaged, oxidized, poorly contacted or loose.<br>B. Inspect whether the starting motor wiring harness connector and starting motor positive cable are damaged, oxidized, poorly contacted or loose.<br>Is the inspection result normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect if resistance of cable between battery and starting motor magnetic switch is too high | |
| | A. Turn the ignition switch to "OFF" to measure the resistance between starting motor housing and battery negative terminal.<br>Is the resistance value lower than 1 Ω?<br>**Yes**<br>Go to step 4.<br>**No**<br>Clean and tighten all the battery negative connectors and all grounding points. Test if the system works normally. If the problem continues, install new negative battery cable. |
| 3. Inspect if resistance of grounding circuit between battery and starting motor is too high | |
| | A. Inspect the battery voltage.<br>Is the starting voltage higher than 10.5 V?<br>**Yes**<br>Go to step 4.<br>**No**<br>Charge the battery.<br>**Refer to: Battery Charging (3.1.10 Charging System, General Inspection).**<br>Or replace with new battery.<br>**Refer to: Battery (3.1.10 Charging System, Removal and Installation).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect battery and charging system | |
| | A. Inspect the battery and charging system.<br>Is the starting voltage higher than 10.5 V?<br>**Refer to: Battery Inspection (3.1.10 Charging System, General Inspection).**<br>Is the fault solved?<br>**Yes**<br>Replace or repair the battery, repair the charging system. |

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## Removal and Installation

# Starting Motor

### Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

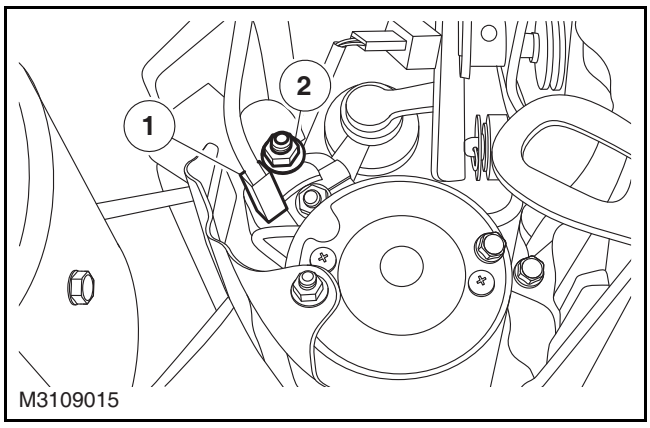
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the starting motor wiring harness connector.

   1 Disconnect the starting motor wiring harness connector (1).

   2 Remove the retaining nut (2) from starting motor magnetic clutch wiring harness.

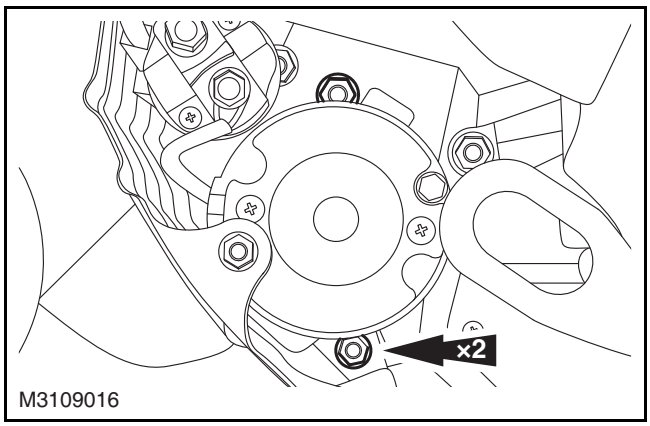
   Torque: 7 ± 1 Nm




4. Remove the starting motor and heat insulator.

   1 Remove 2 retaining bolts from starting motor.

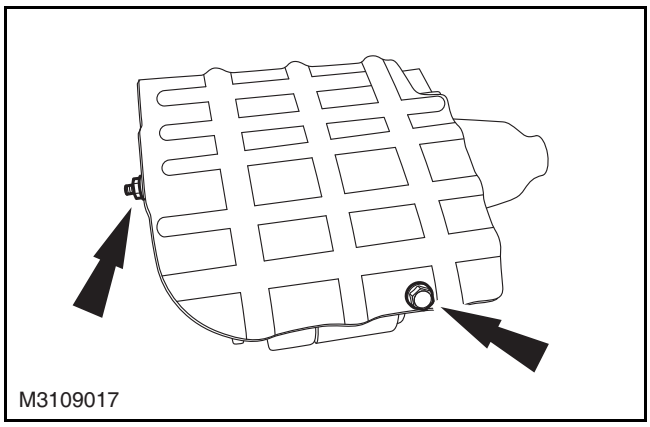
   Torque: 32 ± 2 Nm




   2 Remove the starting motor and heat insulator.

   3 Remove the heat insulator retaining bolt and nut.

   Torque: 10 ± 1 Nm



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## Installation

1. Installation is in the reverse order of removal.

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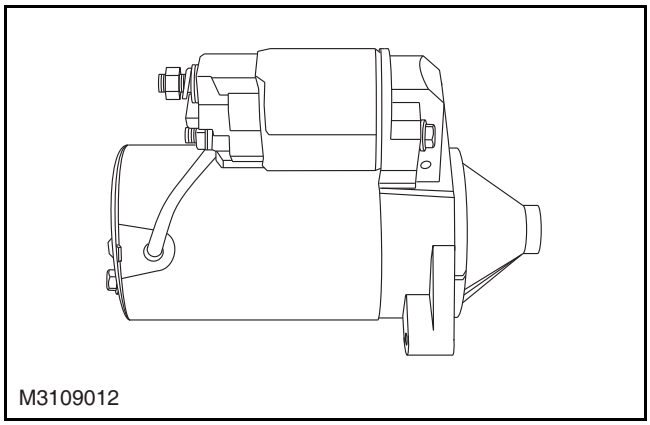
## Disassembly and Assembly

# Starting Motor

### Disassembly

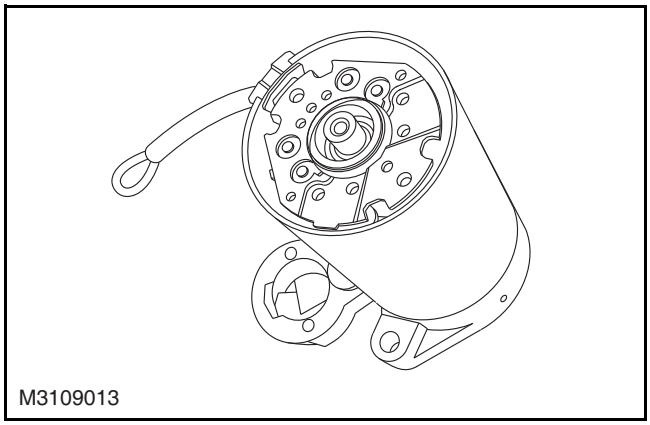
1. Remove the nut from magnetic switch and disconnect the wiring harness.
2. Remove the 2 bolts, then pull the back part of the magnetic switch to remove it to disengage the inner hook from drive lever.

**CAUTION: Do not remove the magnetic switch; replace in assembling process if necessary.**



M3109012

3. Remove the housing bolts and pull out the commutator end cap.
4. Remove the insulator and brush spring, then remove the brush holder.
5. Remove the stator, armature and drive lever.



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## Assembly

1. Inspect and replace the corresponding components if necessary.

   **Refer to: (3.1.9 Starting System, General Inspection).**

2. Apply grease to the drive lever and install it together with the armature and drive end cover.
3. Install the stator and brush holder, and then fix the four brushes with spring, and then install the insulator.

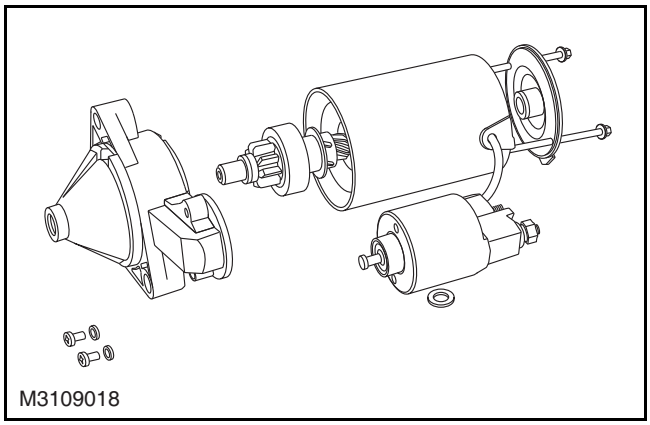
**CAUTION: When installing the brush, make sure to remove the grease from the brush and commutator completely.**

**CAUTION: Make sure that there is no unnecessary contact between the brush and other component.**

4. Apply grease to the inside of the bushing, and then install the rear housing.
5. Replace with a new magnetic switch or its cover. Apply grease to the top of the plunger if necessary.
6. Turn the drive lever to hook the magnetic switch plunger, and then tighten the magnetic switch assembly with nut.
7. Connect the wiring harness in place and then inspect the magnetic switch operation.

**CAUTION: Before installing the nut, ensure that the plunger and drive lever are connected.**

**CAUTION: Face the bleeding hole on the cover downward.**



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# Specifications

# Component Specifications

### Battery Specifications

| Item | Specifications |
|---|---|
| Type | Maintenance free |
| Nominal voltage | DC 12 V |
| 20h rated capacity | 45 AH |
| Capacity | Above 94 minutes |
| Charging ability | Above 9 A |
| Weight (with electrolyte) | 13.2 Kg |

### Alternator Specifications

| Item | Specifications |
|---|---|
| Rated working speed | 6000 rpm |
| Maximum working speed | 18000 rpm |
| Voltage specifications | 14.2 ~ 14.8 V |
| Rated current | 70 A |
| Permissible ambient temperature | -40°C ~ 105°C |
| Polarity | Negative grounding |
| Direction of rotation | Clockwise viewed from drive end |
| Weight | 6.8 kg |

### Alternator Thermal State Performance

| Speed<br>r/min | Output Current<br>A | Test Voltage<br>V |
|---|---|---|
| 1900 | 40 or higher | 13.4 ~ 13.6 |
| 2500 | 50 or higher | |
| 6000 | 70 or higher | |

### Alternator Cold State Performance

| Speed<br>r/min | Output Current<br>A | Test Voltage<br>V |
|---|---|---|
| 1900 | 50 or higher | 13.4 ~ 13.6 |
| 2500 | 60 or higher | |
| 5000 | 80 or higher | |

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**Normal Temperature Voltage Regulation Performance**

| Performance | Regulating Voltage or Regulating Voltage Difference Value V |
|---|---|
| Regulating voltage | 14.55 ± 0.25 |
| Load characteristic | \| △ U\| 0.5 or less |
| Speed characteristic | \| △ U\| 0.3 or less |

**High Temperature Voltage Regulation Performance**

| Regulating Voltage V | Regulator Temperature Compensation Coefficient mV/°C |
|---|---|
| 13 or higher | 0 ~ 7 |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Battery retaining pressure plate retaining nut | 8 | - | 71 |
| Positive battery cable nut | 9 | - | 80 |
| Negative battery cable nut | 8 | - | 71 |
| Alternator upper adjusting bolt | 23 | 17 | - |
| Alternator lower adjusting bolt | 23 | 17 | - |
| Alternator adjusting bracket bolt | 23 | 17 | - |
| Alternator charging cable retaining nut | 9 | - | 80 |

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## Description and Operation

# System Overview

### Battery Self-discharge

Battery self-discharge is inevitable in theory. For the maintenance-free battery, self-discharge is much less than ordinary battery, but still has a certain of self-discharge. The battery power will reduce significantly even if not powered on for a long time. Battery self-discharge is mainly affected by factors as follows:

1. The higher the temperature is, the higher the self-discharge rate is. Generally, when the temperature rises for every 10°C, the self-discharge rate would also increase by about 2.7 times. The self-discharge rate of the battery is different for the vehicle in summer and winter.
2. The battery self-discharge may become serious due to the storage place conditions, such as high humidity and heavy dust.

### Battery Capacity Loss after Loading

After loading, the power loss of the battery is mainly in the following aspects:

1. Power loss in commissioning.
2. Power loss of some electrical equipments which is constant working in the vehicle, such as anti-theft alarm.
3. Electricity leakage caused by poor insulation of the vehicle electrical components.
4. Without disconnecting the negative cable, power loss caused by static current and current leakage in circuit.

**⚠ CAUTION: The standing time of battery depends on many factors. Generally, fully charged battery with the negative cable disconnected can start the vehicle after standing for 6 months.**

### Charging System

Alternator is characterized by built-in solid state regulator. All components of the regulator are installed in an sealed box. The regulator and brush holder assembly are installed on the slip ring and frame, the set voltage of alternator cannot be adjusted.

Alternator rotor bearing with sufficient grease, and does not require regular lubrication. Two brushes make the current go to the rotor field coil through two slip rings. In normal circumstances, the brush can be free of maintenance for a long time.

The stator winding is assembled within the laminated iron core which is the alternator frame component. The rectifier connected to the stator winding has six diodes, which converted the AC voltage on the stator into DC voltage on the alternator output terminal. The central diode is used to convert the neutral point voltage into DC to increase the alternator output.

The capacitor that installed in the regulator assembly protects the diode voltage and suppresses the radio wave interference.

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# Components Description

## Battery

The vehicle adopts maintenance-free battery. Without vent plug on the battery cover, it is completely sealed besides the two small vent holes on both sides of the battery, which is different from the conventional battery.

Compared with conventional battery, this battery has the following advantages:

1. Refilling liquid is not required within the battery service life.
2. Overcharging protection.
3. Electric leakage is not as easy as conventional battery.
4. Weight and volume is smaller, but with more capacity.

If the battery test is normal, but such faults as battery has insufficient voltage and vehicle cannot be started after the night occur, the causes can be considered from the following aspects:

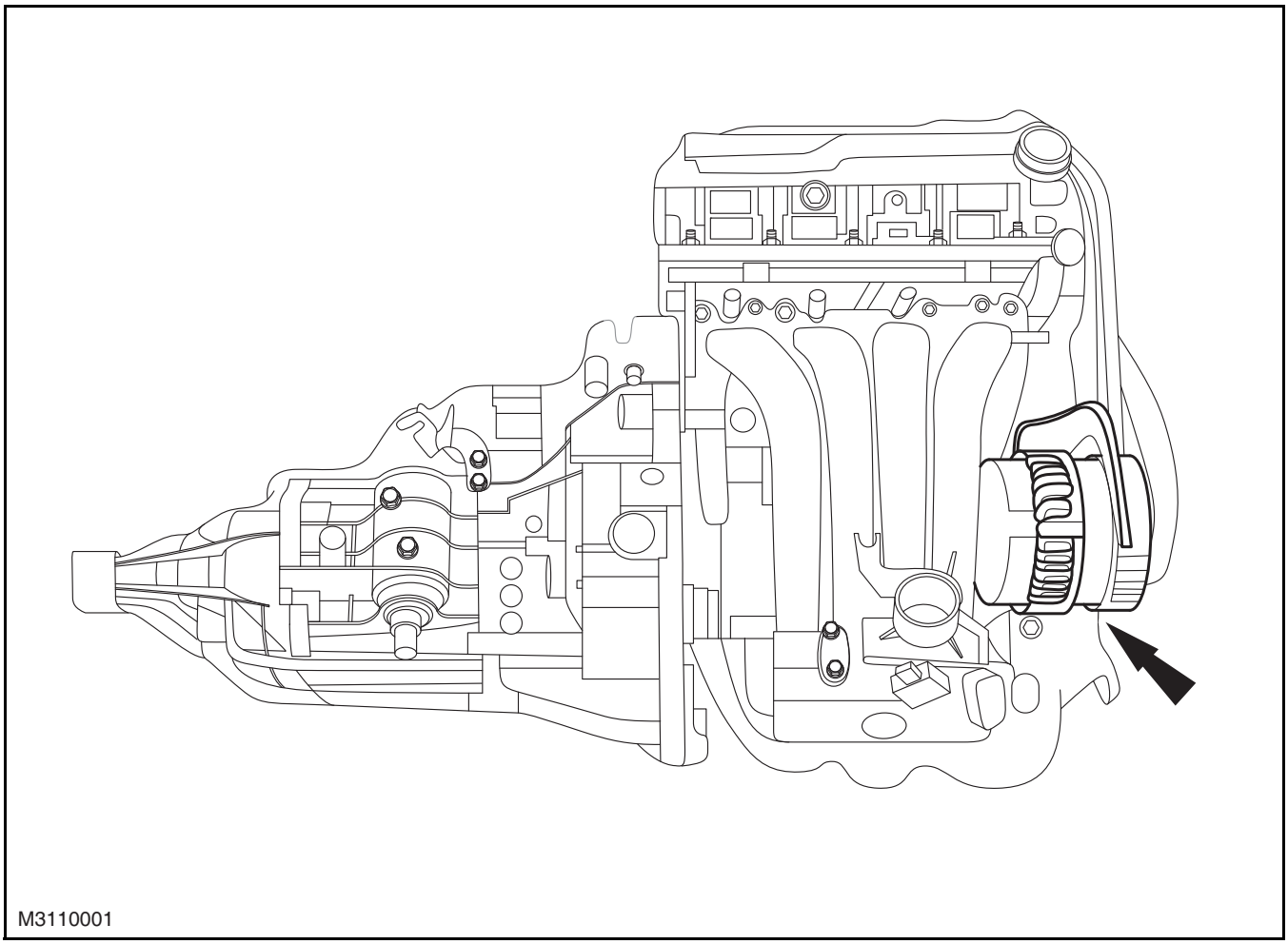
1. Electrical equipment in the vehicle is not turned off over the whole night.
2. Slow speed and stop and go.
3. Vehicle electrical load exceeds the alternator output, especially when the vehicle is equipped with after-sale devices.
4. Charging system has faults, such as electrical short circuit, accessory drive belt slipping, alternator or voltage regulator fault.
5. Improper use of the battery, including fail to keep the battery cable terminals clean and tightened, or the pressure plate is loose.
6. Mechanical fault of the electrical system, such as wiring harness short circuit or damaged which lead to electric leakage.

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# Components Location View

## Alternator



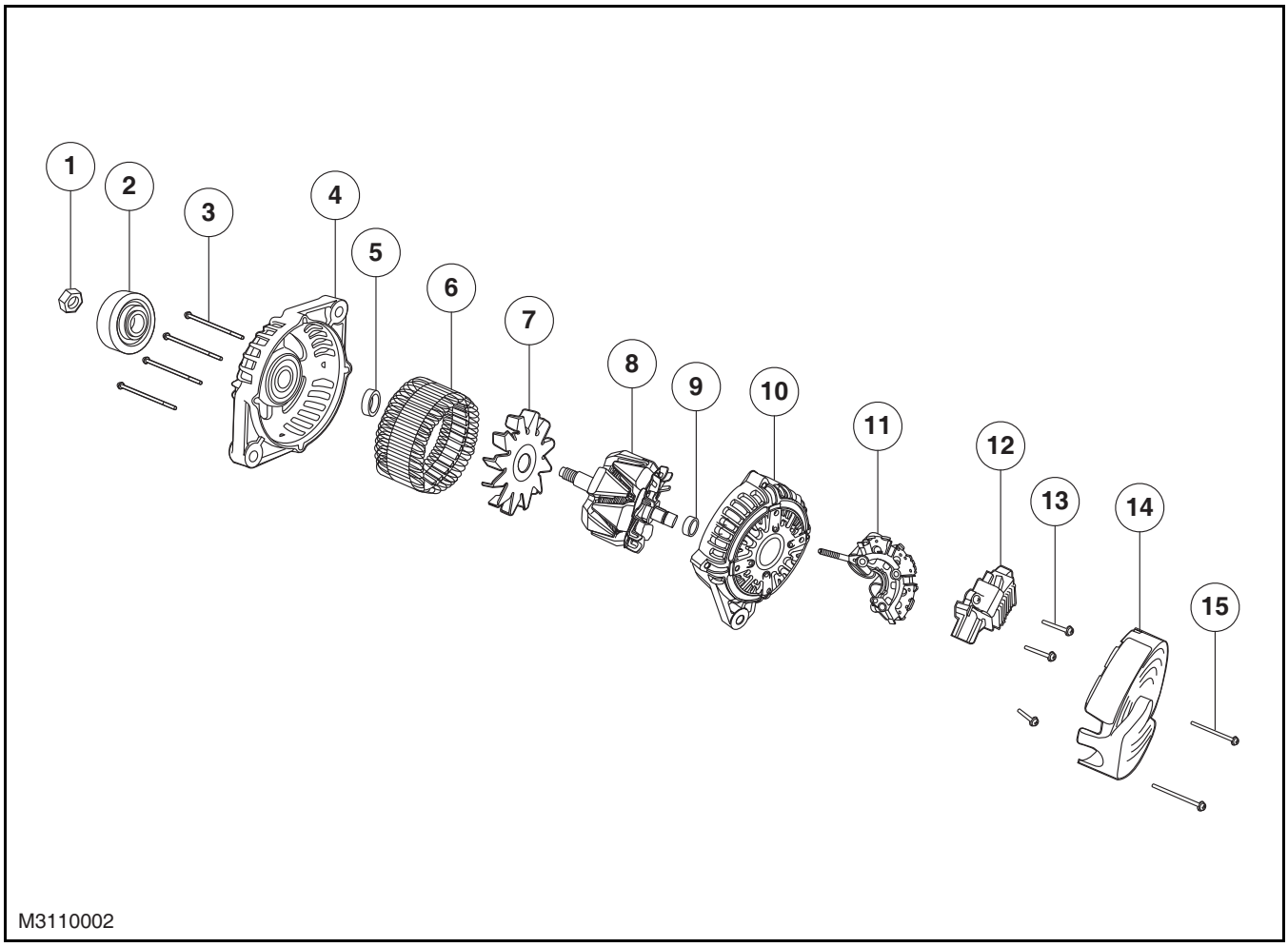
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# Components Exploded View

## Alternator

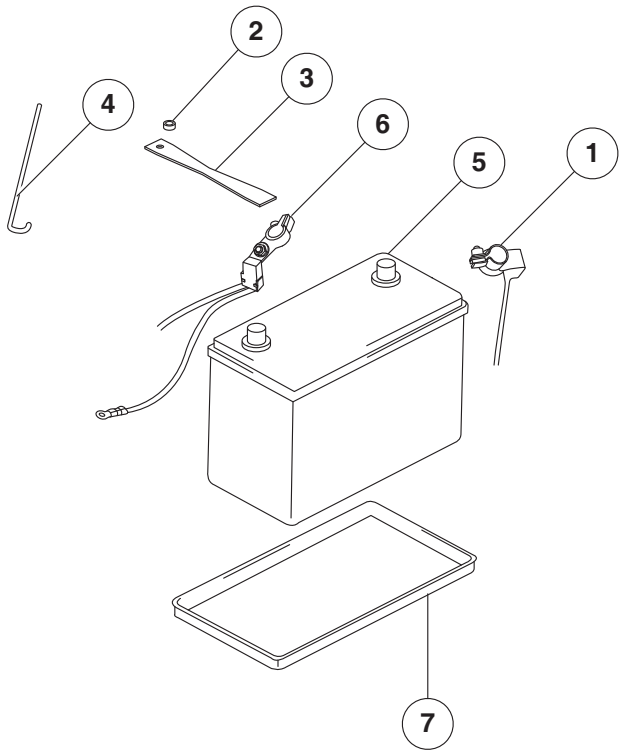



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Nut | 9 | Rear bearing |
| 2 | Pulley | 10 | Rear cover |
| 3 | Bolt | 11 | Rectifier |
| 4 | Front cover | 12 | Regulator |
| 5 | Front bearing | 13 | Screw |
| 6 | Stator | 14 | Cover |
| 7 | Heat sink | 15 | Bolt |
| 8 | Rotor | | |

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## Battery and Accessory




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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Negative battery grounding cable | 5 | Battery assembly |
| 2 | Battery retaining pressure plate retaining nut | 6 | Positive battery cable |
| 3 | Battery retaining pressure plate | 7 | Battery tray |
| 4 | Battery retaining screw | | |

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## General Inspection

### General Equipment

| |
|---|
| Multimeter |
| Battery charger |

## Battery Inspection

1. Battery appearance inspection:

   Battery should be free of leakage on the surface, crack and damage in the housing, corrosion on the electrode, and the electrode wire is connected securely.

2. Inspect with a discharge detector:

   Press the corresponding contact hardly on the battery negative and positive. When the discharge detector pointer is in the green range for about 2 seconds, it indicates that the battery capacity is sufficient to meet high current starting demands. When the discharge detector pointer in the red range and with no other abnormalities, it indicates the battery capacity is insufficient and charging is required.

3. Use the voltmeter to inspect with headlamp as the load:

   According to the battery voltage measuring method, connect the voltmeter to the battery, and read the battery voltage value, and then turn on the headlamp, if the battery voltage does not drop rapidly, and keeps at 10 V or higher, the battery can start the vehicle after the charging fully. If the headlamp is turned on and the battery voltage decreases rapidly, charge the battery to restore the function. If the standing time is too long, charge the battery for a relatively longer time. It is best to charge and discharge several times to make it fully activated.

**CAUTION: It is improper to inspect the battery that just is charging, discharging or has just completed charging with discharge detector. Because the process of charging will generate a lot of hydrogen gas, when the inspection is carried out by discharging detector or resistance wire, it will generate spark and cause the gas exploded causing injury and damage.**

## Battery Charging

**WARNING: Keep the battery away from children. The battery includes sulphuric acid. Keep it away from skin, eye or clothes. Wear the goggles to avoid acidic dissolution fluid spraying into the eyes when working near the battery. In case of acid solvent spraying to the skin or eyes, wash immediately for at least 15 minutes and seek for medical treatment immediately. If acid solution is swallowed, please seek medical treatment immediately. Failure to comply with the instructions may cause serious injury and death.**

**WARNING: Battery may produce explosive gases to cause personal injury and death. So keep the flame, spark or other inflammable materials away from the battery. When getting close to the charging battery or working area, wear protective mask to protect face and eyes. Put the battery in a ventilated location. Failure to comply with the instructions may cause serious injury and death.**

**WARNING: When using any charging device, comply with all the manufacturers' instructions. Failure to comply with the instructions may cause serious injury and death.**

**WARNING: The battery charger switch must not be ON before connecting to the battery. Failure to comply with the instructions may cause serious injury and death.**

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**WARNING: Turn off the switch before removing the battery charger from the battery. Failure to comply with the instructions may cause serious injury and death.**

**CAUTION: Do not charge the battery in the vehicle.**

**CAUTION: Do not only use the alternator to charge the completely discharged battery, as charging system must work continuously more than 8 hours without electrical load.**

1. Connect the battery charger to the battery, charging as the following method.

   Constant voltage charging:

   Constant voltage 14.8 V. When the charging current drops to 3 A, continue to charge for 3 hours to complete the charging process. Note that the charging current should not exceed 25 A.

   Constant current charging:

   Charge it with 6 A until the voltage is 14.8 V, then with 3 A for 3 hours, and then the charging is completed.

## Battery Parasitic Current Test

If the battery is out of power for a long time, perform the following testing procedure to inspect whether the battery generates parasitic current.

1. Disconnect the negative battery cable.
2. Connect the positive probe of the multimeter to positive battery cable and negative probe to the negative cable.
3. Ensure all electrical equipment shut down on the test vehicle. Close all doors, hood and trunk lid.
4. Select the mA range of the multimeter to measure current.
5. Wait for vehicle module sleep, measure the parasitic current.

**CAUTION: The module sleep time is different depending on vehicles with different configuration.**

**Parasitic current standard value: 0.02 A or less**

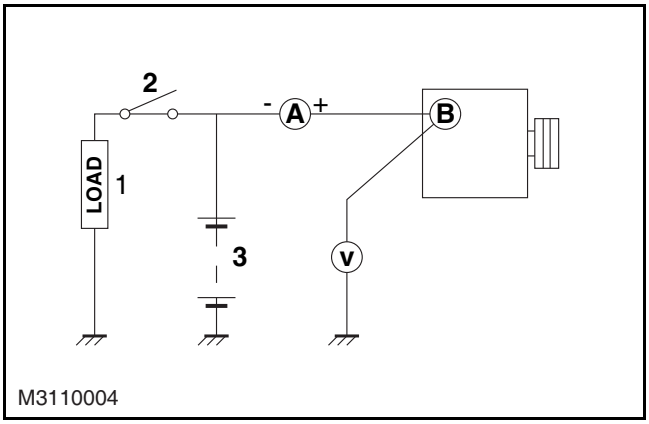
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# Alternator Test

**1.** Connect the test equipment

Select the appropriate range, connect the voltmeter between alternator B terminal and grounding. Connect the ammeter between alternator B terminal and battery positive terminal.




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**2.** Test without load

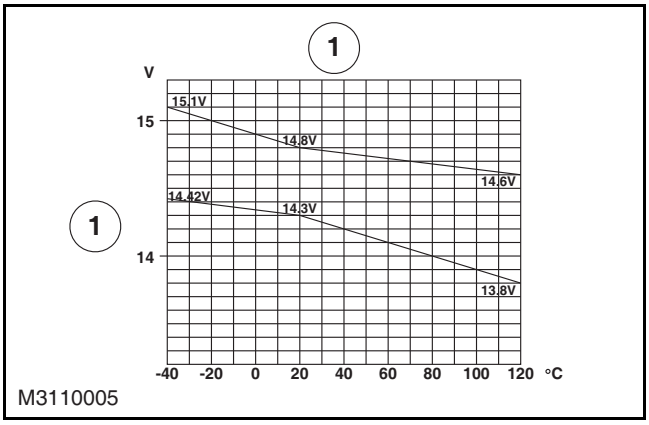
Start the engine and run it from idle speed to 2000 rpm, and then read the meter readings.

**CAUTION: The voltage will be different as the temperature of voltage regulator varies should be considered. Do not carry out this test with the discharged battery. Before the test, ensure that the battery is fully charged.**

**CAUTION: When the engine running, do not disconnect the battery terminal, otherwise you may damage the electrical components.**

**Standard current: 10 A (Max.)**

**Standard voltage: 14.2 ~ 14.8 V at 25°C**




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**3.** Test with load

Running the engine at 2000 rpm, turn on the headlamp and HVAC motor. Measure the current, if it is less than 20 A, repair or replace the motor.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Accessory drive belt<br>• Alternator | • Fuse<br>• Wiring harness<br>• Electrical connector<br>• Battery<br>• Battery cable<br>• Charging system warning lamp |

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## Symptom Chart

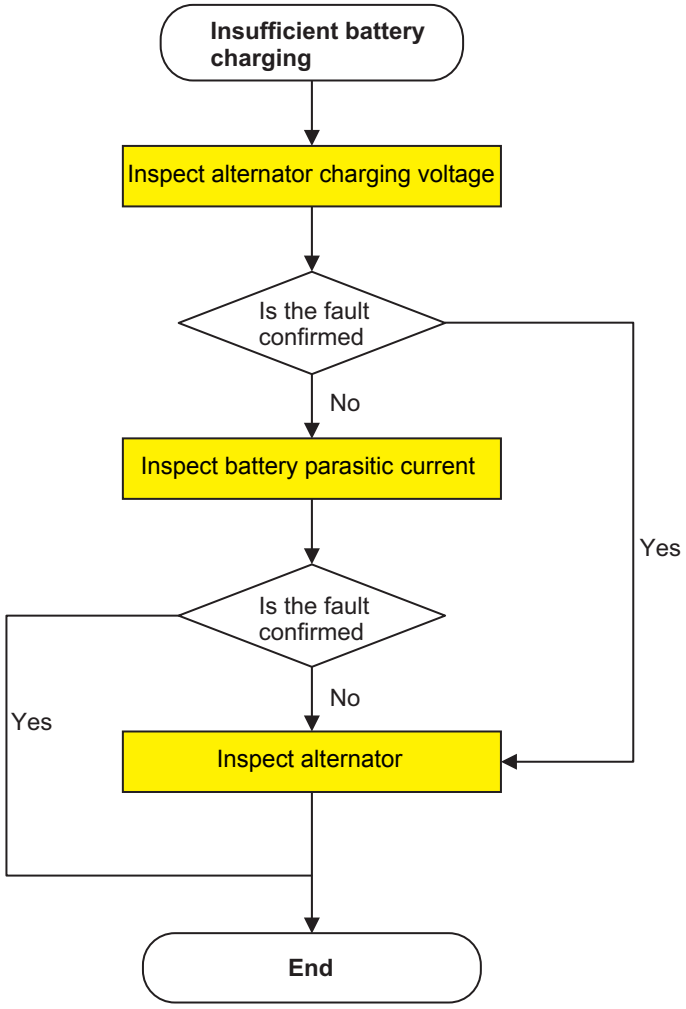
If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Insufficient battery charging | • Accessory drive belt<br>• Alternator regulator<br>• Alternator | **Refer to: Diagnosis Procedure for Insufficient Battery Charging (3.1.10 Charging System, Symptom Diagnosis and Testing).** |
| Battery overcharging | • Alternator regulator<br>• Alternator | **Refer to: Diagnosis Procedure for Battery Overcharging (3.1.10 Charging System, Symptom Diagnosis and Testing).** |
| Charging indicator constant on | • Drive belt loose or worn<br>• Alternator<br>• Circuit fault | **Refer to: Diagnosis Procedure for Charging Indicator Constant ON (3.1.10 Charging System, Symptom Diagnosis and Testing).** |
| Charging indicator not on | • Instrument cluster LED<br>• Instrument cluster<br>• Circuit fault<br>• Poor contact between brushes and slip rings<br>• Voltage regulator | **Refer to: Diagnosis Procedure for Charging Indicator not ON (3.1.10 Charging System, Symptom Diagnosis and Testing).** |
| Alternator noise | • Accessory drive belt<br>• Bearing<br>• Stator and rotor | **Refer to: Diagnosis Procedure for Alternator Noise (3.1.10 Charging System, Symptom Diagnosis and Testing).** |

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# Diagnosis Procedure for Insufficient Battery Charging



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect alternator charging voltage | |
| | A. Start the engine and run it from idle speed to 2500 rpm.<br>B. Use a multimeter to measure the voltage between positive battery cable and negative.<br>Is the voltage value not less than 14.35 V?<br>**Yes**<br>Go to step 2.<br>**No**<br>Go to step 3. |
| 2. Inspect battery parasitic current | |
| | A. Perform the inspection procedure of battery parasitic current.<br>**Refer to: Battery Parasitic Current Test (3.1.10 Charging System, General Inspection).**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Charge the battery.<br>**Refer to: Battery Charging (3.1.10 Charging System, General Inspection).**<br>Or replace the battery.<br>**Refer to: Battery (3.1.10 Charging System, Removal and Installation).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect alternator | |
| | A. Perform the alternator test procedures.<br>**Refer to: Alternator Test Procedure (3.1.10 Charging System, General Inspection).**<br>Is it normal?<br>**Yes**<br>Charge the battery.<br>**Refer to: Battery Charging (3.1.10 Charging System, General Inspection).**<br>Or replace the battery.<br>**Refer to: Battery (3.1.10 Charging System, Removal and Installation).**<br>**No**<br>Inspect the alternator.<br>**Refer to: Diagnosis Procedure for Charging Indicator Constant ON (3.1.10 Charging System, Symptom Diagnosis and Testing).** |

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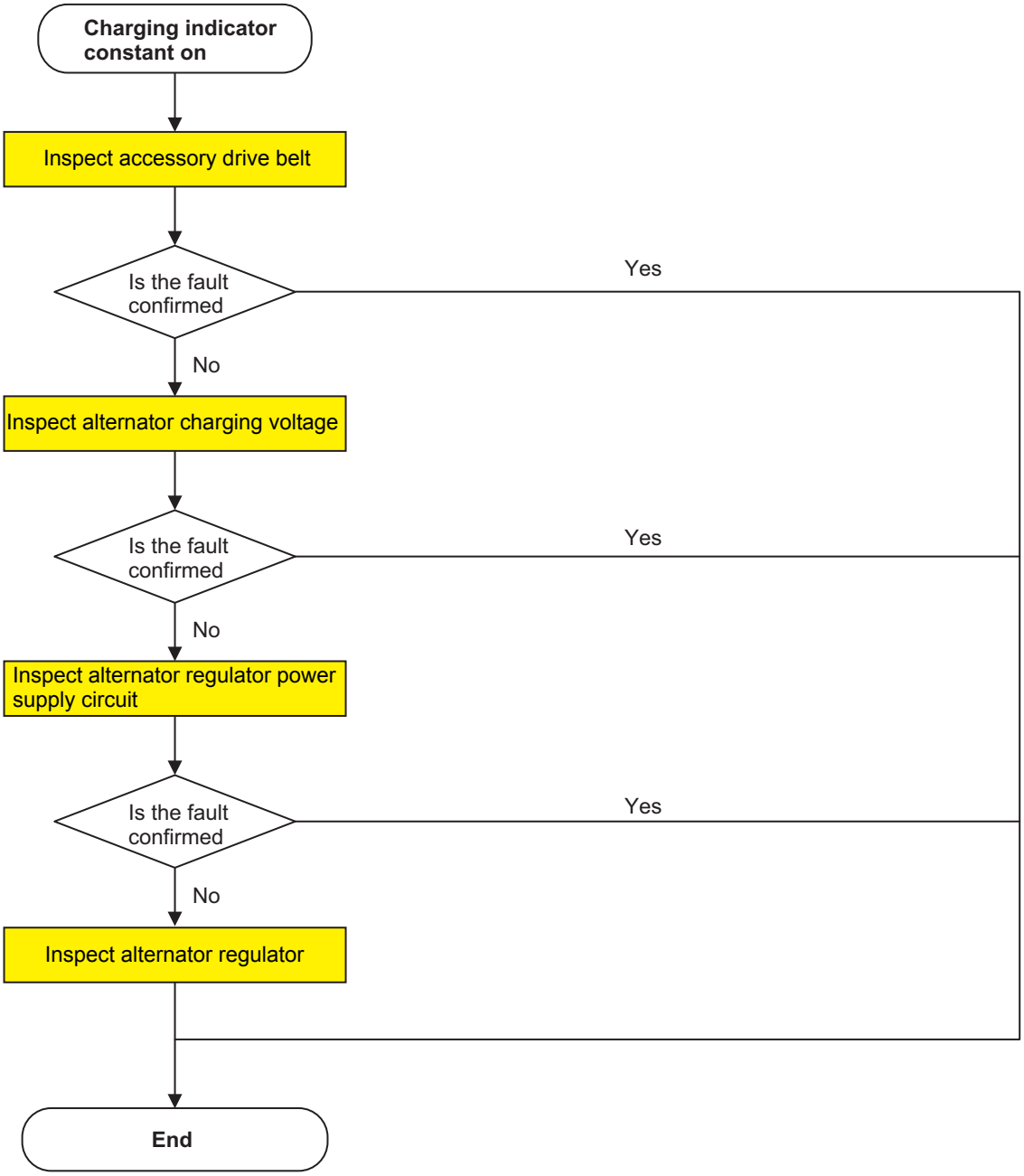
# Diagnosis Procedure for Battery Overcharging

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect alternator charging voltage | |
| | A. Start the engine and run it from idle speed to 2500 rpm.<br>B. Use a multimeter to measure the voltage between positive battery cable and negative.<br>Is the voltage value higher than 14.35 V?<br>**Yes**<br>Go to step 2.<br>**No**<br>The system is normal. |
| 2. Inspect alternator regulator | |
| | A. Replace the alternator regulator.<br>Is the alternator charging voltage normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the alternator.<br>**Refer to: Alternator (3.1.10 Charging System, Removal and Installation).** |

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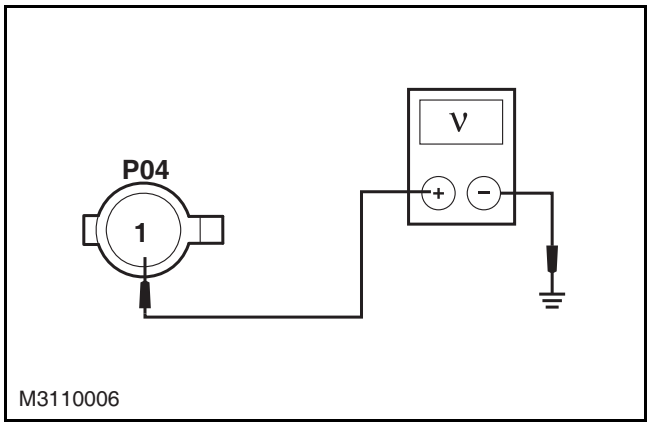
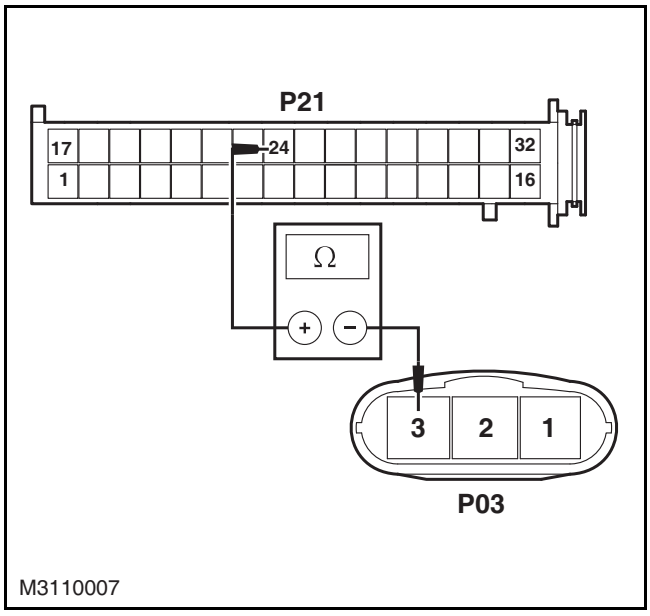


# Diagnosis Procedure for Charging Indicator Constant ON



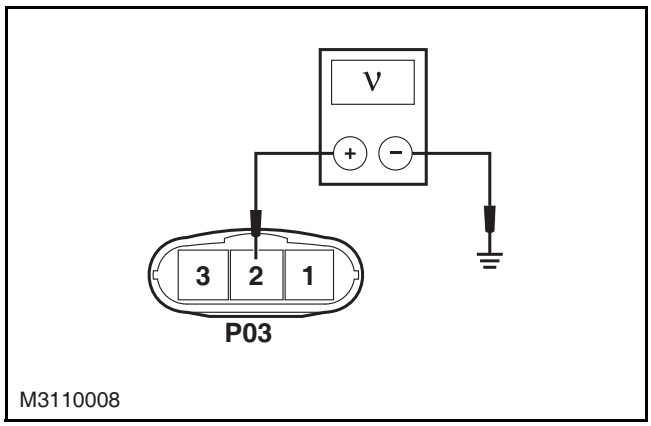
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect accessory drive belt | |
| | A. Inspect the accessory drive belt installation.<br>B. Inspect the tension of the accessory drive belt.<br>**Refer to: Alternator Drive Belt Tension Inspection (3.1.4 Cooling System, General Inspection).**<br>Is the accessory drive belt normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Adjust or replace the accessory drive belt or tension pulley. |
| 2. Inspect alternator charging voltage | |
|  <br>  | A. Start the engine and increase the speed to 2500 rpm.<br>B. Measure the voltage between terminal 1 of alternator output wiring harness connector P04 and grounding.<br>**Is the output voltage between 14.2 and 14.35 V**?<br>C. Measure the voltage between terminal 2 of alternator output wiring harness connector P03 and grounding.<br>**Standard voltage: 11 ~ 14 V**<br>D. Measure the circuit resistance between terminal 3 of alternator output wiring harness connector P03 and terminal 24 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the measured value normal?<br>**Yes**<br>Repair the circuit between terminal 3 of alternator wiring harness connector P03 and terminal 24 of instrument cluster wiring harness connector P21.<br>**No**<br>Go to step 3. |

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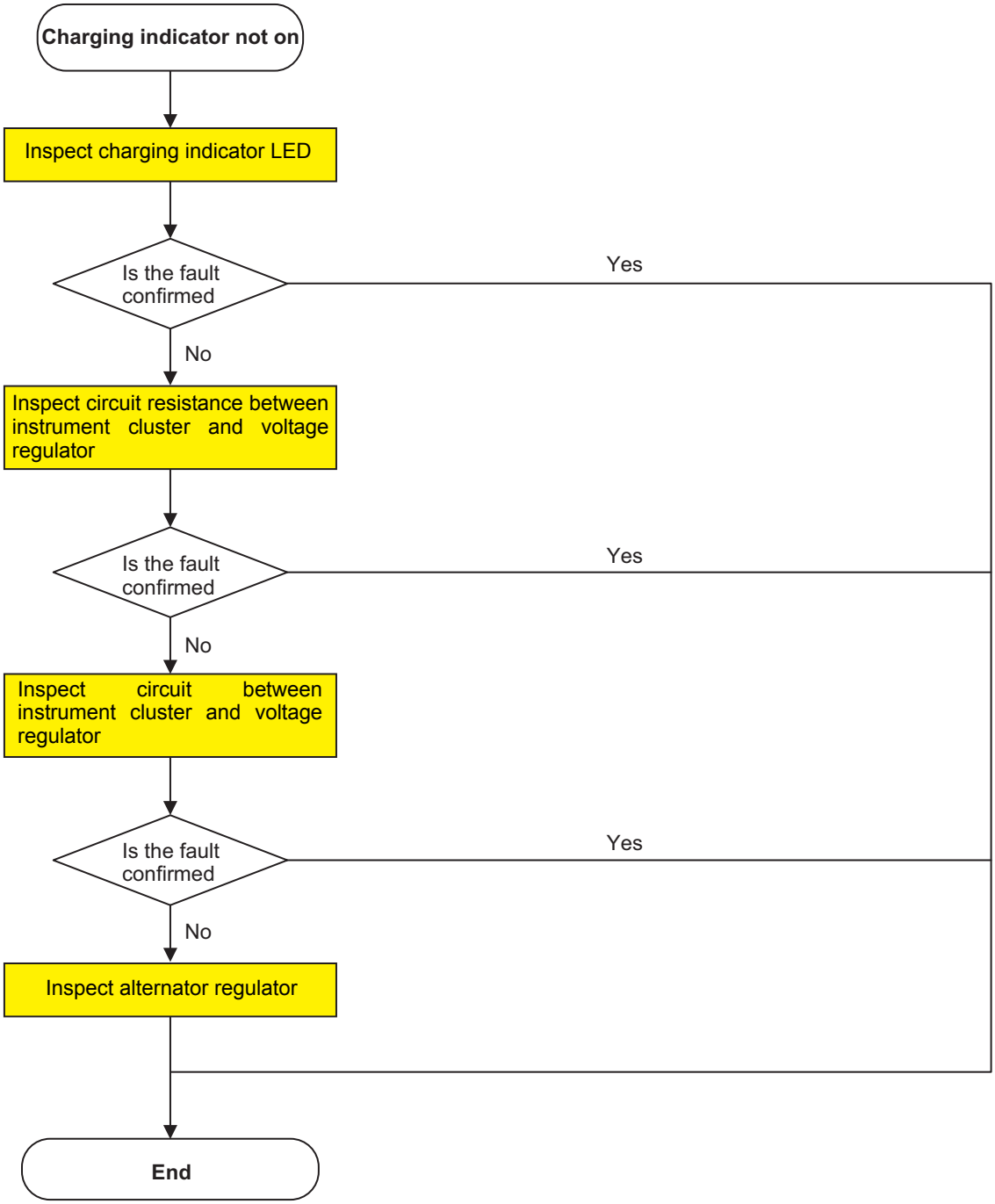


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect alternator regulator power supply circuit | |
|  | A. Turn the ignition switch to "OFF".<br>B. Inspect the fuse IF15.<br>C. Disconnect the alternator wiring harness connector P03.<br>D. Turn the ignition switch to "ON".<br>E. Measure the voltage between terminal 2 of alternator wiring harness connector P03 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value within the standard range?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the alternator regulator power supply circuit. |
| 4. Inspect alternator regulator | |
| | A. Replace the alternator regulator.<br>Does the fault solved?<br>**Yes**<br>Inspect the wiring harness.<br>**No**<br>Replace the alternator.<br>**Refer to: Alternator (3.1.10 Charging System, Removal and Installation).** |

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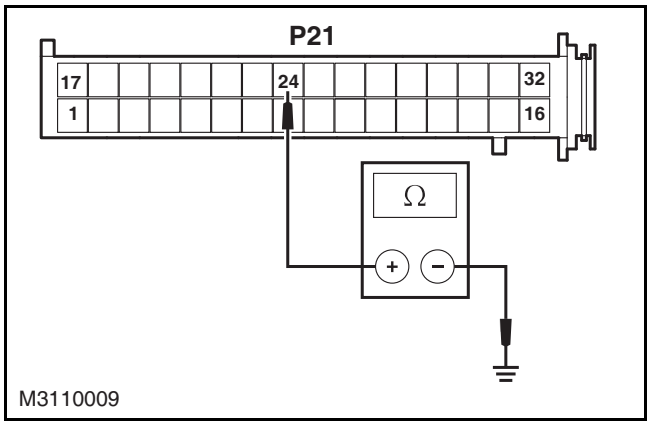
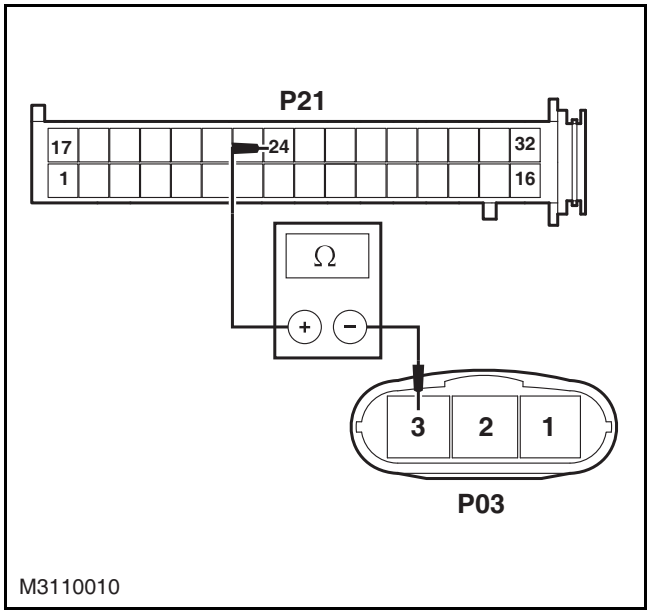


# Diagnosis Procedure for Charging Indicator not ON



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect charging indicator LED | |
| | A. Turn the ignition switch to "ON".<br>B. Visually inspect whether the charging indicator turns off after 2 seconds.<br>Is the LED normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 2. |
| 2. Inspect circuit resistance between instrument cluster and voltage regulator | |
|  | A. Start the engine and increase the speed to 2500 rpm.<br>B. Measure the voltage between terminal 24 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the measured value normal?<br>**Yes**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>**No**<br>Go to step 3. |
| 3. Inspect circuit between instrument cluster and voltage regulator | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 24 of instrument cluster wiring harness connector P21 and the terminal 3 of alternator regulator wiring harness connector P03;<br>Is the resistance value less than 1Ω?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the circuit between regulator and instrument cluster. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect alternator regulator | |
| | A. Replace the alternator regulator.<br>**Refer to: Alternator (3.1.10 Charging System, Removal and Installation).**<br>Does the fault solved?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the brush.<br>**Refer to: Alternator (3.1.10 Charging System, Removal and Installation).** |

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# Diagnosis Procedure for Alternator Noise

Diagnosis Tips: Alternator noise may be caused by electrical or mechanical noise. Electrical noise (electromagnetic vroom) usually varies with the alternator's electrical load. This is the normal operating characteristics of all alternators, pay attention to distinguish them from each other, otherwise it will cause unnecessary customer complaints. When diagnosing the alternator with mechanical noise, first inspect if there are loose components around the alternator, mutual interference or other abnormal problems. In some cases even if the light noise inside the cabin will be transferred into the passenger compartment, if so, the alternators replacement cannot solve the fault, which lead to misjudgment.

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect accessory drive belt | |
| | A. Inspect whether the accessory drive belt missing teeth.<br>B. Inspect the tension of the accessory drive belt.<br>**Refer to: Alternator Drive Belt Tension Inspection (3.1.4 Cooling System, General Inspection).**<br>Is the accessory drive belt normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the accessory drive belt. |
| 2. Inspect alternator noise | |
| | A. Remove the accessory drive belt.<br>B. Run the engine.<br>Does the alternator noise still exist?<br>**Yes**<br>Inspect the noise from compressor and tension pulley.<br>**No**<br>Replace the alternator.<br>**Refer to: Alternator (3.1.10 Charging System, Removal and Installation).** |

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## Removal and Installation

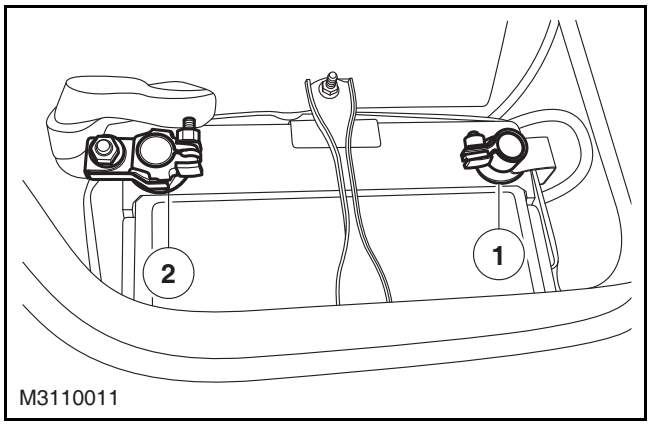
# Battery

### Removal

**1.** Disconnect the negative battery cable (1) and positive cable (2).

Torque for positive cable: 9 Nm

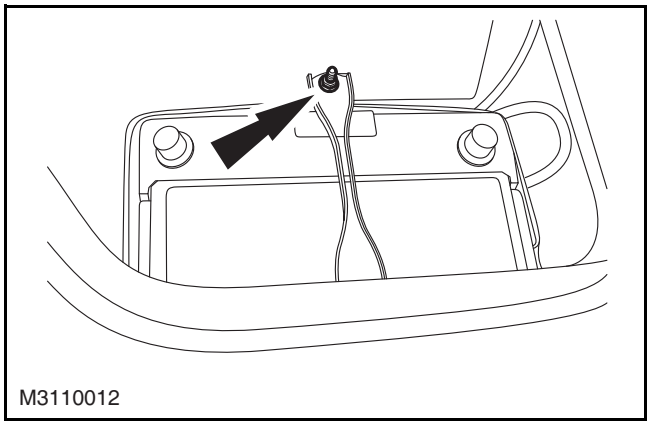
Torque for negative cable: 8 Nm



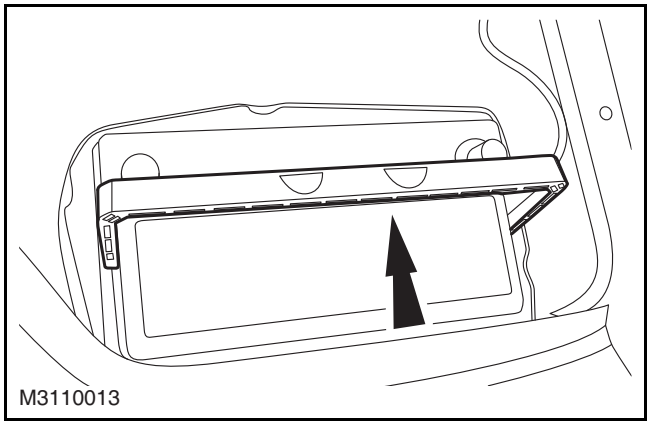
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**2.** Remove the battery retaining pressure plate retaining nut.

Torque: 8 Nm


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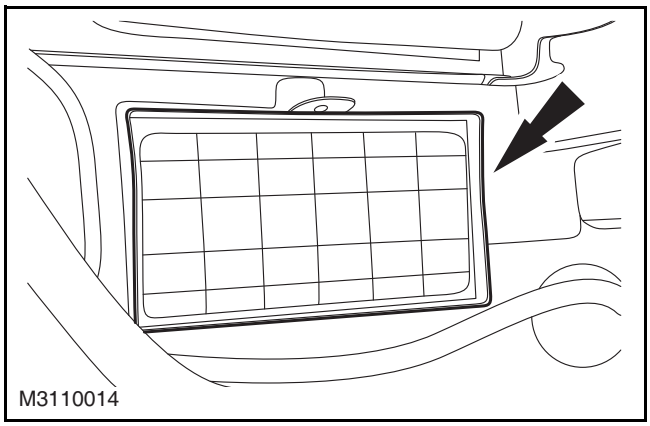
**3.** Remove the battery.


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4. Remove the battery tray.




## Installation

1. Installation is in the reverse order of removal.

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# Alternator

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the alternator belt.

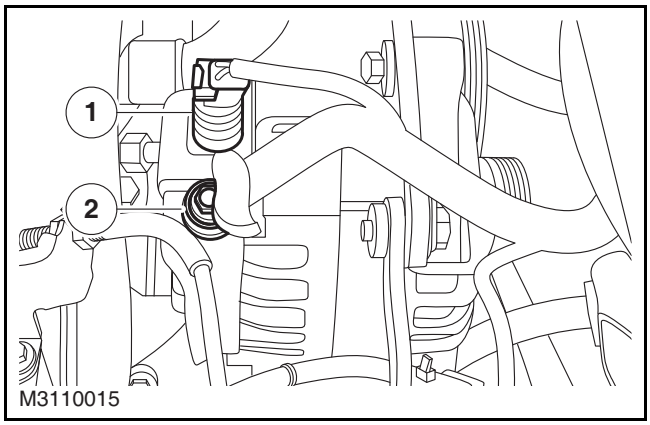
   **Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

3. Disconnect the alternator wiring harness connector.

   1 Disconnect the alternator regulator wiring harness connector (1).

   2 Remove the alternator charging cable retaining nut (2).

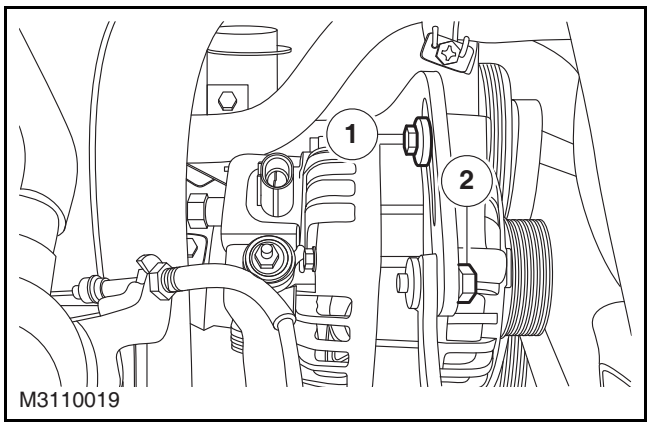
   Torque: 9 Nm




4. Remove the alternator upper adjusting bolt (1).

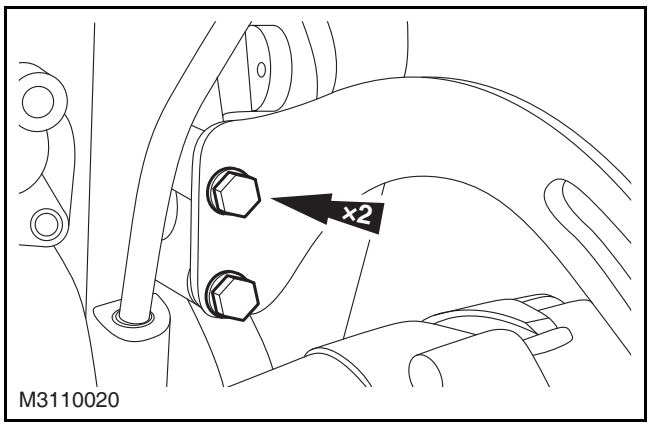
   Torque: 23 Nm

5. Remove the connecting bolt (2) between alternator adjusting bracket and compressor adjusting bracket.




6. Remove 2 retaining bolts from the alternator adjusting bracket, and remove the alternator adjusting bracket.

   Torque: 23 Nm

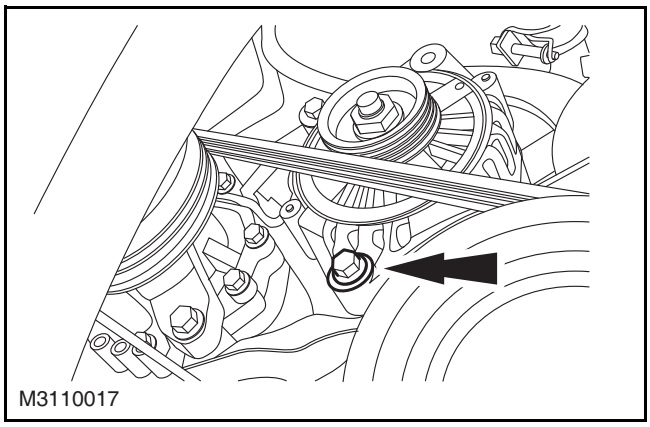


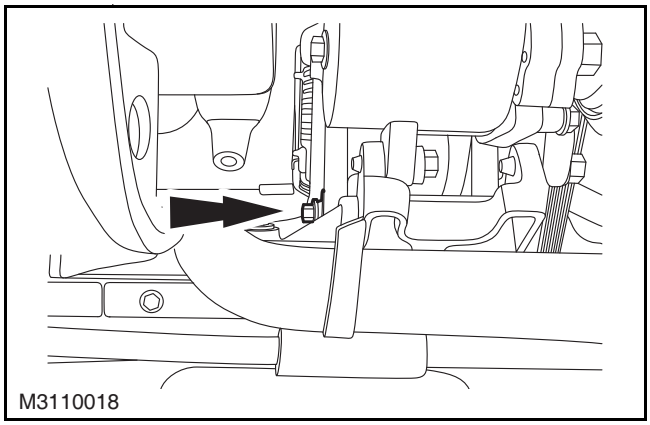
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7. Remove 2 retaining bolts from the lower part of alternator.

   Torque: 23 Nm


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8. Remove the alternator.

## Installation

1. Installation is in the reverse order of removal.

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## Description and Operation

# System Overview

### Positive Crankcase Ventilation (PCV) System

At the end of the combustion stroke, some unburned mixture gas leaks from the piston rings into the crankcase under high pressure, which is called "blow-by gas". The blow-by gas contains nitrogen oxides, carbon monoxide and hydrocarbons. If the mixed gas is not exhausted, the oil in the crankcase will be diluted and deteriorated to cause premature engine component wear. The blow-by gas will escape into atmosphere from the crankcase to cause pollution. In order to avoid emission deterioration, blow-by gas getting into atmosphere and oil deterioration, positive crankcase ventilation system is adopted to conduct the blow-by gas in crankcase back to the air intake system, which go through the PCV valve and intake manifold into the combustion chamber for burning.

Positive crankcase ventilation system consists of the following components:

- Positive crankcase ventilation valve
- Crankcase ventilation vacuum tube
- Hose and joint

The main control unit of engine crankcase blow-by gas is the positive crankcase ventilation (PCV) valve. Positive crankcase ventilation valve measures the blow-by gas flow based on the manifold vacuum signal. Positive crankcase ventilation valve allows some vacuum pressure to go through the internal orifice inside the valve to form low pressure condition in the crankcase. The blow-by gas in crankcase then is inhaled into the air intake system and combusted during normal combustion. The blow-by gas inhaled into intake manifold is precisely controlled to maintain idle quality. Use precisely calibrated positive crankcase ventilation valve. The relationship between flow rate of blow-by gas and vacuum degree of engine manifold is shown in the following table:

| Manifold Vacuum Degree | Positive Crankcase Ventilation Valve Opening | Blow-by Gas Flow |
|---|---|---|
| Low | Large | Large |
| High | Small | Small |

### Evaporative Emission (EVAP) Control System

Due to temperature, shaking and other factors, the fuel stored in fuel tank will generate fuel vapor, which will escape from the fuel tank into atmosphere to cause pollution. In order to avoid this situation, fuel evaporative emission (EVAP) control system, which is an active carbon tank storage method, is adopted to control fuel vapor emission. This method can transfer fuel vapor from fuel tank to the active carbon canister, namely fuel vapor is transferred from the fuel tank to the fuel vapor recovery pipe, which will be absorbed by carbon canister and stored when the vehicle is not running. When the engine is running for a required period and the cleaning working condition is met, engine control module provides a grounding circuit, so that carbon canister control valve energized to make the air inhaled into carbon canister and mixed with fuel vapor. Then the mixture of fuel vapor is sucked out from the carbon core into the intake manifold, and consumed in the combustion stroke inside cylinder. The carbon canister control valve is controlled by the pulse width modulation (PWM) signal to open or close. The PWM duty ratio of emission control valve changes according to the operating conditions determined by air flow, fuel regulator and intake air temperature.

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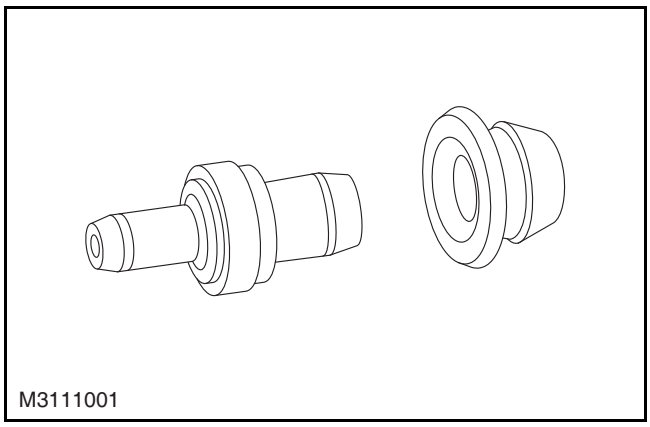
# Components Description

## Positive Crankcase Ventilation Valve (PCV)

Positive crankcase ventilation valve includes valve body, valves, valve cover and spring.

The positive crankcase ventilation valve below the lower O-ring are partially exposed in the intake manifold vacuum. The part between lower and upper O-ring is exposed in the crankcase gas. As these conditions occur, the leakage beyond system capacity (caused by severe worn engine, continuous overload, etc.) enters into the air intake pipe, and then is brought into the engine.

The correct operation of crankcase ventilation system depends on engine seals. If normal oxidation or dilution and crankcase ventilation system is observed, inspect the engine to determine the possible cause. Solve the fault.

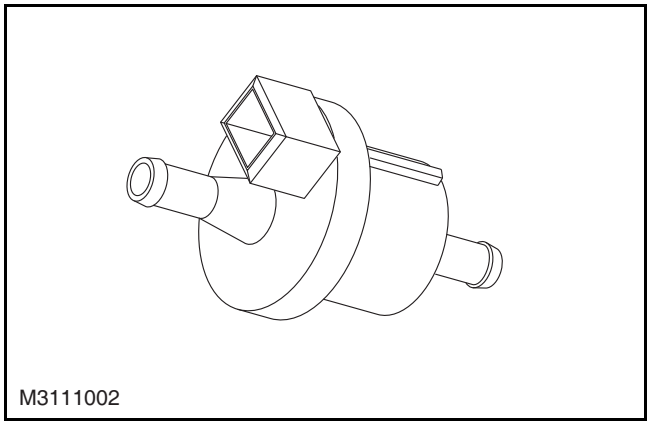


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## Emission Control Valve

Emission control valve is a normal close solenoid, controls the vapor flowing from the evaporative emission system into the intake manifold. The valve is controlled by the engine control module through pulse width modulation (PWM) to precisely control the fuel vapor flowing into the engine.

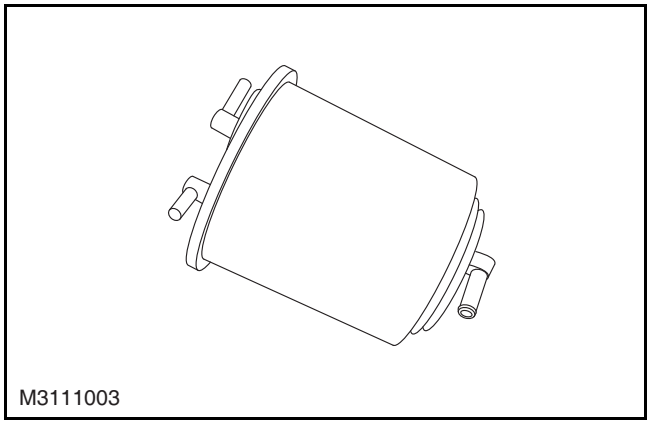
In some test processes of evaporative emissions system, this valve will open to make the engine vacuum enter the evaporative emissions system.



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## Evaporative Emission Carbon Canister

Evaporative emission carbon canister is an emission control device with active carbon particles, which is used to absorb and store the fuel vapor from fuel tank. Fuel vapor is always stored in the carbon canister. When meeting certain conditions, the engine control module will make the emission control valve energized to make the fuel vapor inhaled into cylinder for combustion.



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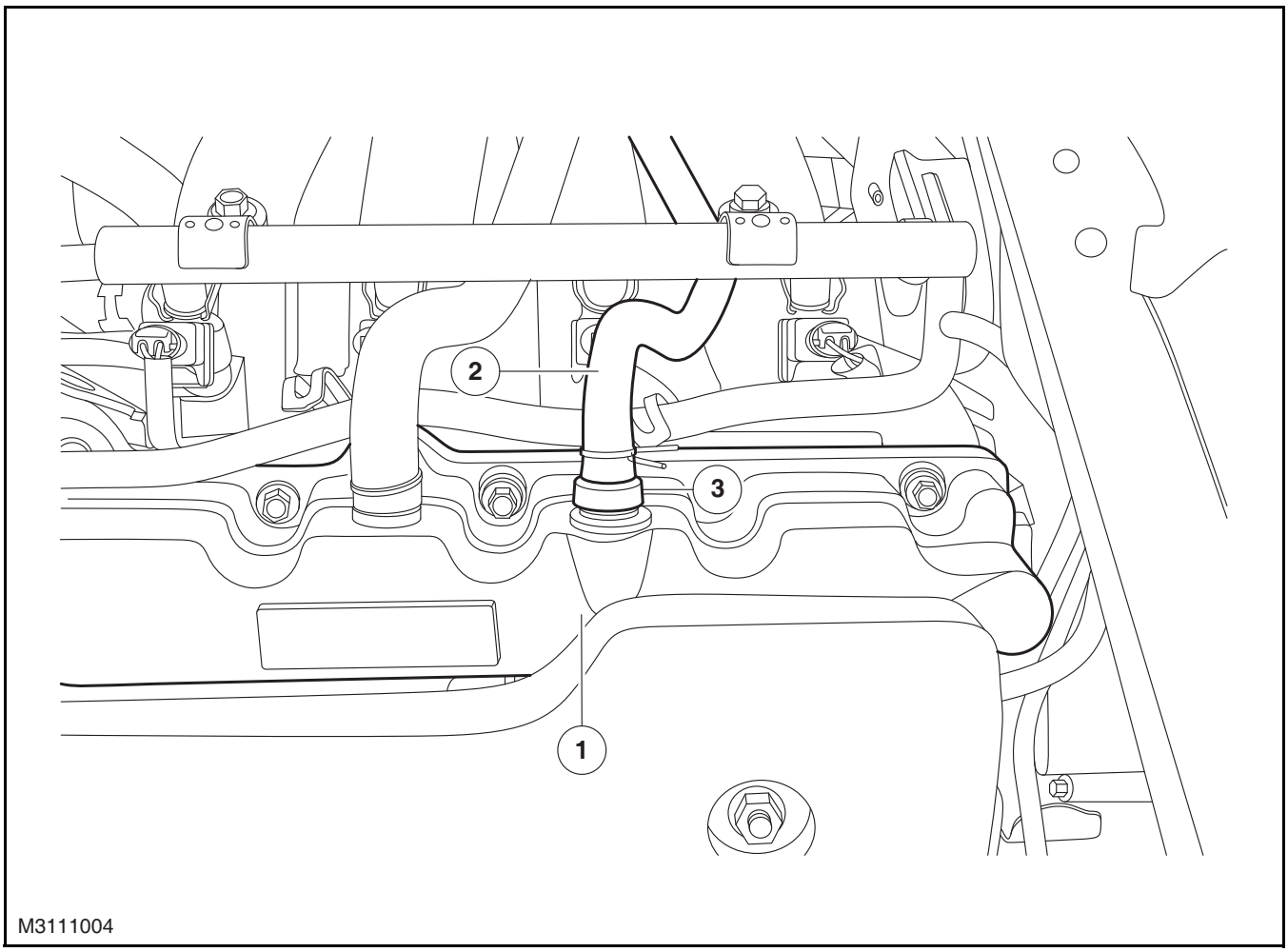
The following conditions can lead to poor engine idle, stalling and poor driving performance:

- Carbon canister solenoid does not work.
- The carbon canister is damaged.
- Hose is broken, cracked, or not properly connected to the pipe.

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# Components Location View

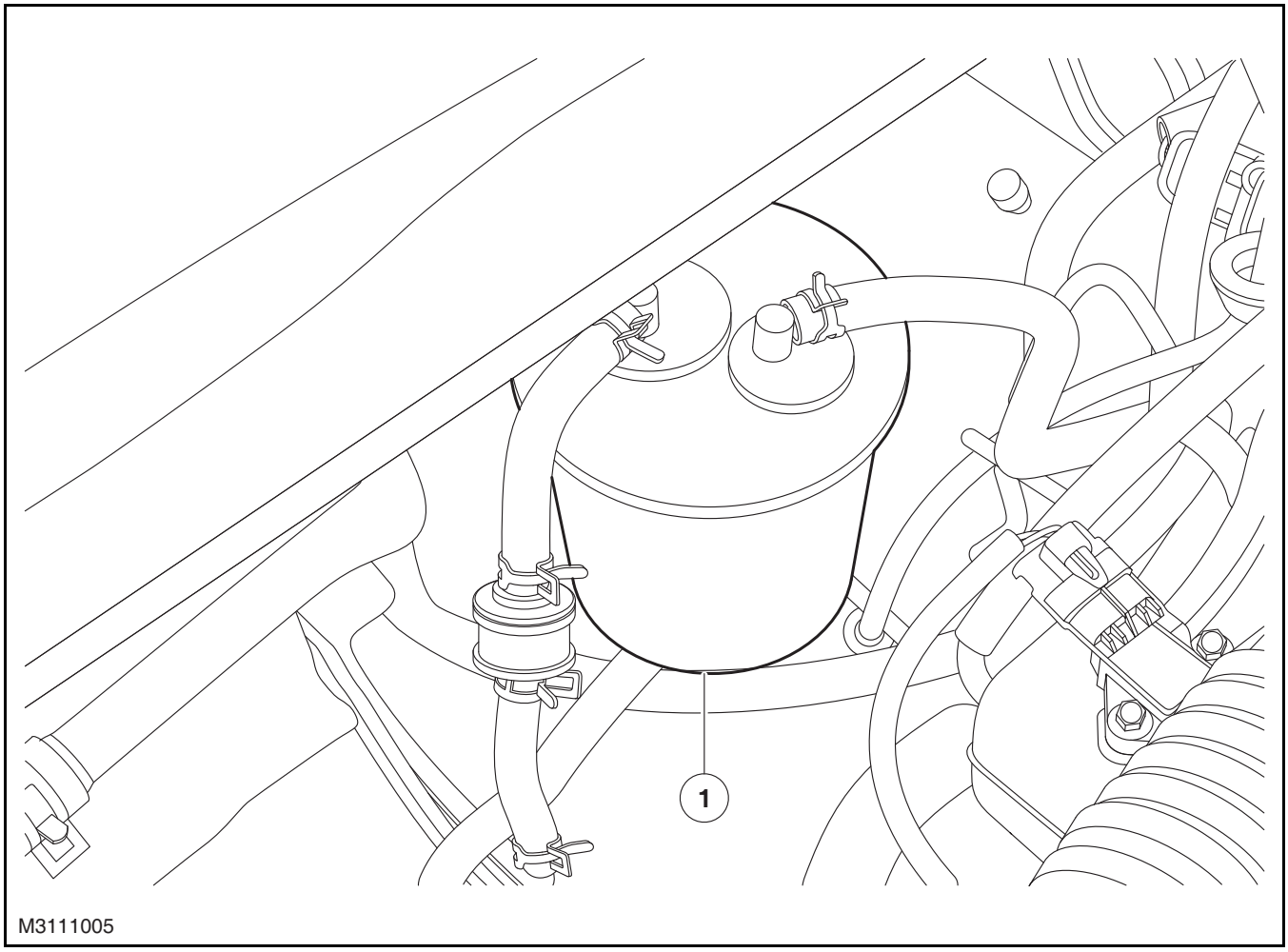



M3111004

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Exhaust hose | 3 | Intake hose |
| 2 | PCV Valve | | |

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M3111005

| Item | Description |
|---|---|
| 1 | Carbon canister |

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## General Inspection

**General Equipment**

| |
|---|
| Digital multimeter |

# PCV Valve Inspection

If the engine idle is unstable, inspect the crankcase ventilation valve for blockage or air leakage, the vent hole filter and air filter element for excessive dirty, or the hose for blockage or air leakage. Perform the following procedures:

1. Remove the crankcase ventilation valve from the valve chamber cover.
2. Run the engine at idle speed.
3. Put finger on the valve end to inspect for vacuum. If there is no vacuum, inspect for the following faults:
   - Hose blocked
   - Manifold port blocked
   - Crankcase ventilation valve blocked

Clogged PCV valve or hose may cause the following faults:

- idle speed is too low
- Engine oil leakage
- Oil into the air filter
- Oil dirt in engine
- Engine crankcase pressure is too high

leaked PCV valve or hose may cause the following faults:

- Engine idle is unstable
- Engine stalling
- Engine idle speed is too high
- Engine oil leakage

# Emission Control Valve Inspection

Perform the following procedures:

1. Remove the vacuum hose from emission control valve.
2. Run the engine at idle speed.
3. Put finger on the farther end of vacuum hose, inspect whether the tube is vacuum. If there is no vacuum, inspect for the following faults:
   - Vacuum hose blocked
   - Vacuum hose cracked
4. Use appropriate gas source to blow from the inlet of solenoid, the solenoid channel should be blocked, if there is leakage, replace the solenoid.
5. Use a diagnostic tool to drive the solenoid, then use appropriate gas source to blow from the inlet of solenoid, the solenoid channel should be unblocked, otherwise, inspect and repair the solenoid fault.

# Carbon Canister Inspection

1. Inspect the filter on carbon canister ventilation pipe for blockage, crack, or deformation, replace the filter.
2. Carbon canister visual inspection: replace if there is crack or deformation.
3. Remove and shake the carbon canister, replace if there is abnormal noise.
4. Inspect the connecting hose on the carbon canister, replace if blocked or damaged is found.
5. Use suitable air source to blow from one pipe inlet of the carbon canister, gas should flow out from the other two orifices, otherwise, replace the carbon canister.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, solve the fault before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Hose/hose joint<br>• Washer<br>• Positive crankcase ventilation valve (PCV)<br>• Vacuum tube<br>• Evaporative Emission Carbon Canister<br>• Evaporative emission system pipe | • Electrical connector<br>• Wiring harness<br>• Fuse<br>• Relay<br>• Emission Control Valve<br>• Engine control module (ECM) |

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the ECM for this fault, and can not confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Crankcase pressure is too high | • PCV valve or hose blocked or damaged<br>• Crankcase ventilation oil separator blocked | • Inspect PCV system set for blockage, clean or replace when necessary. |
| | • Engine set worn or damaged | **Refer to: (3.1.2 Mechanical System, Disassembly and Assembly).** |
| Evaporative emission system leakage | • Purge pipe cracked<br>• Carbon canister broken | • Replace the purge pipe.<br>• Replace the carbon canister. |
| Evaporative emission system is blocked | • Ventilation pipe blocked | • Clean the ventilation pipe.<br>• Replace the ventilation pipe.<br>• Replace the ventilation pipe filter. |
| | • Purge pipe blocked | • Clean the purge pipe port.<br>• Replace the purge pipe. |
| | • Solenoid pipe blocked | • Clean the solenoid pipe.<br>• Replace the solenoid. |
| Purge solenoid fault | • Circuit fault<br>• Purge solenoid fault<br>• ECM fault | • Diagnose the DTC.<br>• Inspect and repair the circuit.<br>• Replace the purge solenoid.<br>• Replace the ECM. |

## Diagnosis Procedure for Emission Control Valve Fault

**Refer to: P0444, P0448, P0459 Diagnosis Procedure (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**

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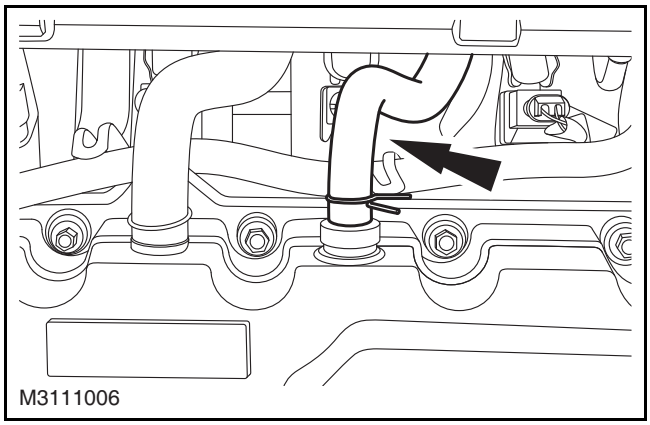


## Removal and Installation

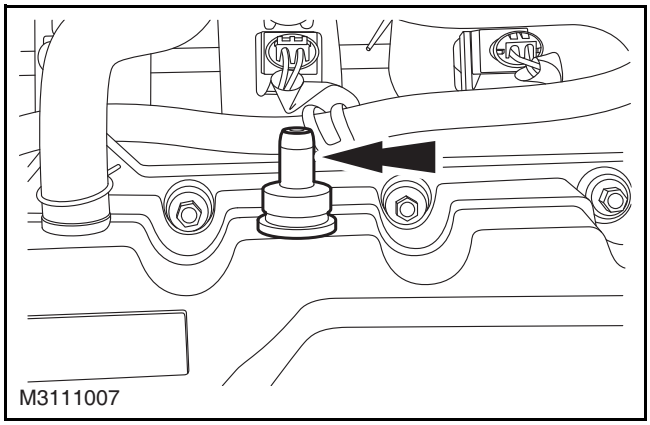
# PCV Valve

### Removal

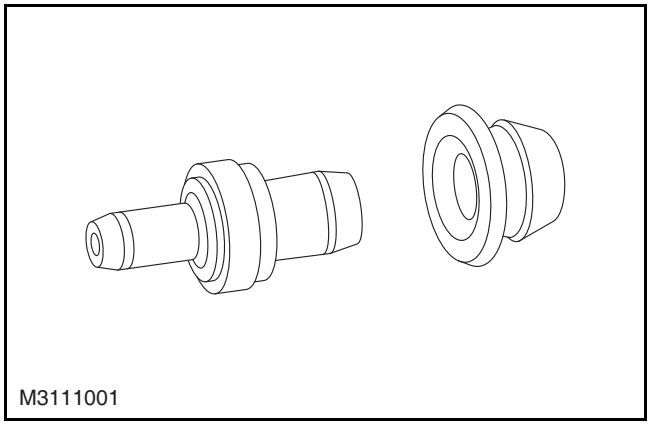
1. Loosen the PCV valve vacuum tube hoop, disconnect the PCV valve vacuum tube.


M3111006

2. Remove the PCV valve.


M3111007

3. Remove the PCV valve seal boot.
4. Inspect the PCV valve seal boot, replace when necessary.


M3111001

### Installation

1. Installation is in the reverse order of removal.

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# Carbon Canister Control Valve

## Removal

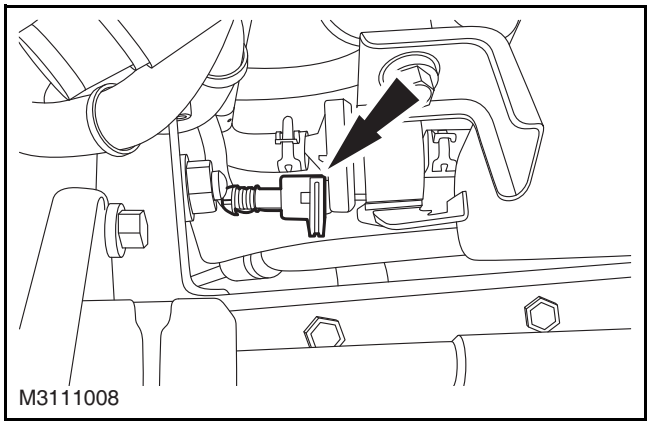
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

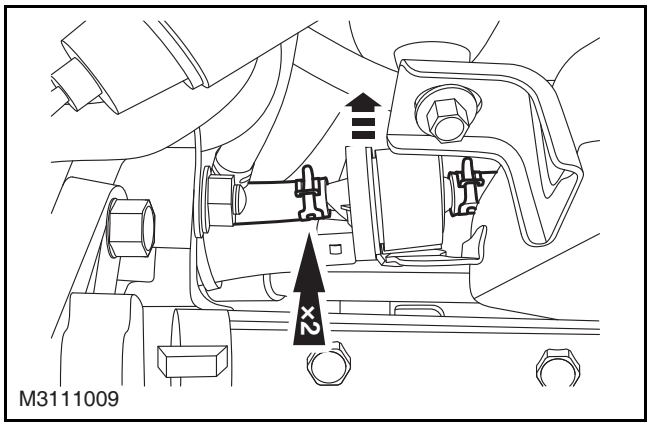
2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Disconnect the carbon canister control valve wiring harness connector.


M3111008

4. Disconnect the carbon canister control valve from carbon canister control valve support.
5. Loosen the carbon canister control valve hose hoop and disconnect the carbon canister control valve hose.



M3111009

## Installation

1. Installation is in the reverse order of removal.

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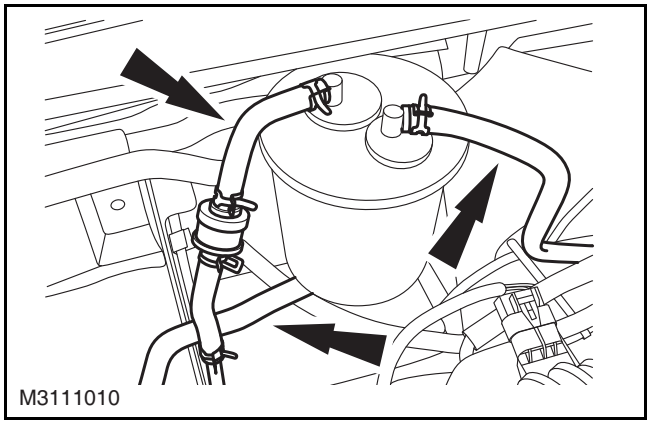
# Active Carbon Canister

## Removal

1. Disconnect the negative battery cable.

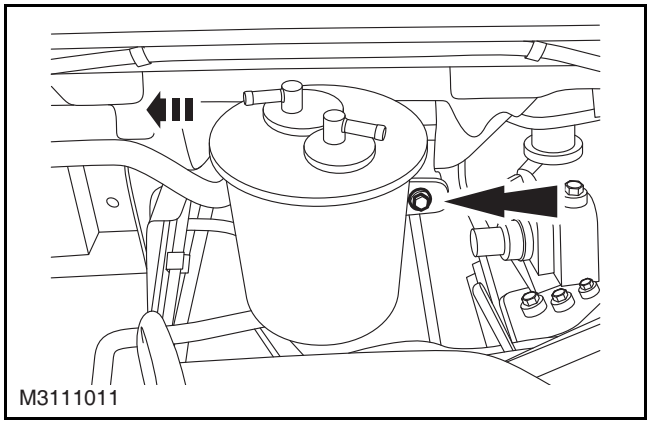
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Loosen the active carbon canister hose hoop and disconnect the active carbon canister hose.


M3111010

3. Remove the active carbon canister retaining bolt, and then remove the active carbon canister in the direction as shown in the figure.

   Torque: 10 ± 1 Nm


M3111011

## Installation

**CAUTION: When installing the active carbon canister, the airflow direction must be as specified and it should not be installed reversely. And take appropriate measures such as filtration or purification, to prevent foreign objects (particles, etc.) entering the carbon canister control valve from carbon canister or hose.**

1. Installation is in the reverse order of removal.

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# Front Oxygen Sensor

## Removal

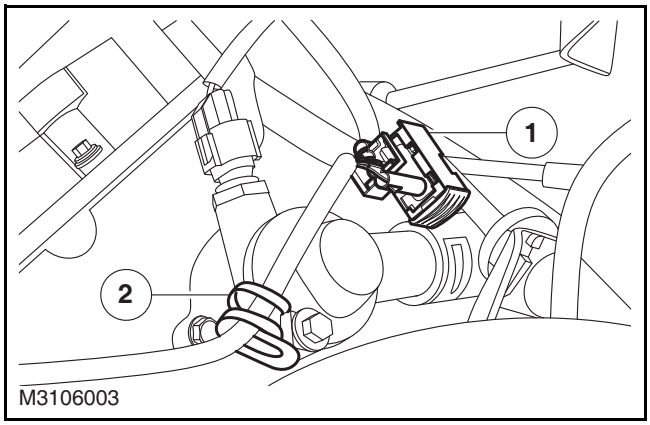
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

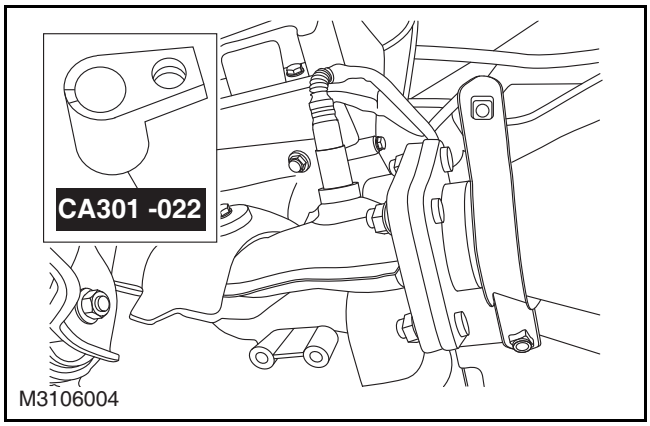
3. Disconnect the front oxygen sensor wiring harness connector (1).
4. Separate the front oxygen sensor wiring harness from bracket (2).




5. Use the special tool to remove the front oxygen sensor.

   Torque: 50 ± 10 Nm

   Special tool: oxygen sensor sleeve CA301-022




## Installation

1. Installation is in the reverse order of removal.

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# Rear Oxygen Sensor

## Removal

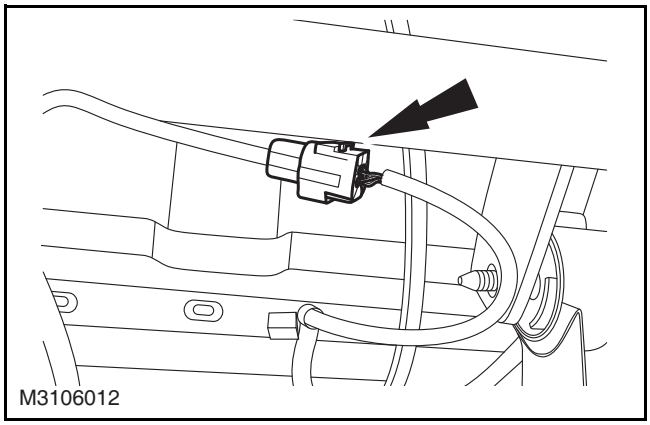
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

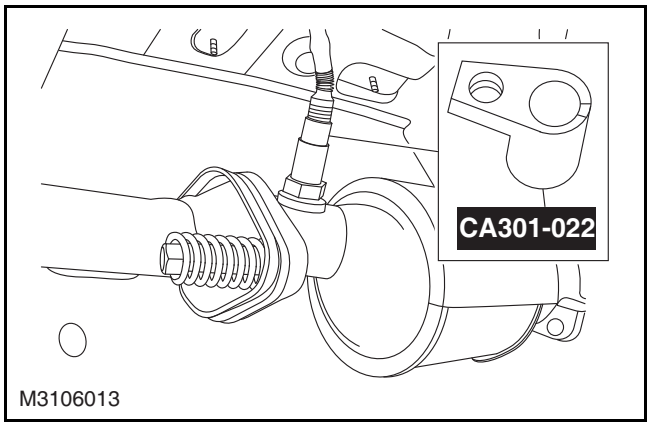
3. Disconnect the rear oxygen sensor wiring harness connector.


M3106012

4. Use the special tool to remove the rear oxygen sensor.

   Torque: 50 ± 10 Nm

   Special tool: oxygen sensor sleeve CA301-022



M3106013

## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Engine control module retaining nut | 8 ± 2 | - | - |
| Crankshaft position sensor retaining bolt | 10 ± 2 | - | - |
| Throttle position sensor retaining bolt | 1.5 - 2.5 | - | - |
| Idling stepper motor retaining bolt | 4 ± 0.4 | - | - |
| Coolant temperature sensor | 20 or less | 15 or less | - |
| Retaining bolt of intake pressure/temperature sensor | 8 ± 2 | - | - |
| Front oxygen sensor | 50 ± 10 | - | - |
| Rear oxygen sensor | 50 ± 10 | - | - |
| Knock sensor retaining bolt | 20 ± 5 | - | - |

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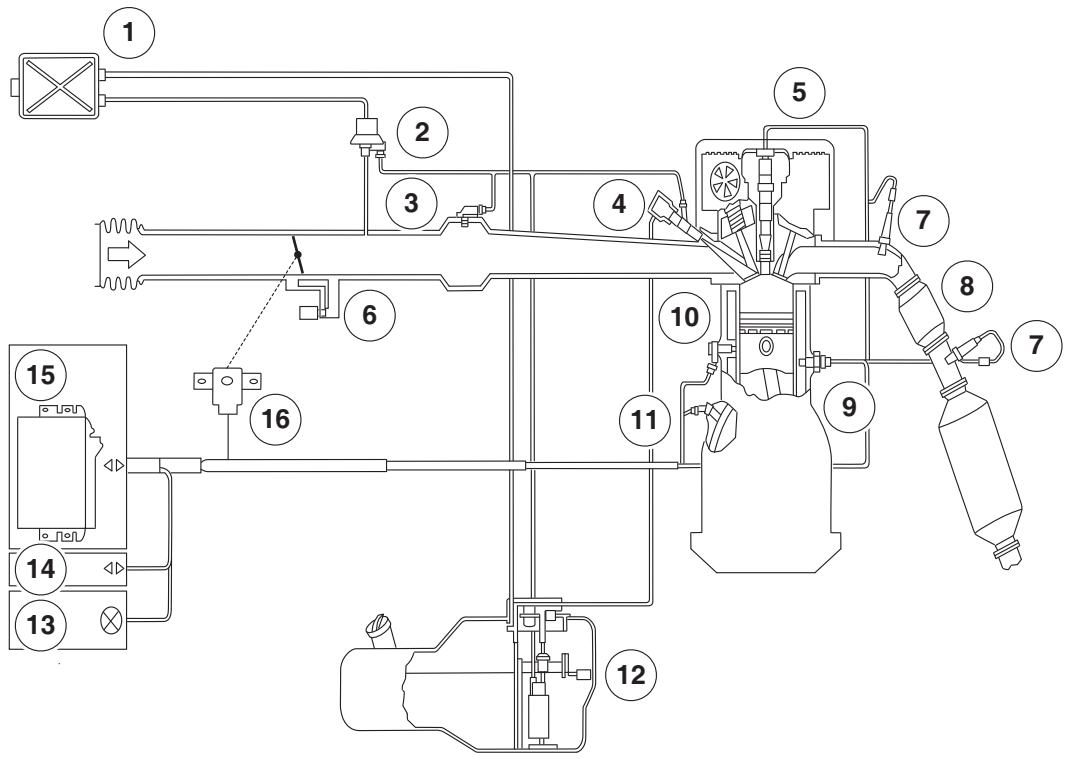


## Description and Operation

# System Overview

Engine electronic control system consists of the followings:

- Sensors that detect engine condition and operation.
- Engine control module that controls each actuator for electronic injection system according to signals from each sensor.
- Electronically controlled actuators.




M3112001

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Carbon canister | 9 | Coolant temperature sensor |
| 2 | Carbon canister control valve | 10 | Knock sensor |
| 3 | Air intake pressure/temperature sensor | 11 | Crankshaft position sensor |
| 4 | Fuel injector | 12 | Electrical fuel pump |
| 5 | Ignition coil | 13 | Malfunction indicator |
| 6 | Stepper motor | 14 | Data link connector |
| 7 | Oxygen sensor | 15 | ECM |
| 8 | Three-way catalytic converter | 16 | Throttle position sensor |

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# Control System Function Overview

## M7 System Input/Output Signals

The main sensor input signals of ECM in M7 system include:

- Air pressure and temperature signal
- Throttle rotation angle signal
- Coolant temperature signal
- Engine speed signal
- Knock sensor signal
- Oxygen sensor signal
- A/C pressure signal

After the above information goes into ECM, they are processed and then the required actuator control signals are generated, which are amplified in the output drive circuit, and are transmitted to corresponding actuator. These control signals include:

- Injection timing and injection duration
- Fuel pump relay
- Carbon canister control valve opening
- Ignition coil close angle and ignition advance angle
- A/C compressor relay
- Fan relay

Electronic control system can be divided into the following subsystems:

- Fuel injection control system
- Idle speed control system
- Fuel pump control system
- Ignition timing control system
- Radiator-fan control system
- Fuel evaporative emission control system
- Heating, ventilation and air conditioning system

## Fuel Injection Control

ECM controls the injection duration and injection timing based on various sensor signals, to ensure that appropriate gas mixture is provided in different driving conditions. There are two forms of injection timing, one is synchronous injection, which always injects at the same crankshaft angle; the other is non-synchronous injection, which is controlled based on signals from the air intake pressure/temperature sensor and other sensors.

**1.** Synchronous injection

When the engine starts, air in the intake manifold is static, the internal pressure of intake manifold shows as the surrounding atmospheric pressure. The 4 injectors will inject synchronously in each cycle of engine rotation. Fuel injection amount varies according to the engine temperature. Before the engine reaches a certain speed, the mixture needs to be enriched. Once the engine is running, the system immediately begins to reduce the cranking enrichment, and it will be completely canceled until the end of starting (600 ~ 700 rpm).

When a cylinder is in exhaust stroke after the engine starts, the injector only in that cylinder injects. ECM follows the order of cylinders 1, 3, 4, 2 to control the injection order of injectors.

**2.** Non-synchronous injection

All the injectors will not be controlled by the pressure/temperature sensor after the engine starts and meets the following two conditions.

- Fuel injection system starts to inject when fuel is cut off.
- When the throttle opening rate is higher than the specified value (throttle opens too fast).

Non-synchronous injection is generated quickly under the above two situations.

**3.** Injection time

The main factor of identifying the fuel injection time is the basic injection time value that calculated according to the engine speed, the intake manifold pressure and temperature (air intake flow), and the compensation value that is determined by signals from various sensors used for detecting the engine and operating conditions.

**4.** Fuel cut-off

The injection stops (by stopping injector) while slowing down (for example, when throttle is on idling position and engine is running at high speed). It ensures that unburned gas will not be discharged and be started again under above different conditions.

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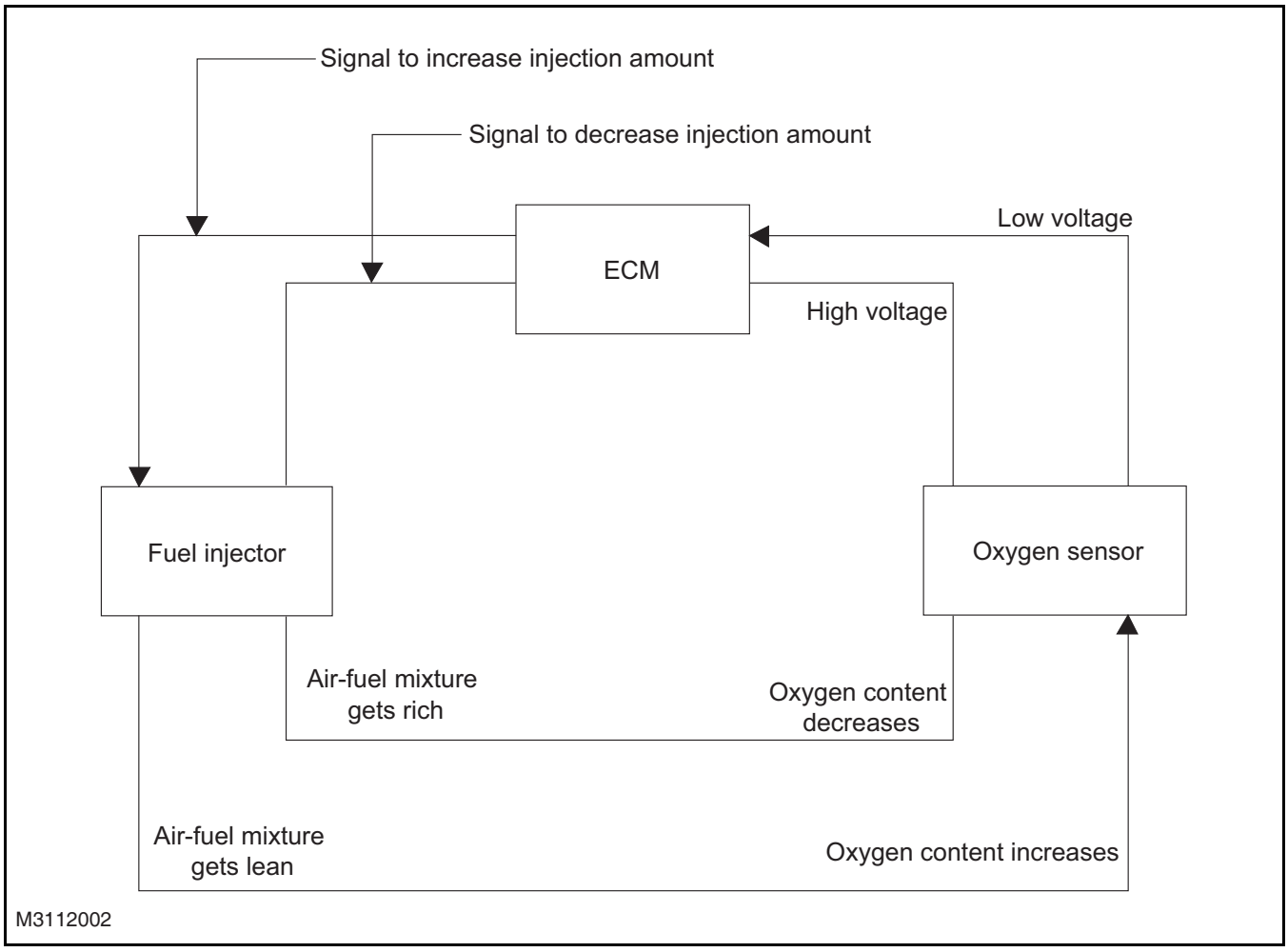
## Air-fuel Ratio Feedback Compensation (Closed-loop System)

The air-fuel mixture must be close to stoichiometric air-fuel ratio (14.7) to ensure that the three-way catalytic conversion process is fully performed and high purification rate of CO, HC and NOx in exhausting is reached.

λ closed loop control system can work only with oxygen sensor equipped. Oxygen sensor monitors the oxygen content in the exhaust gas at the up/down location of three-way catalytic converter. Lean mixture (λ is more than 1) generates about 100 mV sensor voltage and rich mixture (λ is less than 1) generates about 800 mV sensor voltage. When λ is equal to 1, the sensor voltage will change greatly. The λ closed-loop control responds to the input signal (λ is 1 or greater for too lean mixture, and 1 or less for too rich mixture) to modify the control variables, resulting in correction factor as a multiplier to correct the fuel injection duration.

When any of the following conditions is met, ECM exits from closed-loop control.

- When the engine starts and injection amount is increased after the engine starts.
- When the engine coolant temperature is too low.
- When the load is high and injection amount increases.
- When the fuel is cut off.
- When the oxygen sensor is cooled.



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## Idle Speed Control

The control system uses ECM and idling stepper motor to achieve control purposes as follows: Engine always keeps a certain speed under idling status. The idling speed of engine varies with reasons as follows:

- Add load to the engine (electrical load, for example, turn on A/C switch).
- Engine itself changes with time.
- Improve the engine start performance.
- Adjust the air-fuel ratio during deceleration (reduction buffer function).
- When engine warms up, improve its performance.

Operation:

Idle speed control operates in accordance with effective information output from ECM, which detects operation status of engine with sensors and switch signals, and controls air flow through idling stepper motor.

## Fuel Pump Control

ECM controls the fuel pump ON/OFF. In either of the following cases, it energizes the fuel pump through fuel pump relay.

- Two seconds after the ignition switch is turned off.
- When engine starts (engine start signal output to ECM).

## Ignition Timing Control

The system adopts distributorless, double-cylinder direct ignition, and each ignition coil is connected to two spark plugs. ECM controls the internal high power transistor of injector according to the signals from sensors to cut on or off the ignition coil primary winding circuit, increasing the ignition reliability and ignition coil life and improving the engine dynamic property and economy. The control includes the following three different forms:

- Ignition timing when the engine starts (initial ignition timing)
- Engine after-start control
- Charge current time control

**1.** The ignition time after engine starts can be confirmed as follows, then the ignition occurs in the most appropriate moment under different conditions of engine.

| Ignition time | = | Initial ignition timing | + | Ignition timing | + | Basic ignition advance angle | + | Various compens-ation advance angles |
|---|---|---|---|---|---|---|---|---|

When the throttle is at idle speed position, ignition time is calculated based on the initial ignition timing, plus the basic ignition advance angle that is determined by engine speed and engine cooling compensation, and the idle stability related advance compensation angle.

When the throttle opening is larger than that at idle speed position, it is also calculated based on the initial ignition timing, plus the basic ignition advance angle that is determined by engine speed, air intake pressure and engine cooling compensation, and the idle stability related advance compensation angle.

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## Radiator-fan Control

The system controls radiator-fan motor ON/OFF, which is achieved through a relay controlled by ECM. When air conditioning is running or stopped, the radiator-fan motor should be turned on or off accordingly.

## Fuel Evaporative Emission Control

Fuel evaporative emission control system is used to prevent fuel vapor from evaporating. This vapor, generated from the fuel during engine run or stop, goes into the carbon canister through the tank pressure control valve, and is absorbed or stored by carbon canister. Carbon canister control valve is controlled by ECM based on various sensor signals.

Only when the following conditions are met, ECM will open the vacuum channel of carbon canister control valve.

- When the engine is at normal operating temperature.
- When the engine speed is higher than the specified value.
- When the throttle opening is larger than that at idle speed position (throttle close position).
- When the engine is running within the required load.

The result is that the carbon canister is purified due to the air flow going through the carbon filter located at the bottom of the canister.

Fuel tank pressure control valve is used to maintain constant tank pressure. This valve opens so that the vapor goes into the carbon canister. On the contrary, when the tank pressure becomes negative and reaches its specified value, the valve opens so that air goes into the tank.

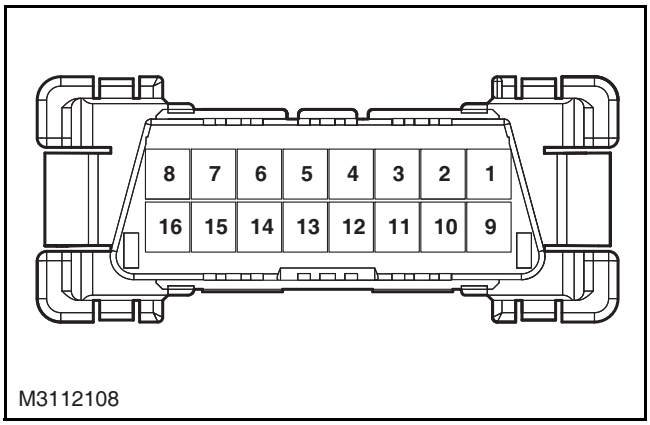
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# Fault Diagnosis Function Overview

## Diagnostic Tool and Connection

This system applies standard Data Link Connector (DLC), which is installed under the ashtray of instrument panel in the cab. Terminals 12 and 13 of DLC are connected to ground wire; terminal 15 is connected to terminal 15 of ECM, i.e. engine data K-line; and terminal 8 is connected to battery positive.




M3112108

The diagnostic tool communicates with ECM via K-line, and the following operations can be performed with it (for details, refer to diagnostic tool instruction manual):

## Engine Parameter Display

1. Speed, coolant temperature, throttle opening, ignition advance angle, injection pulse width, intake pressure, intake temperature, vehicle speed, system voltage, injection trim, carbon canister scour rate, idle speed air control, oxygen sensor wave.
2. Target speed, engine relative load, ambient temperature, ignition close time, evaporator temperature, intake flow, signal voltage of throttle position sensor, signal voltage of coolant temperature sensor, signal voltage of intake temperature sensor, signal voltage of intake pressure sensor.

## Electronic Injection System Condition Display

Cooling system condition, stable condition, dynamic condition, emission control condition, oxygen sensor condition, idle speed condition, malfunction indicator condition, A/C system condition.

## Active Test Function

Malfunction indicator, fuel pump, A/C relay, fan, ignition, injection (single cylinder with fuel cut-off).

## Edition Information Display

Vehicle Identification Number (VIN) (for vehicle with VIN code), ECM hardware number, ECM software number.

## Fault Display

Intake pressure sensor, intake temperature sensor, engine coolant temperature sensor, throttle position sensor, oxygen sensor, oxygen sensor heating wires, air-fuel ratio correction, fuel injector of each cylinder, fuel pump, knock sensor, crankshaft position sensor, carbon canister control valve, cooling fan relay, vehicle speed signal, idle speed, idle stepper motor, system voltage, ECM, A/C compressor relay, evaporator temperature sensor, malfunction indicator.

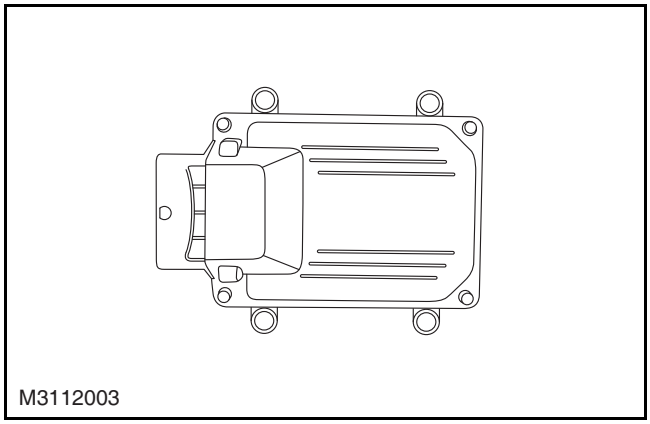
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# Components Description

## Engine Control Module

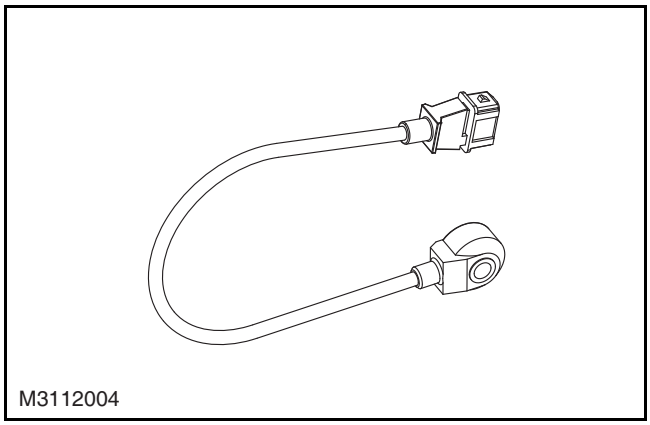
Engine Control Module (ECM), installed under the front passenger seat, receives input signals, output control signals, detects system conditions, record trouble code and illuminates the malfunction indicator when a malfunction occurs.



M3112003

## Knock sensor

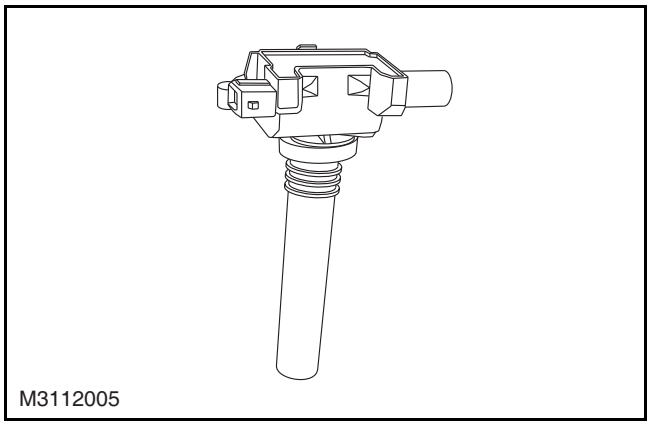
The knock sensor is directly installed on the engine block and located at the bottom of intake manifold. The knock sensor will record the vibration when engine knocking happens. ECM adjusts the ignition timing by using the knock sensor signal to avoid knocking.



M3112004

## Ignition coil

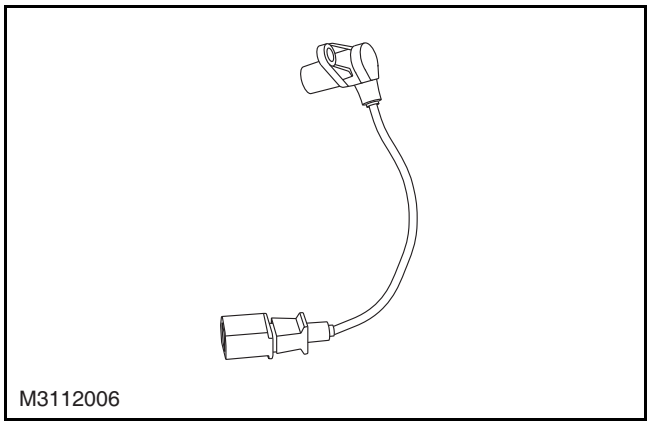
The ignition coil for cylinder 1 and 4 is located on the spark plug hole for cylinder 1. The ignition coil for cylinder 2 and 3 is located on the spark plug hole for cylinder 3. The ignition coil transforms the low voltage of primary winding into high voltage of secondary winding, and the spark is discharged through the spark plug, igniting the mixture of air and fuel in the cylinder. ECM controls the ground of ignition coil primary winding.



M3112005

## Crankshaft position sensor

Crankshaft position sensor is a electromagnetic induction sensor located on the clutch housing, it's used to pick up signals from the flywheel gear ring. The gear ring has 58 teeth, and ECM determines top dead center of cylinder 1 by the missing teeth signal. The crankshaft position sensor is unadjustable and requires no set procedure during installation.



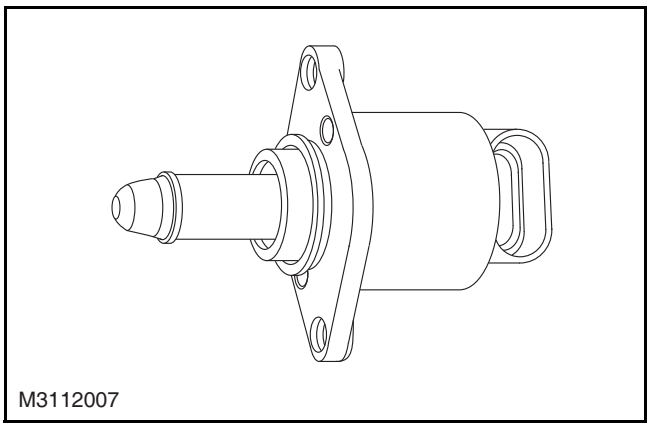
M3112006

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## Idling stepper motor

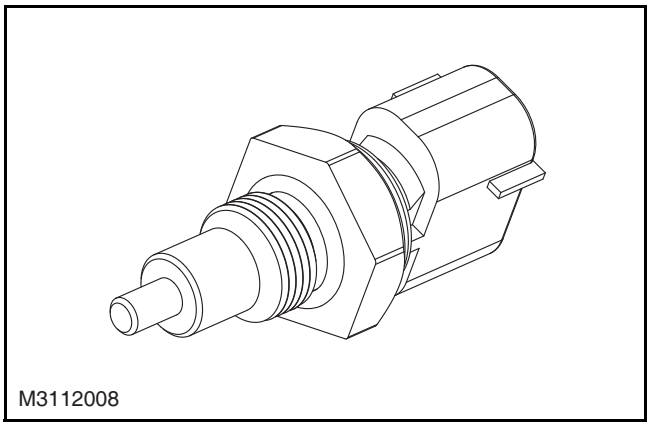
Idling stepper motor, installed on the air passage of throttle body, can change the flow area of air by-pass passage through controlling the adjustable head forward and backward on the basis of signals from ECM to regulate the air amount entering the engine, thus controlling the engine idle speed.



M3112007

## Coolant temperature sensor

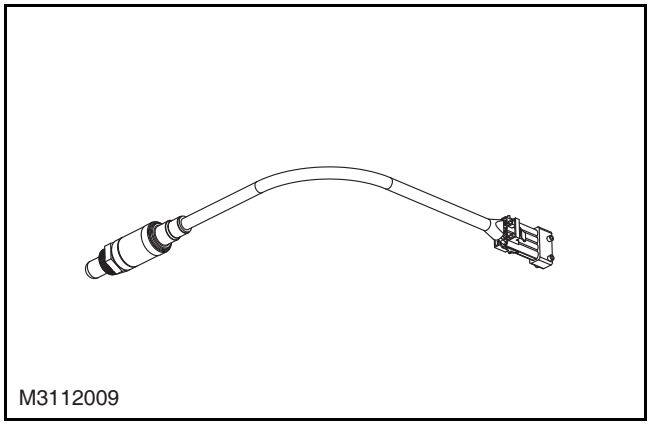
Coolant temperature sensor is mounted on the thermostat seat. The sensor, in which a thermistor with negative temperature coefficient is built, transforms the change of coolant temperature to that of thermistor resistance value using the temperature sensitive characteristic of thermistor, and then transforms it to voltage signal by voltage division circuit, to output to ECM.



M3112008

## Oxygen sensor

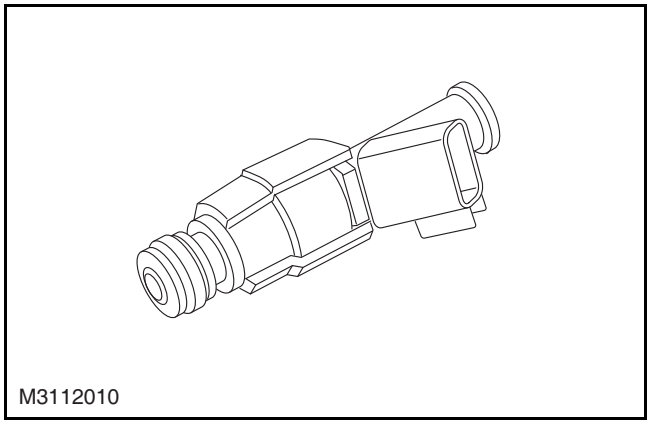
The vehicle is equipped with two oxygen sensors, which are located in the front and rear of three-way catalytic converter respectively. The oxygen sensor can detect the oxygen content in the exhaust gas, by which ECM determines whether the fuel mixture is lean or rich and performs feedback control. A heater is built into the oxygen sensor and used to heat the sensor to working temperature when the cold engine is started.



M3112009

## Fuel injector

Fuel injectors are located on the cylinder head. They inject fuel during determined time according ECM commands. ECM controls injector ground signal. The injectors are electromagnetic controlled, and injection volume depends on needle valve open time, i.e. open impulse width.



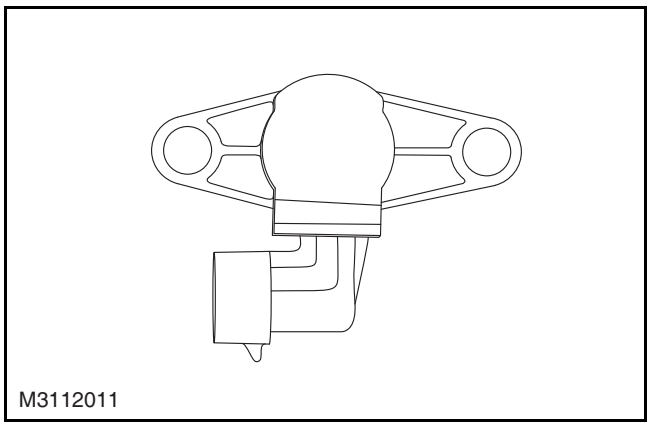
M3112010

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## Throttle position sensor

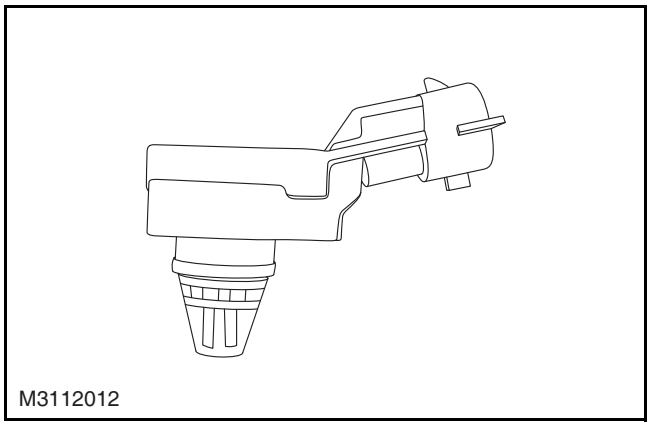
Throttle position sensor, located on the throttle body, is used to detect the throttle opening angle and output the voltage signal to ECM as engine load signal, thus making a judgment of engine operation.



M3112011

## Air intake pressure/temperature sensor

Air intake pressure/temperature sensor is located on the intake manifold and integrated with pressure sensor and temperature sensor. Based on sensor signals and other information, ECM regulates the injection amount.

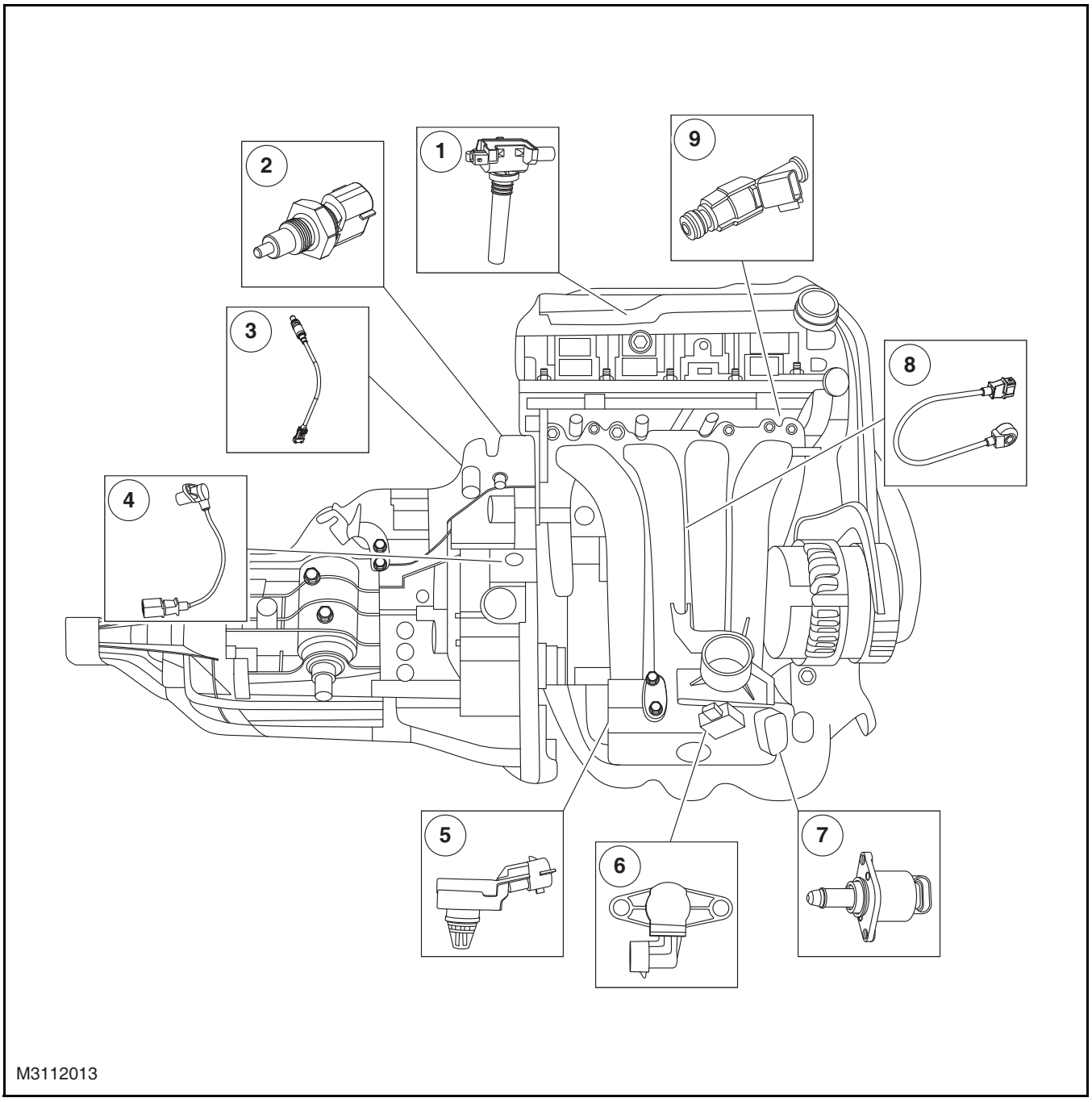


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# Components Location View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Ignition coil | 6 | Throttle position sensor |
| 2 | Coolant temperature sensor | 7 | Idling stepper motor |
| 3 | Oxygen sensor | 8 | Knock sensor |
| 4 | Crankshaft position sensor | 9 | Fuel injector |
| 5 | Air intake pressure/temperature sensor | | |

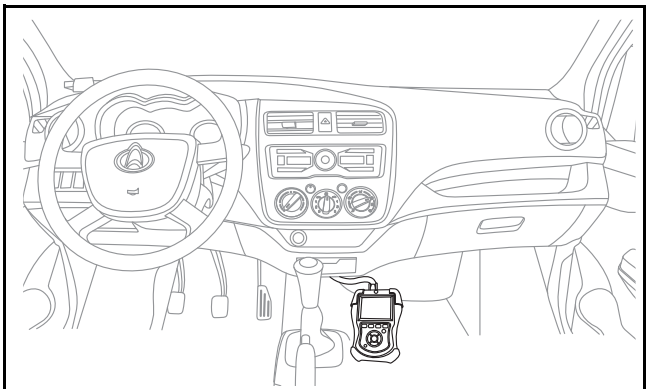
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## General Inspection

**General Tool**

| |
|---|
| Diagnostic tool |
| Multimeter |



M3112014

# DTC Read Procedure

1. Carry out necessary vehicle preparation and appearance inspection.
2. Connect the diagnostic tool to data link connector in the cab.
3. Use the diagnostic tool to read the DTC.

# Data Flow Read Procedure

1. Carry out necessary vehicle preparation and appearance inspection.
2. Connect the diagnostic tool to data link connector in the cab.
3. Use diagnostic tool to enter the engine system to read the data flow.

# Active Test Procedure

1. Carry out necessary vehicle preparation and appearance inspection.
2. Connect the diagnostic tool to data link connector in the cab.
3. Use the diagnostic tool to enter Actuators menu, and carry out the desired active test.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |
| Diagnostic tool |
| Exhaust backpressure gauge |
| Cylinder pressure gauge |
| Fuel pressure gauge |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and diagnose the system with diagnostic tool.

### Visual Inspection Chart

| Electrical |
|---|
| • Fuse |
| • Relay |
| • Wiring harness |
| • Electrical connector |
| • Sensor |
| • Switch |
| • Engine Control Module (ECM) |

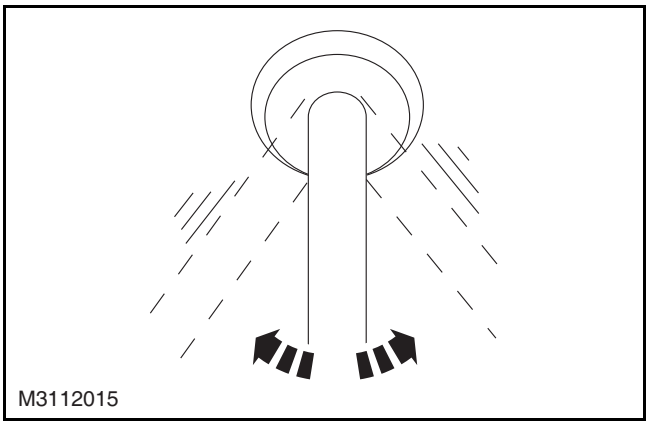
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# Intermittent Malfunction Diagnosis Procedure

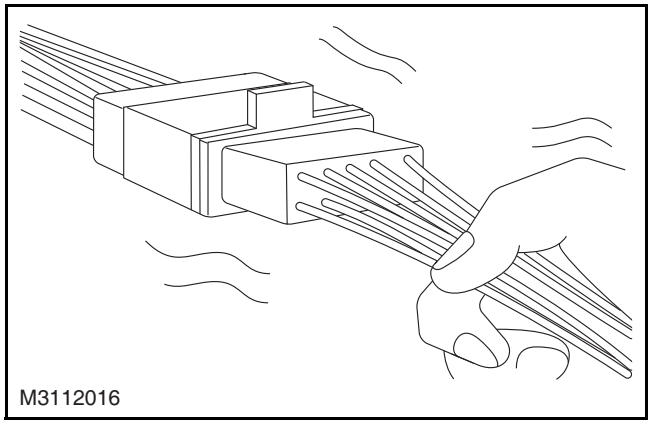
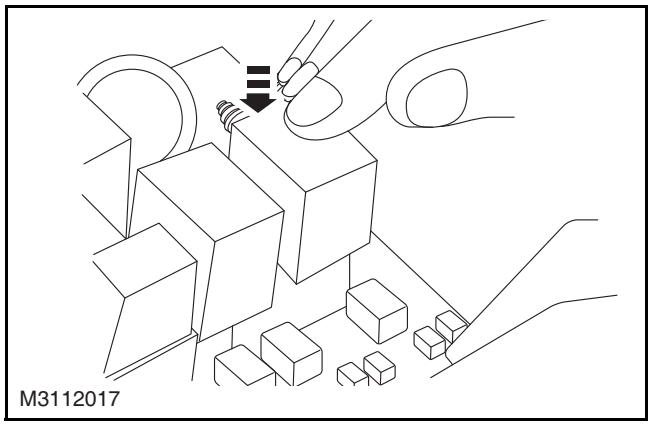
If the fault cannot be confirmed via DTC check, the symptom only occurs during application occasionally. At this point, confirm all wires and parts that may cause fault. Mostly, fault area can be determined quickly and effectively through basic inspection as shown in the diagram below. Especially the symptom, such as poor contact of wiring harness connector.

Malfunction definition: This malfunction currently does not appear, but the historical DTC record indicates that the malfunction occurred before. Or customer reports the malfunction, but as the malfunction is not related to the diagnostic trouble code, and currently the malfunction symptom cannot recur.

<table>
<tr><th>Test Conditions</th><th>Details/Results/Actions</th></tr>
<tr><td colspan="2">1.Vibration method</td></tr>
<tr><td></td><td>A. If driving on a rough road, a malfunction occurs or becomes more serious, or engine starts to vibrate, perform the following steps.<br>B. Electrical faults may be caused by vehicle or engine vibration for some reasons. Inspect the following items:<br>• Connector is not fully in position.<br>• Wiring harness does not have enough space.<br>• Wiring harness comes across the supports or moving components.<br>• Wiring harness too close to the high temperature components.<br>C. Incorrect wiring layout, tight or loose wiring harness will cause itself to be squeezed between the components.<br>D. Connector joint, vibration location and wiring harness location are all items for focus inspection, such as: wiring harness through firewall and body panels.</td></tr>
<tr><td colspan="2">2. Inspection method for switch connector or wiring harness</td></tr>
<tr><td>  <br>M3112015</td><td>A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>Note: If the malfunction occurs when engine is running, carry out the following procedure with the engine idling.<br>C. Access to the data flow of switch that you are inspecting.<br>D. Turn on the switch manually.<br>E. When monitoring the data flow, gently shake the connector or wiring harness of switch.<br>If the data flow value is unstable, please inspect if there is a poor connection.</td></tr>
<tr><td colspan="2">3. Inspection method for sensor connector or wiring harness</td></tr>
</table>

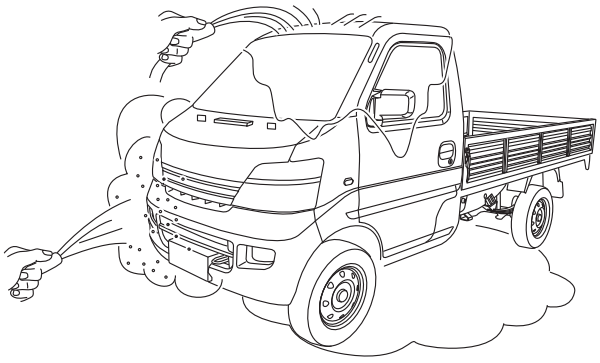
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| Test Conditions | Details/Results/Actions |
|---|---|
|  M3112016 | A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>**Note: If the malfunction occurs when engine is running, carry out the following procedure with the engine idling.**<br>C. Access to the data flow of sensor that you are inspecting.<br>D. When monitoring the data flow, gently shake the connector or wiring harness of sensor.<br>If the data flow value is unstable, please inspect if there is a bad connection. |
| 4. Inspect method for actuator or relay | |
|  M3112017 | A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>**Note: If the malfunction occurs when engine is running, carry out the following procedure with the engine idling.**<br>C. By diagnostic tool, turn on the actuator or relay that you are inspecting.<br>D. Vibrate the actuator or relay with fingers for 3 seconds.<br>If you hear unstable "clicking" sound, inspect if there are poor connections or abnormal installation.<br>**CAUTION: Strong vibration of relay may open it.** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Water sprinkling method | |
|  <br>M3112018 | If the malfunction only occurs in high humidity, or snow/rain weather, the following steps should be performed:<br>Spray water on the face of radiator to indirectly change the temperature and humidity. If the vehicle easily leaks, it may damage the control module. In detecting the existence of vehicle leaking problem, special precautions must be taken.<br>A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>**Note: If the malfunction occurs when engine is running, carry out the following procedure with the engine idling.**<br>C. Access to the data flow of sensor or switch.<br>D. If you want to inspect the switch, manually turn on it.<br>E. Spray water onto the vehicle, or drive the vehicle through the car wash.<br>If the data flow value is unstable or fails, please repair or replace the parts when necessary. |

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine cannot start at normal start speed | • Crankshaft position sensor<br>• Fuel pump<br>• Ignition coil<br>• Exhaust system blocked<br>• Engine mechanical<br>• ECM | Refer to: Diagnosis Procedure for Engine not Starting at Normal Start Speed (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |
| Cold start problem | • Coolant temperature sensor<br>• Spark plug<br>• Fuel pump<br>• Fuel injector<br>• Throttle body<br>• Engine mechanical<br>• Engine control module circuit | Refer to: Diagnosis Procedure for Cold Start Problem (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |
| Hot start problem | • Coolant temperature sensor<br>• Ignition system<br>• Fuel pump<br>• Engine control module circuit | Refer to: Diagnosis Procedure for Hot Start Problem (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |
| Start normal but idle speed unstable at any time | • Air intake system<br>• Ignition system<br>• Throttle body<br>• Ignition timing<br>• Fuel system<br>• Engine mechanical<br>• Engine control module circuit | Refer to: Diagnosis Procedure for Start Normal but Idle Speed Unstable at Any Time (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |
| Start normal, idle speed unstable or flameout with partial load | • Heating, ventilation and air conditioning<br>• Throttle body<br>• Fuel injector | Refer to: Diagnosis Procedure for Start Normal but Idle Speed Unstable or Flameout with Partial Load (A/C ON) (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Start normal, idle speed too high | • Coolant temperature sensor<br>• Throttle body<br>• Vacuum tube<br>• Ignition timing<br>• Engine control module circuit | **Refer to: Diagnosis Procedure for Start Normal, Idle Speed Too High (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| Speed does not increase or flameout at acceleration<br>Acceleration problem<br>Acceleration slow reaction<br>Acceleration weak, poor performance | • Air intake system<br>• Air intake pressure sensor<br>• Throttle body<br>• Fuel injector<br>• Spark plug<br>• Ignition timing<br>• Fuel<br>• Exhaust blockage<br>• Engine control module circuit | **Refer to: Diagnosis Procedure for Acceleration Fault (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| Unstable engine operation | • Oxygen sensor<br>• Fuel injector<br>• Spark plug<br>• Ignition timing<br>• Fuel pressure<br>• Retaining bolts loose or engine mounting components damaged<br>• Engine control module circuit | **Refer to: Diagnosis Procedure for Unstable Engine Operation (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| Easy flameout at start | • Crankshaft position sensor<br>• Fuel injector<br>• Spark plug<br>• Ignition timing<br>• Fuel pressure<br>• A/C compressor<br>• Engine control module circuit | **Refer to: Diagnosis Procedure for Easy Flameout at Start (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Emergency during vehicle running | • MAP sensor<br>• Incorrect A/C system operation<br>• Intake system components leakage<br>• Carbon canister control valve<br>• Unstable signal from CKP sensor<br>• Vacuum leakage<br>• Poor fuel quality<br>• Main relay and fuel pump relay intermittent fault<br>• Throttle body<br>• Engine overheating<br>• Spark plug<br>• Ignition timing<br>• Exhaust system restriction<br>• Fuel pressure inadequate<br>• Fuel pump mechanical<br>• Fuel injector | **Refer to: Diagnosis Procedure for Emergency During Vehicle Running (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| Flameout during coasting | • Vacuum leakage<br>• Intake system leakage<br>• Air/fuel mixing ratio improper control<br>• Fuel evaporative emission control system<br>• TPS sensor or related circuit<br>• MAP sensor or related circuit<br>• Incorrect operation of A/C magnetic clutch<br>• Fuel injector<br>• Spark plug<br>• Ignition timing<br>• Fuel<br>• Exhaust blockage | **Refer to: Diagnosis Procedure for Flameout During Coasting (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |

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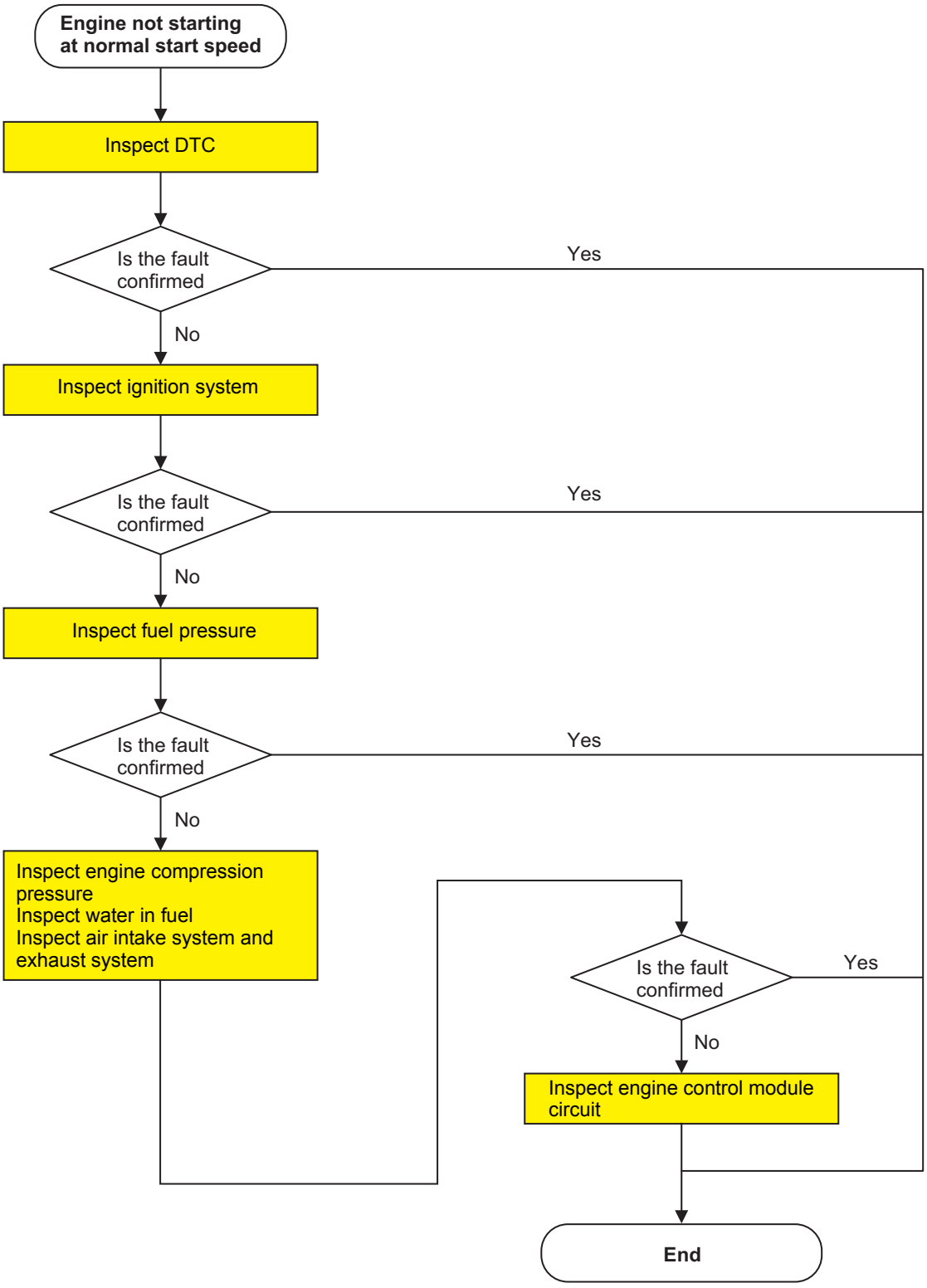


| Symptom | Possible Causes | Solutions |
|---|---|---|
| MIL indicator is always on | • Instrument cluster circuit<br>• Instrument cluster<br>• ECM<br>• ECM circuit | Refer to: Diagnosis Procedure for DTC P0650 (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |
| MIL indicator is not on | • MIL indicator bulb<br>• Instrument cluster circuit<br>• Instrument cluster<br>• ECM | Refer to: Diagnosis Procedure for DTC P0650 (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |

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# Diagnosis Procedure for Engine not Starting at Normal Start Speed



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect ignition system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Carry out the ignition spark test.<br>**Refer to: Ignition Spark Test (3.1.8 Ignition System, General Inspection).**<br>Is the ignition spark test normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect the ignition system.<br>**Refer to: Diagnosis Procedure for Spark Plugs not Flashing Over (3.1.8 Ignition System, Symptom Diagnosis and Testing).** |
| 3. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect the fuel system. |

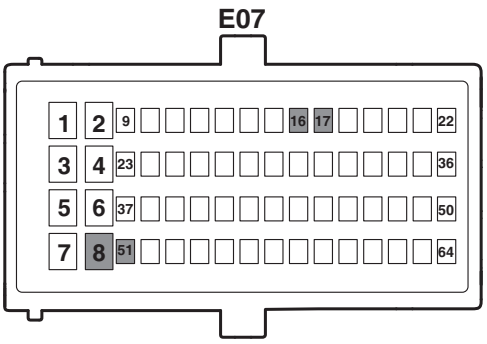
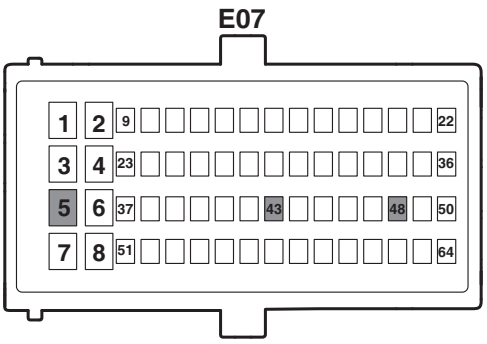
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect engine compression pressure | |
| | A. Inspect the engine compression pressure.<br>**Refer to: Cylinder Compression Pressure Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the compression pressure normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect the engine mechanical system. |
| 5. Inspect water in fuel | |
| | A. Remove the fuel filter joints.<br>**Refer to: Fuel Filter (3.1.7 Fuel System, Removal and Installation).**<br>B. Discharge the fuel in the filter and inspect the water in the fuel.<br>Is there any water in the fuel?<br>**Yes**<br>Clean the fuel tank, and add qualified fuel.<br>**No**<br>Go to step 6. |
| 6. Inspect air intake system and exhaust system | |
| | A. Remove intake system hose in front of throttle and idling stepper motor, and inspect for dirt or clog due to foreign matter.<br>B. Remove the exhaust pipe and three-way catalytic converter, and inspect if there is foreign matter or three-way catalytic converter which comes off due to damage to get the emission system clogged.<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Clean or replace the fault parts. |

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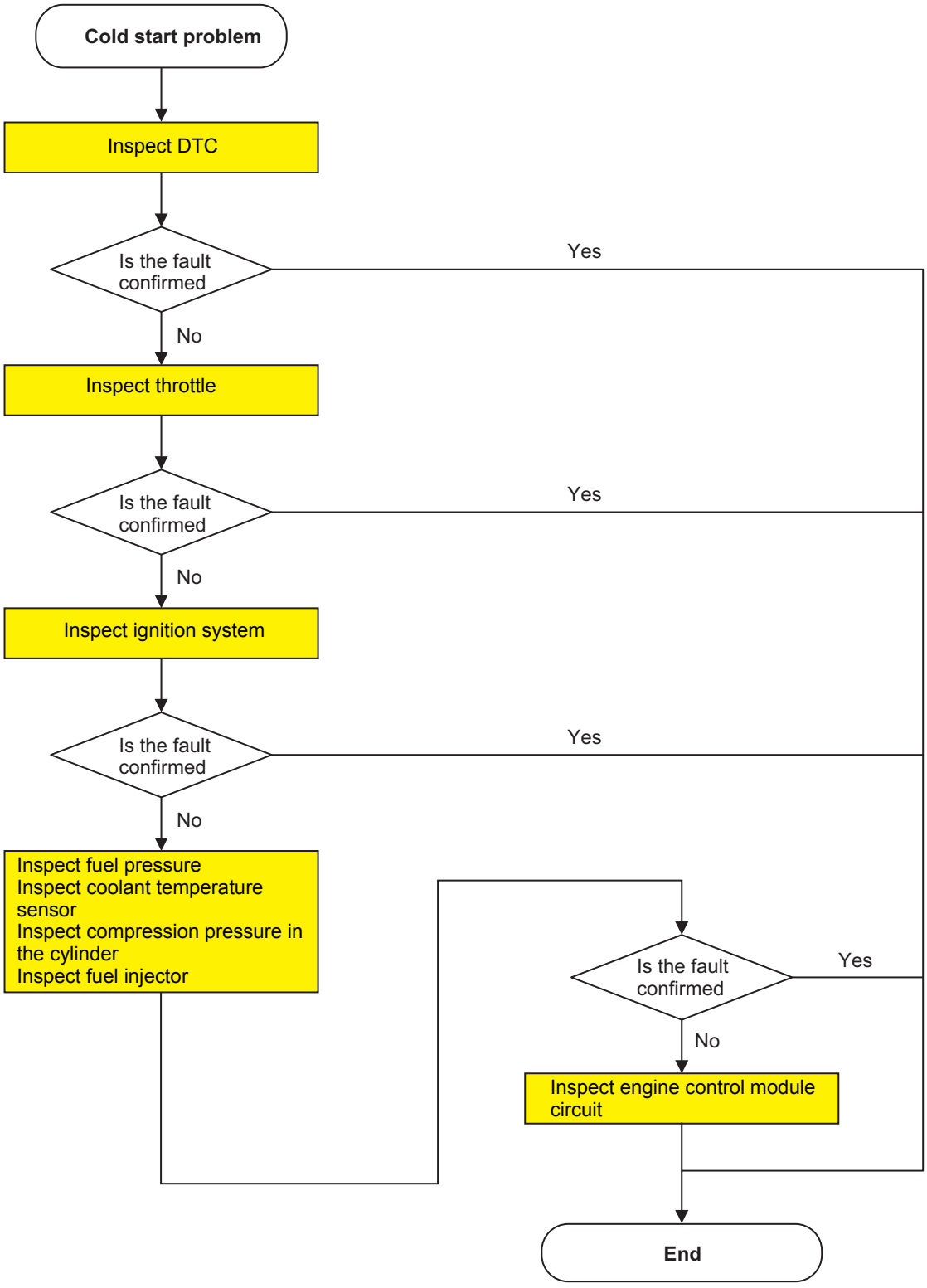


| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Cold Start Problem



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect throttle | |
| | A. Start the engine by depressing the accelerator pedal slightly.<br>Can the engine be started easily?<br>**Yes**<br>Clean the throttle, idling stepper motor. If the intake system has thick carbon deposit, clean the throttle and intake duct.<br>**No**<br>Go to step 3. |
| 3. Inspect ignition system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Carry out the ignition spark test.<br>**Refer to: Ignition Spark Test (3.1.8 Ignition System, General Inspection).**<br>Is the ignition spark test normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect the ignition system.<br>**Refer to: Diagnosis Procedure for Spark Plugs not Flashing Over (3.1.8 Ignition System, Symptom Diagnosis and Testing).** |

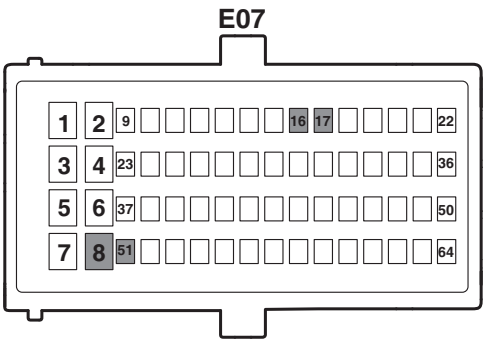
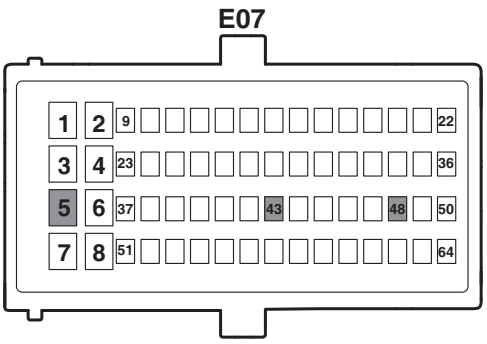
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect the fuel system fault. |
| 5. Inspect coolant temperature sensor | |
| | A. Disconnect the coolant temperature sensor connector.<br>B. Connect a 2.5 kΩ resistor in series substituted for coolant temperature sensor at the sensor connector.<br>C. Start the cold engine.<br>Is the start smooth?<br>**Yes**<br>Replace the coolant temperature sensor.<br>**No**<br>Go to step 6. |
| 6. Inspect compression pressure in the cylinder | |
| | A. Inspect the compression pressure in the cylinder.<br>**Refer to: Cylinder Compression Pressure Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the pressure insufficient in any cylinder?<br>**Yes**<br>Inspect the engine mechanical system.<br>**No**<br>Go to step 7. |
| 7. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage or blockage.<br>Are they normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Replace the fuel injector. |

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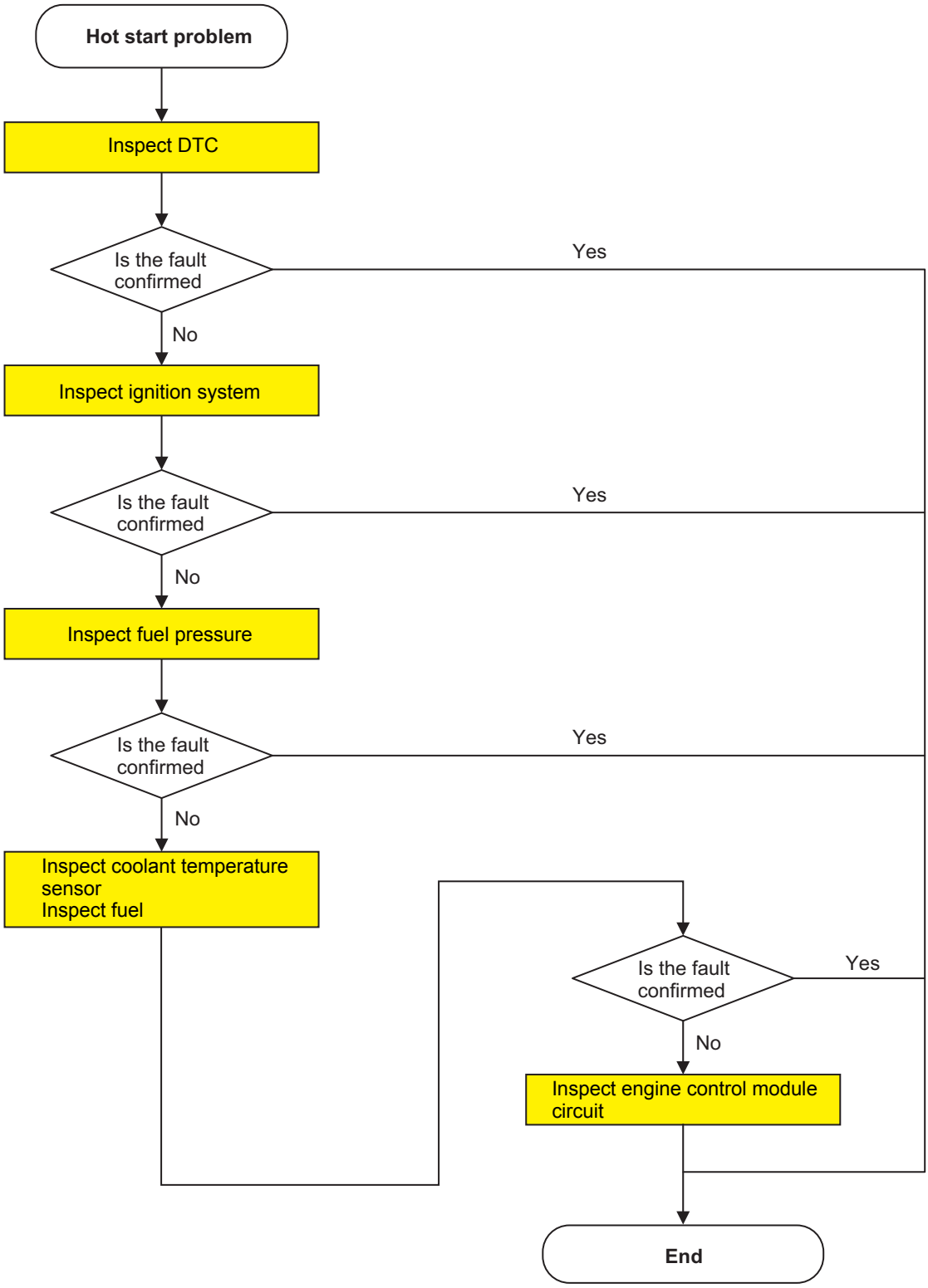


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Hot Start Problem



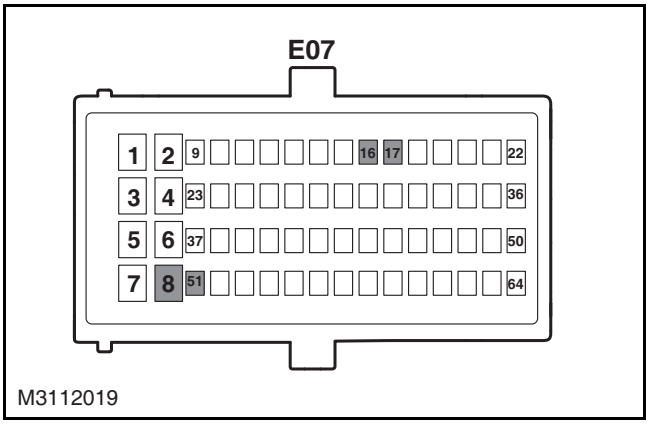
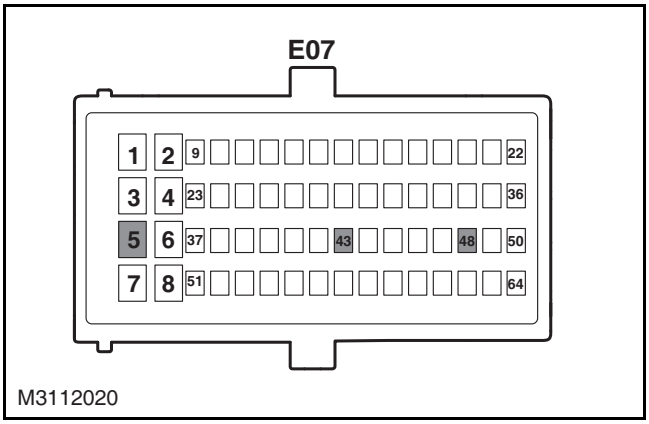
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect ignition system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Carry out the ignition spark test.<br>**Refer to: Ignition Spark Test (3.1.8 Ignition System, General Inspection).**<br>Is the ignition spark test normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect the ignition system.<br>**Refer to: Diagnosis Procedure for Spark Plugs not Flashing Over (3.1.8 Ignition System, Symptom Diagnosis and Testing).** |
| 3. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect the fuel system fault. |

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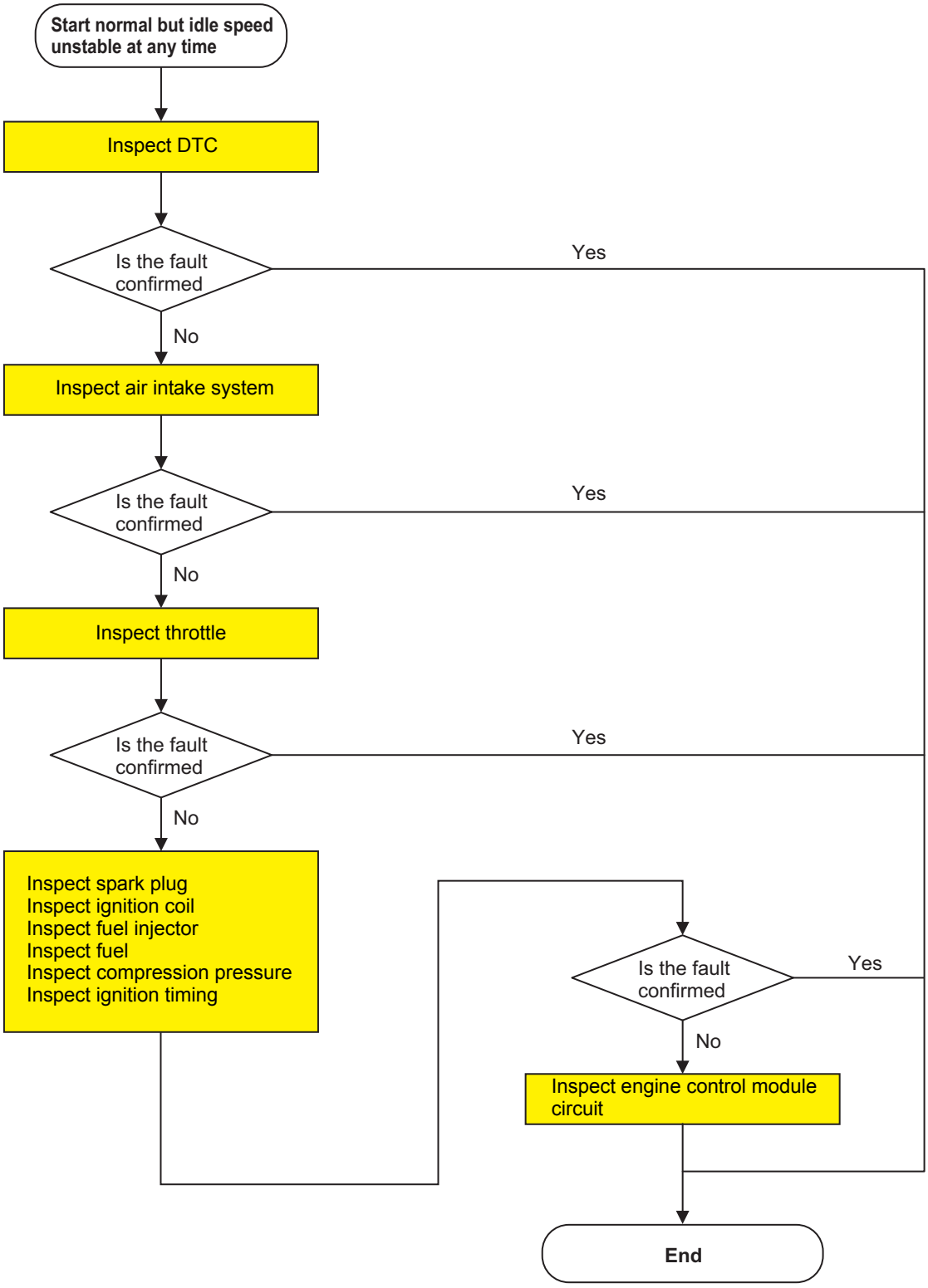


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect coolant temperature sensor | |
| | A. Disconnect the coolant temperature sensor connector.<br>B. Connect a 300 Ω resistor in series substituted for coolant temperature sensor at the sensor connector.<br>C. Start the engine.<br>Is the start smooth?<br>**Yes**<br>Replace the coolant temperature sensor.<br>**No**<br>Go to step 5. |
| 5. Inspect fuel | |
| | A. Is the fault caused by just refueling?<br>**Yes**<br>Replace the fuel.<br>**No**<br>Go to step 6. |
| 6. Inspect engine control module circuit | |
|  <br>M3112019<br>  <br>M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Start Normal but Idle Speed Unstable at Any Time



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect air intake system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the air intake system for blockage.<br>C. Inspect the air intake system for leakage.<br>**Refer to: Diagnosis Procedure for Intake Air Leak (3.1.5 Air Intake System, Symptom Diagnosis and Testing).**<br>Is the air intake system normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the air intake system. |
| 3. Inspect throttle | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the throttle is stuck.<br>Is the throttle normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Clean the throttle, idling stepper motor or replace the throttle. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.1.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the spark plug. |
| 5. Inspect ignition coil | |
| | A. Carry out the ignition coil inspection procedure.<br>**Refer to: Ignition Coil Test (3.1.8 Ignition System, General Inspection).**<br>Is the ignition coil normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the fuel injector. |
| 6. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace the fuel injector. |
| 7. Inspect fuel | |
| | A. Is the fault caused by just refueling?<br>**Yes**<br>Replace the fuel.<br>**No**<br>Go to step 8. |

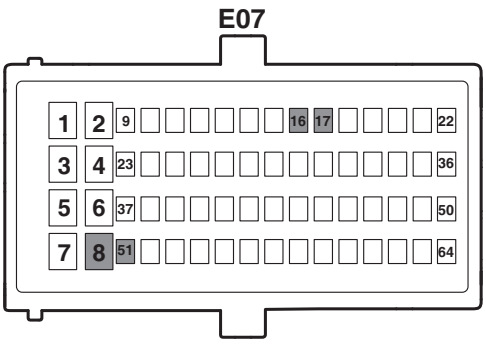
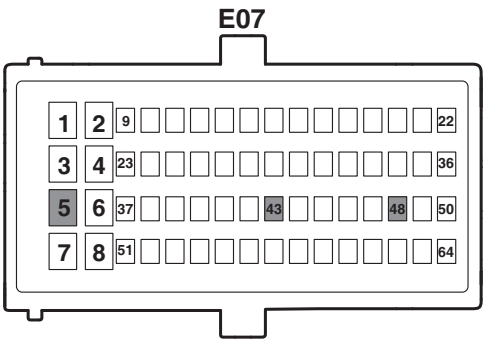
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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect compression pressure | |
| | A. Inspect the compression pressure in the cylinder.<br>**Refer to: Cylinder Compression Pressure Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is there insufficient pressure or large difference among cylinders?<br>**Yes**<br>Inspect the engine mechanical system.<br>**No**<br>Go to step 9. |
| 9. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Adjust the ignition timing. |

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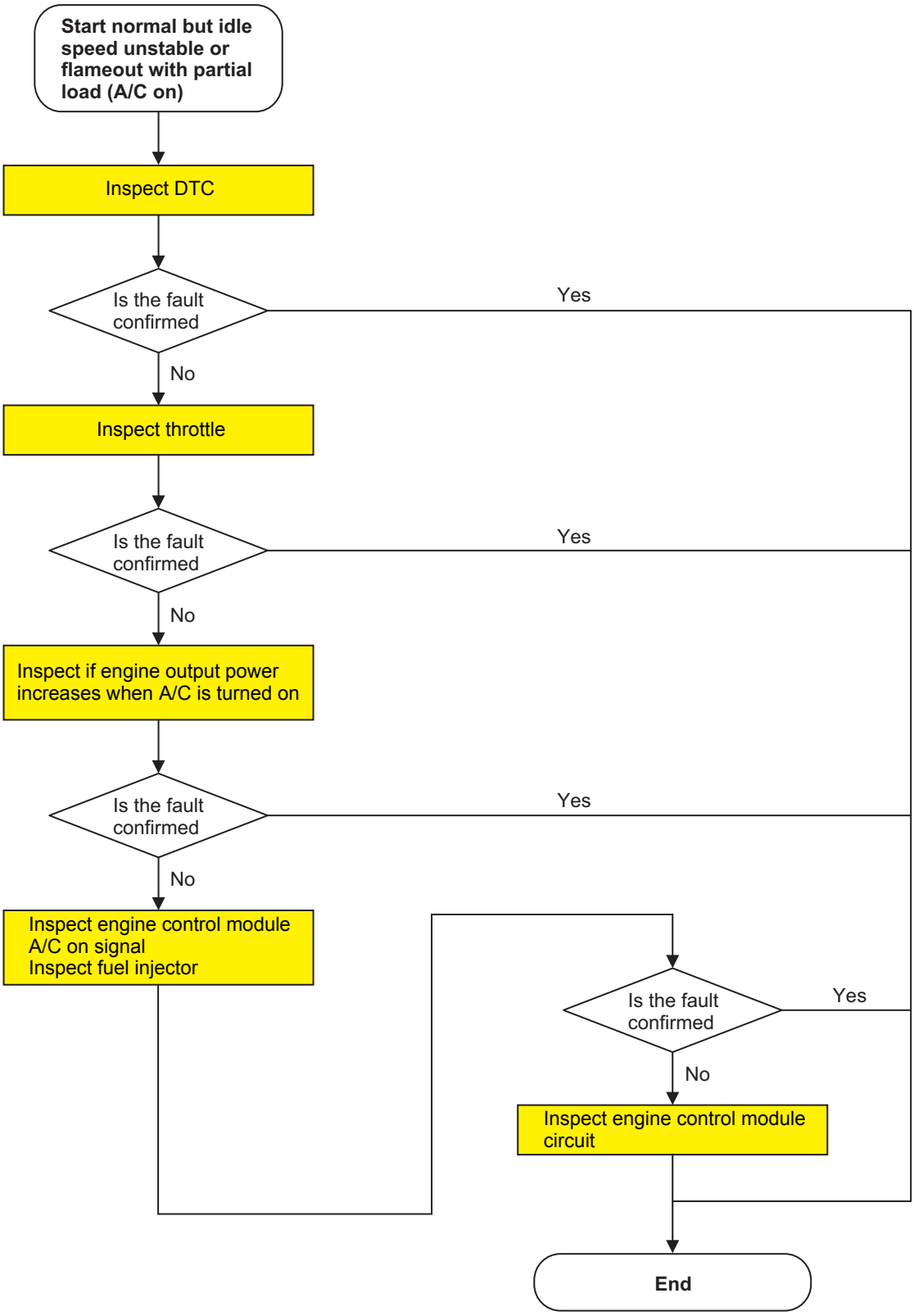


| Test Conditions | Details/Results/Actions |
|---|---|
| 10. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Start Normal but Idle Speed Unstable or Flameout with Partial Load (A/C ON)



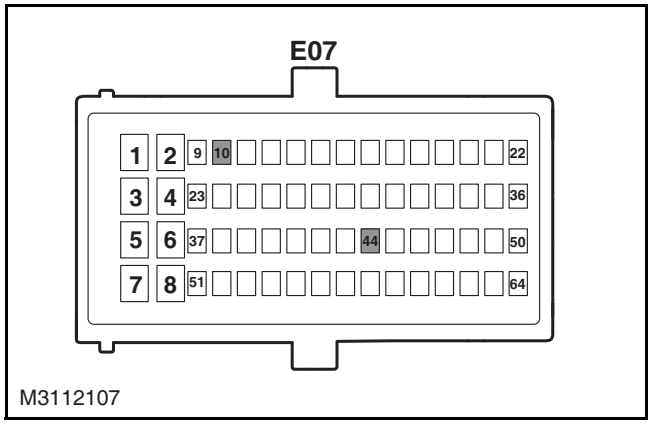
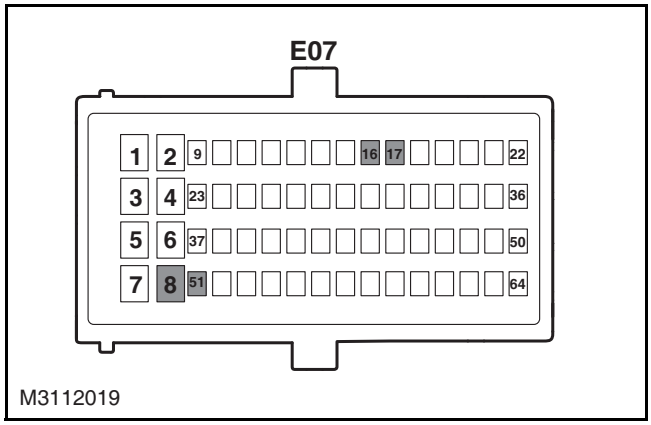
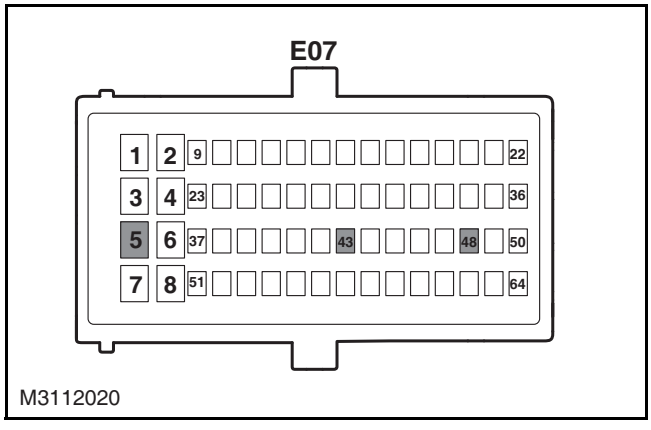
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect throttle | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the throttle is stuck.<br>C. Inspect the throttle and idling stepper motor for carbon deposit.<br>Is the throttle normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Clean the throttle, idling stepper motor or replace the throttle. |
| 3. Inspect if engine output power increases when A/C is turned on | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start the engine, access to engine data flow menu, select the parameters such as ignition advance angle, fuel injection pulse width and intake pressure sensor.<br>D. Turn on the A/C, observe the change of data flow parameters.<br>Are there changes?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect the A/C system.<br>**Refer to: Diagnosis Procedure for Insufficient A/C Refrigeration (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing).** |

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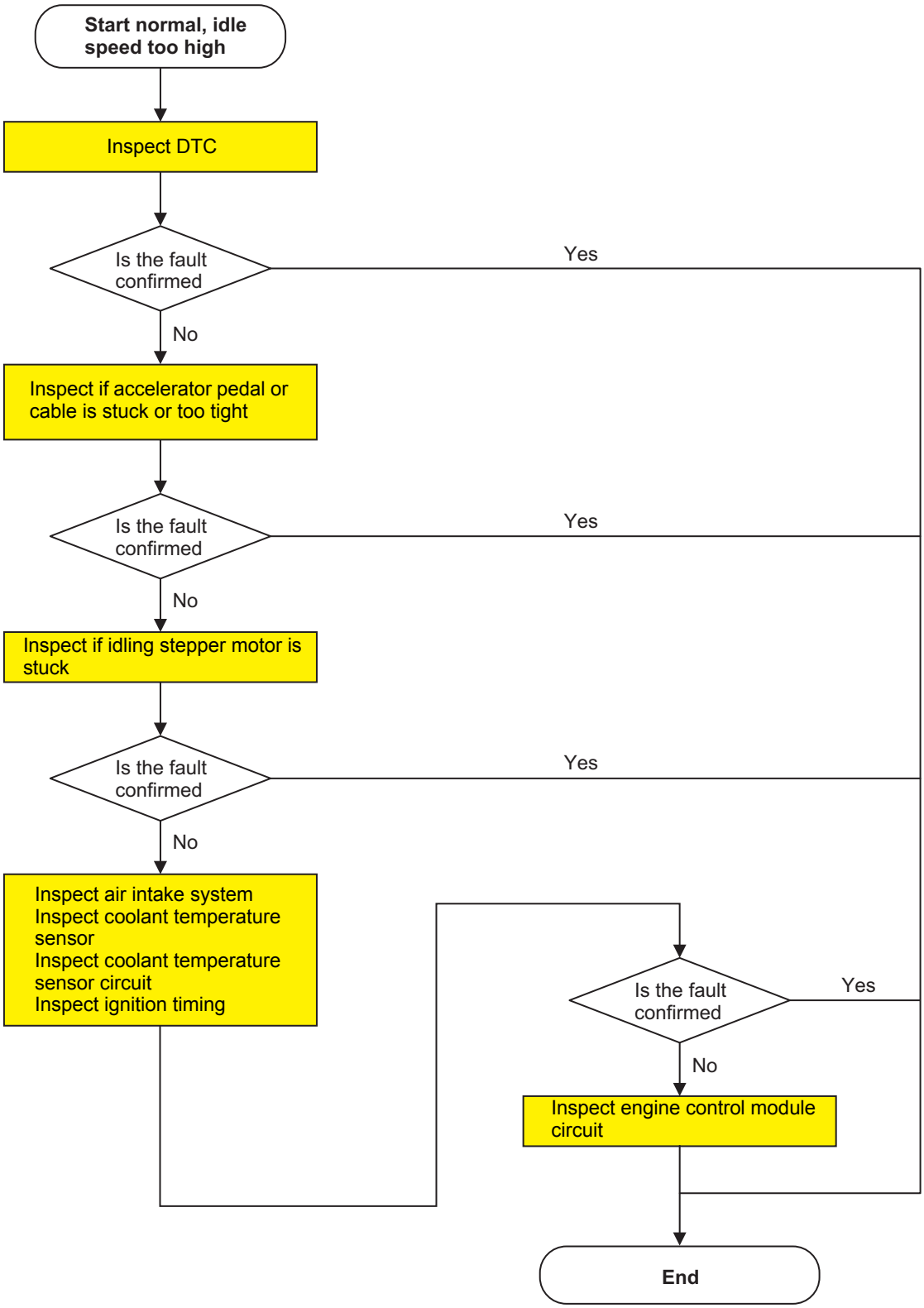


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect engine control module A/C on signal | |
|  M3112107 | A. Turn the ignition switch to "ON".<br>B. Turn on the A/C. Measure the voltages of terminals 10, 44 of engine control module wiring harness connector E07 with the multimeter.<br>Are the voltages of terminals 10 and 44 about 12 V when A/C is turned on?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair the circuit. |
| 5. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the fuel injector. |
| 6. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Start Normal, Idle Speed too High



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect if accelerator pedal or cable is stuck or too tight | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the accelerator pedal is stuck or too tight.<br>C. Inspect if the accelerator cable is stuck or too tight.<br>Are they stuck or too tight?<br>**Yes**<br>Repair or replace the accelerator pedal or cable.<br>**No**<br>Go to step 3. |
| 3. Inspect if idling stepper motor is stuck | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the idling stepper motor has too much carbon deposit.<br>C. Inspect if the idling stepper motor is stuck.<br>**Yes**<br>Clean the idling stepper motor, throttle or replace the idling stepper motor.<br>**No**<br>Go to step 4. |
| 4. Inspect air intake system | |
| | A. Inspect the air intake system for leakage.<br>Does the air intake system leak?<br>**Yes**<br>Repair the air intake system.<br>**Refer to: Diagnosis Procedure for Intake Air Leak (3.1.5 Air Intake System, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 5. |

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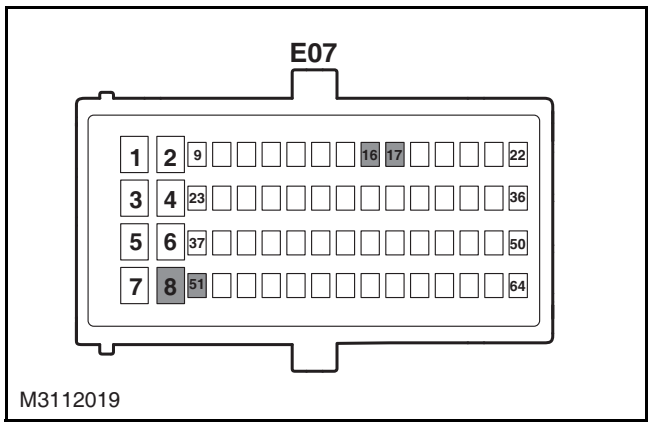


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect coolant temperature sensor | |
| | A. Disconnect the coolant temperature sensor wiring harness connector.<br>B. Start the engine, and observe it.<br>Is the engine idle speed too high?<br>**Yes**<br>Go to step 7.<br>**No**<br>Go to step 6. |
| 6. Inspect coolant temperature sensor circuit | |
| | A. Replace the coolant temperature sensor.<br>B. Start the engine, and observe it.<br>Is the engine idle speed too high?<br>**Yes**<br>Repair the coolant temperature sensor circuit.<br>**No**<br>The system is normal. |
| 7. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Adjust the ignition timing. |

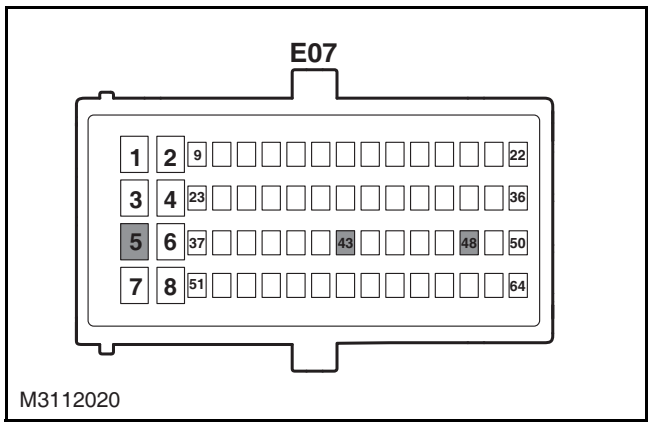
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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect engine control module circuit | |



M3112019



M3112020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**

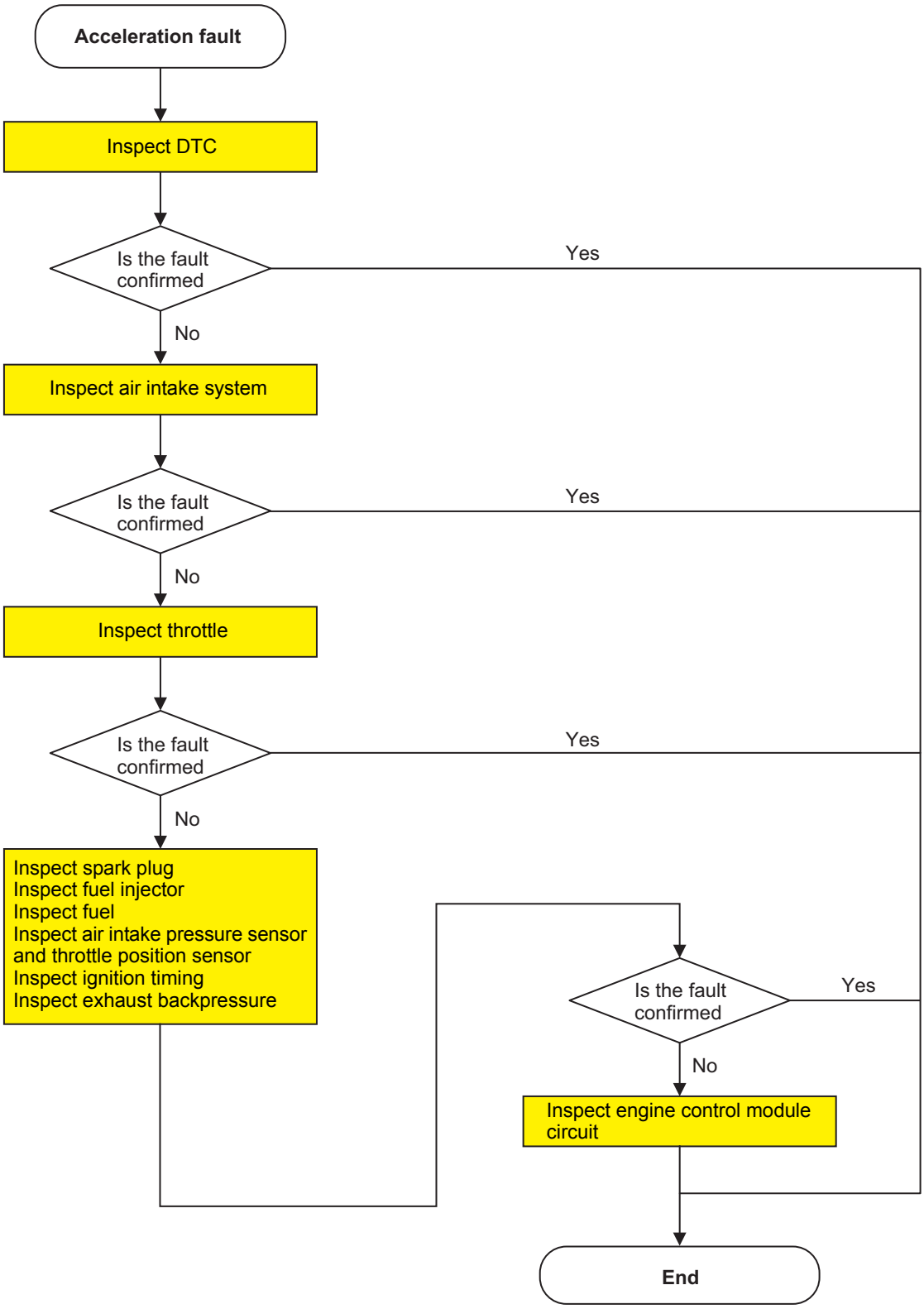
**No**

Repair the circuit.

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# Diagnosis Procedure for Acceleration Fault



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect air intake system | |
| | A. Inspect the air intake system for blockage.<br>B. Inspect the air intake system for leakage.<br>Is the air intake system normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the air intake system. |
| 3. Inspect throttle | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the throttle is stuck.<br>C. Inspect the throttle for carbon deposit.<br>Is the throttle normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Clean or replace the throttle. |
| 4. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.1.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the spark plug. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the fuel injector. |
| 6. Inspect fuel | |
| | A. Is the fault caused by just refueling?<br>**Yes**<br>Replace the fuel.<br>**No**<br>Go to step 7. |
| 7. Inspect air intake pressure sensor and throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start engine and inspect the data flow for air intake pressure sensor and throttle position sensor.<br>Are their data flows normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Replace the air intake pressure sensor and throttle position sensor, or repair the sensor circuit.<br>**Refer to: (3.1.12 Electronic Control System - M7, Removal and Installation).** |

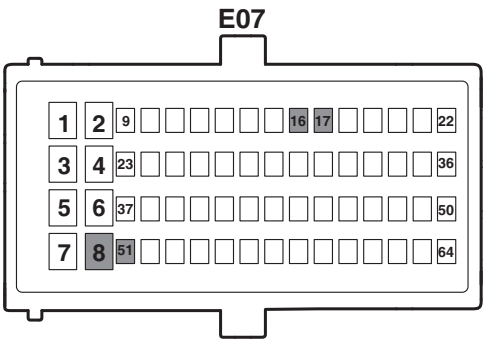
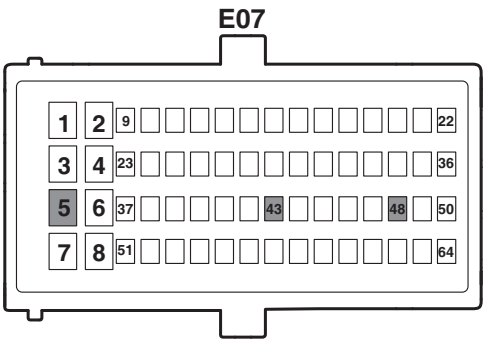
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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Adjust the ignition timing. |
| 9. Inspect exhaust backpressure | |
| | A. Inspect the exhaust backpressure.<br>**Refer to: Exhaust Backpressure Test (3.1.6 Exhaust System, General Inspection).**<br>Is the exhaust backpressure normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Repair the exhaust system. |

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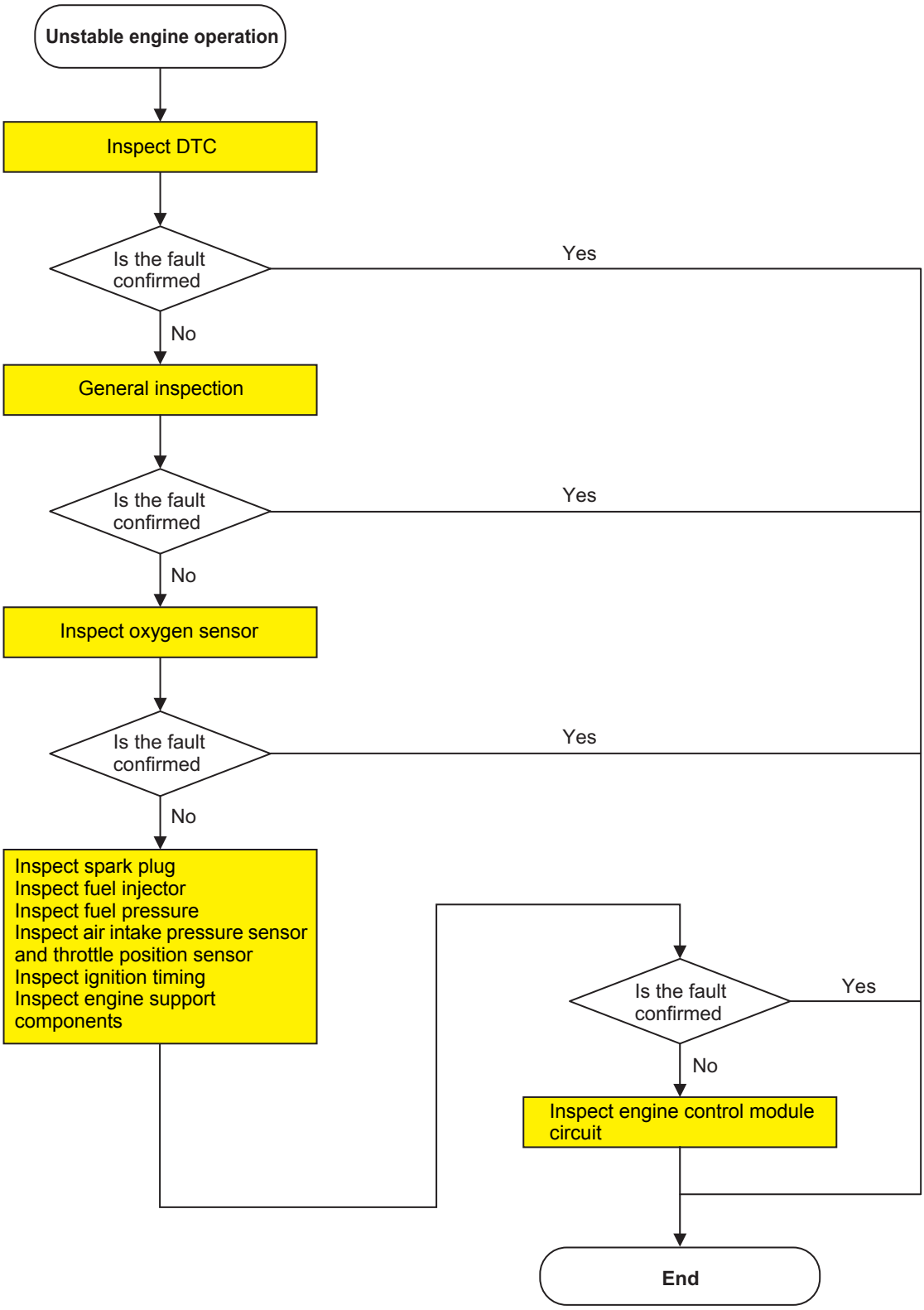


| Test Conditions | Details/Results/Actions |
|---|---|
| 10. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Unstable engine operation



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. General inspection | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the air intake system for blockage.<br>C. Inspect the air intake system for leakage.<br>**Refer to: Diagnosis Procedure for Intake Air Leak (3.1.5 Air Intake System, Diagnosis and Testing).**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the fault parts. |
| 3. Inspect oxygen sensor | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", operate the diagnostic tool to access to the engine data flow and read "O2 sensor voltage bank1 sensor 1, O2 sensor voltage bank1 sensor 2".<br>Is the data flow normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair or replace the oxygen sensor or circuit. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.1.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the spark plug. |
| 5. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the fuel injector. |
| 6. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect the fuel system. |

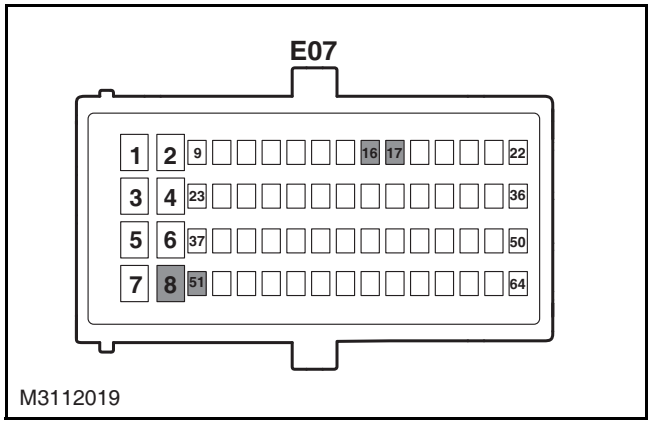
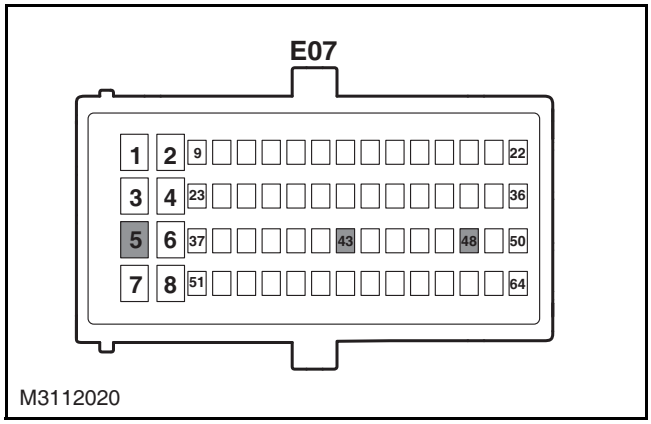
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect air intake pressure sensor and throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start engine and inspect the data flow for air intake pressure sensor and throttle position sensor.<br>Are their data flows normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Replace the air intake pressure sensor and throttle position sensor, or repair the sensor circuit.<br>**Refer to: (3.1.12 Electronic Control System - M7, Removal and Installation).** |
| 8. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Adjust the ignition timing. |
| 9. Inspect engine support components | |
| | A. Inspect the engine support components.<br>Is there crack, damage, or loose or lost bolt on the engine support components?<br>**Yes**<br>Repair the fault parts.<br>**No**<br>Go to step 10. |

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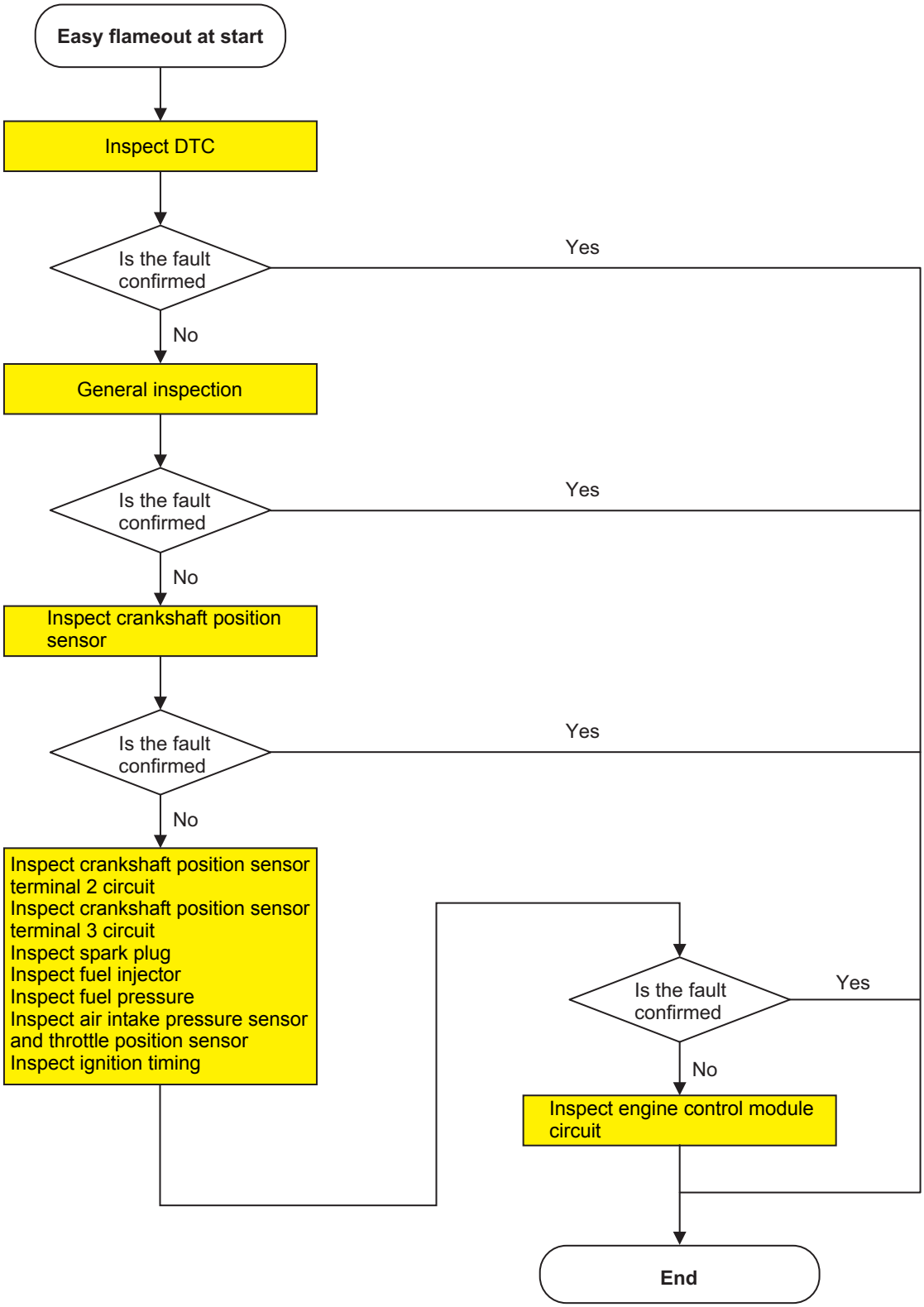


| Test Conditions | Details/Results/Actions |
|---|---|
| 10. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Easy Flameout at Start



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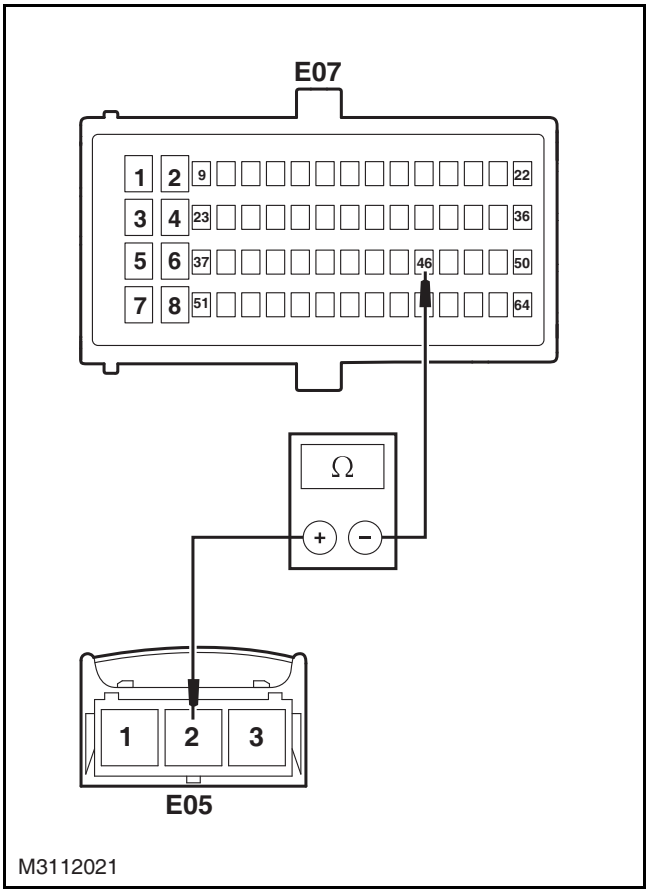


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. General inspection | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the air intake system for blockage.<br>C. Inspect the air intake system for leakage.<br>D. Inspect wiring harness connectors of oxygen sensor, fuel injector, crankshaft position sensor and ignition coil for disconnection, looseness or damage.<br>Are they normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the fault parts. |
| 3. Inspect crankshaft position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the crankshaft position sensor wiring harness connector.<br>C. Measure the resistance between terminals 2 and 3 of the crankshaft position sensor.<br>**Standard resistance: 860 Ω ± 10%**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the crankshaft position sensor.<br>**Refer to: Crankshaft Position Sensor (3.1.12 Electronic Control System - M7, Removal and Installation).** |

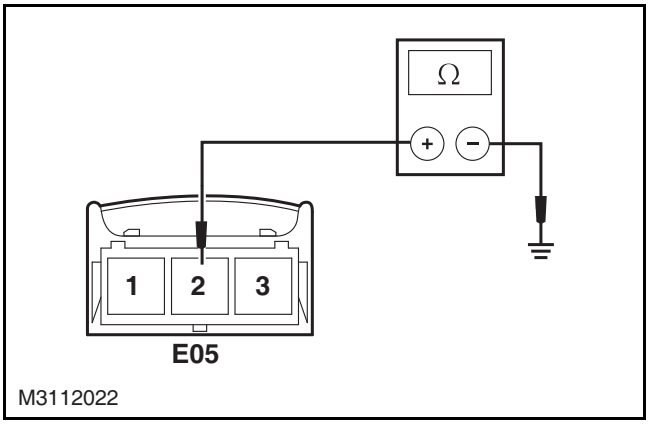
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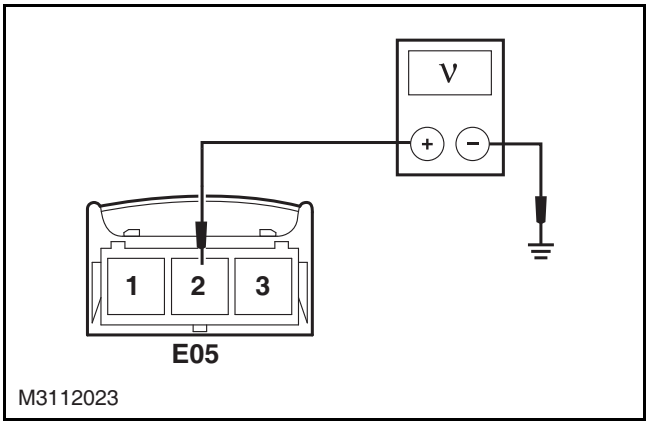
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect crankshaft position sensor terminal 2 circuit | |




M3112021




M3112022




M3112023

A. Turn the ignition switch to "LOCK".

B. Disconnect the crankshaft position sensor wiring harness connector E05.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 2 of crankshaft position sensor wiring harness connector E05 and terminal 46 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of crankshaft position sensor wiring harness connector E05 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of crankshaft position sensor wiring harness connector E05 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is the circuit normal?

**Yes**

Go to step 5.

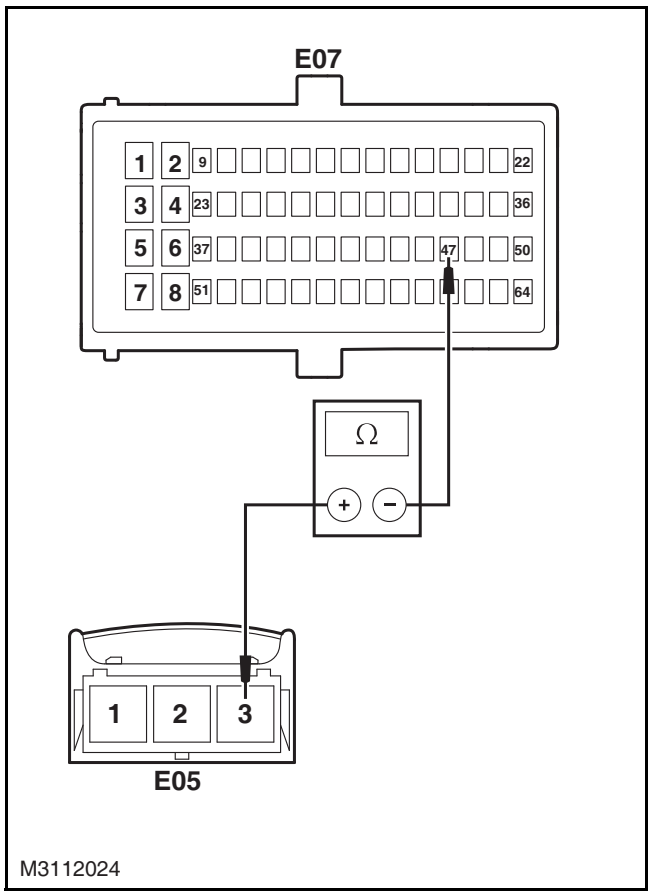
**No**

Repair the fault circuit between terminal 2 of crankshaft position sensor E05 and terminal 46 of engine control module E07.

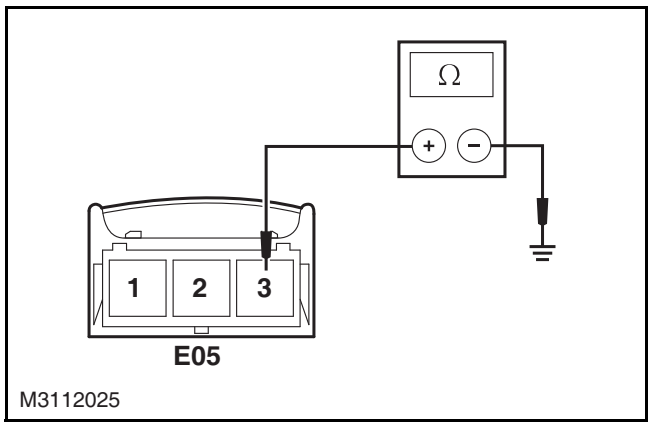
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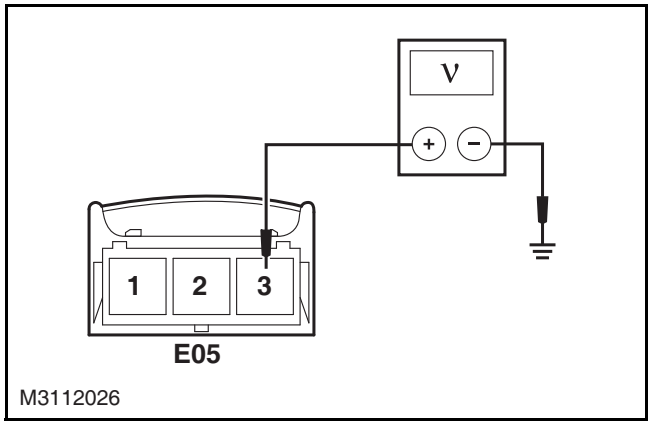
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect crankshaft position sensor terminal 3 circuit | |




M3112024




M3112025




M3112026

A. Turn the ignition switch to "LOCK".

B. Disconnect the crankshaft position sensor wiring harness connector E05.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 3 of crankshaft position sensor wiring harness connector E05 and terminal 47 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 3 of crankshaft position sensor wiring harness connector E05 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 3 of crankshaft position sensor wiring harness connector E05 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is the circuit normal?

**Yes**

Replace the crankshaft position sensor.

**Refer to: Crankshaft Position Sensor (3.1.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the fault circuit between terminal 3 of crankshaft position sensor E05 and terminal 47 of engine control module E07.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.1.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace the spark plug. |
| 7. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Clean or replace the fuel injector. |
| 8. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect the fuel system. |

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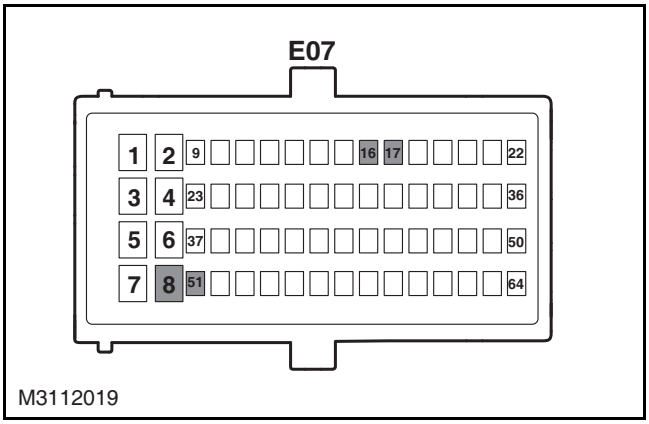


| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect air intake pressure sensor and throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start engine and inspect the data flow for air intake pressure sensor and throttle position sensor.<br>Are their data flows normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Replace the air intake pressure sensor and throttle position sensor, or repair the sensor circuit.<br>**Refer to: (3.1.12 Electronic Control System - M7, Removal and Installation).** |
| 10. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Adjust the ignition timing. |

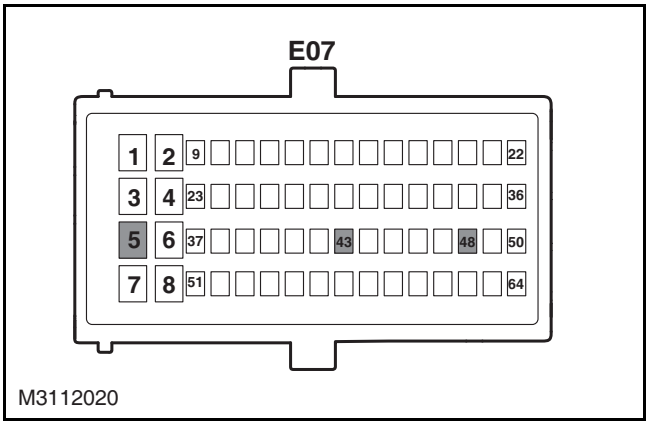
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| Test Conditions | Details/Results/Actions |
|---|---|
| 11. Inspect engine control module circuit | |



M3112019



M3112020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**

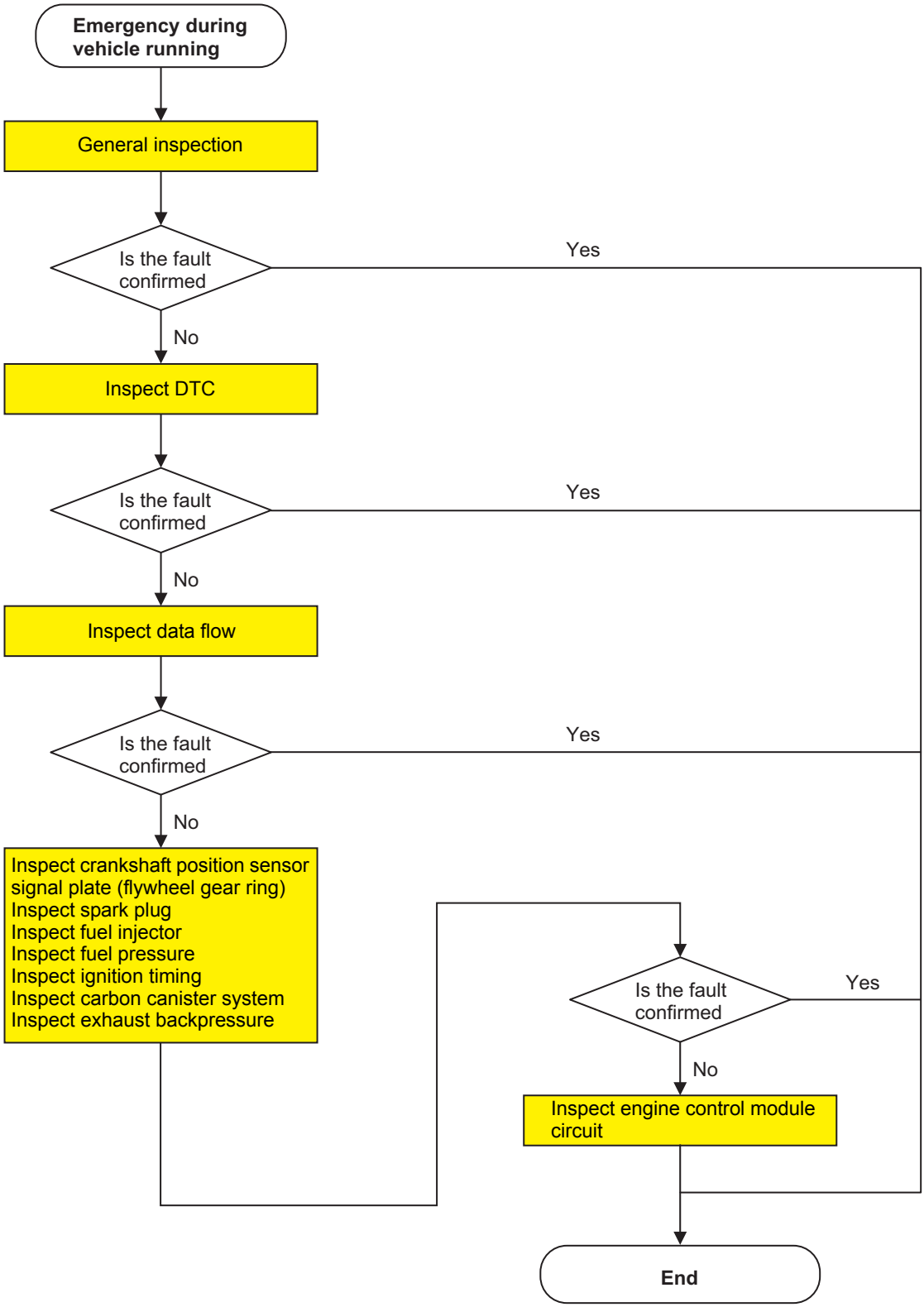
**No**

Repair the circuit.

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# Diagnosis Procedure for Emergency During Vehicle Running



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the following items:<br>• Vacuum pipeline connection<br>• Air cleaner element<br>• No leaks in air intake system<br>• No limitation for air intake system<br>• Proper seal for intake manifold and its installed components<br>• Ignition circuit<br>• Qualified fuel<br>• Electrical connection<br>• Smooth operation of throttle<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault parts. |
| 2. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect data flow | |
| | A. Connect the diagnostic tool.<br>B. Use the diagnostic tool to inspect the following data flow of engine:<br>• Engine speed<br>• Actual intake manifold pressure<br>• Throttle position angle signal<br>• Knock sensor signal 1<br>• Knock sensor signal 2<br>Does the data flow change normally in the specified range?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the corresponding fault. |
| 4. Inspect crankshaft position sensor signal plate (flywheel gear ring) | |
| | A. Visually inspect the crankshaft position sensor signal plate.<br>Is it normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the crankshaft position sensor signal plate. |
| 5. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.1.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the spark plug. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace the fuel injector. |
| 7. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect the fuel system. |
| 8. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Adjust the ignition timing. |

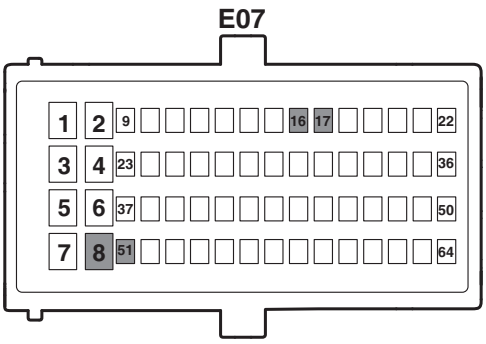
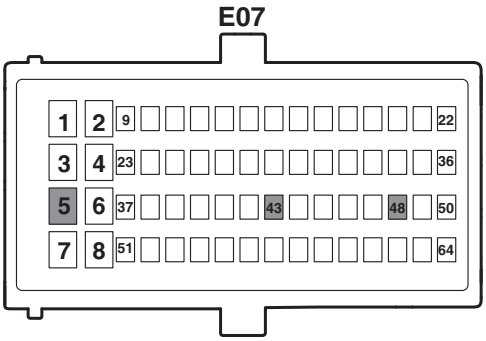
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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect carbon canister system | |
| | A. Inspect the carbon canister system.<br>**Refer to: Carbon Canister Inspection (3.1.11 Emission Control System, General Inspection).**<br>Is the carbon canister system normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Repair the carbon canister system. |
| 10. Inspect exhaust backpressure | |
| | A. Inspect the exhaust backpressure.<br>**Refer to: Exhaust Backpressure Test (3.1.6 Exhaust System, General Inspection).**<br>Is the exhaust backpressure normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Repair the exhaust system. |

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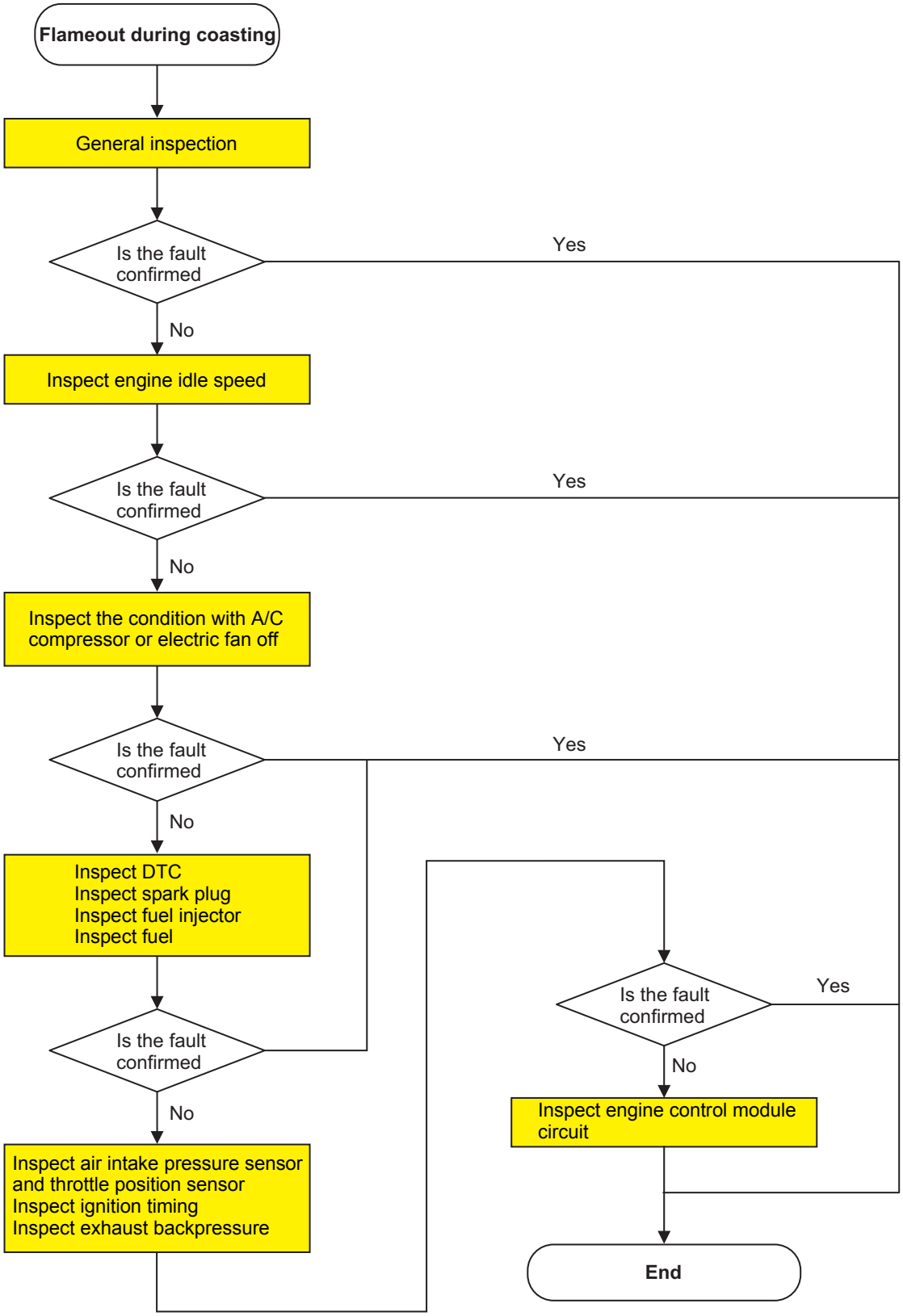


| Test Conditions | Details/Results/Actions |
|---|---|
| 11. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Flameout During Coasting



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect that the vacuum pipeline is correctly positioned without any damage.<br>B. Inspect that the intake system has no leakage.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault parts. |
| 2. Inspect engine idle speed | |
| | A. Inspect the engine idle speed.<br>Is the engine idle speed unstable?<br>**Yes**<br>**Refer to: Diagnosis Procedure for Start Normal but Idle Speed Unstable at Any Time (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Inspect the condition with A/C compressor or electric fan off | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the A/C compressor magnetic clutch wiring harness connector.<br>C. Disconnect the electric fan wiring harness connector.<br>D. Is the A/C system normal?<br>Is the system normal after disconnecting the magnetic clutch and fan wiring harness connectors?<br>**Yes**<br>Repair magnetic clutch connection fault.<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 5. |
| 5. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.1.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the spark plug. |
| 6. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error. Are they normal?<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace or clean the fuel injector. |
| 7. Inspect fuel | |
| | A. Is the fault caused by just refueling?<br>**Yes**<br>Replace the fuel.<br>**No**<br>Go to step 8. |

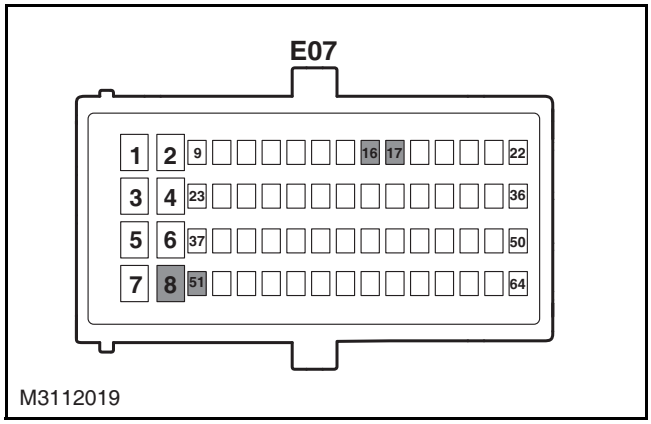
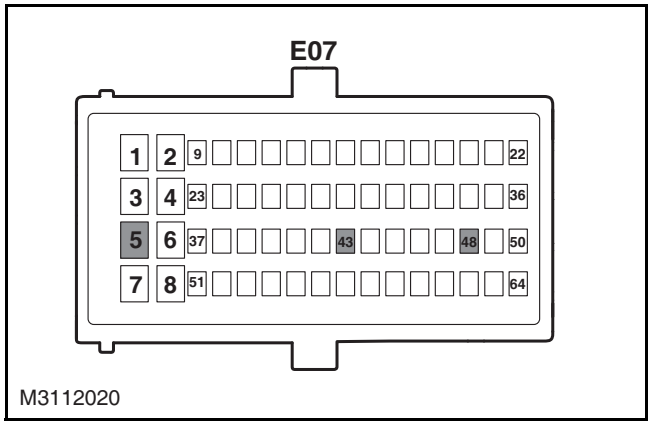
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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect air intake pressure sensor and throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start engine and inspect the data flow for air intake pressure sensor and throttle position sensor.<br>Are their data flows normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Replace the air intake pressure sensor and throttle position sensor, or repair the sensor circuit.<br>**Refer to: (3.1.12 Electronic Control System - M7, Removal and Installation).** |
| 9. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Adjust the ignition timing. |
| 10. Inspect exhaust backpressure | |
| | A. Inspect the exhaust backpressure.<br>**Refer to: Exhaust Backpressure Test (3.1.6 Exhaust System, General Inspection).**<br>Is the exhaust backpressure normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Repair the exhaust system. |

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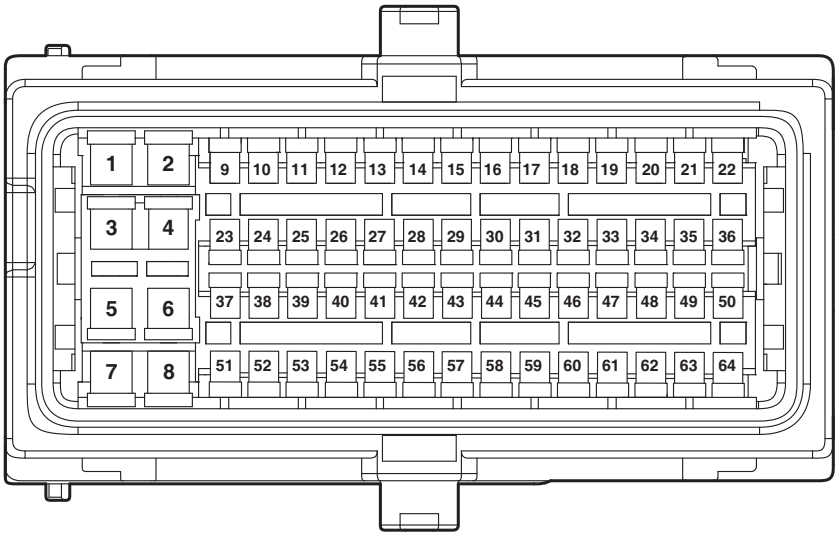
| Test Conditions | Details/Results/Actions |
|---|---|
| 11. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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## DTC Diagnosis and Testing

# Engine Control Module Terminal List




M3112027

| Terminal No. | Wire Diameter/Color | Definition |
|---|---|---|
| 1 | - | - |
| 2 | 0.85 YE/WH | Front oxygen sensor heating |
| 3 | 1.25 BK/YE | Ignition coil of cylinder 1 and 4 signal |
| 4 | 0.85 WH | Rear oxygen sensor heating |
| 5 | 2.0 BK | Ignition GND |
| 6 | - | - |
| 7 | 1.25 BK/BU | Ignition coil of cylinder 2 and 3 signal |
| 8 | 1.25 RD/BU | Non-continuous power supply |
| 9 | 0.5 WH/BU | Engine speed output |
| 10 | 0.5 BU/BK | A/C medium pressure switch |
| 11 | - | - |
| 12 | 0.5 LG | Blower switch |
| 13 | 0.5 LG/BK | A/C temperature sensor |
| 14 | - | - |
| 15 | 0.5 YE/RD | Diagnosis K-line |
| 16 | 0.5 PK/BU | Continuous power supply |
| 17 | 0.5 BU | Ignition switch |
| 18 | 0.5 BU/BN | 5 V power supply 2 |
| 19 | 0.5 YE/BK | 5 V power supply 1 |

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| Terminal No. | Wire Diameter/Color | Definition |
|---|---|---|
| 20 | 0.5 VT/YE | MIL indicator |
| 21 | 0.5 GY/YE | Stepper motor phase B |
| 22 | 0.5 GY/GN | Stepper motor phase A |
| 23 | - | - |
| 24 | 0.5 RD/YE | Headlamp switch |
| 25 | 0.5 BU/GN | Air intake temperature sensor |
| 26 | 0.5 BU/WH | Throttle position sensor |
| 27 | - | - |
| 28 | - | - |
| 29 | 0.5 YE | Rear oxygen sensor |
| 30 | 0.5 RD | Knock sensor A side |
| 31 | 0.5 GN | Knock sensor B side |
| 32 | 0.5 BN/WH | Main relay |
| 33 | - | - |
| 34 | - | - |
| 35 | 0.5 GY | Stepper motor phase C |
| 36 | 0.5 GY/BK | Stepper motor phase D |
| 37 | 0.5 RD/WH | Carbon canister control valve |
| 38 | - | - |
| 39 | 0.5 YE/GN | Sensor GND 1 |
| 40 | 0.5 BU/RD | Sensor GND 2 |
| 41 | 0.5 BN/YE | Coolant temperature sensor |
| 42 | - | - |
| 43 | 0.5 BK | Electrical GND 1 |
| 44 | 0.5 PK/BK | A/C switch |
| 45 | 0.5 BK/OG | Front oxygen sensor |
| 46 | 0.5 VT | Crankshaft position sensor signal A |
| 47 | 0.5 BU | Crankshaft position sensor signal B |
| 48 | 0.5 BK | Power GND 1 |
| 49 | 0.5 WH/GN | Cylinder 3 fuel injector |
| 50 | 0.5 WH/BN | Cylinder 1 fuel injector |
| 51 | 0.5 RD/BU | Non-continuous power supply |
| 52 | 0.5 BK/WH | Radiator-fan relay |
| 53 | - | - |

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| Terminal No. | Wire Diameter/Color | Definition |
|---|---|---|
| 54 | - | - |
| 55 | - | - |
| 56 | 0.5 YE/WH | Coolant temperature output |
| 57 | 0.5 GN | Vehicle speed signal |
| 58 | - | - |
| 59 | 0.5 YE/BU | Air intake pressure sensor |
| 60 | 0.5 LG/RD | Fuel pump relay |
| 61 | 0.5 BK/YE | A/C compressor relay |
| 62 | 0.5 BK/RD | A/C condenser-fan relay |
| 63 | 0.5 WH/YE | Cylinder 2 fuel injector |
| 64 | 0.5 WH/BK | Cylinder 4 fuel injector |

# Diagnostic Trouble Code (DTC) Type

| DTC Type | Definition |
|---|---|
| Type 0 | If the DTC type is 0, no lamp is on and the system makes no diagnosis. |
| Type 2 | Diagnosis for misfire related failure generally is defined as 2. For the misfire fault that will cause damage to catalytic converters, MIL will immediately flash to warn the driver; for the misfire fault that may cause the deterioration of emissions, if in 3 consecutive driving cycles, the relative level of misfire is all fully detected, then MIL will come on; the fault will be deleted after 40 continuous trouble-free warm-up cycles. |
| Type 3 | After the fault is detected in 3 consecutive driving cycles, MIL will come on; then off if it is detected to be repaired in 3 consecutive driving cycles; and the fault will be deleted after 40 continuous trouble-free warm-up cycles. |
| Type 4 | MIL will come on 2.5 seconds after the fault occurs; if it is detected to be repaired in 3 consecutive driving cycles, MIL will go off; and the fault will be deleted after 40 continuous trouble-free warm-up cycles. |
| Type 5 | If the fault is detected in 3 consecutive driving cycles, it will be confirmed but without lamp on; if the fault is detected to be repaired in 3 consecutive driving cycles, it proves to be repaired; then deleted after 40 continuous trouble-free warm-up cycles. |
| Type 6 | Once the fault occurs, it will be confirmed immediately; then deleted after 40 continuous trouble-free warm-up cycles. No lamp will come on and universal scan tool is unreadable for the fault. |
| Type 7 | The external test tools can activate the fuel supply system fault diagnosis and are generally used only for offline test or repair station. No lamp will come on and universal scan tool is unreadable for the fault. |
| Type 11 | It is a special diagnostic path for fuel supply system. After the fault is detected in 3 consecutive driving cycles, MIL will come on; then off if it is detected to be repaired in 4 consecutive driving cycles; and the fault will be deleted after 40 continuous trouble-free warm-up cycles. |

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| DTC Type | Definition |
|---|---|
| Type 12 | Once the fault occurs, it will be confirmed immediately and SVS will come on; then off if the fault is repaired; and it will be deleted after 40 continuous trouble-free warm-up cycles. The universal scan tool is unreadable. |
| Type 13 | Once the fault occurs, SVS will come on, then off if the fault is repaired; or when the fault is detected in 3 consecutive driving cycles and is confirmed, SVS will go off and MIL will come on; then off if the fault is detected to be repaired in 4 consecutive driving cycles; and the fault will be deleted after 40 continuous trouble-free warm-up cycles. |
| Type 35 | Once the fault occurs, it will be confirmed immediately and SVS will flash; then off if the fault is repaired; and it will be deleted after 20 continuous trouble-free warm-up cycles. |
| Type 36 | Once the fault occurs, it will be confirmed immediately but without SVS on; and it will be deleted after 20 continuous trouble-free warm-up cycles. |
| Type 38 | Once the fault occurs, it will be confirmed immediately and SVS will flash; then off if it is repaired; and the fault memory will not record this fault. |
| Type 39 | Once the fault occurs, it will be confirmed immediately but without SVS on; the fault memory will not record this fault. |

# DTC Code List

| DTC Code | Description | DTC Type | MIL ON |
|---|---|---|---|
| P0030 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) | 3 | √ |
| P0031 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) Low | 3 | √ |
| P0032 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) High | 3 | √ |
| P0036 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) | 3 | √ |
| P0037 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) Low | 3 | √ |
| P0038 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) High | 3 | √ |
| P0053 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 1) | 3 | √ |
| P0054 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 2) | 3 | √ |
| P0105 | Manifold Absolute Pressure/Barometric Pressure Circuit | 3 | √ |
| P0106 | Manifold Abs.Pressure or Bar. Pressure Range/ Performance | 3 | √ |
| P0107 | Manifold Abs. Pressure or Bar. Pressure Low Input | 3 | √ |
| P0108 | Manifold Abs. Pressure or Bar. Pressure High Input | 3 | √ |
| P0112 | Intake Air Temp. Circ. Low Input | 3 | √ |
| P0113 | Intake Air Temp. Circ. High Input | 3 | √ |
| P0117 | Engine Coolant Temp. Circ. Low Input | 3 | √ |

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| DTC Code | Description | DTC Type | MIL ON |
|---|---|---|---|
| P0118 | Engine Coolant Temp. Circ. High Input | 3 | √ |
| P0122 | Throttle/Pedal Pos. Sensor A Circ. Low Input | 3 | √ |
| P0123 | Throttle/Pedal Pos. Sensor A Circ. High Input | 3 | √ |
| P0130 | O2 Sensor Circ., Bank1-Sensor1 Malfunction | 3 | √ |
| P0131 | O2 Sensor Circ., Bank1-Sensor1 Low Voltage | 3 | √ |
| P0132 | O2 Sensor Circ., Bank1-Sensor1 High Voltage | 3 | √ |
| P0133 | O2 Sensor Circ., Bank1-Sensor1 Slow Response | 3 | √ |
| P0134 | O2 Sensor Circ., Bank1-Sensor1 No Activity Detected | 3 | √ |
| P0136 | O2 Sensor Circ., Bank1-Sensor2 Malfunction | 3 | √ |
| P0137 | O2 Sensor Circ., Bank1-Sensor2 Low Voltage | 3 | √ |
| P0138 | O2 Sensor Circ., Bank1-Sensor2 High Voltage | 3 | √ |
| P0140 | O2 Sensor Circ., Bank1-Sensor2 No Activity Detected | 3 | √ |
| P0170 | Fuel Trim, Bank1 Malfunction | 7 | × |
| P0171 | Fuel Trim, Bank1 System too Lean | 7 | × |
| P0172 | Fuel Trim, Bank1 System too Rich | 7 | × |
| P0201 | Cylinder 1 - Injector Circuit | 3 | √ |
| P0202 | Cylinder 2 - Injector Circuit | 3 | √ |
| P0203 | Cylinder 3 - Injector Circuit | 3 | √ |
| P0204 | Cylinder 4 - Injector Circuit | 3 | √ |
| P0261 | Cylinder 1 - Injector Circuit Low | 3 | √ |
| P0262 | Cylinder 1 - Injector Circuit High | 3 | √ |
| P0264 | Cylinder 2 - Injector Circuit Low | 3 | √ |
| P0265 | Cylinder 2 - Injector Circuit High | 3 | √ |
| P0267 | Cylinder 3 - Injector Circuit Low | 3 | √ |
| P0268 | Cylinder 3 - Injector Circuit High | 3 | √ |
| P0270 | Cylinder 4 - Injector Circuit Low | 3 | √ |
| P0271 | Cylinder 4 - Injector Circuit High | 3 | √ |
| P0300 | Random/Multiple Cylinder Misfire Detected | 2 | √ or flash |
| P0301 | Cyl.1 Misfire Detected | 2 | √ or flash |
| P0302 | Cyl.2 Misfire Detected | 2 | √ or flash |
| P0303 | Cyl.3 Misfire Detected | 2 | √ or flash |
| P0304 | Cyl.4 Misfire Detected | 2 | √ or flash |
| P0321 | Ign./Distributor Eng. Speed Inp. Circ. Range/ Performance | 3 | √ |

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| DTC Code | Description | DTC Type | MIL ON |
|---|---|---|---|
| P0322 | Ign./Distributor Eng. Speed Inp. Circ. No Signal | 4 | √ |
| P0327 | Knock Sensor 1 Circ. Low Input | 3 | √ |
| P0328 | Knock Sensor 1 Circ. High Input | 3 | √ |
| P0420 | Catalyst System, Bank1 Efficiency Below Threshold | 3 | √ |
| P0444 | Evaporative Emiss. System Purge Control Valve Circ. Open | 3 | √ |
| P0458 | Evaporative Emission System Purge Control Valve Circuit Low | 3 | √ |
| P0459 | Evaporative Emission System Purge Control Valve Circuit High | 3 | √ |
| P0480 | Cooling Fan 1 Control Circuit | 5 | × |
| P0481 | Cooling Fan 2 Control Circuit | 5 | × |
| P0501 | Vehicle Speed Sensor Range/Performance | 3 | √ |
| P0506 | Idle Control System RPM Lower than Expected | 3 | √ |
| P0507 | Idle Control System RPM Higher than Expected | 3 | √ |
| P0508 | Idle Air Control System Circuit Low | 3 | √ |
| P0509 | Idle Air Control System Circuit High | 3 | √ |
| P0511 | Idle Air Control Circuit | 3 | √ |
| P0537 | A/C Evaporator Temperature Sensor Circuit Low | 5 | × |
| P0538 | A/C Evaporator Temperature Sensor Circuit High | 5 | × |
| P0560 | System Voltage Malfunction | 5 | × |
| P0562 | System Voltage Low Voltage | 5 | × |
| P0563 | System Voltage High Voltage | 5 | × |
| P0602 | Control Module Programming Error | 3 | √ |
| P0627 | Fuel Pump "A" Control Circuit/Open | 3 | √ |
| P0628 | Fuel Pump "A" Control Circuit Low | 3 | √ |
| P0629 | Fuel Pump "A" Control Circuit High | 3 | √ |
| P0645 | AC Clutch Relais Circuit | 5 | × |
| P0646 | A/C Clutch Relay Control Circuit Low | 5 | × |
| P0647 | A/C Clutch Relay Control Circuit High | 5 | × |
| P0650 | Malfunction Indicator Lamp Control Circ. | 3 | √ |
| P0691 | Cooling Fan 1 Control Circuit Low | 5 | × |
| P0692 | Cooling Fan 1 Control Circuit High | 5 | × |
| P0693 | Cooling Fan 2 Control Circuit Low | 5 | × |
| P0694 | Cooling Fan 2 Control Circuit High | 5 | × |

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| DTC Code | Description | DTC Type | MIL ON |
|---|---|---|---|
| P2177 | System Too Lean Off Idle | 11 | √ |
| P2178 | System Too Rich Off Idle | 11 | √ |
| P2187 | System Too Lean at Idle | 11 | √ |
| P2188 | System Too Rich at Idle | 11 | √ |
| P2195 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 1 | 3 | √ |
| P2196 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 1 | 3 | √ |
| P2270 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 2 | 3 | √ |
| P2271 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 2 | 3 | √ |

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# Failure Protection List

| DTC Code | Description | Failure-Protection Operation | Prerequisite of Releasing Failure Protection |
|---|---|---|---|
| P0262, P0261, P0201 | Cylinder 1 injector circuit fault | - | Repair the circuit fault or replace the injector. |
| P0268, P0267, P0203 | Cylinder 2 injector circuit fault | - | Repair the circuit fault or replace the injector. |
| P0271, P0270, P0204 | Cylinder 3 injector circuit fault | - | Repair the circuit fault or replace the injector. |
| P0265, P0264, P0202 | Cylinder 4 injector circuit fault | - | Repair the circuit fault or replace the injector. |
| P0038, P0037, P0036 | Rear oxygen sensor heating circuit fault | • Rear oxygen sensor internal resistance reasonable diagnosis off | Repair the rear oxygen circuit fault or replace the rear oxygen sensor. |
| P0032, P0031, P0030 | Front oxygen sensor heating circuit fault | • Turn off rear oxygen sensor function and diagnose | Repair the front oxygen circuit fault or replace the front oxygen sensor. |
| P0647, P0646, P0645 | A/C circuit fault | - | Repair the circuit fault. |
| P0629, P0628, P0627 | Fuel pump relay circuit fault | - | Repair the circuit fault. |
| P0692, P0691, P0480 | Low speed fan control circuit fault | - | Repair the circuit fault. |
| P0694, P0693, P0481 | High speed fan control circuit fault | - | Repair the circuit fault. |
| P0650 | MIL circuit fault | - | Repair the circuit fault. |

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| DTC Code | Description | Failure-Protection Operation | Prerequisite of Releasing Failure Protection |
|---|---|---|---|
| P0459, P0458, P0444 | Carbon canister valve control circuit fault | • Turn rear oxygen control function off<br>• Turn catalytic converter diagnosis off<br>• Turn idle diagnosis off<br>• Turn front oxygen sensor aging diagnosis off<br>• Turn rear oxygen sensor aging diagnosis off<br>• Turn front oxygen sensor internal resistance reasonable diagnosis off<br>• Turn rear oxygen sensor internal resistance reasonable diagnosis off<br>• Turn misfire detection fuel supply self-learning function off | Repair the circuit fault. |
| P0602 | Diagnose the Diagnostic Data Identification (DDI) code programming | - | Repair the fault or update the data. |
| P0300, P0301, P0302, P0303, P0304 | One cylinder or multi-cylinder misfire | 1. Misfire fault (E_md = 1)<br>• Turn misfire detection fuel supply self-learning function off<br>2. B_mdarv set due to misfire<br>• Turn off rear oxygen control %LRHK<br>• Misfire detection fuel supply self-learning<br>• Forbid air-fuel ratio self-learning<br>• Forbid carbon canister flushing<br>3. Maximum misfire fault is detected and cylinder cut-off operation is performed:<br>• Turn off Lambda closed loop control | Repair the fault and inspect the ignition system and fuel supply system. |

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| DTC Code | Description | Failure-Protection Operation | Prerequisite of Releasing Failure Protection |
|---|---|---|---|
| P2177, P2178 | Fuel supply system | • Forbid catalytic converter diagnosis<br>• Forbid front/rear oxygen sensor aging diagnosis<br>• Forbid carbon canister passive detection<br>• Forbid rear oxygen closed loop<br>• Forbid misfire detection fuel supply self-learning | Repair the fault, and inspect the fuel supply components and oxygen sensor circuit. |
| P0054 | Rear oxygen sensor heating | • Forbid front oxygen sensor aging diagnosis<br>• Forbid catalytic converter diagnosis<br>• Forbid rear oxygen closed loop control | Repair the fault or replace the rear oxygen sensor. |
| P0053 | Front oxygen sensor heating | • Forbid front oxygen sensor aging diagnosis<br>• Forbid catalytic converter diagnosis<br>• Forbid rear oxygen closed loop control<br>• Forbid fuel supply system self-learning | Repair the fault or replace the front oxygen sensor. |
| P2270, P2271 | Rear oxygen sensor aging | • Forbid catalytic converter diagnosis<br>• Forbid rear oxygen sensor closed loop control | Repair the fault or replace the oxygen sensor |
| P0133, P2195, P2196 | Front oxygen sensor aging | • Forbid catalytic converter diagnosis | Repair the fault or replace the oxygen sensor |
| P0138, P0137, P0136, P0140 | Rear oxygen sensor circuit | • Forbid catalytic converter diagnosis<br>• Forbid rear oxygen sensor aging diagnosis | Repair the fault, inspect the sensor circuit or replace the oxygen sensor. |

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| DTC Code | Description | Failure-Protection Operation | Prerequisite of Releasing Failure Protection |
|---|---|---|---|
| P0130, P0131, P0132, P0134 | Front oxygen sensor circuit | • Forbid catalytic converter diagnosis<br>• Forbid fuel supply system self-learning<br>• Forbid front oxygen sensor closed loop<br>• Forbid oxygen sensor aging diagnosis | Repair the fault, inspect the sensor circuit or replace the oxygen sensor. |
| P0420 | Catalytic converter | • Forbid rear oxygen closed loop<br>• Forbid front oxygen sensor rational curves drift diagnosis | Repair the fault, replace the catalytic converter. |
| P0327 | Knock sensor open fault | • Ignition angle of each cylinder is retarded for - 9 degrees when entering knock control | Repair the fault, and inspect the knock sensor connection. |
| P0328 | Knock sensor short fault | • Ignition angle of each cylinder is retarded for - 9 degrees when entering knock control | Repair the fault, and inspect the knock sensor connection. |

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# Data Flow List

By reading the "Actual values" displayed on the diagnostic tool, the working state of switches, sensors, and actuators can be inspected without removing any components. Before the fault diagnosis of electronic control system, observing and analyzing the data first in troubleshooting can shorten the troubleshooting time.

**CAUTION: The following table lists the data under normal conditions, only for reference. Do not depend solely on these reference values when deciding whether a part is faulty or not. Generally, compare a normal vehicle to the diagnosing vehicle under the same state, to determine whether the data of diagnosing vehicle under the current state is normal or not.**

1. Allow the engine to reach normal operating temperature.
2. Turn the ignition switch to "LOCK".
3. Connect the diagnostic tool.
4. Turn the ignition switch to "ON", and turn on the diagnostic tool.
5. Select "CHANA others/UAES M7/Actual values".
6. Refer to the chart below to inspect each item.

| Item | Ignition Switch "ON" | Idling | Engine Speed 2000 rpm |
|---|---|---|---|
| Battery voltage | 11.62 V | 13.65 V | 13.65 V |
| Engine speed | 0 rpm | 862 rpm | 2112 rpm |
| Vehicle speed | 0 km/h | 0 km/h | 0 km/h |
| vehicle acceleration | 0.0 $m/s^2$ | 0.0 $m/s^2$ | 0.0 $m/s^2$ |
| Engine cooling fluid temperature sensor voltage | 0.88 V | 0.66 V | 0.68 V |
| Engine cooling fluid temperature | 66°C | 78°C | 78°C |
| Air intake temperature sensor | 3.1 V | 2.8 V | 2.6 V |
| Air intake temperature | 11°C | 19°C | 22°C |
| Environment temperature | 3°C | 9°C | 9°C |
| Actual air intake manifold pressure sensor voltage | 4.0 V | 1.0 V | 0.7 V |
| Actual air intake manifold pressure | 1010 hPa | 330 hPa | 260 hPa |
| Air intake mass | 0.0 kg/h | 6.6 kg/h | 13.6 kg/h |
| Step motor target position | 122 Step | 49 Step | 47 Step |
| Throttle angle ADC signal | 0.49 V | 0.49 V | 0.68 V |
| Throttle position angle signal | 9.77% | 9.77% | 13.67% |
| Calculate throttle position | 0.0% | 0.0% | 3.5% |
| Throttle motor PWM control signal | 0.0% | 0.0% | 0.0% |
| Canister control valve air ratio | 0.0% | 0.0% | 5.9% |

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| Item | Ignition Switch "ON" | Idling | Engine Speed 2000 rpm |
|---|---|---|---|
| Charging time | 4.4 ms | 3.3 ms | 3.3 ms |
| Average injection pulse width | 0.0 ms | 3.2 ms | 2.8 ms |
| 1st cylinder advanced ignition angle | 0.0° | 3.0° | 30.5° |
| Fuel volume flow | 0.0 L/h | 0.586 L/h | 1.174 L/h |
| Knock sensor signal 1 | 0.0 V | 0.0 V | 0.0 V |
| Knock sensor signal 2 | 0.0 V | 0.0 V | 0.0 V |
| 1st cylinder ignition delay | 0° | 0° | 0° |
| 2nd cylinder ignition delay | 0° | 0° | 0° |
| 3rd cylinder ignition delay | 0° | 0° | 0° |
| 4th cylinder ignition delay | 0° | 0° | 0° |
| 1st group lambda sensor integral value [short term fuel trim] | 1.00 | 0.97 | 1.04 |
| 1st group lambda sensor voltage (sensor 1) | 0.5 V | 0.5 V | 0.1 V |
| 2nd group lambda sensor voltage (sensor 2) | 0.5 V | 0.7 V | 0.6 V |
| 1st group lambda sensor integral value [long term fuel trim] | 1.0 | 1.0 | 1.0 |
| Engine relative load | 100.0% | 20.3% | 16.2% |
| Idle speed torque self-adapting | -0.7% | 0.9% | 0.9% |
| Idle speed control target torque correction | 0.0% | 0.6% | 0.0% |
| Carbon canister control relative injection | 0.0% | 0.0% | 1.2% |
| Carbon canister purifying rate | 0.0% | 0.0% | 0.0% |
| Carbon canister load | 0.0 | 9.3 | 12.6 |
| Operating time after speed fault | 0 min | 0 min | 0 min |

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# Active Test List

Through the "Actuators" in the diagnostic tool, the working state of relays and actuators controlled by ECM can be tested without removing any components. Before the fault diagnosis of electronic control system, performing the active test first in troubleshooting can shorten the troubleshooting time.

**CAUTION: The following table lists the data under normal conditions, only for reference. Do not depend solely on these reference values when deciding whether a part is faulty or not. Generally, compare a normal vehicle to the diagnosing vehicle under the same state, to determine whether the data of diagnosing vehicle under the current state is normal or not.**

1. Allow the engine to reach normal operating temperature.
2. Turn the ignition switch to "LOCK".
3. Connect the diagnostic tool.
4. Turn the ignition switch to "ON", and turn on the diagnostic tool.
5. Select "UAES M7/Actuators".
6. Refer to the chart below to perform active test.

| Diagnostic Tool Display | Description | Control Range | Diagnosis Description |
|---|---|---|---|
| Fault indicator | Enable the engine indicator lamp | On/Off | - |
| Fuel Pump Relay | Enable the fuel pump | On/Off | Test conditions: The vehicle speed must be equal to zero. There must not be any vehicle speed sensor malfunction detected. |
| Blower 1 | Enable the cooling fan #1 | On/Off | Test conditions for Fan Relay Off: The engine coolant temperature must be below a unique calibration threshold (lower than 100°C). Otherwise, the ECM should turn on the fan to prevent engine from overheating. Air conditioning request is not allowed.<br>Test condition for Fan Relay On: No device control limit for this case. |
| Blower 2 | Enable the cooling fan #2 | On/Off | Test conditions for Fan Relay Off: The engine coolant temperature must be below a unique calibration threshold (lower than 100°C). Otherwise, the ECM should turn on the fan to prevent engine from overheating. Air conditioning request is not allowed.<br>Test condition for Fan Relay On: No device control limit for this case. |
| Ignition delay | Retard the ignition coil ignition angle | 0-7 | - |
| Set step motor Position | Set the stepper motor position | 0-255 | Test condition: No stepper actuator test active. |

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| Diagnostic Tool Display | Description | Control Range | Diagnosis Description |
|---|---|---|---|
| Canister control valve | Control the carbon canister control valve duty ratio | 0-100 | - |
| A/C Clutch | Engage the A/C clutch | On/Off | Test condition: Engine is not running. |
| Forbidden fuel injection | Disable the injector fuel injection | Cylinder 1/ Cylinder 2/ Cylinder 3/ Cylinder 4 | Test conditions: The vehicle speed must be equal to zero. There must not be any vehicle speed sensor malfunction detected. The oxygen sensor state must be in "lean". |
| Idle Speed Control | Control the idle speed | 0-2550 | Test condition: The engine idle speed must be less than 1000 rpm. |
| Step motor Test | Test the stepper motor | On/Off | Test condition: No set stepper position active. |

## DTC Diagnosis Procedure Index

| DTC Code | Description | Diagnosis Procedures |
|---|---|---|
| P0030 | O2 Sensor Heater Contr. Circ. (Bank1(1) Sensor 1) | Refer to: DTCs P0030, P0031, P0032, P0053 |
| P0031 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) Low | |
| P0032 | O2 Sensor Heater Contr. Circ. (Bank1(1) Sensor 1) High | |
| P0036 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) | Refer to: DTCs P0036, P0037, P0038, P0054 |
| P0037 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) Low | |
| P0038 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) High | |
| P0053 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 1) | Refer to: DTCs P0030, P0031, P0032, P0053 |
| P0054 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 2) | Refer to: DTCs P0036, P0037, P0038, P0054 |
| P0105 | Manifold Absolute Pressure/Barometric Pressure Circuit | Refer to: DTCs P0105, P0106, P0107, P0108 |
| P0106 | Manifold Abs. Pressure or Bar. Pressure Range/Performance | |
| P0107 | Manifold Abs. Pressure or Bar. Pressure Low Input | |
| P0108 | Manifold Abs. Pressure or Bar. Pressure High Input | |

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| DTC Code | Description | Diagnosis Procedures |
|---|---|---|
| P0112 | Intake Air Temp. Circ. Low Input | Refer to: DTCs P0112, P0113 |
| P0113 | Intake Air Temp. Circ. High Input | |
| P0117 | Engine Coolant Temp. Circ. Low Input | Refer to: DTCs P0117, P0118 |
| P0118 | Engine Coolant Temp. Circ. High Input | |
| P0122 | Throttle/Pedal Pos. Sensor A Circ. Low Input | Refer to: DTCs P0122, P0123 |
| P0123 | Throttle/Pedal Pos. Sensor A Circ. High Input | |
| P0130 | O2 Sensor Circ., Bank1-Sensor1 Malfunction | Refer to: DTCs P0130, P0131, P0132, P0133, P0134, P2195, P2196 |
| P0131 | O2 Sensor Circ., Bank1-Sensor1 Low Voltage | |
| P0132 | O2 Sensor Circ., Bank1-Sensor1 High Voltage | |
| P0133 | O2 Sensor Circ., Bank1-Sensor1 Slow Response | |
| P0134 | O2 Sensor Circ., Bank1-Sensor1 No Activity Detected | |
| P0136 | O2 Sensor Circ., Bank1-Sensor2 Malfunction | Refer to: DTCs P0136, P0137, P0138, P0140, P2270, P2271 |
| P0137 | O2 Sensor Circ., Bank1-Sensor2 Low Voltage | |
| P0138 | O2 Sensor Circ., Bank1-Sensor2 High Voltage | |
| P0140 | O2 Sensor Circ., Bank1-Sensor2 No Activity Detected | |
| P0201 | Cylinder 1 - Injector Circuit | Refer to: DTCs P0201, P0261, P0262 |
| P0202 | Cylinder 2 - Injector Circuit | |
| P0203 | Cylinder 3 - Injector Circuit | |
| P0204 | Cylinder 4 - Injector Circuit | |
| P0261 | Cylinder 1 - Injector Circuit Low | |
| P0262 | Cylinder 1 - Injector Circuit High | |
| P0264 | Cylinder 2 - Injector Circuit Low | |
| P0265 | Cylinder 2 - Injector Circuit High | |
| P0267 | Cylinder 3 - Injector Circuit Low | |
| P0268 | Cylinder 3 - Injector Circuit High | |
| P0270 | Cylinder 4 - Injector Circuit Low | |
| P0271 | Cylinder 4 - Injector Circuit High | |
| P0300 | Random/Multiple Cylinder Misfire Detected | Refer to: DTCs P0300, P0301, P0302, P0303, P0304 |
| P0301 | Cyl.1 Misfire Detected | |
| P0302 | Cyl.2 Misfire Detected | |
| P0303 | Cyl.3 Misfire Detected | |
| P0304 | Cyl.4 Misfire Detected | |

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| DTC Code | Description | Diagnosis Procedures |
|---|---|---|
| P0321 | Ign./Distributor Eng. Speed Inp. Circ. Range/ Performance | Refer to: DTCs P0321, P0322 |
| P0322 | Ign./Distributor Eng. Speed Inp. Circ. No Signal | |
| P0327 | Knock Sensor 1 Circ. Low Input | Refer to: DTCs P0327, P0328 |
| P0328 | Knock Sensor 1 Circ. High Input | |
| P0420 | Catalyst System, Bank1 Efficiency Below Threshold | Refer to: DTC P0420 |
| P0444 | Evaporative Emiss. System Purge Control Valve Circ. Open | Refer to: DTCs P0444, P0458, P0459 |
| P0458 | Evaporative Emission System Purge Control Valve Circuit Low | |
| P0459 | Evaporative Emission System Purge Control Valve Circuit High | |
| P0480 | Cooling Fan 1 Control Circuit | Refer to: DTCs P0480, P0691, P0692 |
| P0481 | Cooling Fan 2 Control Circuit | |
| P0506 | Idle Control System RPM Lower than Expected | Refer to: DTCs P0506, P0507 |
| P0507 | Idle Control System RPM Higher than Expected | |
| P0508 | Idle Air Control System Circuit Low | Refer to: DTCs P0508, P0509, P0511 |
| P0509 | Idle Air Control System Circuit High | |
| P0511 | Idle Air Control Circuit | |
| P0560 | System Voltage Malfunction | Refer to: DTCs P0560, P0562, P0563 |
| P0562 | System Voltage Low Voltage | |
| P0563 | System Voltage High Voltage | |
| P0602 | Control Module Programming Error | Refer to: DTC P0602 |
| P0627 | Fuel Pump "A" Control Circuit/Open | Refer to: DTCs P0627, P0628, P0629 |
| P0628 | Fuel Pump "A" Control Circuit Low | |
| P0629 | Fuel Pump "A" Control Circuit High | |
| P0645 | AC Clutch Relais Circuit | Refer to: DTCs P0645, P0646, P0647 |
| P0646 | A/C Clutch Relay Control Circuit Low | |
| P0647 | A/C Clutch Relay Control Circuit High | |
| P0650 | Malfunction Indicator Lamp Control Circ. | Refer to: DTC P0650 |

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| DTC Code | Description | Diagnosis Procedures |
|---|---|---|
| P0691 | Cooling Fan 1 Control Circuit Low | Refer to: DTCs P0480, P0691, P0692 |
| P0692 | Cooling Fan 1 Control Circuit High | |
| P0693 | Cooling Fan 2 Control Circuit Low | |
| P0694 | Cooling Fan 2 Control Circuit High | |
| P2177 | System Too Lean Off Idle | Refer to: DTCs P2177, P2178, P2187, P2188 |
| P2178 | System Too Rich Off Idle | |
| P2187 | System Too Lean at Idle | |
| P2188 | System Too Rich at Idle | |
| P2195 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 1 | Refer to: DTCs P0130, P0131, P0132, P0133, P0134, P2195, P2196 |
| P2196 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 1 | |
| P2270 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 2 | Refer to: DTCs P0136, P0137, P0138, P0140, P2270, P2271 |
| P2271 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 2 | |

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# DTCs P0030, P0031, P0032, P0053

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0030 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) | The working voltage of front oxygen sensor heater is provided by the main relay that is controlled by ECM. When the ignition switch is turned to "ON", battery voltage is applied to the terminal 1 of front oxygen sensor connector E01. ECM controls the working time of heater by the terminal 2 of ECM connector E07. |
| P0031 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) Low | |
| P0032 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) High | |
| P0053 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 1) | |

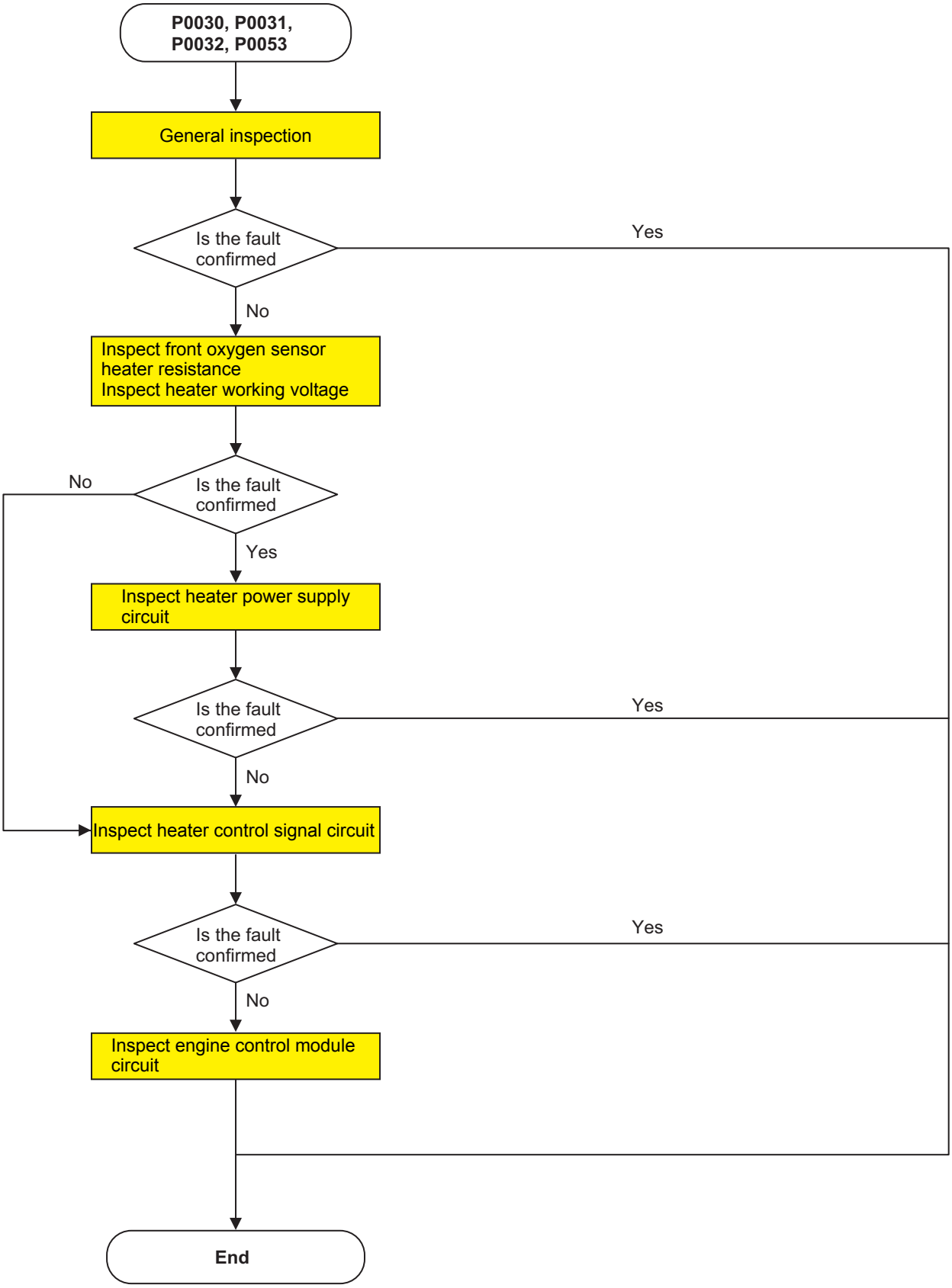
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0030 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Sensor circuit<br>• Sensor<br>• ECM |
| P0031 | | | |
| P0032 | | | |
| P0053 | Present resistance value is greater than threshold value | • Exhaust temperature is within 250°C ~ 550°C<br>• Front oxygen sensor internal resistance value is higher than about 1600 Ω | |

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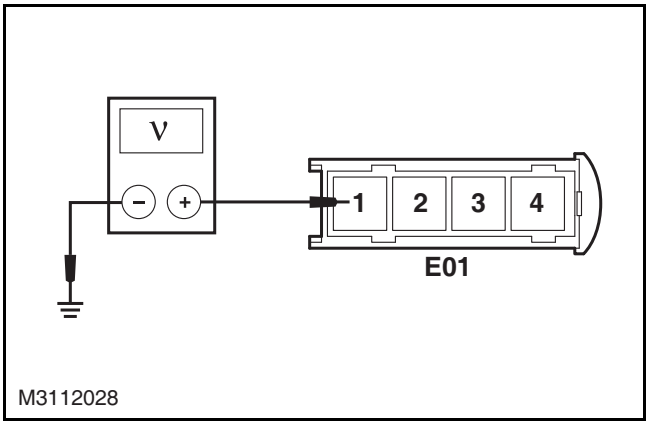


### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wire harness connector related to the front oxygen sensor for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect front oxygen sensor heater resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front oxygen sensor wiring harness connector.<br>C. Measure the resistance of heater between terminals 1 and 2 of front oxygen sensor .<br>**Standard resistance: 7 ~ 14 Ω (normal temperature)**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the front oxygen sensor. The system is normal. |
| 3. Inspect heater working voltage | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front oxygen sensor wiring harness connector E01.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 1 of front oxygen sensor wiring harness connector E01 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 4. |

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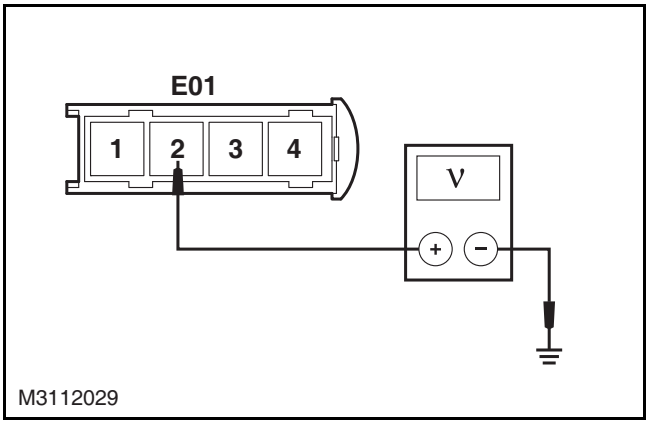


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect heater power supply circuit | |
| | A. Remove the fuse IF30.<br>B. Inspect the fuse.<br>Is the fuse normal?<br>**Yes**<br>Inspect and repair the conductivity between terminal 1 of front oxygen sensor wiring harness connector E01 and terminal 60 of fuse IF30 in the instrument panel fuse box P40.<br>**No**<br>Replace the fuse. Go to step 5. |

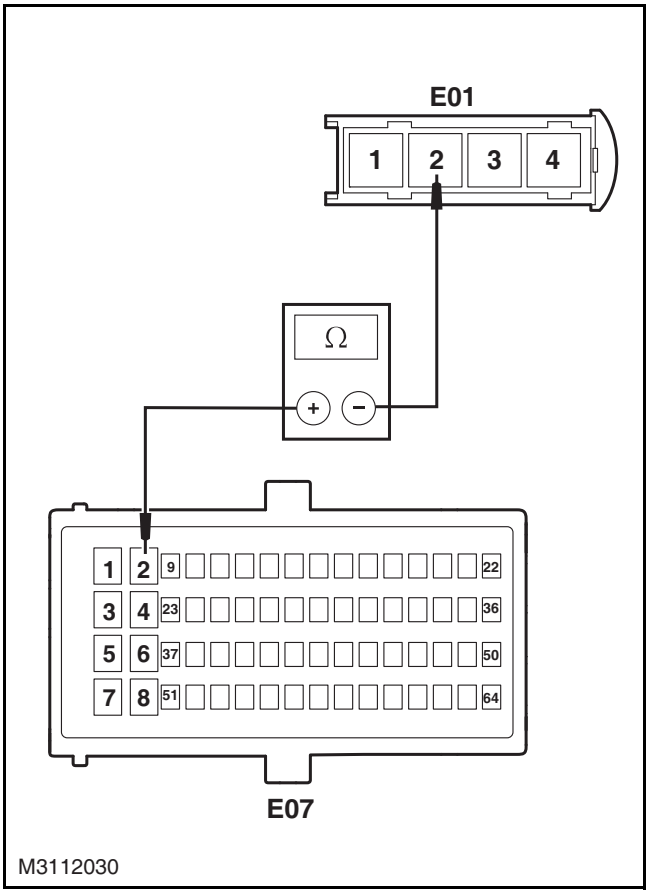
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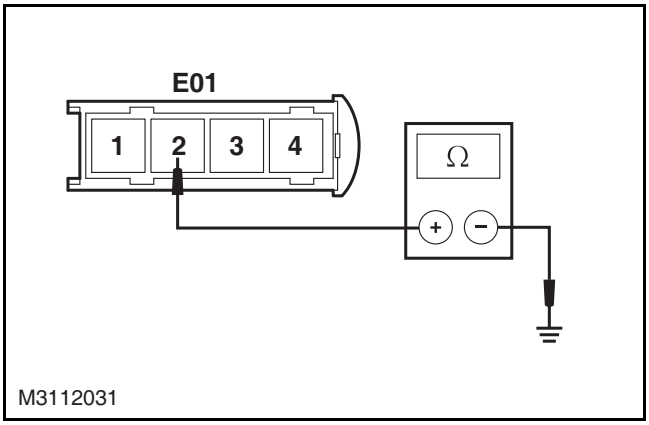
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect heater control signal circuit | |




M3112029




M3112030




M3112031

A. Turn the ignition switch to "LOCK".

B. Disconnect the front oxygen sensor wiring harness connector E01.

C. Measure the voltage between terminal 2 of E01 and reliable grounding.

**Standard voltage: 0 V**

D. Disconnect the ECM wiring harness connector E07.

E. Measure the resistance between terminal 2 of front oxygen sensor wiring harness connector E01 and terminal 2 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 2 of E01 and reliable grounding.

**Standard resistance: 10 MΩ or more**

Are they normal?

**Yes**

Go to step 6.

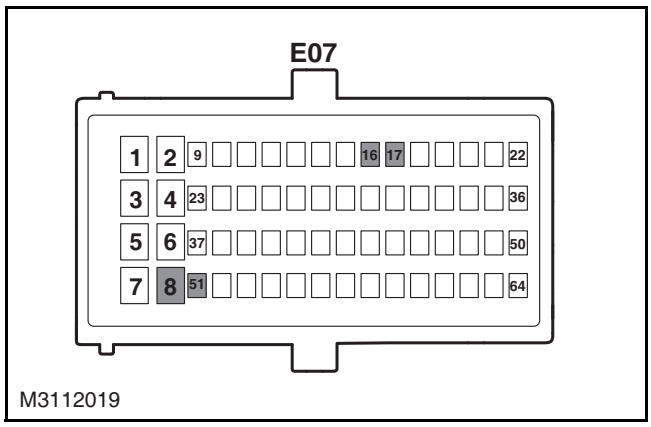
**No**

Repair the fault circuit between terminal 2 of front oxygen sensor wiring harness connector E01 and terminal 2 of ECM wiring harness connector E07. Verify that the system is normal.

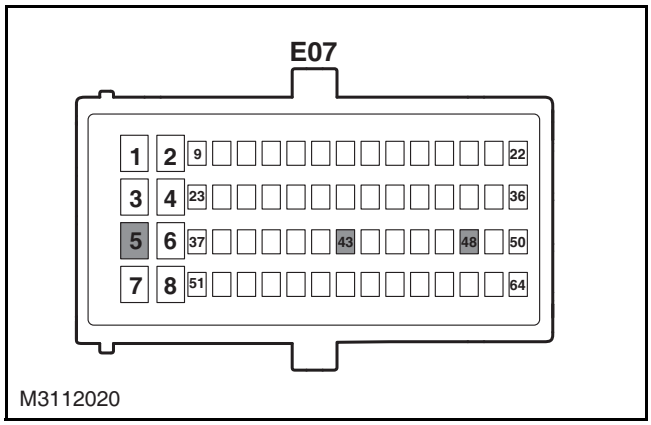
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect engine control module circuit | |



M3112019



M3112020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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# DTCs P0036, P0037, P0038, P0054

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0036 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) | The working voltage of rear oxygen sensor heater is provided by the main relay that is controlled by ECM. When the ignition switch is turned to "ON", battery voltage is applied to the terminal 3 of rear oxygen sensor connector S10. ECM controls the working time of heater by the terminal 4 of ECM wiring harness connector E07. |
| P0037 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) Low | |
| P0038 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) High | |
| P0054 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 2) | |

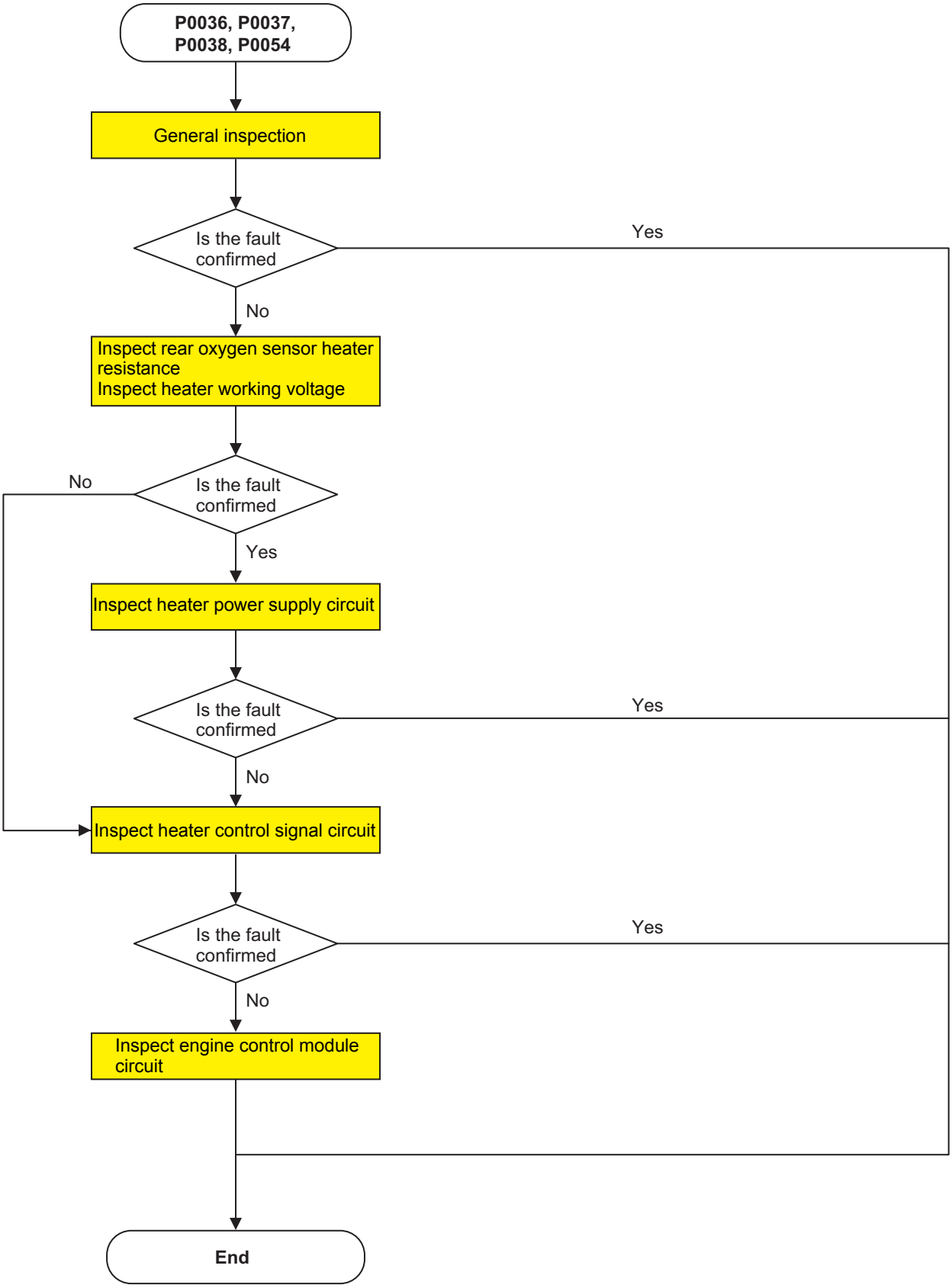
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0036 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Sensor circuit<br>• Sensor<br>• ECM |
| P0037 | | | |
| P0038 | | | |
| P0054 | Present resistance value is greater than threshold value | • Exhaust temperature is within 250°C ~ 550°C<br>• Rear oxygen sensor internal resistance value is higher than about 2200 Ω | |

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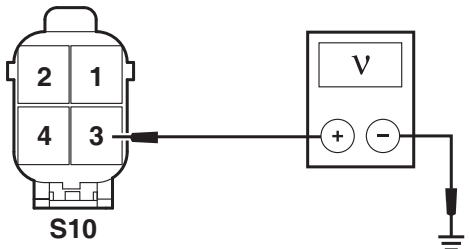


### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wire harness connector related to the rear oxygen sensor for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect rear oxygen sensor heater resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the rear oxygen sensor wiring harness connector S10.<br>C. Measure the resistance of heater between terminals 1 and 3 of rear oxygen sensor.<br>**Standard resistance: 7 ~ 14 Ω (normal temperature)**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the rear oxygen sensor. The system is normal. |
| 3. Inspect heater working voltage | |
|  <br>M3112032 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the rear oxygen sensor wiring harness connector S10.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 3 of rear oxygen sensor wiring harness connector S10 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 4. |

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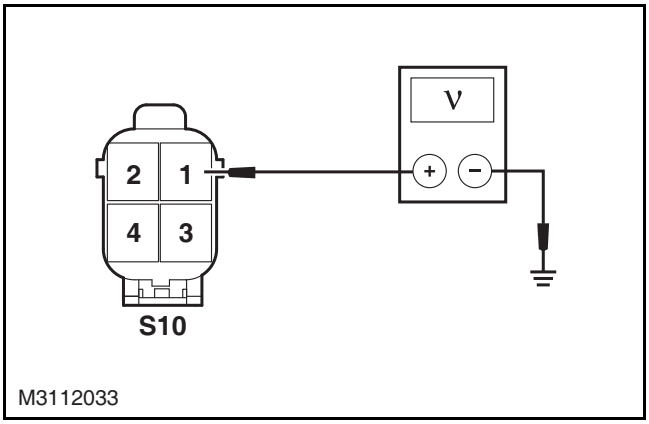


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect heater power supply circuit | |
| | A. Remove the fuse IF30.<br>B. Inspect the fuse.<br>**Standard resistance: less than 5 Ω**<br>Is the fuse normal?<br>**Yes**<br>Inspect and repair the conductivity between terminal 3 of rear oxygen sensor wiring harness connector S10 and terminal 60 of fuse IF30 in the instrument panel fuse box P40.<br>**No**<br>Replace the fuse. Go to step 5. |

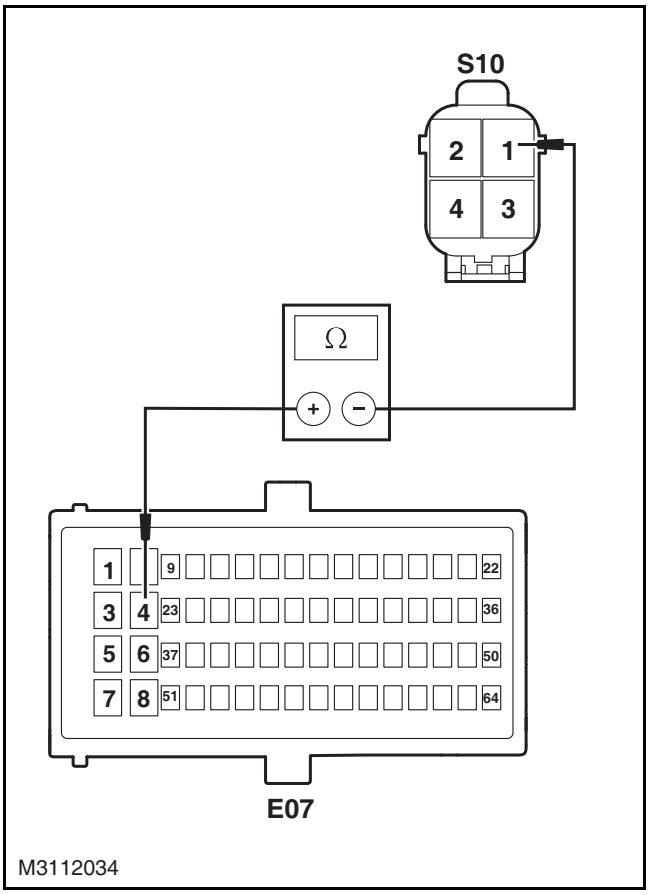
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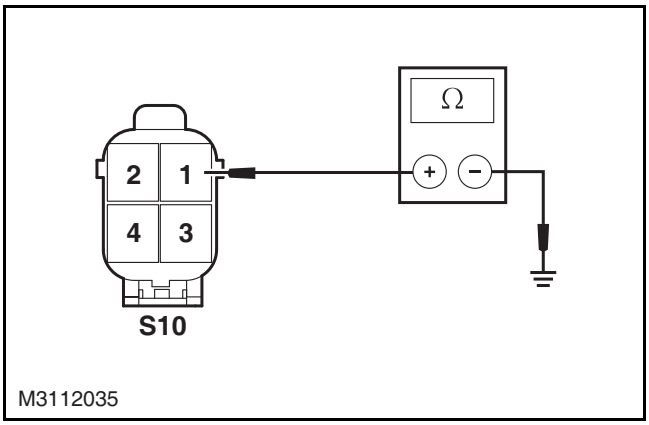
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect heater control signal circuit | |




M3112033




M3112034




M3112035

A. Turn the ignition switch to "LOCK".

B. Disconnect the rear oxygen sensor wiring harness connector S10.

C. Measure the voltage between terminal 1 of S10 and reliable grounding.

**Standard voltage: 0 V**

D. Disconnect the ECM wiring harness connector E07.

E. Measure the resistance between terminal 1 of rear oxygen sensor wiring harness connector S10 and terminal 4 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 1 of S10 and reliable grounding.

**Standard resistance: 10 MΩ or more**

Is it normal?

**Yes**

Go to step 6.

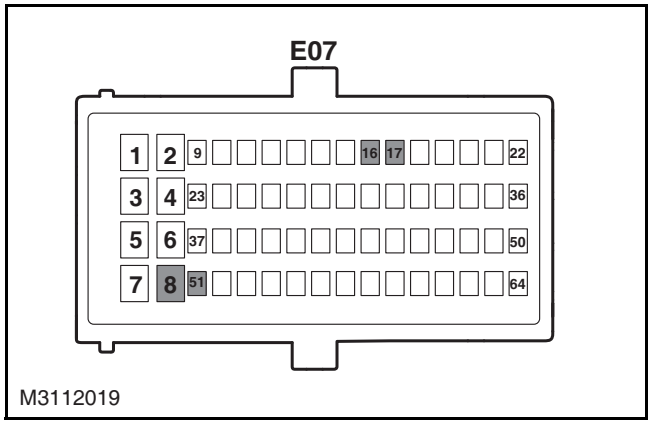
**No**

Repair the fault circuit between the terminal 1 of rear oxygen sensor wiring harness connector S10 and terminal 4 of ECM wiring harness connector E07.

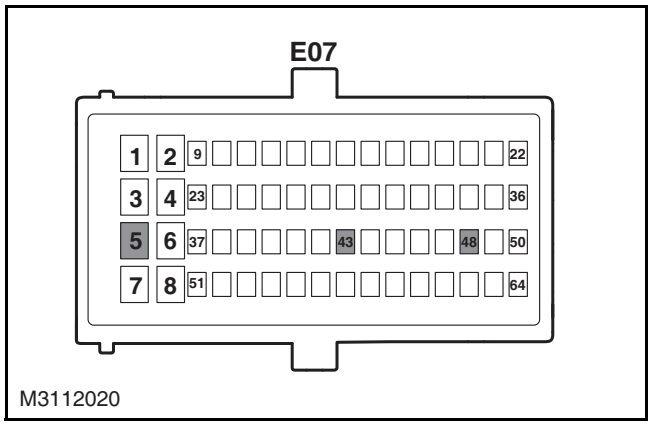
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect engine control module circuit | |



M3112019



M3112020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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# DTCs P0105, P0106, P0107, P0108

### 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0105 | Manifold Absolute Pressure/ Barometric Pressure Circuit | Air intake pressure/temperature sensor has four terminals. When the ignition switch is turned to "ON", the ECM provides 5 V to the terminal 3 of sensor through terminal 19 of connector E07; the terminal 40 of E07 enables the terminal 1 of sensor grounding; and the terminal 4 of sensor provides an signal that changes according to the air intake pressure to terminal 59 of ECM connector E07. |
| P0106 | Manifold Abs.Pressure or Bar. Pressure Range/Performance | |
| P0107 | Manifold Abs. Pressure or Bar.Pressure Low Input | |
| P0108 | Manifold Abs. Pressure or Bar. Pressure High Input | |

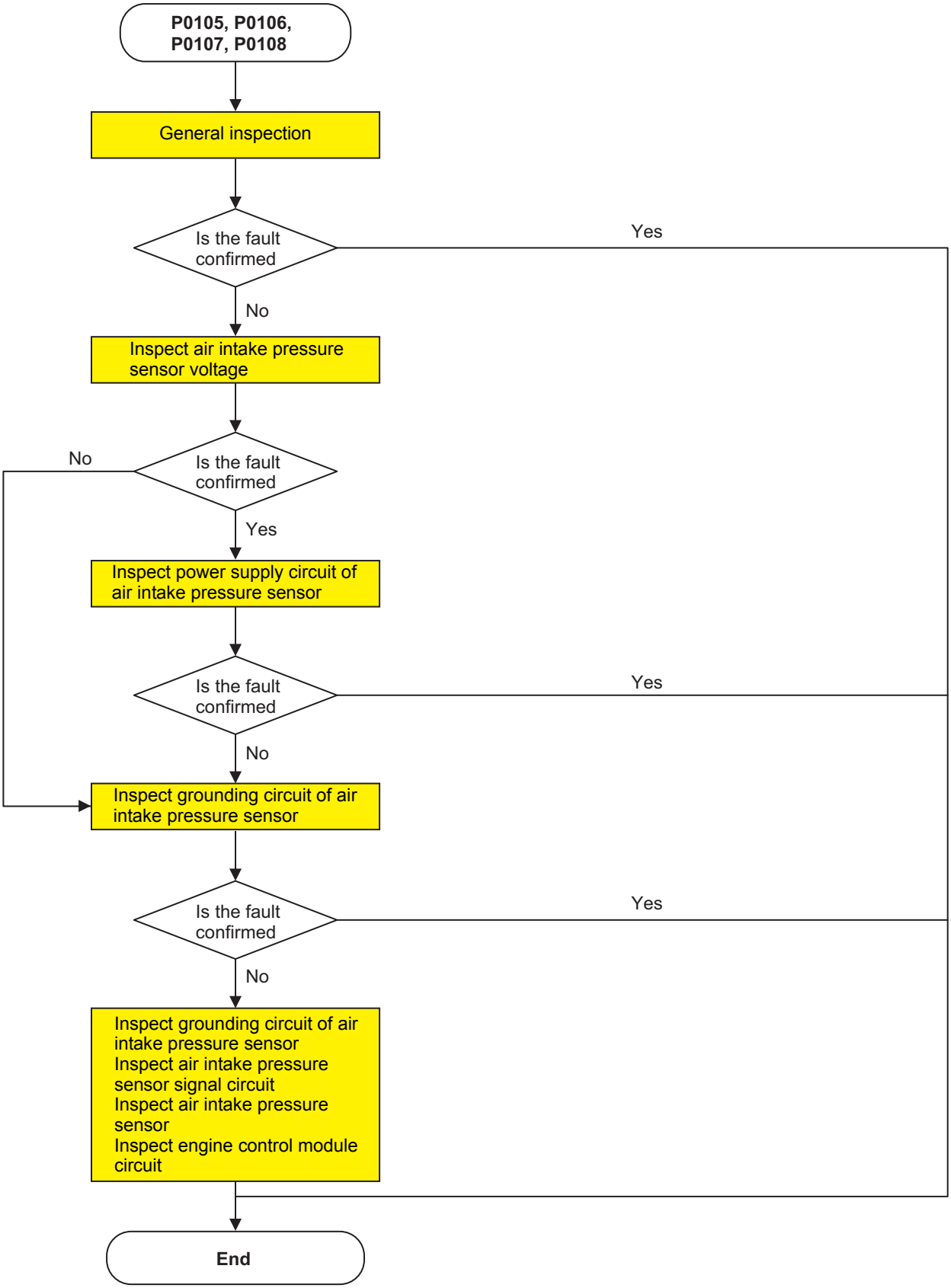
### 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0105 | Signal inspection: no pressure drop after start | • Engine speed is more than 800 rpm<br>• Pressure drops less than 20 hPa after starting<br>• Last for more than 1 s | • Sensor circuit<br>• Sensor<br>• ECM |
| P0106 | signal non-plausible | • Depend on engine speed and throttle opening<br>• Last for more than 1 s | |
| P0107 | Circuit inspection, lower limit exceeded | • Pressure sensor voltage is lower than 0.195 V<br>• Last for more than 1 s | |
| P0108 | Circuit inspection, upper limit exceeded | • 1 s after start<br>• Pressure sensor voltage is more than 4.883 V<br>• Last for more than 1 s | |

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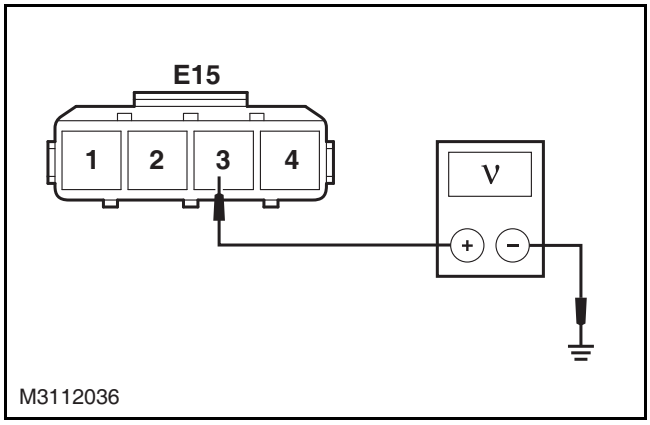


### 3. Diagnosis Procedure



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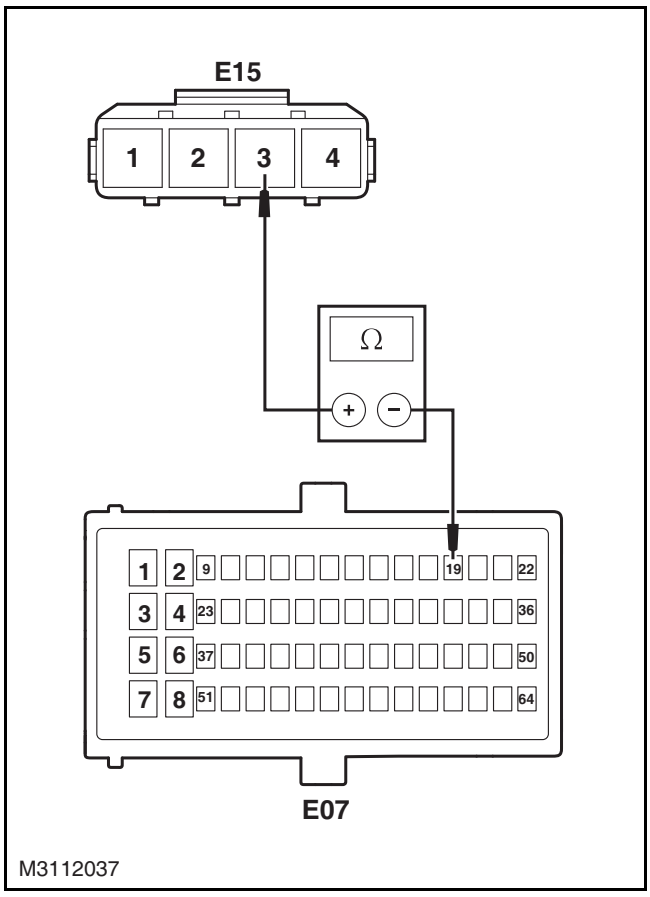


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect for the following conditions:<br>• Sensor housing damaged, and vacuum tube cracked<br>• Sensor sealing damaged<br>• Sensor loose or improperly installed<br>• Sensor vacuum tube blocked<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault, and verify that the system is normal. |
| 2. Inspect air intake pressure sensor voltage | |
|  <br>M3112036 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 3 of air intake pressure/temperature sensor wiring harness connector E15 and reliable grounding.<br>**Standard voltage: 4.5 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 3. |

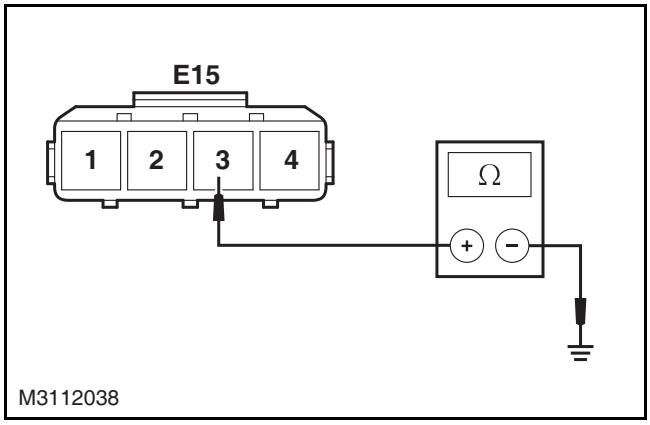
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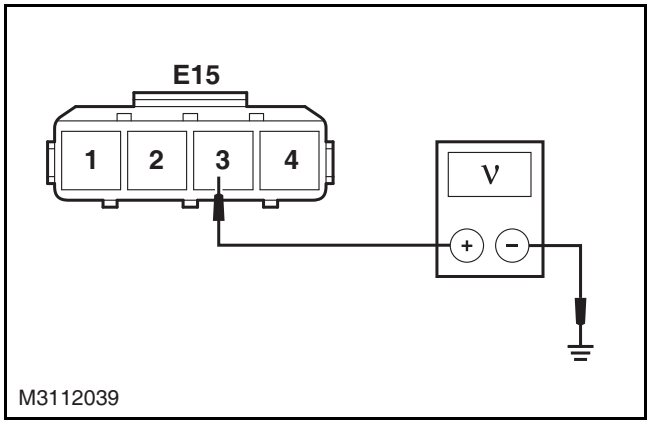
| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect power supply circuit of air intake pressure sensor | |




M3112037




M3112038




M3112039

A. Turn the ignition switch to "LOCK".

B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 3 of air intake pressure/temperature sensor wiring harness connector E15 and terminal 19 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 3 of air intake pressure/temperature sensor wiring harness connector E15 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 3 of air intake pressure/temperature sensor wiring harness connector E15 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

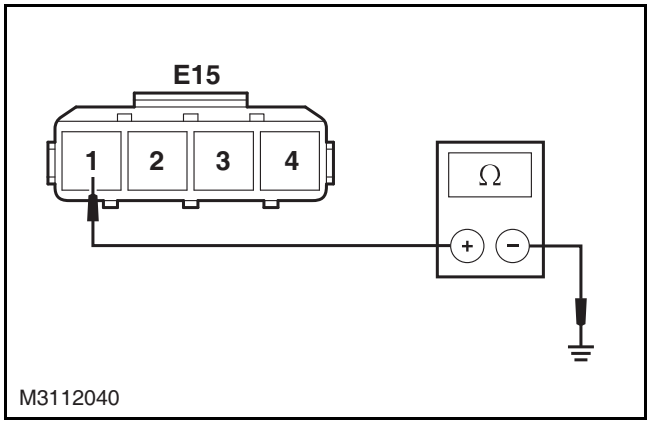
Go to step 4.

**No**

Repair the fault circuit between terminal 3 of E15 and terminal 19 of E07, and verify that the system is normal.

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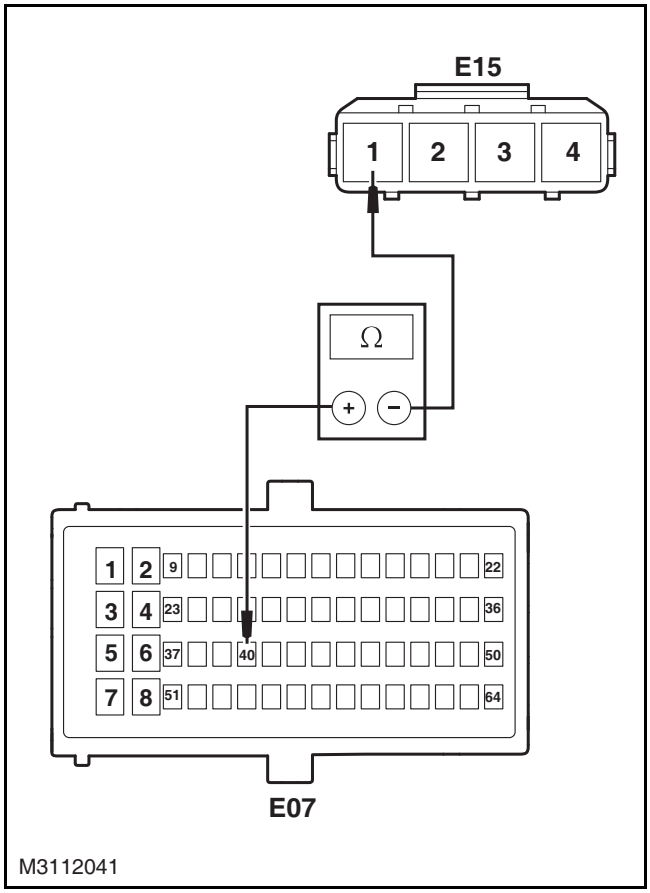


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect grounding circuit of air intake pressure sensor | |
|  <br>M3112040 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 1 of air intake pressure/temperature sensor wiring harness connector E15 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Go to step 5. |

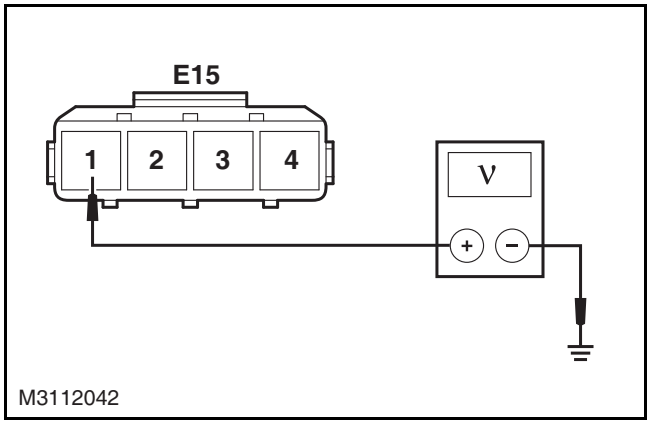
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect grounding circuit of air intake pressure sensor | |




M3112041




M3112042

A. Turn the ignition switch to "LOCK".

B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 1 of air intake pressure/temperature sensor wiring harness connector E15 and terminal 40 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the voltage between terminal 1 of air intake pressure/temperature sensor wiring harness connector E15 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

**Is the resistance value normal?**

**Yes**

Go to step 6.

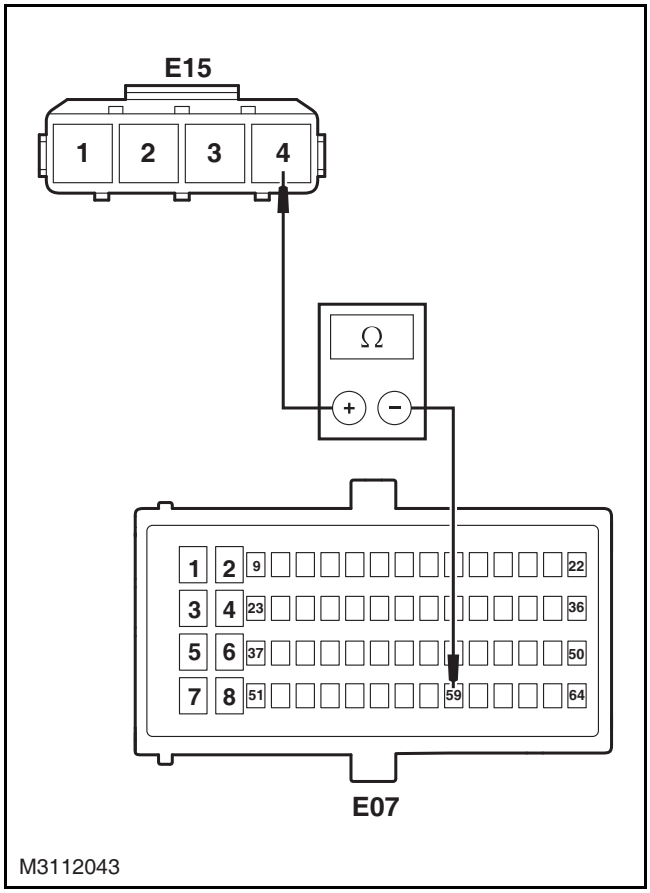
**No**

Repair the fault circuit, and verify that the system is normal.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect air intake pressure sensor signal circuit | |




M3112043

A. Turn the ignition switch to "LOCK".

B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 4 of air intake pressure/temperature sensor wiring harness connector E15 and terminal 59 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 4 of air intake pressure/temperature sensor wiring harness connector E15 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 4 of air intake pressure/temperature sensor wiring harness connector E15 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

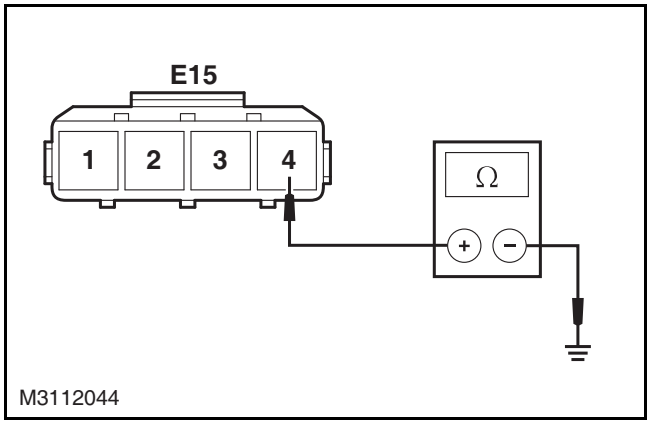
Are they normal?

**Yes**

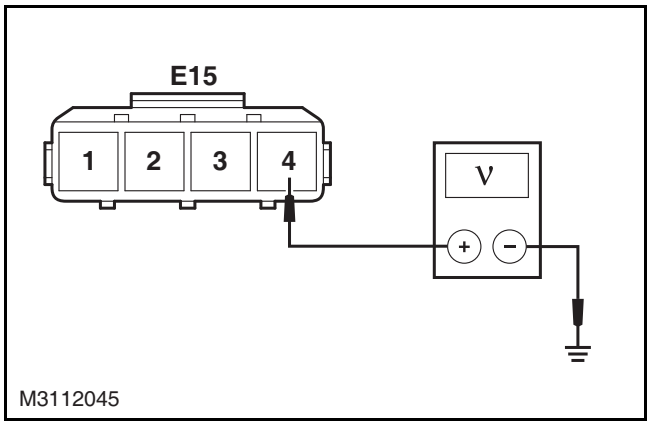
Go to step 7.

**No**

Repair the circuit, and verify that the system is normal.



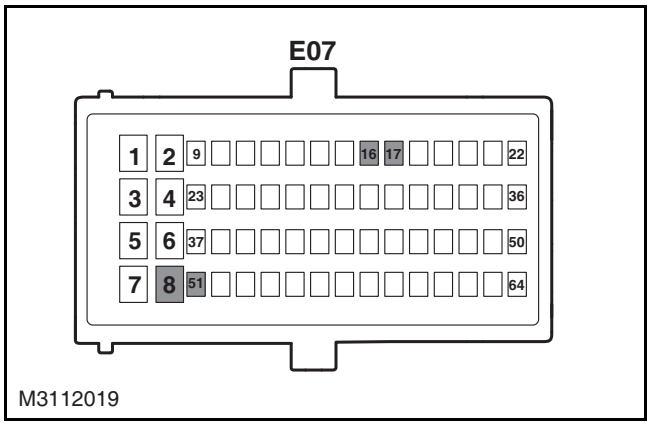
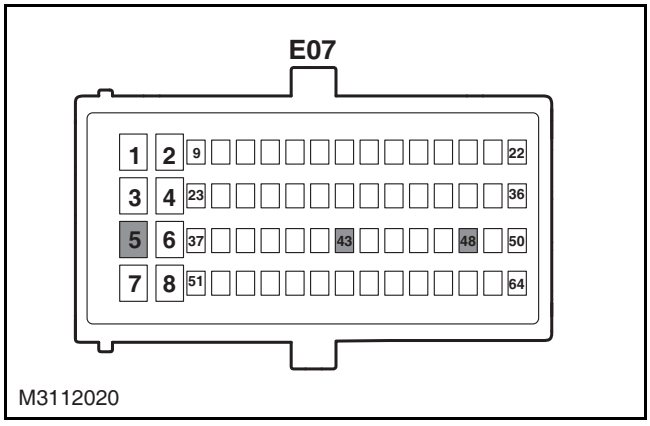

M3112044




M3112045

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect air intake pressure sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15.<br>C. Turn the ignition switch to "ON".<br>D. Connect a jumper cable with 5 A fuse between terminals 3 and 4 of E15.<br>E. Connect the diagnostic tool and enter engine data flow and read the "actual intake manifold pressure" parameter.<br>**Standard parameter: 1050 kPa**<br>Is the data normal?<br>**Yes**<br>Replace the air intake pressure sensor.<br>**No**<br>Go to step 8. |
| 8. Inspect engine control module circuit | |
|  <br>M3112019 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |
|  <br>M3112020 | |

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# DTCs P0112, P0113

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0112 | Intake Air Temp. Circ. Low Input | Air intake temperature sensor is integrated into the engine air intake pressure/temperature sensor to measure the temperature of air that goes into the engine. ECM internal pressure regulator circuit provides 5 V reference voltage to terminal 2 of air intake pressure/temperature sensor wiring harness connector E15 via terminal 25 of ECM wiring harness connector E07. The air intake temperature sensor voltage-drop signal can be obtained in this circuit. Set terminal 1 of intake pressure/temperature sensor E15 to low potential via terminal 40 of E07. |
| P0113 | Intake Air Temp. Circ. High Input | |

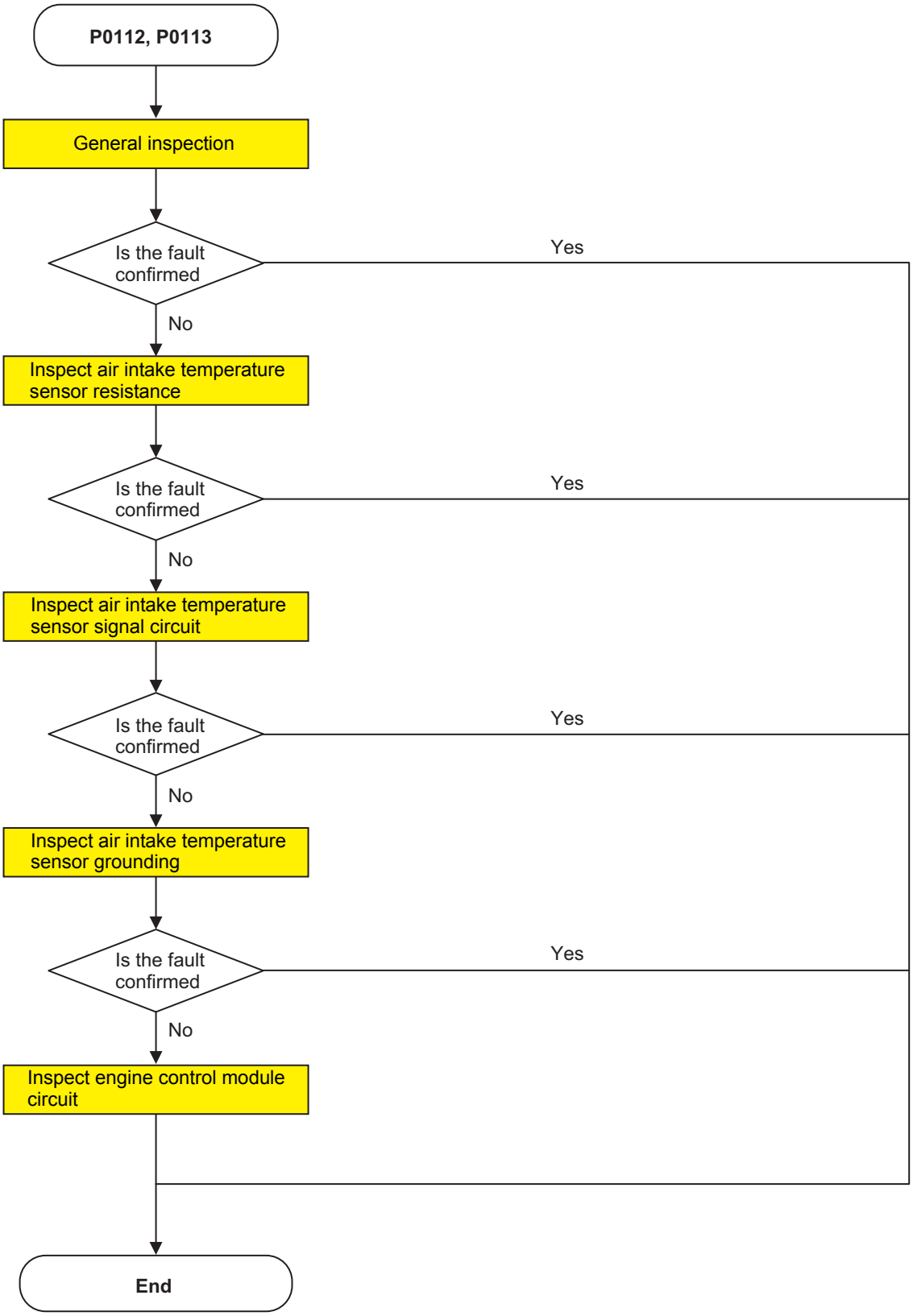
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0112 | Upper limit exceeded, short to ground | • Air intake temperature is higher than 128.25°C<br>• Last for more than 1 s | • Sensor circuit<br>• Sensor<br>• ECM |
| P0113 | Lower limit exceeded, short to power supply | • 240 s after start<br>• Air intake temperature is lower than -38.25°C<br>• Last for more than 10 s | |

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### 3. Diagnosis Procedure



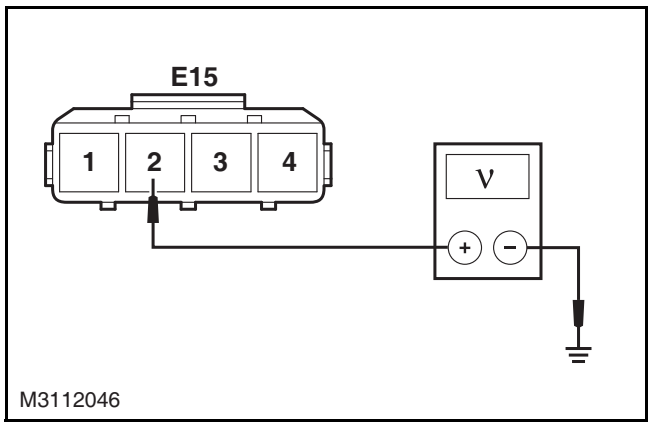
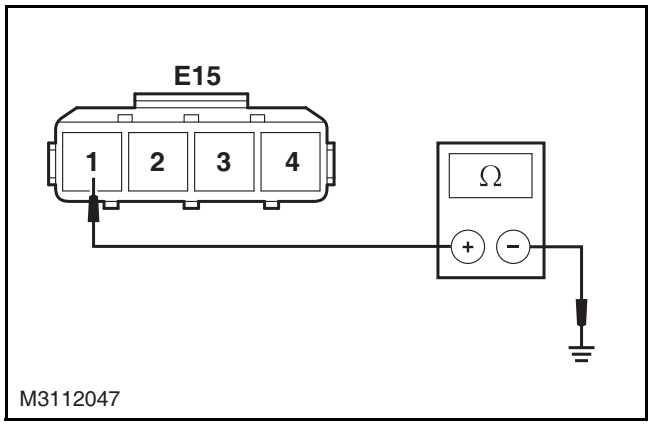
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect for the following conditions:<br>• Sensor housing damaged, and vacuum tube cracked<br>• Sensor sealing damaged<br>• Sensor loose or improperly installed<br>• Sensor vacuum tube blocked<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault, and verify that the system is normal. |
| 2. Inspect air intake temperature sensor resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15.<br>C. Measure the resistance of air intake temperature sensor (terminals 1 to 2).<br>**Standard resistance:**<br>**2.5 kΩ ± 5% at 20°C**<br>D. Connect the air intake pressure/temperature sensor wiring harness connector.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the air intake pressure/temperature sensor. |

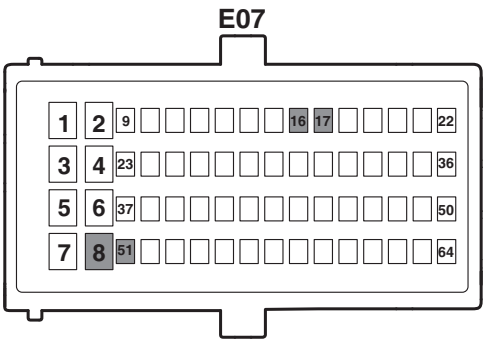
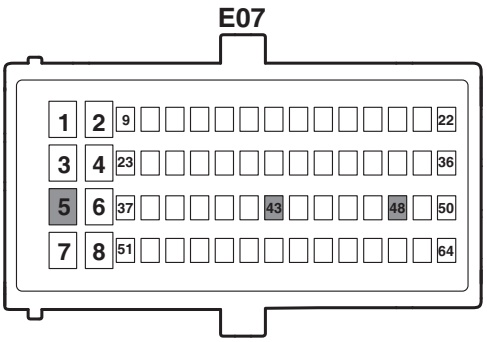
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect air intake temperature sensor signal circuit | |
|  M3112046 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 2 of air intake pressure/temperature sensor wiring harness connector E15 and reliable grounding.<br>**Standard voltage: 4.7 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the fault circuit between terminal 2 of air intake pressure/temperature sensor wiring harness connector E15 and terminal 25 of engine control module wiring harness connector E07. Verify that the system is normal. |
| 4. Inspect air intake temperature sensor grounding | |
|  M3112047 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 1 of air intake pressure/temperature sensor wiring harness connector E15 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair the fault circuit between terminal 1 of air intake pressure/temperature sensor E15 and terminal 40 of engine control module wiring harness connector E07. Verify that the system is normal. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0117, P0118

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0117 | Engine Coolant Temp.Circ. Low Input | Coolant temperature sensor, a variable resistor of negative temperature coefficient, is used for measuring engine coolant temperature. ECM provides 5 V to the terminal 1 of coolant temperature sensor wiring harness connector E11 via terminal 41 of ECM wiring harness connector E07, and obtains sensor signals from terminal 41 of E07. ECM sets terminal 3 of sensor connector E11 to low potential via terminal 40 of E07. |
| P0118 | Engine Coolant Temp.Circ. High Input | |

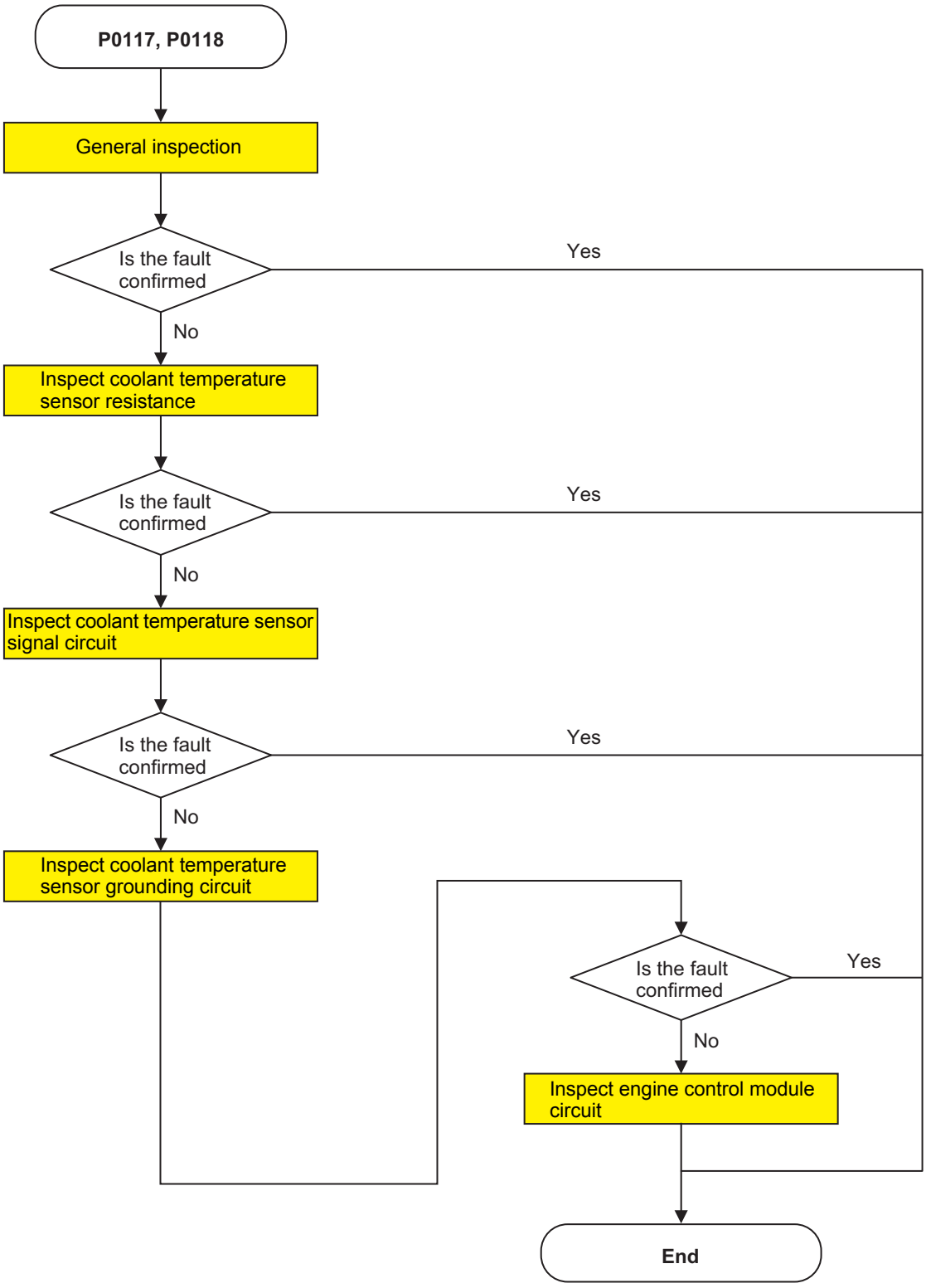
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0117 | Upper limit exceeded, short to ground | Coolant temperature measured value is higher than 135°C for 2 s | • Sensor circuit<br>• Sensor<br>• ECM |
| P0118 | Lower limit exceeded, short to power supply | Coolant temperature measured value is lower than -37.5°C for 2 s | |

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### 3. Diagnosis Procedure



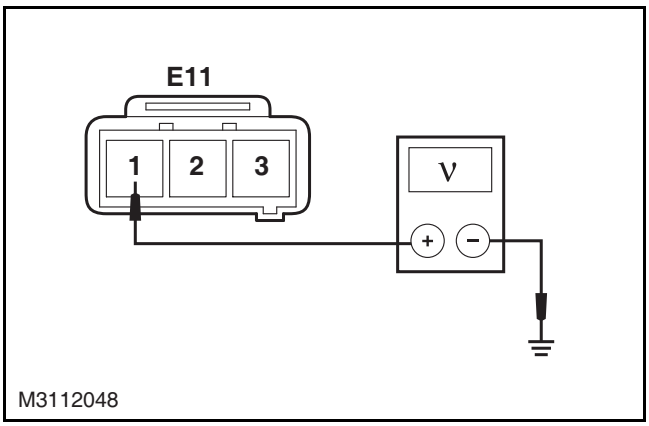
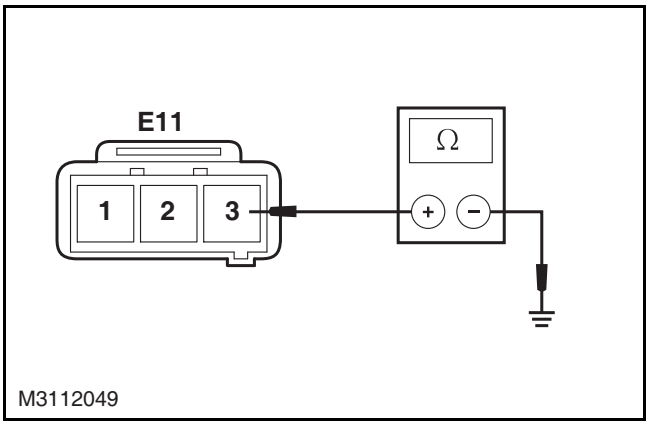
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect if the engine coolant temperature sensor is corroded, and if the coolant leaks through the sensor.<br>B. Inspect if the level of engine coolant in cooling system reservoir is proper.<br>C. Inspect the sensor for looseness or improper installation.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect coolant temperature sensor resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the coolant temperature sensor wiring harness connector E11.<br>C. Measure the resistance of coolant temperature sensor with a multimeter.<br>**Standard resistance:**<br>**2.5 kΩ for rated resistance at 20°C**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the coolant temperature sensor. |

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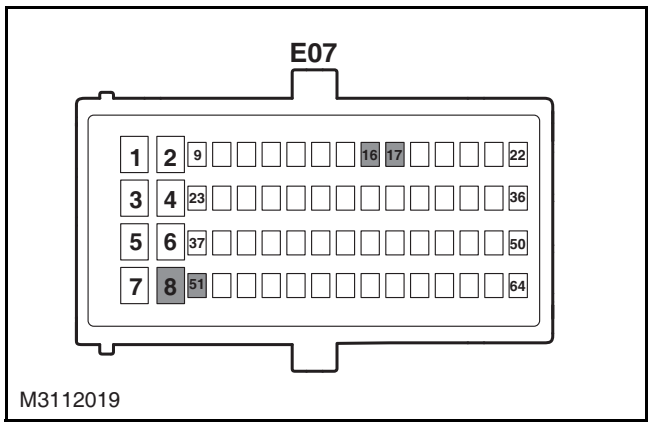


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect coolant temperature sensor signal circuit | |
|  <br>M3112048 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the coolant temperature sensor wiring harness connector E11.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 1 of coolant temperature sensor wiring harness connector E11 and reliable grounding.<br>**Standard voltage: 4.7 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the fault circuit between terminal 1 of coolant temperature wiring harness sensor E11 and terminal 41 of engine control module wiring harness connector E07. |
| 4. Inspect coolant temperature sensor grounding circuit | |
|  <br>M3112049 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the coolant temperature sensor wiring harness connector E11.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 3 of coolant temperature sensor wiring harness connector E11 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the fault circuit between terminal 3 of coolant temperature sensor wiring harness connector E11 and terminal 40 of engine control module wiring harness connector E07. |

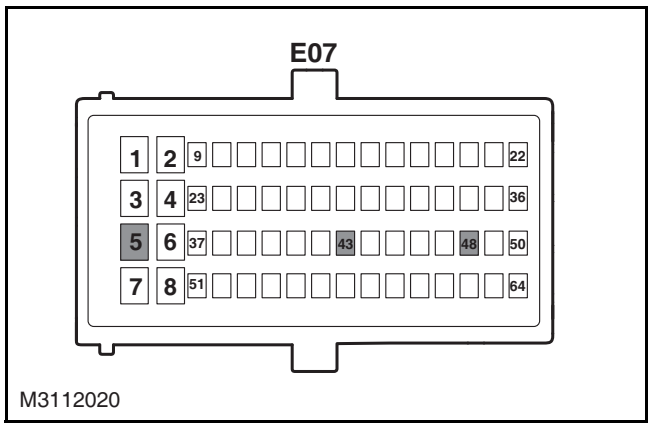
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect engine control module circuit | |



M3112019



M3112020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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# DTCs P0122, P0123

### 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0122 | Throttle/Pedal Pos.Sensor A Circ. Low Input | ECM provides 5 V reference voltage to terminal 1 of TPS sensor wiring harness connector E03 via terminal 18 of ECM wiring harness connector E07. TPS sensor provides sensor signal voltage to terminal 26 of ECM wiring harness connector E07 via terminal 3 of E03. ECM sets terminal 2 of TPS sensor wiring harness connector E03 to low potential via terminal 39 of ECM wiring harness connector E07. |
| P0123 | Throttle/Pedal Pos.Sensor A Circ. High Input | |

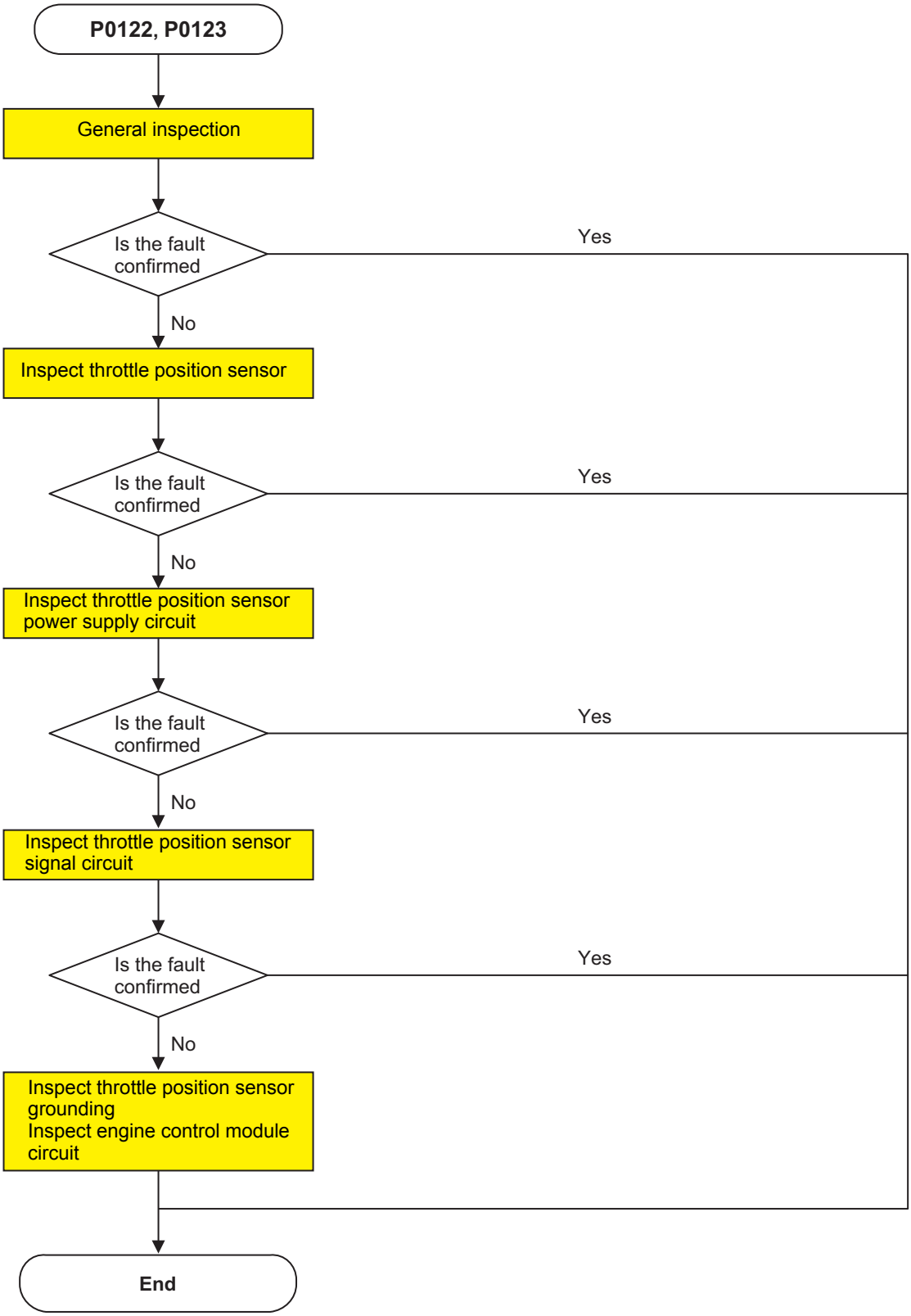
### 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0122 | Lower limit of throttle position angle signal exceeded | • Engine speed is more than 600 rpm<br>• Throttle position angle signal is less than 1% for 1 s | • Sensor circuit<br>• Sensor<br>• ECM |
| P0123 | Upper limit of throttle position angle signal exceeded | • Engine speed is more than 600 rpm<br>• Throttle position angle signal is more than 99% for 1 s | |

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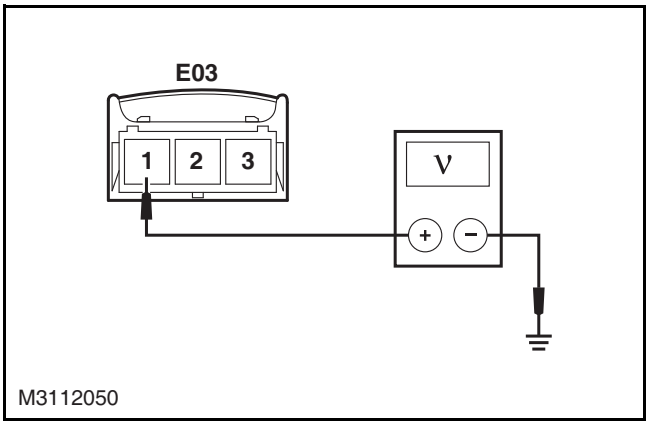


### 3. Diagnosis Procedure



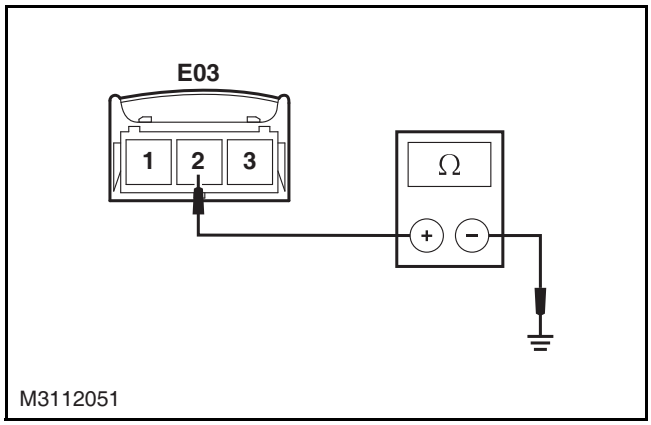
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the sensor wiring harness connector for looseness.<br>B. Visually inspect the sensor for damage.<br>C. Measure the resistance of throttle position sensor.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. The system is normal. |
| 2. Inspect throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the throttle position sensor wiring harness connector E03.<br>C. Measure the resistance of throttle position sensor.<br>**Standard resistance:**<br>**2 kΩ ± 20% between terminals 1 and 2**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the throttle position sensor. |
| 3. Inspect throttle position sensor power supply circuit | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the throttle position sensor wiring harness connector E03.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 1 of throttle position sensor E03 and reliable grounding.<br>**Standard voltage: 4.5 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the fault circuit between terminal 1 of throttle position sensor wiring harness connector E03 and terminal 18 of engine control module wiring harness connector E07. Verify that the system is normal. |

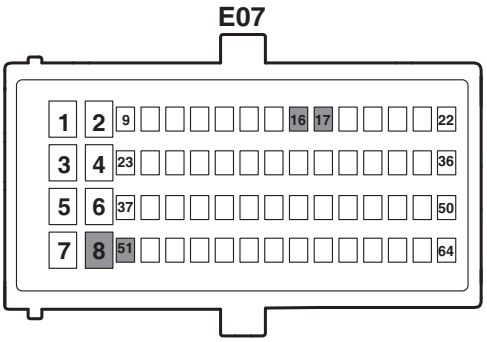
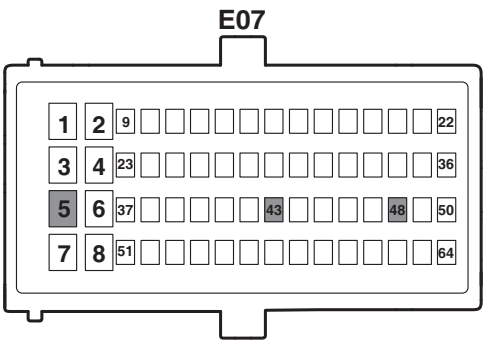
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect throttle position sensor signal circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the throttle position sensor wiring harness connector E03.<br>C. Turn the ignition switch to "ON".<br>D. Connect a jumper cable with 5 A fuse between terminals 2 and 3 of E03. Use the diagnostic tool to observe the "ADC-signal throttle angle" parameter.<br>**Standard voltage: 4.5 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair the fault circuit between terminal 3 of throttle position sensor wiring harness connector E03 and terminal 26 of engine control module wiring harness connector E07. Verify that the system is normal. |
| 5. Inspect throttle position sensor grounding | |
|  <br>M3112051 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the throttle position sensor wiring harness connector E03.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 2 of throttle position sensor wiring harness connector E03 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the fault circuit between terminal 2 of throttle position sensor wiring harness connector E03 and terminal 39 of engine control module wiring harness connector E07. Verify that the system is normal. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0130, P0131, P0132, P0133, P0134, P2195, P2196

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0130 | O2 Sensor Circ., Bank1-Sensor1 Malfunction | After vehicle starts, the control module works in open loop mode, and it will ignore the front oxygen sensor signal voltage in the calculation of air-fuel ratio. Control module provides approximately 450 mV reference voltage to the front oxygen sensor. When the engine is running, the front oxygen sensor starts heating and generating 0.1 ~ 0.9 V voltage. The voltage fluctuates up and down along the reference voltage. Once the control module detects that the front oxygen sensor voltage exceeds the set threshold, it will immediately enter closed loop mode. Control module determines the air-fuel ratio based on the front oxygen sensor voltage. If the front oxygen sensor voltage is higher than 0.45 V, it indicates that the mixture is too rich. If the front oxygen sensor voltage is lower than 0.45 V, it indicates that the mixture is too lean. ECM sets the terminal 3 of front oxygen sensor E01 to low potential via terminal 39 of E07. When the oxygen sensor reaches normal working temperature, it transmits oxygen sensor signal to the ECM via terminal 4 of E01 connected to terminal 45 of E07 of ECM. |
| P0131 | O2 Sensor Circ., Bank1-Sensor1 Low Voltage | |
| P0132 | O2 Sensor Circ., Bank1-Sensor1 High Voltage | |
| P0133 | O2 Sensor Circ., Bank1-Sensor1 Slow Response | |
| P0134 | O2 Sensor Circ., Bank1-Sensor1 No Activity Detected | |
| P2195 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 1 | |
| P2196 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 1 | |

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**2. Possible Causes**

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0130 | Front oxygen sensor coupled with heater line | • Front oxygen sensor reaches the working temperature<br>• Front oxygen sensor output voltage is higher than 2.0 V | • Sensor circuit<br>• Sensor<br>• ECM |
| P0131 | Signal short to ground | • Front oxygen sensor output voltage is less than 0.06 V | |
| P0132 | Front oxygen sensor voltage too high | • Battery voltage is higher than 10.68 V<br>• Engine speed is more than 25 rpm<br>• Target λ = 1<br>• Exhaust temperature is lower than 800°C<br>• Front oxygen sensor reaches working temperature for 150 s<br>• Front oxygen sensor output voltage is higher than 1.5 V | |

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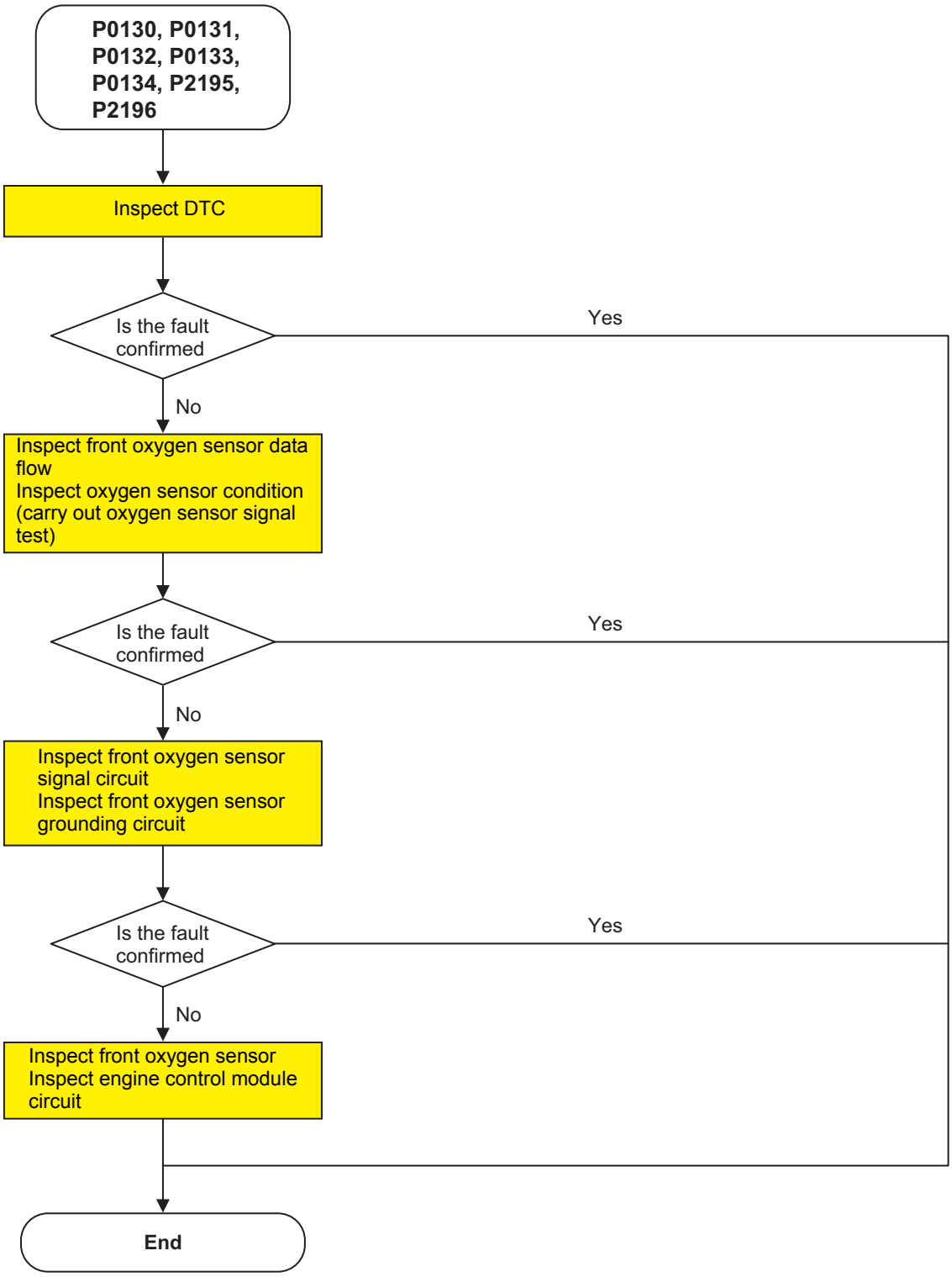


| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0133 | Cycle duration of front oxygen sensor signal filtered is more than threshold | • Cycle duration of front oxygen sensor signal filtered is more than 2.0 s<br>• Effective cycle count is more than 14<br>• Front oxygen sensor closed loop control active<br>• No pressure sensor fault<br>• No coolant temperature sensor fault<br>• No air intake temperature sensor fault<br>• Basic mixture adaptation not disabled<br>• No diagnosis stop condition<br>• Engine speed is within 1800 ~ 2840 rpm<br>• Engine load is within 25 ~ 50<br>• Exhaust temperature model value is greater than 500<br>• Front oxygen sensor heating diagnosis passed<br>• CDLATP diagnosis function on | • Sensor circuit<br>• Sensor<br>• ECM |
| P0134 | Signal open circuit | • Front oxygen sensor reaches the working temperature for 150 s<br>• Front oxygen sensor voltage is within 0.40 ~ 0.60 V | |
| P2195 | Rear oxygen control integrator value exceeds upper limit | • Diagnosis function on<br>• Rear oxygen control active<br>• Rear oxygen control integrator value is greater than 1.0 s | |
| P2196 | Rear oxygen control integrator value exceeds lower limit | • No catalytic converter fault<br>• No diagnosis stop condition<br>• Diagnosis time is 20 s<br>• Rear oxygen control integrator value is less than -1.0 s | |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start the engine, and use the diagnostic tool to inspect the engine system.<br>Is there any DTC besides P0130, P0131, P0132, P0133, P0134, P2195 and P2196?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Repair the fault. |
| 2. Inspect front oxygen sensor data flow | |
| | A. Start the engine, and run it till the engine coolant temperature reaches above 80°C.<br>B. Use diagnostic tool to access to engine data flow, and observe the "O2 sensor voltage bank 1, sensor 1" parameter.<br>**Standard voltage: fluctuates between 0.1 ~ 0.9 V**<br>Does the voltage of oxygen sensor fluctuate between 0.1 ~ 0.9 V?<br>**Yes**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 3. |

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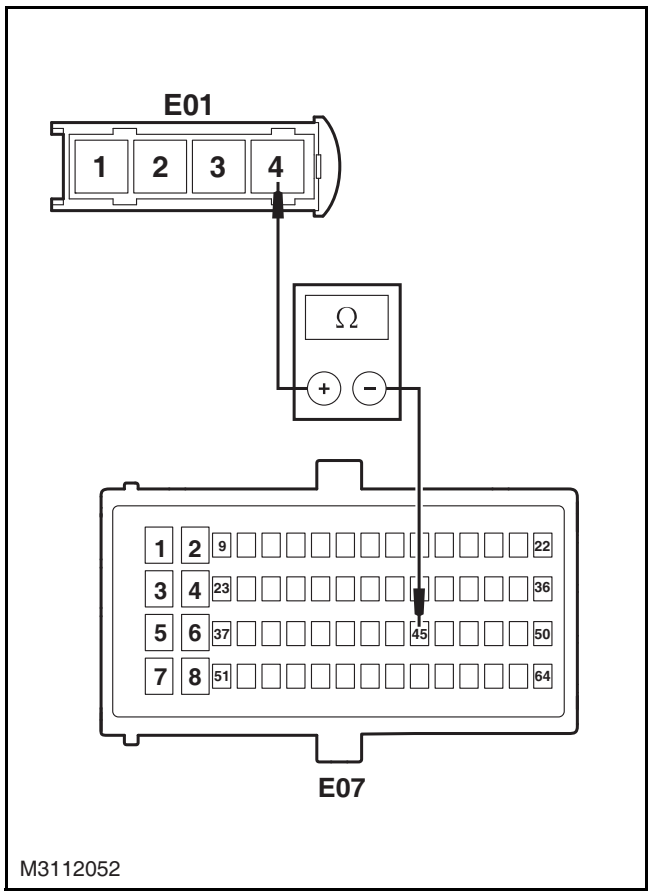


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect oxygen sensor condition (carry out oxygen sensor signal test) | |
| | A. If the voltage displayed in data flow remains below 0.45 V (mixture too lean), inspect according to the following steps:<br>• Jet a proper amount of propane into the inlet port.<br>• Observe if the front oxygen sensor voltage in data flow changes obviously and the signal voltage rises quickly.<br>B. If the voltage displayed in data flow remains above 0.45 V (mixture too rich), inspect according to the following steps:<br>• Position the transmission at neutral gear.<br>• Apply the parking brake.<br>• Depress the accelerator pedal until the engine speed suddenly increases to 4000 rpm and then quickly release the accelerator pedal.<br>• Repeat the previous step more than 3 times.<br>• Observe if the front oxygen sensor voltage in data flow changes obviously and the signal voltage drops quickly.<br>• In the implementation of above test, the oxygen sensor signal voltage should change significantly as the test continues.<br>Does it change significantly?<br>**Yes**<br>**Refer to: DTCs P2177, P2178, P2187, P2188 (3.1.12 Electronic control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 4. |

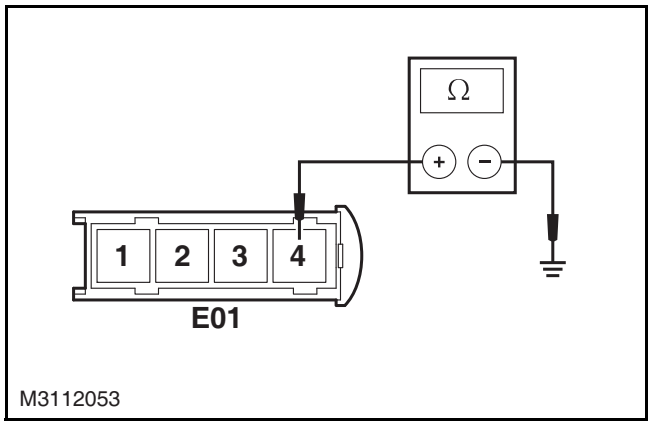
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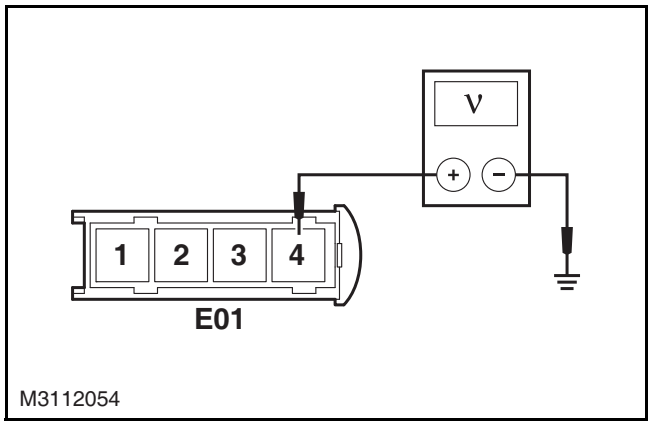
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect front oxygen sensor signal circuit | |




M3112052




M3112053




M3112054

A. Inspect the front oxygen sensor signal circuit.

B. Turn the ignition switch to "LOCK".

C. Disconnect the front oxygen sensor wiring harness connector E01.

D. Disconnect the ECM wiring harness connector E07.

E. Measure the resistance between terminal 4 of front oxygen sensor wiring harness connector E01 and terminal 45 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 4 of front oxygen sensor wiring harness connector E01 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

G. Measure the voltage between terminal 4 of front oxygen sensor wiring harness connector E01 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is it normal?

**Yes**

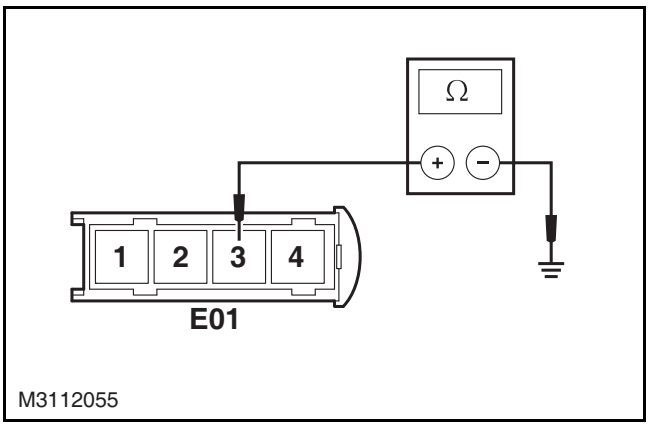
Go to step 5.

**No**

Repair the fault circuit between terminal 4 of front oxygen sensor wiring harness connector E01 and terminal 45 of ECM wiring harness connector E07.

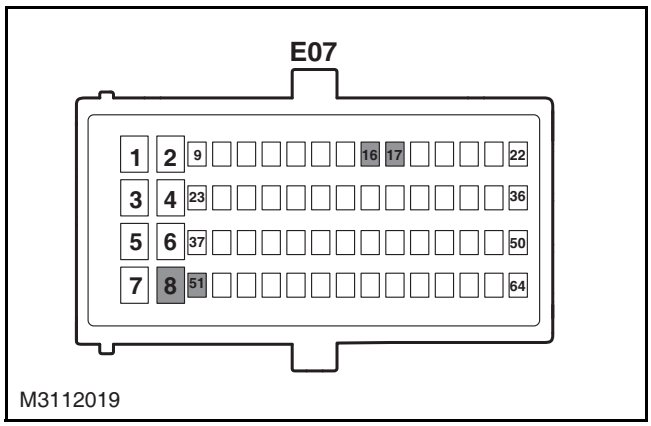
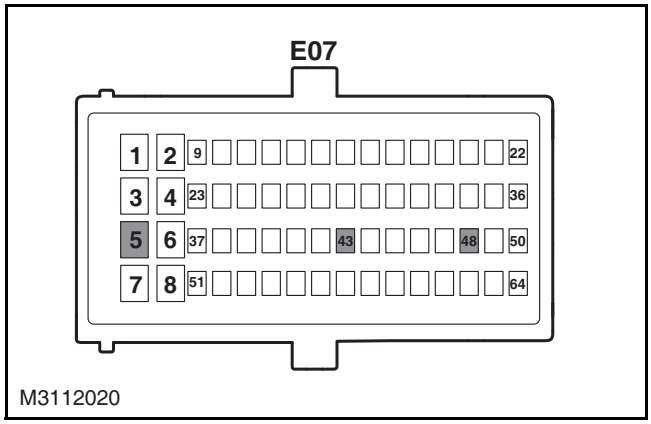
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect front oxygen sensor grounding circuit | |
|  <br>M3112055 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front oxygen sensor wiring harness connector E01.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 3 of E01 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the fault circuit between terminal 3 of front oxygen sensor wiring harness connector E01 and terminal 39 of ECM wiring harness connector E07. |
| 6. Inspect front oxygen sensor | |
| | A. Replace the front oxygen sensor.<br>Is the fault repaired?<br>**Yes**<br>Diagnosis completes. The system is normal.<br>**No**<br>Go to step 7. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0136, P0137, P0138, P0140, P2270, P2271

### 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0136 | O2 Sensor Circ., Bank1-Sensor2 Malfunction | ECM sets the terminal 4 of rear oxygen sensor S10 to low potential via terminal 39 of E07.<br>When the rear oxygen sensor reaches normal working temperature, it transmits oxygen sensor signal to the ECM via terminal 2 of S10 connected to terminal 29 of E07 of ECM. |
| P0137 | O2 Sensor Circ., Bank1-Sensor2 Low Voltage | |
| P0138 | O2 Sensor Circ., Bank1-Sensor2 High Voltage | |
| P0140 | O2 Sensor Circ., Bank1-Sensor2 No Activity Detected | |
| P2270 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 2 | |
| P2271 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 2 | |

### 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0136 | Rear oxygen sensor coupled with heater line | • Rear oxygen sensor reaches the working temperature<br>• Rear oxygen sensor output voltage is higher than 2.0 V | • Sensor circuit<br>• Sensor<br>• ECM |
| P0137 | Signal short to ground | • Rear oxygen sensor reaches the working temperature<br>• Rear oxygen sensor voltage signal is lower than 0.06 V | |
| P0138 | Rear oxygen sensor signal voltage too high | • Battery voltage is higher than 10.68 V<br>• Engine speed is more than 25 rpm<br>• Target λ = 1<br>• Catalytic converter temperature is higher than 250°C<br>• Rear oxygen sensor reaches the working temperature<br>• Rear oxygen sensor signal voltage is higher than 1.5 V | |
| P0140 | Rear oxygen sensor signal open circuit | • Rear oxygen sensor reaches the working temperature<br>• Rear oxygen sensor voltage is within 0.4 ~ 0.5 V | |

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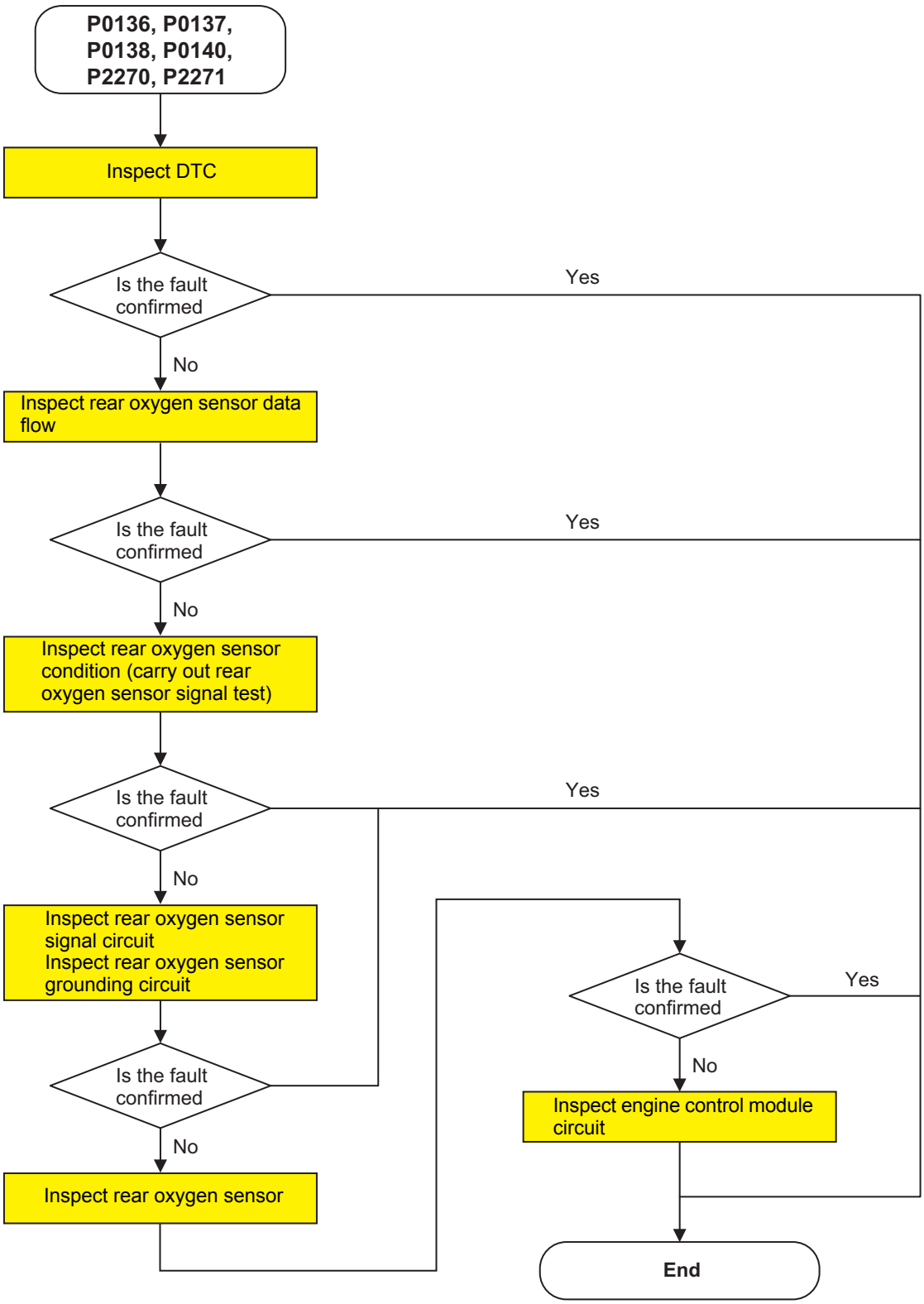


| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P2270 | Rear oxygen sensor voltage is always low | • Rear oxygen sensor voltage is lower than 0.582 V<br>• Access to diagnosis request | • Sensor circuit<br>• Sensor<br>• ECM |
| P2271 | Rear oxygen sensor voltage is always high | • Rear oxygen sensor voltage is higher than 0.619 V<br>• Access to diagnosis request | |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Turn off the ignition switch and connect the diagnostic tool.<br>B. Start the engine, and use the diagnostic tool to inspect the engine system.<br>Is there any DTC besides P0136, P0137, P0138, P0140, P2270 and P2271?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect rear oxygen sensor data flow | |
| | A. Start the engine, and run it till the engine coolant temperature reaches above 80°C.<br>B. Use diagnostic tool to access to engine data flow, and observe the "O2 sensor voltage bank 1, sensor 2" parameter.<br>**Standard voltage: fluctuates around 0.5 V**<br>Does the voltage of oxygen sensor fluctuate around 0.5 V?<br>**Yes**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 3. |

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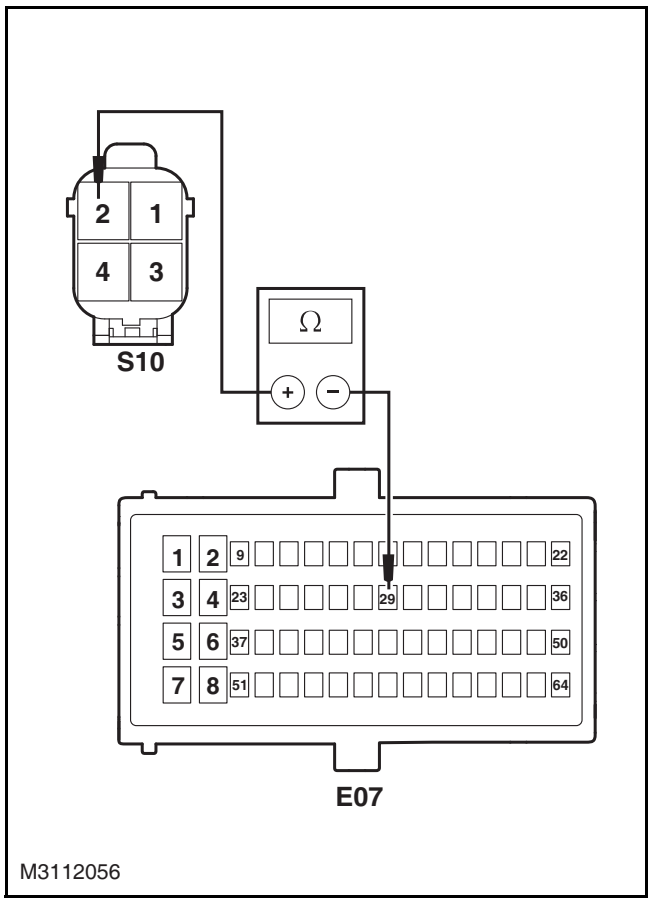


| 3. Inspect rear oxygen sensor condition (carry out rear oxygen sensor signal test) | |
|---|---|
| | A. If the voltage displayed in data flow remains below 0.45 V (mixture too lean), inspect according to the following steps:<br>• Jet a proper amount of propane into the inlet port.<br>• Observe if the rear oxygen sensor voltage in data flow changes obviously and the signal voltage rises quickly.<br>B. If the voltage displayed in data flow remains above 0.45 V (mixture too rich), inspect according to the following steps:<br>• Position the transmission at neutral gear.<br>• Apply the parking brake.<br>• Depress the accelerator pedal until the engine speed suddenly increases to 4000 rpm and then quickly release the accelerator pedal.<br>• Repeat the previous step more than 3 times.<br>• Observe if the rear oxygen sensor voltage in data flow changes obviously and the signal voltage drops quickly.<br>• In the implementation of above test, the oxygen sensor signal voltage should change significantly as the test continues.<br>Does it change significantly?<br>**Yes**<br>**Refer to: DTCs P2177, P2178, P2187, P2188 (3.1.12 Electronic control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 4. |

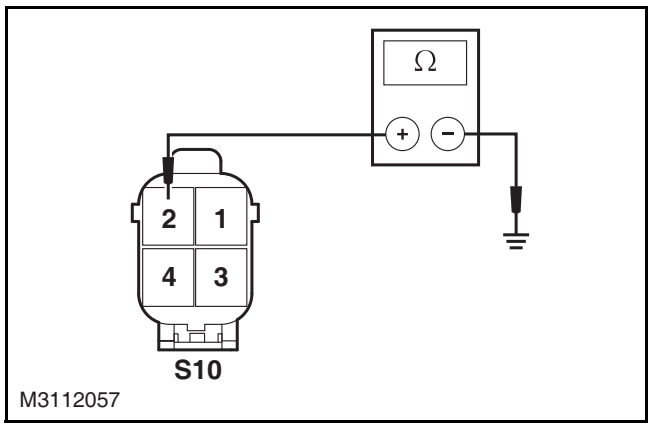
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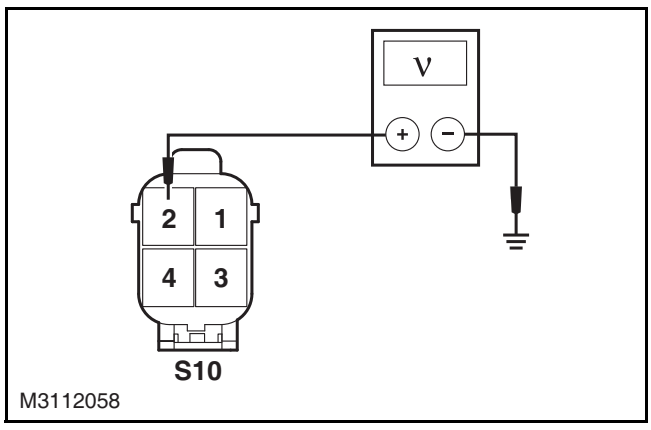
4. Inspect rear oxygen sensor signal circuit




M3112056




M3112057




M3112058

A. Turn the ignition switch to "LOCK".

B. Disconnect the rear oxygen sensor wiring harness connector S10.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 2 of rear oxygen sensor wiring harness connector S10 and terminal 29 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of rear oxygen sensor wiring harness connector S10 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of rear oxygen sensor wiring harness connector S10 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is it normal?

**Yes**

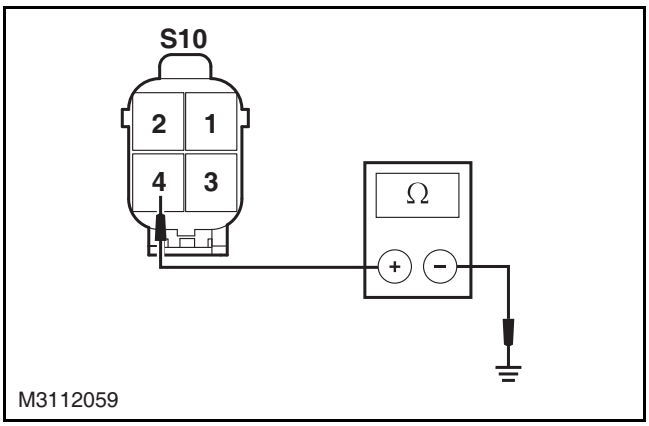
Go to step 5.

**No**

Inspect and repair the fault circuit between terminal 2 of rear oxygen sensor wiring harness connector S10 and terminal 29 of ECM wiring harness connector E07. Verify that the system is normal.

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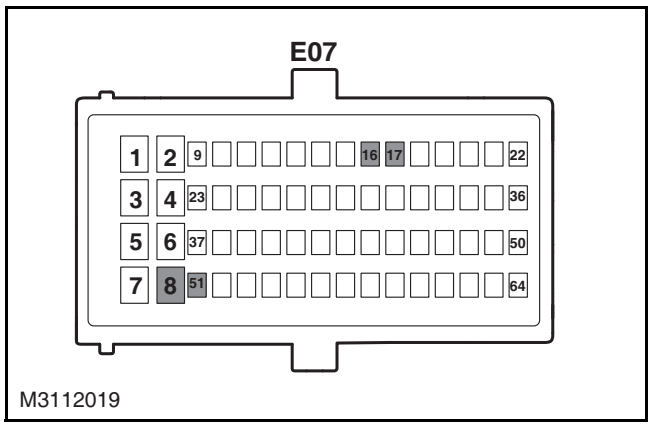


| | |
|---|---|
| 5. Inspect rear oxygen sensor grounding circuit | |
|  M3112059 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the rear oxygen sensor wiring harness connector S10.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 4 of rear oxygen sensor S10 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the fault circuit between terminal 4 of rear oxygen sensor wiring harness connector S10 and terminal 39 of ECM wiring harness connector E07. |
| 6. Inspect rear oxygen sensor | |
| | A. Replace the rear oxygen sensor.<br>**Refer to: Rear Oxygen Sensor (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>The system is normal.<br>**Yes**<br>Diagnosis completes.<br>**No**<br>Go to step 7. |

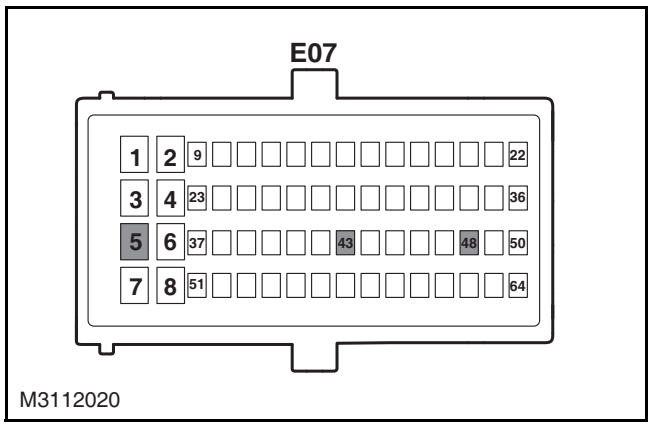
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7. Inspect engine control module circuit



M3112019



M3112020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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# DTCs P0201, P0261, P0262

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0201 | Cylinder 1 - Injector Circuit | Injector operating voltage is provided by the main relay controlled by the ECM. Battery voltage is transmitted to terminal 1 of each injector wiring harness connector via terminal 69 of main relay IR05 of instrument panel fuse box P40. ECM controls the internal grounding of cylinder 1 injector via terminal 50 of ECM wiring harness connector E07. ECM monitors the state of all injector drive circuits. If the ECM detects that the voltage corresponding to drive circuit command state is incorrect, it will set up a DTC indicating fuel injector control circuit fault. |
| P0261 | Cylinder 1 - Injector Circuit Low | |
| P0262 | Cylinder 1 - Injector Circuit High | |

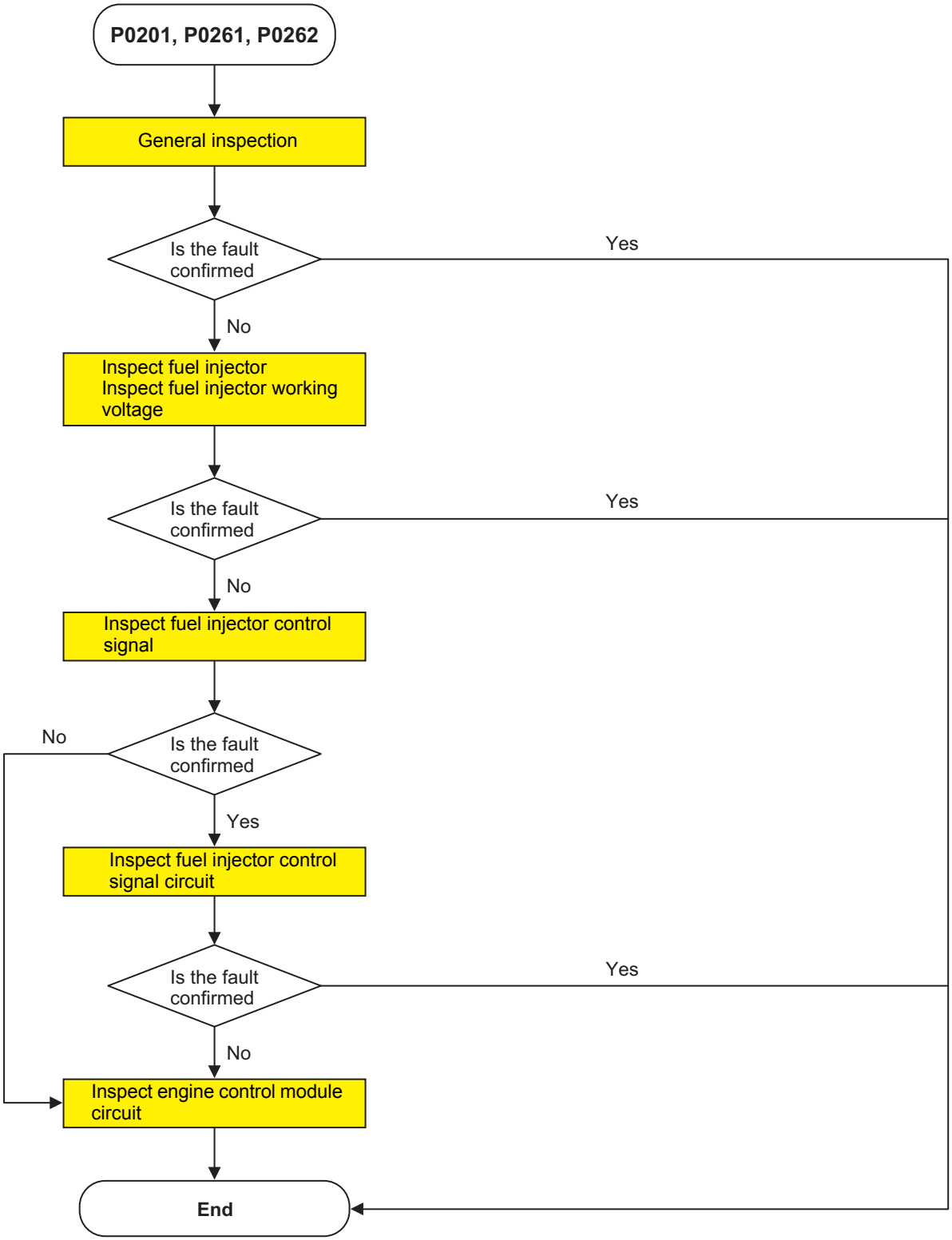
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0201 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Injector circuit<br>• Fuel injector<br>• ECM |
| P0261 | | | |
| P0262 | | | |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the fuel injectors for damage, poor contact, aging and looseness.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. The system is normal. |
| 2. Inspect fuel injector | |
| | A. Disconnect the fuel injector wiring harness connector E09.<br>B. Measure the resistance between two terminals of fuel injector.<br>**Standard resistance: 11.5 ~ 12.6 Ω at 20°C**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the fuel injector. The system is normal. |
| 3. Inspect fuel injector working voltage | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the cylinder 1 injector wiring harness connector E09.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 1 of cylinder 1 injector wiring harness connector E09 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the circuit fault between terminal 1 of fuel injector wiring harness connector E09 and terminal 69 of main relay IR05. |

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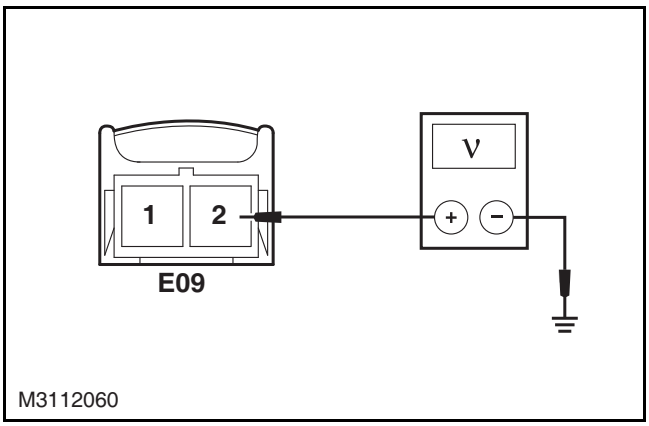


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuel injector control signal | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the cylinder 1 injector wiring harness connector E09.<br>C. Connect the test pencil with LED to the terminals 1 and 2 of E09 according to specification.<br>**CAUTION: LED must connect with 1 ~ 2 kΩ resistor in series, otherwise the LED or ECM may be damaged.**<br>D. Start the engine.<br>E. Observe if the test lamp flashes normally.<br>Does the test lamp flash normally?<br>**Yes**<br>Go to step 6.<br>**No**<br>Go to step 5. |

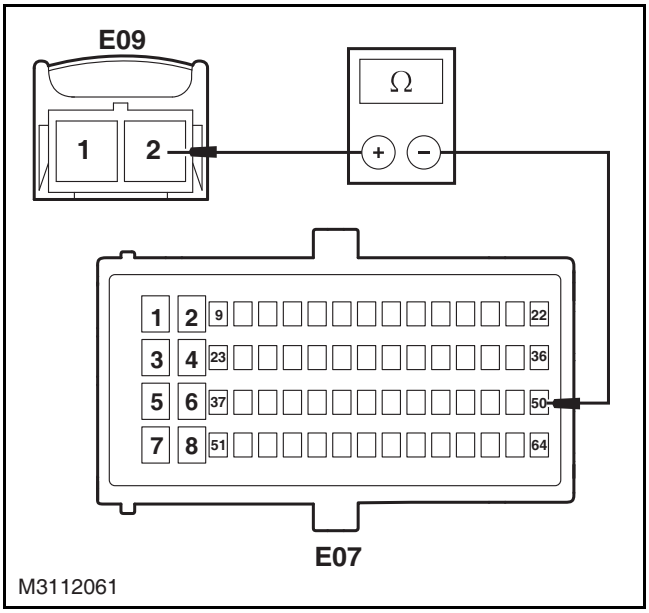
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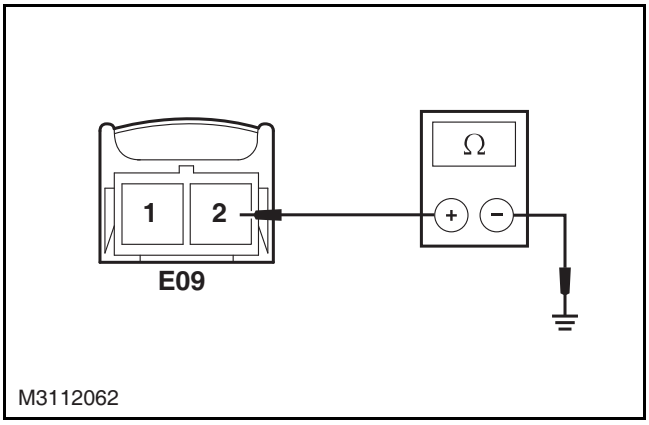
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect fuel injector control signal circuit | |




M3112060




M3112061




M3112062

A. Turn the ignition switch to "LOCK".

B. Disconnect the cylinder 1 injector wiring harness connector E09.

C. Measure the voltage between terminal 2 of E09 and reliable grounding.

**Standard voltage: 0 V**

D. Disconnect the ECM wiring harness connector E07.

E. Measure the resistance between terminal 2 of cylinder 1 injector wiring harness connector E09 and terminal 50 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 2 of E09 and reliable grounding.

**Standard resistance: 10 MΩ or more**

Is it normal?

**Yes**

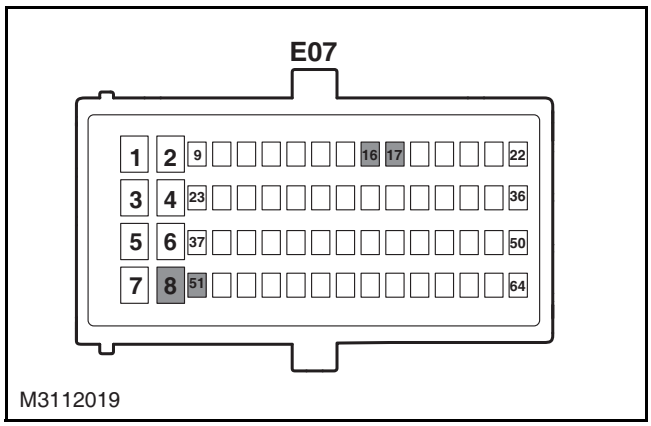
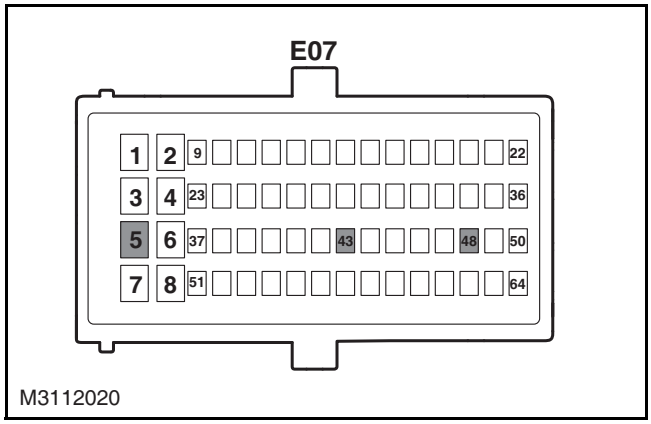
Go to step 6.

**No**

Repair the fault circuit between the terminal 2 of E09 and terminal 50 of ECM wiring harness connector E07.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0300, P0301, P0302, P0303, P0304

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0300 | Random/Multiple Cylinder Misfire Detected | ECM monitors the interval of CKP sensor input signal. ECM calculates the interval time change of each cylinder. If the interval time change exceeds preprogrammed standard, then ECM will detect poor ignition of corresponding cylinder. When the engine is running, ECM calculates the counts of ignition misfire at 200 and 1000 crankshaft revolutions, and the misfire rate per crankshaft revolution. If the misfire rate exceeds the preprogrammed standard, then ECM will determine the occurrence of poor ignition that can damage the catalytic converter or affect emission performance. |
| P0301 | Cyl.1 Misfire Detected | |
| P0302 | Cyl.2 Misfire Detected | |
| P0303 | Cyl.3 Misfire Detected | |
| P0304 | Cyl.4 Misfire Detected | |

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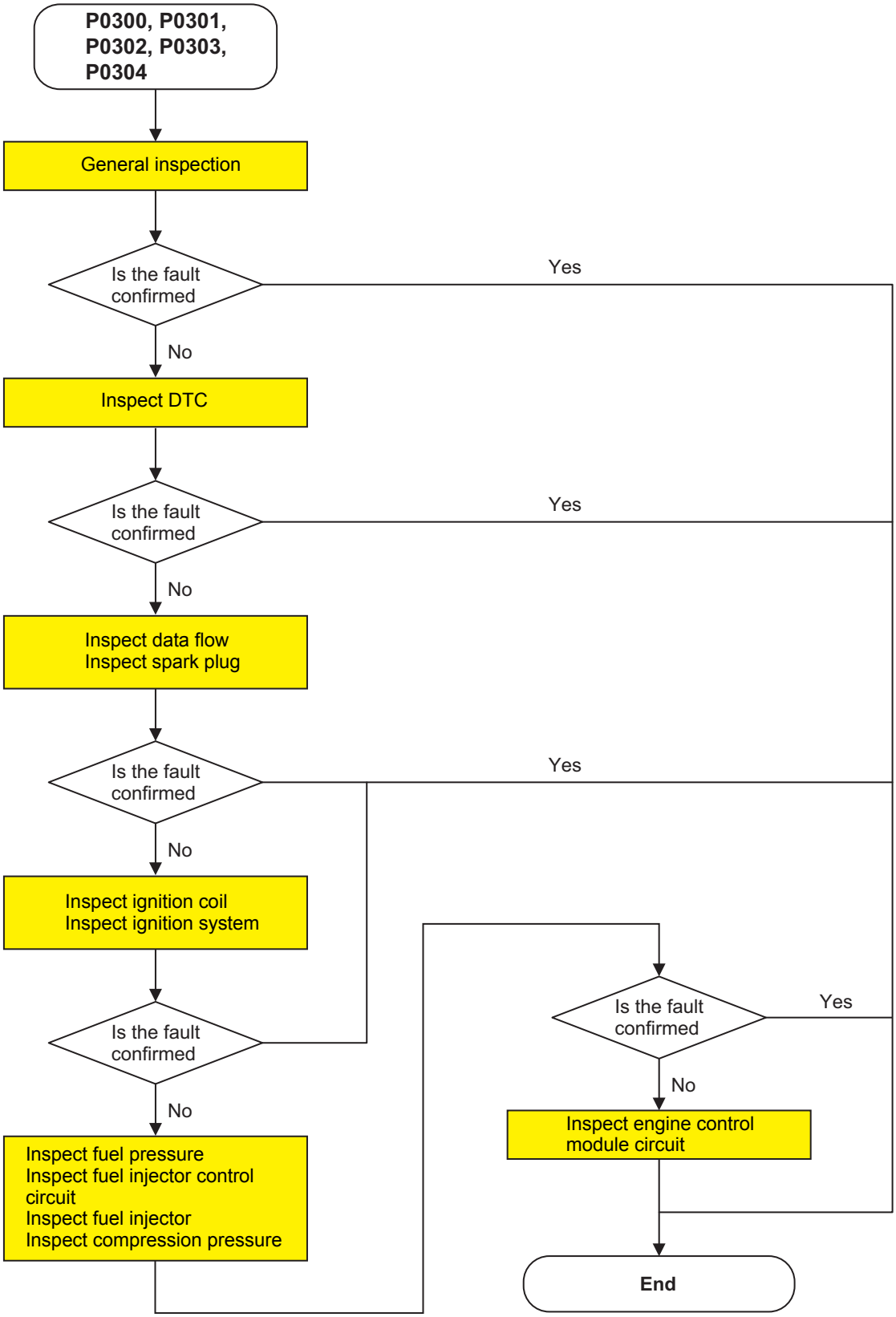
**2. Possible Causes**

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0300<br>P0301<br>P0302<br>P0303<br>P0304 | Misfire rate that damages catalytic converter | • Misfire rate that damages the catalytic converter is greater than 4% ~ 23%<br>• Bad circuit not detected<br>• Fuel cut-off not active<br>• Torque intervention not active | • Connector looseness, poor contact<br>• Vacuum hose broken, loose<br>• Ignition system<br>• Fuel injector<br>• Fuel pressure<br>• Air intake pressure sensor<br>• Engine coolant temperature sensor<br>• Cylinder compression pressure<br>• Valve clearance and timing<br>• Evaporative emission control system<br>• Positive crankcase ventilation system<br>• Air intake system<br>• Exhaust system air vent clog<br>• ECM |
| | Misfire rate that deteriorates the emission | • Misfire rate that deteriorates the emission is greater than 3.6%<br>• Engine speed is more than 600 rpm, less than 5200 rpm | |
| | Implausible fault | • Misfire rate that deteriorates the emission is greater than 3.6%<br>• Air intake temperature is higher than -25°C | |

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### 3. Diagnosis Procedure



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**CAUTION: If the engine electronic control system stores DTCs other than misfire DTCs, carry out troubleshooting for these DTCs first.**

**CAUTION: If misfire does not occur when the vehicle is taken to a service station, carry out road test again to reproduce the misfire fault. And use the diagnostic tool to record the ECM data when the misfire occurs in order to help analyze the cause of fault.**

**CAUTION: If the vehicle still stores no DTC related to misfire after long road test, the fault may be caused by the following:**
**1. Fuel tank is overfull, and fuel goes into the engine evaporative emission control system, causing misfire due to too rich mixture.**
**2. Misfire caused by insufficient combustion of improper fuel.**
**3. Misfire caused by ignition fault of contaminated spark plug.**
**4. Carry out basic inspection on the system according to the faulty area indicated by DTC.**

**CAUTION: After repair, road test the vehicle to confirm that no DTC is stored.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors for damage, poor contact, aging and looseness.<br>B. Inspect the vacuum tube for damage, looseness or leakage.<br>C. Inspect the air intake system for leakage.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault parts. The system is normal. |
| 2. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Start the engine and diagnose the engine system.<br>C. Inspect DTC.<br>Is there any DTC besides P0300, P0301, P0302, P0303 and P0304?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect data flow | |
| | A. Connect the diagnostic tool.<br>B. Start engine and access to the engine system data flow on diagnostic tool.<br>C. Inspect the data flow for coolant temperature sensor, air intake pressure sensor, engine speed and throttle position.<br>Is the data flow normal?<br>**Yes**<br>Repair the abnormal data flow fault.<br>**No**<br>Go to step 4. |
| 4. Inspect spark plug | |
| | A. Remove the spark plug from the misfire cylinder.<br>B. Inspect if the spark plug gap is too large or too small.<br>**Standard gap: 0.7 ~ 0.8 mm**<br>C. Inspect if the spark plug electrode is burnt or damaged.<br>D. Inspect spark plug skirt and electrode for moisture, serious smell of gasoline.<br>E. Reinstall the spark plug.<br>Is the spark plug normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair or replace the spark plug. |
| 5. Inspect ignition coil | |
| | A. Remove the ignition coil.<br>B. Inspect the ignition coil.<br>**Refer to: Ignition Coil Test (3.1.8 Ignition System, General Inspection).**<br>Is the ignition coil normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the ignition coil.<br>**Refer to: Ignition Coil (3.1.8 Ignition System, Remove and Installation).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect ignition system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Carry out the ignition spark test.<br>**Refer to: Ignition Spark Test (3.1.8 Ignition System, General Inspection).**<br>Is the ignition spark test normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect the ignition system.<br>**Refer to: Diagnosis Procedure for Spark Plugs not Flashing Over (3.1.8 Ignition System, Symptom Diagnosis and Testing).** |
| 7. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect the fuel system. |

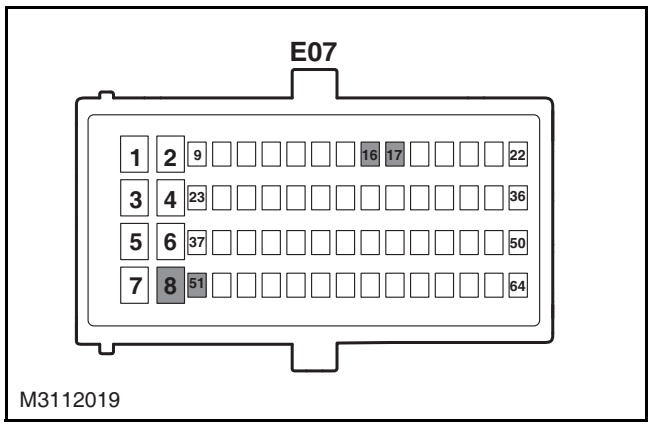
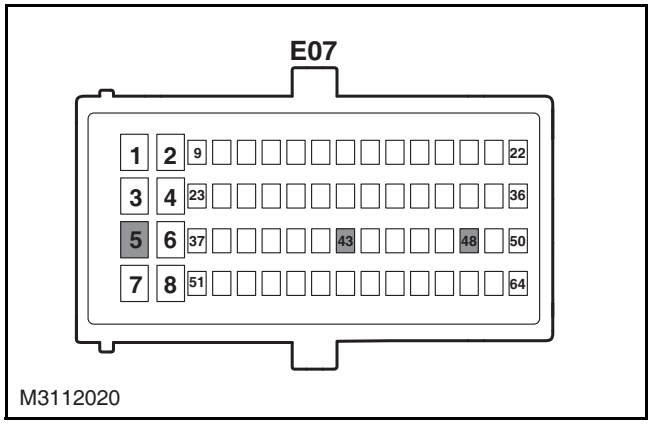
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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect fuel injector control circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the misfire cylinder fuel injector wiring harness connector.<br>C. Connect the test pen with LED to the terminals 1 and 2 of fuel injector connector according to specification.<br>**⚠ CAUTION: LED must connect with 1 ~ 2 kΩ resistor in series, otherwise the LED or ECM may be damaged.**<br>D. Start the engine.<br>E. Observe if the test lamp flashes normally.<br>Does the test lamp flash normally?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect the fuel injector wiring harness. Repair or replace if necessary. |
| 9. Inspect fuel injector | |
| | A. Remove the fuel injector from the misfire cylinder.<br>B. Use the fuel injectors on the other cylinders instead.<br>C. Start the engine and idle it.<br>Does the misfire DTC correspond to the fuel injector in trouble.<br>**Yes**<br>Replace the failure injector.<br>**No**<br>Go to step 10. |
| 10.Inspect compression pressure | |
| | A. Inspect the compression pressure in the cylinder.<br>**Refer to: Cylinder Compression Pressure Inspection (3.1.2 Mechanical System, General Inspection).**<br>B. Is the compression pressure normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Repair engine mechanical system fault. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 11. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0321, P0322

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0321 | Ign./Distributor Eng. Speed Inp.Circ. Range/Performance | CKP sensor signal informs ECM of the current speed and position of crankshaft. This sensor detects the teeth and grooves of ferromagnetic signal plate, and outputs the electric signals that indicate the speed and position of signal plate.ECM can calculate the ignition timing, injection timing and knock control according to input signals of CKP sensor. CKP sensor is also used for misfire detection and tachometer display. CKP sensor signal is connected to grounding point G301 and terminals 46, 47 of ECM wiring harness connector E07 respectively via terminals 1, 2, 3 of CKP sensor wiring harness connector E05. |
| P0322 | Ign./Distributor Eng. Speed Inp.Circ. No Signal | |

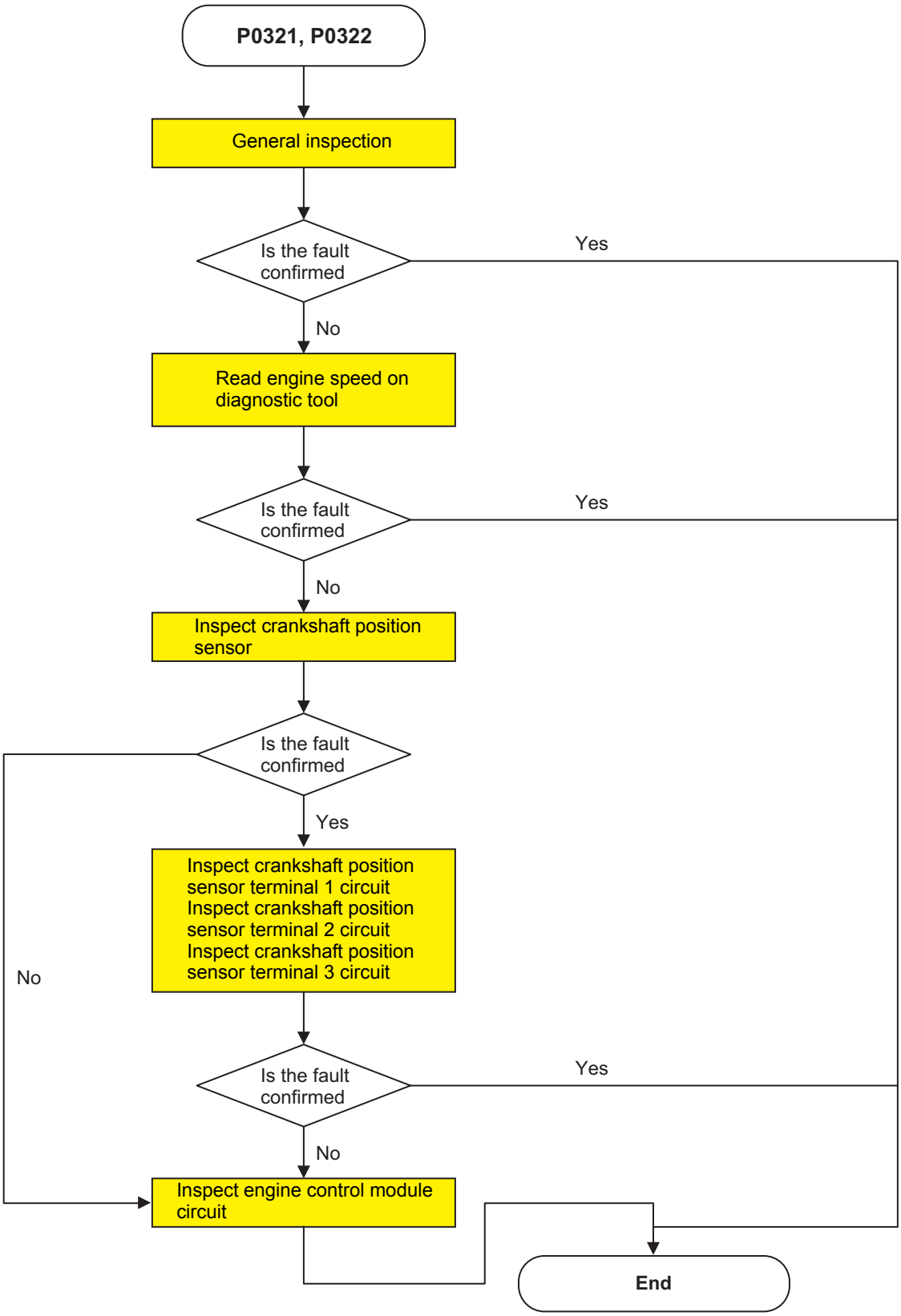
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0321 | • Frequent gap correction by plus one tooth<br>• Frequent gap correction by minus one tooth<br>• Speed sensor signal exists but no reference mark is found<br>• Frequent loss of reference mark | • Count of gap correction by plus one tooth is greater than 250<br>• Count of gap correction by minus one tooth is greater than 250<br>• Count of no reference gaps detected is greater than 6<br>• Count of lost reference gaps is greater than 2000 | • Crankshaft position sensor<br>• Crankshaft position sensor circuit<br>• ECM |
| P0322 | No speed signal detected after a certain quantity of phase sensor signal | • Count of phase signal hop is greater than 8<br>• Low engine speed | |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the sensor wiring harness connector E05 for looseness or poor contact.<br>B. Inspect the sensor for proper installation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. The system is normal. |
| 2. Read engine speed on diagnostic tool | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON".<br>C. Select "UAES M7/Actual values/Engine speed".<br>D. Start the engine.<br>E. Read the engine speed data displayed on the diagnostic tool when the engine is running.<br>Standard value: Refer to Data Flow List<br>F. If the engine cannot start, inspect the data when the engine is running.<br>G. If the engine speed displayed on the diagnostic tool is "0", it means the wiring harness between crankshaft position sensor and ECM has open or short circuit.<br>Is the data flow normal?<br>**Yes**<br>Intermittent fault.<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 3. |

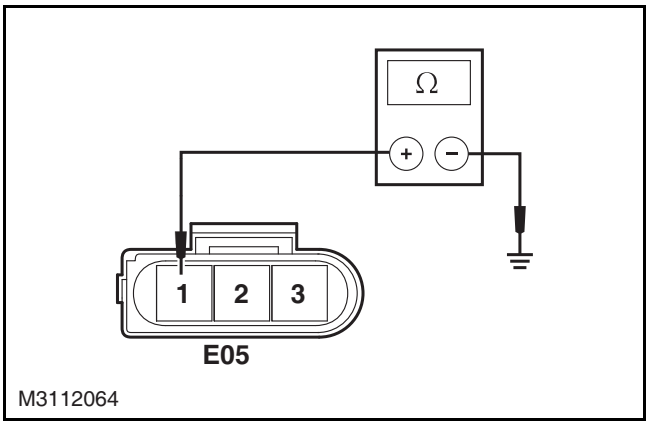
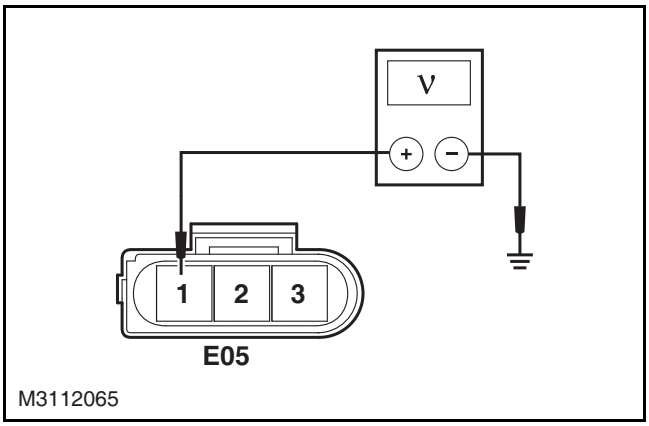
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect crankshaft position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the crankshaft position sensor wiring harness connector.<br>C. Measure the resistance between terminal 2 and 3 of the crankshaft position sensor.<br>**Standard resistance：860 Ω ± 10%**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the crankshaft position sensor.<br>**Refer to: Crankshaft Position Sensor (3.1.12 Electronic Control System - M7, Removal and Installation).** |

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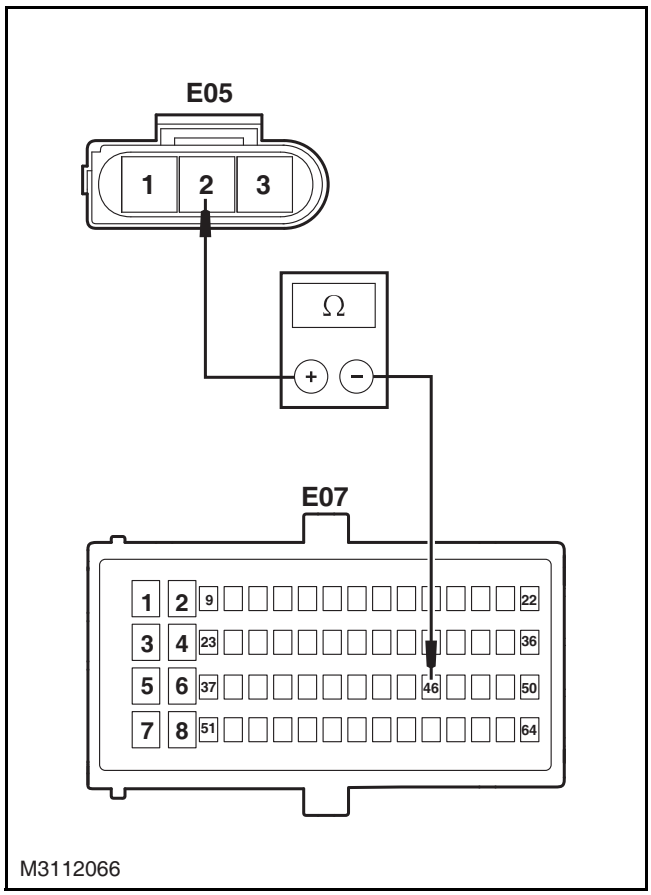


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect crankshaft position sensor terminal 1 circuit | |
|  <br>M3112064<br>  <br>M3112065 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the crankshaft position sensor wiring harness connector E05.<br>C. Measure the resistance between terminal 1 of crankshaft position sensor wiring harness connector E05 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>D. Measure the voltage between terminal 1 of crankshaft position sensor wiring harness connector E05 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is the circuit normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair the fault circuit between terminal 1 of crankshaft position sensor E05 and terminal 19 of ECM wiring harness connector E07. |

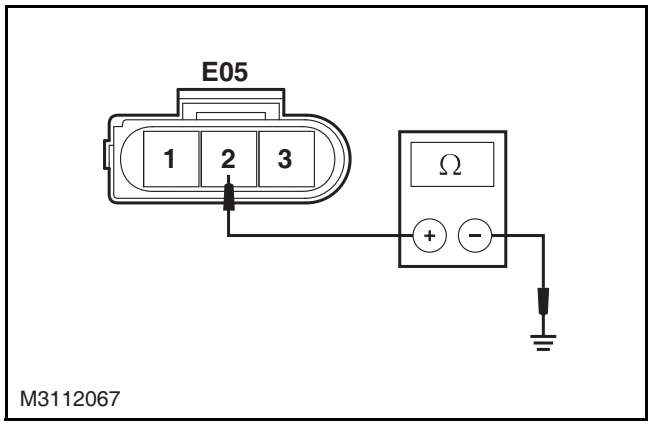
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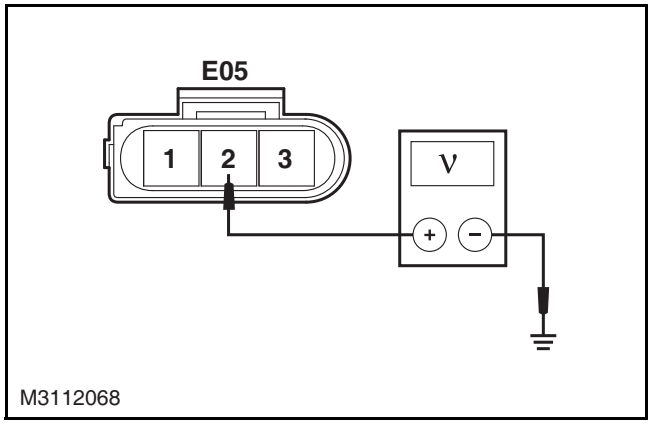
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect crankshaft position sensor terminal 2 circuit | |



M3112066



M3112067



M3112068

A. Turn the ignition switch to "LOCK".

B. Disconnect the crankshaft position sensor wiring harness connector E05.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 2 of crankshaft position sensor wiring harness connector E05 and terminal 46 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of crankshaft position sensor wiring harness connector E05 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of crankshaft position sensor wiring harness connector E05 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is the circuit normal?

**Yes**

Go to step 6.

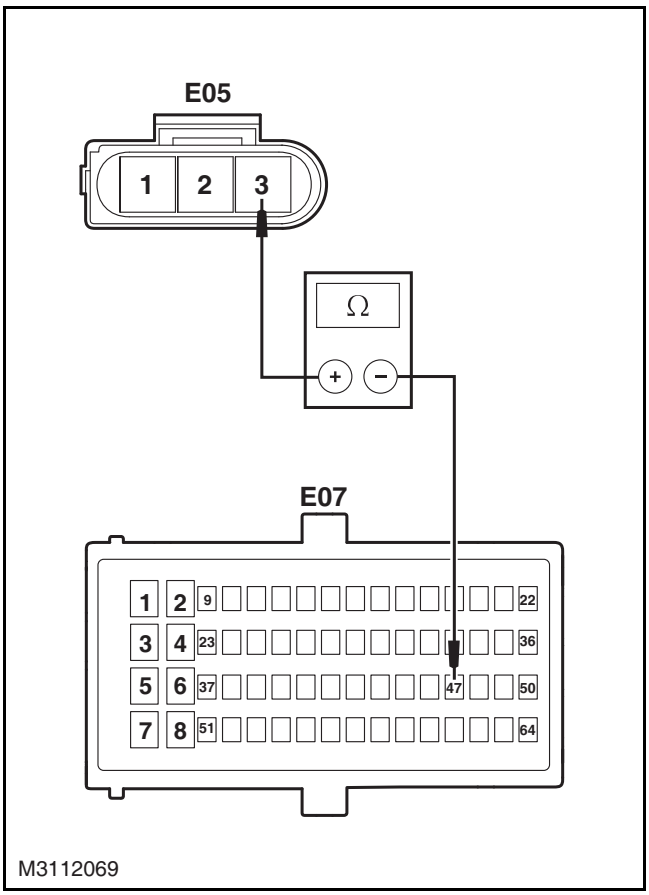
**No**

Repair the fault circuit between terminal 2 of crankshaft position sensor E05 and terminal 46 of engine control module E07.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect crankshaft position sensor terminal 3 circuit | |



M3112069

A. Turn the ignition switch to "LOCK".

B. Disconnect the crankshaft position sensor wiring harness connector E05.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 3 of crankshaft position sensor wiring harness connector E05 and terminal 47 of ECM wiring harness connector E07.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 3 of crankshaft position sensor wiring harness connector E05 and reliable grounding.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 3 of crankshaft position sensor wiring harness connector E05 and reliable grounding.

**Standard voltage: 0 V**

Is the circuit normal?

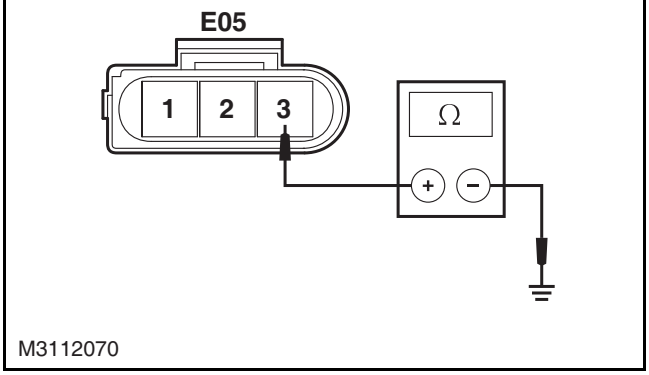
**Yes**

Replace the crankshaft position sensor.

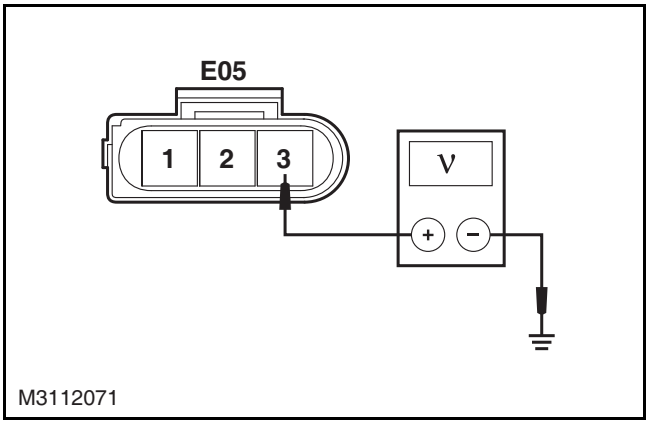
**Refer to: Crankshaft Position Sensor (3.1.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the fault circuit between terminal 3 of crankshaft position sensor E05 and terminal 47 of ECM wiring harness connector E07.



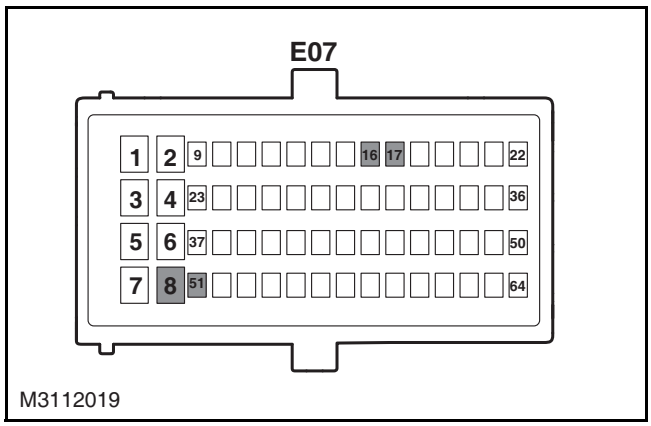
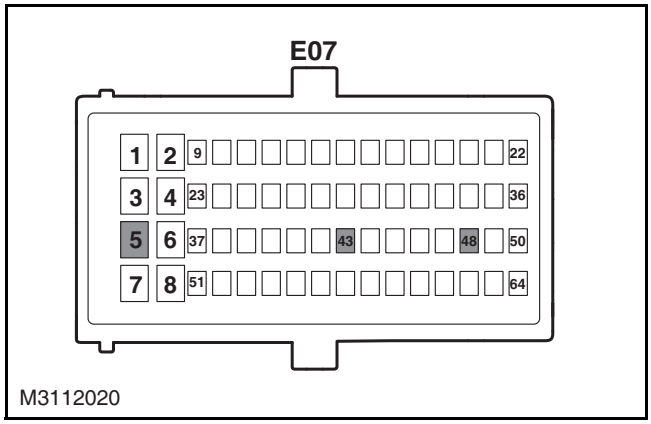
M3112070



M3112071

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0327, P0328

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0327 | Knock Sensor 1 Circ. Low Input | A piezoelectric ceramic is built into the knock sensor. Using the special piezoelectric effect of piezoelectric ceramic, it generates output voltage with large amplitude when engine knocking occurs, and transmits it to the electronic controller. Terminals 1 and 2 of knock sensor provides knock signal to ECM, and terminal 3 is grounded by wire for shielding. |
| P0328 | Knock Sensor 1 Circ. High Input | |

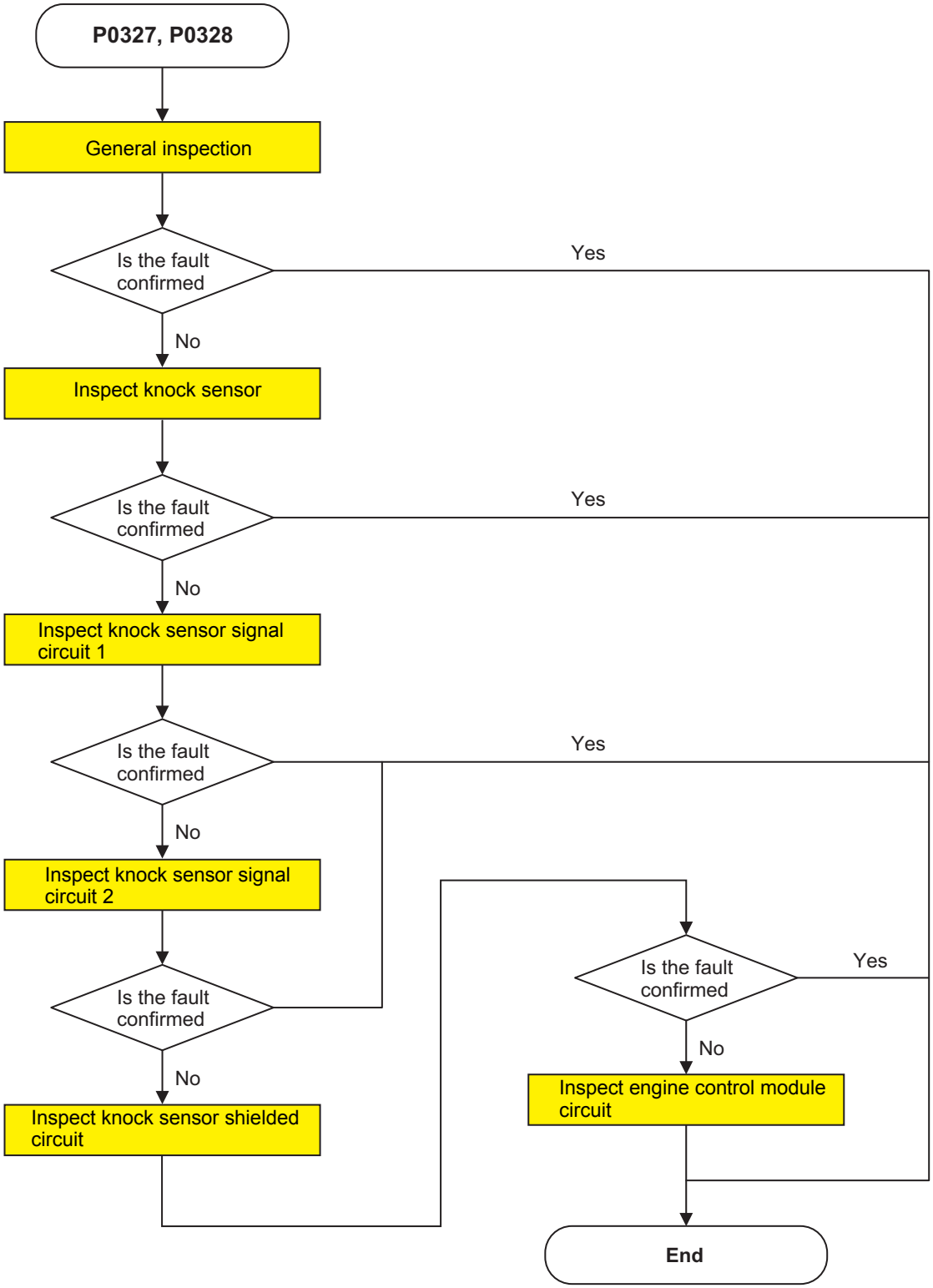
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0327 | Signal range check low | • Knock identification reference voltage is lower than 0.5 V 30 times in succession<br>• Coolant temperature is higher than 40°C<br>• Engine speed is higher than 2600 rpm<br>• cylinder 1 identification is possible | • Sensor circuit<br>• Sensor<br>• ECM |
| P0328 | Signal range check high | • Knock identification reference voltage is higher than 320 V 30 times in succession<br>• No dynamics in engine speed<br>• No dynamics in engine load<br>• No knock control circuit fault<br>• Limp home not active<br>• Engine load is greater than 39.8% | |

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### 3. Diagnosis Procedure



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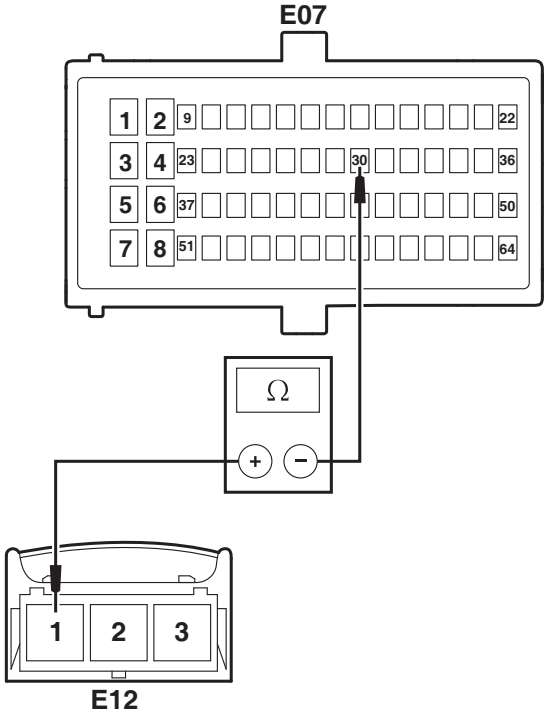


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the knock sensor wiring harness connector for looseness or damage.<br>B. Inspect the knock sensor for looseness or improper installation.<br>C. Inspect the knock sensor for corrosion.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect knock sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the knock sensor wiring harness connector E12.<br>C. Measure the resistance between terminals 1 and 2 of knock sensor with a multimeter.<br>**Standard resistance: more than 1 MΩ**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the knock sensor. |

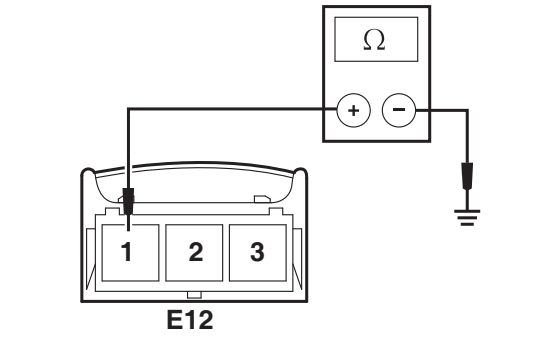
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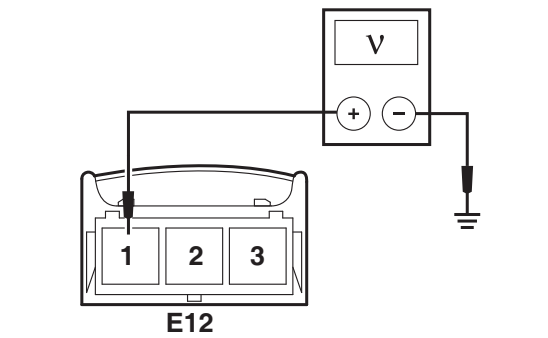
| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect knock sensor signal circuit 1 | |




M3112072




M3112073




M3112074

A. Turn the ignition switch to "LOCK".

B. Disconnect the knock sensor wiring harness connector E12.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 1 of knock sensor wiring harness connector E12 and terminal 30 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 1 of knock sensor wiring harness connector E12 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 1 of knock sensor wiring harness connector E12 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

Go to step 4.

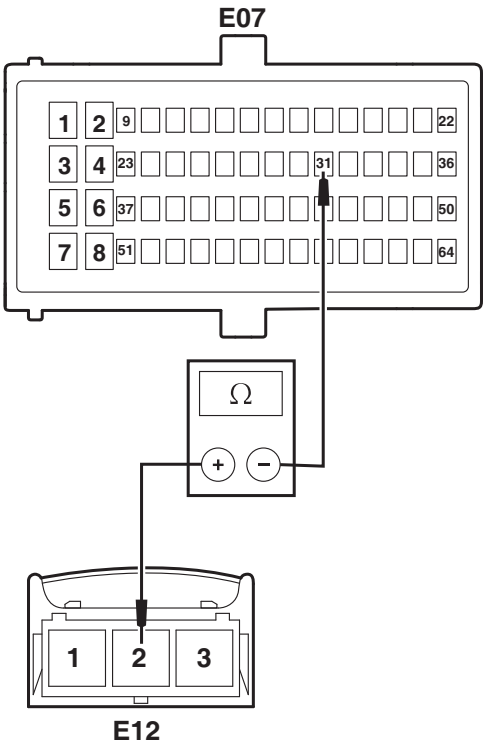
**No**

Repair the fault circuit between terminal 1 of knock sensor wiring harness connector E12 and terminal 30 of ECM wiring harness connector E07. Verify that the system is normal.

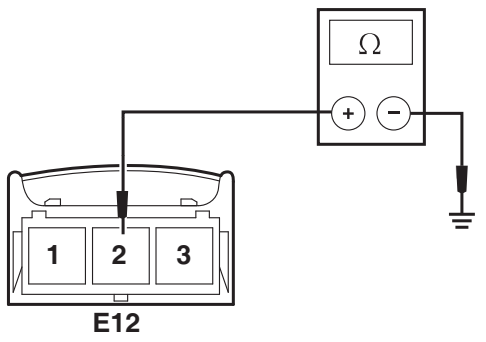
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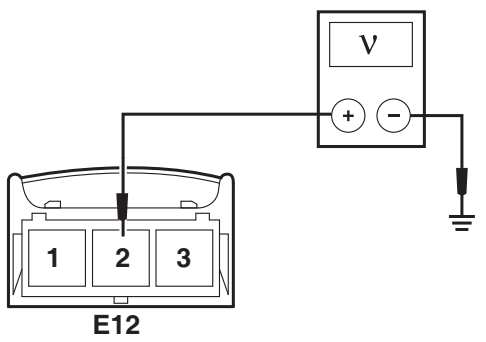
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect knock sensor signal circuit 2 | |




M3112075




M3112076




M3112077

A. Turn the ignition switch to "LOCK".

B. Disconnect the knock sensor wiring harness connector E12.

C. Disconnect the ECM wiring harness connector E07.

D. Measure the resistance between terminal 2 of knock sensor wiring harness connector E12 and terminal 31 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of knock sensor wiring harness connector E12 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of knock sensor wiring harness connector E12 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

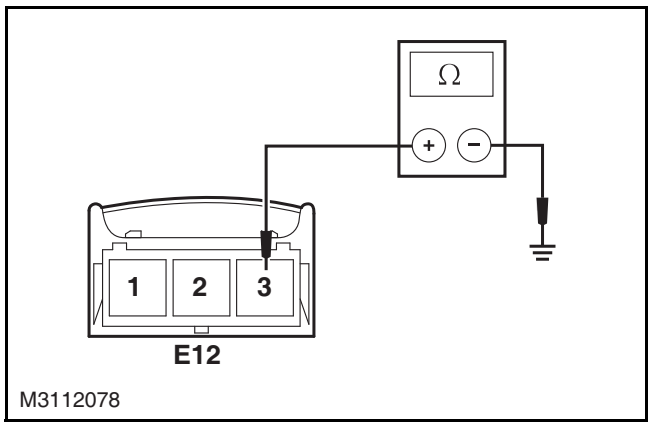
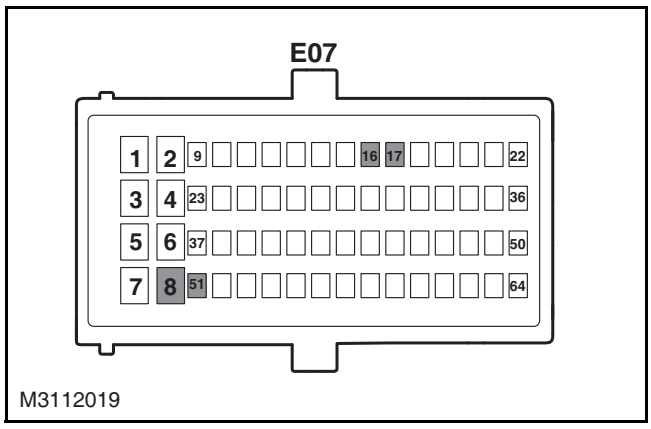
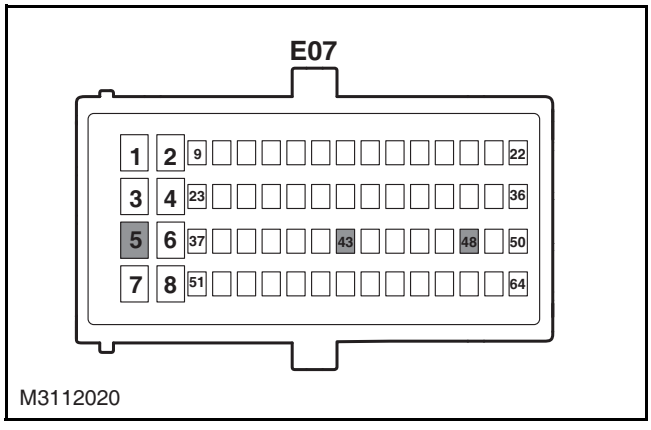
Go to step 5.

**No**

Repair the fault circuit between terminal 2 of knock sensor wiring harness connector E12 and terminal 31 of ECM wiring harness connector E07. Verify that the system is normal.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect knock sensor shielded circuit | |
|  M3112078 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the knock sensor wiring harness connector E12.<br>C. Measure the resistance between terminal 3 of knock sensor wiring harness connector E12 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Repair the fault circuit between terminal 3 of knock sensor wiring harness connector E12 and grounding point G301. |
| 6. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTC P0420

## 1. DTC Description

**CAUTION: If oxygen sensor DTC and catalytic converter efficiency DTC are set simultaneously, diagnose the oxygen sensor DTC first before proceeding.**

**CAUTION: Inspect for contamination that damages the oxygen sensor and catalytic converter, such as dirty fuel, unqualified silicon resin, oil and coolant. Repair as necessary.**

| DTC Code | Description | Definition |
|---|---|---|
| P0420 | Catalyst System, Bank1 Efficiency Below Threshold | - |

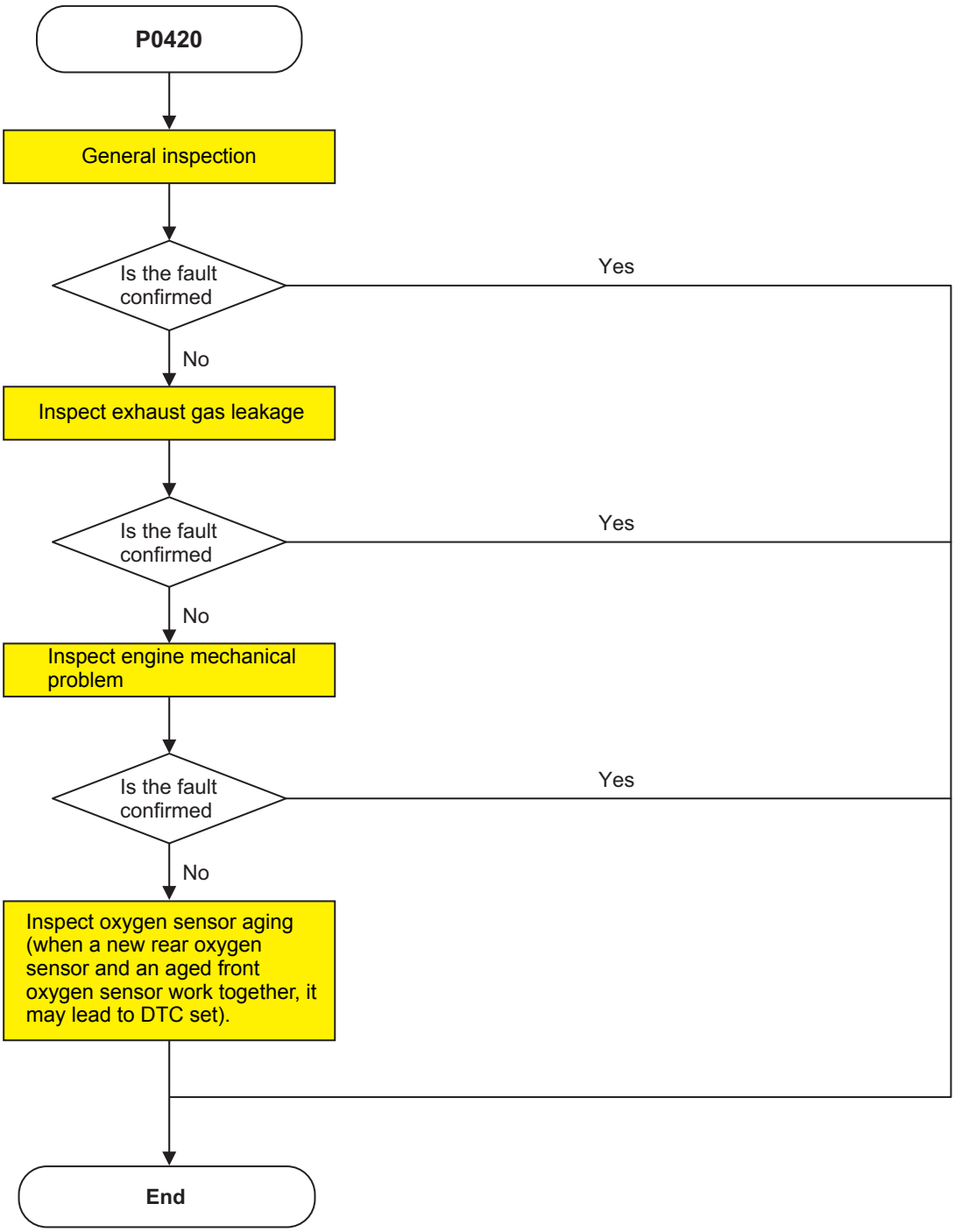
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0420 | Maximum limit exceeded | • Mean amplitude value of rear oxygen sensor signal after corrected by catalytic converter is greater than 0.60<br>• Active monitoring time for catalytic converter diagnosis is more than 40 s | • Catalytic converter<br>• Exhaust leakage<br>• Engine mechanical<br>• Oxygen sensor aging |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the catalytic converter for following defects.<br>Damage, dent or hole in catalytic converter.<br>Serious discoloration due to catalytic converter overheating.<br>Breakage inside the catalytic converter.<br>Catalytic converter leakage.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the catalytic converter. The system is normal. |
| 2. Inspect exhaust gas leakage | |
| | A. Start the engine.<br>B. Inspect if there is exhaust gas leakage between engine and front oxygen sensor.<br>C. Inspect if there is exhaust gas leakage between engine and rear oxygen sensor.<br>Is there any exhaust gas leakage?<br>**Yes**<br>Repair the leakage fault. The system is normal.<br>**No**<br>Go to step 3. |
| 3. Inspect engine mechanical problem | |
| | A. Inspect the exhaust gas for excessive black smoke and blue smoke due to the internal problems of engine.<br>Is the exhaust gas with excessive black smoke and blue smoke?<br>**Yes**<br>Repair the engine mechanical.<br>The system is normal.<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect oxygen sensor aging (when a new rear oxygen sensor and an aged front oxygen sensor work together, it may lead to DTC set). | |
| | A. Inspect the repair record to see if the oxygen sensor has been replaced.<br>Has the rear oxygen sensor rather than front oxygen sensor been replaced?<br>**Yes**<br>Replace the front oxygen sensor as needed.<br>**No**<br>Replace the catalytic converter. |

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# DTCs P0444, P0458, P0459

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0444 | Evaporative Emiss. System Purge Control Valve Circ. Open | Carbon canister control valve circuit includes the following circuit:<br>• The operating voltage of carbon canister control valve is provided by the main relay controlled by the ECM. Battery voltage is transmitted to terminal 1 of carbon canister control valve wiring harness connector E13 via terminal 69 of main relay IR05 of instrument panel fuse box P40.<br>• Control circuit: ECM controls terminal 2 of carbon canister control valve wiring harness connector E13 to ground via terminal 37 of ECM wiring harness connector E07. |
| P0458 | Evaporative Emission System Purge Control Valve Circuit Low | |
| P0459 | Evaporative Emission System Purge Control Valve Circuit High | |

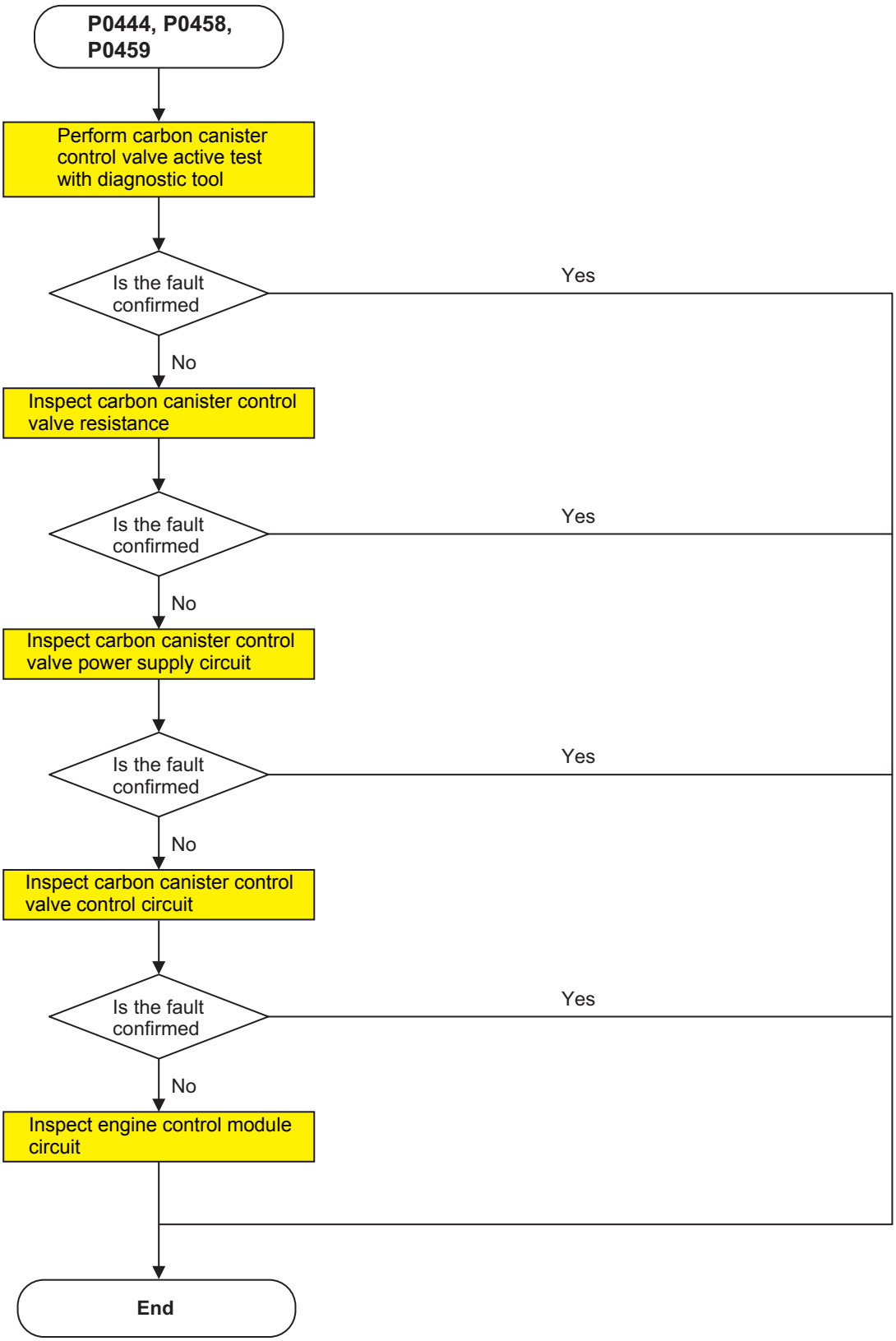
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0444 | Hardware circuit inspection | Open circuit | • Solenoid valve<br>• Solenoid valve circuit<br>• ECM |
| P0458 | | Short to ground | |
| P0459 | | Short to power supply | |

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### 3. Diagnosis Procedure



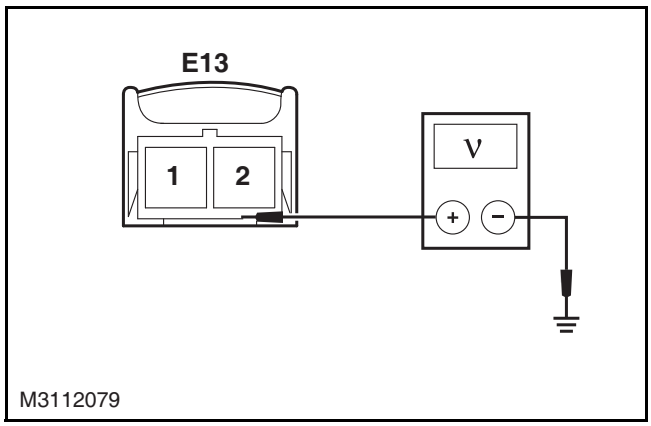
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Perform carbon canister control valve active test with diagnostic tool | |
| | A. Connect the diagnostic tool.<br>B. Disconnect the vacuum tube between carbon canister control valve and carbon canister.<br>C. Start the engine, and turn on the diagnostic tool.<br>D. Access to menu as follows: UAES M7/Actuators/ Carbon canister control valve".<br>E. Operate the carbon canister control valve. Cover the valve vacuum port with fingers.<br>Is there vacuum suction?<br>**Yes**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect carbon canister control valve resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the carbon canister control valve wiring harness connector E13.<br>C. Measure the resistance between two terminals of carbon canister control valve.<br>**Standard resistance: 26 ± 4 Ω at 20°C**<br>D. Connect the carbon canister control valve wiring harness connector E13.<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the carbon canister control valve. |

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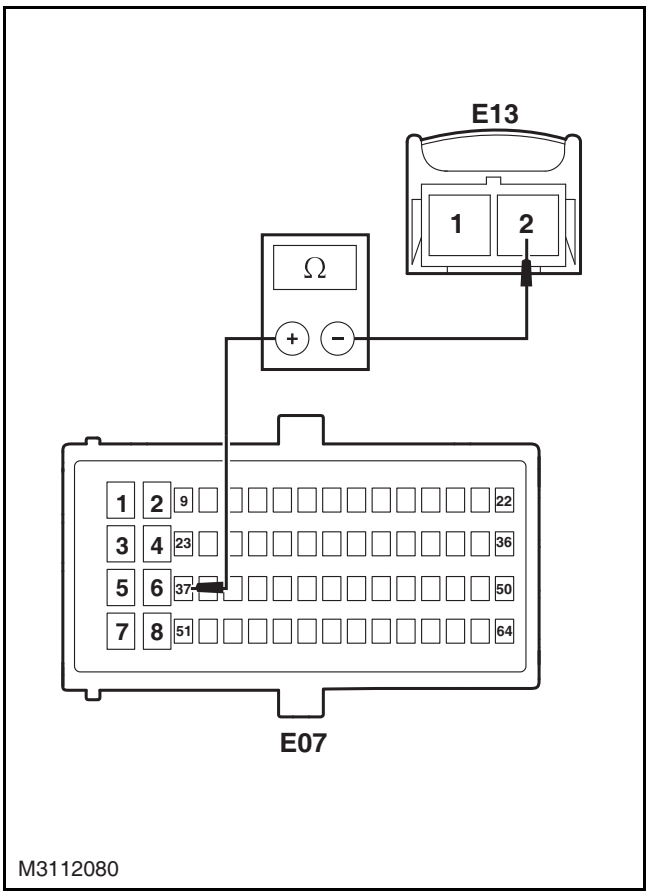


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect carbon canister control valve power supply circuit | |
|  <br>M3112079 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the carbon canister control valve wiring harness connector E13.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 1 of carbon canister control valve wiring harness connector E13 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the fault circuit between terminal 1 of carbon canister control valve wiring harness connector E13 and terminal 69 of main relay IR05 in the instrument panel fuse box P40. |

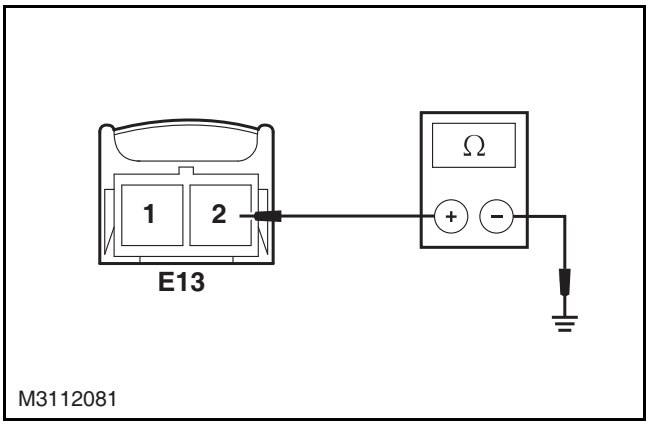
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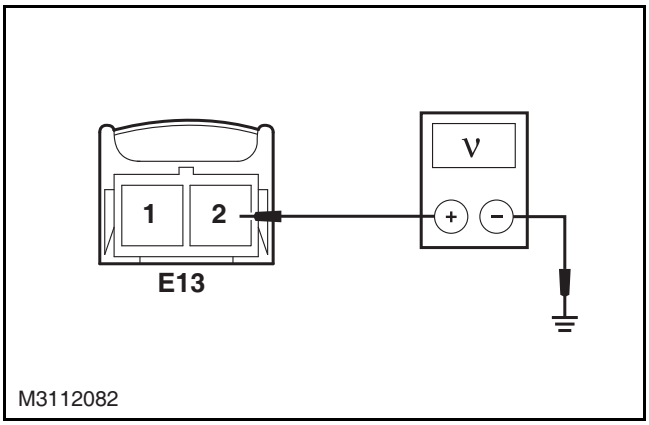
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect carbon canister control valve control circuit | |




M3112080




M3112081




M3112082

A. Turn the ignition switch to "LOCK".

B. Disconnect the carbon canister control valve wiring harness connector E13.

C. Disconnect the engine control module wiring harness connector E07.

D. Measure the resistance between terminal 2 of carbon canister control valve wiring harness connector E13 and terminal 37 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of carbon canister control valve wiring harness connector E13 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of carbon canister control valve wiring harness connector E13 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is it normal?

**Yes**

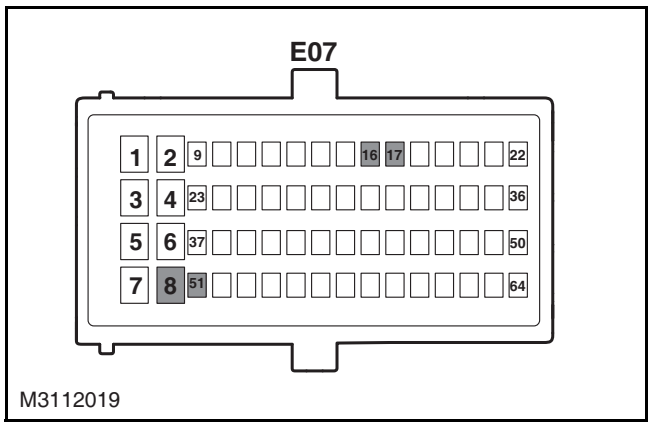
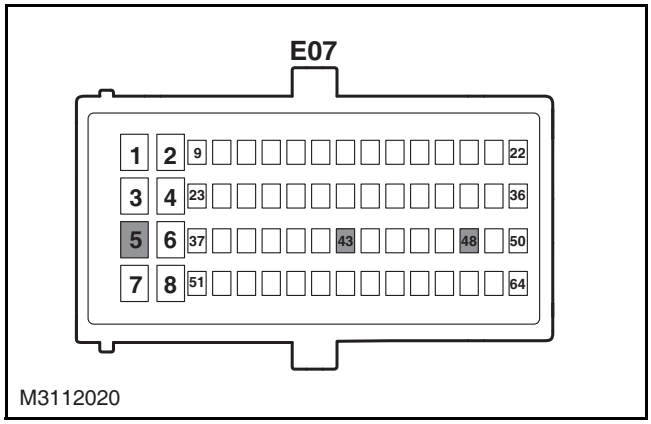
Go to step 5.

**No**

Inspect and repair the fault circuit between the terminal 2 of carbon canister control valve wiring harness connector E13 and terminal 37 of ECM wiring harness connector E07. Replace when necessary.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0480, P0691, P0692

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0480 | Cooling Fan 1 Control Circuit | Operating power of cooling fan relay coil is supplied by the main relay controlled by ECM. ECM controls the relay to operate via terminal 52 of ECM wiring harness connector E07. There is a drive circuit control relay coil equipped within the ECM for grounding. Drive circuit provides a feedback circuit to ECM, and ECM determines if an open circuit, short to ground or power supply occurs in control circuit by monitoring the feedback voltage. |
| P0691 | Cooling Fan 1 Control Circuit Low | |
| P0692 | Cooling Fan 1 Control Circuit High | |

## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0480 | Hardware circuit inspection | Open circuit | • Relay<br>• Relay circuit<br>• ECM |
| P0691 | | Short to ground | |
| P0692 | | Short to power supply | |

## 3. Diagnosis Procedure

**Refer to: Diagnosis Procedure for Non-operation of Radiator-fan (3.1.4 Cooling System, Symptom Diagnosis and Testing).**

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# DTCs P0506, P0507

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0506 | Idle Control System RPM Lower than Expected | Idling stepper motor is controlled by Engine Control Module (ECM). ECM controls the forward/backward movement and amount of stepper motor valve via digitized square signal to regulate the flow area of throttle body air passage to control the air volume entering the engine, thus realizing engine idling control. Engine Control Module (ECM) calculates and controls the engine target idle speed based on the coolant temperature, vehicle speed compensation, deceleration adjustment, voltage compensation.<br>Terminals 22, 21, 35, 36 of ECM wiring harness connector E07 are connected to terminals 1, 2, 3, 4 of idling stepper motor E14 respectively. |
| P0507 | Idle Control System RPM Higher than Expected | |

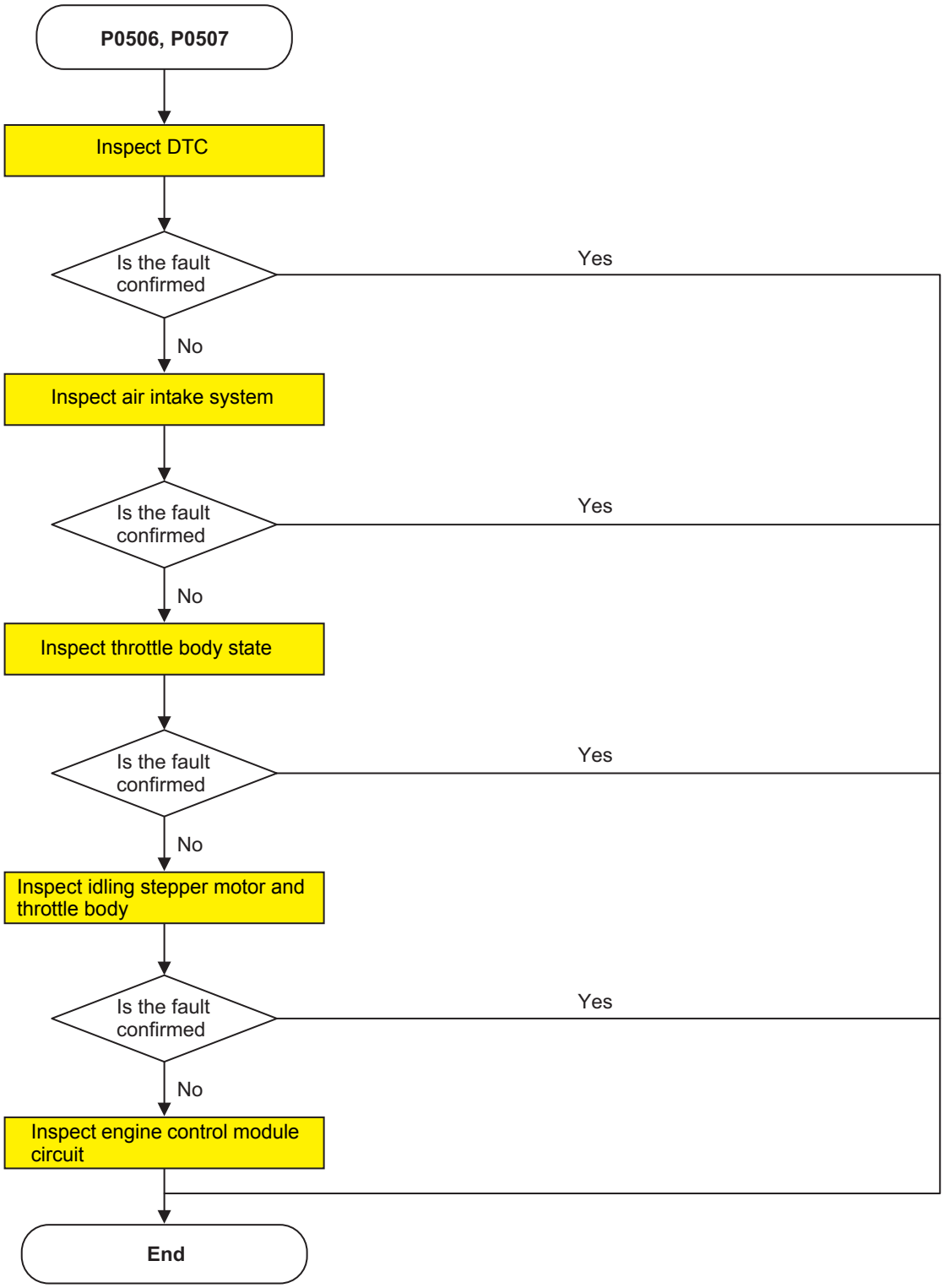
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0506 | Idling stepper motor stuck in the position with small opening | • Idle speed control integrator reaches the maximum value<br>• Difference between static idle speed and actual speed is less than 100 U/min for 8 s<br>• Engine coolant temperature is higher than 80.3°C<br>• Air intake temperature is higher than 20.3°C | • Air intake system<br>• Throttle body<br>• ECM |
| P0507 | Idling stepper motor stuck in the position with large opening | • Idle speed control integrator reaches the minimum value<br>• Difference between static idle speed and actual speed is less than -200 U/min for 10 s<br>• At idle state<br>• Carbon canister is not at high load<br>• Vehicle speed sensor diagnosis completes with no fault<br>• Vehicle speed is 0<br>• Altitude correction factor is greater than 0.703 | |

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### 3. Diagnosis Procedure



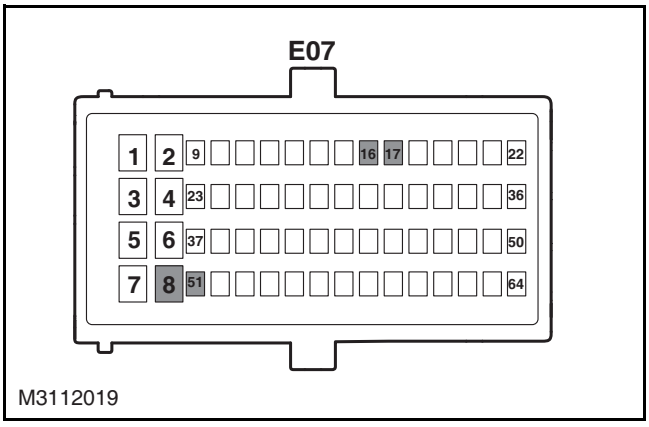
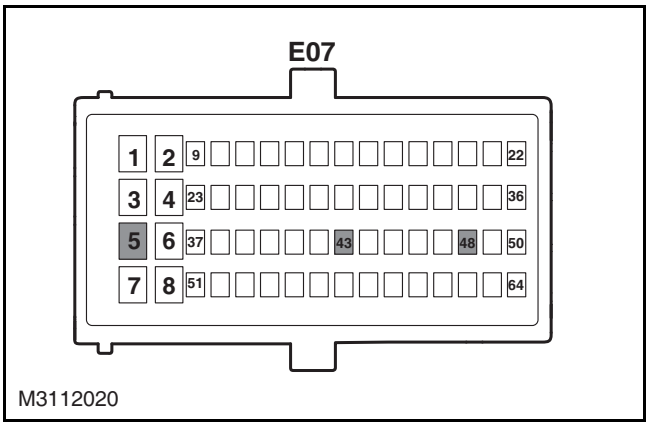
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>C. Select menu: "UAES M7/Read DTC", and read the DTC.<br>Is there any DTC other than DTCs P0506 and P0507?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect air intake system | |
| | A. Inspect the air intake system for the followings.<br>Blockage: Air filter dirty, impurity trapped in the air intake pipe, etc.<br>Leakage: Air intake pipe joint, air cleaner housing, etc.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the fault. |
| 3. Inspect throttle body state | |
| | A. Inspect the throttle body for carbon deposit and foreign matter. If the throttle disc cannot close completely, it may bend and need to be replaced.<br>B. Remove the idling stepper motor, and inspect the valve body for carbon deposit and other objects, and inspect if the stepper motor is stuck. If it is dirty and stuck, clean the idling stepper motor. Replace the throttle body assembly when necessary.<br>C. While the vehicle is running, knock idling stepper motor gently with your hands, and listen to the sound of idle speed rising.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the fault, and replace the idling stepper motor or throttle body assembly when necessary. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect idling stepper motor and throttle body | |
| | A. Replace with a normal idling stepper motor or throttle body assembly.<br>B. Clear the DTC.<br>Are they normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 5. |
| 5. Inspect engine control module circuit | |
|  <br>M3112019<br>  <br>M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0508, P0509, P0511

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0508 | Idle Air Control System Circuit Low | ECM controls engine idle speed by adjusting the position of IAC valve core shaft. IAC valve is a stepper motor that is driven by two internal coils. Movement of idling stepper motor is electrically controlled by four circuits. Driver inside ECM controls the polarity of two windings in the idling stepper motor by these circuits, and ECM commands the motor in the IAC valve to rotate clockwise or counterclockwise. IAC valve motor is connected to idling stepper motor core shaft by drive screws. Electrical pulse delivered from ECM to IAC valve coil allows the core shaft to stretch or contract into the passage of throttle body. The air passes through the throttle valve by contracting of core shaft to increase air flow and improve engine speed. When the core shaft stretches, the air flow is reduced and the engine speed is decreased. DTC will be set if engine control module detects that engine speed is not in the expected range. Terminals 22, 21, 35, 36 of ECM wiring harness connector E07 are connected to terminals 1, 2, 3, 4 of IAC valve wiring harness connector E14 respectively. |
| P0509 | Idle Air Control System Circuit High | |
| P0511 | Idle Air Control Circuit | |

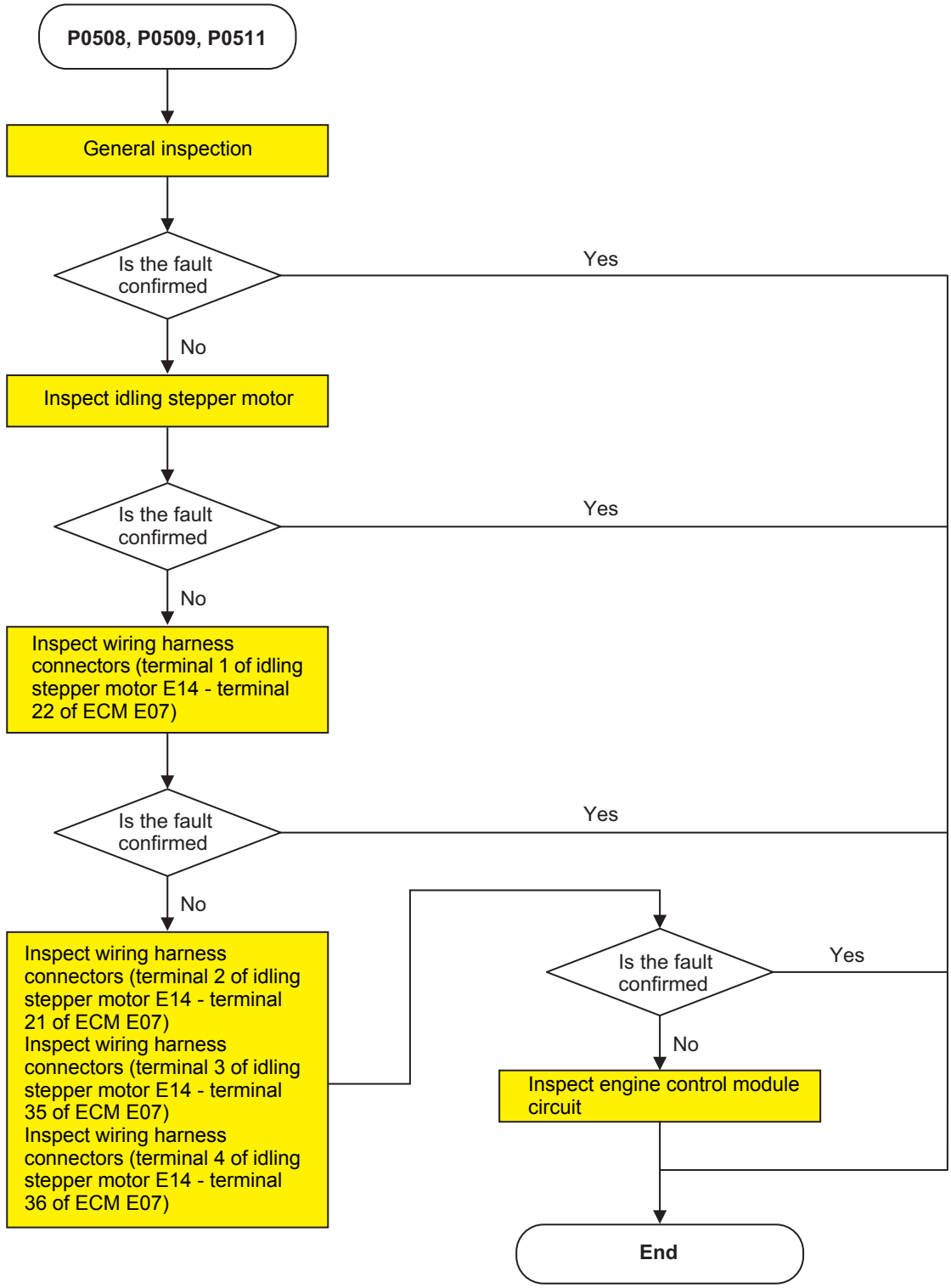
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0508 | Hardware circuit inspection | One terminal of stepper motor is short to ground | • Stepper motor circuit<br>• Stepper motor<br>• ECM |
| P0509 | | One terminal of stepper motor is short to battery positive | |
| P0511 | | One terminal of stepper motor is open | |

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### 3. Diagnosis Procedure



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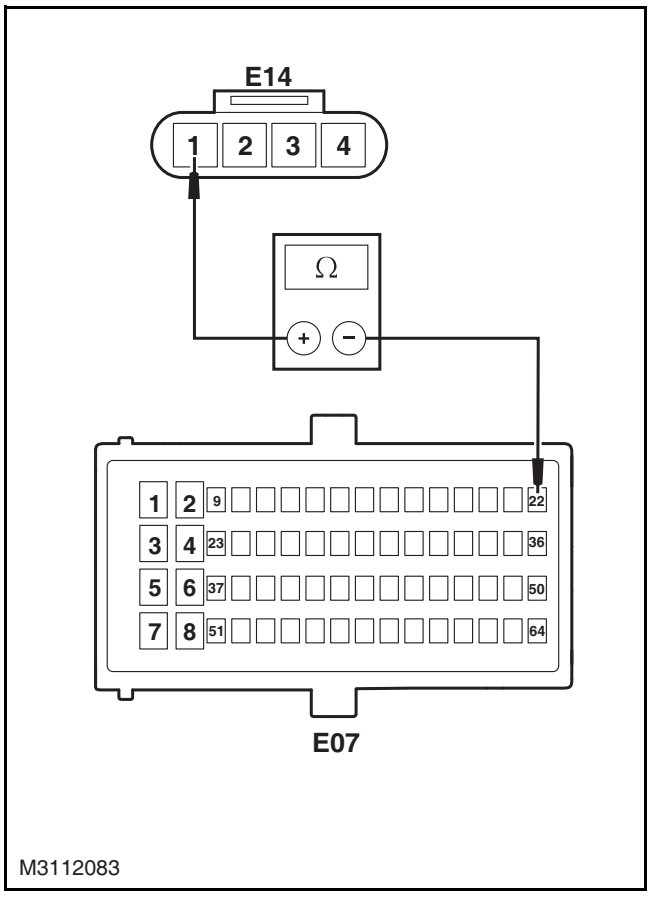


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the stepper motor wiring harness connector E14 for looseness or poor contact.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect idling stepper motor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the idling stepper motor wiring harness connector E14.<br>C. Measure the resistance of idling stepper motor.<br>**Standard resistance:**<br>53 ± 5.3 Ω between terminals A and D, B and C<br>10 MΩ or more between terminals A and C, B and D<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the idling stepper motor. |

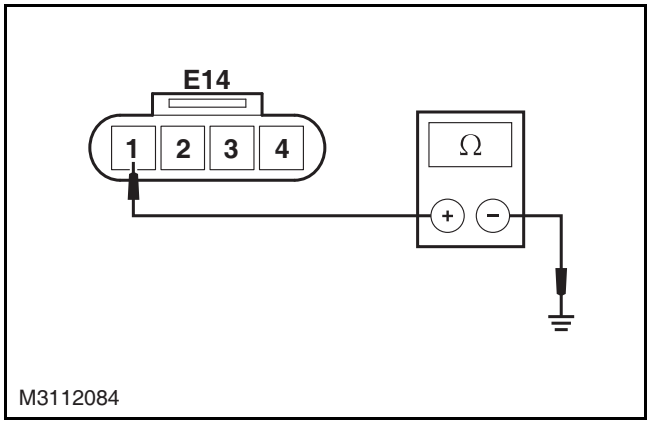
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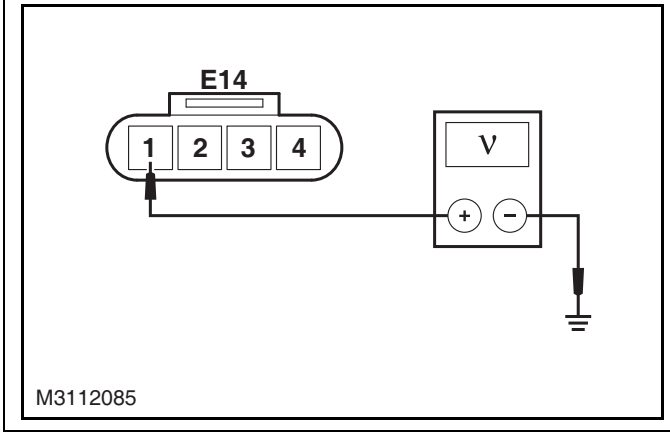
| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect wiring harness connectors (terminal 1 of idling stepper motor E14 - terminal 22 of ECM E07) | |




M3112083




M3112084




M3112085

A. Turn the ignition switch to "LOCK".

B. Disconnect the idling stepper motor wiring harness connector E14.

C. Disconnect the engine control module wiring harness connector E07.

D. Measure the resistance between terminal 1 of idling stepper motor wiring harness connector E14 and terminal 22 of engine control module wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 1 of idling stepper motor wiring harness connector E14 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 1 of idling stepper motor wiring harness connector E14 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

Go to step 4.

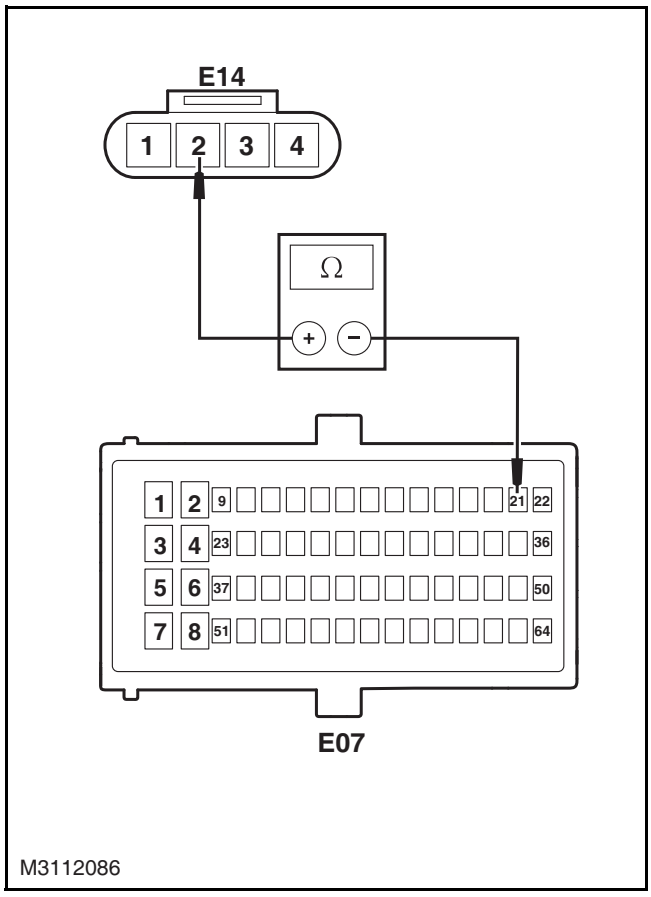
**No**

Repair the fault circuit between terminal 1 of idling stepper motor wiring harness connector E14 and terminal 22 of engine control module wiring harness connector E07.

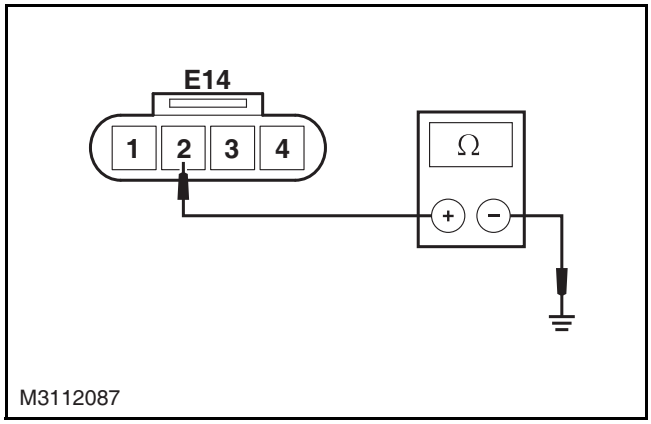
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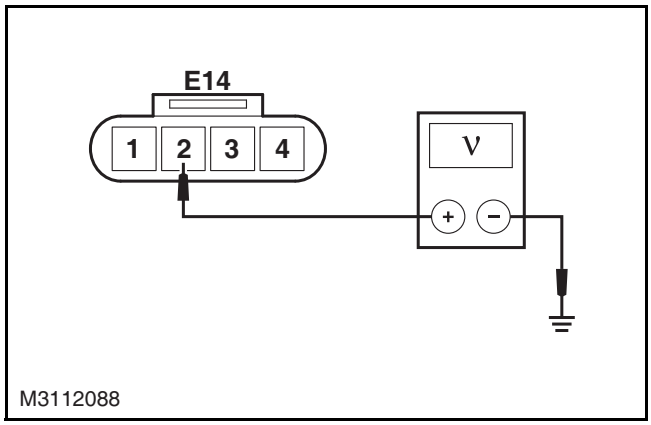
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect wiring harness connectors (terminal 2 of idling stepper motor E14 - terminal 21 of ECM E07) | |




M3112086




M3112087




M3112088

A. Turn the ignition switch to "LOCK".

B. Disconnect the idling stepper motor wiring harness connector E14.

C. Disconnect the engine control module wiring harness connector E07.

D. Measure the resistance between terminal 2 of idling stepper motor wiring harness connector E14 and terminal 21 of engine control module wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of idling stepper motor wiring harness connector E14 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of idling stepper motor wiring harness connector E14 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

Go to step 5.

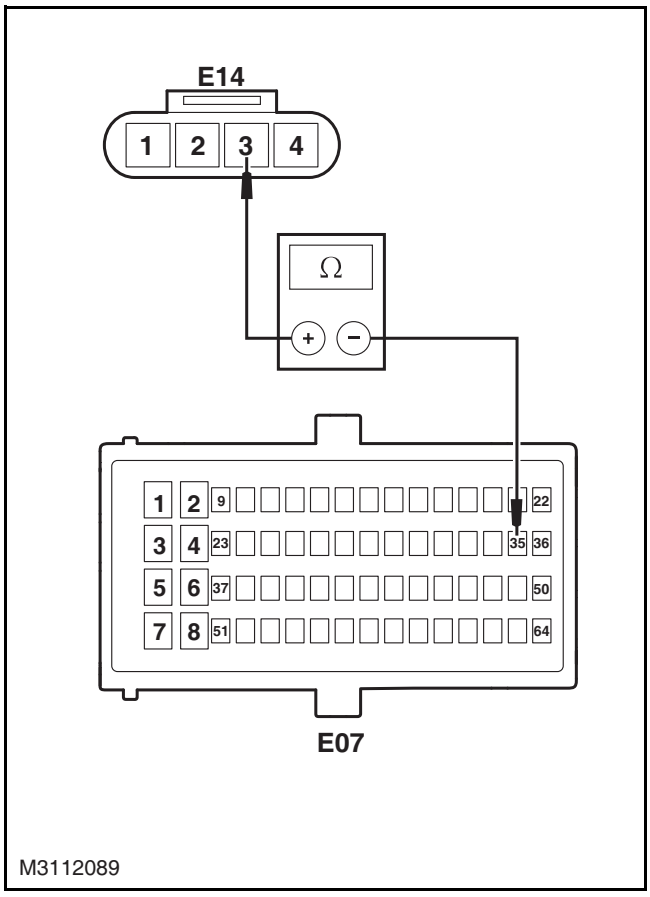
**No**

Repair the fault circuit between terminal 2 of idling stepper motor wiring harness connector E14 and terminal 21 of engine control module wiring harness connector E07.

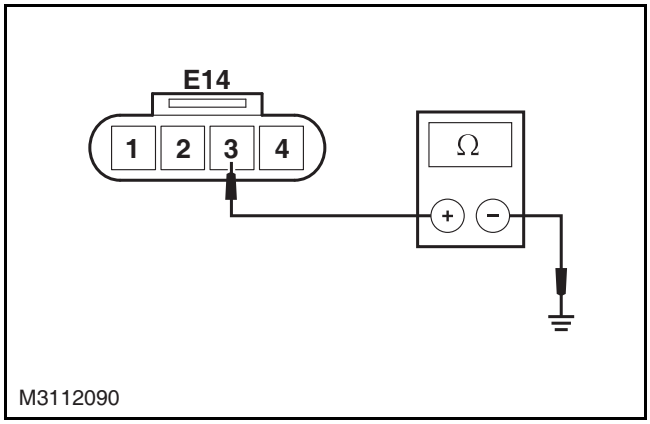
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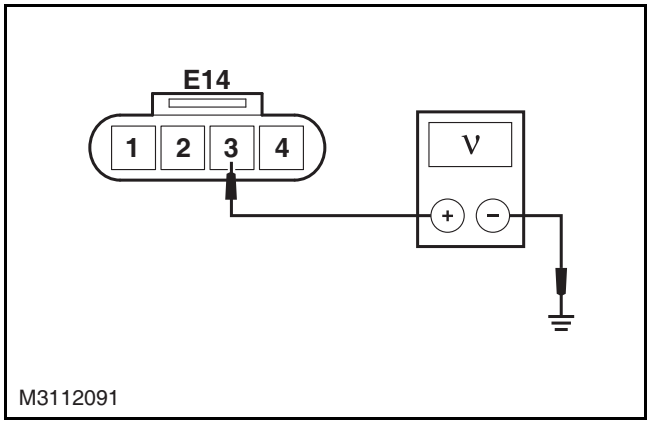
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect wiring harness connectors (terminal 3 of idling stepper motor E14 - terminal 35 of ECM E07) | |




M3112089




M3112090




M3112091

A. Turn the ignition switch to "LOCK".

B. Disconnect the idling stepper motor wiring harness connector E14.

C. Disconnect the engine control module wiring harness connector E07.

D. Measure the resistance between terminal 3 of idling stepper motor wiring harness connector E14 and terminal 35 of engine control module wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 3 of idling stepper motor wiring harness connector E14 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 3 of idling stepper motor wiring harness connector E14 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

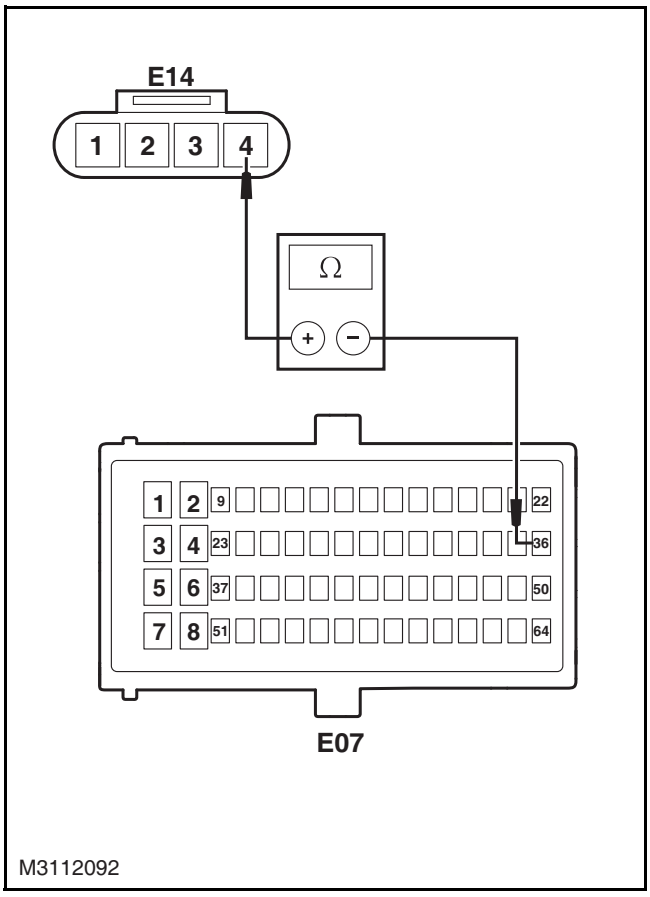
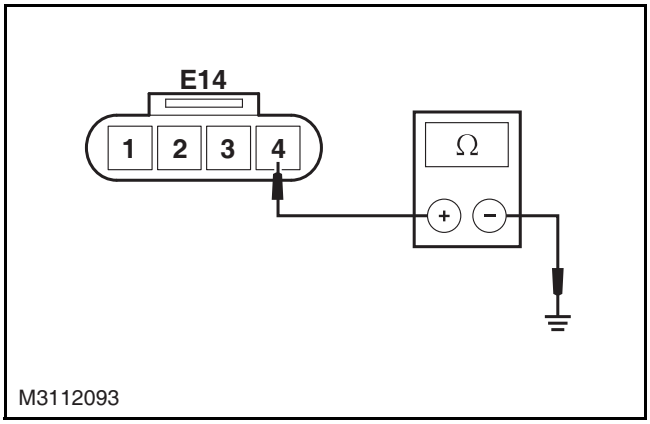
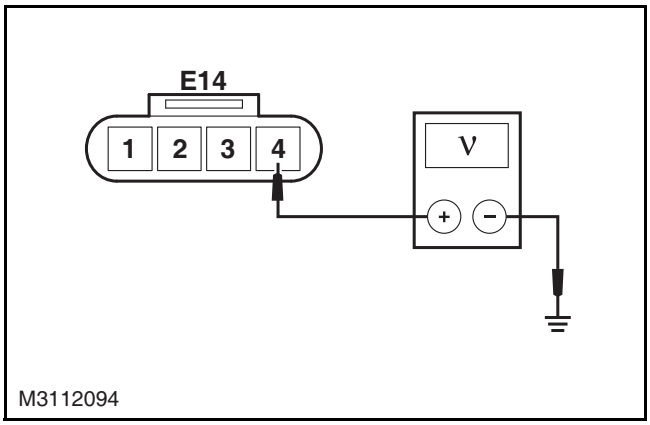
Go to step 6.

**No**

Repair the fault circuit between terminal 3 of idling stepper motor wiring harness connector E14 and terminal 35 of engine control module wiring harness connector E07.

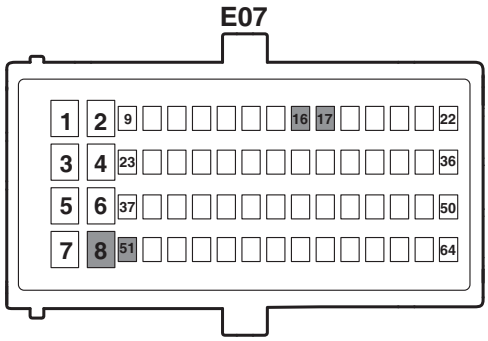
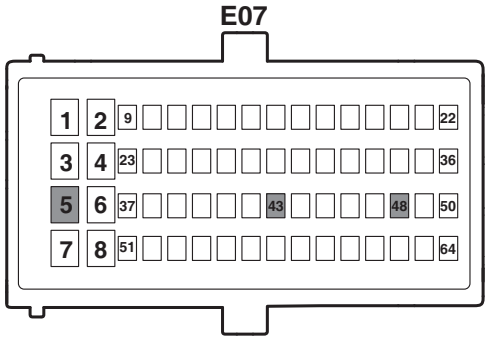
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect wiring harness connectors (terminal 4 of idling stepper motor E14 - terminal 36 of ECM E07) | |
|  <br>M3112092 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the idling stepper motor wiring harness connector E14.<br>C. Disconnect the engine control module wiring harness connector E07.<br>D. Measure the resistance between terminal 4 of idling stepper motor wiring harness connector E14 and terminal 36 of engine control module wiring harness connector E07. Inspect for open circuit.<br>**Standard resistance: less than 5 Ω**<br>E. Measure the resistance between terminal 4 of idling stepper motor wiring harness connector E14 and reliable grounding. Inspect for short to ground.<br>**Standard resistance: 10 MΩ or more**<br>F. Measure the voltage between terminal 4 of idling stepper motor wiring harness connector E14 and reliable grounding. Inspect for short to power supply.<br>**Standard voltage: 0 V**<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Repair the fault circuit between terminal 4 of idling stepper motor wiring harness connector E14 and terminal 36 of engine control module wiring harness connector E07. |
|  <br>M3112093 | |
|  <br>M3112094 | |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module circuit | |
|  M3112019 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |
|  M3112020 | |

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# DTCs P0560, P0562, P0563

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0560 | System Voltage Malfunction | ECM power supply consists of the following circuits:<br>Through the ECM fuse, constant battery power is supplied to ECM via the terminal 16 of ECM wiring harness connector E07.<br>When the ignition switch is turned to "ON", the fuse IF37 supplies power to terminal 17 of engine control module wiring harness connector E07.<br>• When ECM detects battery voltage at terminal 17 of ECM wiring harness connector E07, it controls the main relay to close by internal grounding of E07 terminal 32.<br>• After the main relay is closed, the power from battery supply main relay IR05 is supplied to ECM via E07 terminals 8, 51. |
| P0562 | System Voltage Low Voltage | |
| P0563 | System Voltage High Voltage | |

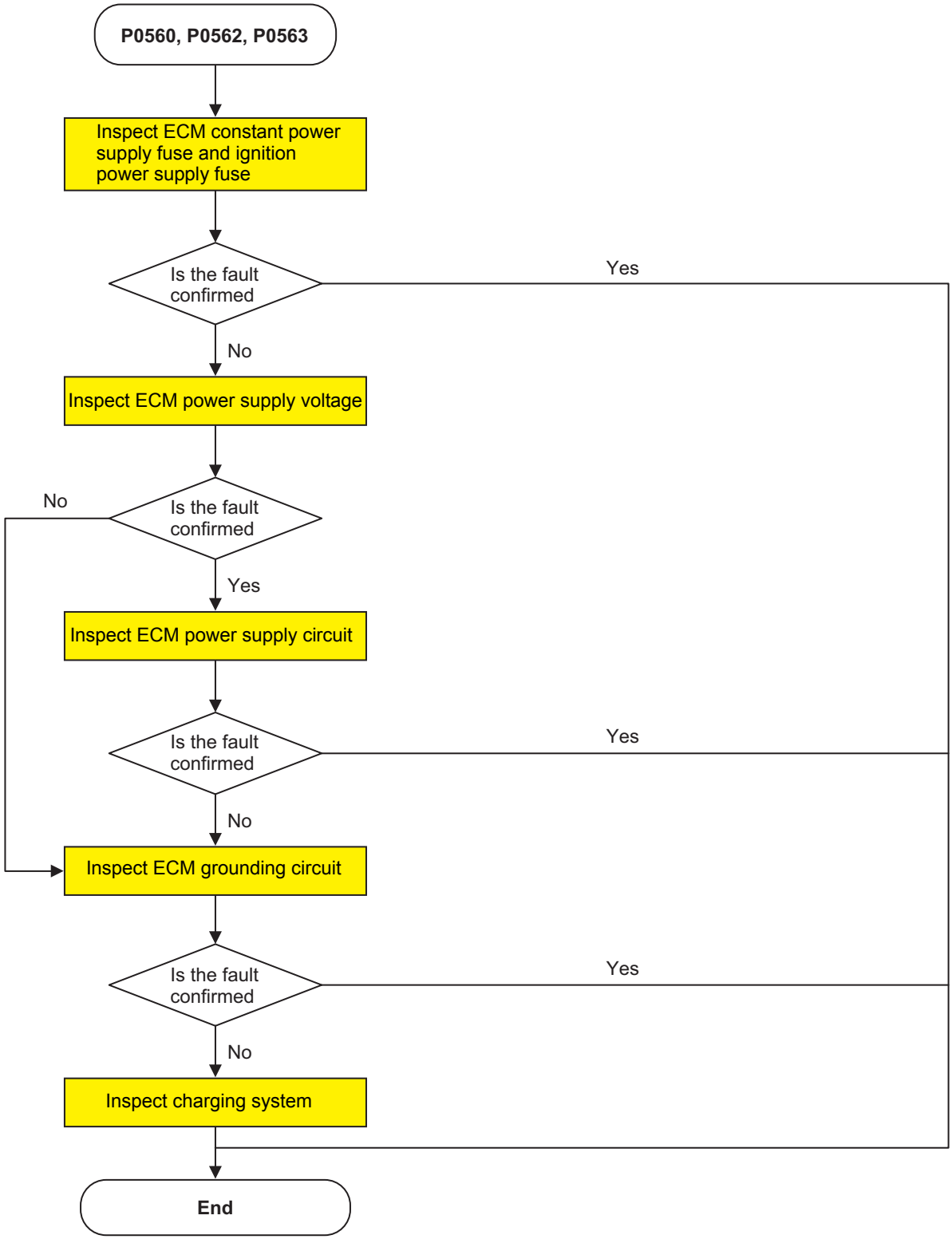
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0560 | Implausibility check | • ADC value of battery voltage is lower than 2.5 V | • Battery<br>• ECM power supply and grounding circuit<br>• Charging system |
| P0562 | Lower limit value exceeded | • Starting time is more than 180 s<br>• ADC value of battery voltage is higher than 2.5 V, lower than 10.02 V | |
| P0563 | Upper limit value exceeded | • ADC value of battery voltage is higher than 17.02 V for 0.2 s<br>• Vehicle speed is greater than 25 km/h<br>• Starting time is more than 180 s | |

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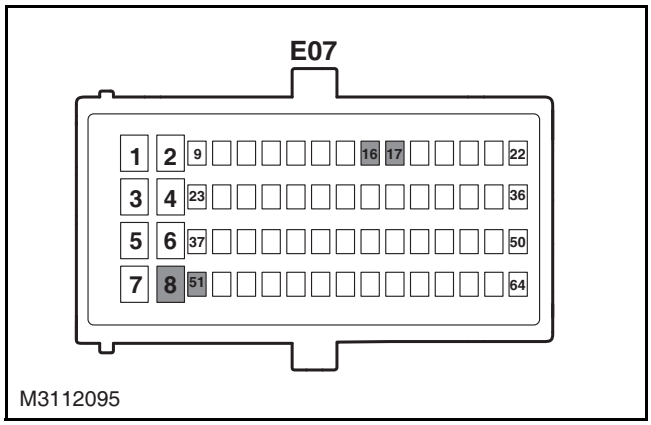


### 3. Diagnosis Procedure



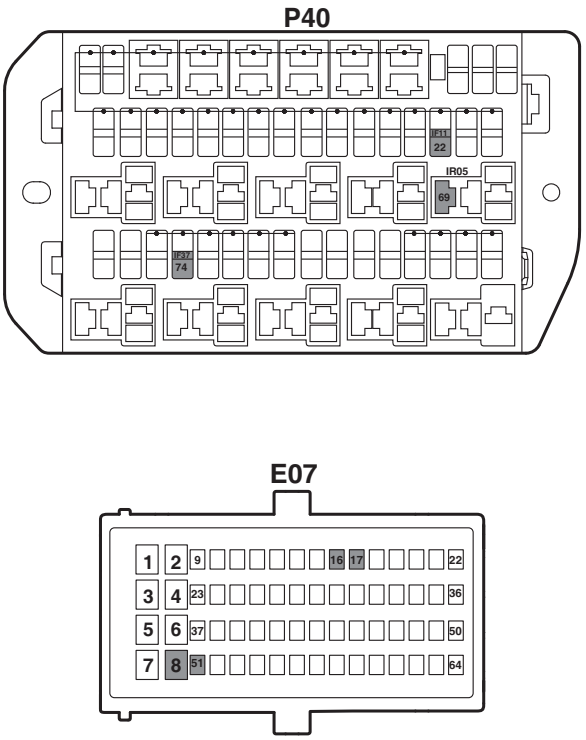
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect ECM constant power supply fuse and ignition power supply fuse | |
| | A. Turn the ignition switch to "LOCK".<br>B. Remove the ECM constant power supply fuse IF11 and ignition power supply fuse IF37 from the instrument panel fuse box P40.<br>C. Inspect the conductivity between two terminals of fuses with the multimeter.<br>Are the fuses normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the fuses. Verify that the system is normal. |
| 2. Inspect ECM power supply voltage | |
|  <br>M3112095 | A. Turn the ignition switch to "ON".<br>Make sure the main relay operates normally, or replace it.<br>B. Measure the voltages between terminals 16, 17, 8, 51 of ECM wiring harness connector E07 and reliable grounding from the backside.<br>**Standard voltage: 11 ~ 14 V**<br>Are the voltage values normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 3. |

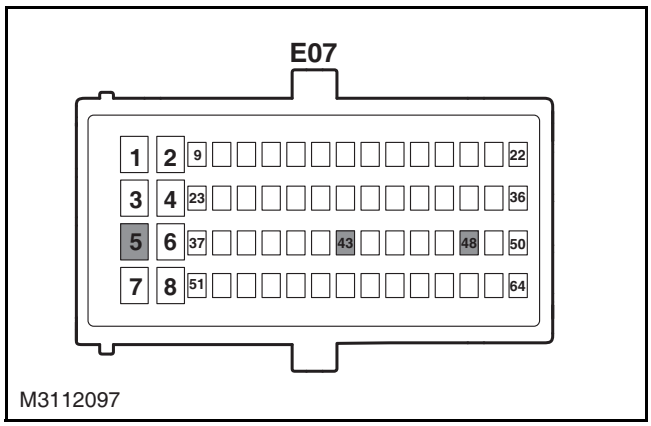
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect ECM power supply circuit | |
|  <br>M3112096 | A. Turn the ignition switch to "LOCK".<br>B. Remove the ECM constant power supply fuse IF11.<br>C. Remove the main relay IR05.<br>D. Measure the resistance between terminal 22 of ECM constant power supply fuse IF11 and terminal 16 of ECM wiring harness connector E07.<br>**Standard resistance: less than 5 Ω**<br>E. Measure the resistance between terminal 74 of fuse IF37 in the instrument panel fuse box P40 and terminal 17 of ECM wiring harness connector E07.<br>**Standard resistance: less than 5 Ω**<br>F. Measure the resistances between terminal 69 of main relay IR05 and terminals 8, 51 of ECM wiring harness connector E07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair related circuit. The system is normal. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect ECM grounding circuit | |
|  <br>M3112097 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the ECM wiring harness connector E07.<br>C. Measure the resistances between terminals 5, 43, 48 of ECM wiring harness E07 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Are the resistance values normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair the fault circuit between terminal 5 of ECM wiring harness connector E07 and grounding point G301, or between terminals 43, 48 of E07 and grounding point G302. |
| 5. Inspect charging system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the battery voltage.<br>**Standard voltage: 11 ~ 14 V**<br>C. Start and run the engine to the normal temperature, turn off all equipment, and change the engine speed from idle speed to 4000 rpm.<br>D. Inspect the engine charging voltage.<br>**Standard voltage: 11.5 ~ 14.5 V**<br>Is the voltage value normal?<br>**Yes**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Repair battery or charging system fault. |

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# DTC P0602

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0602 | Control Module Programming Error | ECM internal program processing fault, ECM power supply and grounding abnormal. |

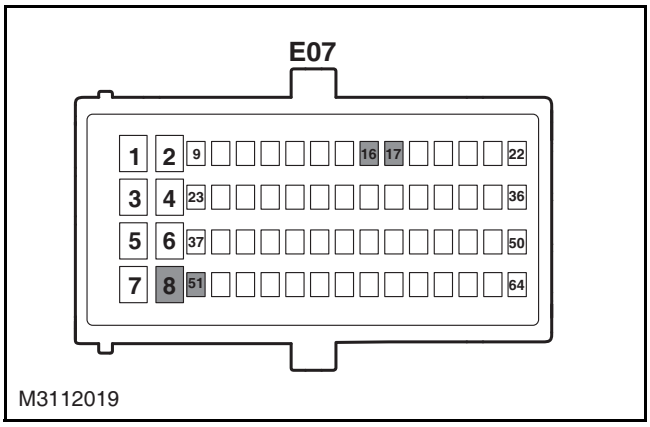
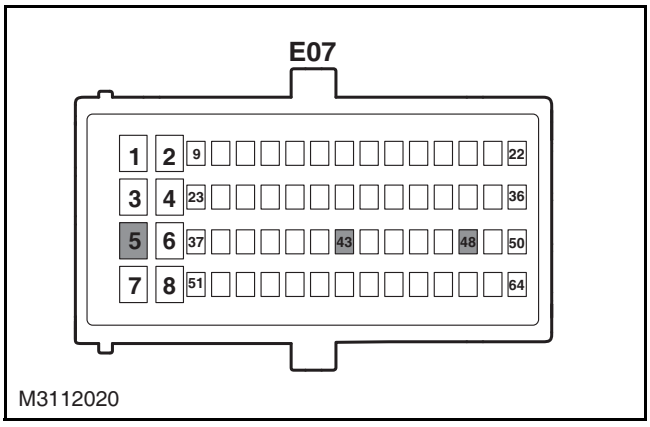
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0602 | Diagnose the Diagnostic Data Identification (DDI) code programming | - | • ECM circuit<br>• ECM |

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### 3. Diagnosis Procedure

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>C. Diagnose the engine system.<br>Is there any DTC other than P0602?<br>**Yes**<br>Repair the DTC other than P0602.<br>**No**<br>Go to step 2. |
| 2. Inspect engine control module circuit | |
|  <br>M3112019<br>  <br>M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0627, P0628, P0629

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0627 | Fuel Pump "A" Control Circuit/ Open | Working power of oil pump relay coil is supplied by main relay controlled by ECM. ECM controls the grounding of terminal 80 of oil pump relay IR08 via terminal 60 of ECM wiring harness connector E07 to close the oil pump relay. There is a drive circuit in the ECM to control the relay coil grounding. The drive circuit provides a feedback circuit to ECM, and ECM determines if an open circuit, short to ground or power supply occurs in control circuit by monitoring the feedback voltage. |
| P0628 | Fuel Pump "A" Control Circuit Low | |
| P0629 | Fuel Pump "A" Control Circuit High | |

## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0627 | Hardware circuit inspection | Open circuit | • Relay<br>• Relay circuit<br>• ECM |
| P0628 | | Short to ground | |
| P0629 | | Short to power supply | |

## 3. Diagnosis Procedure

**Refer to: Diagnosis Procedure for Fuel Pump Failure (3.1.7 Fuel System, Symptom Diagnosis and Testing).**

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# DTCs P0645, P0646, P0647

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0645 | AC Clutch Relays Circuit | Working power of A/C compressor relay is supplied by main relay controlled by ECM. ECM controls the internal grounding of A/C compressor relay via terminal 61 of ECM wiring harness connector E07 to close the relay. There is a drive circuit in the ECM to control the relay coil grounding. The drive circuit provides a feedback circuit to ECM, and ECM determines if an open circuit, short to ground or power supply occurs in control circuit by monitoring the feedback voltage. |
| P0646 | A/C Clutch Relay Control Circuit Low | |
| P0647 | A/C Clutch Relay Control Circuit High | |

## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0645 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Relay<br>• Relay circuit<br>• ECM |
| P0646 | | | |
| P0647 | | | |

## 3. Diagnosis Procedure

**Refer to: Diagnosis Procedure for A/C Compressor Clutch Fault (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing).**

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# DTC P0650

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0650 | Malfunction Indicator Lamp Control Circ. | Engine malfunction indicator lamp is controlled by ECM. When ECM detects engine malfunction, it sets DTC and turns on MIL by setting it at low potential via special line. |

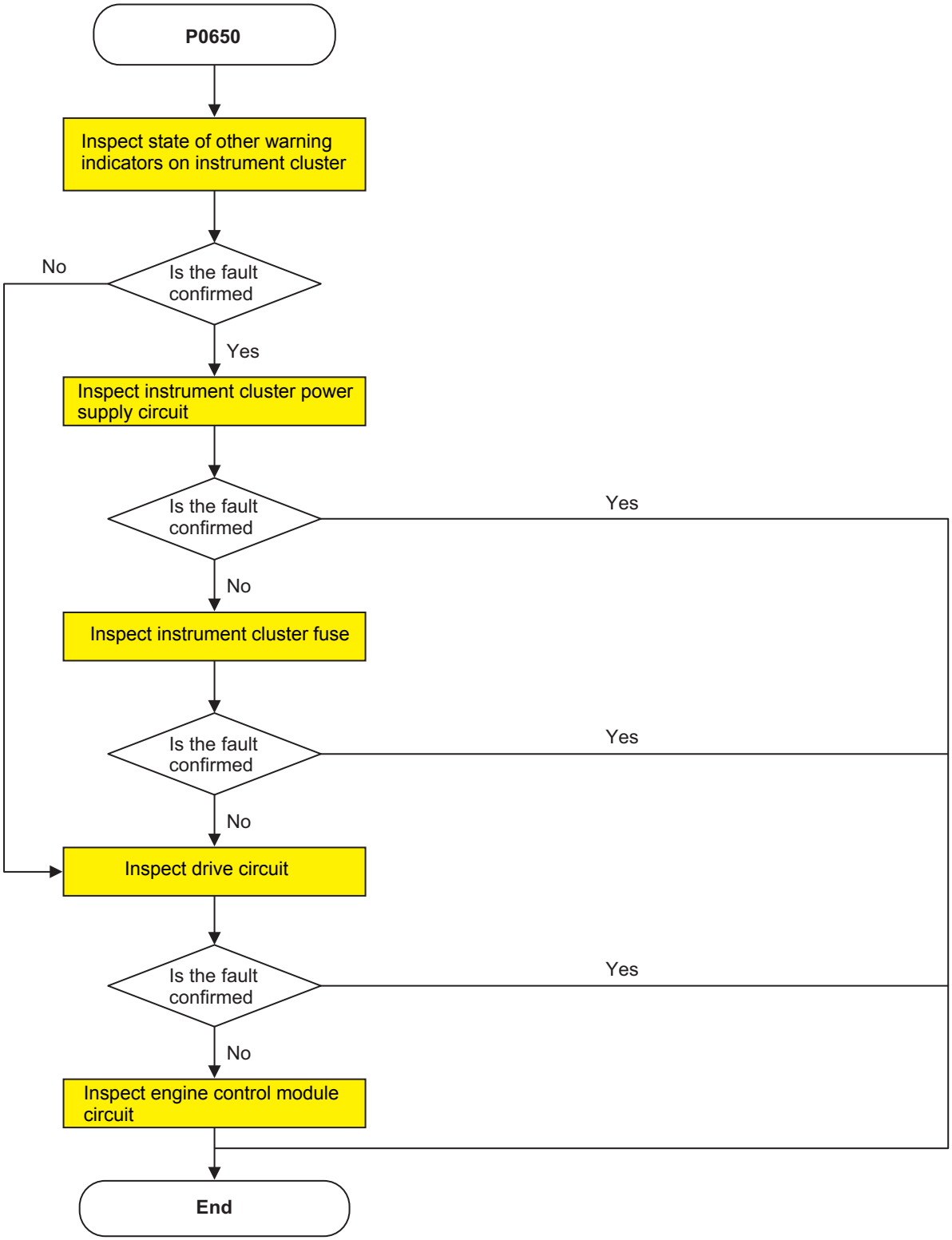
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0650 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Instrument cluster<br>• MIL circuit<br>• ECM |

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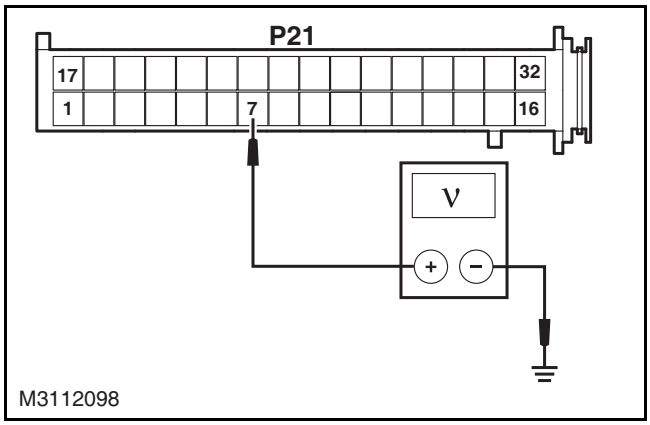


### 3. Diagnosis Procedure



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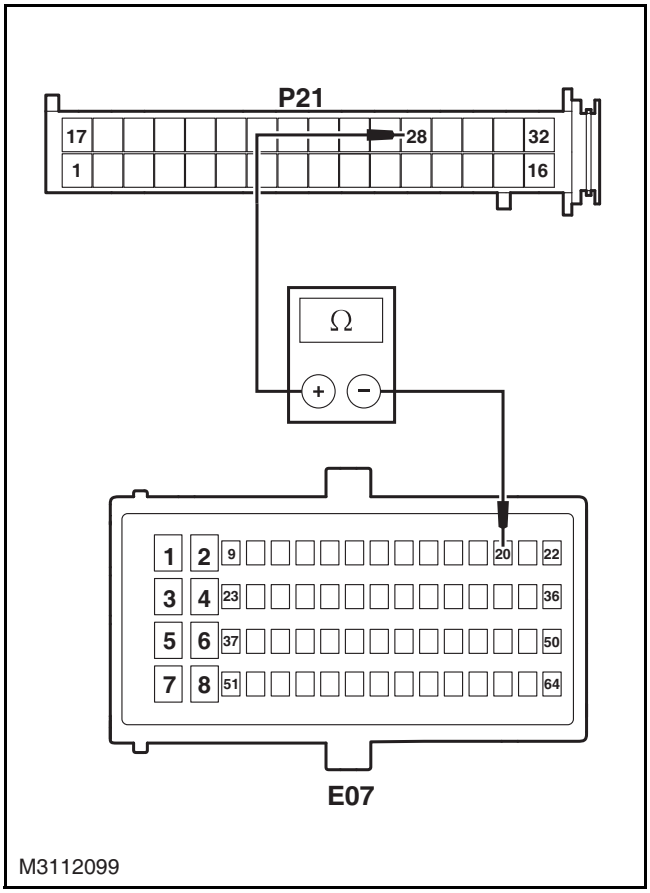


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect state of other warning indicators on instrument cluster | |
| | A. Turn the ignition switch to "ON".<br>B. Inspect the status of all the warning indicators.<br>Is there any other warning indicator abnormal besides MIL indicator?<br>**Yes**<br>Go to step 2.<br>**No**<br>Go to step 4. |
| 2. Inspect instrument cluster power supply circuit | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 7 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the instrument cluster. The system is normal.<br>**No**<br>Go to step 3. |
| 3. Inspect instrument cluster fuse | |
| | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument cluster fuse IF35 from the instrument panel fuse box P40.<br>C. Inspect the conductivity between two terminals of fuse with the multimeter.<br>Is the fuse normal?<br>**Yes**<br>Inspect and repair the fault circuit between terminal 7 of instrument cluster wiring harness connector P21 and fuse IF35.<br>**No**<br>Replace the fuse. Verify that the system is normal. |

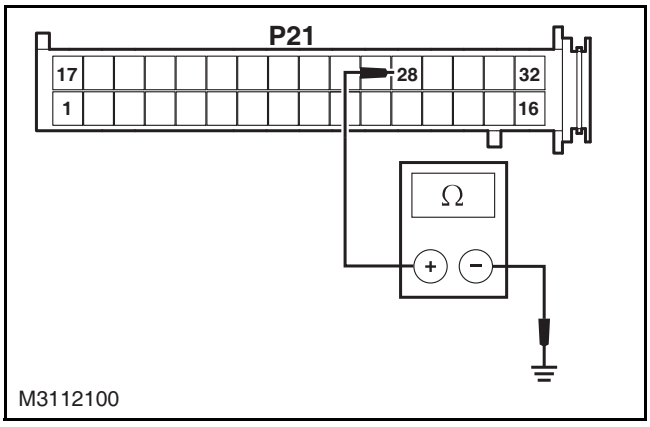
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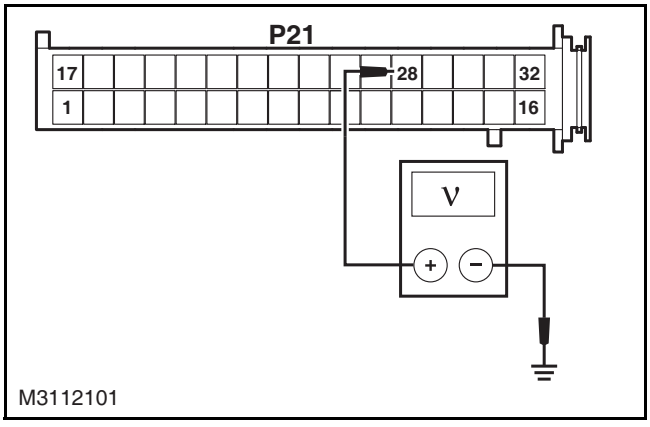
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect drive circuit | |




M3112099




M3112100




M3112101

A. Turn the ignition switch to "LOCK".

B. Disconnect the instrument cluster wiring harness connector P21.

C. Disconnect the engine control module wiring harness connector E07.

D. Measure the resistance between the terminal 28 of instrument cluster wiring harness connector P21 and terminal 20 of engine control module wiring harness connector E07.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 28 of instrument cluster wiring harness connector P21 and reliable grounding.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 28 of instrument cluster wiring harness connector P21 and reliable grounding.

**Standard voltage: 0 V**

Are they normal?

**Yes**

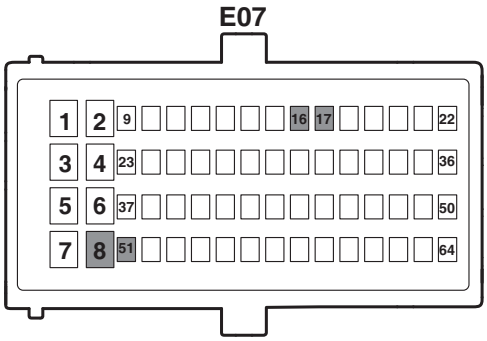
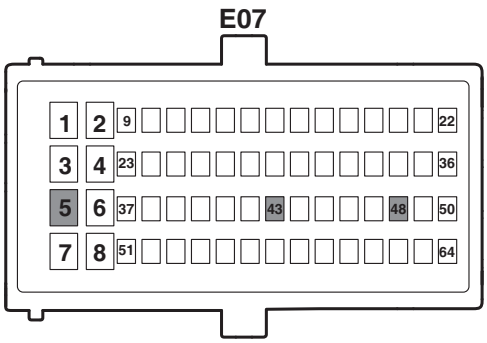
Go to step 5.

**No**

Repair the fault circuit between terminal 28 of instrument panel wiring harness connector P21 and terminal 20 of engine control module wiring harness connector E07.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect engine control module circuit | |
|  M3112019<br>  M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P2177, P2178, P2187, P2188

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P2177 | System Too Lean Off Idle | Engine Control Module (ECM) controls closed loop air-fuel ratio measuring system, achieving best cooperation of drivability, fuel economy and emission control. In closed loop mode, ECM monitors the signal voltage of heated oxygen sensor (HO2S) and regulates the fuel supply according to the signal voltage.<br>Changes in fuel supply will change the fuel trim values of long term and short term. The fuel short term trim value will change rapidly, responding to the change of heated oxygen sensor signal voltage. These changes will finely tune the engine fuel supply. The fuel long term trim value changes in response to the fuel short term trim trend. The fuel long term trim adjusts fuel supply roughly, in order to return to the short term center fuel value, and to recover the control to fuel short term trim.<br>Ideal value of the fuel trim is about 0%. If the fuel trim value is positive, it shows the engine control module is increasing fuel to compensate the condition that the fuel mixture is too lean. If the fuel trim value is negative, it shows the engine control module is decreasing fuel to compensate the condition that the fuel mixture is too rich. |
| P2178 | System Too Rich Off Idle | |
| P2187 | System Too Lean at Idle | |
| P2188 | System Too Rich at Idle | |

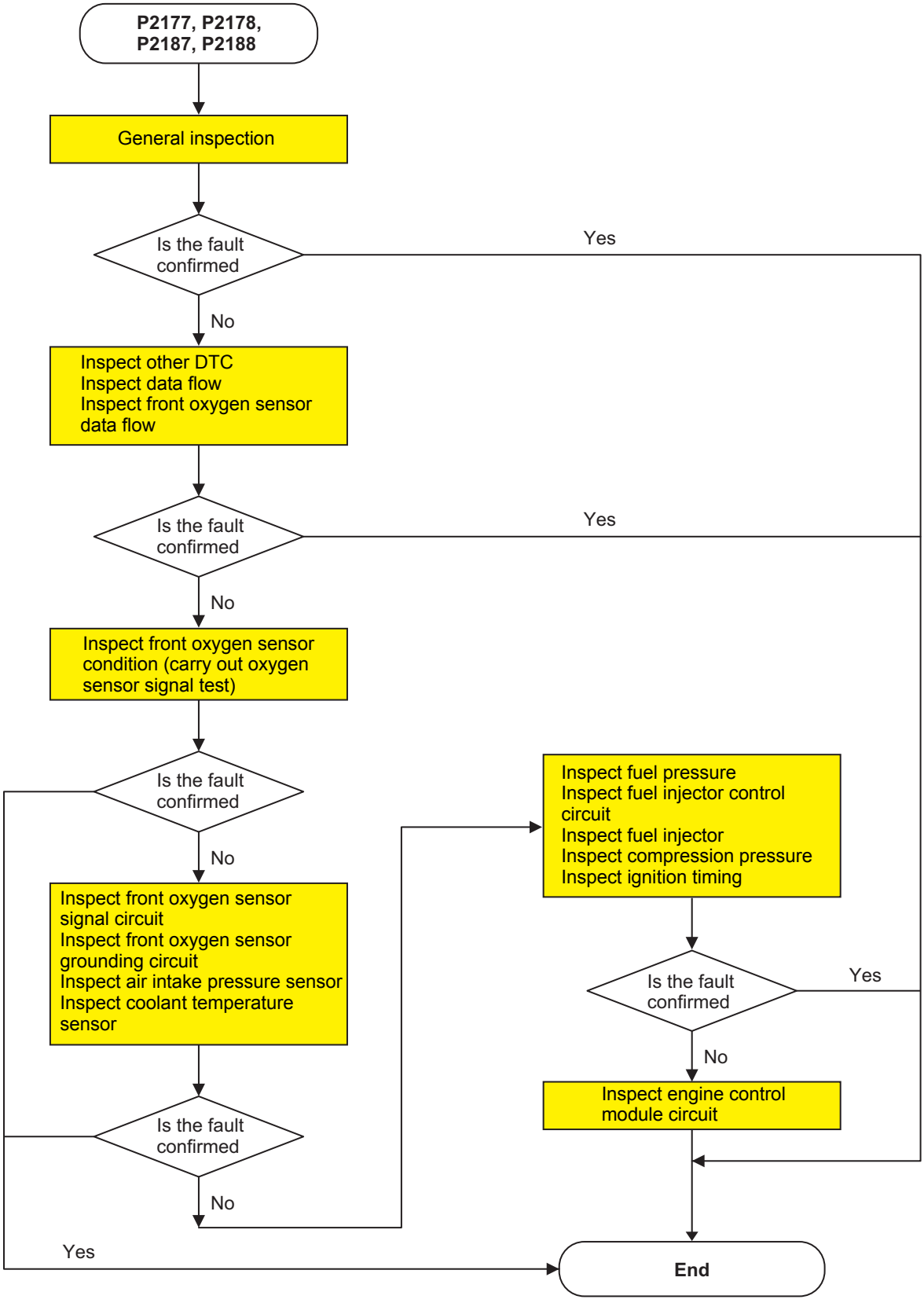
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P2177 | Fuel trim high limits exceeded | • Multiplicative adaption value is more than 1.23 for 25 s<br>• Air-fuel ratio adaption on<br>• Engine speed is 1400 ~ 4000 rpm<br>• Air mass flow is 18 ~ 70 kg/h<br>• Load is 16% ~ 70% | • Air intake pressure sensor<br>• Oxygen sensor<br>• Sensor circuit<br>• Coolant temperature sensor<br>• Fuel pressure<br>• Fuel injector and control circuit<br>• Engine mechanical<br>• ECM |
| P2178 | Fuel trim low limits exceeded | • Multiplicative adaption value is less than 0.77 for 25 s<br>• Air-fuel ratio adaption on<br>• Engine speed is 1400 ~ 4000 rpm<br>• Air mass flow is 18 ~ 70 kg/h<br>• Load is 16% ~ 70% | |
| P2187 | - | - | |
| P2188 | - | - | |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the oxygen sensor, air intake pressure/ temperature sensor, engine coolant temperature sensor wiring harness connector for damage, poor contact, aging, looseness and so on.<br>B. Inspect the vacuum tube for damage, looseness or leakage.<br>C. Inspect the air intake system for leakage.<br>D. Inspect for contamination that may damage the oxygen sensor: dirty fuel, unqualified silicone, oil and coolant.<br>E. Inspect the engine PCV (Positive Crankcase Ventilation) system.<br>F. Inspect the engine exhaust system for blockage or leakage.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault, and verify that the system is normal. |
| 2. Inspect other DTC | |
| | A. Connect the diagnostic tool.<br>B. Start the engine and diagnose the engine system.<br>C. Inspect DTC.<br>Is there any DTC other than P2177, P2178, P2187 and P2188?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect data flow | |
| | A. Connect the diagnostic tool.<br>B. Start engine and access to the engine system data flow on diagnostic tool.<br>C. Inspect the long, short and final long term fuel trim values.<br>Are the values normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.1.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| 4. Inspect front oxygen sensor data flow | |
| | A. Start the engine, and run it till the engine coolant temperature reaches above 80°C.<br>B. Use diagnostic tool to enter engine data flow, and observe the "O2 sensor voltage bank 1, sensor 1" parameter.<br>**Standard voltage: fluctuates between 0.1 ~ 0.9 V.**<br>C. Turn the ignition switch to "LOCK" after measurement.<br>Does the voltage of oxygen sensor fluctuate between 0.1 ~ 0.9 V?<br>**Yes**<br>Go to step 8.<br>**No**<br>Go to step 5. |

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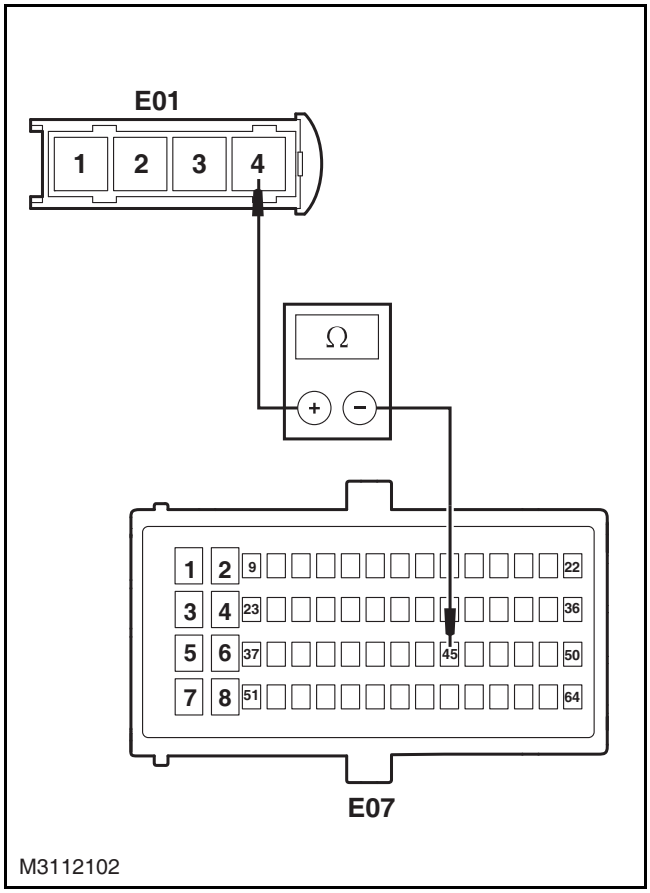


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect front oxygen sensor condition (carry out oxygen sensor signal test) | |
| | A. If the voltage displayed in data flow remains below 0.45 V (mixture too lean), inspect according to the following steps:<br>• Jet a proper amount of propane into the intake port.<br>• Observe if the front oxygen sensor voltage in data flow changes obviously and the signal voltage rises quickly.<br>B. If the voltage displayed in data flow remains above 0.45 V (mixture too rich), inspect according to the following steps:<br>• Position the transmission at neutral gear.<br>• Apply the parking brake.<br>• Depress the accelerator pedal until the engine speed suddenly increases to 4000 rpm and then quickly release the accelerator pedal.<br>• Repeat the previous step more than 3 times.<br>• Observe if the front oxygen sensor voltage in data flow changes obviously and the signal voltage drops quickly.<br>In the implementation of above test, the oxygen sensor signal voltage should change significantly as the test continues.<br>Does it change significantly?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the front oxygen sensor.<br>**Refer to: Front Oxygen Sensor (3.1.12 Electronic Control System - M7, Removal and Installation).** |

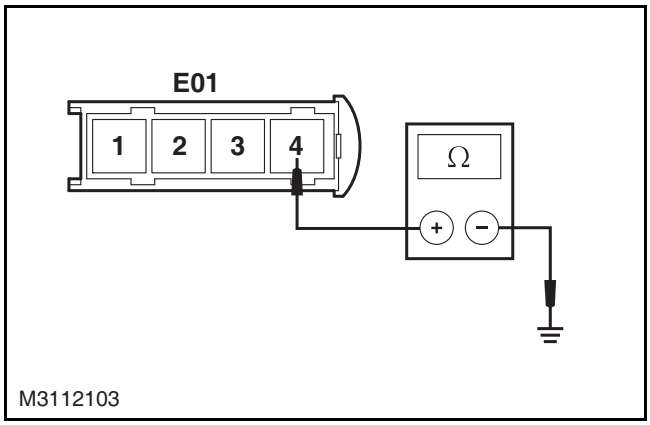
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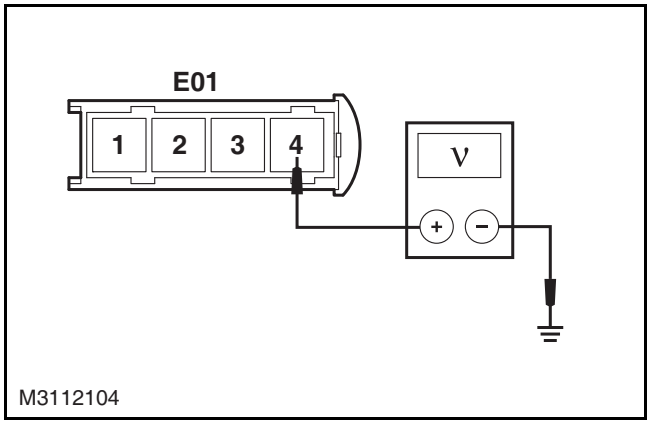
| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect front oxygen sensor signal circuit | |




M3112102




M3112103




M3112104

A. Inspect the front oxygen sensor signal circuit.

B. Turn the ignition switch to "LOCK".

C. Disconnect the front oxygen sensor wiring harness connector E01.

D. Disconnect the ECM wiring harness connector E07.

E. Measure the resistance between terminal 4 of front oxygen sensor wiring harness connector E01 and terminal 45 of ECM wiring harness connector E07. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 4 of front oxygen sensor wiring harness connector E01 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

G. Measure the voltage between terminal 4 of front oxygen sensor wiring harness connector E01 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is it normal?

**Yes**

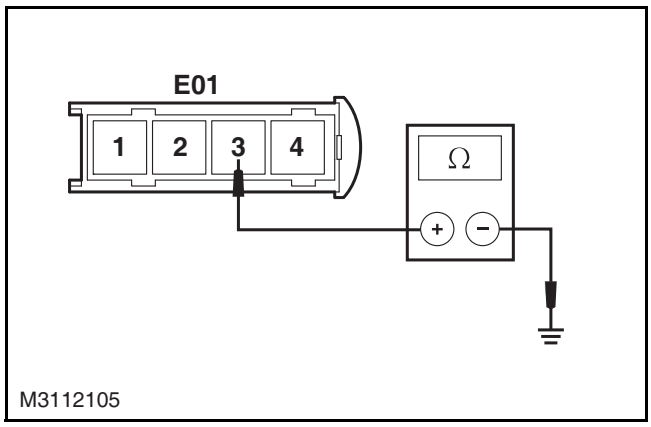
Go to step 7.

**No**

Repair the fault circuit between terminal 4 of front oxygen sensor wiring harness connector E01 and terminal 45 of ECM wiring harness connector E07.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect front oxygen sensor grounding circuit | |
|  M3112105 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front oxygen sensor wiring harness connector E01.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 3 of E01 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the fault circuit between terminal 3 of front oxygen sensor wiring harness connector E01 and terminal 39 of ECM wiring harness connector E07. |
| 8. Inspect air intake pressure sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect a vacuum gauge to the intake manifold vacuum source.<br>C. Start the engine and idle it.<br>D. Read the "Actual intake manifold pressure" data flow with the diagnostic tool.<br>Is the difference between readings on the diagnostic tool and vacuum gauge within 1 in (25 mm)?<br>**Yes**<br>Go to step 9.<br>**No**<br>Replace the air intake pressure/temperature sensor, and clean the throttle and intake manifold. Verify that the system is normal. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect coolant temperature sensor | |
| | **CAUTION: To make the test effective, the thermostat should work normally.**<br><br>**CAUTION: Carry out this test when the engine is cold (cool it to the ambient temperature).**<br><br>A. Turn the ignition switch to "ON" with engine not running.<br>B. Use the diagnostic tool to read the value of engine coolant temperature (ECT) sensor. The temperature should be close to the ambient temperature.<br>C. Start the engine.<br>When the engine is warmed up, monitor the ECT sensor value. Changes from start to normal operating temperature (82°C (180°F)) should be stable.<br>This value should be at least 82°C (180°F).<br>Is it normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Replace the coolant temperature sensor. |
| 10.Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Inspect the fuel system fault.<br>**Refer to: Low Pressure in Fuel System (3.3.7 Fuel System, Symptom Diagnosis and Testing).** |

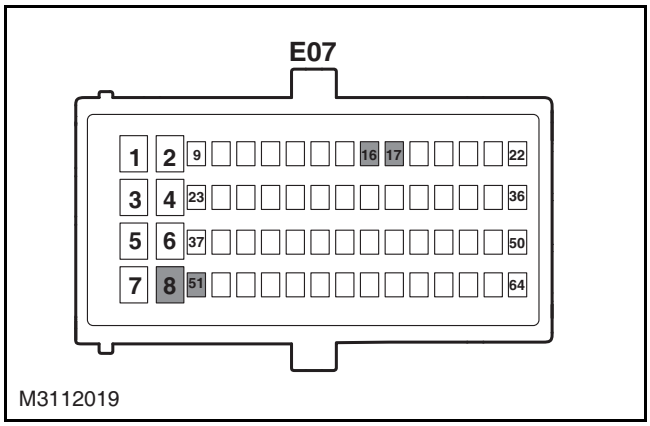
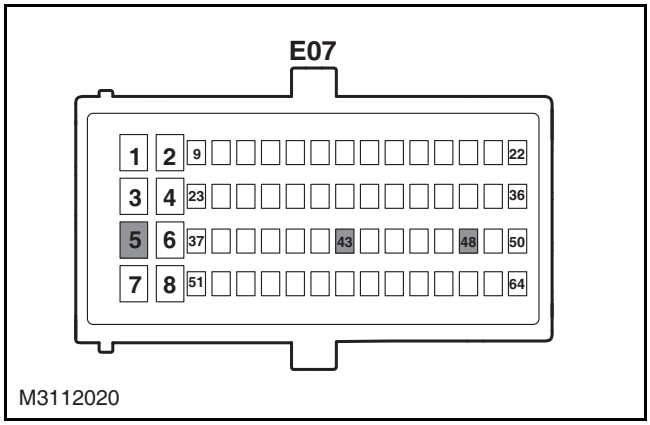
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| Test Conditions | Details/Results/Actions |
|---|---|
| 11.Inspect fuel injector control circuit | |
| | A. Disconnect the fuel injector wiring harness connector from the possible faulty cylinder.<br>B. Connect the test pen with LED to the fuel injector terminal.<br>**CAUTION: LED must connect with 1 ~ 2 kΩ resistor in series, otherwise the LED or ECM may be damaged.**<br>C. Inspect the LED state during engine start.<br>Does the LED flash?<br>**Yes**<br>Go to step 12.<br>**No**<br>Inspect the fuel injector wiring harness. Repair or replace if necessary. |
| 12.Inspect fuel injector | |
| | A. Remove the fuel injector.<br>B. Replace with a fuel injector in good condition.<br>C. Clear the DTC.<br>D. Start engine and carry out road test when necessary.<br>E. Diagnose the engine system.<br>Are there DTCs P2177, P2178, P2187 and P2188?<br>**No**<br>Replace the fuel injector.<br>**Yes**<br>Go to step 13. |
| 13.Inspect compression pressure | |
| | A. Inspect the engine compression pressure.<br>**Refer to: Cylinder Compression Pressure Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the compression pressure normal?<br>**Yes**<br>Go to step 14.<br>**No**<br>Inspect the cause of low compression pressure, and repair the fault. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 14.Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.1.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 15.<br>**No**<br>Repair the ignition timing fault. Verify that the system is normal. |
| 15.Inspect engine control module circuit | |
|  <br>M3112019<br>  <br>M3112020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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## Removal and Installation

# Engine Control Module

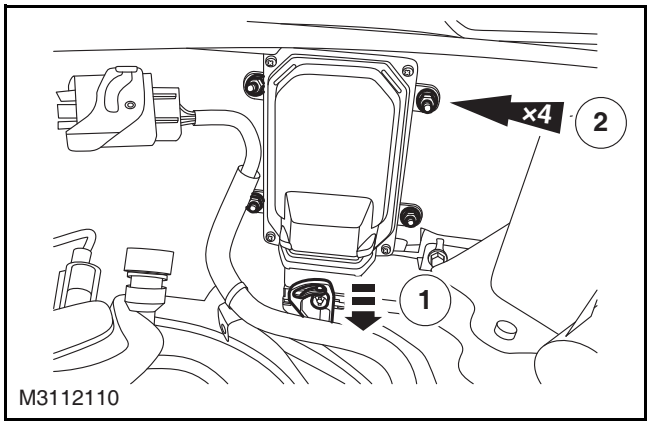
### Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect the engine control module wiring harness connector (1).
3. Remove the engine control module retaining nuts (2).

   Torque: 8 ± 2 Nm




### Installation

1. Installation is in the reverse order of removal.

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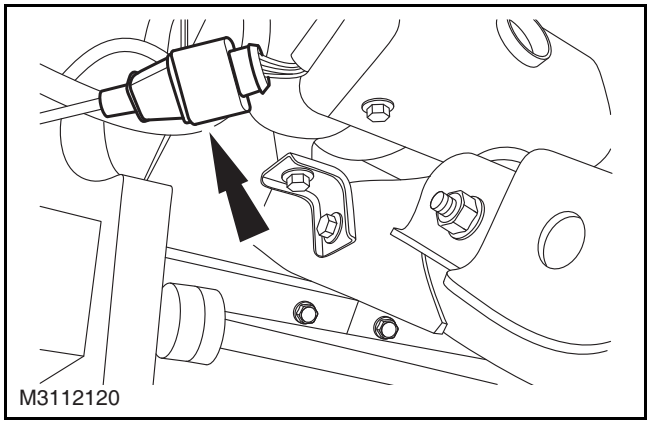
# Crankshaft Position Sensor

## Removal

1. Disconnect the negative battery cable.

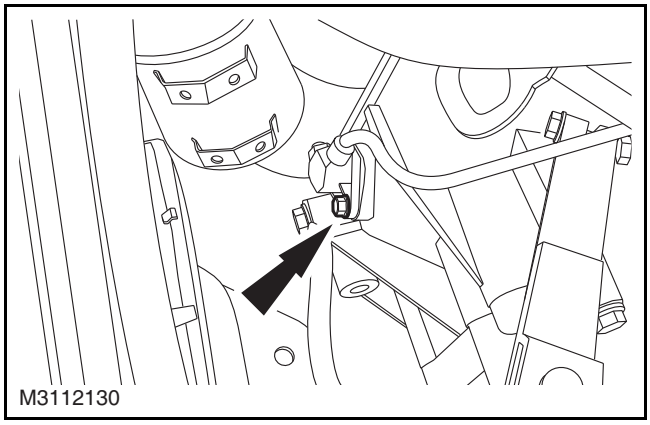
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect the crankshaft position sensor wiring harness connector.




3. Remove the crankshaft position sensor retaining bolt.

   Torque: 10 ± 2 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Before installation, apply lubricant to the O-ring and press in the sensor with hands.**

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# Throttle Position Sensor

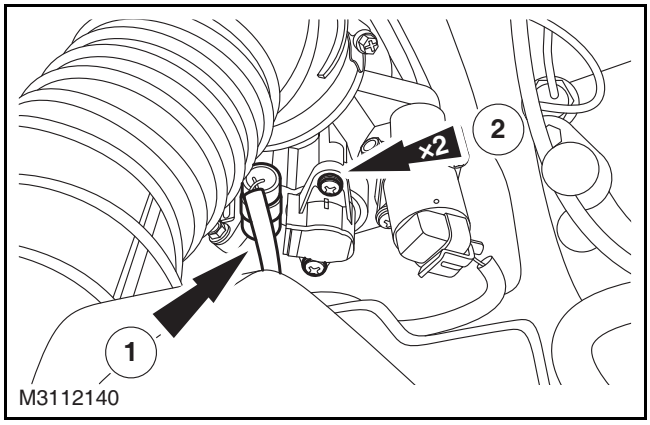
## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect the throttle position sensor wiring harness connector (1).
3. Remove 2 retaining bolts (2) from the throttle position sensor.

   Torque: 1.5 ~ 2.5 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure the seal ring of sensor is fully inserted to the end and the wiring harness connector is set in place during installation.**

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# Idling Stepper Motor

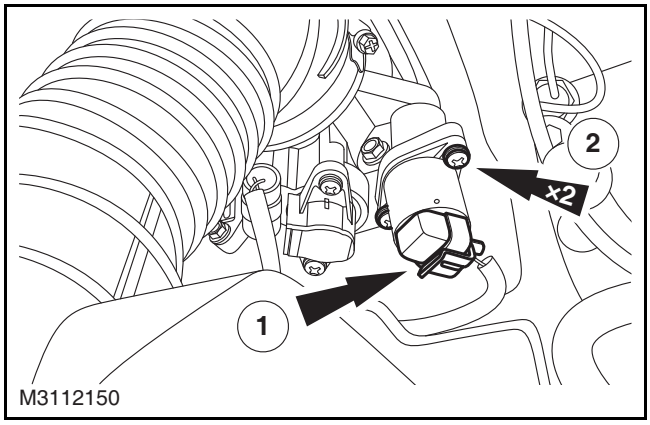
## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect idling stepper motor wiring harness connector (1).
3. Remove 2 retaining bolts (2) from the idling stepper motor.

   Torque: 4 ± 0.4 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Pulling or pushing the shaft of stepper motor is prohibited, or it will cause permanent damage.**

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# Coolant Temperature Sensor

## Removal

1. Disconnect the negative battery cable.

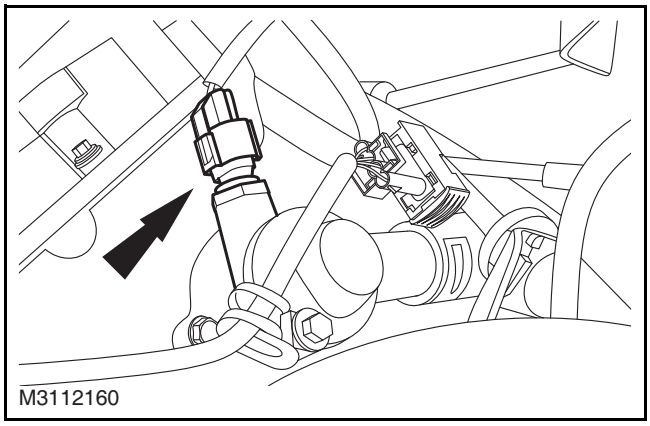
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Drain the coolant.

   **Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).**

3. Disconnect the coolant temperature sensor connector.
4. Remove the coolant temperature sensor.

   Torque: 20 Nm or less


M3112160

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure the sensor is fully inserted to the end and there is no coolant leakage.**

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# Air Intake Pressure/Temperature Sensor

## Removal

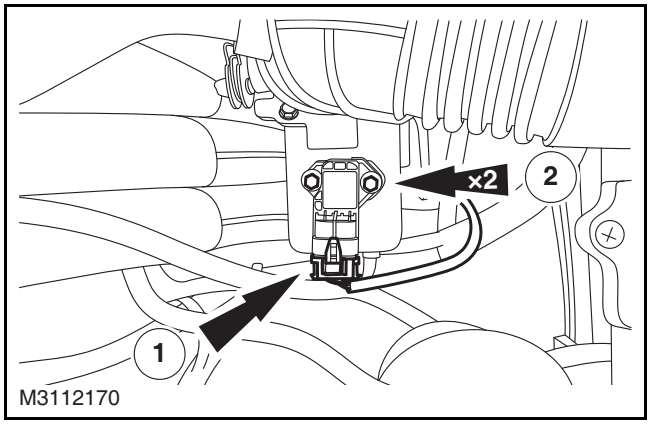
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect the air intake pressure/temperature sensor wiring harness connector (1).

3. Remove the retaining bolts (2) from the air intake pressure/temperature sensor.

   Torque: 8 ± 2 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Installing the sensor with any impactive tool (such as hammer) is prohibited. Avoid water, oil etc. entering the sensor.**

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# Fuel Injector

## Removal

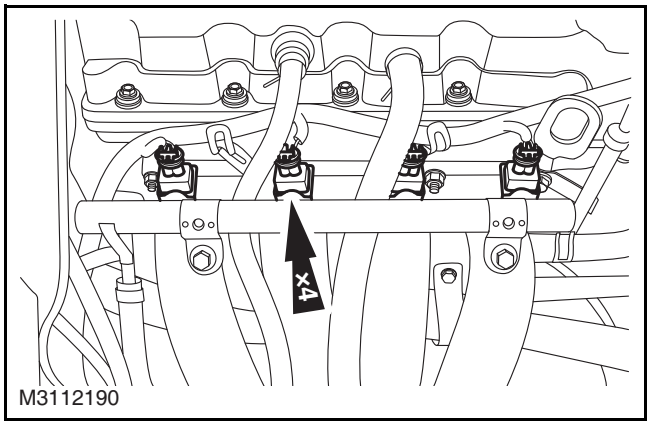
1. Release the fuel pressure.

   **Refer to: Fuel System Pressure Test (3.1.7 Fuel System, General Inspection).**

2. Disconnect the negative battery cable.

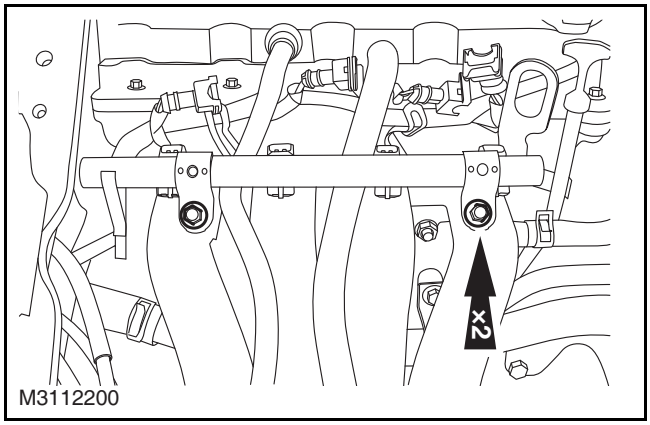
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

3. Disconnect 4 wiring harness connectors from the fuel injectors.



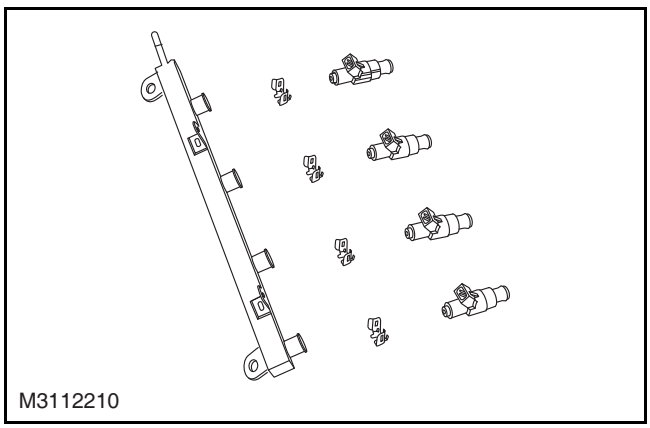
M3112190

4. Remove 2 retaining bolts from the fuel rail and separate the fuel main pipe assembly from the cylinder block.



M3112200

5. Loosen the retaining clips from the fuel injectors, and remove the fuel injectors.


M3112210

## Installation

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1. Installation is in the reverse order of removal.

**CAUTION: Replace the fuel injector clips and seal rings during installation.**
**Before assembly, it is necessary to apply clean lubricant to the injector lower seal ring. Prevent the lubricant contaminating the injector plate, and keep the injector mounting hole on the engine clean. Carefully install the fuel rail to the cylinder block with an even force in the axial direction of injector. Avoid applying excessive impact during assembly.**

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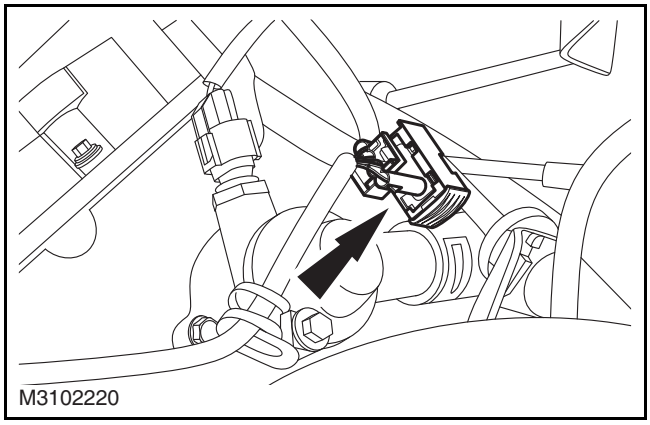
# Front Oxygen Sensor

## Removal

1. Disconnect the negative battery cable.

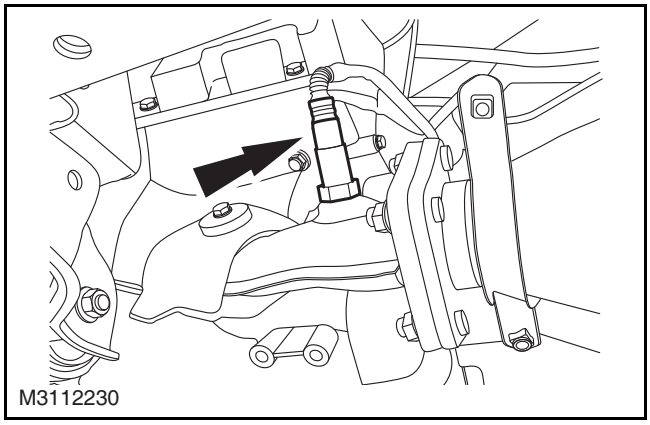
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect the front oxygen sensor wiring harness connector.




3. Remove the front oxygen sensor with a suitable tool.

   Torque: 50 ± 10 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Applying washer fluid, oily liquid or volatile solid on the oxygen sensor is prohibited.**

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# Rear Oxygen Sensor

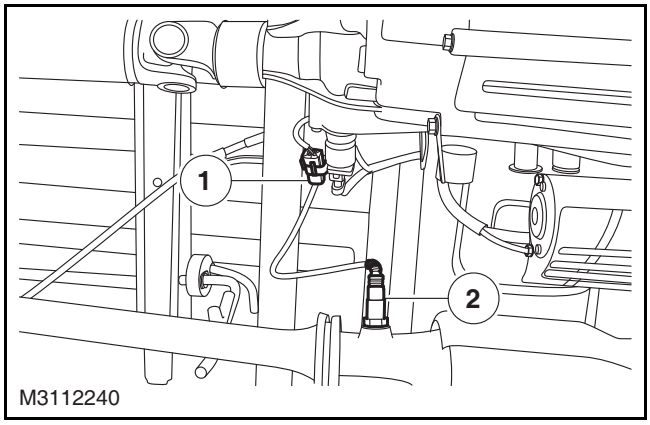
## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and**

2. Disconnect the rear oxygen sensor wiring harness connector (1).
3. Remove the rear oxygen sensor (2) with a suitable tool.

   Torque: 50 ± 10 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Applying washer fluid, oily liquid or volatile solid on the oxygen sensor is prohibited.**

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# Knock Sensor

## Removal

1. Disconnect the negative battery cable.

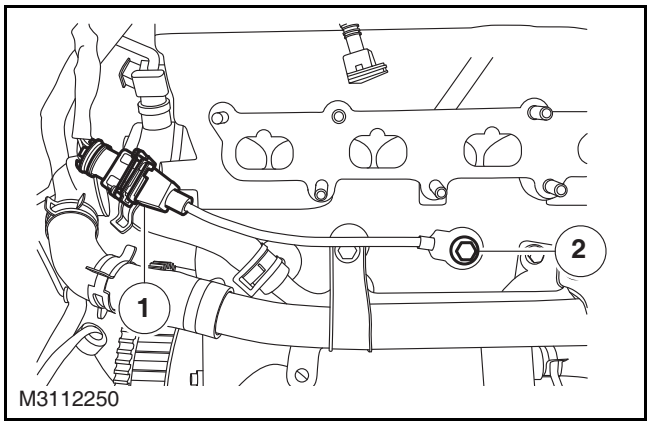
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the air intake manifold.

   **Refer to: Intake Manifold (3.1.5 Air Intake System, Removal and Installation).**

3. Disconnect the knock sensor wiring harness connector (1).
4. Remove the retaining bolt (2) from the knock sensor.

   Torque: 20 ± 5 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure that the mounting boss surface is clean with no oil stain. Any type of washer shall not be used between sensor and cylinder block when installing the metal face to the cylinder block.**

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# 3.2 Engine - 1.2 L (EA12MR)

## 2014 MD/MS201

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## General Information

The vehicle adopts EA12MR engine which is the first engine of Changan EA series featuring high power, high quality and low fuel consumption. It is a newly-designed type characterized by advanced combustion system, air intake and exhaust system and excellent NHV (Noise, Harshness and Vibration) performance etc. The engine adopts many advanced technologies, such as double over-head camshaft (DOHC), four valves, low-tension piston ring, offset crankshaft, low load valve spring, mute valve drive chain, oil pan integrated with transmission case, thin-wall cylinder block wrapped with aluminum. Its volume power reaches 57.9 kW/L, meets the China "third-phase" fuel standard and reaches the requirements of China emission standards. Repeated and strict bench tests, high strength 33500 kilometers road tests with 30 units, limit condition tests of high temperature, extremely cold and plateau, high strength 100000 kilometers road tests with 2 units, limit condition tests of high temperature, extremely cold and plateau, all guarantee more effective service life of engine and better product quality.

The engine has the following advantages:

1. The design of double over-head camshaft (DOHC) and four valves improves air intake and exhaust efficiency and engine reliability, reducing the fuel consumption rate and maintenance rate.
2. The timing system of engine adopts maintenance-free timing mute chain, which is durable in use and not prone to fault and can reduce noise without maintenance in the whole service life, compared to the timing belt of traditional engine.
3. The three technologies including hollow camshaft, direct drive valve and low load valve spring, make engine arrangement more compact, reducing the mechanical loss of engine and enhancing fuel economy.
4. Engine pistons adopt the advanced high temperature aluminum alloy material to make pistons lighter and engine running easier, reducing unnecessary loss, which is beneficial to power improvement and fuel consumption reduction. Piston rings adopt high-quality material and advanced processing technology, realizing the minimum friction loss of piston set.
5. Adopts the high-performance combustion chamber and air duct to make airflow distribution reasonably, making volumetric efficiency nearly 100%, and ensuring high performance of engine.
6. Cylinder block, made of aluminum fully, adopts gantry structure and concave structure design in different end face to reduce cylinder block weight. The short water jacket is designed to reduce combustion energy loss, improve fuel efficiency, shorten the engine warm-up time and decrease pollutant emitted by engine.
7. Adopts offset type crankshaft to reduce the lateral force caused by piston in burning and expansion stroke for cylinder, and the friction loss between piston and cylinder wall.

**WARNING: Before the removal or installation of any electrical equipment, it is necessary to disconnect the negative battery cable when any tool or equipment has an easy access to any uncovered electrical terminals. Disconnect the wiring harness to prevent any personal injury or damage to the vehicle. It is necessary to turn the ignition switch to "LOCK" if there is no particular description.**

**CAUTION: The air intake port must be covered to keep any foreign matters from it, each time the air filter is removed. Otherwise, the foreign matters could block the cylinder inlet duct, which will lead to serious damage when starting the engine.**

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## Specifications

# Material Specifications

| Item | Specifications | Area |
|---|---|---|
| Sealant | Tonsan 1596Fa | 1 Connecting part of cylinder head assembly and oil pump timing chain housing assembly<br>2 Matching surface of oil pump timing chain housing assembly<br>3 Matching surface of water pump assembly<br>4 Connecting parts of crankcase assembly, cylinder gasket assembly, cylinder head assembly and oil pump timing chain housing assembly |
| | Tonsan 1591 | 1 Matching surface of crankshaft rear end cover<br>2 Matching surface of oil pan upper part (and crankcase assembly)<br>3 Matching surface of oil pan lower part assembly (and oil pan upper part)<br>4 Installation surface of oil pump timing chain housing assembly and lower surface of crankcase<br>5 Installation surface of crankshaft rear end cover and lower surface of crankcase |
| | Loctite 962 or Tonsan 1662 | Spark plug guide surface (matching surface with cylinder head assembly) |
| | Loctite 516 | Oil pressure alarm assembly |

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# Component Specifications

| Item | | | Specifications | |
|---|---|---|---|---|
| | | | Standard (mm) | Limit (mm) |
| Camshaft | Radial runout | No.1 and No.5 journals | - | 0.03 |
| | | No.2, No.3 and No.4 journals | - | 0.015 |
| | Intake cam | | | |
| | Exhaust cam | | | |
| | Cam base circle runout limit | | - | 0.02 |
| | Camshaft journal outer diameter | | 22.934 ~ 22.955 | - |
| | Camshaft journal clearance | | 0.045 ~ 0.087 | 0.117 |
| Cylinder head | Cylinder head camshaft bore diameter | | 27.000 ~ 27.021 | - |
| | Flatness limit for cylinder head surface | | - | 0.030 |
| | Deformation limit for cylinder head manifold matching surface | | - | 0.05 |
| Valve spring | Valve spring free length | | 40 | - |
| | Valve spring preload | | 109 ~ 127 N: 29.9 | - |
| | Valve spring uprightness limit | | 1.0 | - |
| Valve | Valve stem diameter | Intake | 5.465 ~ 5.48 | - |
| | | Exhaust | 5.44 ~ 5.455 | - |
| | Clearance between valve stem and guide | Intake | 0.02 ~ 0.047 | - |
| | | Exhaust | 0.045 ~ 0.072 | - |
| | Valve seat width (after repairs) | Intake | 1.1 ~ 1.3 | - |
| | | Exhaust | 1.0 ~ 1.4 | - |
| | Valve head thickness | Intake | 3 ~ 3.3 | - |
| | | Exhaust | 2.3 ~ 2.7 | - |
| | Valve imprint standard width | Intake | Min: 1.1 mm, Unevenness: 0.4 mm | - |
| | | Exhaust | | |

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| Item | | | Specifications | |
|---|---|---|---|---|
| | | | Standard (mm) | Limit (mm) |
| Valve clearance | | Intake | Cold 0.16 ~ 0.24 mm (coolant temperature 15 ~ 25°C) | - |
| | | Exhaust | Cold 0.26 ~ 0.34 mm (coolant temperature 15 ~ 25°C) | - |
| Valve guide | Valve guide inner diameter | Intake | 5.5 ~ 5.512 | - |
| | | Exhaust | 5.5 ~ 5.512 | - |
| | Extended length of valve guide from cylinder head | | 11.3 ± 0.2 | - |
| Piston | Piston standard diameter | | 72.975 ~ 72.99 | - |
| | Piston pin hole diameter | | 18.002 ~ 18.006 | - |
| Piston ring | Piston ring groove side clearance | First ring | 0.03 ~ 0.07 | - |
| | | Second ring | 0.03 ~ 0.07 | - |
| | End gap | First ring | 0.155 ~ 0.275 | 0.5 |
| | | Second ring | 0.28 ~ 0.41 | 0.5 |
| Piston pin | Piston pin diameter | | 17.995 ~ 18 | - |
| | Clearance between piston pin and piston pin hole | | 0.002 ~ 0.011 | - |
| | Clearance between connecting rod small end hole and piston pin | | 0.003 ~ 0.016 | - |
| Connecting rod | Side clearance for connecting rod large end | | 0.10 ~ 0.25 | - |
| | Bending limit | | 0.05/80 | - |
| | Twisting limit | | 0.10/80 | - |
| | Connecting rod small end hole diameter | | 18.003 ~ 18.011 | - |

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| Item | | | | | Specifications | |
|---|---|---|---|---|---|---|
| | | | | | Standard (mm) | Limit (mm) |
| Connecting rod large end hole diameter | Group | 1 | Mark | 1 | 41 ~ 41.006 | - |
| | | 2 | | 2 | 41.0061 ~ 41.012 | - |
| | | 3 | | 3 | 41.0121 ~ 41.018 | - |
| Crankshaft connecting rod journal diameter | Group | 1 | Mark | 1 | 37.994 ~ 38 | - |
| | | 2 | | 2 | 37.988 ~ 37.9939 | - |
| | | 3 | | 3 | 37.982 ~ 37.9879 | - |
| Crankshaft | Connecting rod journal diameter | | | | 37.982 ~ 38.000 | - |
| | Connecting rod journal out-of-round and taper | | | | - | 0.005 |
| | Connecting rod bearing shell clearance | | | | 0.020 ~ 0.040 | - |
| | Radial runout limit | | | | - | 0.06 |
| | Main bearing shell clearance | | | | 0.020 ~ 0.040 | 0.026 ~ 0.046 |
| | Crankshaft thrust clearance | | | | 0.16 ~ 0.36 | 0.36 |
| | Main journal taper and out-of-round | | | | - | 0.005 |
| | Main journal diameter | Group | 1 | Mark 1 | 44.994 ~ 45.000 | - |
| | | | 2 | Mark 2 | 44.988 ~ 44.9939 | - |
| | | | 3 | Mark 3 | 44.982 ~ 44.9879 | - |
| Main bearing cap hole diameter | Group | 1 | Mark | 1 | 49.000 ~ 49.006 | - |
| | | 2 | | 2 | 49.0061 ~ 49.012 | - |
| | | 3 | | 3 | 49.0121 ~ 49.018 | - |
| Main bearing thickness | 2 | | | | 2.005 ~ 2.009 | - |
| | 3 | | | | 2.002 ~ 2.006 | - |
| | 4 | | | | 1.999 ~ 2.003 | - |
| | 5 | | | | 1.996 ~ 2.000 | - |
| | 6 | | | | 1.993 ~ 1.997 | - |
| Flywheel end face runout limit | | | | | - | 0.2 |
| Cylinder block | Flatness (standard) | | | | 0.05 | 0.10 |
| | Diameter | | | | 73.025 or less | - |

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# General Specifications

| Item | Specifications |
|---|---|
| Engine type | Horizontal, in-line, 4-cylinder, water-cooling, four-stroke, DOHC |
| Fuel supply | Sequential multi-point electronic control fuel injection |
| Timing drive mode | Timing chain |
| Cylinder diameter | 73 mm |
| Piston stroke | 74.25 mm |
| Displacement | 1.243 L |
| Compression ratio | 11 : 1 |
| Rated power | 72 kW 6000 ± 200 rpm |
| Max. torque | 119 Nm 4800 ± 500 rpm |
| Min. fuel consumption | 255 g/(kW•h) |
| Min. steady speed without load | 750 ± 30 rpm |
| Cylinder compression pressure | 1450 kPa |
| Ignition sequence | 1 - 3 - 4 - 2 |
| Spark plug type | YR7DE HU10A70P |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| High pressure oil plug | 3 ± 0.5 | - | - |
| Cylinder head connecting bolt | 25 Nm + 90° | - | - |
| Connecting rod bearing cap | 15 Nm + 90° | - | - |
| Connecting rod bearing cap retaining bolt | 15 Nm + 90° | - | - |
| Oil pan baffle plate stud bolt | 10 ± 1 | - | - |
| Engine bracket connecting nut | 70 ± 5 | - | - |
| Water inlet pipe assembly retaining bolt | 10 ± 1 | - | - |
| Alternator adjusting bracket retaining bolt | 23 ± 2 | - | - |
| A/C compressor carrier retaining bolt | 32 ± 2 | - | - |
| Right bracket retaining bolt | 70 ± 5 | - | - |
| Carbon canister control valve mounting bracket retaining bolt | 10 ± 1 | - | - |
| Oil level gauge guide retaining bolt | 10 ± 1 | - | - |
| Main bearing cap bolt | 35 Nm + 45° | - | - |
| Sensor plate retaining screw | 11 ± 1 | - | - |
| Crankshaft rear end cover retaining bolt | 10 ± 1 | - | - |
| Engine trim cover retaining bolt | 10 ± 1 | - | - |
| Alternator charging cable bolt | 9 | - | 80 |

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| Item | | Nm | lb-ft | lb-in |
|---|---|---|---|---|
| Compressor connecting bolt | | 25 ~ 30 | - | - |
| Compressor adjusting bracket bolt 1 | | 25 ± 1 | - | - |
| Water pump pulley retaining bolt | | 10 ± 1 | - | - |
| Guide rail assembly retaining bolt | | 10 ± 1 | - | - |
| Chain slide rail assembly bolt | | 23 ± 2 | - | - |
| Crankshaft pulley | | 90 Nm + 90° | - | - |
| Connecting bolt between exhaust manifold and three-way catalytic converter | | 55 ± 5 | - | - |
| Flywheel retaining bolt | | 74 ± 2 | - | - |
| Clutch pressure plate retaining bolt | | 32 ± 2 | - | - |
| Camshaft bearing cap bolt | | 13 ± 1 | - | - |
| Engine bracket retaining bolt | | 55 ± 10 | - | - |
| Connecting bolt between exhaust manifold and three-way catalytic converter | | 55 ± 5 | - | - |
| Rear wind guiding cover bracket retaining bolt | | 25 | 18 | - |
| Unmarked bolt | M6 | 10 | 8 | - |
| | M8 | 23 | 17 | - |
| | M10 | 50 | 37 | - |
| | M12 | 88 | 65 | - |

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# Engine Oil Application Component and Area Chart

| Component | Area | Note |
|---|---|---|
| Crankcase assembly | Cylinder bore working surface | Lubrication system |
| Crankshaft assembly | Main journal surface, connecting rod journal working surface, high pressure oil hole inside | |
| Connecting rod assembly | Connecting rod small end hole | |
| Piston pin | Working surface | |
| Main bearing shell | Working surface | |
| Connecting rod bearing shell | Working surface | |
| Crankshaft thrust plate | Working surface | |
| Cylinder head assembly | Camshaft bearing seat hole working surface, tappet hole working surface, valve guide tip | |
| Valve | Valve stem cylindrical face or end face | |
| Valve tappet | Tappet face | |
| Camshaft assembly | Camshaft journal working surface | |
| Chain slide rail, guide rail assembly | Working surface | |
| Oil pump timing chain housing assembly | Oil pump inner hole and pump inside | |
| Oil filter assembly | Oil filter assembly seal washer outer circumference (and oil filter inside) | |
| Oil strainer assembly | O-ring outer circumference | |
| Oil level gauge guide | O-ring outer circumference | |
| Oil level gauge assembly | Rubber plug outer circumference | |
| Crankshaft front oil seal assembly | Oil seal retainer surface | Ventilation system |
| Crankshaft rear end cover | Crankshaft rear oil seal installation hole inner wall | |
| PCV valve gasket | PCV valve gasket inner and outer circumference | |
| Intake pressure/ temperature sensor | Intake pressure/temperature sensor O-ring outer circumference | Air Intake system |
| Fuel main pipe assembly | Fuel main pipe assembly O-ring outer circumference | |
| Cylinder head cover assembly | Cylinder head cover assembly gasket surface that contacts with spark plug guide | Other |
| Camshaft bearing cap bolt, timing chain slide rail bolt, high pressure oil plug, clutch pressure plate retaining bolt | As camshaft bearing cap bolt, timing chain slide rail bolt, high pressure oil plug and clutch pressure plate retaining bolt have been phosphate coated, if the surface is oilless, apply the gasoline engine oil before assembly | Other |

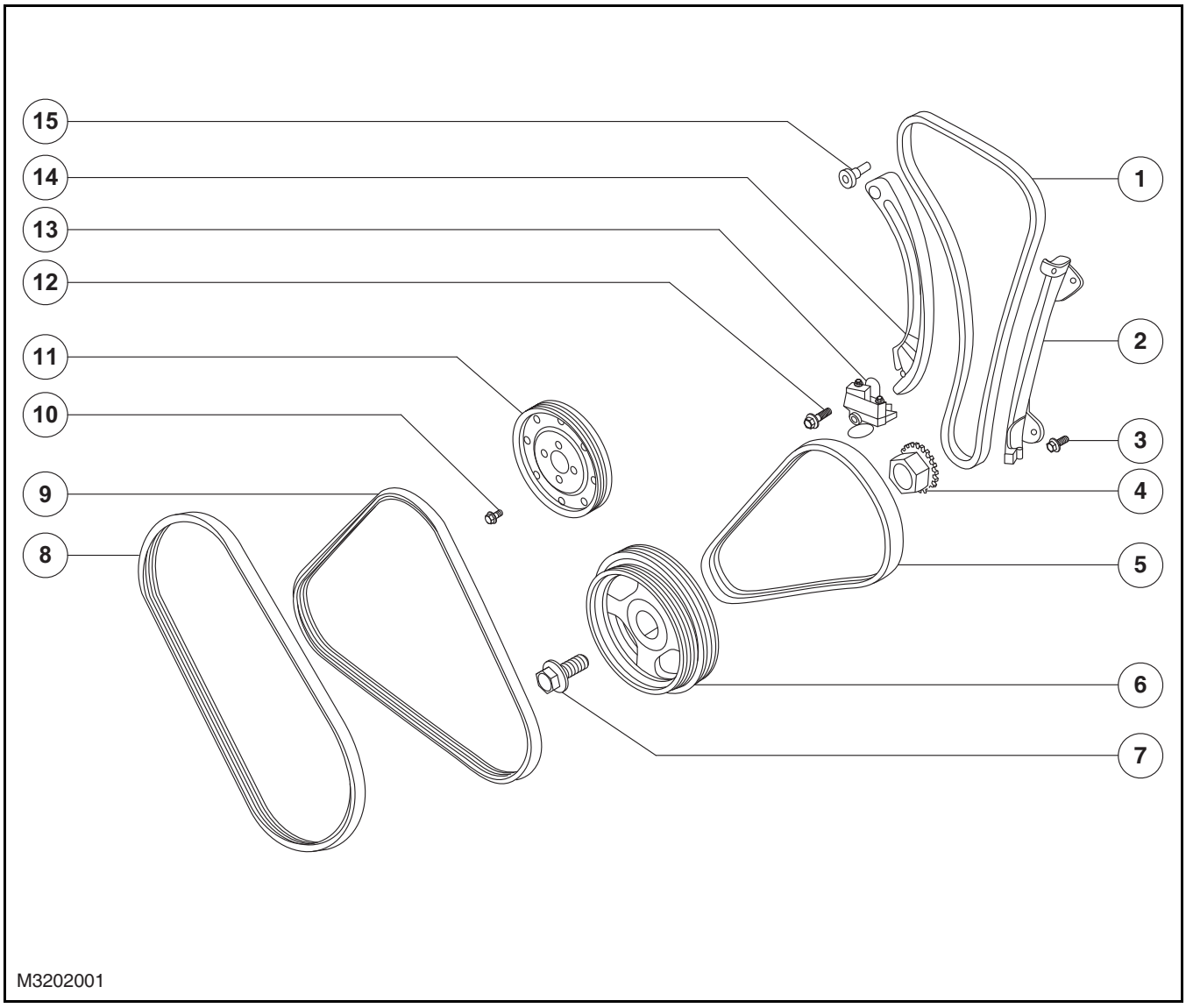
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## Description and Operation

# Components Exploded View

### Timing System and Front Wheel Train



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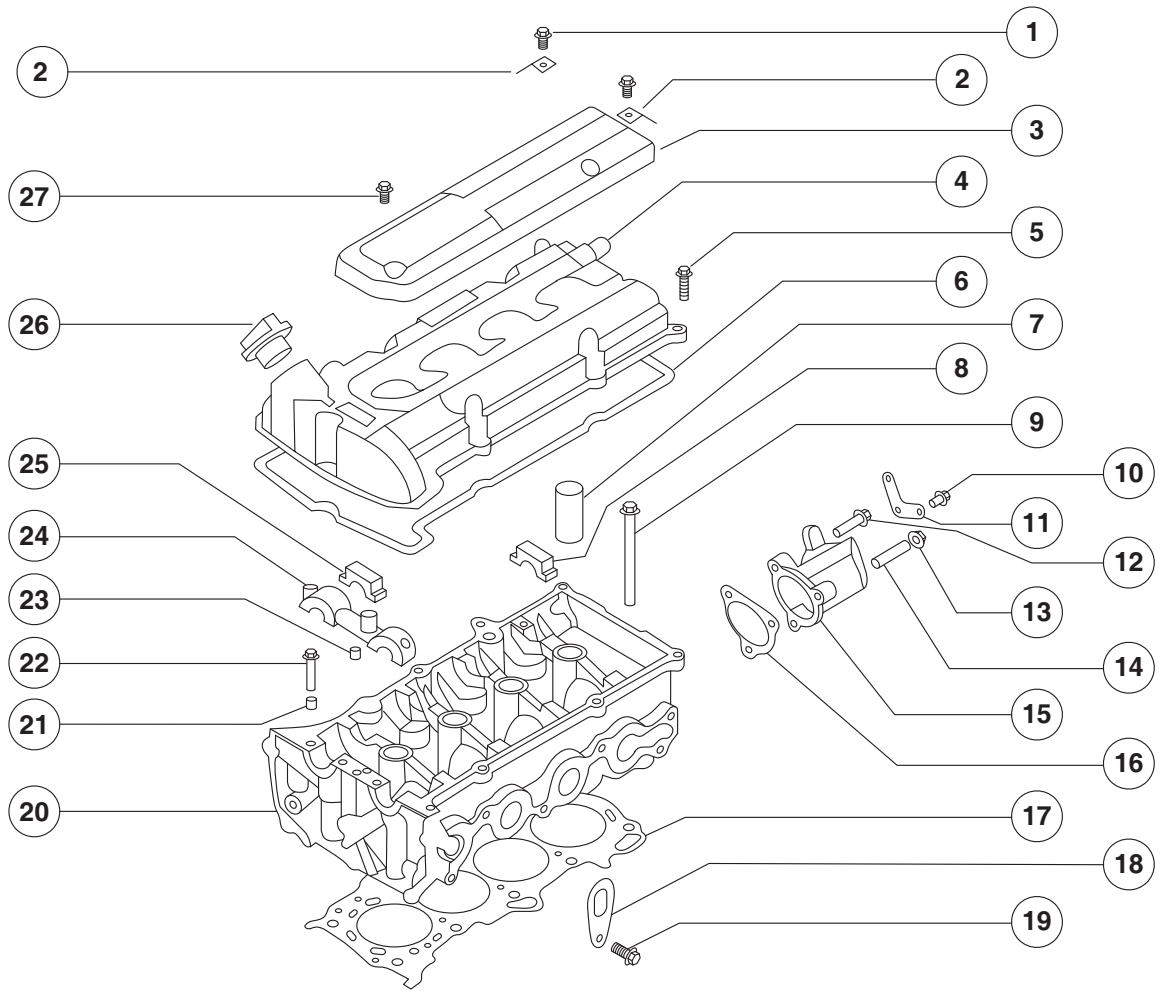


| Item | Description | Qty. | | Item | Description | Qty. | |
|---|---|---|---|---|---|---|---|
| 1 | Timing chain assembly | 1 | | 9 | Compressor belt | with A/C | 1 |
| | | | | | | without A/C | 0 |
| 2 | Chain guide rail assembly | 1 | | 10 | Hexagon flange bolt | 4 | |
| 3 | Hexagon flange bolt | 2 | | 11 | Water pump pulley | 1 | |
| 4 | Crankshaft timing sprocket | 1 | | 12 | Hexagon flange bolt | 2 | |
| 5 | Alternator belt | 1 | | 13 | Hydraulic tensioning adjuster assembly | 1 | |
| 6 | Crankshaft pulley assembly | 1 | | 14 | Chain slide rail assembly | 1 | |
| 7 | Crankshaft pulley bolt | 1 | | 15 | Timing chain guide rail bolt | 1 | |
| 8 | Elastic belt | with A/C | 0 | | | | |
| | | without A/C | 1 | | | | |

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## Cylinder Head




M3202002

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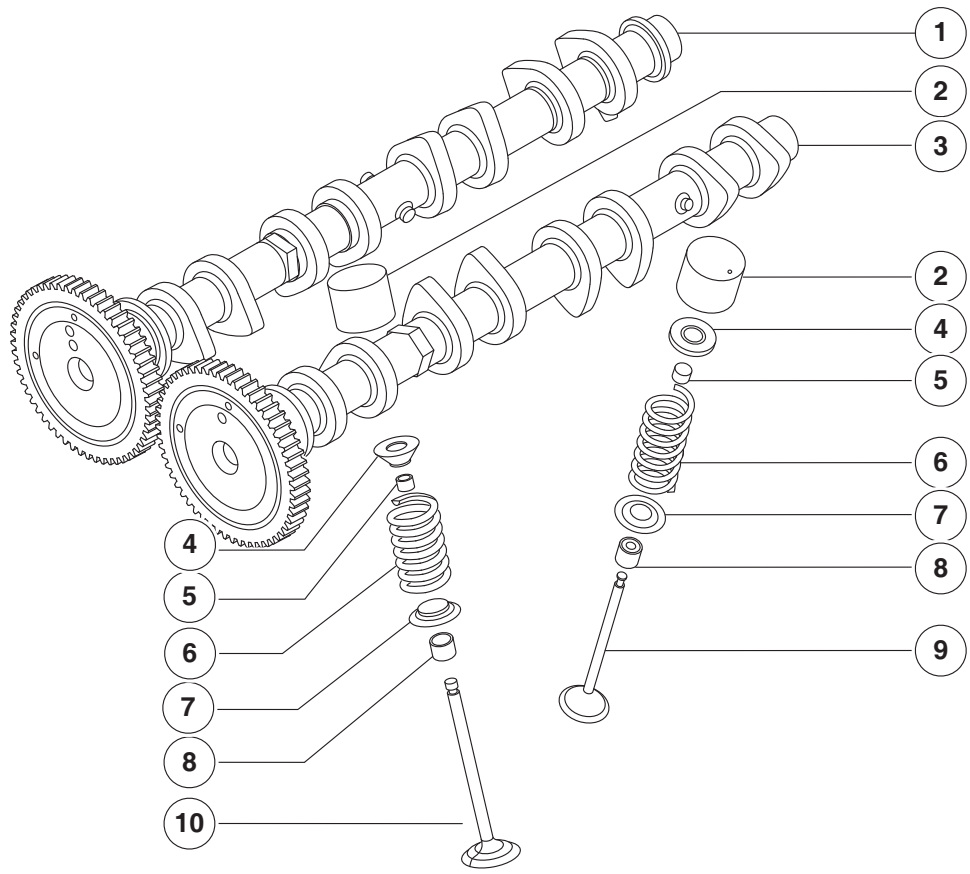


| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Bolt | 2 | 15 | Water outlet pipe jacket | 1 |
| 2 | No.3 wiring harness bracket | 2 | 16 | Water outlet pipe jacket sealing pad | 1 |
| 3 | Engine trim cover assembly | 1 | 17 | Cylinder gasket assembly | 1 |
| 4 | Cylinder head cover assembly | 1 | 18 | No.2 engine hook | 1 |
| 5 | Bolt | 8 | 19 | Bolt | 1 |
| 6 | Cylinder head cover gasket | 1 | 20 | Cylinder head subassembly | 1 |
| 7 | Spark plug guide | 4 | 21 | One-piece camshaft bearing cap dowel pin | 18 |
| 8 | No.3 - No.5 camshaft bearing cap | 6 | 22 | Camshaft bearing cap bolt | 21 |
| 9 | Cylinder head connecting bolt (with washer) | 10 | 23 | High pressure oil plug | 1 |
| 10 | Bolt | 2 | 24 | No.1 camshaft bearing cap | 1 |
| 11 | No.2 wiring harness bracket | 1 | 25 | No.2 camshaft bearing cap | 2 |
| 12 | Bolt | 2 | 26 | Oil filler cap assembly | 1 |
| 13 | Nut | 1 | 27 | Bolt | 3 |
| 14 | Intake manifold stud bolt | 1 | | | |

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## Valve Mechanism



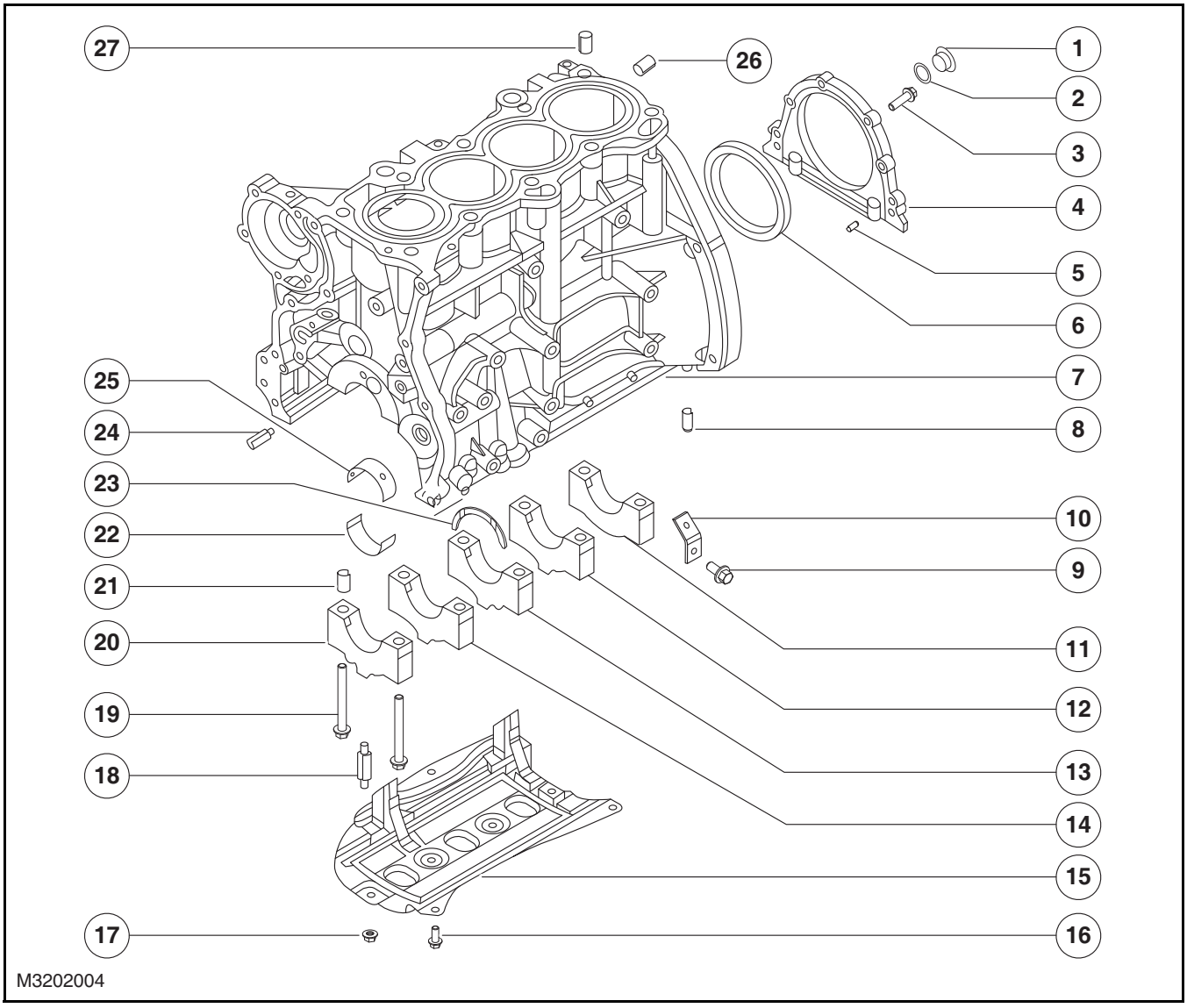

M3202003

| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Intake camshaft assembly | 1 | 6 | Valve spring | 16 |
| 2 | Valve tappet | 16 | 7 | Valve spring lower retainer | 16 |
| 3 | Exhaust camshaft assembly | 1 | 8 | Valve oil seal assembly | 16 |
| 4 | Valve spring upper retainer | 16 | 9 | Exhaust valve | 8 |
| 5 | Taper cotter | 32 | 10 | Intake valve | 8 |

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## Crankcase



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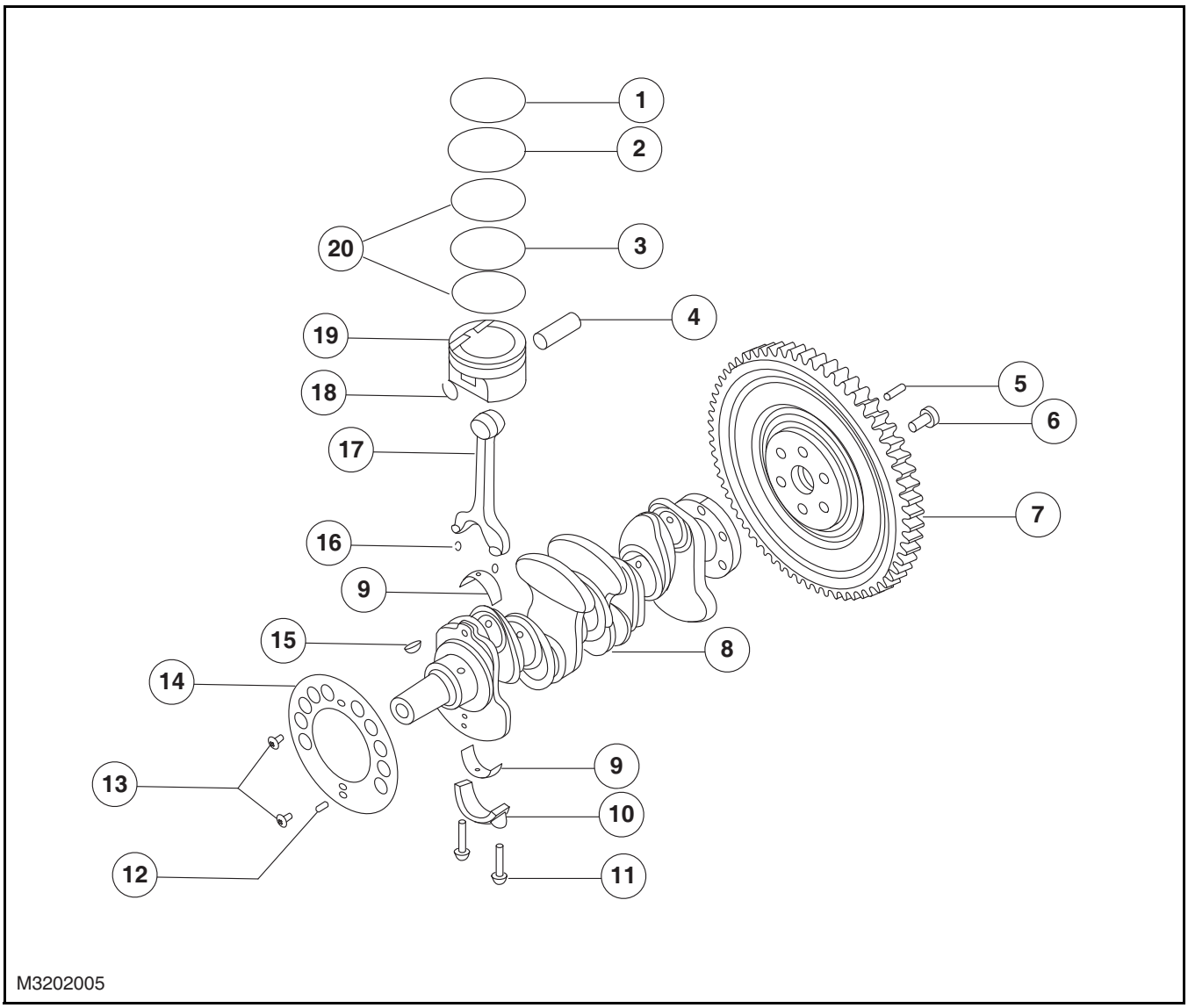


| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Plug | 2 | 15 | Oil pan baffle plate | 1 |
| 2 | Spacer | 2 | 16 | Hexagon flange bolt | 3 |
| 3 | Hexagon flange bolt | 6 | 17 | Hexagon flange nut | 4 |
| 4 | Crankshaft rear end cover | 1 | 18 | Oil pan baffle plate stud bolt | 4 |
| 5 | Flywheel dowel pin | 2 | 19 | Main bearing cap bolt | 10 |
| 6 | Crankshaft rear oil seal assembly | 1 | 20 | No.1 main bearing cap | 1 |
| 7 | Crankcase subassembly | 1 | 21 | Cylinder head dowel pin | 5 |
| 8 | Pressure plate dowel pin | 1 | 22 | Lower main bearing shell | 5 |
| 9 | Hexagon flange bolt | 1 | 23 | Crankshaft thrust plate | 2 |
| 10 | No.1 wiring harness bracket | 1 | 24 | Timing chain nozzle | 1 |
| 11 | Rear end main bearing cap | 1 | 25 | Upper main bearing shell | 5 |
| 12 | No.4 main bearing cap | 1 | 26 | Cylinder head dowel pin | 2 |
| 13 | No.3 main bearing cap | 1 | 27 | Cylinder head dowel pin | 2 |
| 14 | No.2 main bearing cap | 1 | | | |

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## Crankshaft and Connecting Rod Mechanism



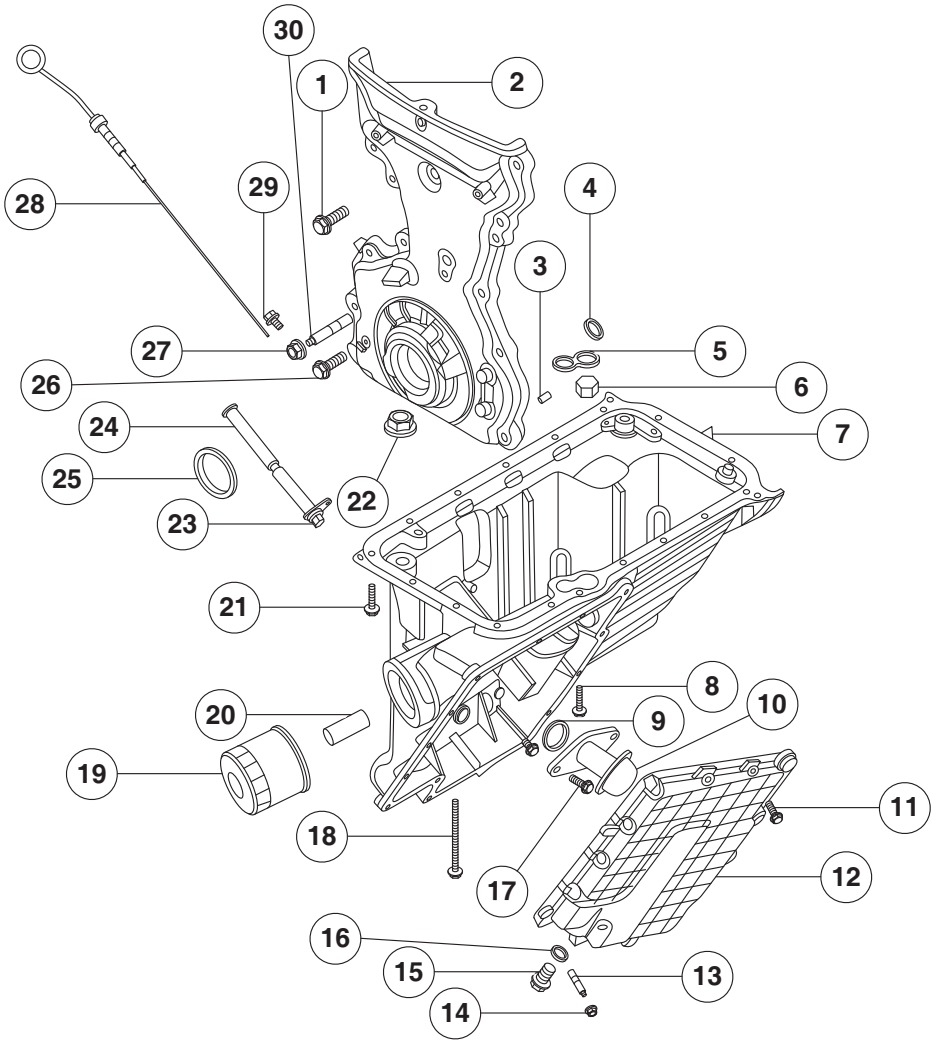

M3202005

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | No.1 piston ring | 11 | Connecting rod bolt |
| 2 | No.2 piston ring | 12 | Sensor plate dowel pin |
| 3 | Coil spring | 13 | Sensor plate screw |
| 4 | Piston pin | 14 | Crankshaft speed sensor plate |
| 5 | Pressure plate dowel pin | 15 | Woodruff key |
| 6 | Flywheel bolt | 16 | Connecting rod dowel pin |
| 7 | Flywheel gear ring assembly | 17 | Connecting rod shank |
| 8 | Crankshaft | 18 | Piston pin circlip |
| 9 | Connecting rod bearing shell | 19 | Piston |
| 10 | Connecting rod bearing cap | 20 | Oil control ring |

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## Oil Pump Timing Chain Housing Assembly and Oil Pan Assembly




M3202006

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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Timing chain housing mounting bolt | 16 | Drain plug gasket |
| 2 | Oil pump timing chain housing assembly | 17 | Hexagon flange bolt |
| 3 | Flywheel dowel pin | 18 | Hexagon flange bolt |
| 4 | Oil pump outlet O-ring | 19 | Oil filter assembly |
| 5 | Oil filter oil way gasket | 20 | Oil filter connecting pipe |
| 6 | Oil pan upper part dowel pin | 21 | Hexagon flange bolt |
| 7 | Oil pan upper part | 22 | Plane gasket |
| 8 | Inner hexagonal round head screw | 23 | O-ring |
| 9 | Oil strainer O-ring | 24 | Oil level gauge guide assembly |
| 10 | Oil strainer assembly | 25 | Crankshaft front oil seal assembly |
| 11 | Hexagon flange bolt | 26 | Hexagon flange bolt |
| 12 | Oil pan lower part assembly | 27 | Hexagon flange nut |
| 13 | Oil pan upper and lower parts connecting stud bolt | 28 | Oil level gauge assembly |
| 14 | Hexagon flange nut | 29 | Hexagon flange bolt |
| 15 | Drain plug | 30 | Oil pump chain cover stud bolt |

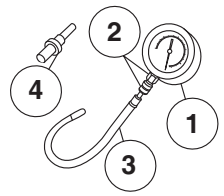
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## General Inspection

# Cylinder Compression Pressure Inspection

**Special Tool:**

| | |
|---|---|
|  09915-64510 | Pressure gauge 09915-64510-001 |
| | Joint 09915-64510-002 |
| | Hose 09915-64530 |
| | Holder 09915-67010 |

**General Equipment:**

| |
|---|
| Cylinder compression pressure gauge assembly |
| Spark plug socket |
| Ratchet wheel |
| Connecting rod |

**WARNING: High temperature engine and oil would lead to serious scalding.**

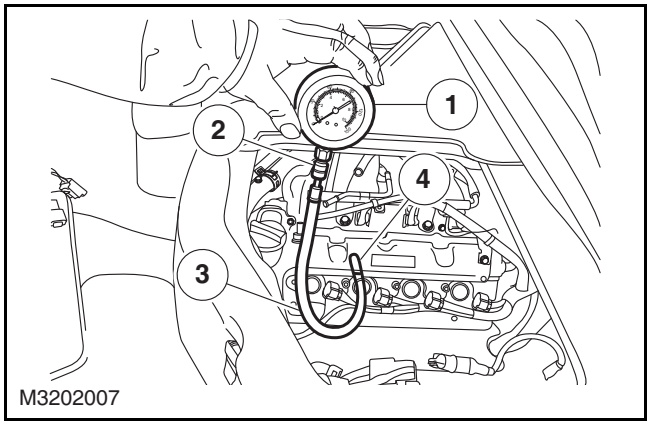
**CAUTION: ECM receives a wrong message when the fuel pump relay or electrical component is removed. The wrong message must be cleared from the trouble memory with the diagnostic tool after the cylinder pressure test is finished.**

**CAUTION: Before compression pressure test, the valve clearance must be adjusted correctly.**

**Refer to: Valve Clearance Inspection and Adjustment (3.2.2 Mechanical System, General Inspection).**

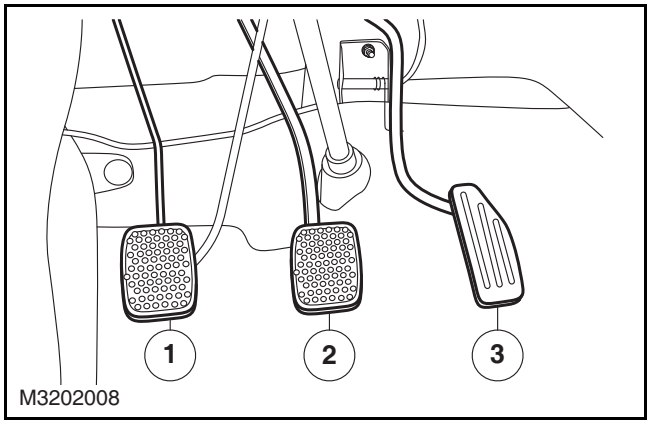
1. Warm up the engine to the normal operation temperature.
2. Turn off the engine after warm up. Also, move the transmission shift lever to "N", apply the parking brake and chock the drive wheels.
3. Remove the fuel pump relay.
4. Disconnect the wiring harness connectors between the fuel injectors and ignition coils.
5. Remove all the spark plugs and ignition coil assembly.
6. Insert the special tool (pressure gauge) into the spark plug hole.

Special Tool:
Pressure gauge 09915-64510-001
Joint 09915-64510-002
Hose 09915-64530
Holder 09915-67010



M3202007

7. Depress the clutch pedal (1) (to reduce the starting load of engine) and depress the accelerator pedal (3) to fully open the throttle valve.



M3202008

| | |
|---|---|
| 1 | Clutch pedal |
| 2 | Brake pedal |
| 3 | Accelerator pedal |

8. Use the fully-charged battery to start the engine, until the reading on the cylinder pressure gauge stops increasing, then read the highest pressure value and record it.

**CAUTION: To measure the compression pressure, it is necessary to use the fully-**

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**charged battery to run the engine at least 300 rpm.**

**CAUTION: When performing the start test, the ignition switch is in "ST" for no more than 15 seconds, or the starting motor may be damaged.**

9. Operate the other 3 cylinders as the step 5 to 8 and record the cylinder compression pressure value.
10. Compare with the specifications in the table below, the condition is as follows:
    - Normal condition: each cylinder pressure increases rapidly and evenly to the specified pressure value.
    - Piston ring fault: pressure is low in the first stroke but increases in the next strokes and never reaches the normal level. The pressure increases considerably after a moderate amount of engine oil has been added to the cylinder. Inspect the piston ring.

      **Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**

| Compression Pressure | Specifications |
|---|---|
| Limit (Min.) | 1500 kPa (300 rpm) |
| Max. pressure difference between two cylinders | 100 kPa |

    - Valve fault: the pressure is low in the first stroke and cannot increase in the next strokes. If the pressure increases slightly after a moderate amount of engine oil has been added to the cylinder, inspect the valve.

      **Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**

    - The cylinder head gasket may be damaged if the compression pressures of 2 cylinders arranged on the cylinder block "in parallel" are too low.
11. Install the spark plugs and ignition coil assembly, and connect the fuel injector wiring harness connectors after inspection.
12. Install the fuel pump relay and clear the trouble code(s) from ECM with a diagnostic tool.

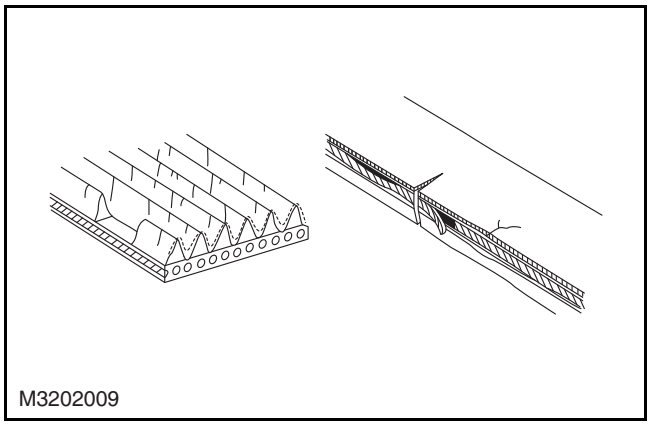
## Accessory Drive Belt Inspection

**CAUTION: Do not overly wind or bend the drive belt.**

**CAUTION: Do not stick the engine oil or coolant to the drive belt.**

**CAUTION: Accessory drive belt consists of alternator belt, elastic belt and compressor belt.**

1. Inspection should be conducted after the engine has cooled down or turned off for 30 minutes.
2. Visually inspect the accessory drive belt surface for pilling, oil stain, aging and cracks. If any defect is found, replace the accessory drive belt.
3. Visually inspect the interior and margin of drive belt for damages, abrasions, foreign matters and cracks. If so, replace the drive belt with a new one.


M3202009

4. Inspect the accessory drive belt tension.

   Inspect the compressor belt tension (method 1).

   1 Inspect the belt tension with sonic tension meter (sonic tension meter should be positioned at the center of belt tight side

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span, perpendicular to the belt and approximately 10 mm away from the belt).

**CAUTION: Do not touch the belt before inspecting the tension.**

2 The compressor belt tension should be 600 ± 50 N (before the engine is starting).

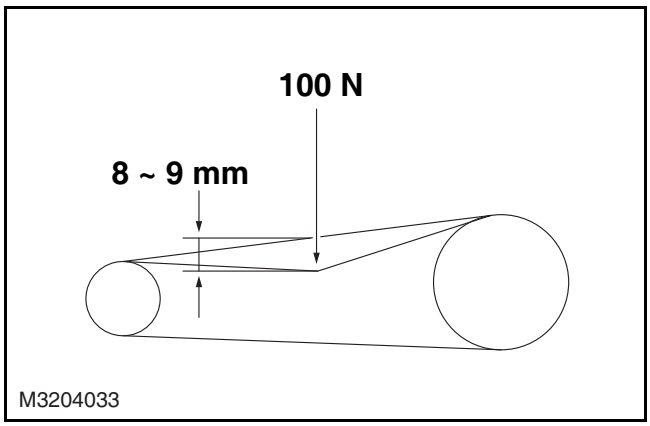
3 If the tested tension is not as specified, readjust the compressor belt tension until it is within the specified range.

Compressor - Gates Unitta Sonic Tension Meter Test

| | |
|---|---|
| Parameter setting | MASS = 4.4 g/m |
| | WIDTH = 14.25 mm/R |
| | SPAN = 181.5 mm |

Inspect the compressor belt tension (method 2).

If the belt sags down 8 ~ 9 mm when pressing on the belt with your thumb (approximately 100 N), the belt tension is proper.




Inspect the alternator belt tension.

1 Inspect the belt tension with sonic tension meter (sonic tension meter should be positioned at the center of belt tight side span, perpendicular to the belt and approximately 10 mm away from the belt).

**CAUTION: Do not touch the belt before inspecting the tension.**

2 The generator belt tension should be 750 ± 50 N (before the engine is starting).

3 If the belt tension is not as specified, readjust the generator belt tension until it is within the specified range.

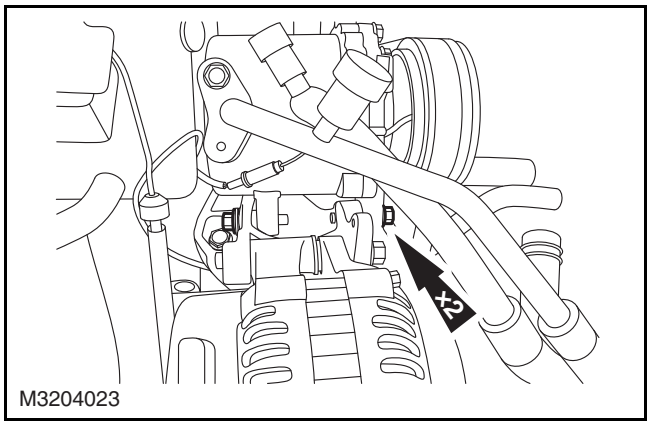
Alternator - Gates Unitta Sonic Tension Meter Test

| | |
|---|---|
| Parameter setting | MASS = 4.4 g/m |
| | WIDTH = 17.8 mm/R |
| | SPAN = 208 mm |

## Accessory Drive Belt Tension Adjustment

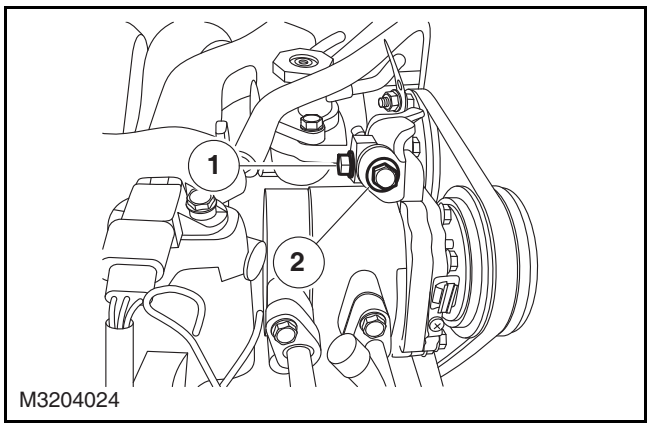
**1.** Compressor Belt Tension Adjustment

1 Loosen 2 compressor connecting bolts.




2 Loosen the compressor adjusting bracket bolt (1) in sequence.

3 Adjust the bolt (2) clockwise.




4 Tighten the compressor adjusting bracket bolt (1) in sequence.

5 Tighten 2 compressor connecting bolts.

6 Inspect if the compressor belt tension reaches the specified value.

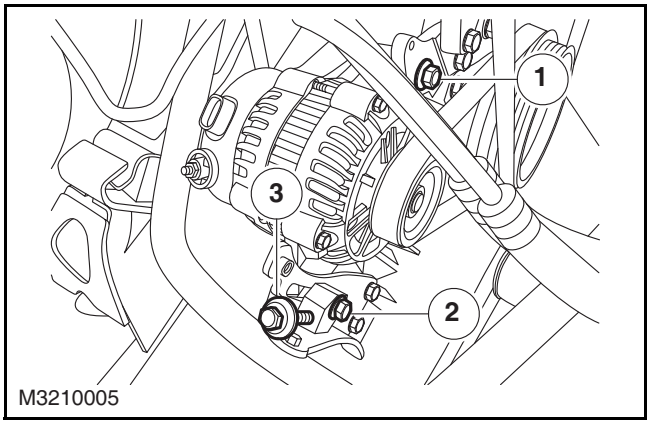
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7 If not, repeat the steps 1 ~ 5 until the compressor belt tension reaches the specified value.

2. Alternator Belt Tension Adjustment

1 Loosen the alternator upper retaining bolt (1) and alternator adjusting bracket bolt (2) in sequence.




2 Adjust the alternator adjusting bracket bolt (3) clockwise.

3 Tighten the alternator adjusting bracket bolt (2) and alternator upper retaining bolt (1) in sequence.

4 Inspect if the alternator belt tension reaches the specified value.

5 If not, repeat the steps 1 ~ 3 until the alternator belt tension reaches the specified value.

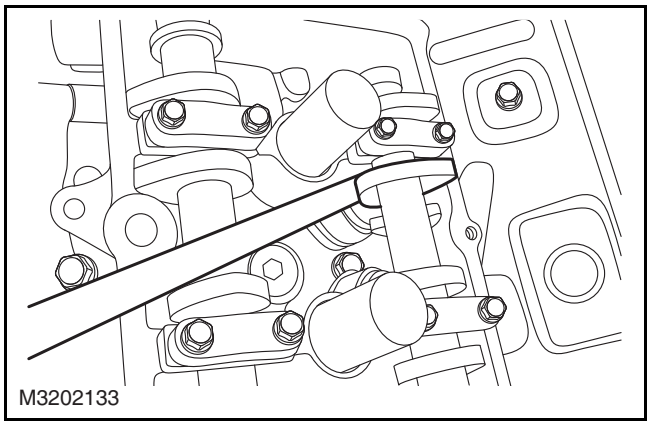
# Valve Clearance Inspection and Adjustment

**General Tool**

| |
|---|
| Valve clearance adjusting set |
| Feeler gauge |

1. Disconnect the battery negative cable.
2. Remove the cylinder head cover.
3. Rotate the crankshaft clockwise and measure the clearance between cam base circle and tappet surface with a feeler gauge.

| | | |
|---|---|---|
| Valve clearance | Cold (coolant temperature 15 ~ 25°C) | |
| | Intake | 0.16 ~ 0.24 mm |
| | Exhaust | 0.26 ~ 0.34 mm |




4. If the valve clearance exceeds the standard, replace the corresponding valve tappet to make sure that the valve clearance is within the specified range.

**CAUTION: Inspect the valve clearance every 20000 km.**

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**5.** The selection method of valve tappet is as follows:

1 Valve tappet grouping chart is as shown below.

| Item | D | ±T | No. | Item | D | ±T | No. | Item | D | ±T | No. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3.08 | 0.010 | 308 | 15 | 3.36 | 0.010 | 336 | 29 | 3.64 | 0.010 | 364 |
| 2 | 3.10 | 0.010 | 310 | 16 | 3.38 | 0.010 | 338 | 30 | 3.66 | 0.010 | 366 |
| 3 | 3.12 | 0.010 | 312 | 17 | 3.40 | 0.010 | 340 | 31 | 3.68 | 0.010 | 368 |
| 4 | 3.14 | 0.010 | 314 | 18 | 3.42 | 0.010 | 342 | 32 | 3.70 | 0.010 | 370 |
| 5 | 3.16 | 0.010 | 316 | 19 | 3.44 | 0.010 | 344 | 33 | 3.72 | 0.010 | 372 |
| 6 | 3.18 | 0.010 | 318 | 20 | 3.46 | 0.010 | 346 | 34 | 3.74 | 0.010 | 374 |
| 7 | 3.20 | 0.010 | 320 | 21 | 3.48 | 0.010 | 348 | 35 | 3.76 | 0.010 | 376 |
| 8 | 3.22 | 0.010 | 322 | 22 | 3.50 | 0.010 | 350 | 36 | 3.78 | 0.010 | 378 |
| 9 | 3.24 | 0.010 | 324 | 23 | 3.52 | 0.010 | 352 | 37 | 3.80 | 0.010 | 380 |
| 10 | 3.26 | 0.010 | 326 | 24 | 3.54 | 0.010 | 354 | 38 | 3.82 | 0.010 | 382 |
| 11 | 3.28 | 0.010 | 328 | 25 | 3.56 | 0.010 | 356 | 39 | 3.84 | 0.010 | 384 |
| 12 | 3.30 | 0.010 | 330 | 26 | 3.58 | 0.010 | 358 | 40 | 3.86 | 0.010 | 386 |
| 13 | 3.32 | 0.010 | 332 | 27 | 3.60 | 0.010 | 360 | 41 | 3.88 | 0.010 | 388 |
| 14 | 3.34 | 0.010 | 334 | 28 | 3.62 | 0.010 | 362 | 42 | 3.90 | 0.010 | 390 |

Note:

**1.** "D": Nominal dimension for tappet thickness

**2.** "±T": Tolerance for tappet thickness

**3.** "No.": the value is D×100, which is located on the top of tappet inner wall

2 First, select one of the tappet groups as the standard tappet (generally, use 3.20 in group 7).

3 Install the selected standard tappet to the cylinder head assembly (valves, camshaft, etc. have been installed in place), then inspect the clearance between each tappet and camshaft base circle separately with a feeler gauge and record it. For example, the measured clearance of No.1 cylinder No.1 valve for intake side is 40.

4 Finally replace more appropriate tappet according to the specified valve clearance in the Valve Clearance Standard Table and the measured clearance above, for example, if selecting the 3.40 in the group 17, the valve clearance is just 20.

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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Verify the customer concern and conduct corresponding inspections.
2. Visually inspect for obvious mechanical damage.
3. Solve the known problems before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

**Visual Inspection Chart**

| Mechanical |
|---|
| • Coolant leaks<br>• Oil leaks<br>• Fuel leaks<br>• Component visibly damaged or worn<br>• Nut or bolt loose, or lost |

# Symptom Chart

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine misfire | • Electronic control system<br>• Fuel system<br>• Ignition system<br>• Mechanical System<br>- Combustion chamber carbon deposit<br>- Camshaft<br>- Intake, exhaust valve<br>- Piston<br>- Piston ring<br>- Cylinder<br>- Inadequate intake air<br>- Exhaust air blockage | • Engine misfire is a synthetical malfunction.<br>**Refer to: DTC P0300, P0301, P0302, P0303, P0304 (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).** |
| Abnormal noise in lower part of engine | • Deformed oil pan<br>• Deformed or damaged oil strainer<br>• Low engine oil pressure<br>• Excessive matching clearance between crankshaft and bearing<br>• Excessive crankshaft thrust clearance | **Refer to: Diagnosis Procedure for Abnormal Noise in Lower Part of Engine (3.2.2 Mechanical System, Symptom Diagnosis and Testing).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Noise from drive belt | • Accessory drive belt<br>• Related fastener<br>• Crankshaft pulley<br>• Related accessory pulley<br>• Related accessory pulley bearing<br>• Alternator<br>• Water pump<br>• A/C compressor | **Refer to: Diagnosis Procedure for Drive Belt Noise (3.2.2 Mechanical System, Symptom Diagnosis and Testing).** |
| Engine backfire<br>**CAUTION: A serious noise of blasting occurs when the fuel in intake manifold is set on fire.** | • Electronic control system malfunction<br>• Engine timing<br>• Lean gas mixture<br>• Intake valve set<br>• Exhaust system blocking<br>• Engine control module (ECM) | **Refer to: Diagnosis Procedure for Engine Backfire (3.2.2 Mechanical System, Symptom Diagnosis and Testing).** |
| Engine knock<br>**CAUTION: A serious noise of blasting occurs when the fuel in exhaust system is set on fire.** | • Electronic control system malfunction<br>• Engine timing<br>• Late ignition<br>• Rich gas mixture<br>• Exhaust valve set<br>• Exhaust system leak(s)<br>• Engine control module (ECM) | **Refer to: Diagnosis Procedure for Engine Knock (3.2.2 Mechanical System, Symptom Diagnosis and Testing).** |
| Abnormal exhaust (white smoke) | • Coolant enters combustion chamber | **Refer to: Coolant Entering Combustion Chamber (3.2.2 Mechanical System, Symptom Chart).** |
| Abnormal exhaust (blue smoke) | • Engine oil burning | **Refer to: Diagnosis Procedure for Abnormal Exhaust (Blue Smoke) (3.2.2 Mechanical System, Symptom Diagnosis and Testing).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Abnormal exhaust (black smoke) | • Rich gas mixture | Refer to: Diagnosis Procedure for Abnormal Exhaust (Black Smoke) (3.2.2 Mechanical System, Symptom Diagnosis and Testing). |
| Engine knock at cold state occurs and continues for 2 or 3 minutes or increases as engine torque increases | • Electronic control system malfunction | Refer to: DTCs P0327, P0328 (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing). |
| | • Low engine oil viscosity | • Fill engine oil with viscosity meeting the season requirement. |
| | • Excessive clearance between piston and cylinder wall | Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly). |
| | • Alignment of connecting rod (end gap, bend, distortion) | |
| | • Excessive piston pin clearance | |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine knock during idle or engine warm-up | • Electronic control system malfunction | Refer to: DTCs P0327, P0328 (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing). |
| | • Low engine oil viscosity | • Fill engine oil with viscosity meeting the season requirement. |
| | • Fuel quality | • Fuel 93 # and above must be used. |
| | • Excessive clearance between piston and cylinder wall | Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly). |
| | • Alignment of connecting rod (end gap, bend, distortion) | Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly). |
| | • Excessive piston pin clearance | |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Main bearing noise<br>⚠ **CAUTION: Remove the accessory drive belt to eliminate the noise caused due to accessory device. Determine the position of noise through a stethoscope.**<br>⚠ **CAUTION: Main bearing noise can be heard when the engine gets loaded. The noise is loud and toneless, and increases as the load increases.**<br>⚠ **CAUTION: Knocking noise is regular and changes with the engine speed.**<br>⚠ **CAUTION: Low engine oil pressure occurs with such case.**<br>⚠ **CAUTION: Knocking noise from bearing will be heard if there is no or little engine oil on the bearing.** | • Low oil pump pressure | **Refer to: Oil Pressure Inspection (3.2.3 Lubrication System, General Inspection).** |
| | • Excessive crankshaft thrust clearance | **Refer to: Main Bearing, Crankshaft and Cylinder Block (3.2.2 Mechanical System, Disassembly and Assembly).** |
| | • Crankshaft journal out-of-round | |
| | • Excessive clearance between crankshaft and bearing | |
| Noise from connecting rod and rod bearing | • Low oil pump pressure | **Refer to: Diagnosis Procedure for Noise from Connecting Rod and Rod Bearing (3.2.2 Mechanical System, Symptom Diagnosis and Testing).** |
| | • Connecting rod large end side clearance beyonds limit | |
| | • Tightening torque of connecting rod bolt | |
| | • Connecting rod distortion / bend beyonds limit | |
| | • Connecting rod journal out-of-round and taper beyond limit | |
| | • Connecting rod bearing clearance beyonds limit | |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Piston and piston pin noise | • Low oil pump pressure<br>• Incorrect installation of connecting rod and piston<br>• Connecting rod distortion / bend beyonds limit<br>• Excessive piston pin clearance<br>• Excessive clearance between piston and cylinder wall<br>• Excessive piston ring groove clearance | Refer to: Diagnosis Procedure for Piston and Piston Pin Noise (3.2.2 Mechanical System, Symptom Diagnosis and Testing). |
| Valve train noise | • Excessive valve clearance<br>• Low oil pump pressure<br>• Damaged cam lobe<br>• Excessive camshaft journal clearance<br>• Excessive camshaft thrust clearance<br>• Excessive valve tappet wear<br>• Valve spring too soft<br>• Excessive clearance between valve stem and valve guide<br>• Valve seat loose<br>• Valve guide wear | Refer to: Diagnosis Procedure for Valve Train Noise (3.2.2 Mechanical System, Symptom Diagnosis and Testing). |
| Engine cannot start - crankshaft cannot turn | • Accessory drive system components seized<br>• Cylinder seized due to hydraulic pressure<br>• Seized or cracked camshaft<br>• Seized or cracked valve system components<br>• Foreign matters in the cylinder(s)<br>• Seized crankshaft or connecting rod bearing<br>• Bent or cracked connecting rod<br>• Cracked crankshaft | Refer to: Diagnosis Procedure for Engine not Starting - Crankshaft not Turning (3.2.2 Mechanical System, Symptom Diagnosis and Testing). |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Coolant enters combustion chamber<br>**CAUTION: White smoke or coolant-flavor gas, which exceeds the acceptable range, are exhausted from the exhaust pipe.**<br>**CAUTION: Spark plug is dipped with coolant when removing it.** | • Engine overheating<br>- Low coolant level<br>- Inoperative cooling fan<br>- Thermostat fault | **Refer to: Symptoms Chart (3.1.4 Cooling System, Symptom Diagnosis and Testing).** |
| | • Cylinder head sealing fault | • Replace cylinder head and gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |
| | • Warped cylinder head | • Replace cylinder head and gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |
| | • Cracked cylinder head | • Replace cylinder head and gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Coolant enters combustion chamber<br>**CAUTION: White smoke or coolant-flavor gas, which exceeds the acceptable range, are exhausted from the exhaust pipe.**<br>**CAUTION: Spark plug is dipped with coolant when removing it.** | • Cracked cylinder liner or cylinder block | • Replace cylinder liner or cylinder block.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |
| | • Pore on the cylinder head or cylinder block | • Replace cylinder head or cylinder block.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |
| Coolant enters engine oil<br>**CAUTION: Oil is foamed or discolored.**<br>**CAUTION: Engine oil is "excessive".** | • Engine overheating<br>- Low coolant level<br>- Inoperative cooling fan<br>- Thermostat fault | **Refer to: Symptom Chart (3.2.4 Cooling System, Symptom Diagnosis and Testing).** |
| | • Cylinder head sealing fault | • Replace cylinder head gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |
| | • Warped cylinder head | • Replace cylinder head and gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |

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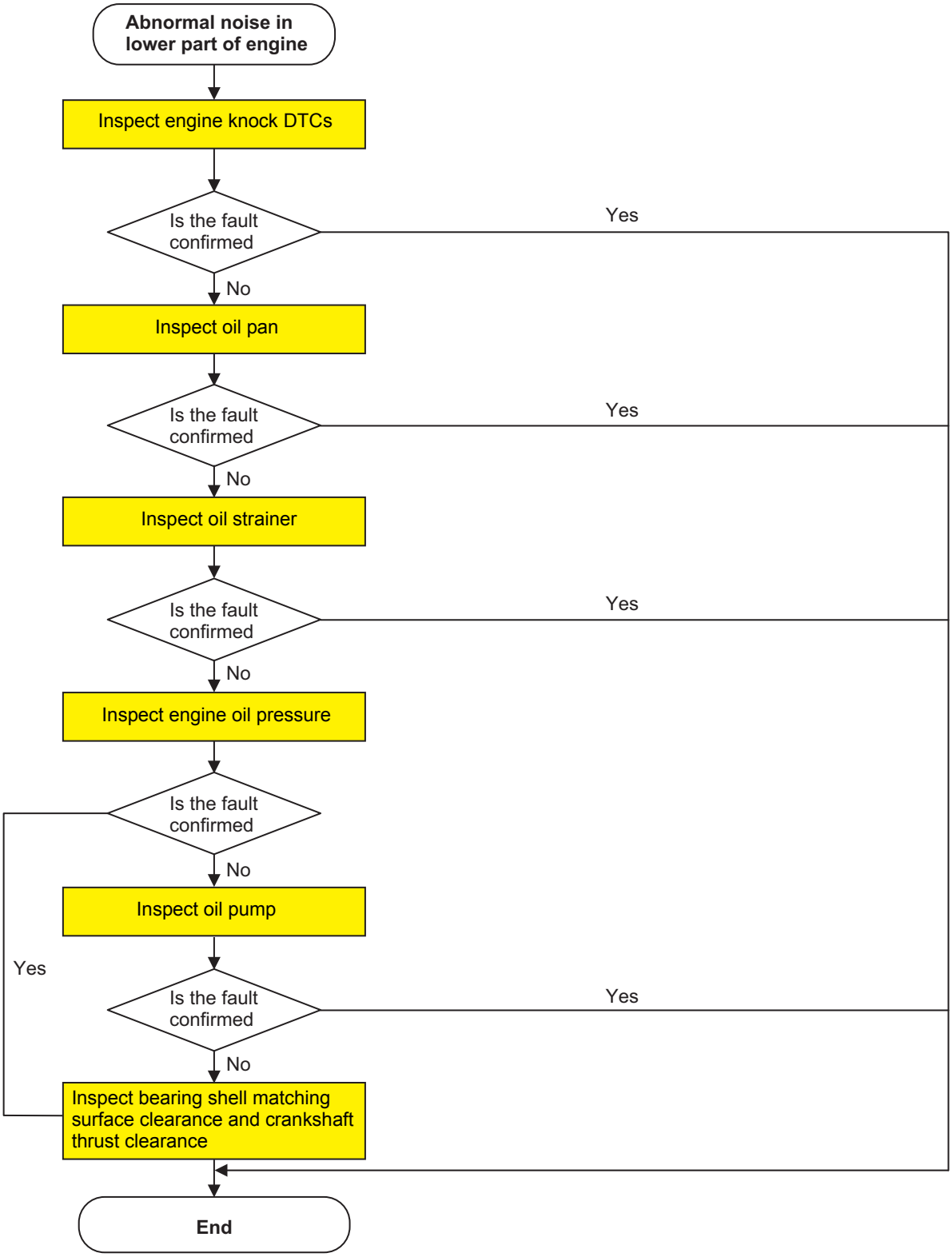


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Coolant enters engine oil<br>**CAUTION: Oil is foamed or discolored.**<br>**CAUTION: Engine oil is "excessive".** | • Cracked cylinder head | • Replace cylinder head and gasket.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |
| | • Cracked cylinder liner or cylinder block | • Replace cylinder block.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |
| | • Pore on the cylinder head or cylinder block | • Replace cylinder head or cylinder block.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |

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# Diagnosis Procedure for Abnormal Noise in Lower Part of Engine



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**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: Remove the accessory drive belt to eliminate the noise caused by these devices.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect engine knock DTCs | |
| | A. Using a diagnostic tool, inspect the DTCs.<br>Is there any engine knock DTC?<br>**Yes**<br>**Refer to: DTCs P0327, P0328 (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect oil pan | |
| | A. Inspect the oil pan.<br>Is it deformed?<br>**Yes**<br>Go to step 3 after repair or replacement.<br>**No**<br>Go to step 4. |
| 3. Inspect oil strainer | |
| | A. Inspect the oil pump strainer.<br>Is it deformed or damaged?<br>**Yes**<br>Repair or replace.<br>**No**<br>Go to step 4. |
| 4. Inspect engine oil pressure | |
| | A. Inspect the engine oil pressure.<br>**Refer to: Engine Oil Pressure Inspection (3.2.3 Lubrication System, General Inspection).**<br>Is the pressure too low?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 6. |

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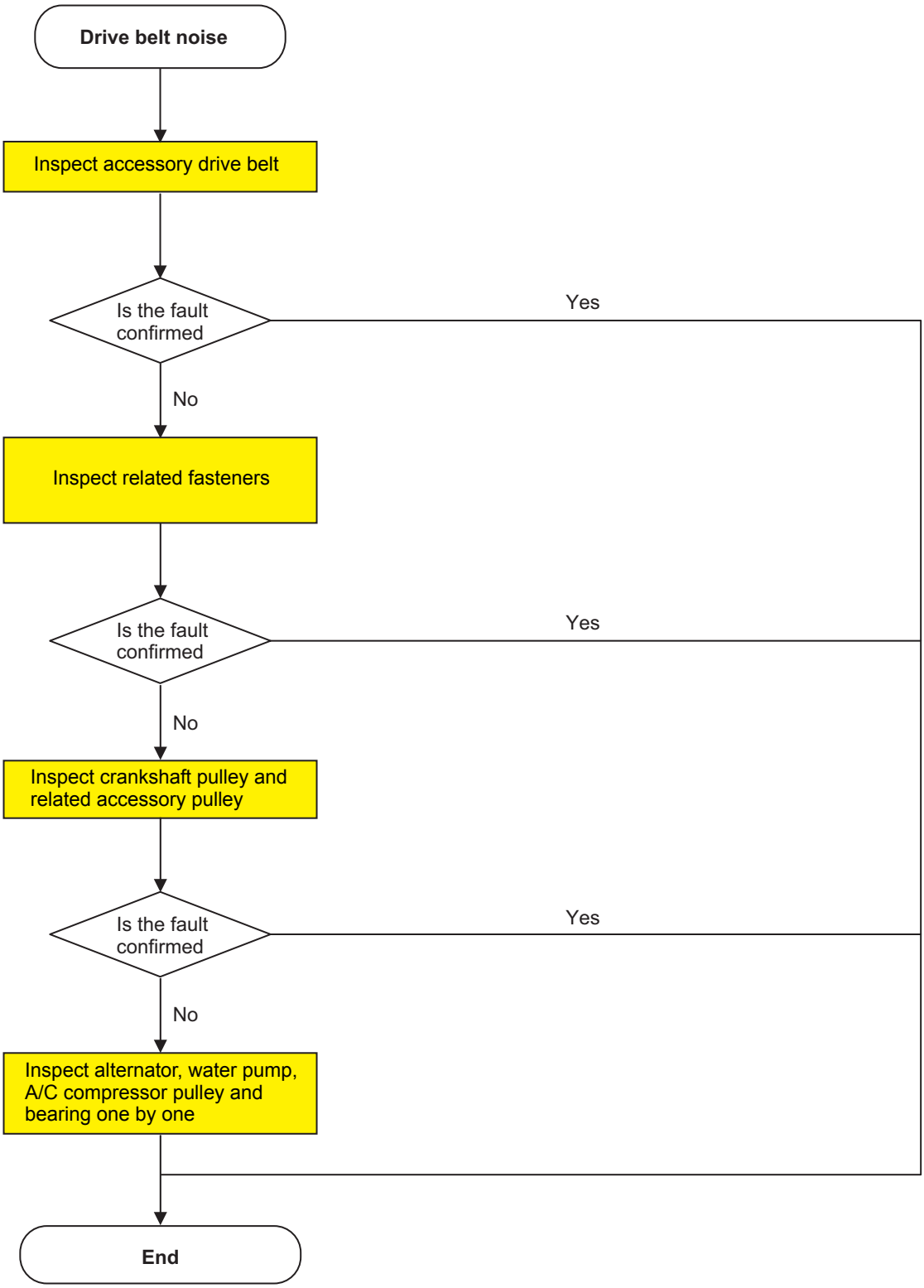


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect oil pump | |
| | A. Remove the oil pump.<br>**Refer to: Oil Pump (3.2.3 Lubrication System, Removal and Installation).**<br>B. Inspect the oil pump.<br>Is it normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the oil pump. |
| 6. Inspect bearing shell matching surface clearance and crankshaft thrust clearance | |
| | A. Disassemble the main bearing shell and connecting rod bearing shell.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.2.2 Mechanical System, Disassembly and Assembly).**<br>B. Inspect the matching clearance of engine main bearing shell and connecting rod bearing shell as well as the crankshaft thrust plate for any wear.<br>Are the matching clearance and crankshaft thrust clearance normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Adjust the matching clearance of engine main bearing shell and connecting rod bearing shell as well as the crankshaft thrust clearance to normal values.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.2.2 Mechanical System, Disassembly and Assembly).** |

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# Diagnosis Procedure for Drive Belt Noise



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**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: A proper drive belt must be used.**

**CAUTION: Accessory drive belt consists of compressor belt and water pump belt.**

**CAUTION: Flatness (unevenness of crankshaft pulley and related accessory pulley) may cause the drive belt abnormal wear, noise and fall-off.**

**CAUTION: Suddenly-increased large load may cause the belt to slip and make noises, for example: when the compressor of air conditioning system starts and engine is running, throttle valve rapidly opens.**

**CAUTION: Heavy load may cause the belt abnormal noises, for example: excessive filling into the air conditioning system, clipped hoses of power steering system, excessive power steering fluid.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect accessory drive belt | |
| | A. Inspect the accessory drive belt.<br>**Refer to: Accessory Drive Belt Inspection (3.2.2 Mechanical System, General Inspection).** |
| 2. Inspect related fasteners | |
| | A. Inspect all the fasteners related to the drive belt.<br>Are they loosened or deformed?<br>**Yes**<br>Tighten or replace.<br>**No**<br>Go to step 3. |
| 3. Inspect crankshaft pulley and related accessory pulley | |
| | A. Misalignment, bend, distortion, cracks and looseness are not allowed for pulley.<br>B. Abnormal scratches, edges and corners are not allowed on the pulley surface.<br>C. Foreign matters are not allowed in the pulley groove.<br>D. Does it conform to above requirements?<br>**Yes**<br>Go to step 4.<br>**No**<br>Clear, tighten or replace. |

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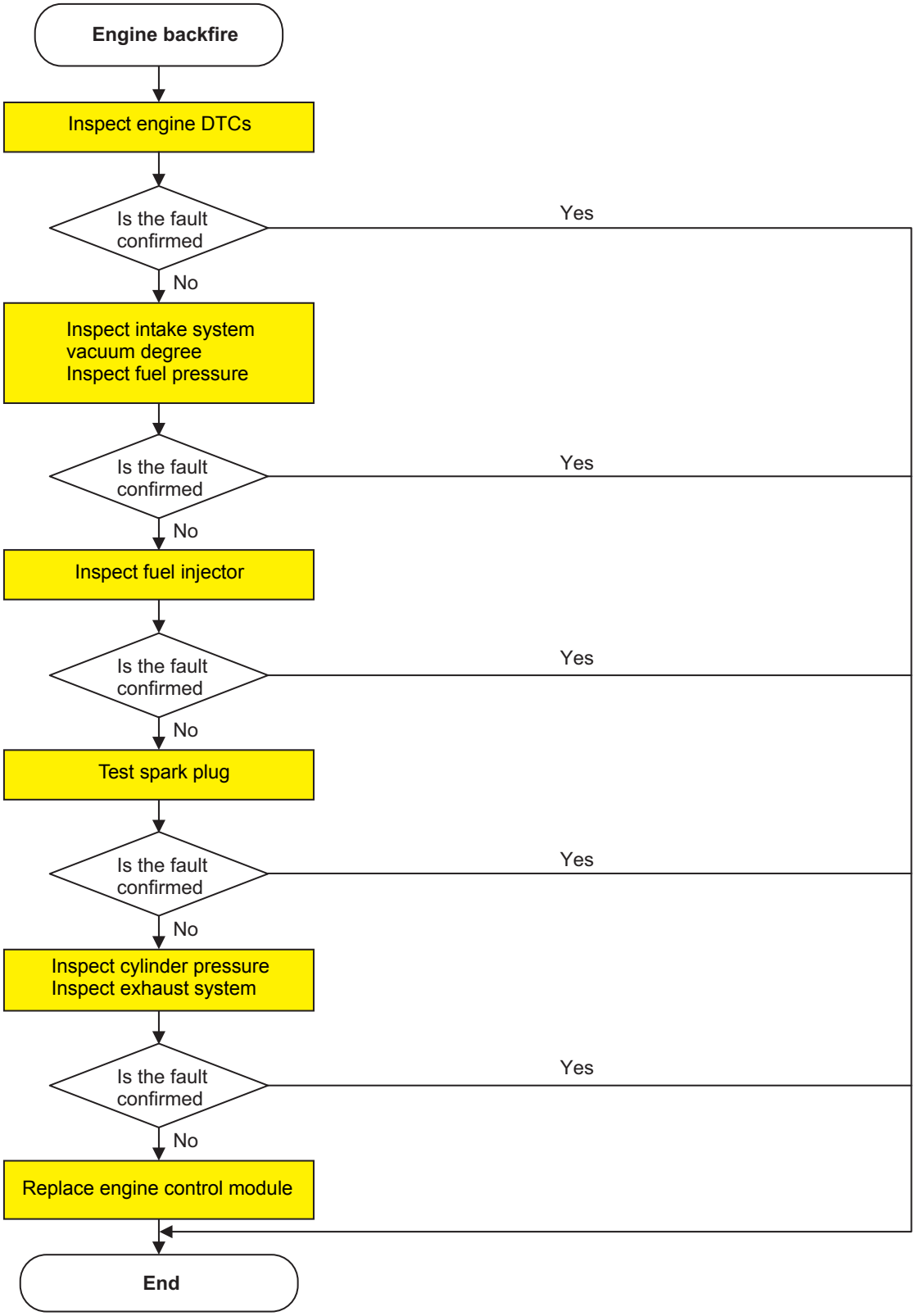


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect alternator, water pump, A/C compressor pulley and bearing one by one | |
| | A. Distortion or deformation is not allowed for pulley, and seizure or looseness is not allowed for bearing.<br>B. Abnormal noise is not allowed when rotating the bearing.<br>Does it conform to above requirements?<br>**No**<br>Tighten or replace. |

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# Diagnosis Procedure for Engine Backfire



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect engine DTCs | |
| | A. Using a diagnostic tool, inspect the DTCs.<br>Are there any DTCs?<br>**Yes**<br>**Refer to: DTC Diagnosis Procedure Index (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect intake system vacuum degree | |
| | A. Inspect the intake system vacuum degree to judge the intake system for air leakage.<br>**Refer to: Vacuum Degree of Intake System Inspection (3.2.5 Air Intake System, General Inspection).**<br>Are there any leaks?<br>**Yes**<br>Repair.<br>**Refer to: Diagnosis Procedure for Intake Air Leak (3.2.5 Air Intake System, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Inspect fuel pressure | |
| | A. Inspect the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the pressure too low?<br>**Yes**<br>Take the symptom actions.<br>**Refer to: Symptom Chart (3.2.7 Fuel System, Symptom Diagnosis and testing).**<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuel injector | |
| | A. Inspect the fuel injector.<br>Is it blocked?<br>**Yes**<br>Clean or replace.<br>**No**<br>Go to step 5. |
| 5. Test spark plug | |
| | A. Inspect if the spark plug is within the specification.<br>**Refer to: Ignition Spark Test (3.2.8 Ignition System, General Inspection).**<br>Is it within the specification?<br>**Yes**<br>Go to step 6.<br>**No**<br>Clear or replace. |
| 6. Inspect cylinder pressure | |
| | A. Carry out the cylinder pressure inspection.<br>**Refer to: Cylinder Compression Pressure Inspection (3.2.2 Mechanical System, General Inspection).** |
| 7. Inspect exhaust system | |
| | A. Carry out an exhaust backpressure test to inspect if the exhaust system has been blocked.<br>**Refer to: Exhaust Backpressure Test (3.2.6 Exhaust System, General Inspection).**<br>Is it blocked?<br>**Yes**<br>Carry out the diagnostic procedure for exhaust system blockage.<br>**Refer to: Diagnosis Procedure for Exhaust System Blockage (3.2.6 Exhaust System, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 8. |

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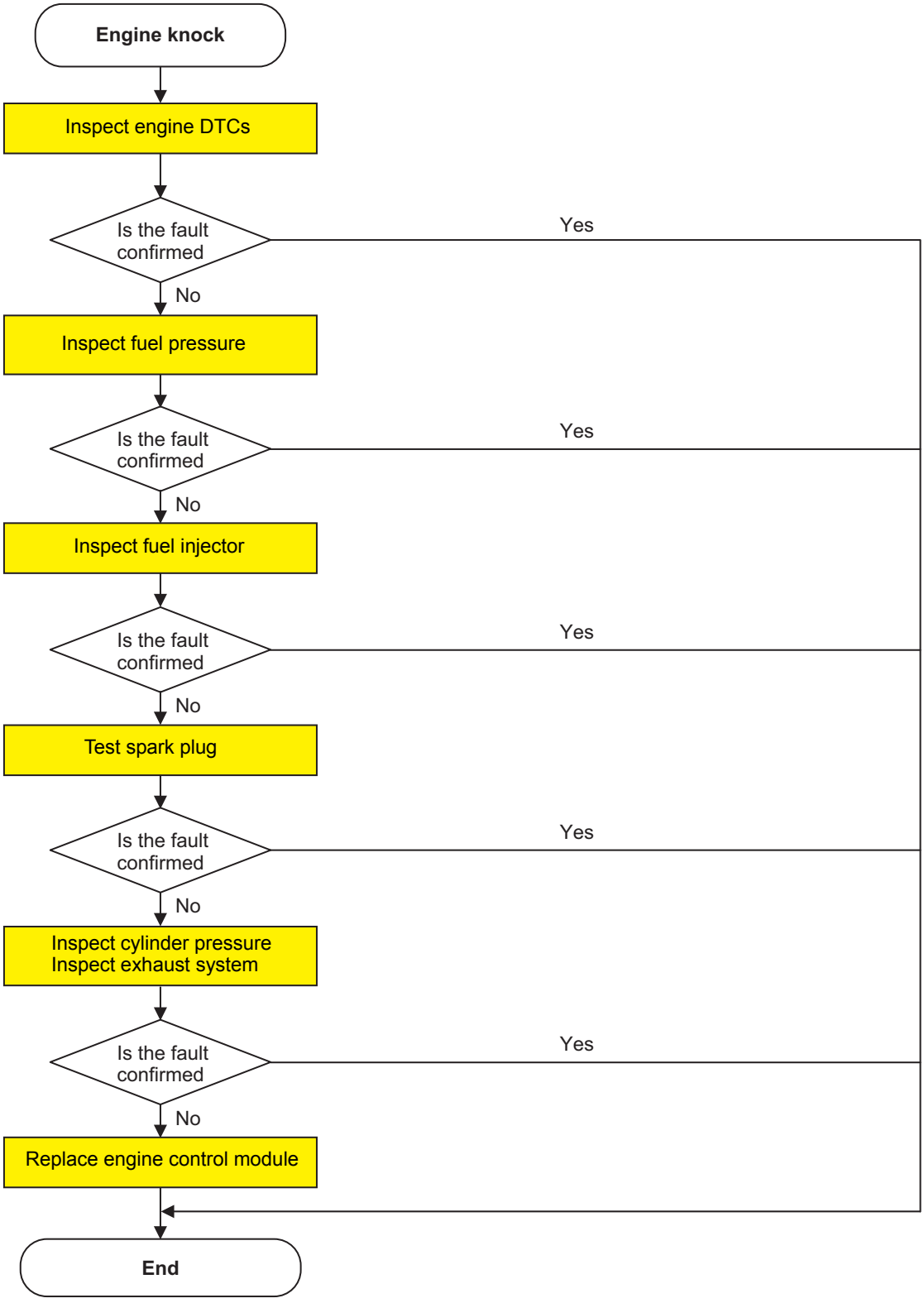


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Replace engine control module | |
| | A. Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for Engine Knock



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect engine DTCs | |
| | A. Using a diagnostic tool, inspect the engine DTCs.<br>Are there any DTCs?<br>**Yes**<br>**Refer to: DTC Diagnosis Procedure Index (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect fuel pressure | |
| | A. Inspect the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the pressure too high?<br>**Yes**<br>Repair the fuel line that is blocked.<br>**No**<br>Go to step 3. |
| 3. Inspect fuel injector | |
| | A. Inspect the fuel injector for leakage.<br>Are there any leaks?<br>**Yes**<br>Replace.<br>**No**<br>Go to step 4. |
| 4. Test spark plug | |
| | A. Carry out the spark plug test.<br>**Refer to: Ignition Spark Test (3.2.8 Ignition System, General Inspection).**<br>Is it within the standard range?<br>**No**<br>Clear or replace.<br>**Yes**<br>Go to step 5. |

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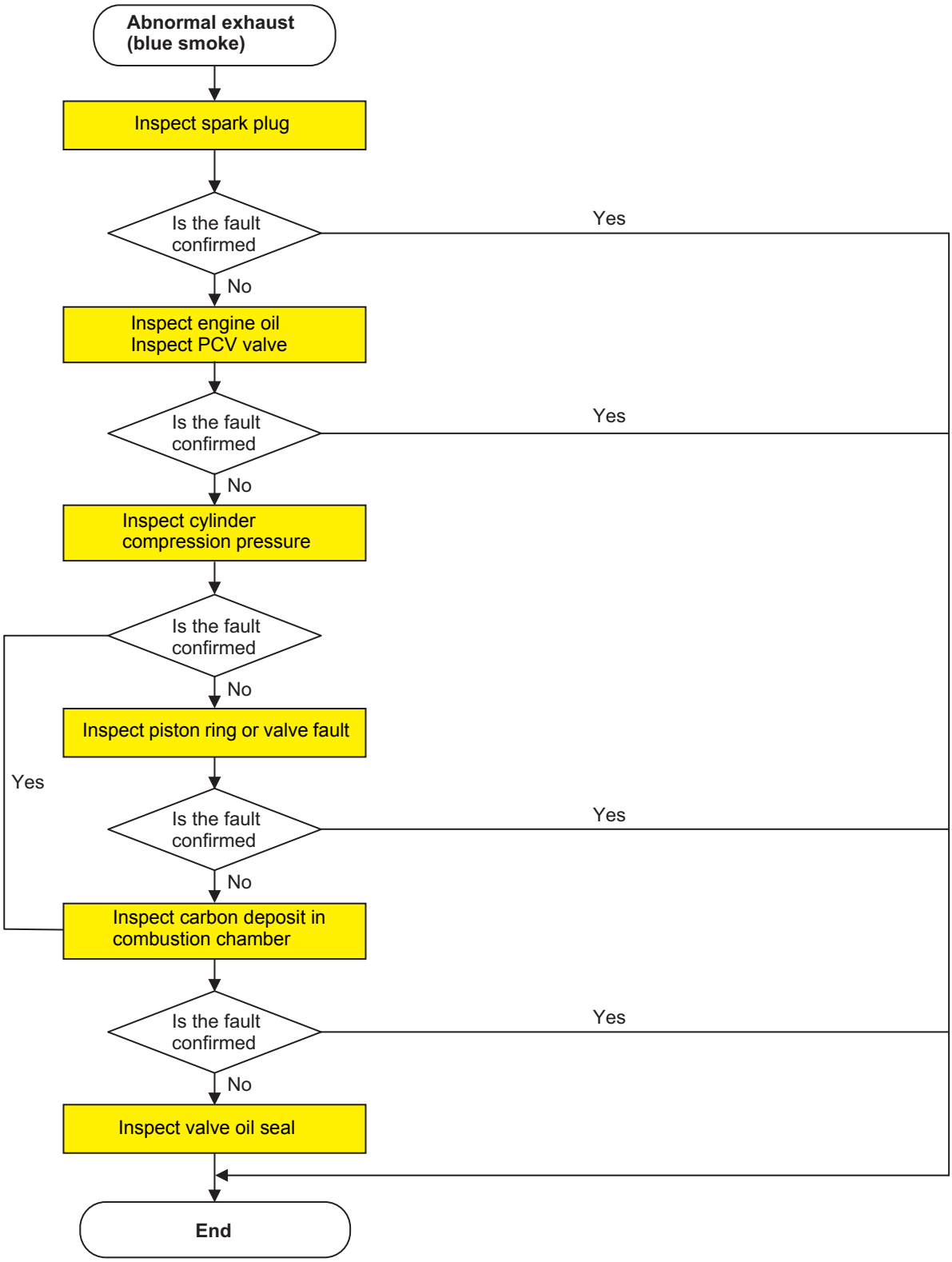


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect cylinder pressure | |
| | A. Carry out the cylinder pressure inspection.<br>**Refer to: Cylinder Compression Pressure Inspection (3.2.2 Mechanical System, General Inspection).** |
| 6. Inspect exhaust system | |
| | A. Carry out an exhaust backpressure test.<br>**Refer to: Exhaust Backpressure Test (3.2.6 Exhaust System, General Inspection).**<br>Is the exhaust system blocked?<br>**Yes**<br>Carry out the diagnosis procedure for exhaust system leakage and noise.<br>**Refer to: Symptom Chart (3.2.6 Exhaust System, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 7. |
| 7. Replace engine control module | |
| | A. Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for Abnormal Exhaust (Blue Smoke)



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**CAUTION: Usually, it is accompanied with spark plug carbon deposit.**

**CAUTION: Use engine oil meeting the specification.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect spark plug | |
| | A. Inspect the spark plug.<br>Is there any carbon deposit?<br>**Yes**<br>Clean or replace.<br>**No**<br>Go to step 2. |
| 2. Inspect engine oil | |
| | A. Inspect the engine oil level.<br>Is the level too high?<br>**Yes**<br>Return to normal level.<br>**No**<br>Go to step 3. |
| 3. Inspect PCV valve | |
| | A. Inspect the PCV valve.<br>Is it normal?<br>**No**<br>Replace the PCV valve.<br>**Yes**<br>Go to step 4. |
| 4. Inspect cylinder compression pressure | |
| | A. Carry out the cylinder compression pressure inspection.<br>**Refer to: Cylinder Compression Pressure Inspection (3.2.2 Mechanical System, General Inspection).**<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 6. |

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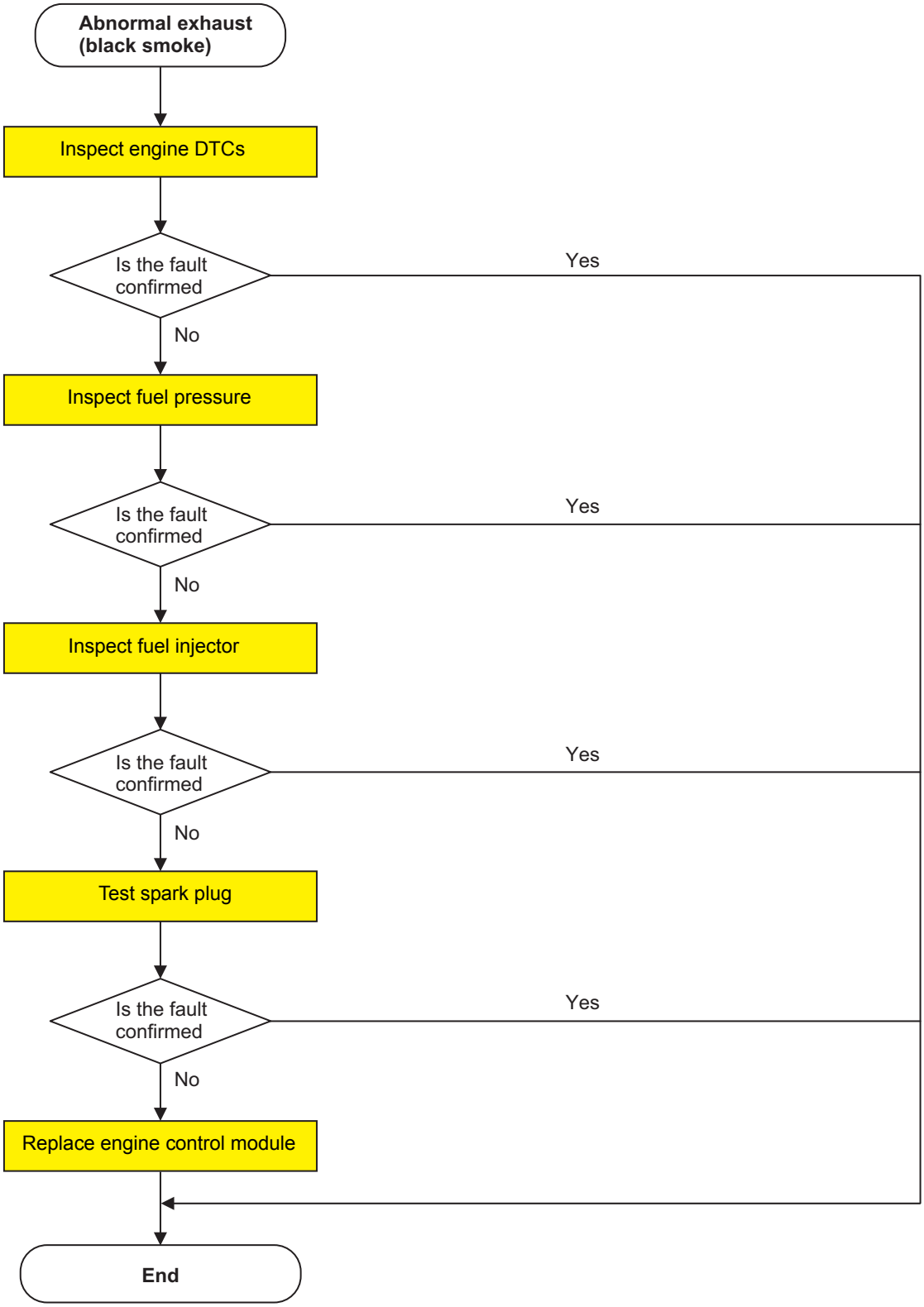


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect piston ring or valve fault | |
| | A. Add an appropriate amount of engine oil to the cylinder block.<br>**Pressure increases remarkably and inspect the piston ring.**<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Pressure increases a little and inspect the valve.**<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).** |
| 6. Inspect carbon deposit in combustion chamber | |
| | A. Inspect the combustion chamber.<br>Is there any carbon deposit?<br>**Yes**<br>Clean.<br>**No**<br>Go to step 7. |
| 7. Inspect valve oil seal | |
| | A. Inspect the valve oil seal.<br>Are there any leaks?<br>**Yes**<br>Replace.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>The system is normal. |

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# Diagnosis Procedure for Abnormal Exhaust (Black Smoke)



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect engine DTCs | |
| | A. Using a diagnostic tool, inspect the engine DTCs.<br>Are there any DTCs?<br>**Yes**<br>**Refer to: DTC Diagnosis Procedure Index (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect fuel pressure | |
| | A. Inspect the fuel pressure.<br>Is the pressure too high?<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>**Yes**<br>Repair the fuel line that is blocked.<br>**Yes**<br>Go to step 3. |
| 3. Inspect fuel injector | |
| | A. Inspect the fuel injector.<br>Are there any leaks?<br>**Yes**<br>Replace.<br>**No**<br>Go to step 4. |
| 4. Test spark plug | |
| | A. Carry out the spark plug test.<br>**Refer to: Ignition Spark Test (3.2.8 Ignition System, General Inspection).**<br>**No**<br>Clear or replace.<br>**Yes**<br>Go to step 5. |

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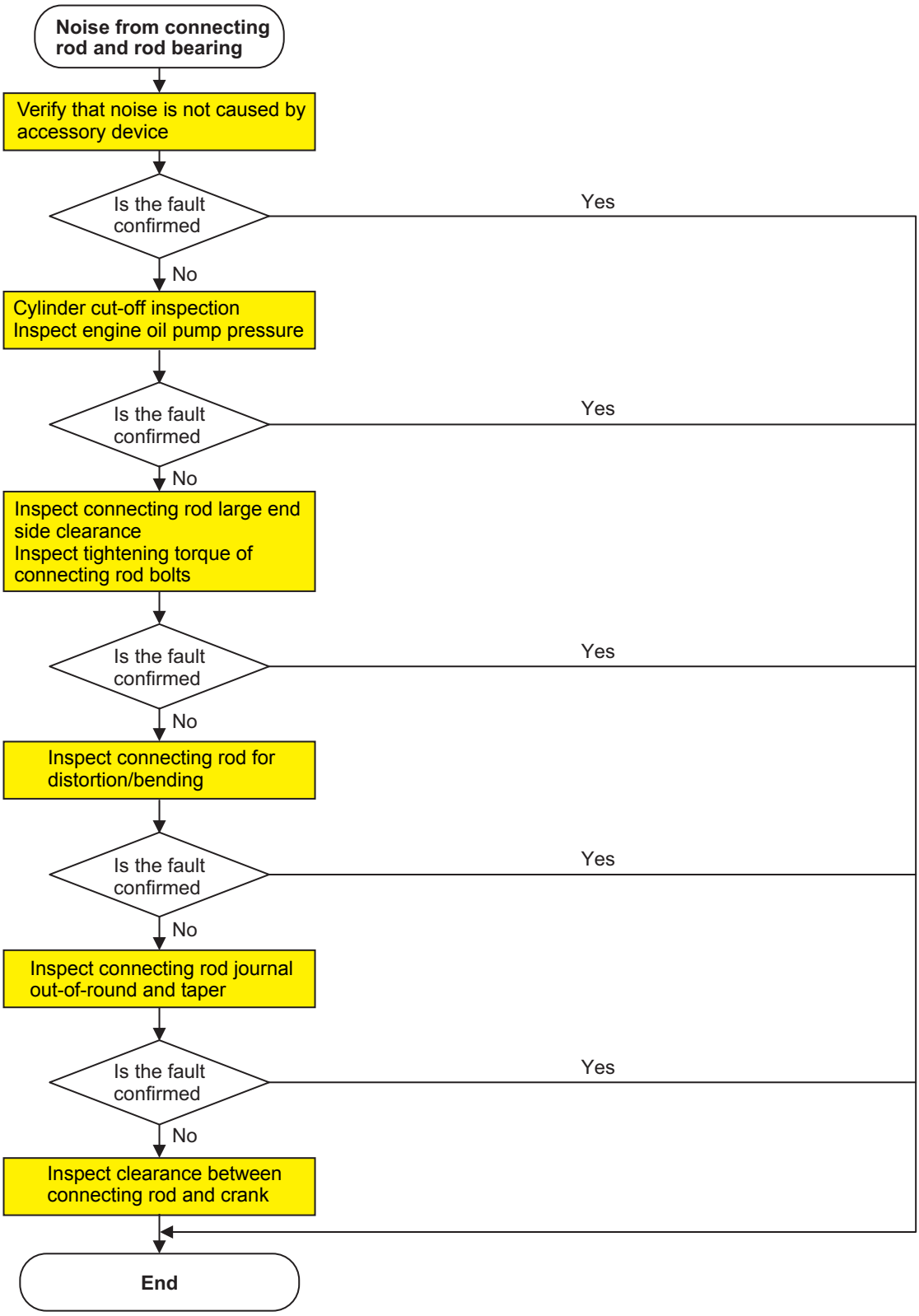


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Replace engine control module | |
| | A. Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for Noise from Connecting Rod and Rod Bearing



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**CAUTION: Remove the accessory drive belt and have a strict limit to the engine running time. Otherwise, the engine may reach high temperature and be damaged.**

**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: Remove the accessory drive belt to eliminate the noise caused by these devices.**

**CAUTION: Such noise sometimes can be isolated by removing one fuel injector wiring harness connector at a time. If the noise volume decreases or disappears, such noise is related to the cylinder, from which the connector is just cut off.**

**CAUTION: Excessive connecting rod clearance can lead to knock noises at each engine speed. Low engine oil pressure also results in such case.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify that noise is not caused by accessory device | |
| | A. Remove the accessory drive belt.<br>**Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**<br>Does the noise exist?<br>**Yes**<br>Go to step 2.<br>**No**<br>Noise is caused by the accessory and replace the accessory drive belt. |
| 2. Cylinder cut-off inspection | |
| | A. Carry out the cylinder cut-off test by removing the fuel injector wiring harness connectors to verify which cylinder is related to the noise. |
| 3. Inspect engine oil pump pressure | |
| | A. Inspect the engine oil pump pressure.<br>**Refer to: Engine Oil Pressure Inspection (3.2.3 Lubrication System, General Inspection).**<br>Is oil pump pressure too low?<br>**Yes**<br>Repair.<br>**Refer to: Symptom Chart (3.2.3 Lubrication System, Symptom Diagnosis and testing).**<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect connecting rod large end side clearance | |
| | A. Inspect the connecting rod large end side clearance.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Replace the connecting rod.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 5. |
| 5. Inspect tightening torque of connecting rod bolts | |
| | A. Inspect the tightening torque of connecting rod bolts.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Record the torques, and replace the bolts and nuts.<br>**Yes**<br>Go to step 6. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect connecting rod for distortion/bending | |
| | A. Inspect if the distortion/bending of connecting rod is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Replace the connecting rod.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 7. |
| 7. Inspect connecting rod journal out-of-round and taper | |
| | A. Inspect the connecting rod journal out-of-round and taper.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>Repair or replace crankshaft.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 8. |

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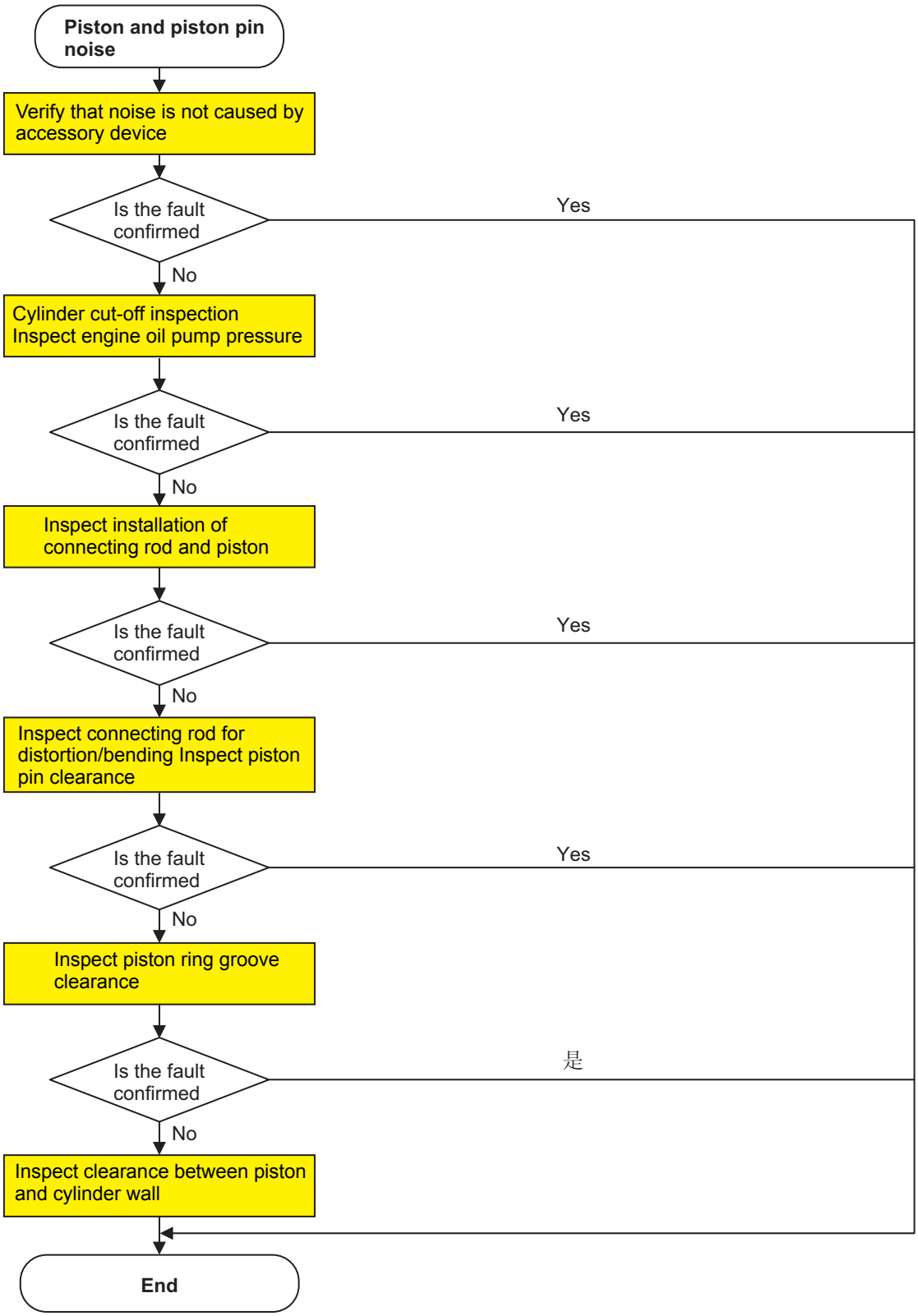


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect clearance between connecting rod and crank | |
| | A. Inspect the clearance between the connecting rod and crank.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair it to the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>The system is normal. |

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# Diagnosis Procedure for Piston and Piston Pin Noise



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**CAUTION: Remove the accessory drive belt and strictly limit to the engine running time, otherwise, the engine may be damaged owing to high temperature.**

**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: Remove the accessory drive belt to eliminate the noise caused by these devices.**

**CAUTION: The knock noise caused by the excessive clearance between the piston and cylinder wall can usually be heard when the engine is running at idle speed. The knock noise will change obviously when the cylinder fuel injector wiring harness connector is removed.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify that noise is not caused by accessory device | |
| | A. Remove the accessory drive belt.<br>**Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**<br>Does the noise exist?<br>**No**<br>Noise is caused by the accessory.<br>**Yes**<br>Go to step 2. |
| 2. Cylinder cut-off inspection | |
| | A. Carry out the cylinder cut-off test by removing the fuel injector wiring harness connectors to verify which cylinder is related to the noise. |
| 3. Inspect engine oil pump pressure | |
| | A. Inspect the engine oil pump pressure.<br>**Refer to: Engine Oil Pressure Inspection (3.2.3 Lubrication System, General Inspection).**<br>Is oil pump pressure too low?<br>**Yes**<br>Repair it.<br>**Refer to: Symptom Chart (3.2.3 Lubrication System, Symptom Diagnosis and testing).**<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect installation of connecting rod and piston | |
| | A. Inspect the installation positions of connecting rod and piston.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Reinstall.<br>**Yes**<br>Go to step 5. |
| 5. Inspect connecting rod for distortion/bending | |
| | A. Inspect if the distortion/bending of connecting rod is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Replace the connecting rod.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 6. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect piston pin clearance | |
| | A. Inspect if the piston pin clearance is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 7. |
| 7. Inspect piston ring groove clearance | |
| | A. Inspect if the piston ring groove clearance is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair to the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 8. |

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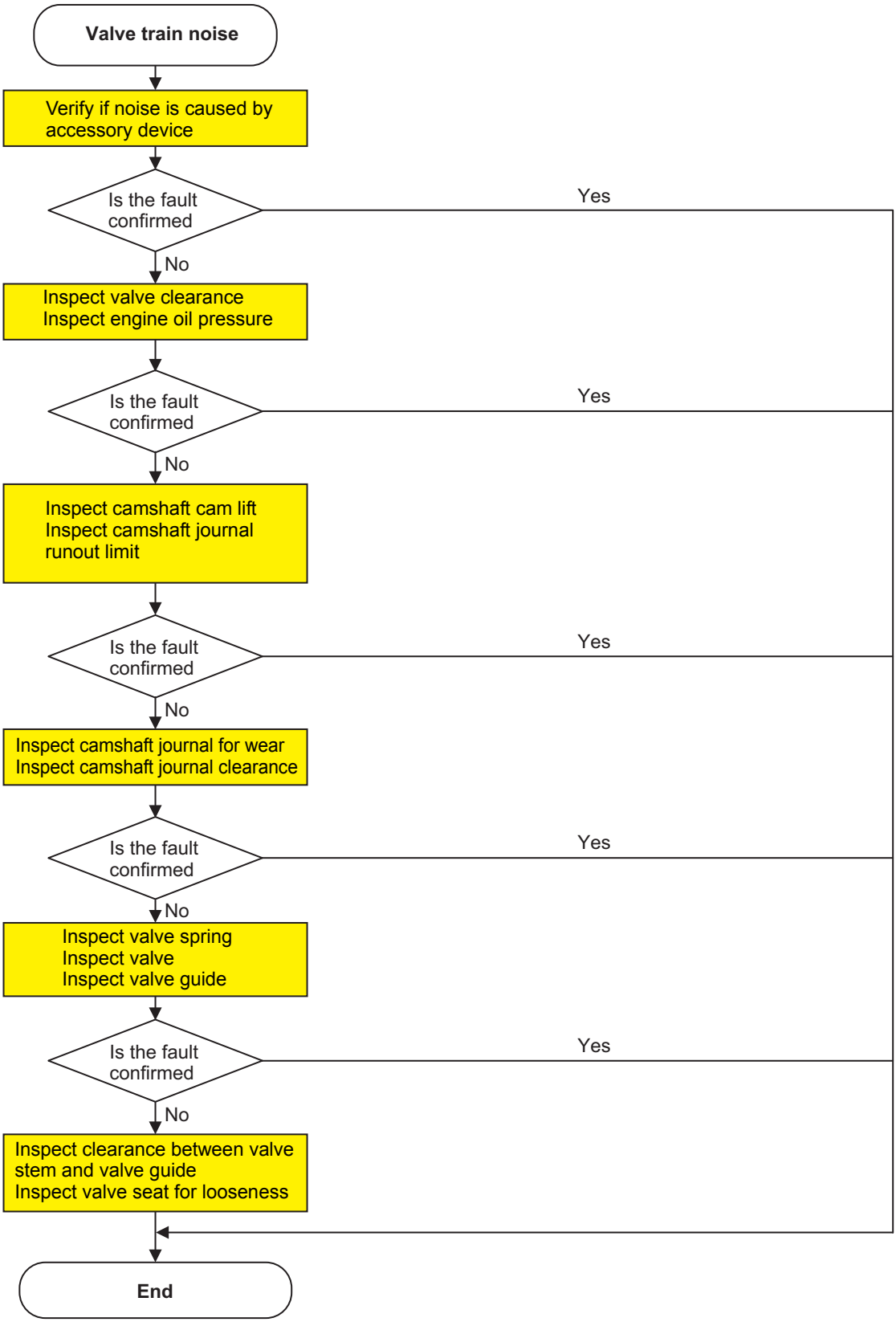


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect clearance between piston and cylinder wall | |
| | A. Inspect if the clearance between piston and cylinder wall is within the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair to the specification.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>The system is normal. |

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# Diagnosis Procedure for Valve Train Noise



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**CAUTION: Remove the accessory drive belt and have a strict limit to the engine running time. or, the engine may reach high temperature and be damaged.**

**CAUTION: Use a stethoscope to help determine the source of engine noises.**

**CAUTION: Remove the accessory drive belt to eliminate the noise caused by these devices.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify if noise is caused by accessory device | |
| | A. Remove the accessory drive belt.<br>**Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**<br>Does the noise exist?<br>**No**<br>Noise is caused by the accessory.<br>**Yes**<br>Go to step 2. |
| 2. Inspect valve clearance | |
| | A. Inspect if the valve clearance is within the specification.<br>**Refer to: Valve Clearance Inspection and Adjustment (3.2.2 Mechanical System, General Inspection).**<br>Is it within the specification?<br>**No**<br>Readjust to the specification.<br>**Refer to: Valve Clearance Inspection and Adjustment (3.2.2 Mechanical System, General Inspection).**<br>**Yes**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect engine oil pressure | |
| | A. Inspect the engine oil pump pressure.<br>**Refer to: Engine Oil Pressure Inspection (3.2.3 Lubrication System, General Inspection).**<br>Is the pressure too low?<br>**Yes**<br>Repair.<br>**Refer to: Symptom Chart (3.2.3 Lubrication System, Symptom Diagnosis and testing).**<br>**No**<br>Go to step 4. |
| 4. Inspect camshaft cam lift | |
| | A. Inspect the camshaft cam lift.<br>**Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**<br>Is it within the specification?<br>**No**<br>Replace.<br>**Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**<br>**Yes**<br>Go to step 5. |
| 5. Inspect camshaft journal runout limit | |
| | A. Inspect the camshaft journal runout limit.<br>**Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**<br>Is it within the specification?<br>**No**<br>Repair.<br>**Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**<br>**Yes**<br>Go to step 6. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect camshaft journal for wear | |
| | A. Inspect the camshaft journals and bearing caps for rust, scratches, abrasions or damages.<br>**Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**<br>Is it within the specification?<br>**No**<br>Repair.<br>**Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**<br>**Yes**<br>Go to step 7. |
| 7. Inspect camshaft journal clearance | |
| | A. Inspect the camshaft journal clearance.<br>**Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**<br>Is it within the specification?<br>**No**<br>Repair.<br>**Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).** |
| 8. Inspect valve spring | |
| | A. Inspect if the valve spring is within the specification.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Replace the valve spring.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>Go to step 9. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect valve | |
| | A. Inspect if the surface of each valve and valve stem are worn, burnt or deformed.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Replace the valve.<br>**Yes**<br>Go to step 10. |
| 10.Inspect valve guide | |
| | A. Inspect the valve guide for wear.<br>Is it worn?<br>**Yes**<br>Replace the valve guide.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>Go to step 11. |
| 11.Inspect clearance between valve stem and valve guide | |
| | A. Inspect the clearance between valve stem and valve guide.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>Go to step 11. |

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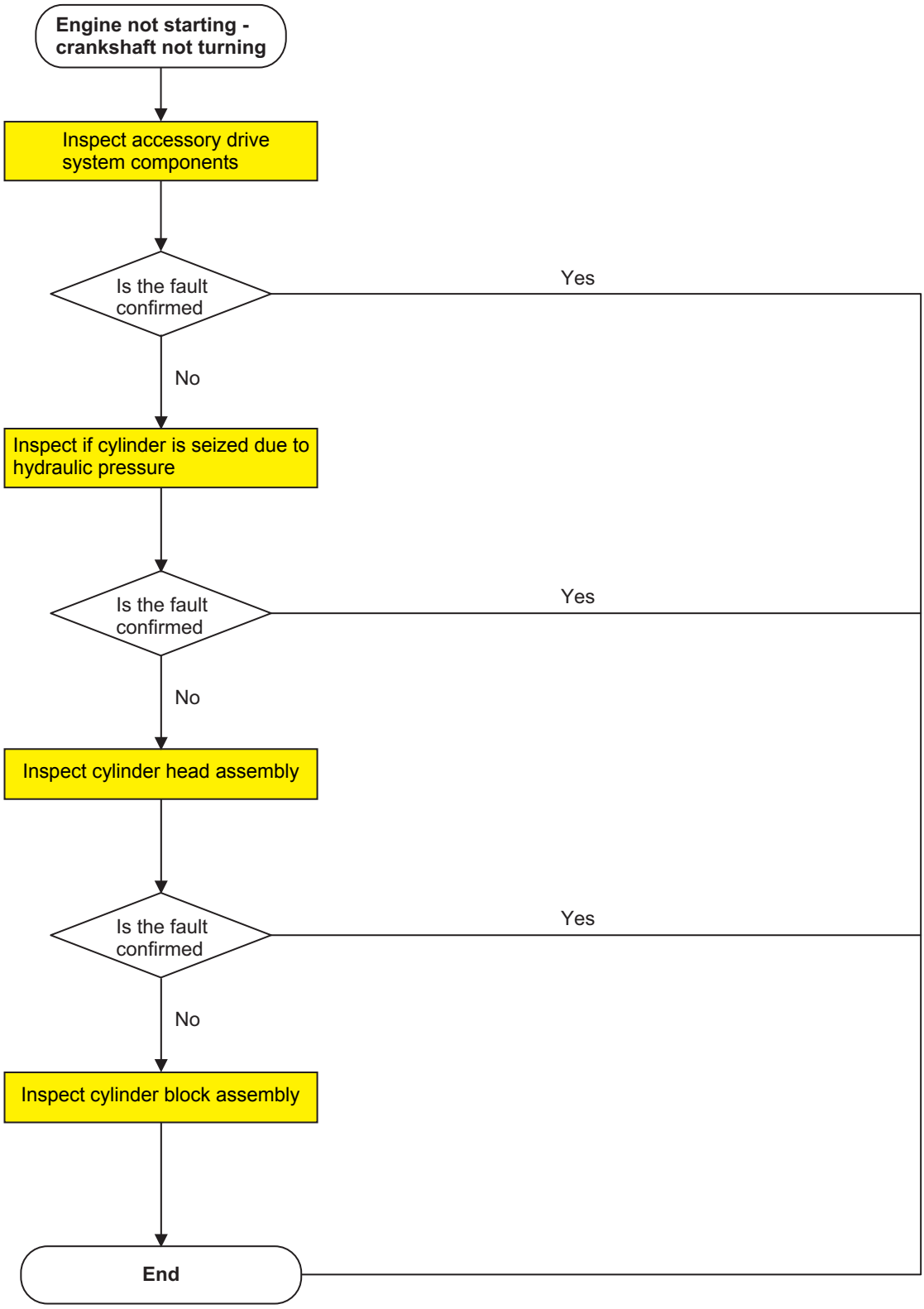


| Test Conditions | Details/Results/Actions |
|---|---|
| 12.Inspect valve seat for looseness | |
| | A. Inspect if the valve seat is loose.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>Is it within the specification?<br>**No**<br>Repair.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Yes**<br>The system is normal. |

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# Diagnosis Procedure for Engine not Starting - Crankshaft not Turning



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect accessory drive system components | |
| | A. Remove the accessory drive belt and try to rotate the crankshaft with a wrench.<br>**Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**<br>Does the crankshaft rotate freely?<br>**Yes**<br>Repair or replace accessory drive system components.<br>**No**<br>Go to step 2. |
| 2. Inspect if cylinder is seized due to hydraulic pressure | |
| | A. Remove all the spark plugs and inspect if any water, engine oil or antifreeze is attached to them.<br>Are they within the specifications?<br>**No**<br>Inspect the cylinder block, cylinder head and gasket for cracks. Repair if necessary.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect cylinder head assembly | |
| | A. Remove the timing chain.<br>**Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**<br>B. Inspect the cylinder head.<br>**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Disassembly and Assembly).**<br>• Camshaft seized or cracked.<br>• Valve tappet severe wear.<br>• Valve or valve spring stuck or broken.<br>Do the conditions above exist?<br>**Yes**<br>Repair or replace.<br>**No**<br>Go to step 4. |
| 4. Inspect cylinder block assembly | |
| | A. Inspect the cylinder block assembly.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.2.2 Mechanical System, Disassembly and Assembly).**<br>• Cracked piston.<br>• Foreign matters in the cylinder.<br>• Cracked crankshaft.<br>• Bent or cracked connecting rod.<br>Do the conditions above exist?<br>**Yes**<br>Repair or replace.<br>**No**<br>The system is normal. |

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## Removal and Installation

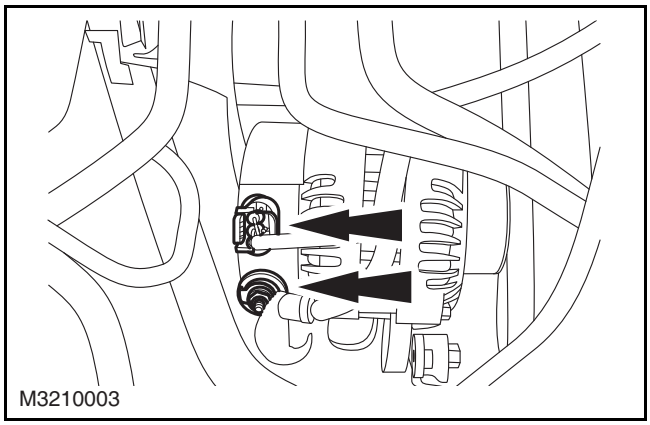
# Accessory Drive Belt

### Removal

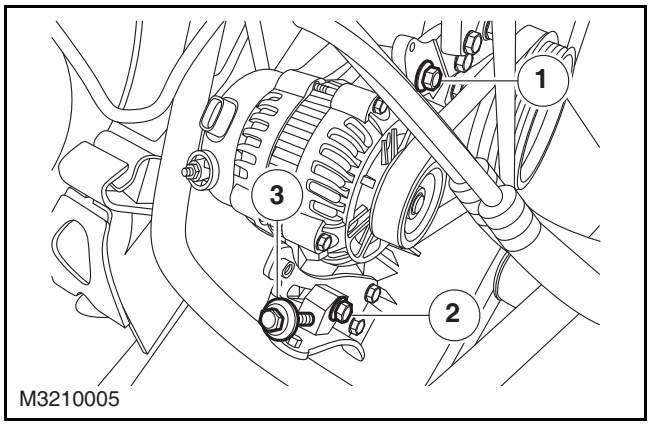
**CAUTION: Accessory drive belt consists of alternator belt, elastic belt and compressor belt.**

1. Fold the front passenger seat.
2. Disconnect the alternator wiring harness connector and remove the alternator charging cable bolt.

   Torque: 9 Nm

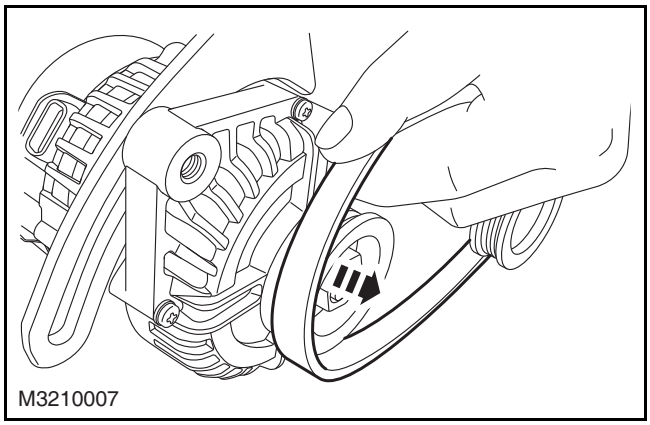

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3. Loosen the alternator upper retaining bolt (1), and then loosen the alternator adjusting bracket bolts (2) and (3) in sequence.



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4. Turn the alternator belt to engine side until it can be separated easily, then remove the alternator belt.


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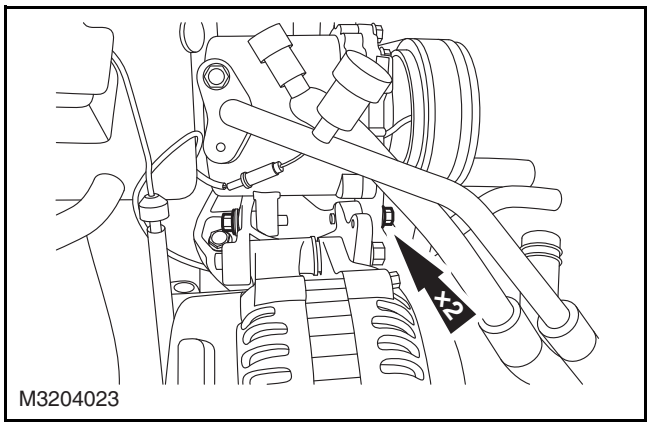
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**5.** Remove the compressor belt. (Models with A/C)

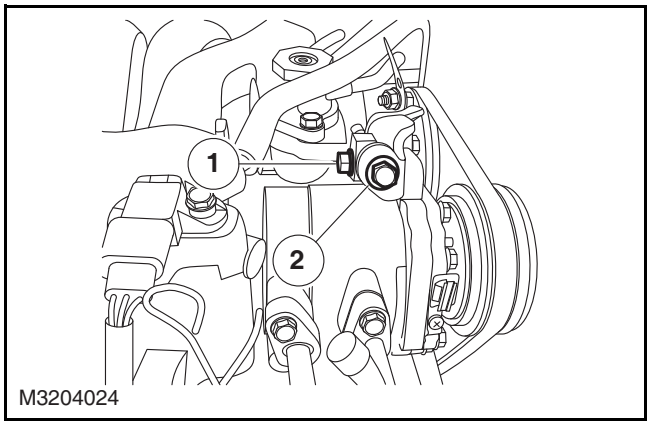
1 Loosen 2 compressor connecting bolts.

Torque: 25 ~ 30 Nm

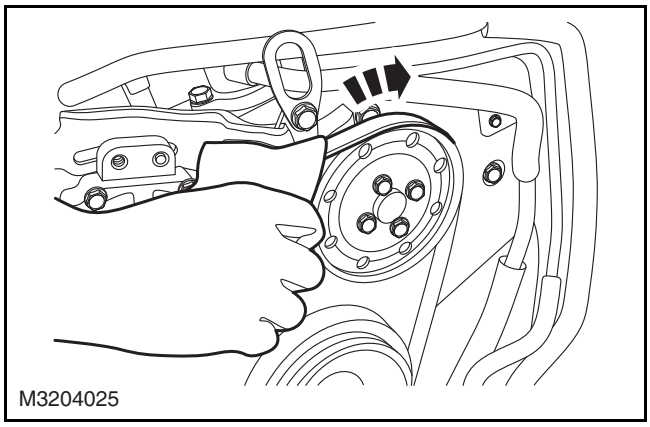



2 Loosen the compressor adjusting bracket bolts (1) and (2) in sequence.

Torque for bolt (1): 25 ± 1 Nm

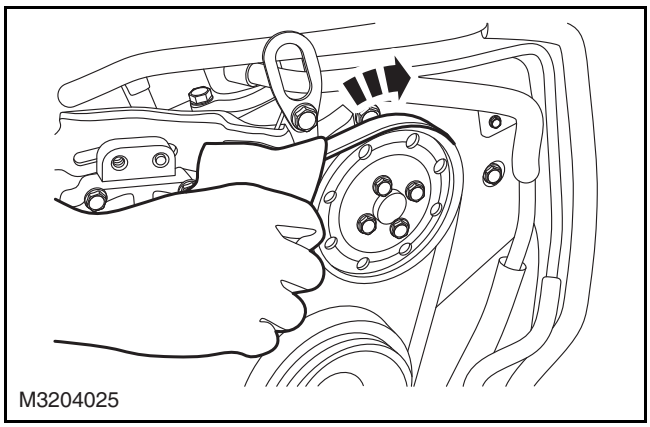



3 Turn the water pump pulley to engine side until the compressor belt can be removed.




**6.** Remove the elastic belt. (Models without A/C)

1 Turn the water pump pulley to engine side until the compressor belt can be removed.



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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect the accessory drive belt tension.**

**Refer to: Accessory Drive Belt Inspection (3.2.2 Mechanical System, General Inspection).**

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# Engine Assembly

## Removal

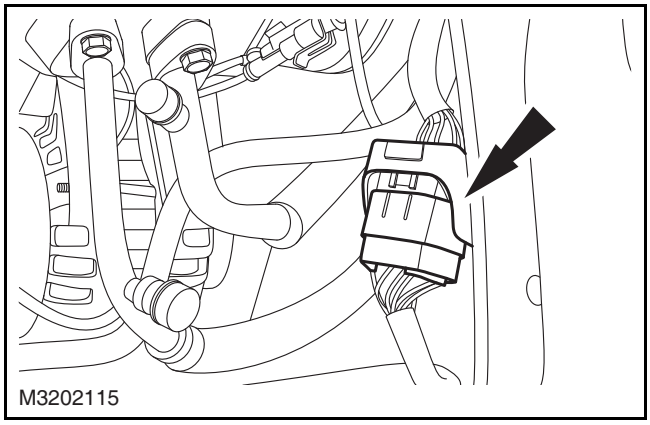
1. Release the fuel pressure.

   **Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**

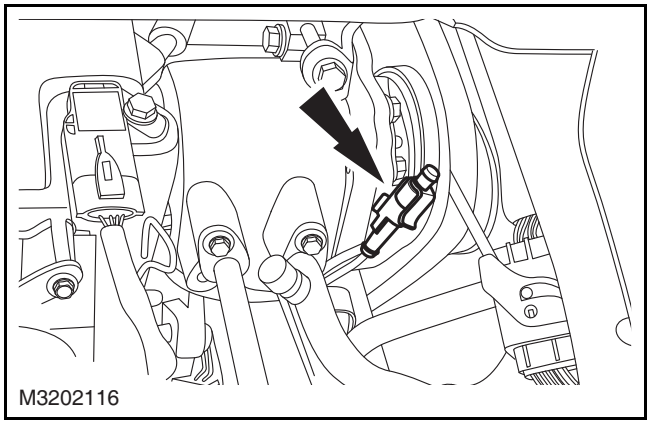
2. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

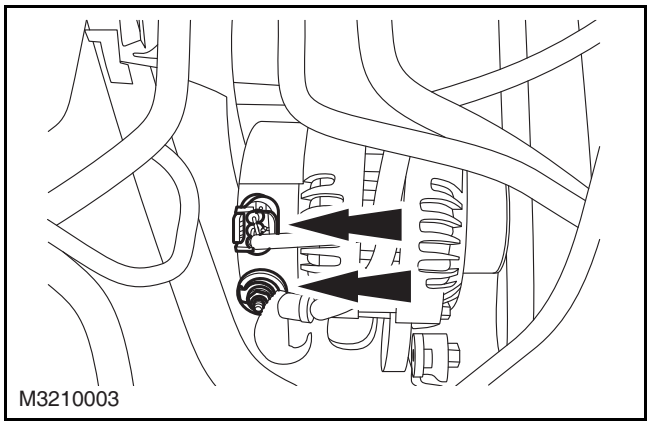
3. Disconnect the engine wiring harness connector.


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4. Disconnect the A/C compressor magnetic clutch wiring harness connector.


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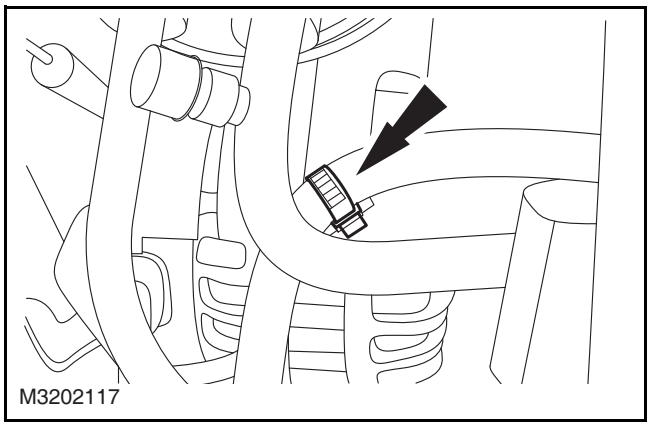
5. Disconnect the alternator wiring harness connector and remove the alternator charging cable bolt.


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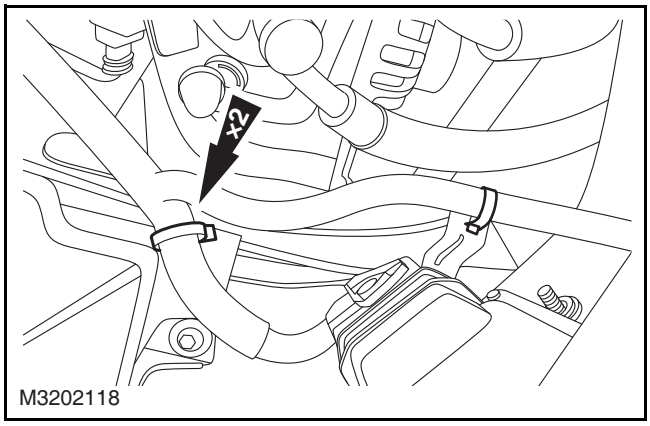
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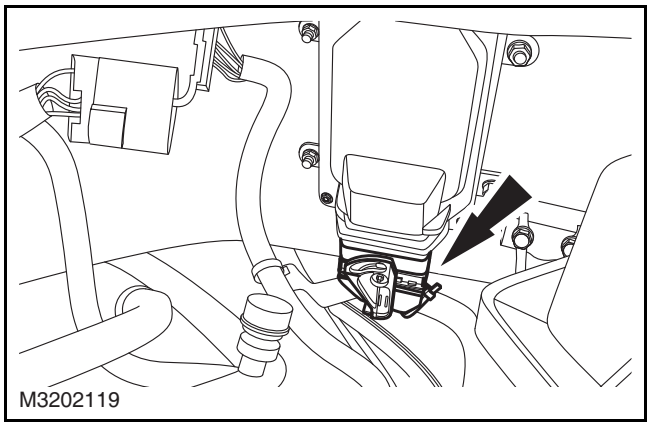
**6.** Disengage the alternator wiring harness retaining clamp.




**7.** Disengage 2 engine wiring harness retaining clamps.

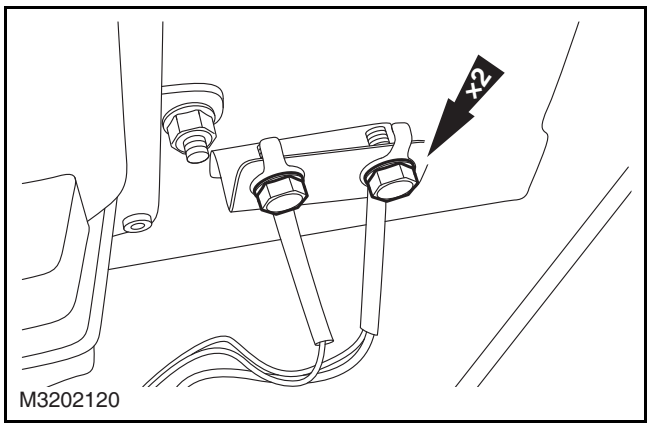



**8.** Disconnect the ECM wiring harness connector.




**9.** Disconnect 2 engine wiring harness grounding points.

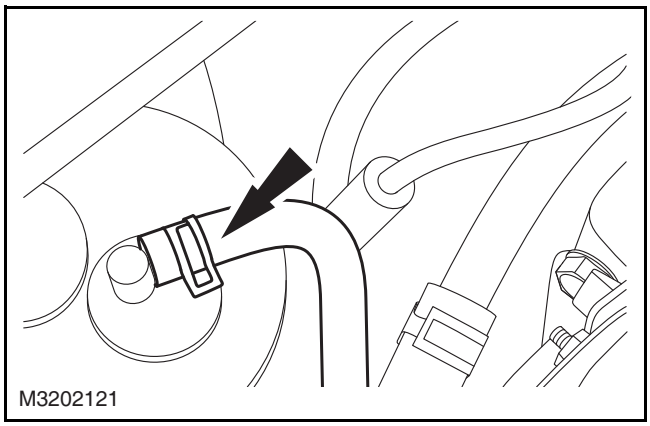
Torque: 10 ± 1 Nm



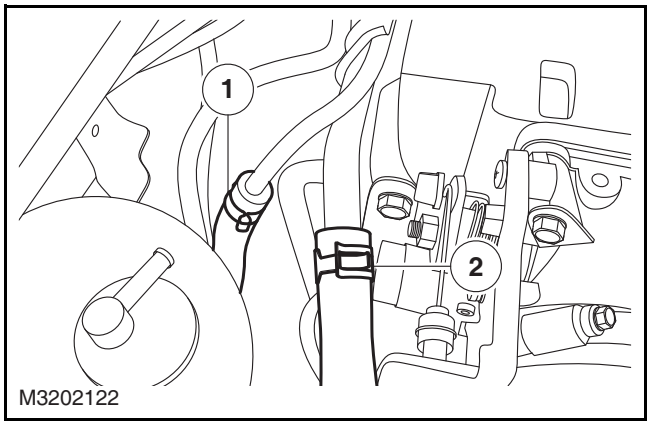
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10. Loosen the hoop and disconnect the connecting hose between carbon canister and carbon canister control valve.


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11. Loosen the hoop and disconnect the delivery hose (1) from the crankcase vent pipe and fuel main pipe.
12. Loosen the hoop and disconnect the crankcase vent hose (2) from the crankcase vent pipe and fuel main pipe.



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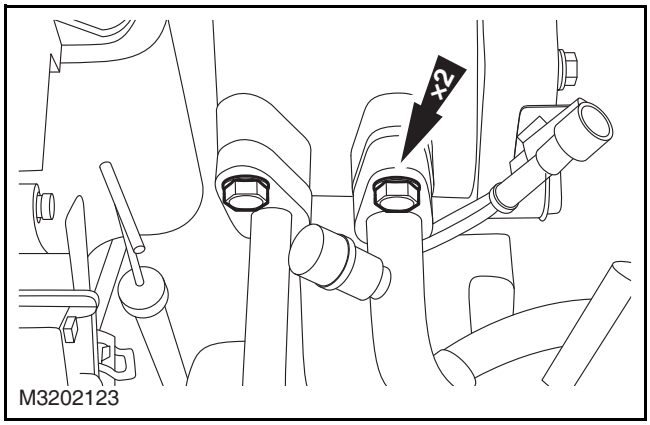
13. Remove the throttle body.

**Refer to: Throttle Body (3.2.5 Air Intake System, Removal and Installation).**

14. Recover the A/C refrigerant.

**Refer to: A/C Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

15. Remove the connecting bolts between A/C high/low pressure pipe and A/C compressor.



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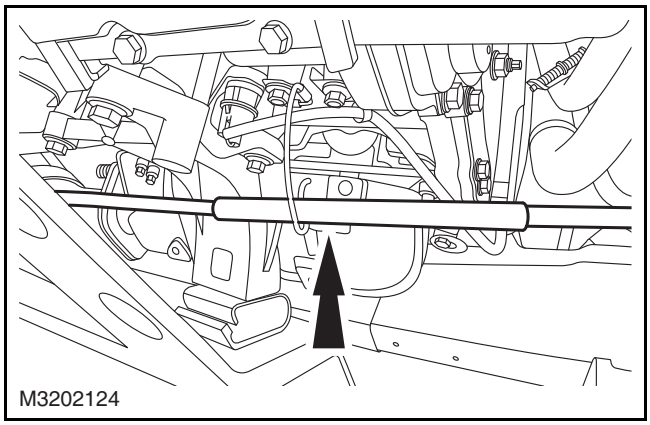
**16.** Lift the vehicle.

**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

**17.** Drain the engine oil.

**Refer to: Engine Oil Change (3.2.3 Lubrication System, General Inspection).**

**18.** Move the clutch cable out of the way.

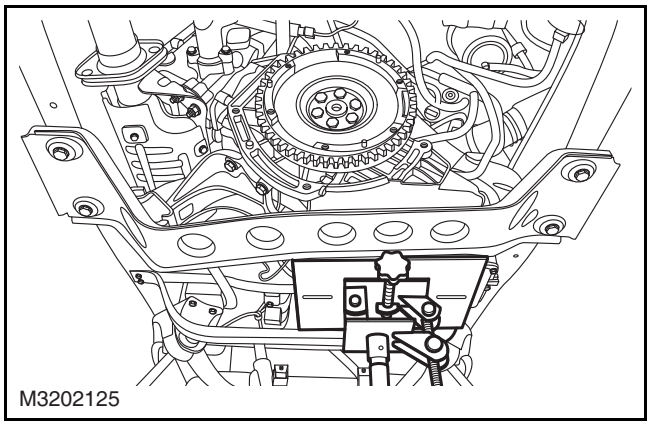

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**19.** Remove the manual transmission.

**Refer to: Manual Transmission (3.2.3 Manual Transmission, Removal and Installation).**

**20.** Support the engine assembly with the flat jack.

**WARNING: Make sure that the contact between jack worktable and engine assembly is secure, or it may cause personal injury.**


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**21.** Drain the engine coolant.

**Refer to: Coolant Draining and Filling (3.2.4 Cooling System, General Inspection).**

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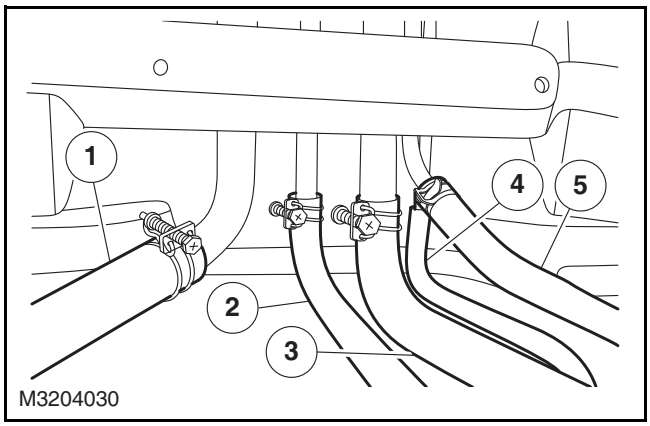
**22.** Loosen the clamp and disconnect the connecting hose (1) between rear end of floor water pipe and engine water inlet pipe.

**23.** Loosen the clamp and disconnect the connecting hose (2) between rear end of floor water pipe and A/C heater core.

**24.** Loosen the clamp and disconnect the connecting hose (3) between rear end of floor water pipe and engine water outlet pipe.

**25.** Disconnect the connecting hose (4) between rear end of floor water pipe and reservoir.

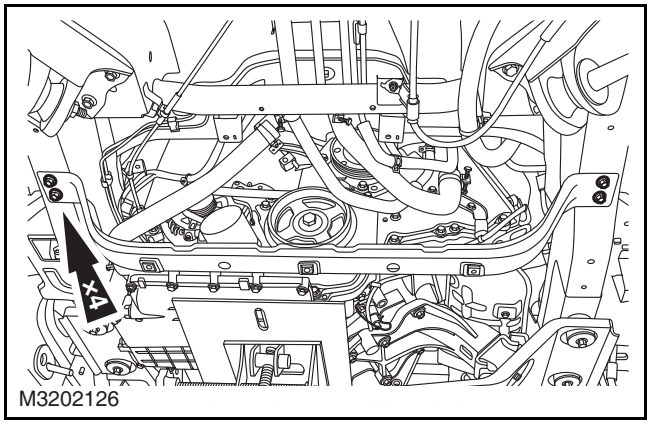
**26.** Loosen the hoop and disconnect the connecting hose (5) between rear end of floor water pipe and the intake manifold.



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**27.** Remove 4 retaining bolts from rear wind guiding cover bracket.

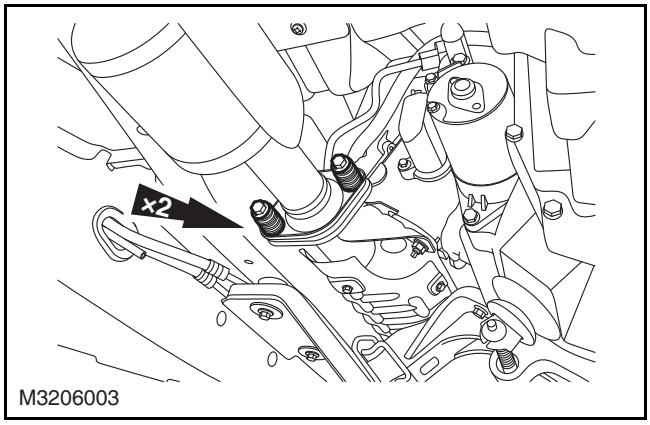
Torque: 25 Nm



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**28.** Remove 2 connecting bolts between exhaust manifold and three-way catalytic converter.

Torque: 55 ± 5 Nm



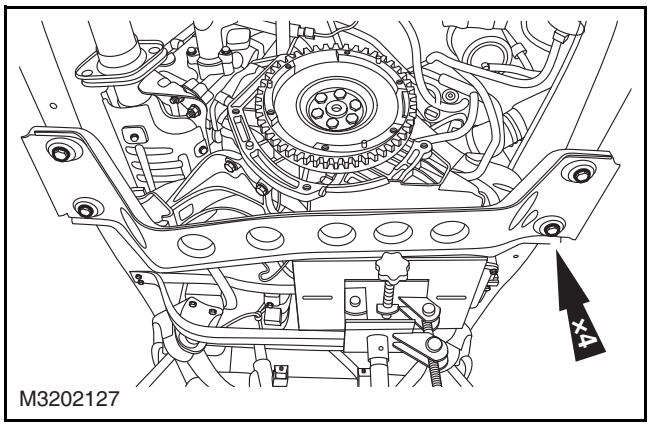
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**29.** Remove 4 engine bracket retaining bolts.

Torque: 55 ± 10 Nm




**30.** Lift the vehicle slowly to separate the engine assembly from the frame.

**CAUTION: During lifting, be aware of preventing the engine assembly from inclining on the jack worktable and any interference of joints connecting the engine assembly and frame.**

## Installation

**1.** Installation is in the reverse order of removal.

**CAUTION: Adjust the clutch pedal stroke after installation. Be sure to adjust it to a proper position as specified, as excessive pedal free play may cause gear shifting noise or disengagement failure and insufficient free play may cause severe wear of friction disc, lack of power, and even burnout of friction disc.**

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# Flywheel

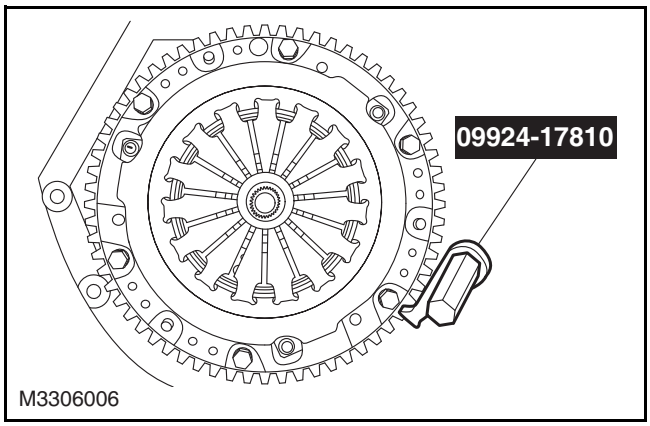
## Removal

1. Remove the manual transmission.

   **Refer to: Manual Transmission (3.2.3 Manual Transmission, Removal and Installation).**

2. Use a suitable tool to lock the flywheel.

   Special tool: 09924-17810

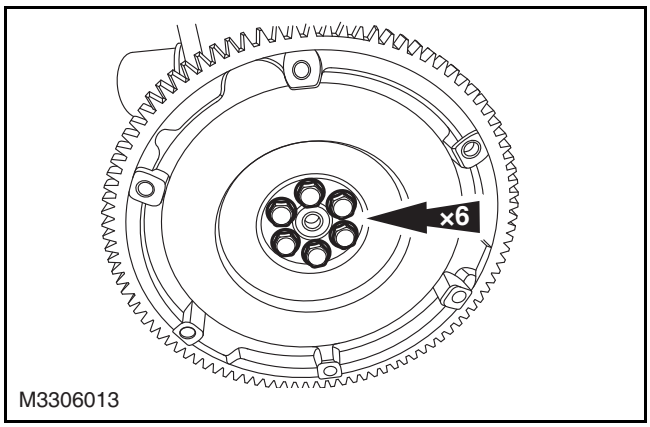



3. Remove the clutch pressure plate and clutch driven disc assembly.

   **Refer to: Clutch Pressure Plate Assembly, Clutch Driven Disc Assembly (3.2.2 Clutch, Removal and Installation).**

4. Remove 6 flywheel retaining bolts.

   Torque: 74 ± 2 Nm



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## Installation

**CAUTION: Make sure the flywheel and pressure plate surfaces are clean and completely dry before assembly.**

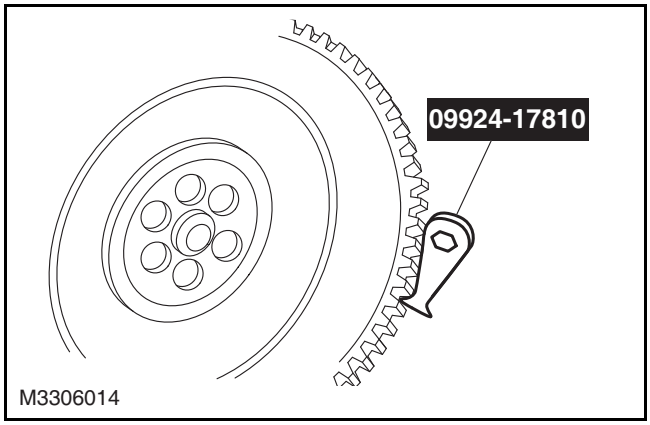
**CAUTION: The flywheel bolt has sealant with itself, and make sure the sealant is continuous with no cracks before assembly.**

**CAUTION: As the flywheel is a non-reusable part, clean the installation hole and replace the flywheel with a new one after removal.**

1. Install the flywheel to crankshaft and tighten it to the specified torque.

   Special tool (A): 09924-17810

   Torque: 74 ± 2 Nm

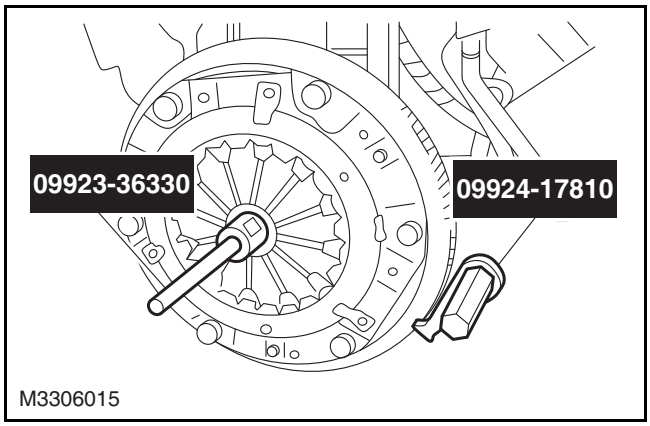



2. Use the special tool to align the clutch driven disc with the center of flywheel, install the clutch pressure plate assembly and bolts, then tighten them to the specified torque.

   Torque: 32 ± 2 Nm

**CAUTION: When tightening the clutch pressure plate retaining bolts, use the special tool to press the clutch driven disc tightly so that the clutch driven disc assembly is aligned with the center of flywheel.**

**CAUTION: Tighten the clutch pressure plate retaining bolts evenly in the diagonal order.**




Special Tool

(A): 09924-17810

(C): 09923-36330

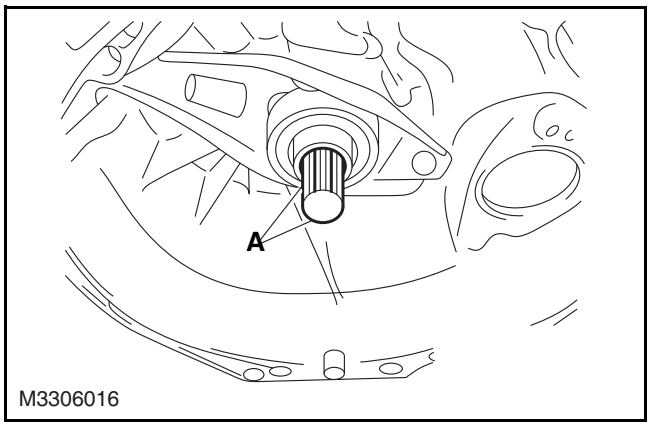
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3. Apply a small amount of grease to input shaft and then connect the transmission assembly and engine.

   "A": Grease 99000-25210

**CAUTION: While inserting the transmission input shaft into the clutch driven disc assembly, use a wrench to turn the crankshaft from the front side until the splines are engaged.**



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# Cylinder Head Cover

## Removal

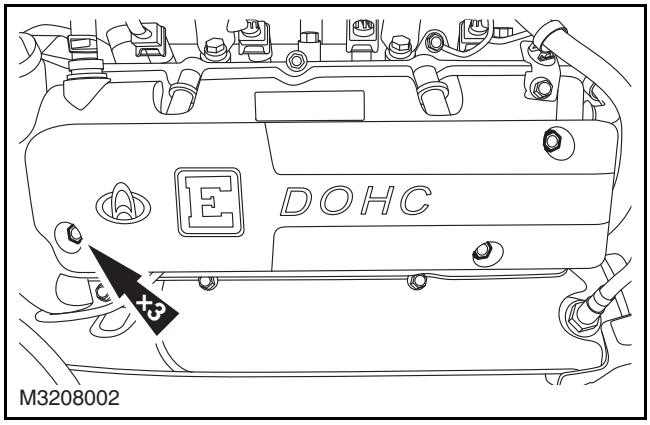
1. Remove the battery.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Remove the engine trim cover.

   1 Remove 3 engine trim cover retaining bolts.

   Torque: 10 ± 1 Nm



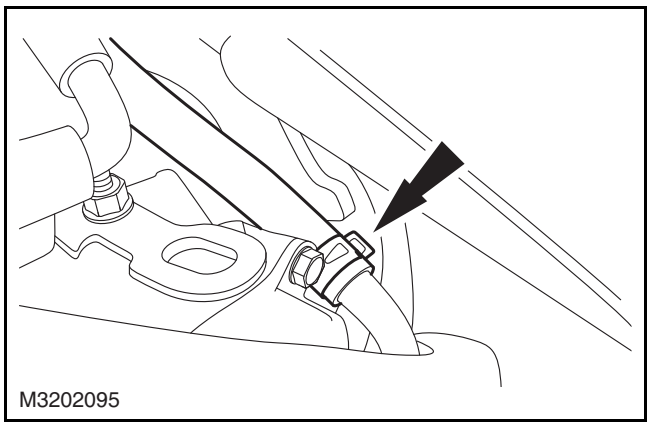

3. Remove the ignition coil.

   **Refer to: Ignition Coil (3.2.8 Ignition System, Removal and Installation).**

4. Remove the PCV valve.

   **Refer to: PCV Valve (3.2.11 Emission Control System, Removal and Installation).**

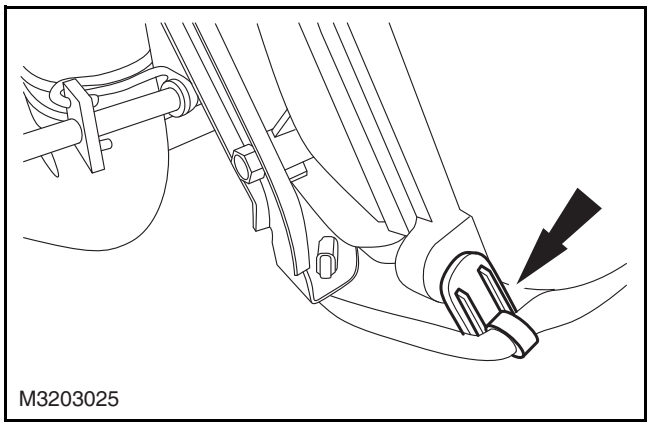
5. Loosen the hoop and disconnect the No.1 vent pipe.



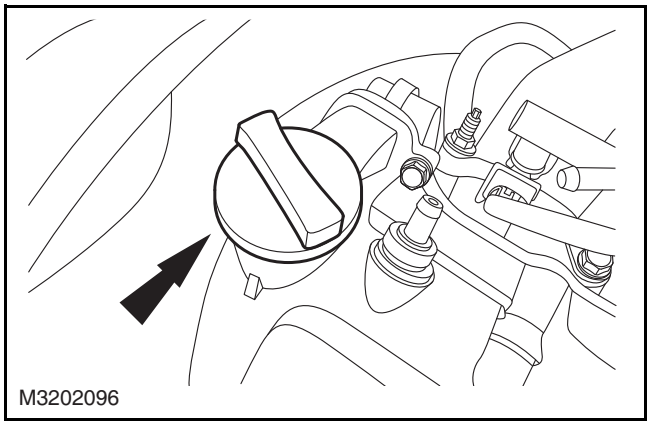
https://truckmanualshub.com/



**6.** Disengage the engine wiring harness retaining clamp.

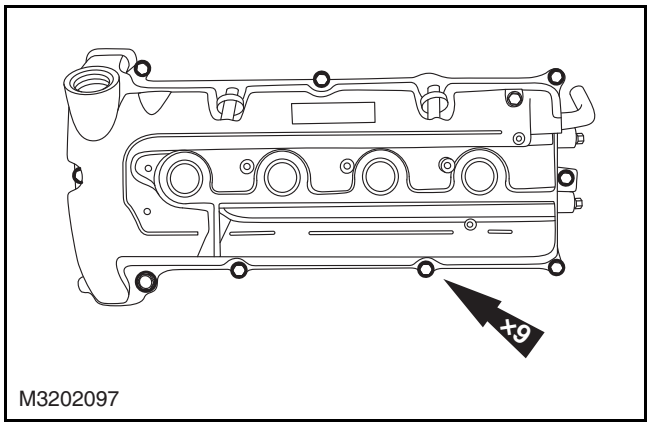

M3203025

**7.** Remove the engine oil filler cap assembly.


M3202096

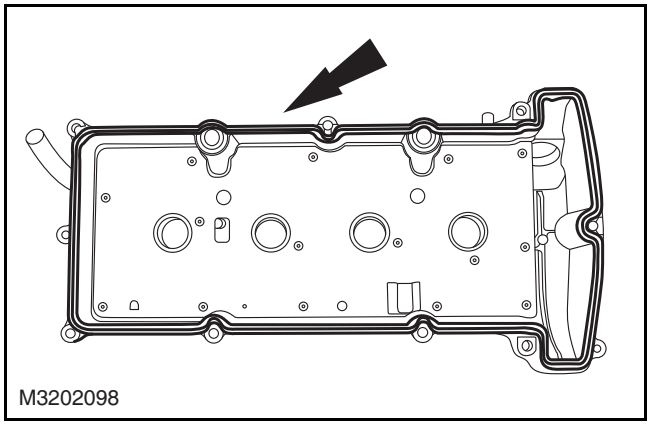
**8.** Remove the cylinder head cover.

1 Remove 9 retaining bolts from the cylinder head cover.



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2 Remove the gasket from the cylinder head cover.


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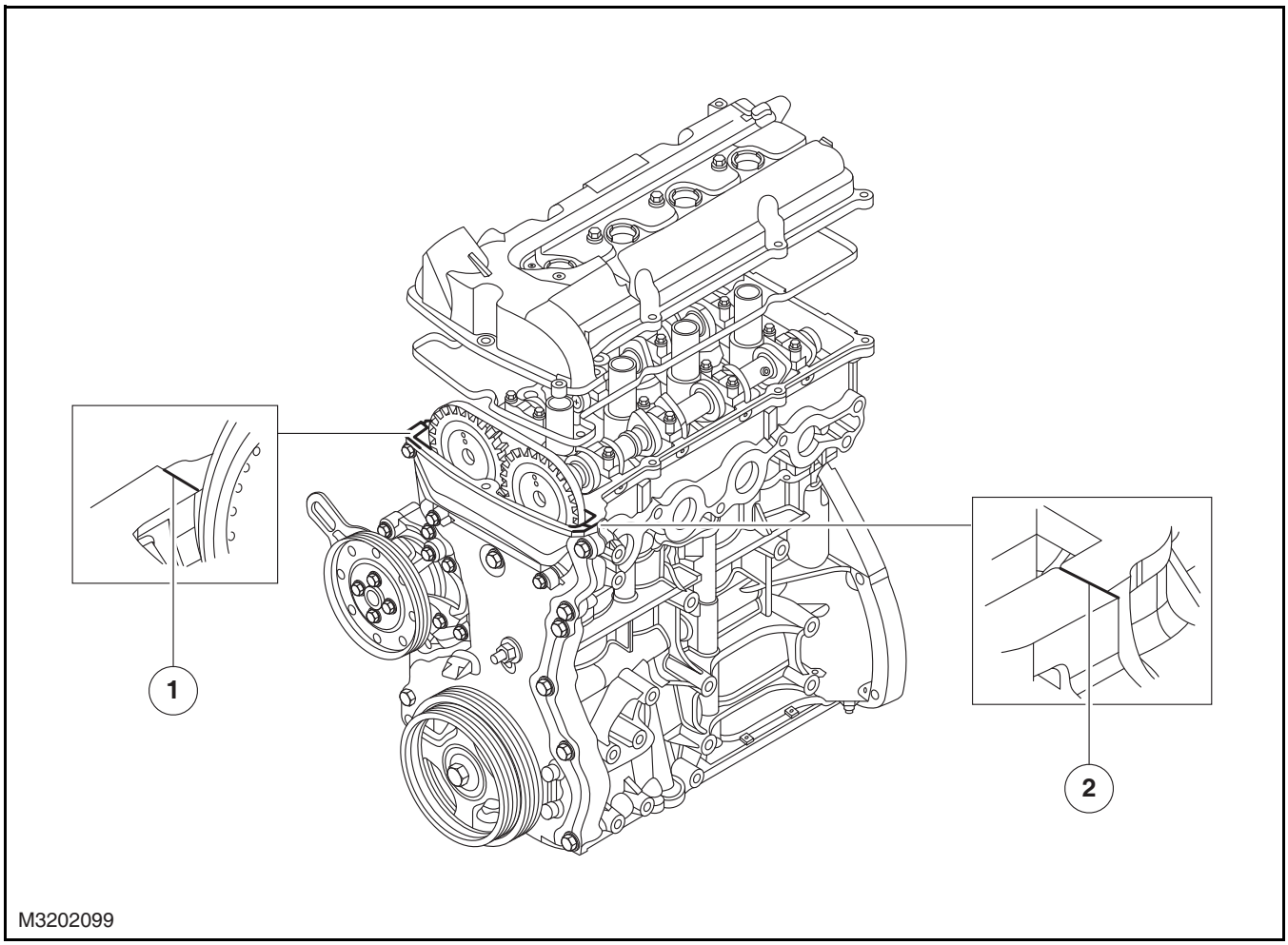
## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Before installation, inspect each part for defects or damages, and replace immediately if found.**

**CAUTION: Carefully inspect if the gasket on the cylinder head cover is installed smoothly. Before installing the cylinder head cover gasket, inspect that there is no foreign matter in the installation groove of gasket, and no oil and foreign matter on the surface of gasket.**

Apply sealant (Tonsan 1596Fa) to the contact surface between cylinder head subassembly and oil pump timing chain housing assembly during installation. Install the cylinder head cover within 5 minutes after applying sealant to positions (1) and (2) as shown in the figure.



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# Camshaft

## Removal

1. Remove the engine assembly.

   **Refer to: Engine Assembly (3.2.2 Mechanical System, Removal and Installation).**

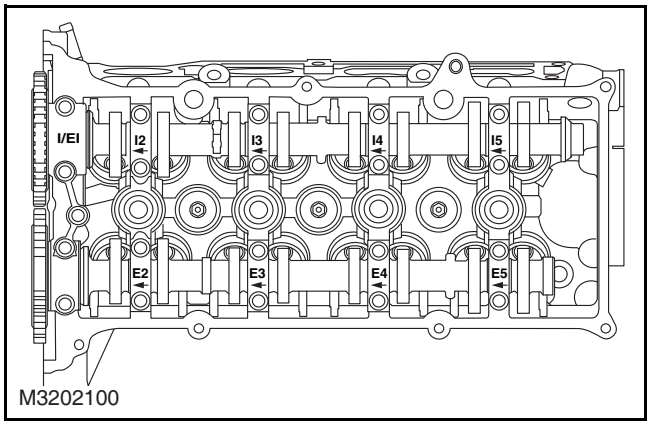
2. Remove the cylinder head cover.

3. Remove the timing chain.

   **Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**

4. Remove the camshaft.

   1 Remove the camshaft bearing cap bolts in the following order: E5 → I5 → E2 → I2 → E4 I4 → I/E1 → E3 → I3, then remove the camshaft bearing caps in sequence.



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   2 Carefully remove the intake and exhaust camshafts.

**CAUTION: Keep the camshaft assembly working surface clean and do not impact or scratch it.**

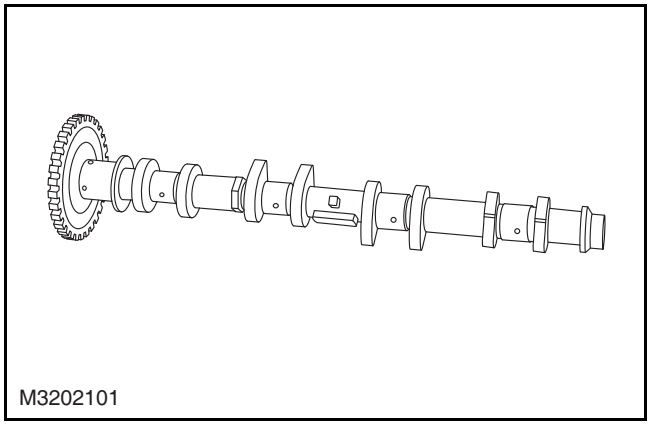
https://truckmanualshub.com/



## Inspection

1. Inspect the camshaft journals and bearing caps for rust, scratches, abrasions or damages.

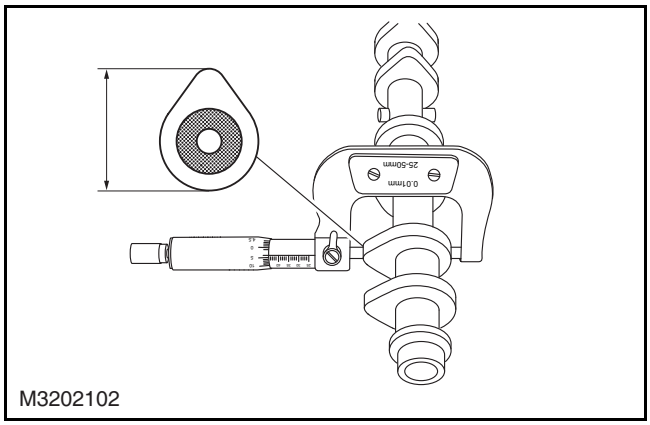
**CAUTION: If any defect is found, replace the camshaft or cylinder head and camshaft bearing cap. Never replace the cylinder head without replacing the camshaft bearing cap, or vice versa.**



M3202101

2. Use the micrometer to measure the cam lift. If the measured lift is less than the limit, replace the camshaft.

| Item | Standard |
|---|---|
| Intake cam lift | 27.000 ~ 27.021 mm |
| Exhaust cam lift | 22.934 ~ 22.955 mm |



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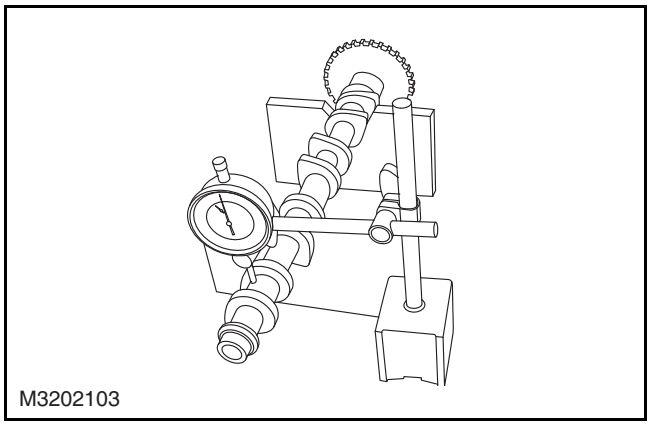
3. Inspect the camshaft radial runout.

**CAUTION: Place the camshaft between two V-blocks and then measure the radial runout with a dial indicator. If the radial runout is more than the limit, replace the camshaft.**

1 Radial runout limit for No.1 and No.5 journals: 0.03 mm.

2 Radial runout limit for No.2, No.3 and No.4 journals: 0.015 mm.

3 Select a piece of plastic feeler gauge with the same width as the camshaft journal and place it parallel to the camshaft.



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**4.** Use the plastic feeler gauge to inspect the clearance as follows:

1 Clean the camshaft bearing caps and journals.

2 Install the camshaft to the cylinder head.

3 Place a piece of plastic feeler gauge with the same width as the camshaft journal (parallel to the camshaft).

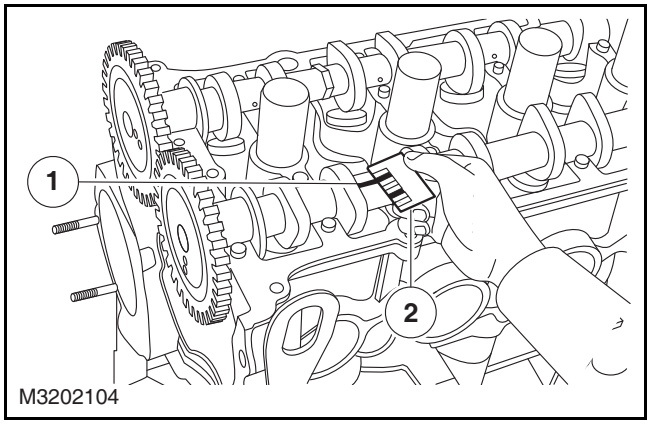
4 Install the camshaft bearing caps and tighten the bearing cap bolts.

**Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**

**CAUTION: Do not rotate the camshaft.**

5 Remove the camshaft bearing caps and measure the clearance width (1) of feeler gauge (2) at its widest point.

| | Standard | Limit |
|---|---|---|
| Clearance | 0.045 ~ 0.087 mm | 0.117 mm |



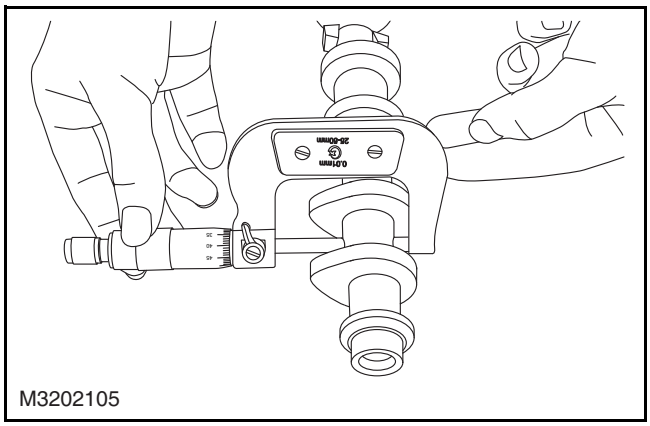
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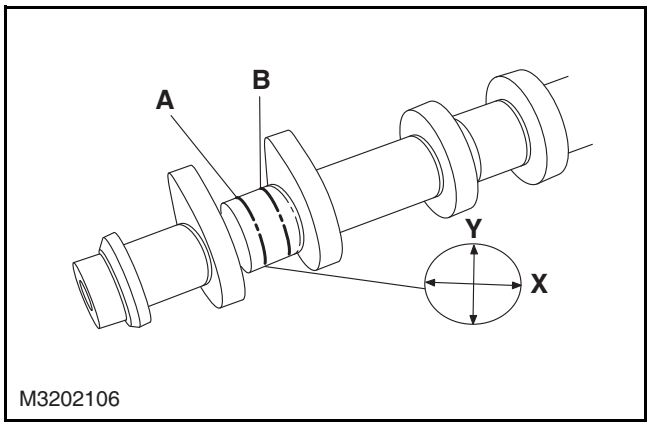
**5.** If the actually measured camshaft journal clearance is more than the limit, measure the camshaft journal outer diameter. If the difference from specifications is large, replace the camshaft.

Measure the camshaft journal outer diameter along the X-axis and Y-axis at sections A and B as shown in the figure.

| Item | Standard |
|---|---|
| Cylinder head camshaft bore diameter | 27.000 ~ 27.021 mm |
| Camshaft journal outer diameter | 22.934 ~ 22.955 mm |



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## Installation

**CAUTION: When installing the camshaft, make sure that each cylinder piston is mainly at the same height.**

**CAUTION: Be careful to distinguish intake and exhaust camshafts, as the intake camshaft is longer than the exhaust camshaft.**

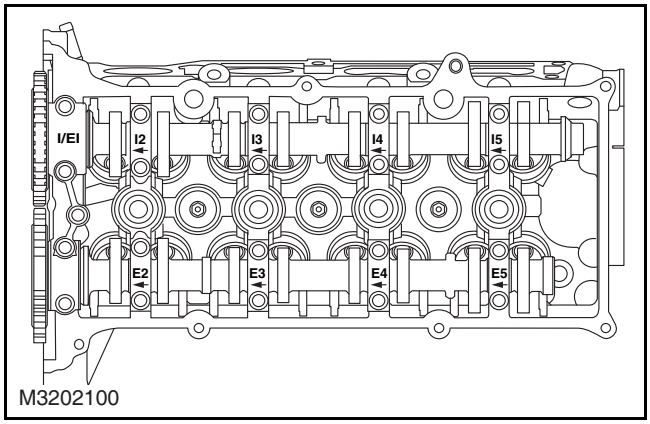
**CAUTION: The applied engine oil should be the one used for the engine: SL 5W-30.**

**CAUTION: Be careful to inspect that the high pressure relief plug is installed if the cylinder head has been replaced.**

1. Apply engine oil to the cams and journals of intake and exhaust camshafts, camshaft bearing seat of cylinder head and valve tappet.
2. Place the camshaft on the cylinder head and then install the camshaft bearing caps to the camshaft and cylinder head.
3. Make sure that there are no scratches, rust on the installation surface of camshaft bearing caps, which should be installed in the specified order as the direction of arrow.
4. Install the camshaft bearing cap bolts and tighten them in the following order: I3 → E3 → I/E1 → I4 → E4 → I2 → E2 → I5 → E5. Pretighten the bolts (pretightening torque must be less than tightening torque) before tightening them to the specified torque.

   Torque: 13 ± 1 Nm

**CAUTION: After tightening the camshaft bearing cap bolts, rotate the camshaft and inspect if it becomes stuck. If so, inspect for proper installation, then remove to inspect the matching surface and reinstall it.**



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5. Inspect the valve clearance, and if it is not as required, reselect the suitable tappet. As described above, remove the camshaft and replace the tappet, then reinstall the camshaft to inspect the valve clearance again until it reaches the standard.

   **Refer to: Valve Clearance Inspection and Adjustment (3.2.2 Mechanical System, General Inspection).**

6. Install the timing chain while aligning the timing marks.

   **Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**

7. Install the cylinder head cover.

   **Refer to: Cylinder Head Cover (3.2.2 Mechanical System, Removal and Installation).**

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# Timing System

## Removal

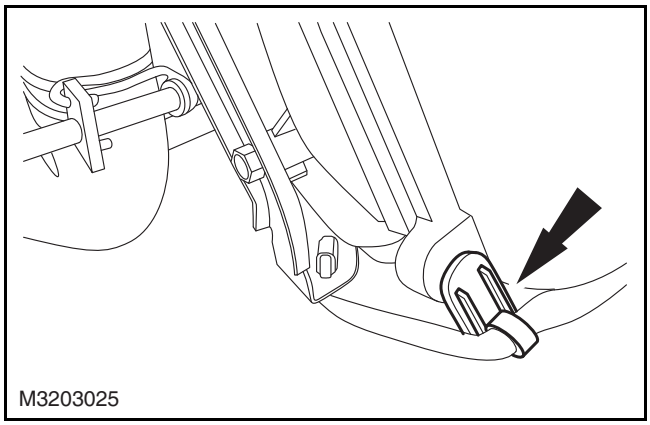
**Note: A lifetime maintenance-free timing system is used for EA12 engine, and unnecessary removal of the timing system is not recommended.**

1. Remove the engine assembly.

   **Refer to: Engine Assembly (3.2.2 Mechanical System, Removal and Installation).**

2. Remove the water pipe.

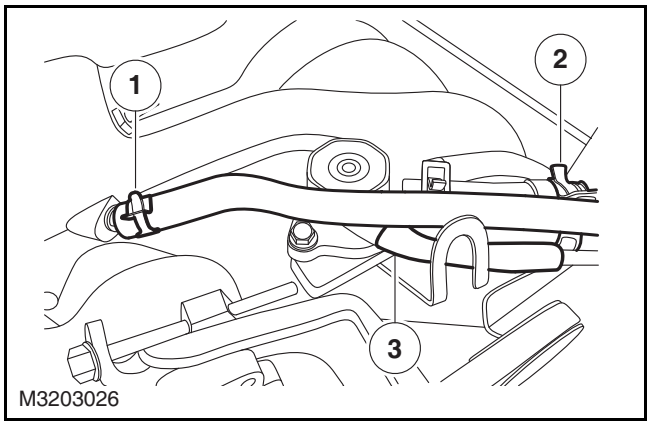
   1 Disengage the engine wiring harness retaining clamp.


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   2 Loosen the hoop and disconnect the intake manifold from the vacuum booster hose (1).

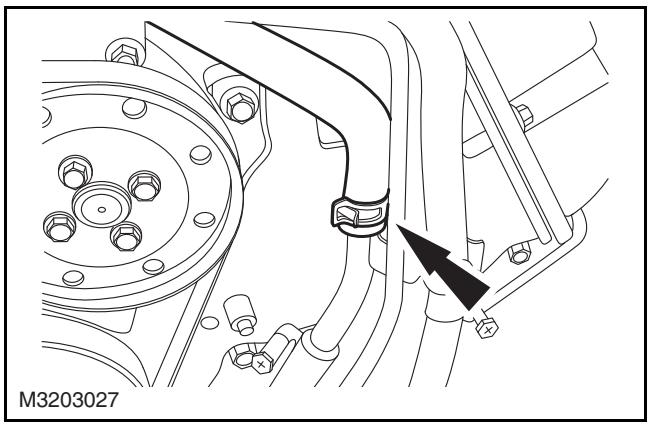
   3 Loosen the hoop and disconnect the water pipe from the top radiator hose (2).

   4 Disconnect the water pipe from the No.2 water outlet pipe (3).



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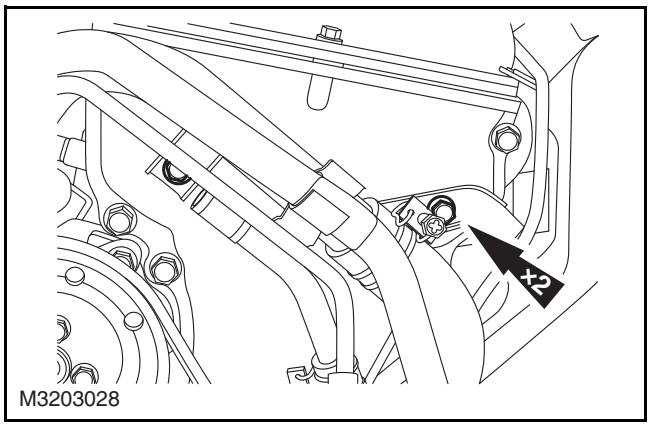
   5 Loosen the hoop and disconnect the water pipe from the A/C heater outlet pipe.


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6 Remove 2 water pipe retaining bolts.



M3203028

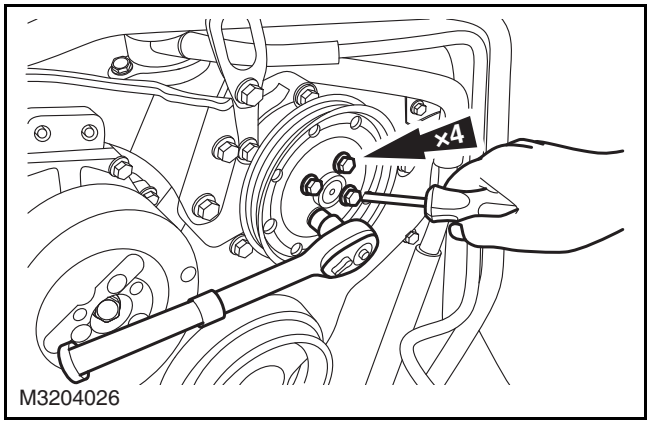
**3.** Remove the accessory drive belt.

**Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**

**4.** Remove the water pump pulley.

1 Using a screwdriver, position the water pump pulley and remove the water pump pulley retaining bolts in sequence with a ratchet wrench.

Torque: 10 ± 1 Nm

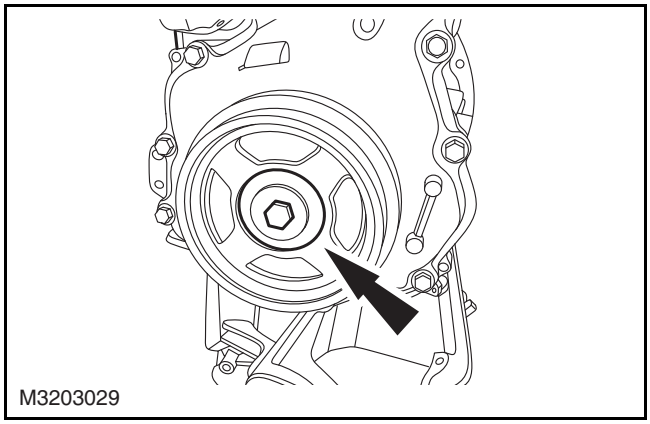


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**5.** Remove the cylinder head cover.

**Refer to: Cylinder Head Cover (3.2.2 Mechanical System, Removal and Installation).**

**6.** Remove the crankshaft pulley.


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7. Remove the oil pan lower part.

   **Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

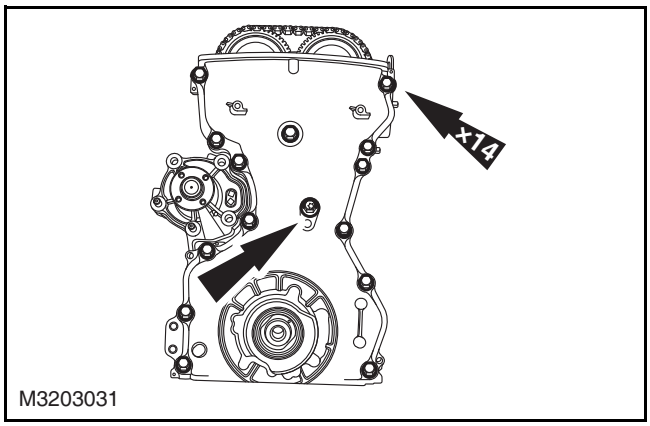
8. Remove the oil pan upper part.

   **Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

9. Remove the oil pump timing chain housing.

   1 Remove 14 retaining bolts and 1 connecting nut from the oil pump timing chain housing.

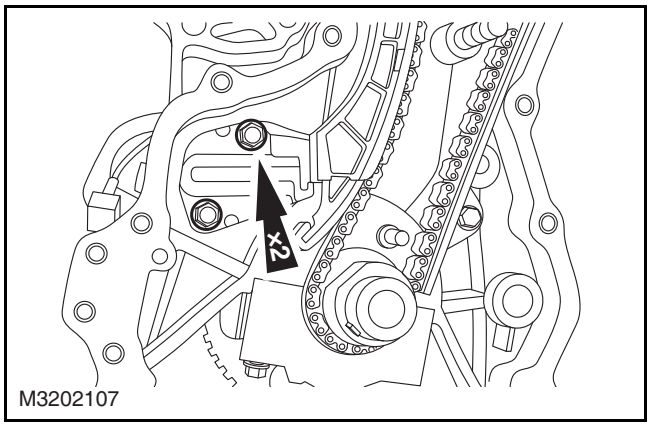
**CAUTION: The crankshaft front oil seal cannot be reused if removed. Replace the crankshaft front oil seal with new one when installing.**



M3203031

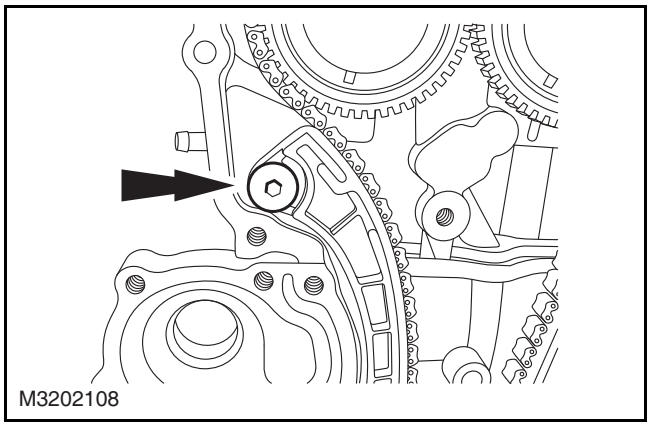
10. Remove the timing chain.

    1 Remove 2 retaining bolts from the hydraulic tensioning adjuster.



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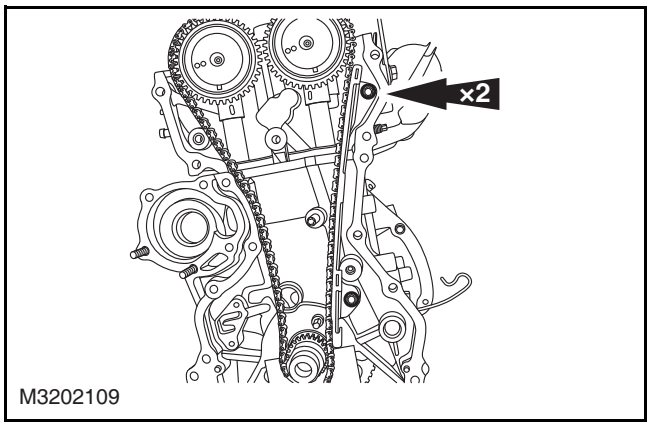
    2 Remove the timing chain slide rail assembly bolt.


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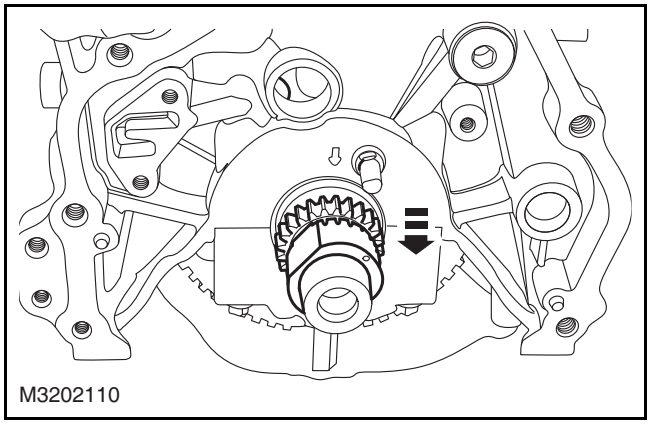
3 Remove 2 retaining bolts from the chain guide rail assembly.



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4 Remove the timing chain.

5 Remove the crankshaft timing sprocket.


M3202110

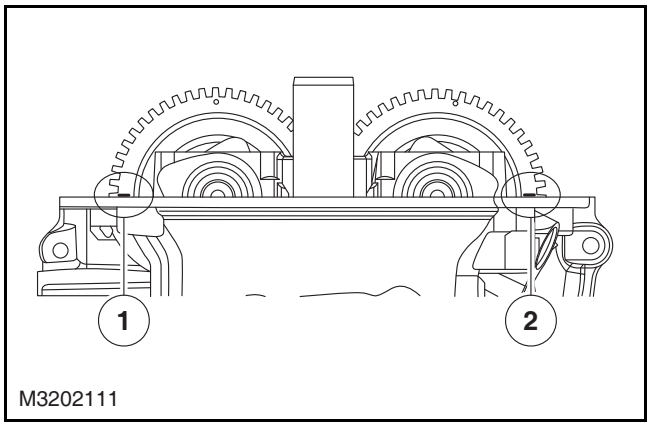
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## Installation

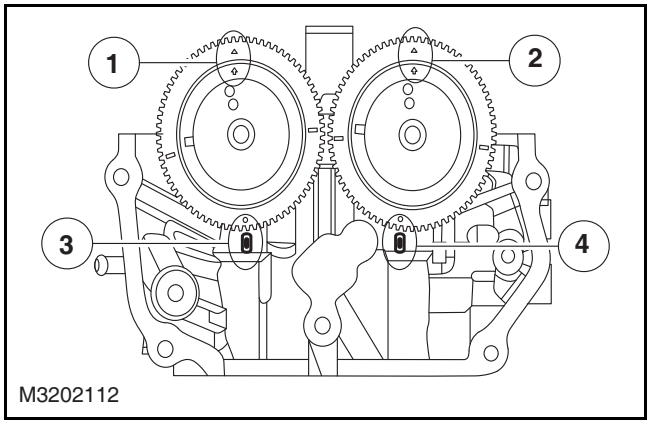
**1.** Align the timing marks.

1 Rotate the camshaft so that the intake and exhaust valves of 4 cylinders are closed (available only with a slight rotation angle, not too much), rotate the crankshaft so that 4 pistons are at the same height, where the woodruff key is facing the both sides of engine. Rotate the camshaft to align the timing marks.



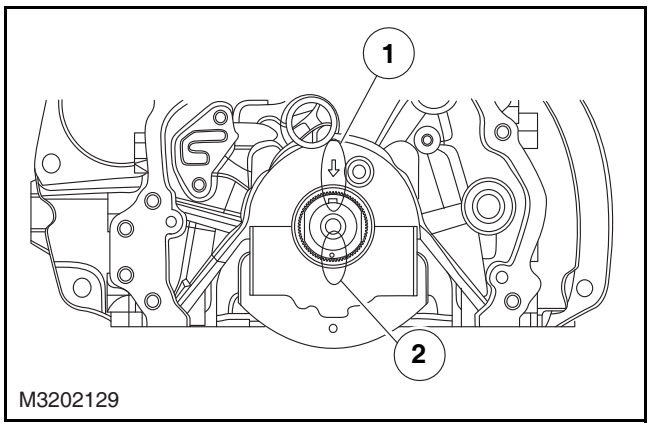
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| | |
|---|---|
| 1 | Intake camshaft assembly timing mark |
| 2 | Exhaust camshaft assembly timing mark |
| 3 | Intake camshaft assembly timing mark |
| 4 | Exhaust camshaft assembly timing mark |



M3202112

2 Rotate the crankshaft so that the woodruff key at the front end of crankshaft is aligned with the arrow mark on the crankcase and the 4th cylinder piston is at the top dead center as shown in the figure.



M3202129

| | |
|---|---|
| 1 | Crankshaft woodruff key faces upward and aligns with the crankcase mark |
| 2 | Timing mark point |

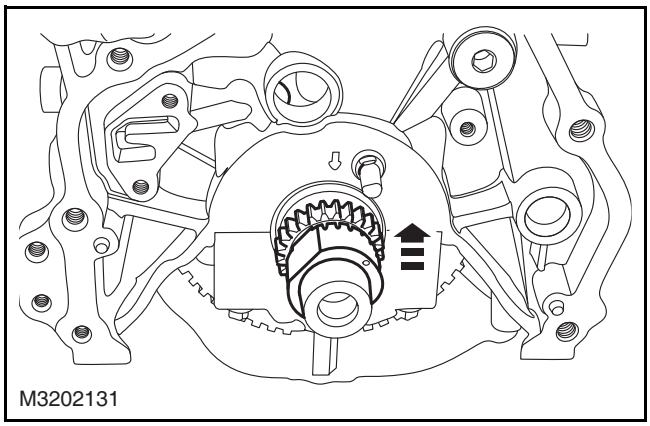
https://truckmanualshub.com/



**2.** Install the timing system.

1 Install the crankshaft timing sprocket.

**CAUTION: Align the square key groove of crankshaft timing sprocket with the square key on the crankshaft.**

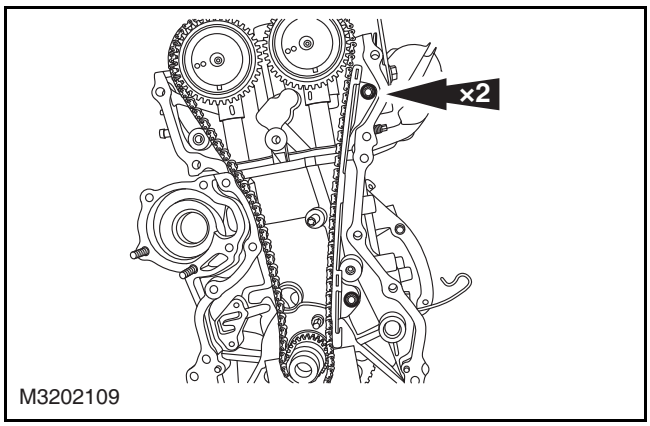


M3202131

2 Install the timing chain.

3 Install 2 chain guide rail assembly retaining bolts.

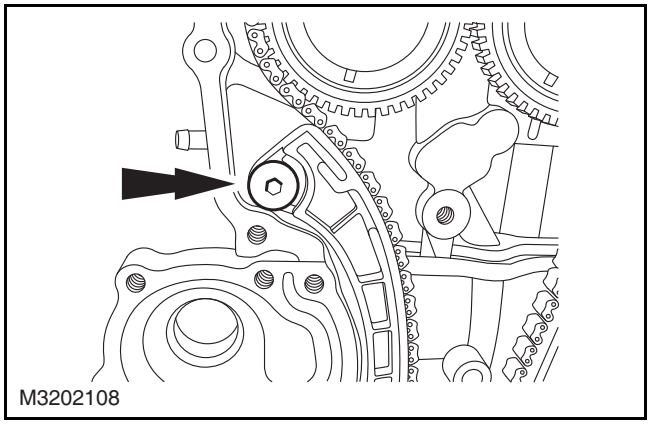
Torque: 10 ± 1 Nm




M3202109

4 Install the chain slide rail assembly bolt.

Torque: 23 ± 2 Nm



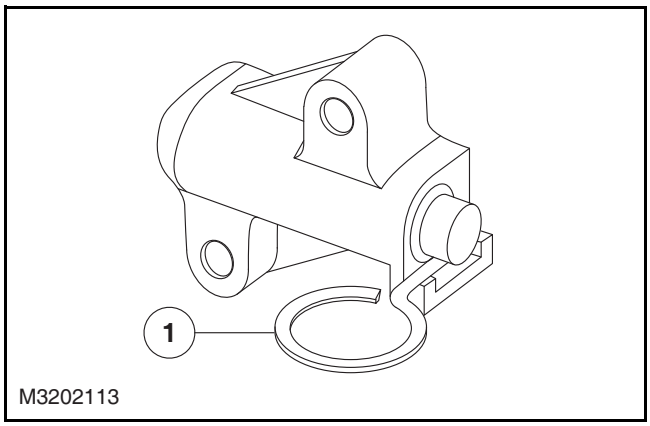
M3202108

5 Inspect if the timing marks are aligned, and if not, align again.

https://truckmanualshub.com/

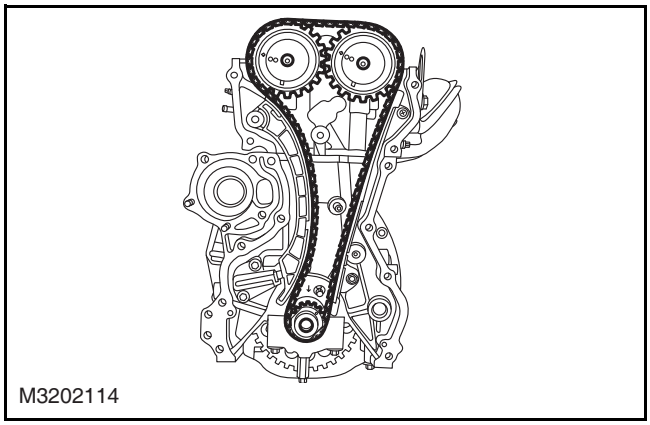


6 Install the hydraulic tensioning adjuster assembly and make sure to pull out the lock pin (1) when the chain is set between chain slide rail and chain guide rail. At that time, inspect the hydraulic tensioning adjuster piston and chain slide rail assembly for proper contact.



M3202113

7 Respectively dip (apply) engine oil onto the points where the intake and exhaust camshaft sprockets, chain slide rail assembly, chain guide rail assembly, crankshaft timing sprocket and chain assembly are engaged.


M3202114

3. Install the oil pump timing chain housing.

   **Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**

4. Install the oil pan upper part.

   **Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

5. Install the oil pan lower part.

   **Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

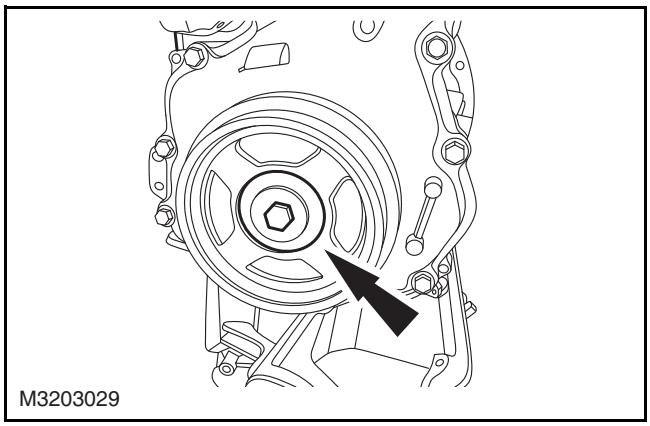
https://truckmanualshub.com/



6. Install the crankshaft pulley.

   Torque: 90 Nm + 90°

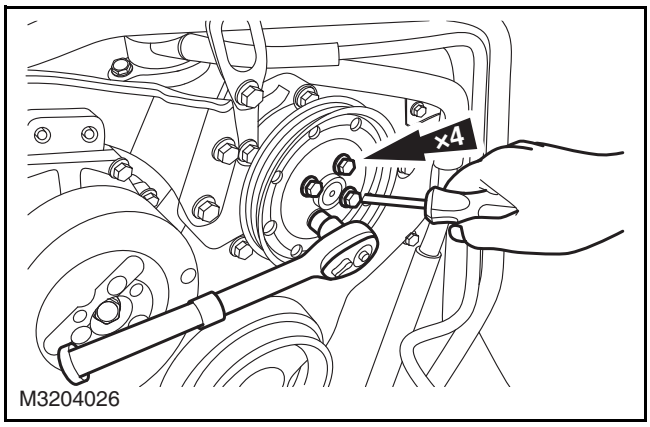
**CAUTION: Align the square key groove of crankshaft pulley with the square key on the crankshaft.**


M3203029

7. Install the water pump pulley.

   1 Using a screwdriver, position the water pump pulley and tighten the water pump pulley retaining bolts in sequence with a ratchet wrench.

   Torque: 10 ± 1 Nm



M3204026

8. Install the accessory drive belt.

   **Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**

9. Install the water pipe.

10. Install the cylinder head cover.

    **Refer to: Cylinder Head Cover (3.2.2 Mechanical System, Removal and Installation).**

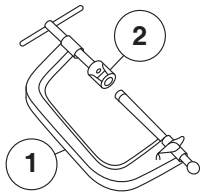
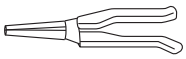
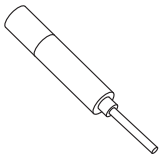
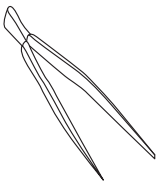
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## Disassembly and Assembly

# Cylinder Head Subassembly and Valve

### Special Tool

| | |
|---|---|
|  <br>09916-14510 | 1. Valve opener<br>09916-14510<br>2. Valve opener holder<br>09916-14910 |
|  <br>CA301-012 | Valve oil seal plier<br>CA301-012 |
|  <br>09916-58210 | Valve guide installer handle<br>09916-58210 |
|  <br>09916-84511 | Tweezer<br>09916-84511 |
|  <br>09917-98221 | Valve stem oil seal installer<br>09917-98221 |

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### General Equipment

| |
|---|
| Dial indicator |
| Micrometer |
| Plastic feeler gauge |
| Straight scale |
| Caliper gauge |
| Vernier caliper |

### Material

| Item | Specifications |
|---|---|
| Sealant | Tonsan 1596Fa<br>Tonsan 1591 |

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## Disassembly

1. Remove the engine assembly.

   **Refer to: Engine Assembly (3.2.2 Mechanical System, Removal and Installation).**

2. Remove the accessory drive belt.

   **Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**

3. Remove the intake manifold.

   **Refer to: Intake Manifold (3.2.5 Air Intake System, Removal and Installation).**

4. Remove the exhaust manifold.

   **Refer to: Exhaust Manifold (3.2.6 Exhaust System, Removal and Installation).**

5. Remove the cylinder head cover.

   **Refer to: Cylinder Head Cover (3.2.2 Mechanical System, Removal and Installation).**

6. Remove the oil pan lower part.

   **Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

7. Remove the oil pan upper part.

   **Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

8. Remove the timing chain.

   **Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**

9. Remove the camshaft.

   **Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**

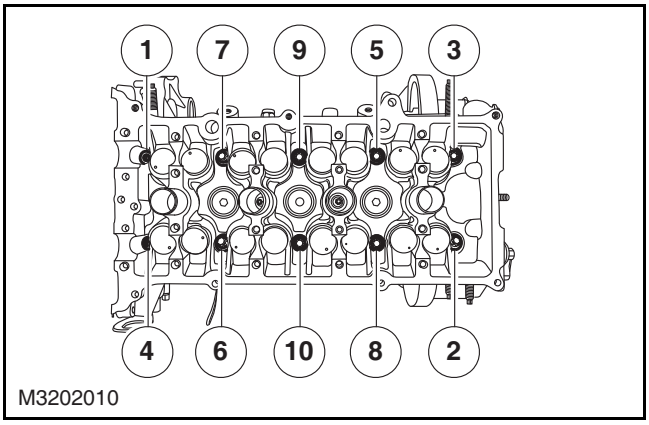
https://truckmanualshub.com/



**10.** Remove the cylinder head subassembly.

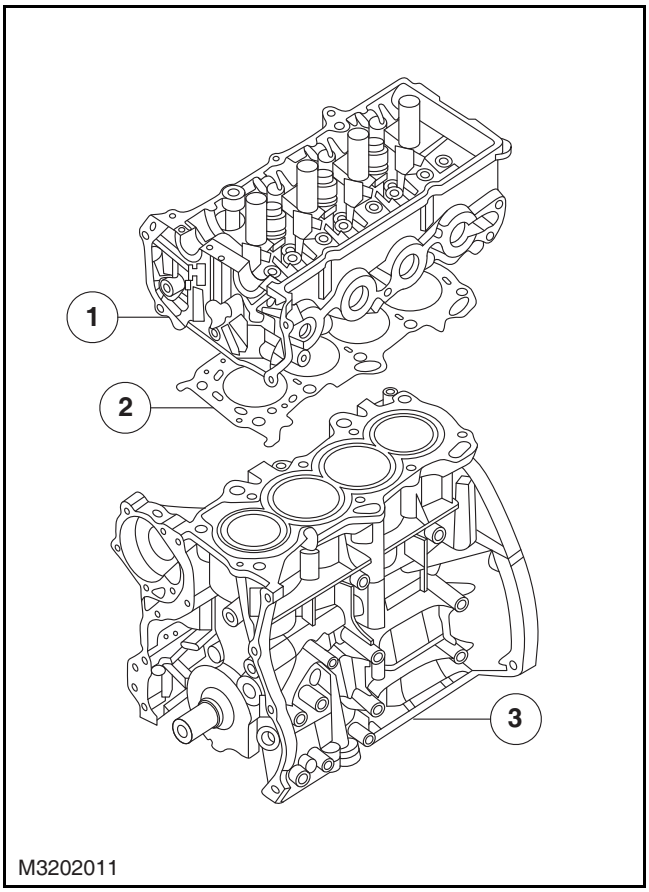
1 Inspect if there is any component that need to be moved or removed around the cylinder head. Please dispose of these components accordingly if necessary.

2 Remove 10 cylinder head connecting bolts in the order shown in the figure.



M3202010

3 Remove the cylinder head subassembly (1) and cylinder gasket assembly (2) from the cylinder block (3).



M3202011

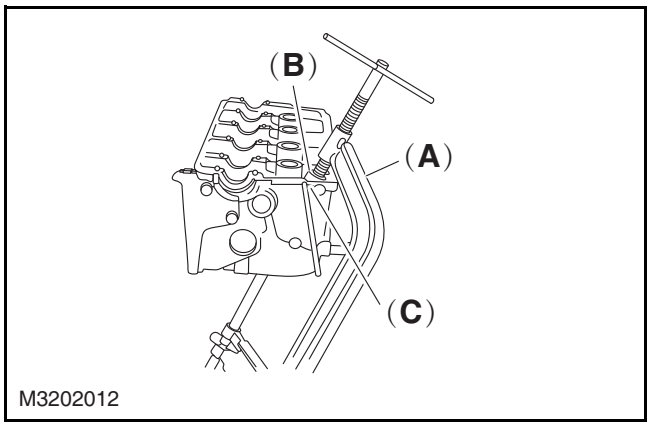
**11.** Use the magnetic finger to remove the tappets one by one, arrange them in order and do not mix them up.

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**12.** Use the valve opener (A) and valve opener holder (B) to squeeze the valve spring (C) as shown in the figure.

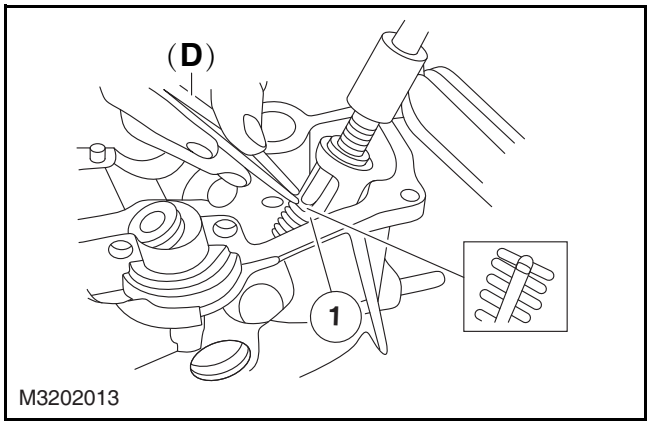
Special tool: Valve opener 09916-14510
Valve opener holder
09916-14910



M3202012

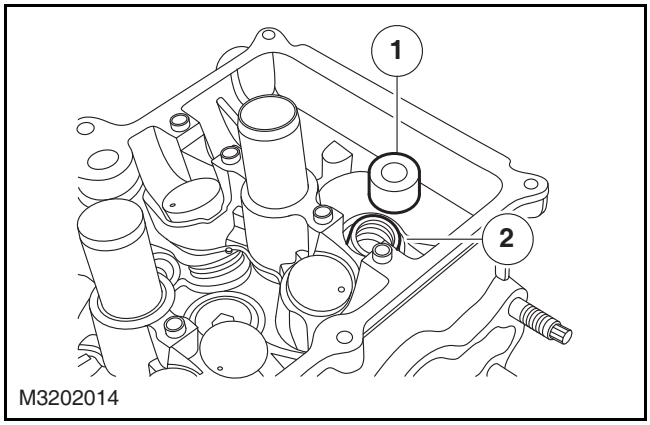
**13.** Use a tweezer (D) to remove the valve cotter (1).

Special tool: Tweezer 09916-84511



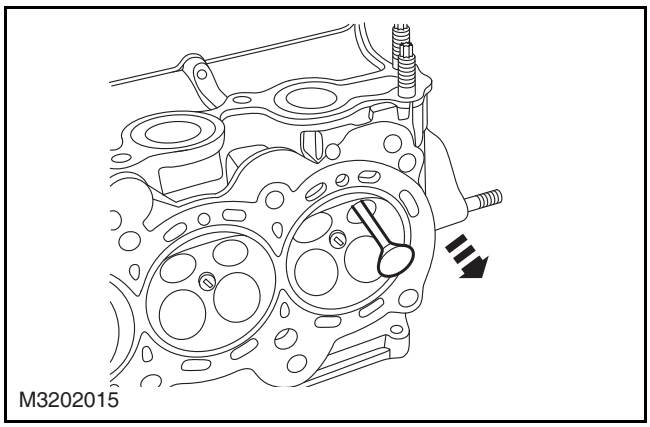
M3202013

**14.** Release the tool and then remove the valve spring upper retainer (1) and valve spring (2).



M3202014

**15.** Remove the valve from the combustion chamber side.


M3202015

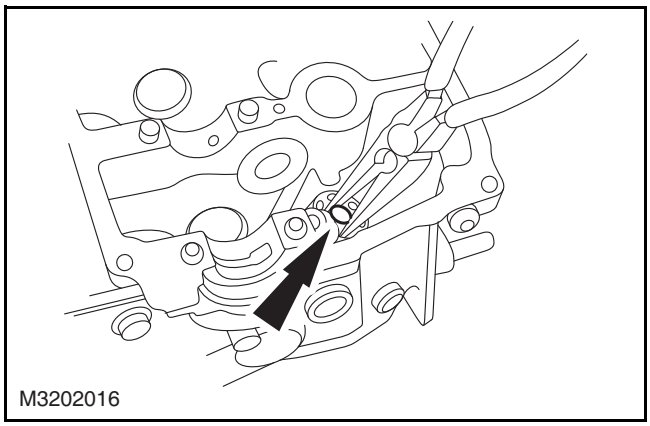
https://truckmanualshub.com/



**16.** Use the special tool to remove the valve oil seal from the valve guide side and then remove the valve spring lower retainer as shown in the figure.

Special tool: Valve oil seal plier CA301-012

**CAUTION: The oil seal will not be reusable if removed. Be sure to use new oil seal when installing.**



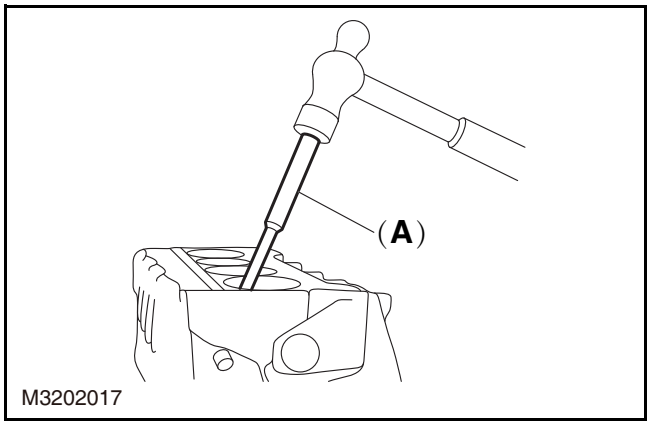
M3202016

**17.** Use the valve guide remover (A) to push against the valve guide from combustion chamber side to valve spring side.

Special tool: Valve guide remover
09916-44910

**CAUTION: The valve guide will not be reusable if removed. Be sure to use a new (oversize) valve guide when assembling.**

**CAUTION: Except for the valve oil seal and valve guide, arrange the removed components in order so that they can be reassembled to their original positions.**



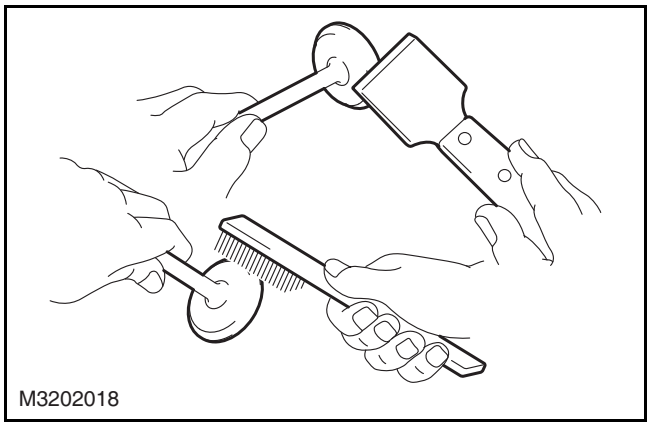

M3202017

https://truckmanualshub.com/

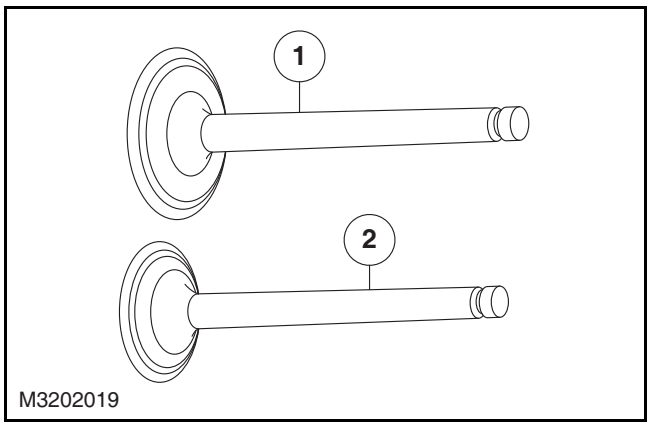


## Inspection

1. Use a gasket scraper to chip off all the carbon deposit from the valve head.


M3202018

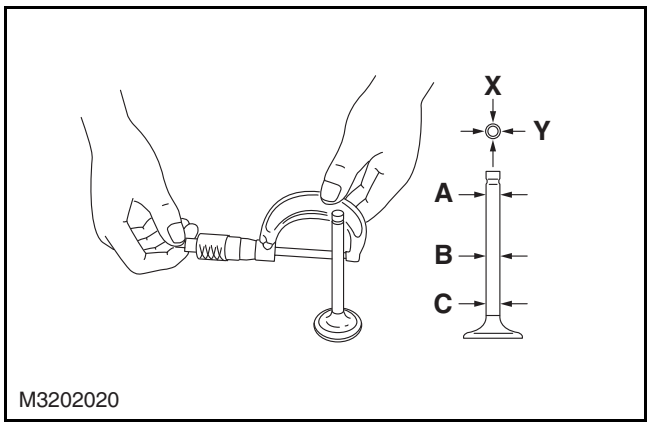
2. Inspect the working surfaces of intake valve (1), exhaust valve (2) and the valve stem for abrasions, burns or deformations, and replace the valves when necessary.



M3202019

3. Get diameter readings of valve stem and guide with the micrometer and caliper gauge to inspect the clearance between valve stem and guide.

   1 Measure the stem diameter at 3 points (A, B and C) along the X-axis and Y-axis as shown in the figure.



M3202020

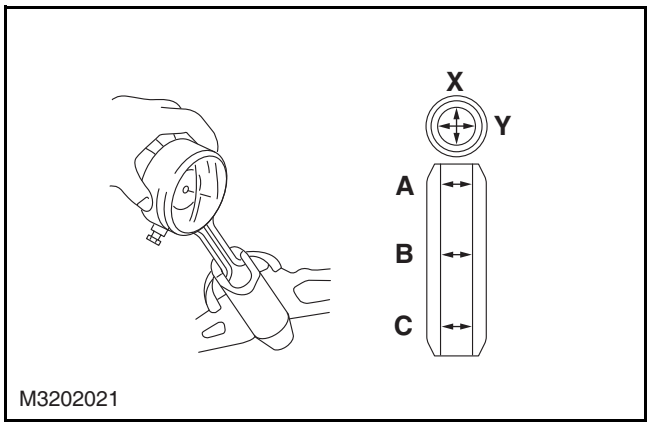
**CAUTION: If the clearance is more than the limit, replace the valve and valve guide.**

**CAUTION: If the measured lift is less than the limit, replace the camshaft.**

https://truckmanualshub.com/



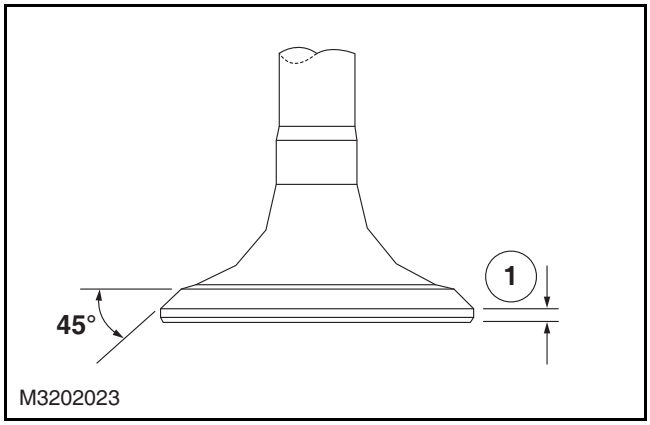
2 Measure the inner diameter of each valve guide at 3 points (A, B and C) along the X-axis and Y-axis as shown in the figure.



M3202021

| Item | | Standard |
|---|---|---|
| Valve stem diameter | Intake | 5.465 ~ 5.480 mm |
| | Exhaust | 5.440 ~ 5.455 mm |
| Valve guide inner diameter | Intake | 5.500 ~ 5.512 mm |
| | Exhaust | |
| Clearance between valve stem and guide | Intake | 0.020 ~ 0.047 mm |
| | Exhaust | 0.045 ~ 0.072 mm |

**4.** Measure the valve head margin thickness (1). If the measured thickness is more than the limit, replace the valve.

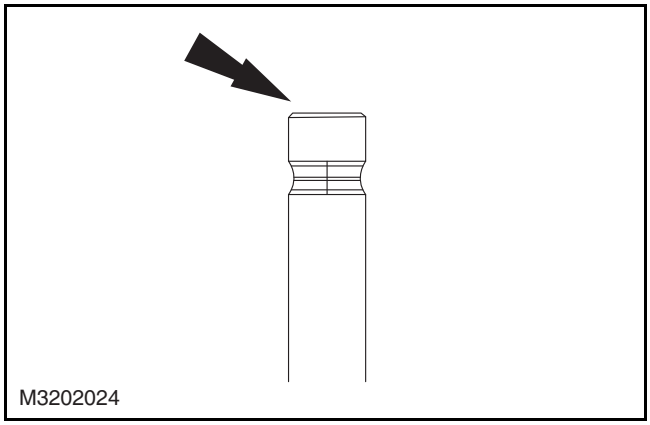


M3202023

| Item | | Standard |
|---|---|---|
| Valve head margin thickness | Intake | 3 ~ 3.3 mm |
| | Exhaust | 2.3 ~ 2.7 mm |

**5.** Inspect the valve stem end face for dents or abrasions.

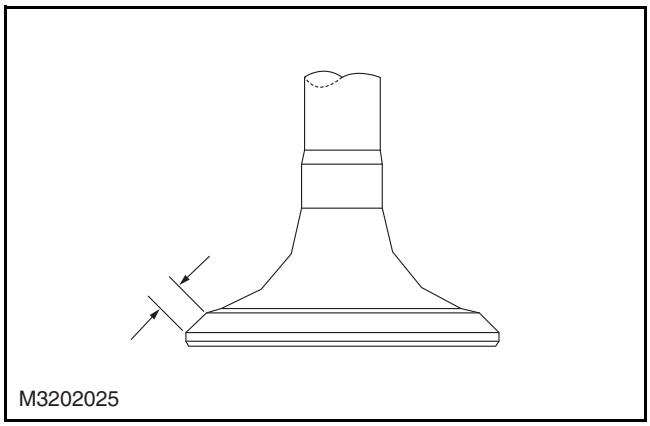
**CAUTION: If any dent or abrasion is found, trim the valve stem end face, but excessive trimness will cause the chamfers to be grinded off. If the chamfers have been grinded off, replace the valve.**


M3202024

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6. Inspect the valve-face width by observing the contact imprint left on the valve matching surface.

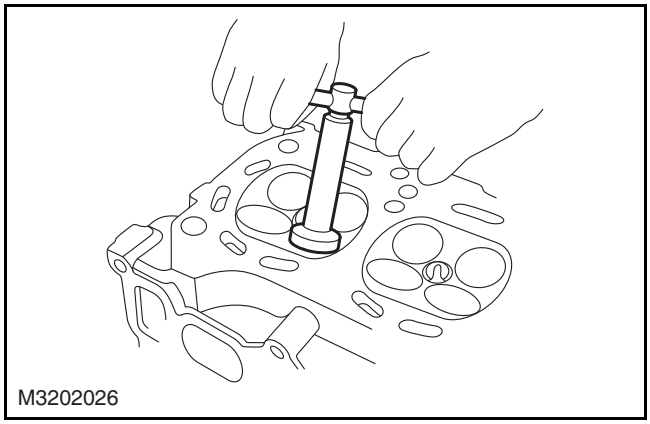

M3202025

**CAUTION: Uniformly apply a coat of membrane on the valve seat and then inspect the valve-face width by turning the valve seat and valve head.**

**CAUTION: The imprint left on the valve matching surface must be a continuous circle, the width of which must be within the specification.**

| Item | Valve Imprint Standard Width |
|---|---|
| Intake | 1.1 mm in minimum, 0.4 mm in unevenness |

7. Repair the valve seat.


M3202026

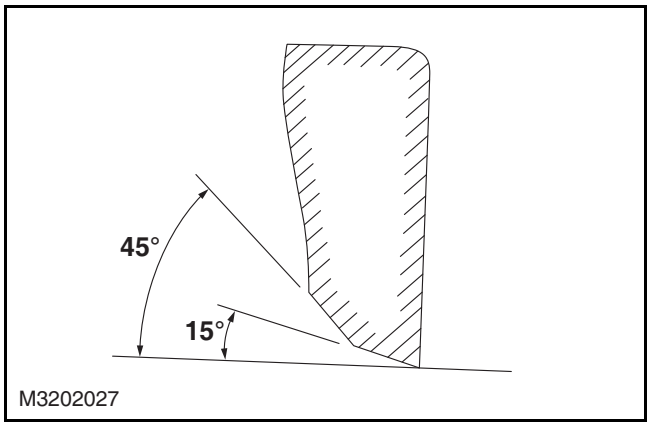
**CAUTION: The valve seat must be dressed, turned, grinded and polished, if the imprint made by the contact between valve seat and valve is not even or the width is not within the specification.**

1 Use a valve reamer to repair twice as shown in the figure.

**CAUTION: Two reamers must be used for repair. Use the first one at an angle of 15° and the second one at an angle of 45°. The width required must be reached at the second repair.**

Exhaust valve seat width: 1.0 ~ 1.4 mm

2 Use the same repair procedure for intake valve seat.



M3202027

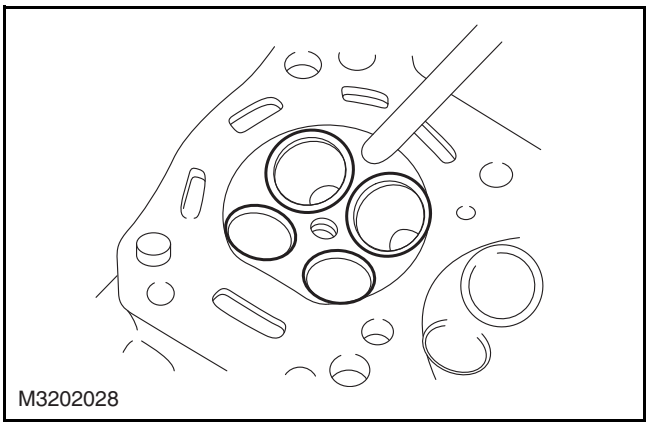
**CAUTION: Two reamers must be used for repair. Use the first one at an angle of 15° and the second one at an angle of 45°. The width required must be reached at the second repair.**

Intake valve seat width: 1.1 ~ 1.3 mm

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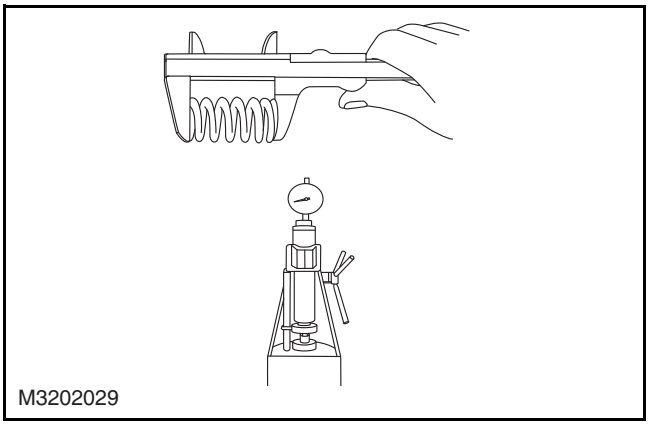
3 Valve grinding: grind the valve in 2 steps. First, grind the end face by spreading rough grinding paste on it. Second, grind the end face with fine grinding paste. Use the common methods to grind the end face by using valve grinding tools in each step.


M3202028

**8.** Inspect the valve spring length and load.

General tool: Vernier caliper

**CAUTION: Inspect if each spring is still functioning or not damaged or weakening referring to the following table. Valve spring(s) with poor elasticity results in vibration and the reduced valve seat pressure results in the occurrence of gas leak, which leads to the reduction of output power.**


M3202029

| Item | Standard |
|---|---|
| Valve spring free length | 40 mm |
| Valve spring preload | 109 ~ 127 N (29.9 mm) |

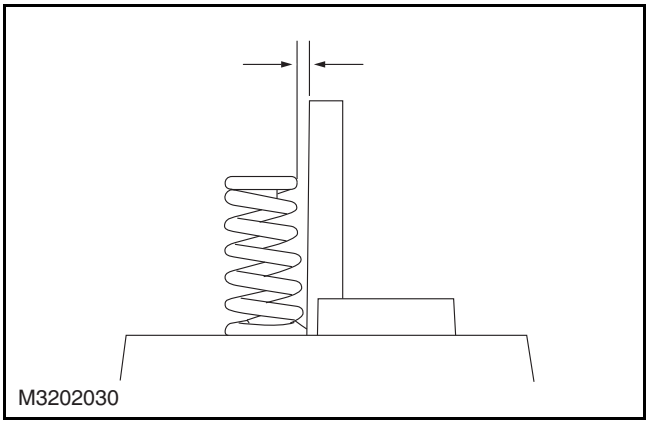
**9.** Inspect the valve spring for uprightness.

General tool: Straight scale

**CAUTION: Use a straight scale and a flat to measure the clearance between the valve spring end and the straight scale.**

**CAUTION: Inspect the uprightness of each spring in accordance with the clearance. Install a new valve spring if the clearance exceeds the limit values shown below.**

Valve spring uprightness limit: 1.0 mm


M3202030

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**10.** Remove the combustion chamber carbon deposit.

**CAUTION: Do not use any sharp tools to scrape the carbon deposit. Be careful not to damage or scrape the metal surface when clearing carbon deposit. It is also applicable to the valve(s) and valve seat(s).**

**11.** Inspect the cylinder head intake and exhaust ports, combustion chamber and cylinder head surface for any possible scratches.

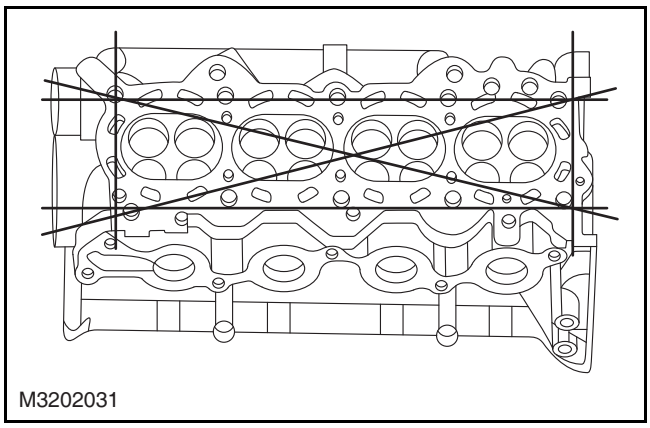
**12.** Inspect the cylinder head for flatness.

General tool: Knife straight scale, feeler gauge

Surface flatness inspection method:

Use a knife straight scale to press on the cylinder matching surface as indicated by the bold black lines shown in the figure, then measure the clearance between knife straight edge and matching surface with a feeler gauge.

Deformation limit: 0.030 mm



M3202031

**CAUTION: The knife straight scale in use should be straight and always in its position to ensure the accuracy when measuring.**

**CAUTION: Use the straight scale and feeler gauge to inspect the cylinder head surface at 6 positions. Use a flat and a 400# sand paper to level the cylinder head if the deformation of cylinder head exceeds the above limit.**

**CAUTION: Install a new cylinder head if the reading on the feeler gauge remains beyond the limit. Combustible gas leaks from the cylinder head surface are generally caused by wrinkles and deformations on the cylinder head surface, and this may result in output power reduction and engine overheat due to high coolant temperature.**

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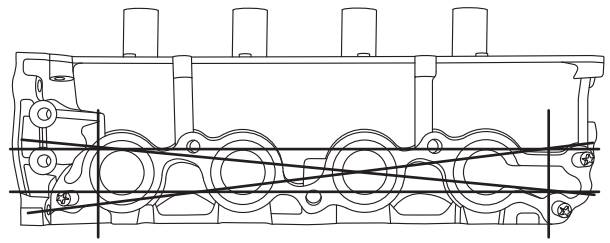


**13.** Inspect the manifold matching surface for deformation.

General tool: Knife straight scale, feeler gauge

Deformation limit: 0.05 mm

**CAUTION: Inspect the cylinder head manifold matching face with a straight scale and a feeler gauge to see if these surfaces need to be leveled or the cylinder head need to be replaced.**



M3202032

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## Assembly

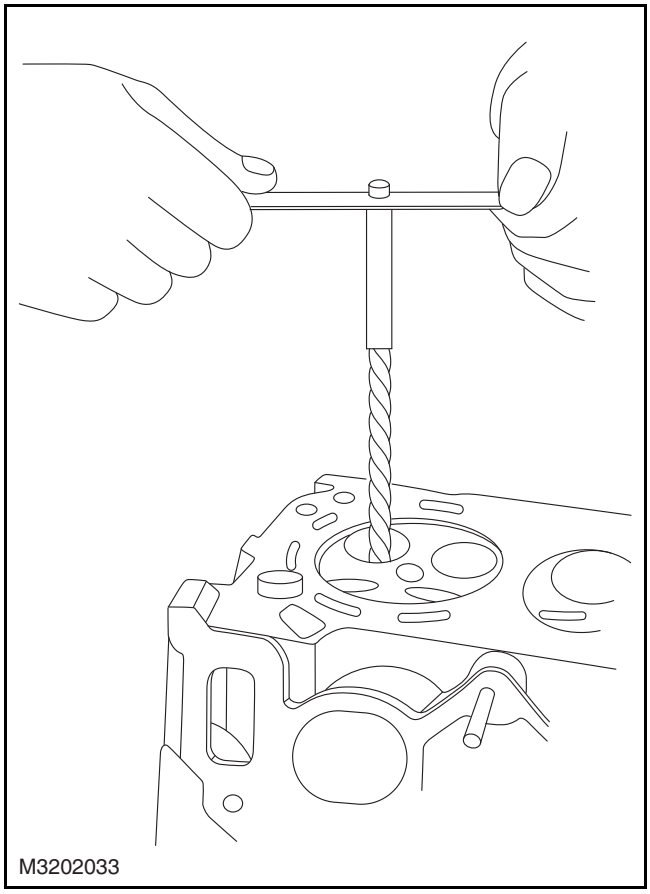
1. Before installing the valve guide into the cylinder head, use a reamer of 10.5 mm diameter to ream the guide installation hole until its diameter reaches $10.5^{+0.068}_{-0.053}$ mm.

   The diameter of oversize valve guide is $10.5^{+0.098}_{-0.083}$ mm.

   General tool: 10.5 mm reamer

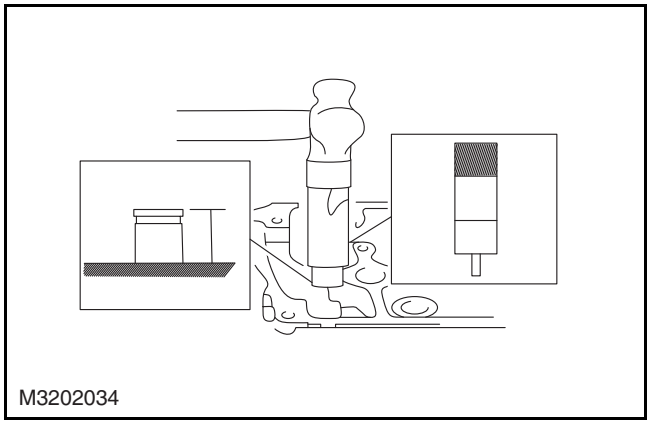
**CAUTION: The valve guide will not be reusable if removed. Install a new valve guide (oversize).**

**CAUTION: The intake and exhaust valve guides are the same.**



M3202033

2. Install the valve guide into the cylinder head. Under the room temperature, use a tool to push the new valve guide into the hole, until the valve guide installer contacts with the cylinder head. After installing, make sure that the valve guide stretches a distance of 11.3 ± 0.2 mm from the cylinder head. The installations of both the intake and exhaust valve guides are the same.



M3202034

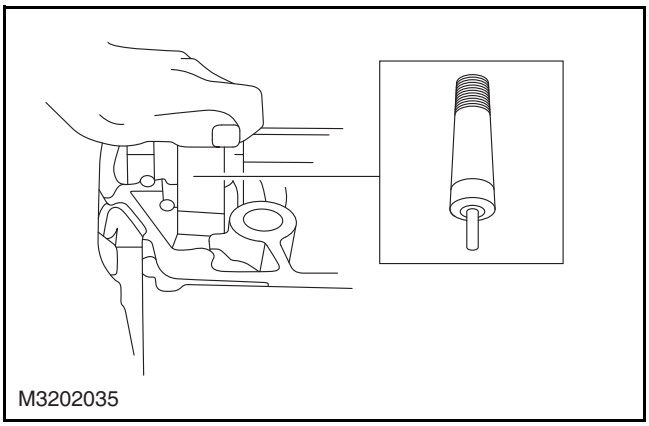
3. Use a reamer of 5.0 mm diameter to ream the valve guide hole. After reaming, clear the guide hole.
4. Install the valve spring lower retainer to the cylinder head.

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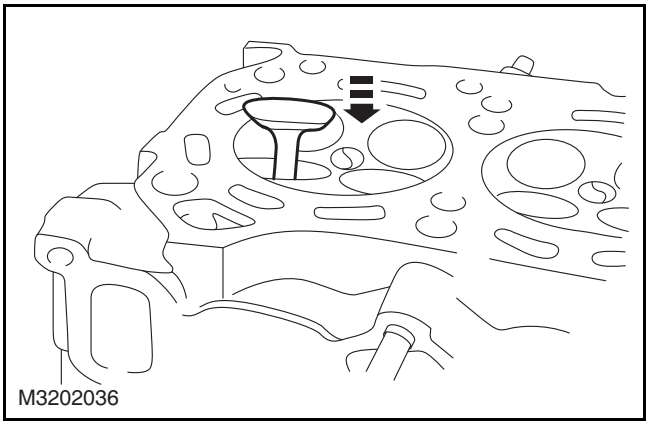
**5.** Install the new valve oil seal. Apply engine oil to the valve guide tip, and install the oil seal to the output shaft, then push the valve guide installer handle by hand to install the oil seal to the valve guide.

Special tool: Valve guide installer handle 09916-58210


M3202035

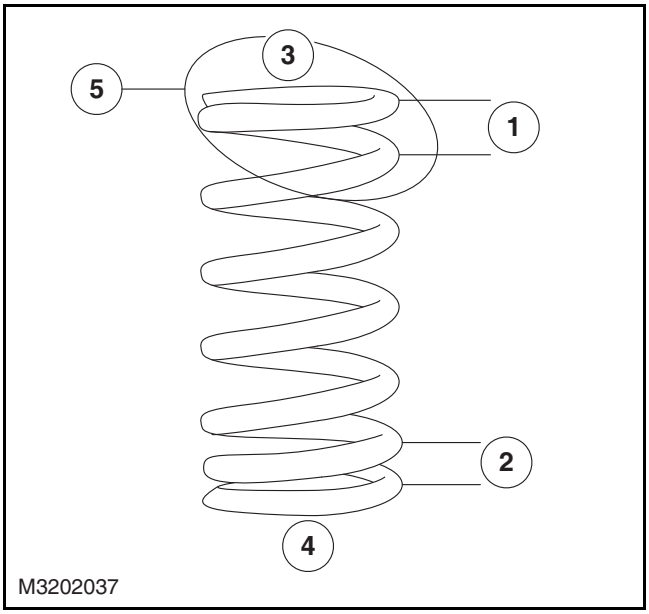
**CAUTION: When installing the valve oil seal, never use a hammer or other objects to tap or strike the valve guide installer handle, as this may cause oil seal damage. Only push the installer handle by hand.**

**6.** Install the valve and apply the engine oil to the valve oil seal, valve guide hole and valve stem when installing the valve.


M3202036

**7.** Install the valve spring lower retainer, and install the valve spring with the white mark side facing upward (white mark is at the big pitch end of valve spring). If the white mark cannot be identified, as each valve spring has top (big pitch end) and bottom (small pitch end), be sure to face the spring bottom (small pitch end) toward the bottom (valve spring lower retainer) when installing the spring.

| | |
|---|---|
| 1 | Big pitch |
| 2 | Small pitch |
| 3 | Valve spring upper retainer side |
| 4 | Valve spring lower retainer side |
| 5 | White mark in the elliptic area of figure |

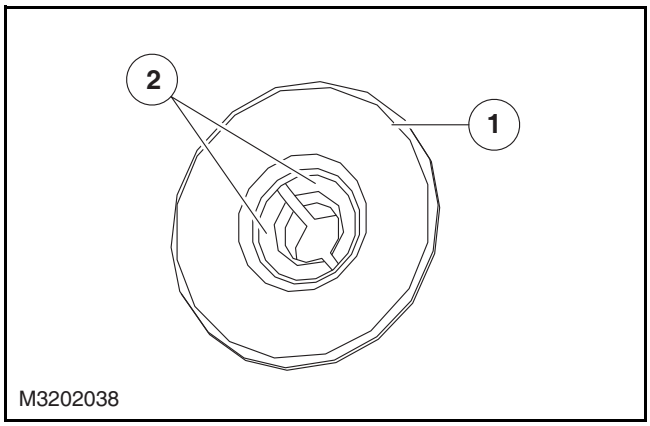


M3202037

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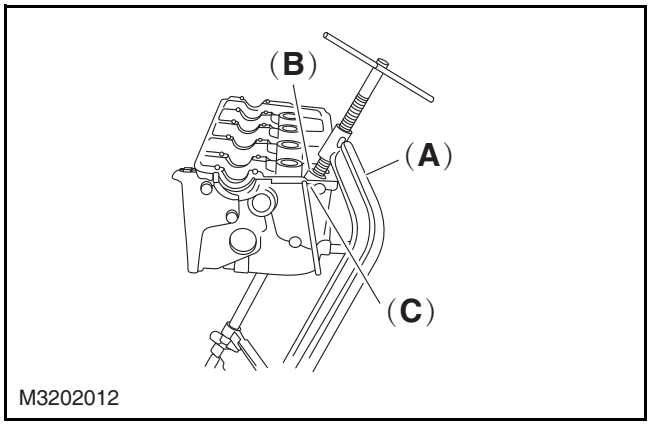


**8.** Install the taper cotters (2) and valve spring retainer (1), place the taper cotters into the valve spring retainer hole with the large ends of both cotters facing upward to be a circle as shown in the figure.




**9.** Use the valve opener (A) and valve opener holder (B), press-fit the taper cotter inside the hole of valve spring (C) retainer into the groove of valve stem as shown in the figure. After press-fitting, inspect that all the taper cotters are in good condition.

Special tool: Valve opener 09916 -14510
Valve opener holder
09916-14910

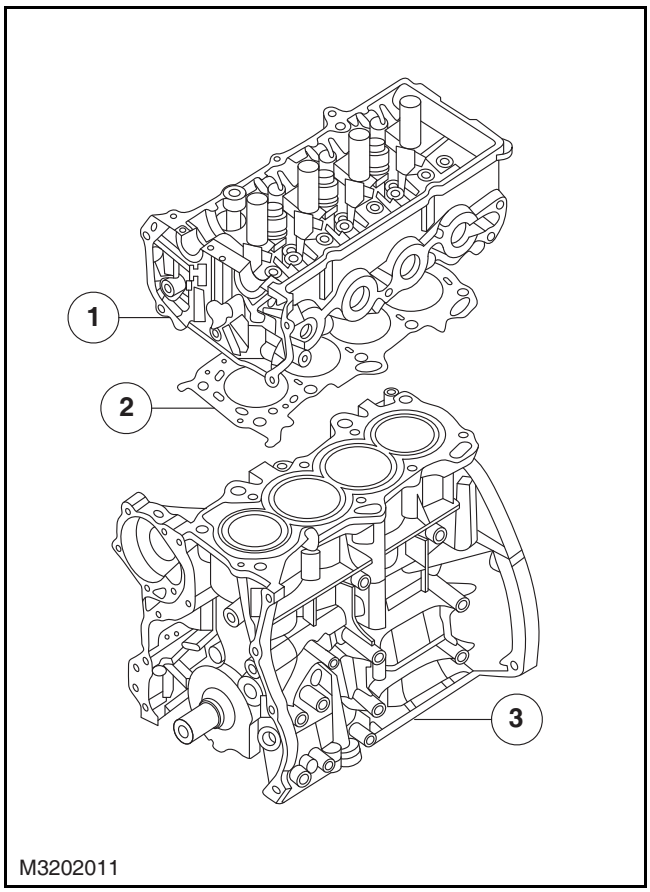



**10.** Apply an appropriate amount of engine oil to the valve tappets, and then place them into each installation hole in turns.

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**11.** Clean and apply an appropriate amount of engine oil to the matching surfaces of cylinder block (3) and cylinder head (1), then install the new cylinder gasket assembly (2) as shown in the figure.



M3202011

**CAUTION: The cylinder gasket assembly cannot be reused if removed. Install a new cylinder gasket assembly when reinstalling.**

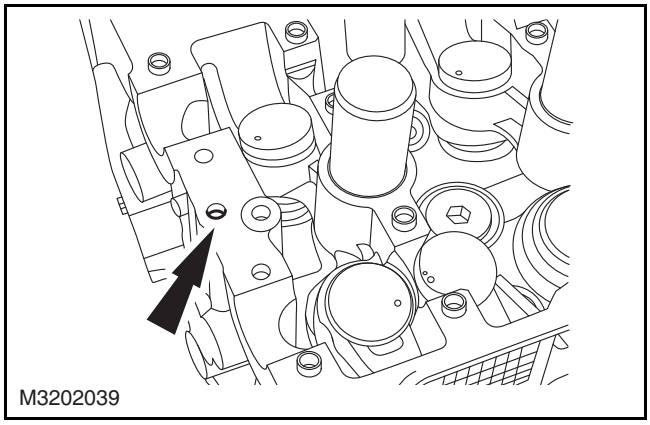
**CAUTION: Inspect if water channels, oil passages and bolt holes to be matched between cylinder gasket assembly and cylinder block are aligned and if the cylinder head dowel pins are deformed or damaged. If damaged, replace immediately.**

**CAUTION: When repairing, replace the cylinder connecting bolts and do not reuse them.**

**CAUTION: Make sure that the high pressure oil hole of cylinder gasket assembly aligns with the hole on the crankcase properly. With the marked side up, do not install it upside down.**

**12.** Inspect that the high pressure oil plug is installed and not blocked.

Torque: 3 ± 0.5 Nm


M3202039

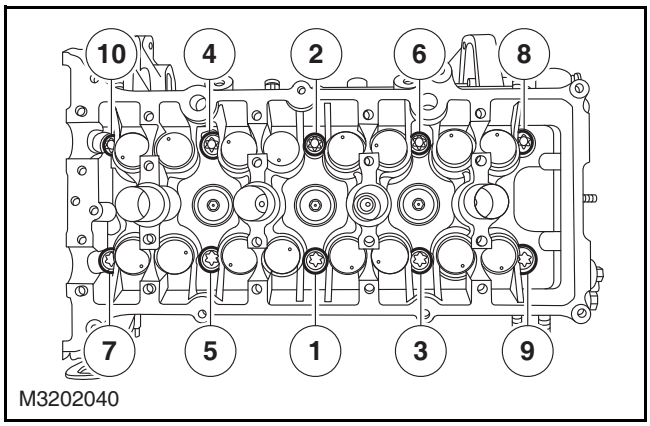
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13. Install and tighten the cylinder head bolts.

    1 Tighten the cylinder head connecting bolts (with washers) as shown in the figure.

    Torque: 25 ± 2 Nm + 90°



M3202040

14. Install the camshaft.

    **Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**

15. Install the timing chain.

    **Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**

16. Adjust the valve clearance.

    **Refer to: Valve Clearance Inspection and Adjustment (3.2.2 Mechanical System, General Inspection).**

17. Remove the oil pan upper part.

    **Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

18. Remove the oil pan lower part.

    **Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

19. Install the cylinder head cover.

    **Refer to: Cylinder Head Cover (3.2.2 Mechanical System, Removal and Installation).**

20. Install the exhaust manifold.

    **Refer to: Exhaust Manifold (3.2.6 Exhaust System, Removal and Installation).**

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**21.** Install the intake manifold.

**Refer to: Intake Manifold (3.2.5 Air Intake System, Removal and Installation).**

**22.** Install the accessory drive belt.

**Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**

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# Piston, Piston Ring, Connecting Rod and Cylinder

## General Equipment

| |
|---|
| Cylinder bore gauge |
| Micrometer |
| Plastic feeler gauge |
| Straight scale |
| Piston ring expander |
| Piston ring compressor |

## Material

| Item | Specifications |
|---|---|
| Sealant | Tonsan 1596Fa<br>Tonsan 1591 |

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## Disassembly

1. Remove the engine assembly.

   **Refer to: Engine Assembly (3.2.2 Mechanical System, Removal and Installation).**

2. Remove the accessory drive belt.

   **Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**

3. Remove the intake manifold.

   **Refer to: Intake Manifold (3.2.5 Air Intake System, Removal and Installation).**

4. Remove the exhaust manifold.

   **Refer to: Exhaust Manifold (3.2.6 Exhaust System, Removal and Installation).**

5. Remove the cylinder head cover.

   **Refer to: Cylinder Head Cover (3.2.2 Mechanical System, Removal and Installation).**

6. Remove the oil pan lower part.

   **Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

7. Remove the oil pan upper part.

   **Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

8. Remove the timing chain.

   **Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**

9. Remove the camshaft.

   **Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**

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**10.** Remove the cylinder head subassembly.

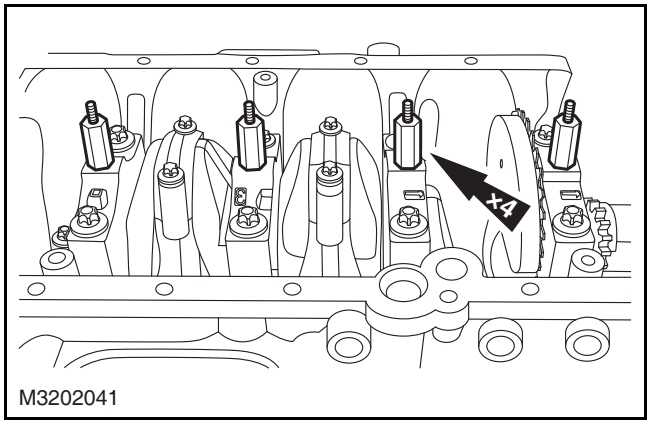
**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Removal and Installation).**

**11.** Remove the carbon deposit from the cylinder upper end.

**12.** Remove the oil pan baffle plate.

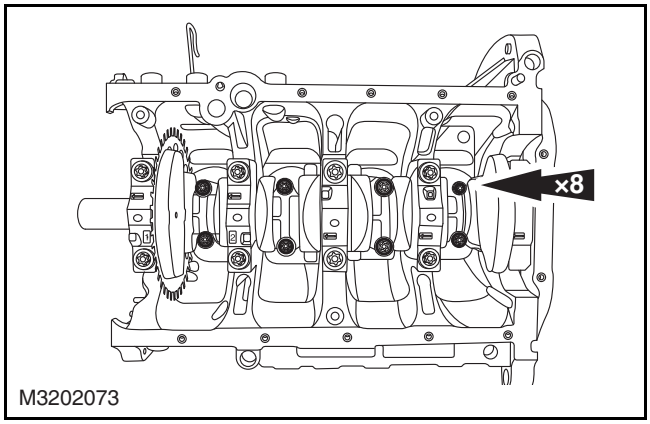
**Refer to: Oil Pan Baffle Plate (3.2.3 Lubrication System, Removal and Installation).**

**13.** Remove 4 stud bolts from the oil pan baffle plate.



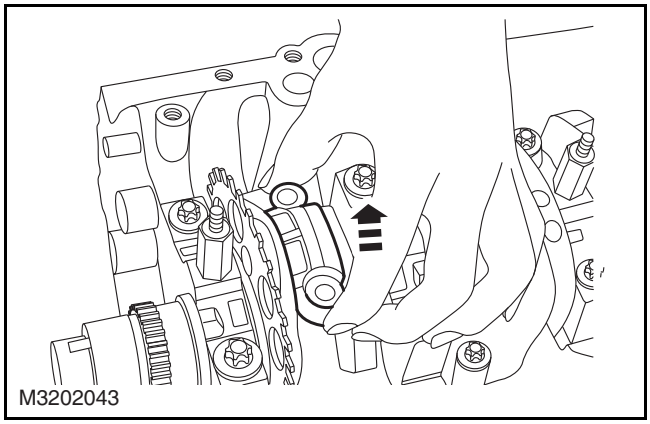
M3202041

**14.** Remove the piston connecting rod bolts.



M3202073

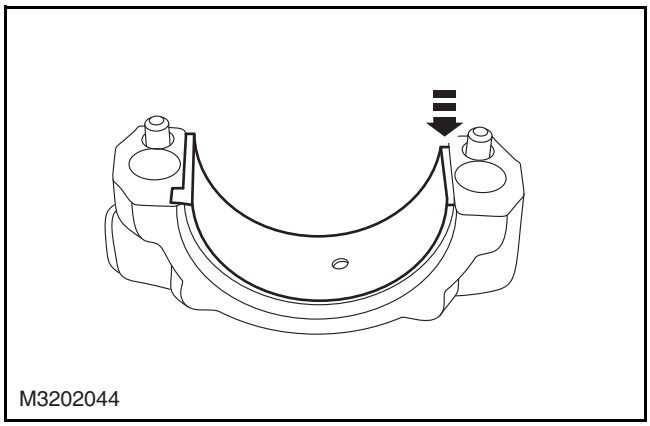
**15.** Remove the piston connecting rod bearing cap.


M3202043

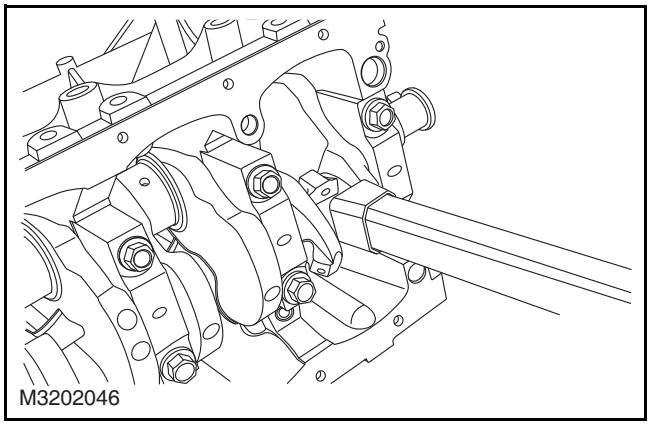
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**16.** Remove the connecting rod bearing shell from the piston connecting rod bearing cap.


M3202044

**17.** Push out the piston and connecting rod from the engine block.

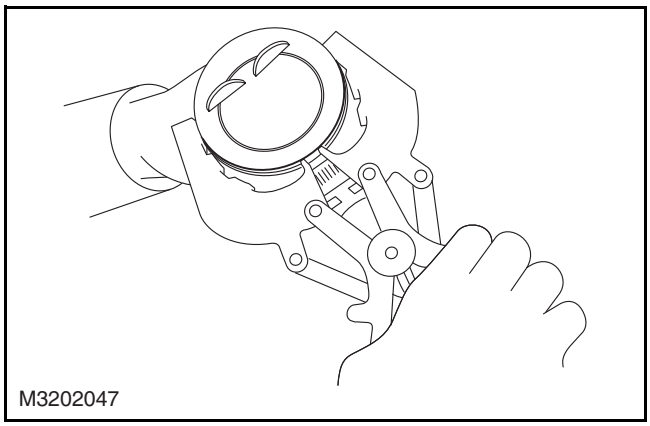

M3202046

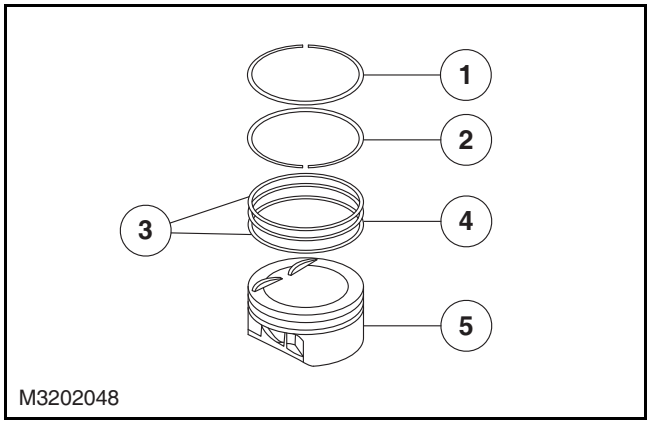
**18.** Label the cylinder number on the piston, connecting rod shank and cap with quick drying paint (keep in mind that the parts should be marked in the order they are removed to avoid a mistake).

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**19.** Use the piston ring expander to remove the No.1 piston ring (1), No.2 piston ring (2), oil control ring (3) and coil spring (4) from the piston (5) in sequence.

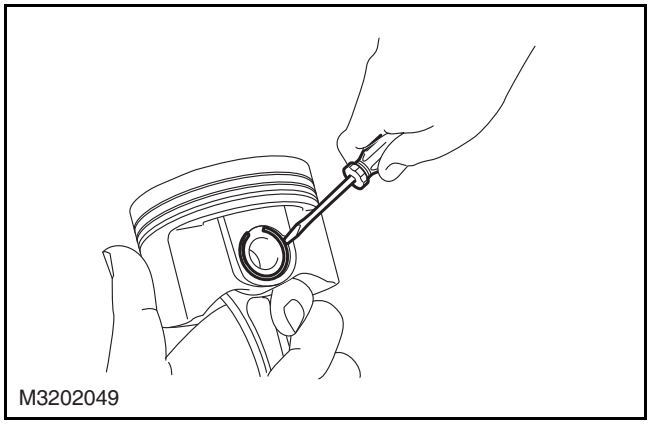

M3202047



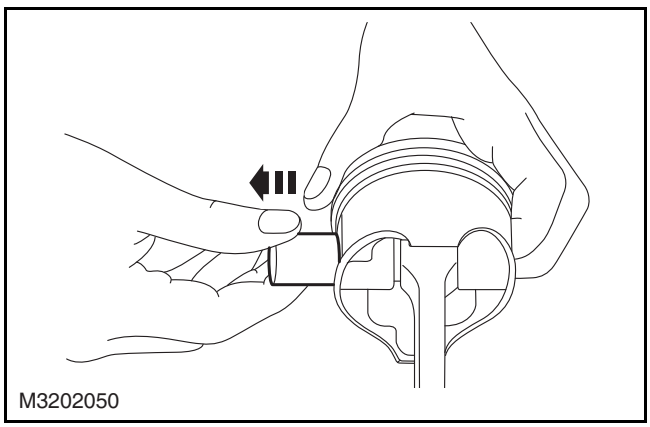
M3202048

**20.** Remove the piston pin from the connecting rod.

1 Carefully loosen the piston pin circlip as shown in the figure.


M3202049

2 Press out the piston pin.


M3202050

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3 Separate the piston from the connecting rod.

**21.** Use a suitable tool to remove the carbon deposit from the piston top and piston ring groove.

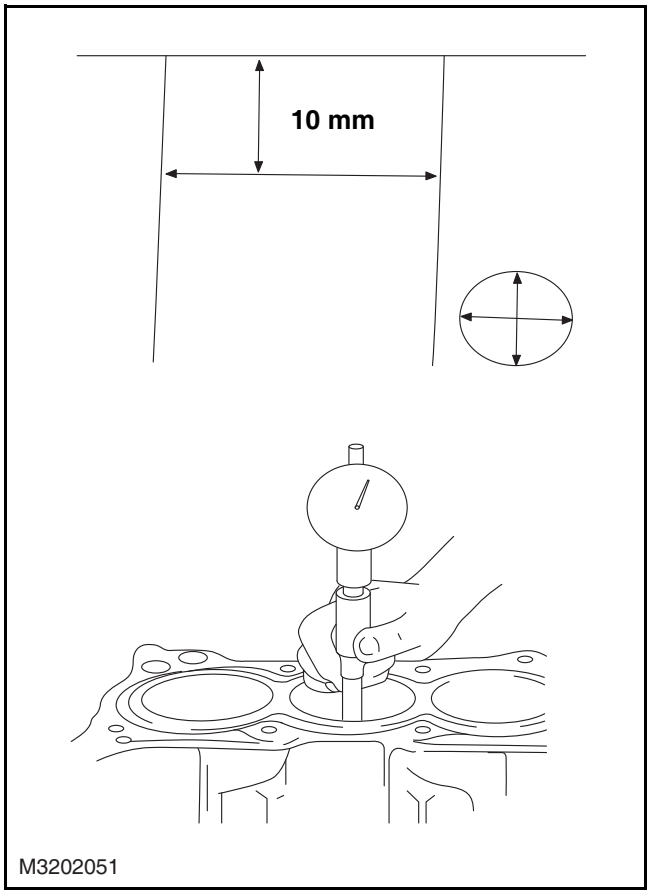
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## Inspection

1. Visually inspect the cylinder walls for evident scratch, roughness or swell. If the cylinder wall is very rough or has some deep scratches, sags and crests, replace the crankcase.

2. Measure the cylinder bore diameter at 10 mm from the top in both radial directions with a cylinder bore gauge. If the average value of the two measurements is more than 73.025 mm, replace the crankcase as shown in the figure.

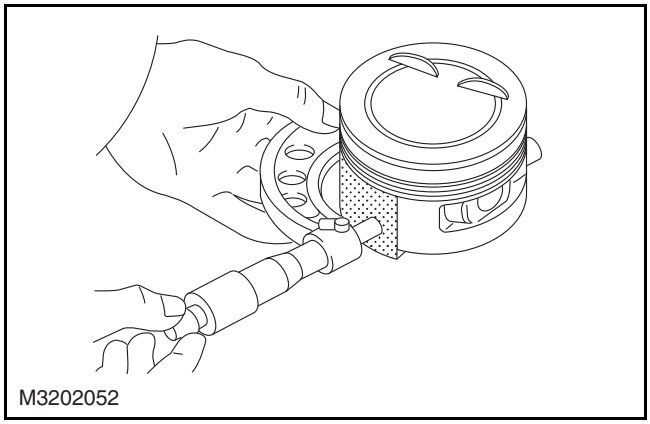


M3202051

3. Inspect the pistons for abrasions, cracks or other damages, and replace if damage is found.

4. The measuring range of piston diameter is from the piston skirt bottom sipigot to vertical position, with 15 mm away from piston pin as shown in the figure.

   Standard piston diameter:
   72.975 ~ 72.99 mm

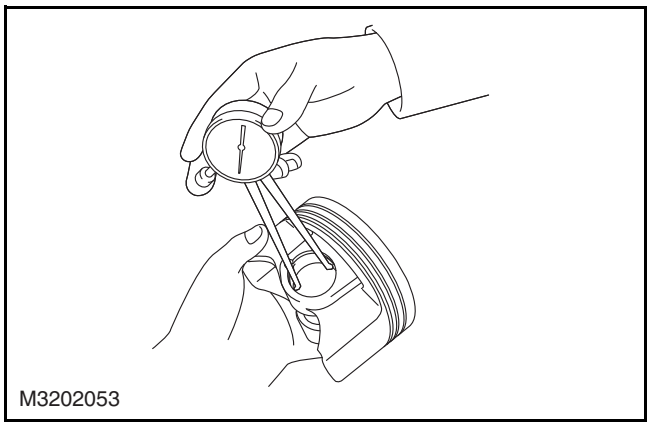

M3202052

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**5.** Inspect the clearance between piston and cylinder, and the piston clearance refers to the difference between cylinder diameter and piston diameter. The piston clearance should be within the following specifications. If out of tolerance, inspect the cylinder bore or piston diameters and replace the corresponding out-of-tolerance part.

Piston clearance: 0.01 ~ 0.039 mm


M3202053

**6.** Inspect the piston pin hole diameter.

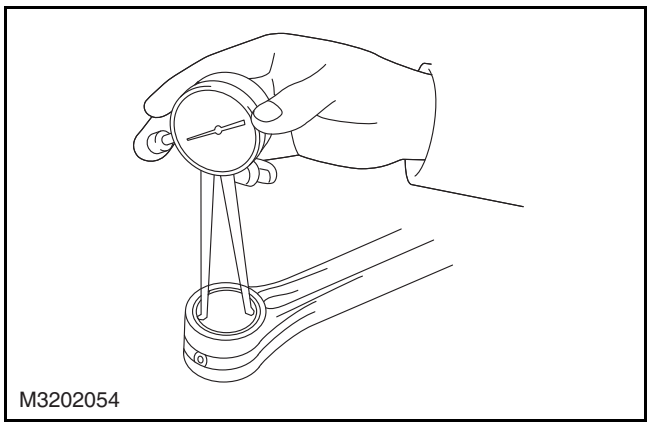
Measure the piston pin hole diameter with a caliper gauge.

Piston pin hole diameter:
18.002 ~ 18.006 mm

**7.** Inspect the piston pins, connecting rod small end holes and piston pin holes for abrasions or damages. If severe abrasion or damage is found, replace the piston pins, connecting rods or pistons.

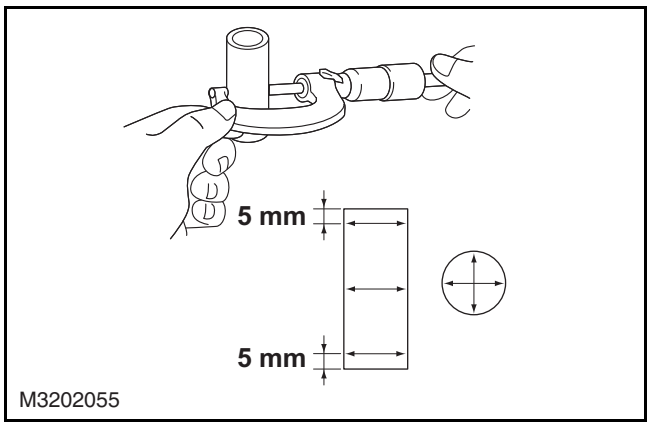
**8.** Measure the connecting rod small end hole diameter with a caliper gauge.

Standard connecting rod small end hole diameter: 18.003 ~ 18.011 mm


M3202054

**9.** Measure the piston pin diameter with a micrometer.

Standard piston pin diameter:
17.995 ~ 18 mm



M3202055

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**10.** Inspect the clearance between piston pin hole and piston pin.

Subtract the piston pin diameter from the piston pin hole diameter.

Clearance between piston pin hole and piston pin: 0.002 ~ 0.011 mm

**11.** Inspect the clearance between connecting rod small end hole and piston pin.

Subtract the piston pin diameter from the connecting rod small end hole diameter.

Clearance between connecting rod small end hole and piston pin: 0.003 ~ 0.016 mm

**12.** Inspect the piston ring groove side clearance.

1 Before inspection, the piston ring groove must be clean, dry and free of carbon deposit.

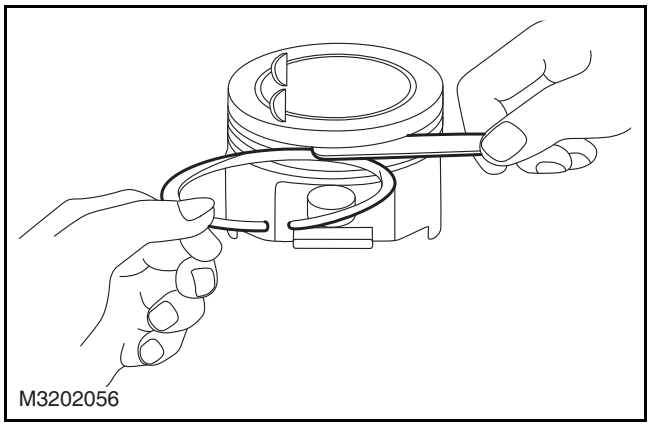
2 Install the piston ring into the ring groove.

3 Measure the clearance between ring and ring groove with a feeler gauge; if out of tolerance, inspect the width of piston ring groove and the height of piston ring, and replace the corresponding out-of-tolerance part.

Piston ring groove side clearance:

First ring: 0.03 ~ 0.07 mm

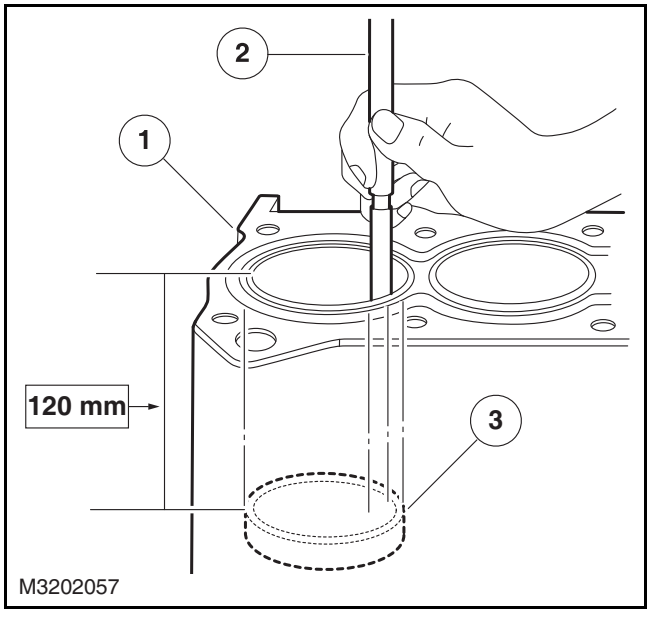
Second ring: 0.03 ~ 0.07 mm


M3202056

**13.** Insert the piston rings into the cylinders and measure the end gap of each piston ring with a feeler gauges.

| Item | | Standard | Limit |
|---|---|---|---|
| Piston ring end gap | First ring | 0.155 ~ 0.275 mm | 0.5 mm |
| | Second ring | 0.28 ~ 0.41 mm | 0.5 mm |

| | |
|---|---|
| 1 | Cylinder block |
| 2 | Feeler gauge |
| 3 | Piston ring |



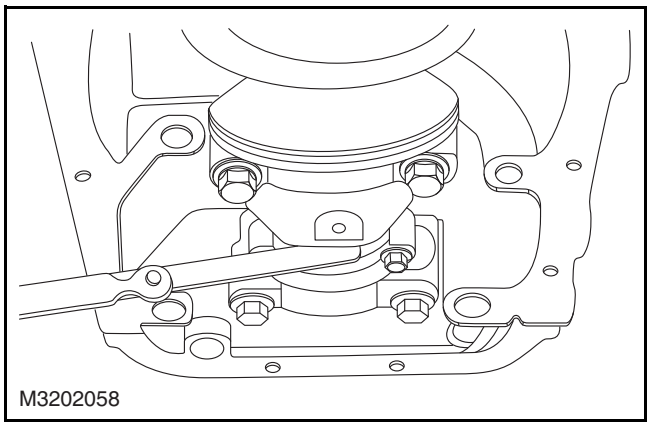
M3202057

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**14.** Connect the crankshaft and connecting rod, and inspect the side clearance of connecting rod large end. If the clearance is outside the standard range, replace the connecting rod.

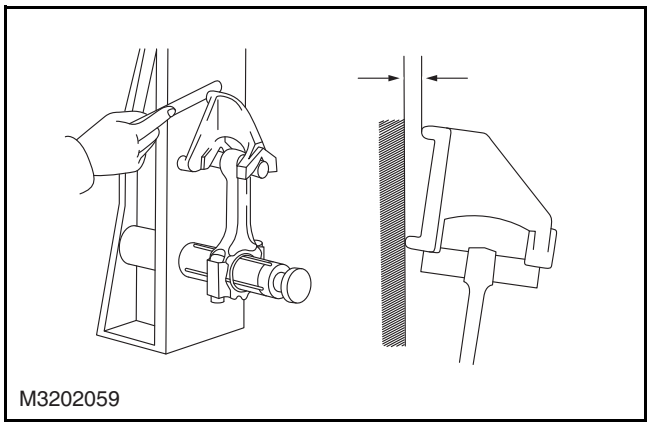
| Item | Standard |
|---|---|
| Side clearance for connecting rod large end | 0.10 ~ 0.20 mm |

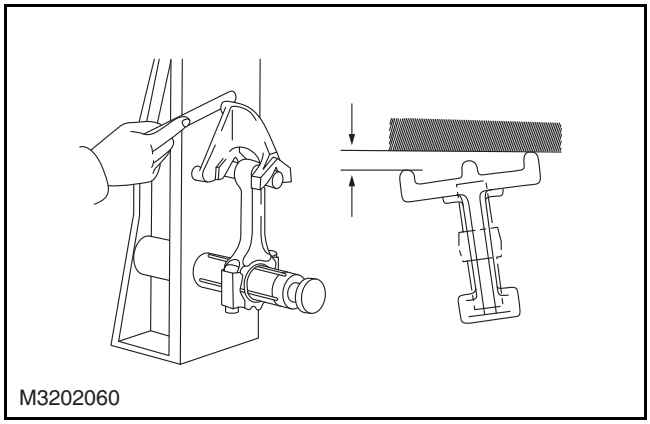

M3202058

**15.** Install the connecting rod on the straightener and inspect if the connecting rod is bent or distorted. If the bend and distortion are out of limits, replace the piston connecting rod.

Bend limit: 0.05/80

Distortion limit: 0.10/80

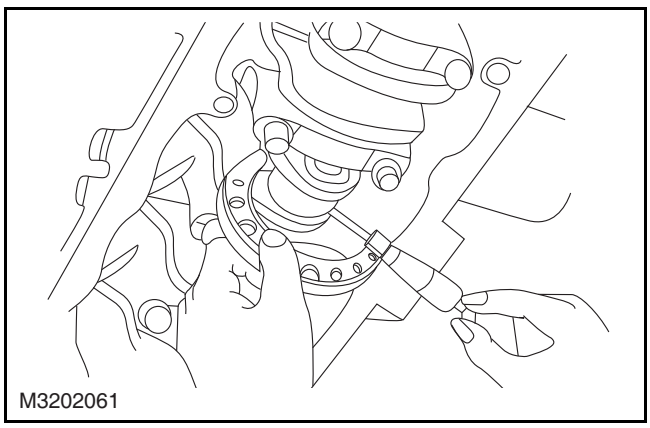

M3202059


M3202060

**16.** Inspect the connecting rod journal for irregular abrasion or damage. Measure the connecting rod journal out-of-round and taper with a micrometer. If the connecting rod journal is damaged, or the out-of-round or taper is out of tolerance, replace the crankshaft.

Connecting rod journal diameter:
37.982 ~ 38.000 mm

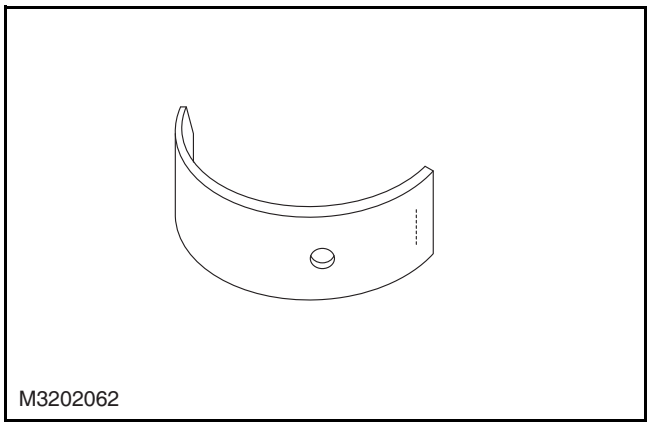
Connecting rod journal out-of-round and taper limit: 0.005 mm


M3202061

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**17.** Inspect the bearing shell for dissolution, drop pits, ablation or surface peeling off as well as contacting pattern. If there are any obvious signs as described above, replace the shell.


M3202062

**18.** Inspect the connecting rod bearing shell clearance.

1 Clean the connecting rod bearing shells and journal.

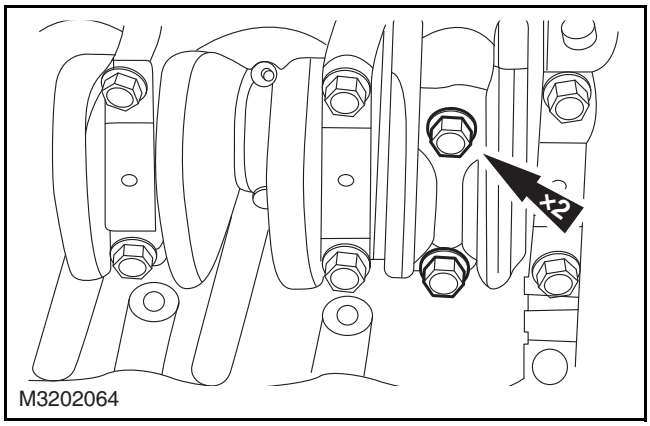
2 Install the bearing shells to the connecting rod and bearing cap.

3 When connecting with the bearing shells, parallel to the crankshaft axis, place a piece of feeler gauge on the journal while away from the oil hole.

General tool: Plastic feeler gauge

4 Install the connecting rod bearing cap.

Torque: 15 Nm + 90°



M3202064

**CAUTION: When installing the connecting rod bearing cap, confirm that dowel pins on the bearing cap are aligned with the positioning holes on the connecting rod shank. Inspect that the boss of connecting rod bearing cap faces the engine front. Tighten the retaining bolts of connecting rod bearing cap to the specified torque. Do not rotate the crankshaft with feeler gauge.**

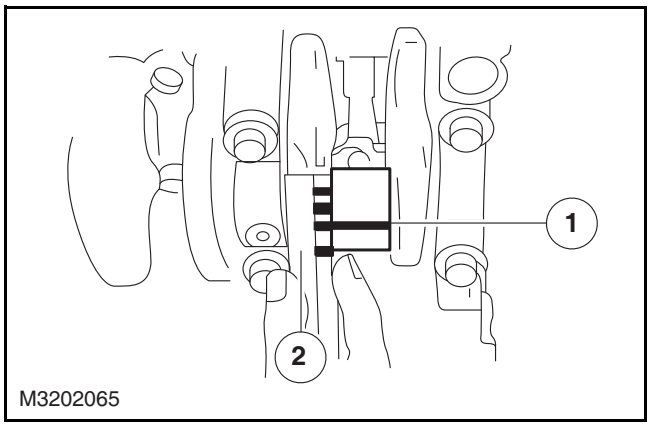
**CAUTION: The bolts cannot be reused if removed. Replace the connecting rod bolts with new ones.**

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5 Remove the connecting rod bearing cap and place a gauge (2) on the plastic feeler gauge (1), then measure the feeler gauge width at its widest point. If out of tolerance, use a new bearing shell of standard size and measure again.

| Item | Standard | Limit |
|---|---|---|
| Bearing shell clearance | 0.020 ~ 0.050 mm | 0.080 mm |




6 If the clearance is still out of tolerance after replacing with a new standard bearing shell, replace the crankshaft.

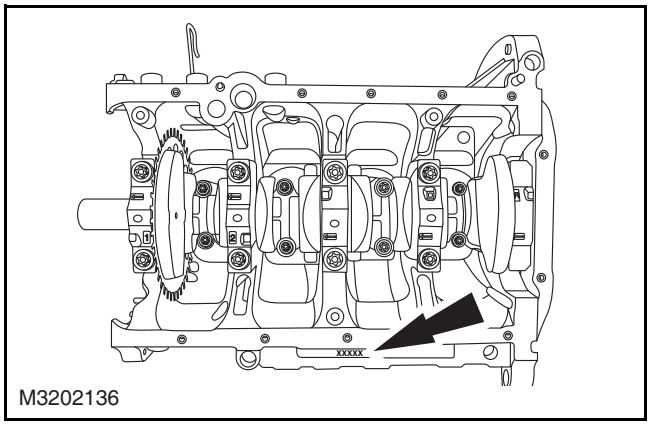
https://truckmanualshub.com/



## Assembly

**CAUTION: There is a quality grouping letter A or B stamped on each piston top as well as the connecting rod assembly large end side. When assembling, all the pistons and connecting rod assemblies from an engine should belong to the same quality group.**

**CAUTION: There are also numbers mark 1 or 2 on the engine block as shown in the figure. The first number represents the inside diameter of No.1 cylinder. The second number represents the inside diameter of No.2 cylinder. The third number represents the inside diameter of No.3 cylinder. The fourth number represents the inside diameter of No.4 cylinder.**

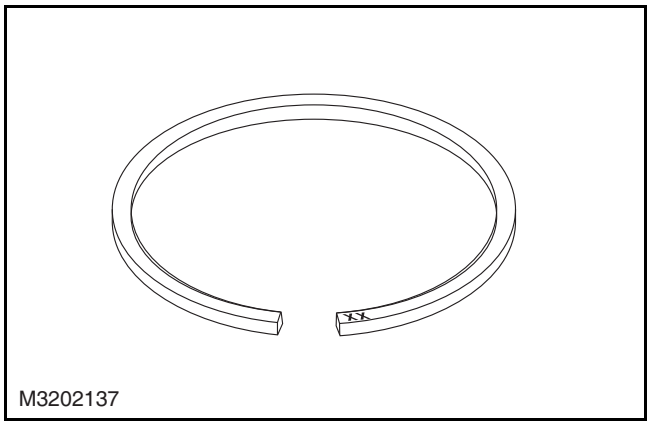


M3202136

**CAUTION: Match the piston to the corresponding cylinder by following the cylinder inside diameter mark on the cylinder block.**

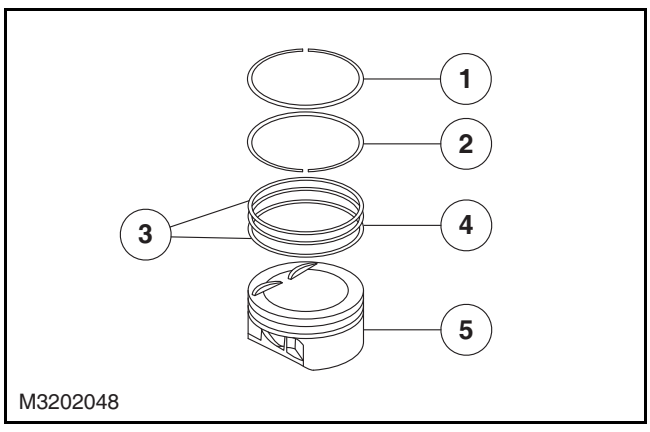
**1.** Install the piston ring to the piston.

1 Install the No.1 piston ring and No.2 piston ring into the corresponding piston ring groove respectively with the marked side towards the piston top.



M3202137

2 Adopt butt joint instead of overlap joint at the opening of coil spring. When installing the oil ring set, install the coil spring first, and then install both oil control rings.



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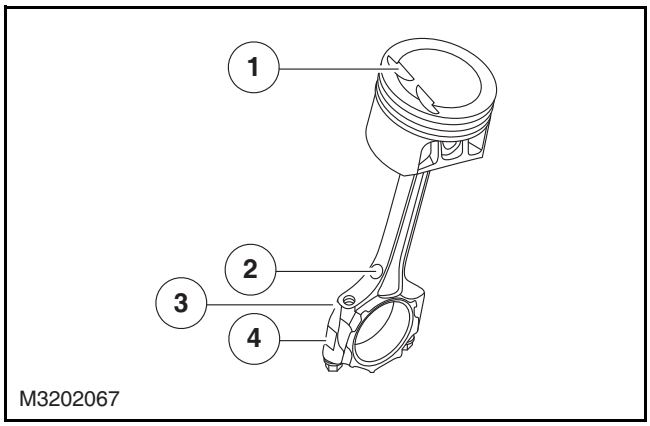


**2.** Install the piston pin to the piston and connecting rod.

1 Apply an appropriate amount of engine oil to the piston pin outer wall, connecting rod small end hole and piston pin hole.

2 Install the piston connecting rod to the piston.

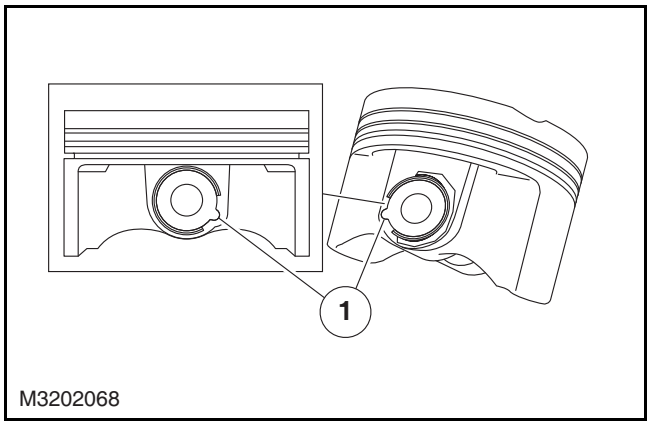
**CAUTION: The piston top drop pit and connecting rod large end oil hole should be on the same side.**



M3202067

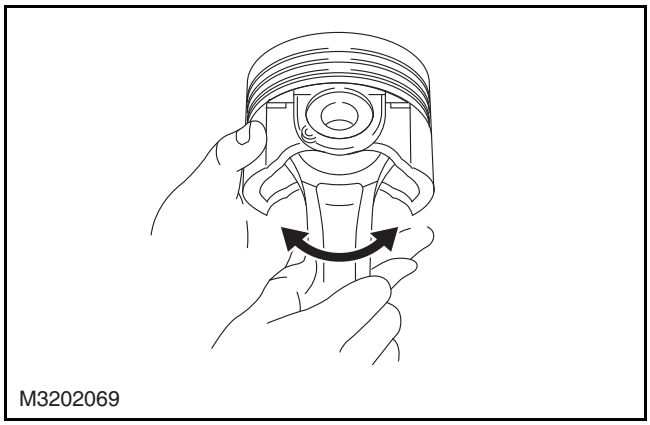
| | |
|---|---|
| 1 | Piston top drop pit |
| 2 | Connecting rod large end oil hole |
| 3 | Connecting rod size grouping |
| 4 | Connecting rod quality grouping |

3 Install the piston pin circlip in place so that it is entirely in the groove, then adjust it so that its opening is facing the installation hole (1) of piston pin circlip.



M3202068

4 Move the piston back and forth on the piston pin to inspect the installation of piston and pin.

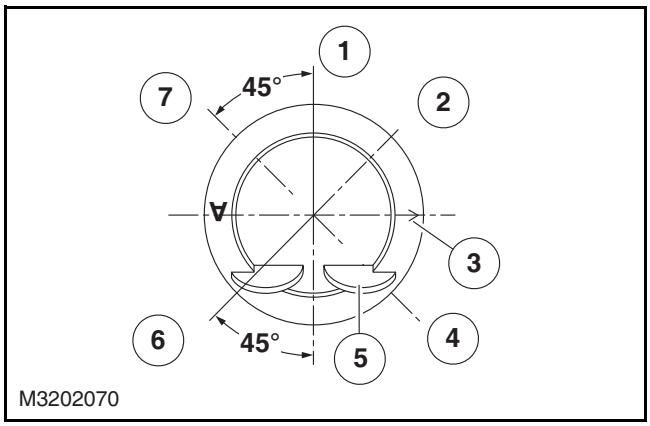

M3202069

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**3.** Place the piston ring so that its end is in the position shown in the figure.

| | |
|---|---|
| 1 | Coil spring opening |
| 2 | No.2 piston ring opening |
| 3 | Arrow pointing to the engine front |
| 4 | (Upper) oil control ring opening |
| 5 | Drop pit on intake side |
| 6 | No.1 piston ring opening |
| 7 | (Lower) oil control ring opening |

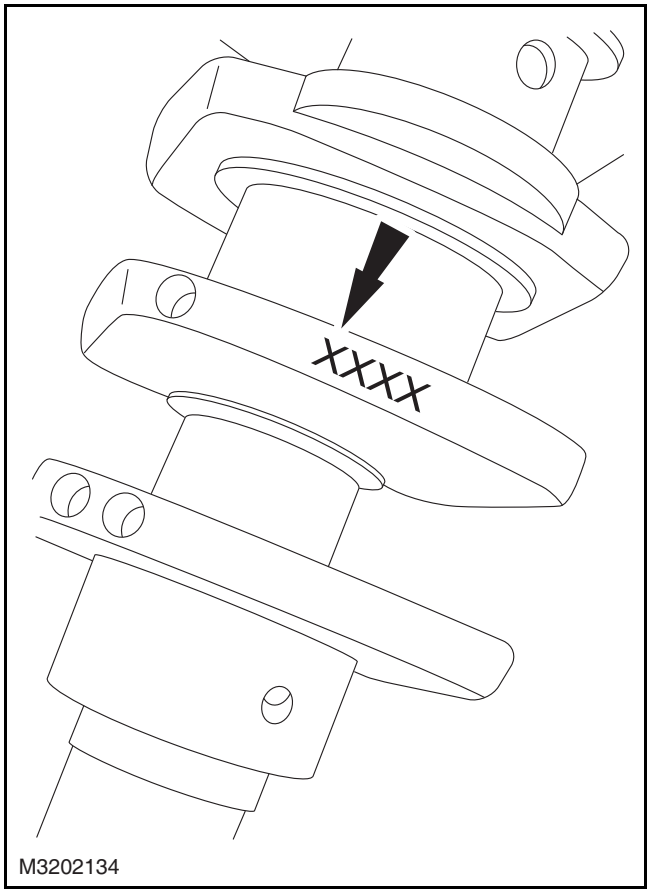


M3202070

**4.** Apply an appropriate amount of engine oil to the pistons, piston rings, cylinder walls, connecting rod bearing shells and crankshaft connecting rod journals.

**5.** Install the connecting rod bearing cap.

1 Verify the crank with 4 printed numbers. The 4 numbers represent the model of the diameter for connecting rod journal and installation sequence of 4 connecting rods.

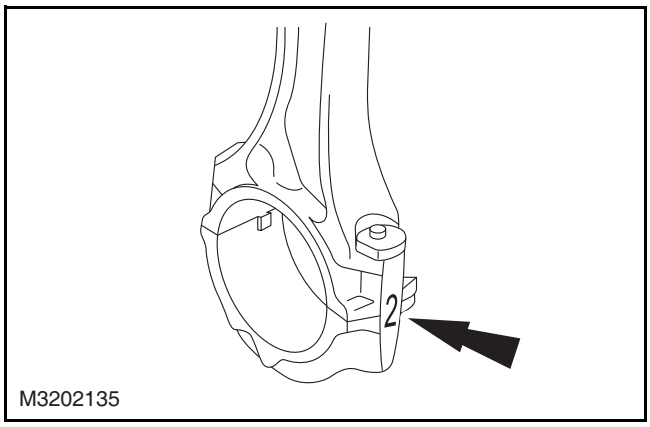


M3202134

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2 Then verify the number on the joint surface of connecting rod bearing caps. The number represents the model of connecting rod large end hole diameter.

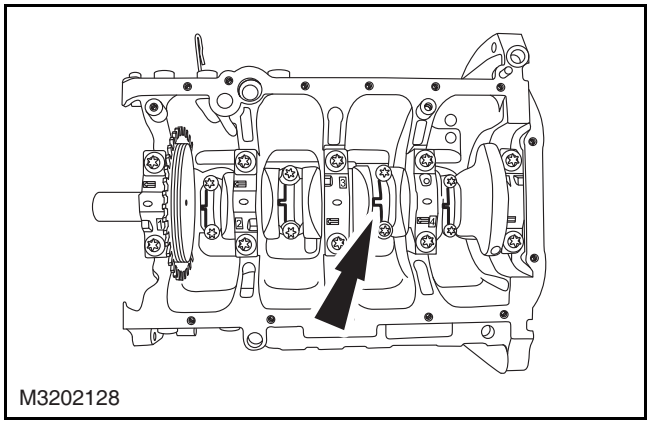


M3202135

3 Selection of connecting rod bearing cap.

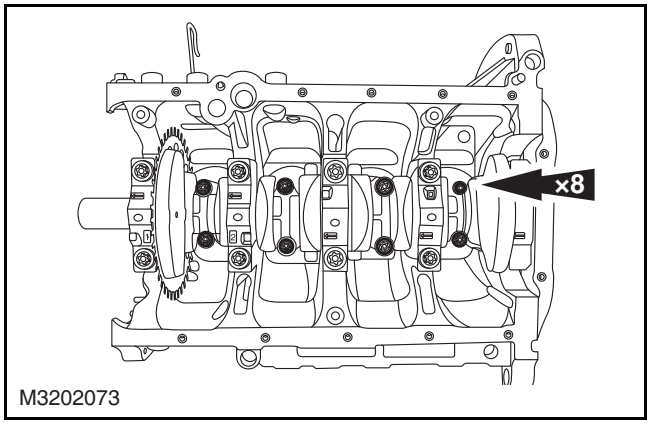
Bearing cap = 7 - Number printed on the crankshaft - Number on the connecting rod bearing cap side.

4 Point all the boss marks of connecting rod bearing cap at the crankshaft pulley side.


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5 Tighten the connecting rod bearing cap retaining bolts.

Torque: 15 Nm + 90°



M3202073

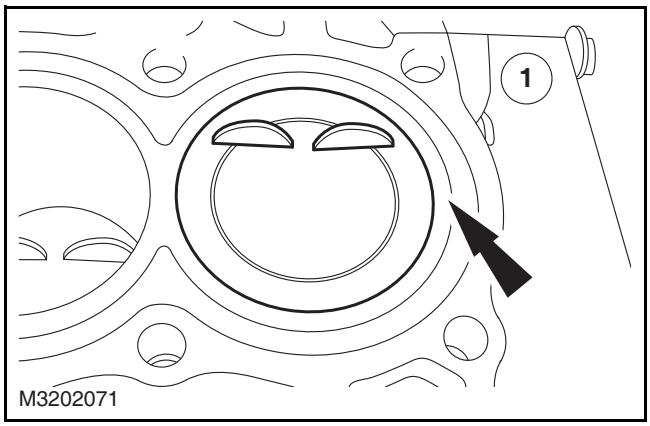
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**6.** Assembly the piston and connecting rod into the cylinder.

1 Use a piston ring compressor to compress the piston ring.

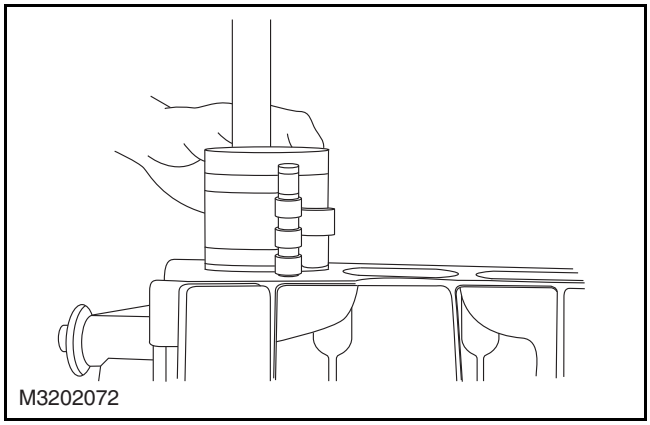
2 Place the connecting rod on the cylinder block.




**CAUTION: When assembling the piston and the connecting rod into the cylinder, the piston top drop pit should be on the intake side and "→" mark on the piston top should point at the gasoline engine front (1).**

3 Use the hammer handle to tap the piston and install it to cylinder.

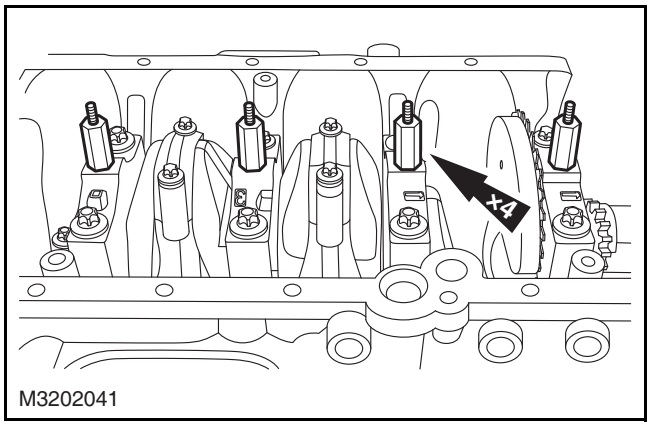
General tool: Piston ring compressor




**CAUTION: Hold the piston ring compressor closely against the cylinder block until all the piston rings enter the cylinder.**

**7.** Install 4 oil pan baffle plate stud bolts.

Torque: 10 ± 1 Nm



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8. Install the oil pan baffle plate.

   **Refer to: Oil Pan Baffle Plate (3.2.3 Lubrication System, Removal and Installation).**

9. Install the cylinder head subassembly.

   **Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Removal and Installation).**

10. Install the camshaft.

    **Refer to: Camshaft (3.2.2 Mechanical System, Removal and Installation).**

11. Install the timing chain.

    **Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**

12. Adjust the valve clearance.

    **Refer to: Valve Clearance Inspection and Adjustment (3.2.2 Mechanical System, General Inspection).**

13. Remove the oil pan upper part.

    **Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

14. Remove the oil pan lower part.

    **Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

15. Install the cylinder head cover.

    **Refer to: Cylinder Head Cover (3.2.2 Mechanical System, Removal and Installation).**

16. Install the exhaust manifold.

    **Refer to: Exhaust Manifold (3.2.6 Exhaust System, Removal and Installation).**

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17. Install the intake manifold.

    **Refer to: Intake Manifold (3.2.5 Air Intake System, Removal and Installation).**

18. Install the accessory drive belt.

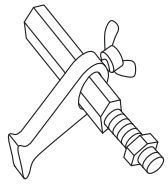
    **Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**

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# Main Bearing, Crankshaft and Cylinder Block

## Special Tool

| | |
|---|---|
|  09924-17810 | Flywheel tightener 09924-17810 |

## General Equipment

| |
|---|
| Micrometer |
| Plastic feeler gauge |
| Straight scale |

## Material

| Item | Specifications |
|---|---|
| Sealant | Tonsan 1596Fa<br>Tonsan 1591 |

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## Disassembly

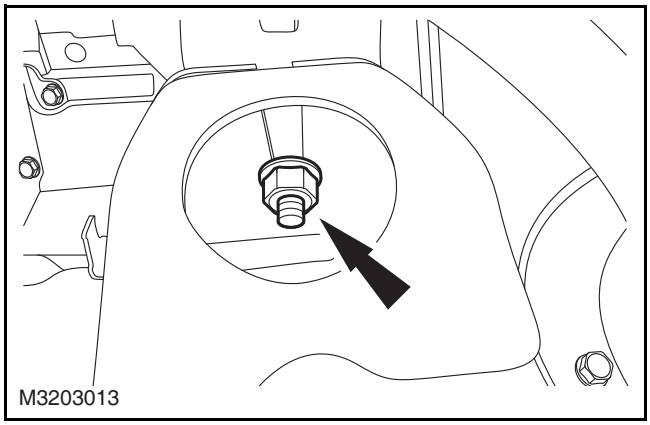
1. Remove the engine assembly.

   **Refer to: Engine Assembly (3.2.2 Mechanical System, Removal and Installation).**

2. Remove the engine bracket.

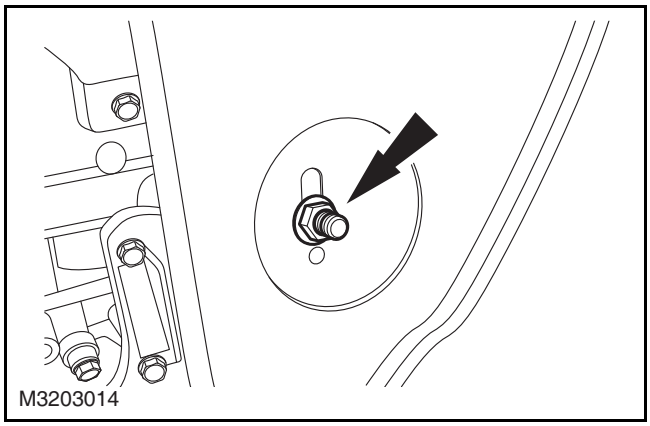
   1 Remove the left connecting nut from the engine bracket.

   Torque: 70 ± 5 Nm




   2 Remove the right connecting nut from the engine bracket.

   Torque: 70 ± 5 Nm




   3 Remove the engine bracket.

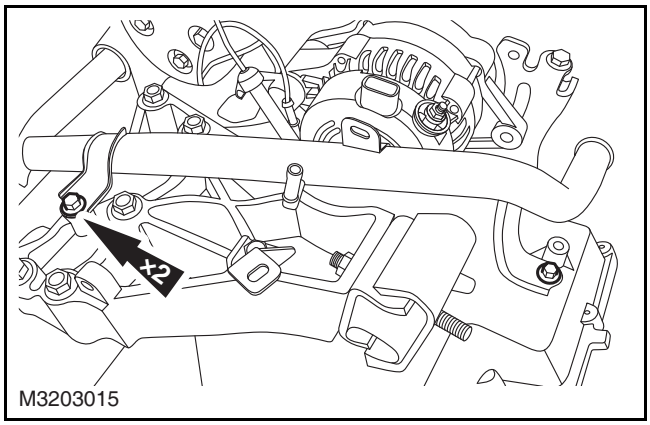
3. Remove the intake manifold.

   **Refer to: Intake Manifold (3.2.5 Air Intake System, Removal and Installation).**

4. Remove the water inlet pipe assembly.

   1 Remove 2 water inlet pipe retaining bolts.

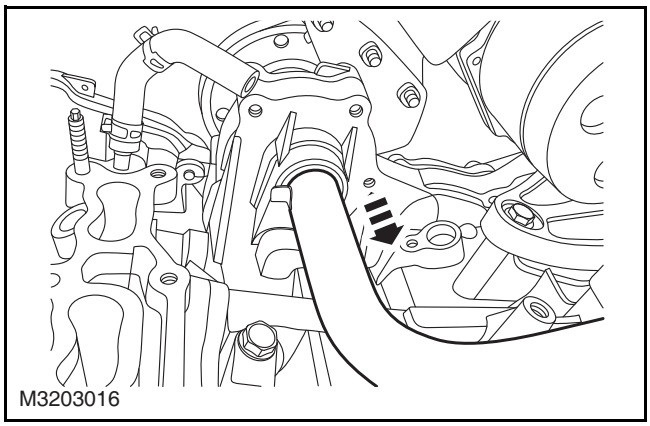
   Torque: 10 ± 1 Nm



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2 Pull out the water inlet pipe assembly from the engine block.


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**5.** Remove the accessory drive belt.

**Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**

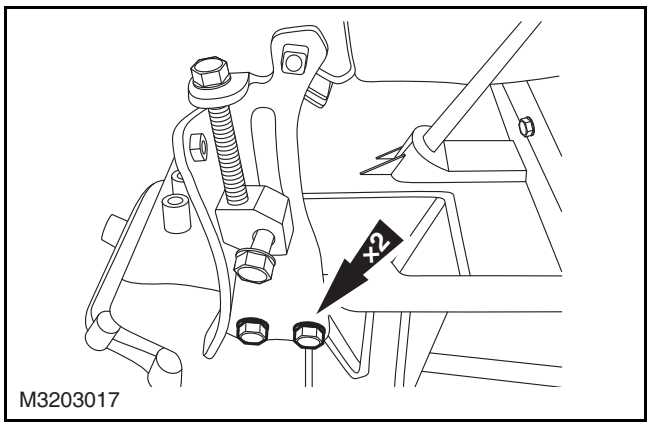
**6.** Remove the alternator.

**Refer to: Alternator (3.2.10 Charging System, Removal and Installation).**

**7.** Remove the alternator adjusting bracket.

1 Remove 2 alternator adjusting bracket retaining bolts.

Torque: 23 ± 2 Nm



M3203017

2 Remove the alternator adjusting bracket.

**8.** Remove the A/C compressor.

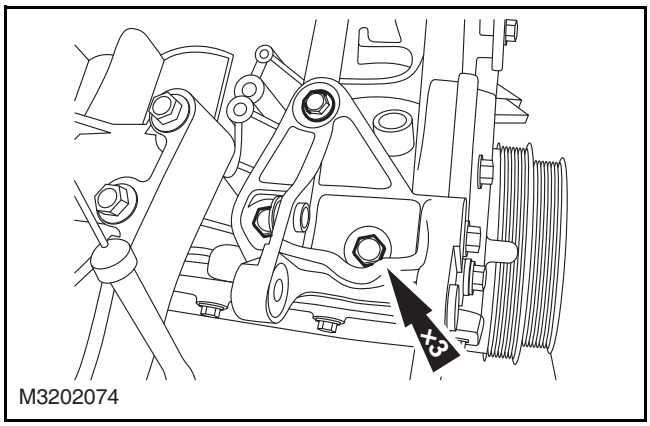
**Refer to: Compressor (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**

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**9.** Remove 3 A/C compressor carrier retaining bolts.

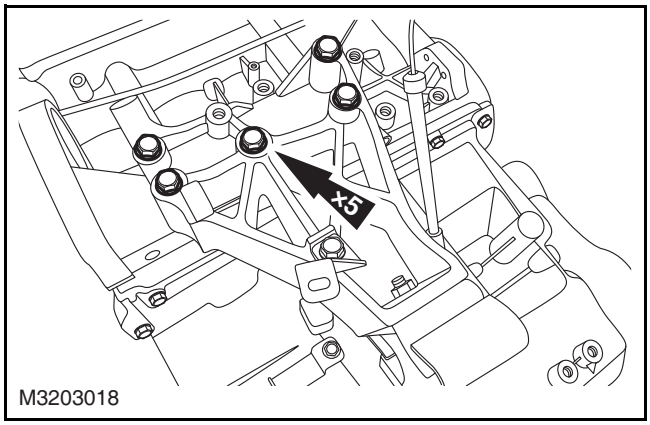
Torque: 32 ± 2 Nm




**10.** Remove the right bracket and mounting bush.

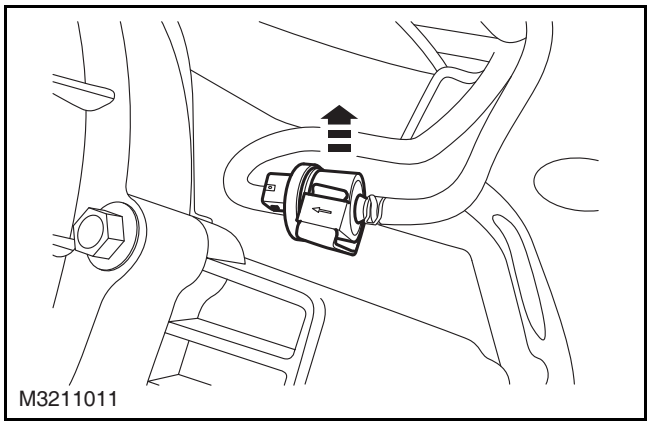
1 Remove 5 right bracket retaining bolts.

Torque: 70 ± 5 Nm




2 Remove the right bracket and mounting bush.

**11.** Remove the carbon canister control valve from the canister control valve mounting bracket.

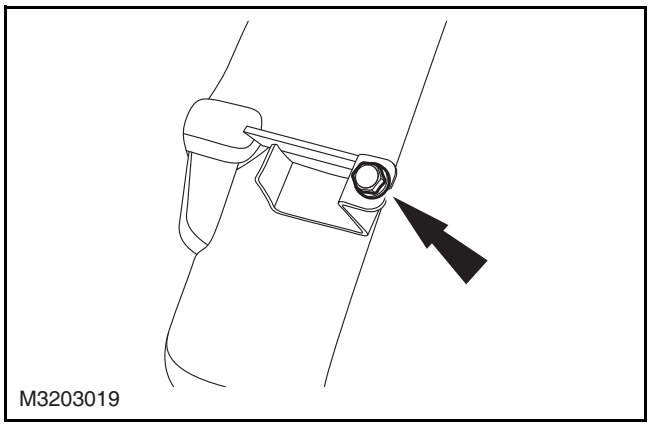


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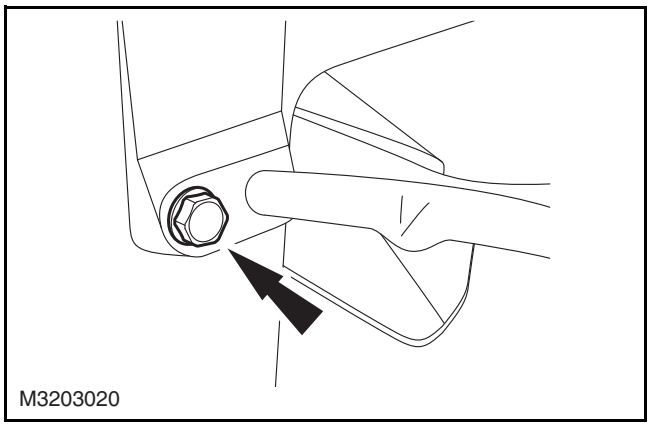
**12.** Remove the retaining bolt from the carbon canister control valve mounting bracket.

Torque: 10 ± 1 Nm




**13.** Remove the oil level gauge guide retaining bolt.

Torque: 10 ± 1 Nm




**14.** Remove the exhaust manifold.

**Refer to: Exhaust Manifold (3.2.6 Exhaust System, Removal and Installation).**

**15.** Remove the timing chain.

**Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**

**16.** Remove the oil pan lower part.

**Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

**17.** Remove the oil pan upper part.

**Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

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**18.** Remove the flywheel.

**Refer to: Flywheel (3.2.2 Mechanical System, Removal and Installation).**

**19.** Remove the cylinder head subassembly.

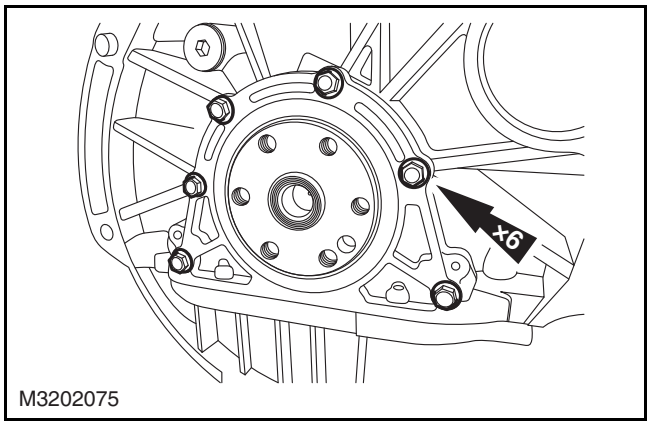
**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Removal and Installation).**

**20.** Remove the piston connecting rod.

**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Removal and Installation).**

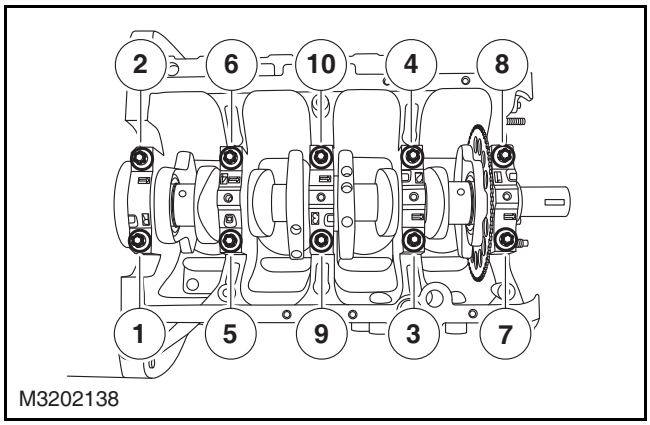
**21.** Remove the crankshaft rear end cover and crankshaft rear oil seal assembly.

⚠ **CAUTION: Replace the rear oil seal assembly with a new one after removing the rear oil seal.**



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**22.** Remove the crankshaft main bearing cap bolts in the order shown in the figure.



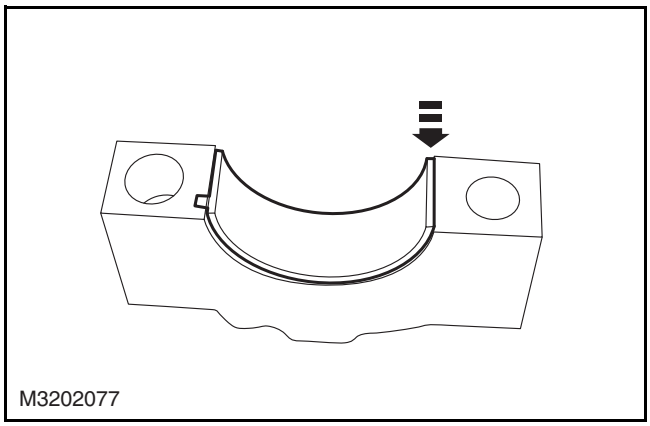
M3202138

**23.** Remove the crankshaft main bearing caps in sequence.

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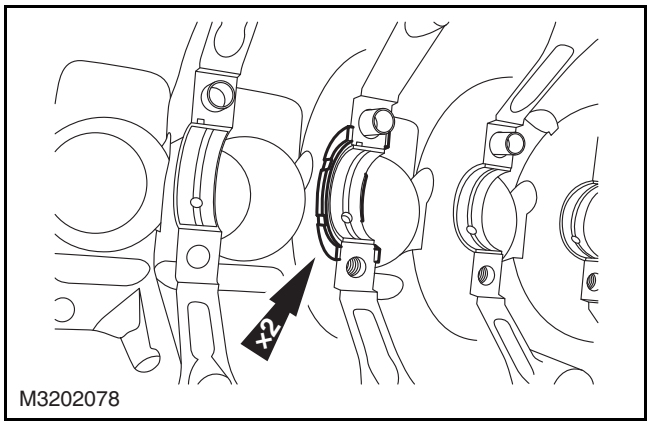


**24.** Remove the lower main bearing shell from the main bearing cap.


M3202077

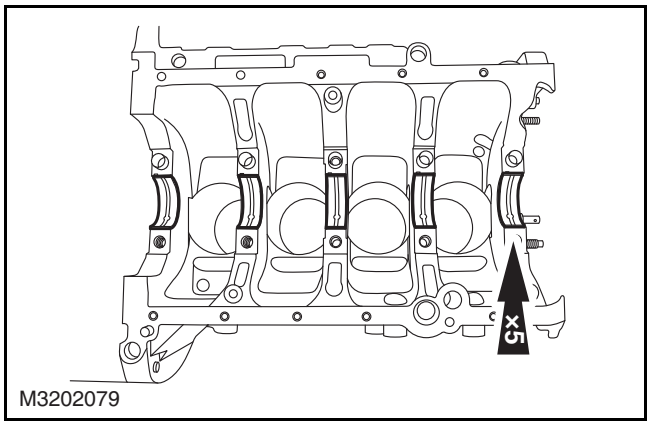
**25.** Remove the crankshaft from the cylinder block.

**26.** Remove 2 crankshaft thrust plates from the cylinder block between No.2 and No.3 cylinders.



M3202078

**27.** Remove the upper main bearing shells from the cylinder block.



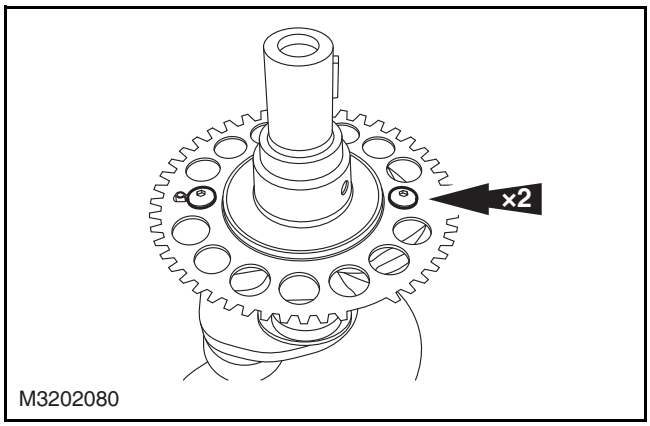
M3202079

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**28.** Remove the crankshaft speed sensor plate from the crankshaft.

1 Remove 2 crankshaft speed sensor plate retaining screws.




2 Remove the crankshaft speed sensor plate from the crankshaft.

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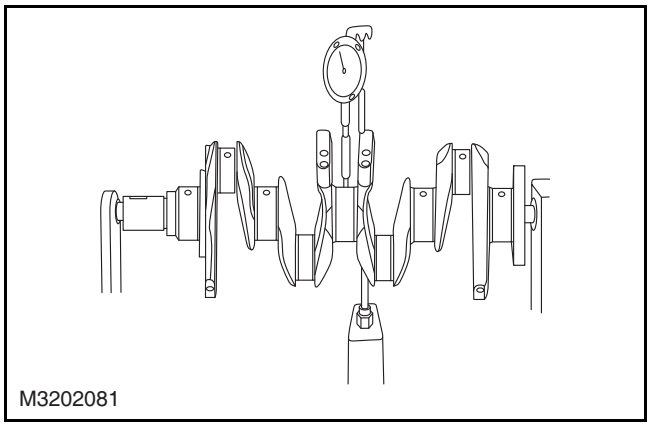


## Inspection

**1.** Inspect the crankshaft.

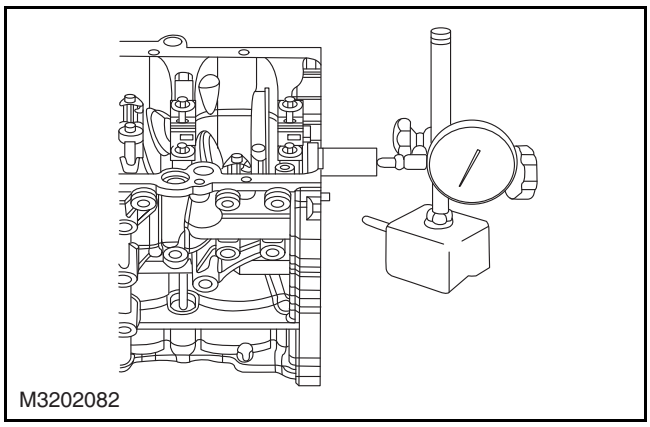
1 Inspect the crankshaft radial runout and measure the radial runout at the center journal with a dial indicator while slowly turning the crankshaft. If the radial runout exceeds the limit, install a new crankshaft.

Radial runout limit: 0.06 mm


M3202081

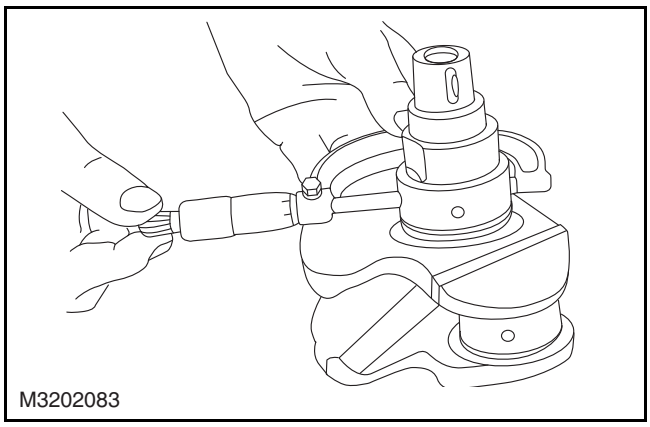
2 Inspect the thrust clearance and read the offset in the axial (thrust) direction with a dial indicator. Install a new thrust plate if the measurement exceeds the limit.

| Item | Standard | Limit |
|---|---|---|
| Crankshaft thrust clearance | 0.16 ~ 0.36 mm | 0.38 mm |


M3202082

3 Inspect the crankshaft for uneven wear (out-of-round and taper) and measure it with a micrometer. Grind the crankshaft or install a new one if any of the bearing journals has been seriously worn or the uneven wear exceeds the limit.

Out-of-round and taper limit: 0.005 mm

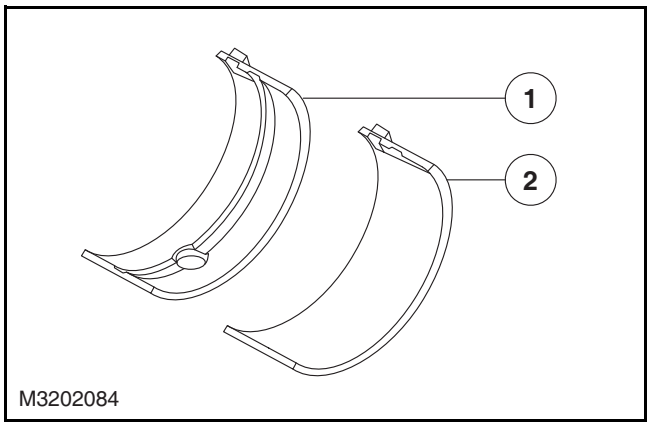

M3202083

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**2.** Inspect the main bearing shell.

1 Inspect the main bearing shell for any corrosive pitting, scratches, abrasions or damages. If any defect is found, replace upper (1) and lower (2) main bearing shells instead of replacing one alone.




**3.** Inspect the main bearing shell clearance.

1 Remove the main bearing cap.
2 Clean the main bearing shell and main journal.
3 Place a piece of plastic feeler gauge (parallel to the crankshaft) with the same width as the bearing shell on the main journal while avoiding the oil hole.
4 Install the main bearing caps in the order shown in the figure and evenly tighten the bolts to the specified torque.
Torque: 35 Nm + 45°

**CAUTION: When installing, the arrow on the main bearing cap must point to the engine front. The main bearing cap marked with "1" is installed at the engine front while one marked with "5" is installed on the flywheel side.**

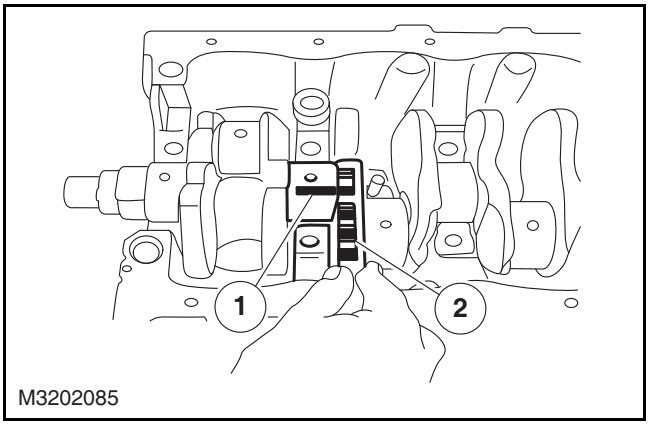
**CAUTION: Do not rotate the crankshaft after installing the main bearing cap.**

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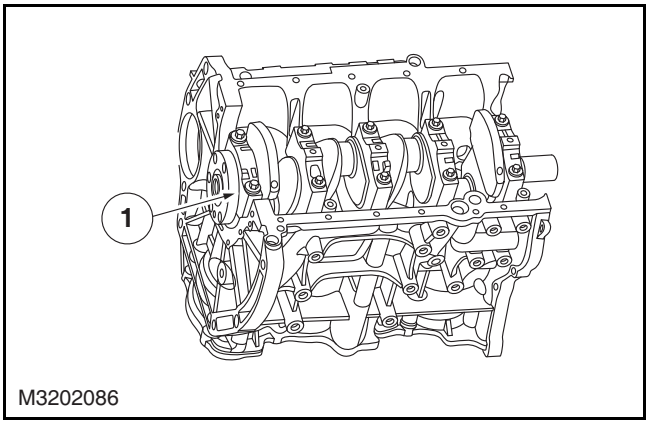
5 Remove the main bearing cap, measure its width by placing the gauge (2) at the widest point of the plastic feeler gauge (1). If the clearance exceeds the limit, replace the main bearing shell. Both the upper and lower bearing shells must be replaced as a whole. If the clearance for standard bearing shell is not as specified, use the oversize 0.25 mm bearing shells to grind the crankshaft journal again. Inspect the bearing clearance again after installing a new bearing.

| Bearing shell clearance | Standard | Limit |
|---|---|---|
| | 0.020 - 0.040 mm | 0.026 ~ 0.046 mm |



M3202085

**4.** Measure the crankshaft rear end circular runout after replacing the flywheel gear ring according to the above steps. If the end face runout is not as qualified, measure the crankshaft rear end circular runout (measured position (1)); if the runout exceeds the limit, replace the crankshaft and measure again.
If the runout is still not as qualified, replace the cylinder block.



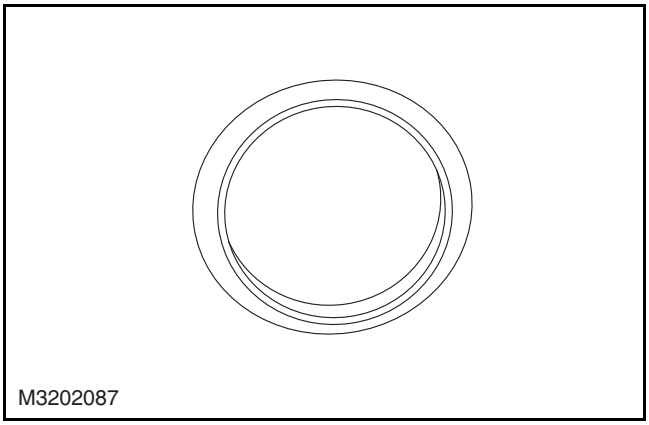
M3202086

**CAUTION: When replacing the crankshaft and cylinder block, replace all the main bearing shells at the same time.**

**CAUTION: When replacing the crankshaft and cylinder block, select new standard bearing shells to be installed by referring to the number printed on the new crankshaft or the letter printed on the matching surface of new cylinder block.**

**5.** Inspect the crankshaft rear oil seal.

1 Inspect the oil seal for abrasions, and if oil seal lip is worn or damaged. replace it with a new one.


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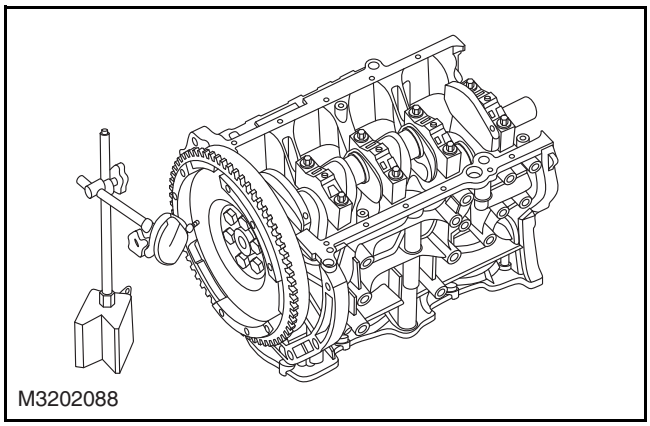
**6.** Inspect the flywheel gear ring.

1 Inspect the flywheel gear ring, and if it is damaged, cracked or worn, replace the flywheel.

2 Inspect the clutch driven disc junction surface, and if it is damaged or worn excessively, replace the flywheel.

3 Measure the flywheel end face runout with a dial indicator, and if it exceeds the limit, replace the flywheel.

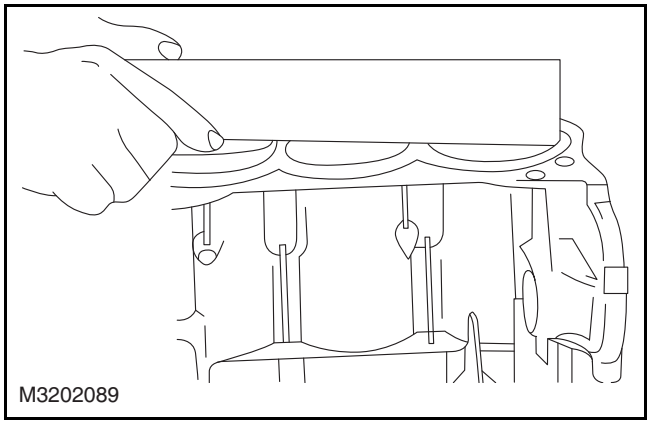
End face runout limit: 0.2 mm


M3202088

**7.** Inspect the cylinder block.

1 Use the straight scale and feeler gauge, inspect the cylinder block and cylinder head sealing surface for deformation. If the flatness exceeds the limit, trim the surface. Inspection and flatness trim methods are the same with that of cylinder head as described previously.

| Item | Standard | Limit |
|---|---|---|
| Flatness | 0.05 mm | 0.10 mm |


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## Assembly

**CAUTION: Clean all the components to be installed thoroughly**

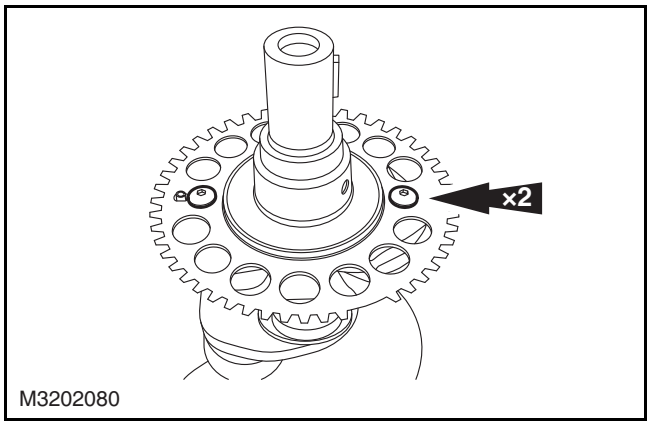
**CAUTION: Apply an appropriate amount of engine oil to the crankshaft journals, crankshaft bearings, thrust plates, connecting rod journals, connecting rod bearings, pistons, piston rings and cylinder bores.**

**CAUTION: Make sure that the crankshaft bearing, bearing cap, connecting rod, connecting rod bearing, connecting bearing cap, piston and piston ring are all assembled into a combination. Do not mess the combination and make sure that each component return to the original position.**

1. Install the crankshaft speed sensor plate to the crankshaft and tighten the retaining screws to the specified torque.

   Torque: 11 ± 1 Nm

**CAUTION: The screws cannot be reused if removed. Replace the sensor plate screws with new ones.**

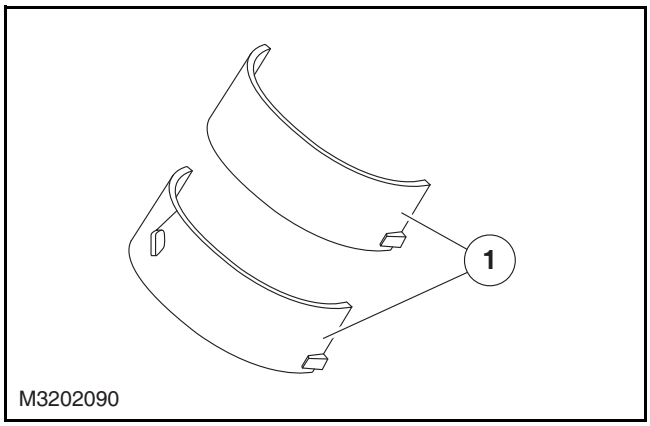


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**2.** Install the crankshaft bearing shells to cylinder block. The bearing shell with oil groove is installed on the cylinder block while the other one without oil groove is installed on the bearing cap. Verify the two bearing shells are of the same size.

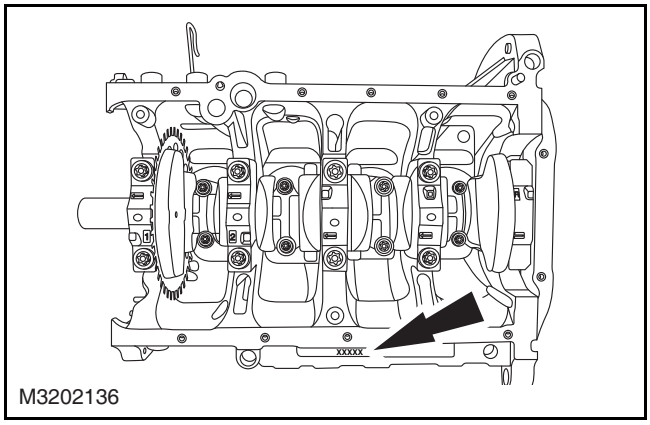


M3202090

**CAUTION: There are 5 standard crankshaft bearing shells with different thicknesses. In order to distinguish them, there is a number such as "2", "3", "4", "5" or "6" stamped on the steel back (thrust side) of each bearing shell. The bearing thickness and matching relation are specified in the table below.**

**CAUTION: The standard main bearing shell and oversize 0.25 mm bearing shell, each with 5 groups of tolerances in size, are useful for repair.**

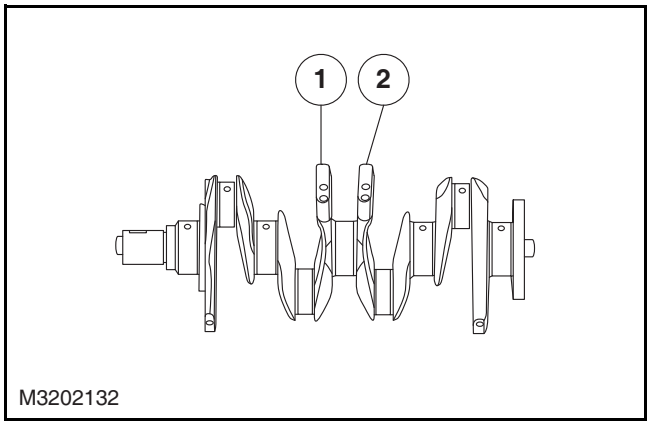
1 There are 5 characters on the cylinder block matching surface (positions as shown in the figure), 3 of which ("1", "2" and "3") represent the following crankcase main bearing hole diameters.



M3202136

2 Select crankshaft main bearing shells that meets the standard according to the numbers printed on the crankshaft crank and characters printed on the cylinder block matching surface plus the following chart.

| | |
|---|---|
| 1 | Main bearing journal grouping number |
| 2 | Connecting rod journal grouping number |



M3202132

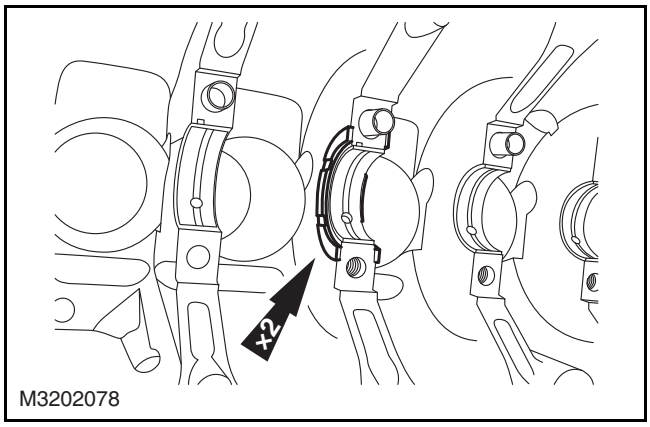
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Crankshaft Main Journal, Main Bearing Hole, Main Bearing Shell Size Grouping Chart Unit: mm

| Matching Clearance 0.006 ~ 0.026 | | | | Crankshaft Main Journal Diameter Grouping | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | | 2 | | 3 | |
| | | | | Grouping Mark | | | | | |
| | | | | 1 | | 2 | | 3 | |
| Crankcase Main Bearing Hole Diameter | Group | Mark | Grouping Size Range | $45^{0}_{-0.006}$ | | $45^{-0.0061}_{-0.012}$ | | $45^{-0.0121}_{-0.018}$ | |
| | 1 | 1 | $49^{+0.006}_{0}$ | 06 | $2.0^{-0.003}_{-0.007}$ | 05 | $2.0^{0}_{-0.004}$ | 04 | $2.0^{+0.003}_{-0.001}$ |
| | 2 | 2 | $49^{+0.012}_{+0.061}$ | 05 | $2.0^{0}_{-0.004}$ | 04 | $2.0^{+0.003}_{-0.001}$ | 03 | $2.0^{+0.006}_{+0.002}$ |
| | 3 | 3 | $49^{+0.018}_{+0.0121}$ | 04 | $2.0^{+0.003}_{-0.001}$ | 03 | $2.0^{+0.006}_{+0.002}$ | 02 | $2.0^{+0.009}_{+0.005}$ |

**3.** Install the crankshaft thrust plates to the cylinder block between No.2 and No.3 cylinders and make sure that the side with oil groove faces the crank.

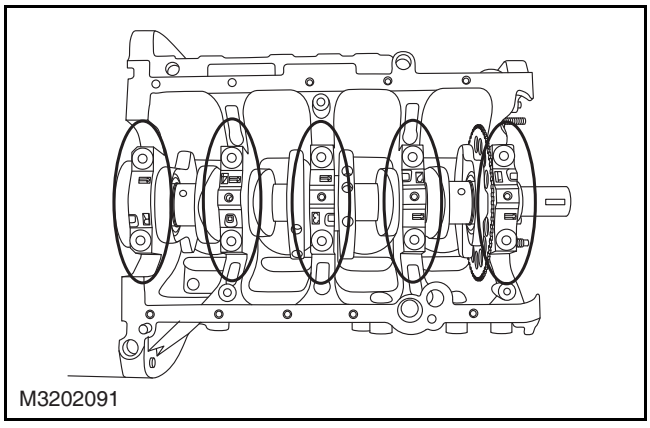


M3202078

**4.** Install the crankshaft to the cylinder block.

**5.** Install the crankshaft main bearing caps, and make sure that the arrow on each bearing cap points to the crankshaft pulley side. Install the caps marked with “1” to the side near the crankshaft belt pulley in sequence and install the caps marked with “5” to the side near the flywheel.

**CAUTION: There are five numbers printed on the cylinder block bottom, each of which (from left to right) represents the crankshaft bore diameter of bearing cap "1", "2", "3", "4" or "5" respectively. There are 3 groups of crankshaft holes: groups 1, 2 and 3, each of which represents the following main bearing hole diameter respectively.**

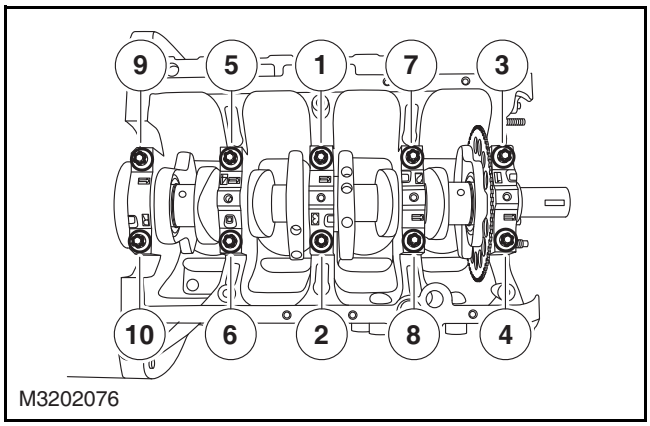

M3202091

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6. Tighten the crankshaft main bearing cap bolts to the specified torque in the order shown in the figure.

   Torque: 25 Nm + 45°



M3202076

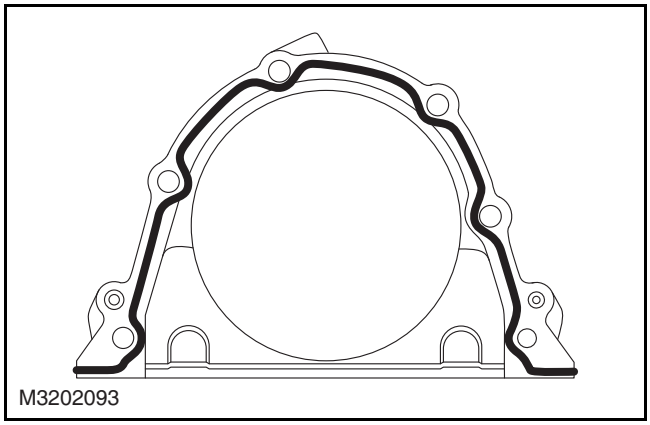
**CAUTION: The bolts cannot be reused if removed. Replace the main bearing cap bolts with new ones.**

**CAUTION: Do not tighten the bolts to the specified torque in one step during installation. The correct procedure is to tighten them in several steps before tightening them to the specified torque.**

**CAUTION: After tightening the bearing cap bolts, make sure that the crankshaft rotates smoothly when rotating it with a force of 8 Nm or less.**

7. Install the new crankshaft rear oil seal.

   1 Apply sealant to the crankshaft rear end cover as shown in the figure.

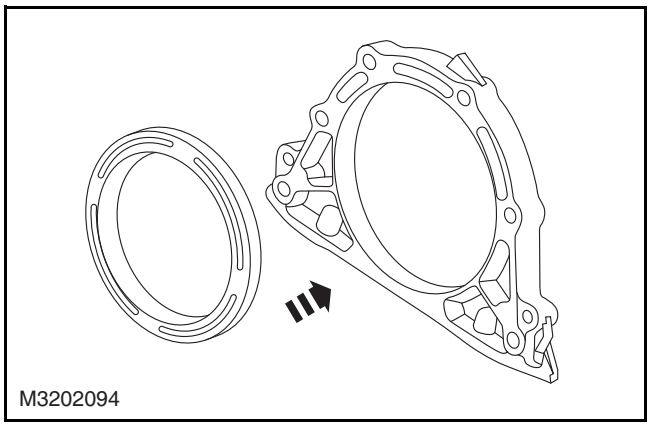

M3202093

**CAUTION: Clear off the residual sealant on the crankshaft rear end cover with a scraper before application. Apply the sealant continuously and evenly to the inner circle with a diameter of 2 ~ 3 mm. Close the box after applying for a certain period. Clean and reapply the sealant if applying time is too long.**

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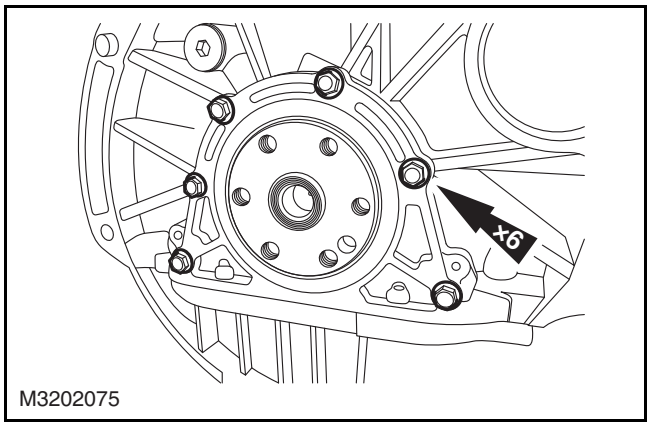
2 Place a square block on the oil seal, and then tap in the oil seal smoothly with a hammer. The end face of crankshaft rear oil seal assembly should be parallel to the installation surface of crankshaft rear end cover. Based on the crankshaft rear end cover machining surface, the top height of rear oil seal after press-fitting is 9.8 ± 0.2 mm and the flatness of oil seal end face is not more than 0.2 mm. Avoid any contacts with foreign matters or your hands and damages to the oil seal lip during handling.


M3202094

**CAUTION: When press-fitting the crankshaft rear oil seal into the crankshaft rear end cover, the direction is as shown in the right figure. Do not press-fit backwards. Clean the crankshaft rear end cover before installing.**

**8.** Tighten 6 retaining bolts of crankshaft rear end cover.

Torque: 10 ± 1 Nm



M3202075

**9.** Install the piston connecting rod.

**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Removal and Installation).**

**10.** Install the cylinder head subassembly.

**Refer to: Cylinder Head Subassembly and Valve (3.2.2 Mechanical System, Removal and Installation).**

**11.** Install the flywheel.

**Refer to: Flywheel (3.2.2 Mechanical System, Removal and Installation).**

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**12.** Install the oil pan upper part.

**Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

**13.** Install the oil pan lower part.

**Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

**14.** Install the timing chain.

**Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).**

**15.** Install the exhaust manifold.

**Refer to: Exhaust Manifold (3.2.6 Exhaust System, Removal and Installation).**

**16.** Installation for other components are in the reverse order of removal.

**CAUTION: Inspect the accessory drive belt tension.**

**Refer to: Accessory Drive Belt Inspection (3.2.2 Mechanical System, General Inspection).**

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## Specifications

# Material Specifications

| Item | Area | Specifications |
|---|---|---|
| Sealant | Fitting surface between oil pan lower part assembly and oil pan upper part | Tonsan 1591 |
| Sealant | Oil pressure alarm assembly | Loctite 516 |
| Sealant | Oil pump timing chain housing assembly fitting surface | Tonsan 1596Fa |

# Component Specifications

| Item | Specifications | | | |
|---|---|---|---|---|
| Oil pump type | Rotor type | | | |
| Oil pressure | Engine speed | idling | 3000 r/min | Rated speed |
| | Oil pressure (kPa) | 52 or higher | 200 ~ 480 | 320 ~ 500 |

# General Specifications

### Lubricant Specifications

| Item | Description |
|---|---|
| Specifications | SL 5W-30 |
| Capacity | 4.5 L |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Oil pan drain plug | 45 ± 2 | - | - |
| Oil pan lower part retaining bolt | 10 ± 1 | - | - |
| Oil pan upper part retaining bolt | 10 ± 1 | - | - |
| Oil filter tightening torque | 14 ± 2 | - | - |
| Oil pressure alarm assembly | 21 ± 2 | - | - |
| Oil pump strainer retaining bolt | 10 ± 1 | - | - |
| Oil level gauge retaining bolt | 10 ± 1 | - | - |

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## Description and Operation

# System Overview

Oil pump is rotor type, which is installed on the oil pump timing chain housing at one side of crankshaft pulley.

Oil enters the filter through the oil strainer. The filtered oil falls into two oil ways in the cylinder. One way leads oil to the crankshaft bearing shell. Oil flowing out of the crankshaft bearing goes to the connecting rod bearing through an inclined passage drilled on the crankshaft, and spurts out of the hole on the connecting rod large end to lubricate the piston, piston ring and cylinder wall. The other oil way leads the oil to the cylinder head, and lubricates the camshaft journal, tappet etc. through an oil way of cylinder head.

### Oil Pump

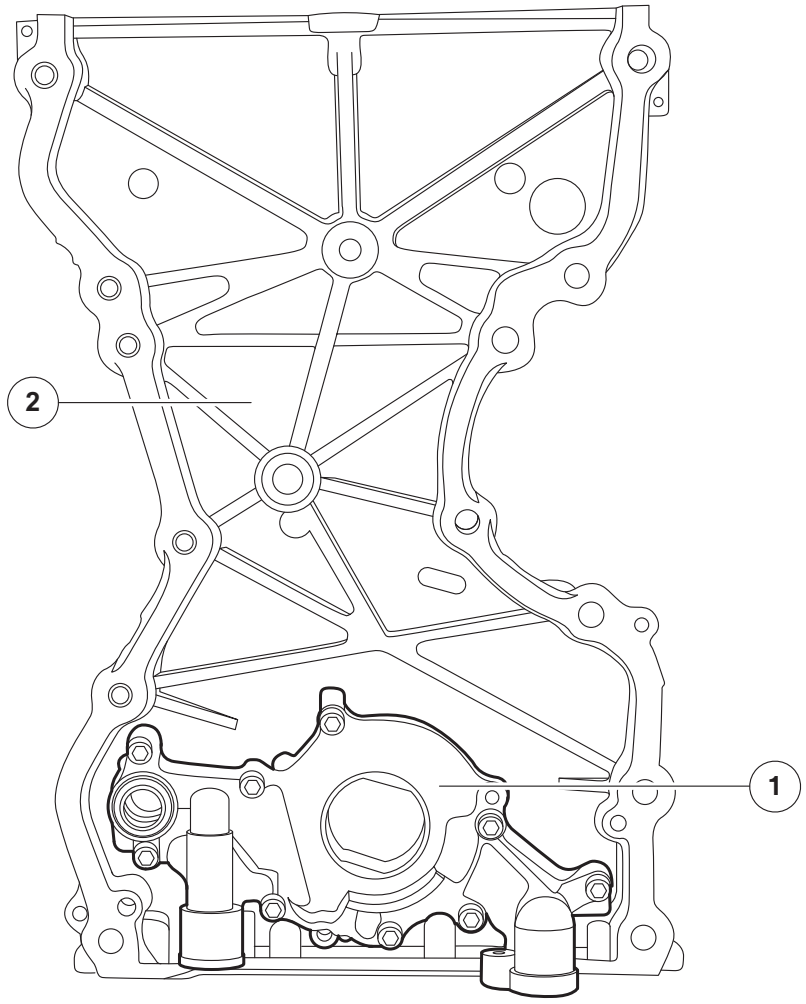
The oil pump is rotor pump which is fixed on the oil pump timing chain housing and driven directly by the crankshaft.

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# Components Location View

## Oil Pump



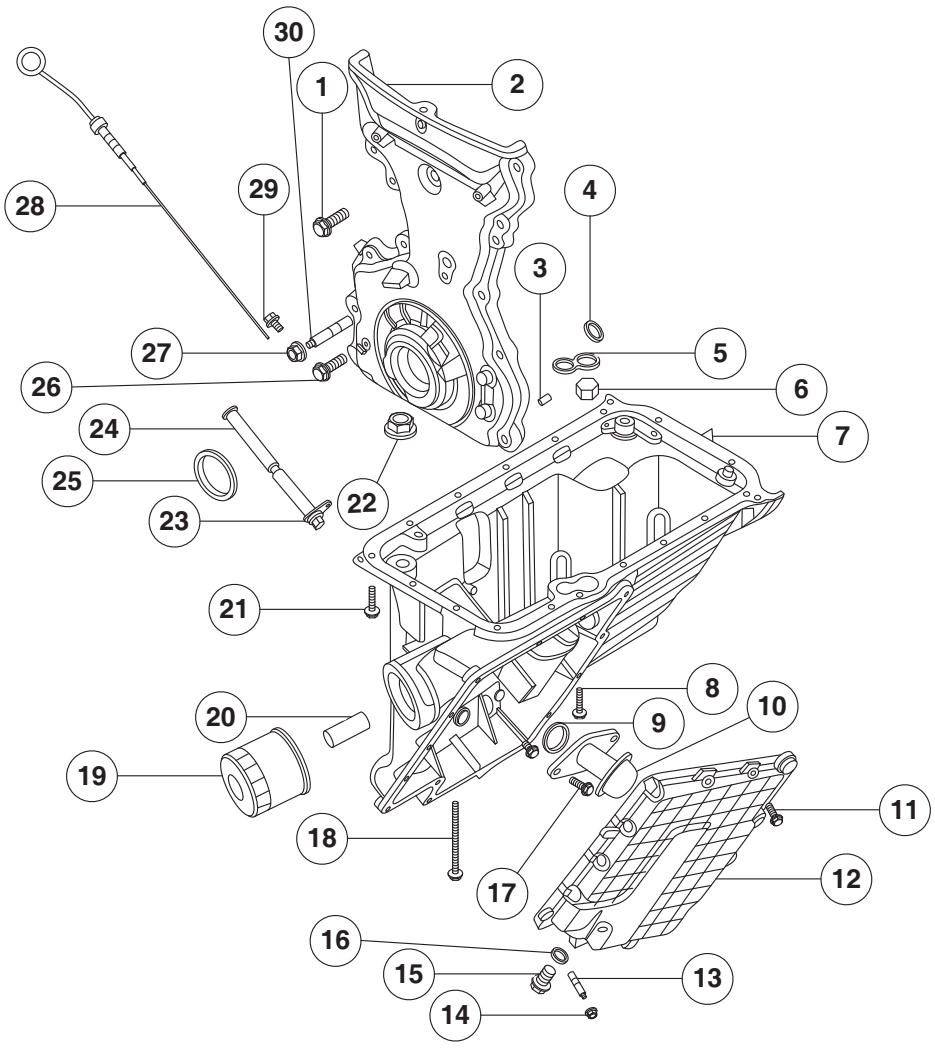

M3203001

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Oil pump | 2 | Oil pump timing chain housing assembly |

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# Components Exploded View




M3203002

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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Timing chain housing mounting bolt | 16 | Drain plug gasket |
| 2 | Oil pump timing chain housing assembly | 17 | Hexagon flange bolt |
| 3 | Flywheel dowel pin | 18 | Hexagon flange bolt |
| 4 | Oil pump outlet O-ring | 19 | Oil filter assembly |
| 5 | Oil filter oil way gasket | 20 | Oil filter connecting pipe |
| 6 | Oil pan upper part dowel pin | 21 | Hexagon flange bolt |
| 7 | Oil pan upper part | 22 | Plane gasket |
| 8 | Inner hexagonal round head screw | 23 | O-ring |
| 9 | Oil strainer O-ring | 24 | Oil level gauge guide assembly |
| 10 | Oil strainer assembly | 25 | Crankshaft front oil seal assembly |
| 11 | Hexagon flange bolt | 26 | Hexagon flange bolt |
| 12 | Oil pan lower part assembly | 27 | Hexagon flange nut |
| 13 | Oil pan upper and lower part connecting stud bolt | 28 | Oil level gauge assembly |
| 14 | Hexagon flange nut | 29 | Hexagon flange bolt |
| 15 | Drain plug | 30 | Oil pump chain cover stud bolt |

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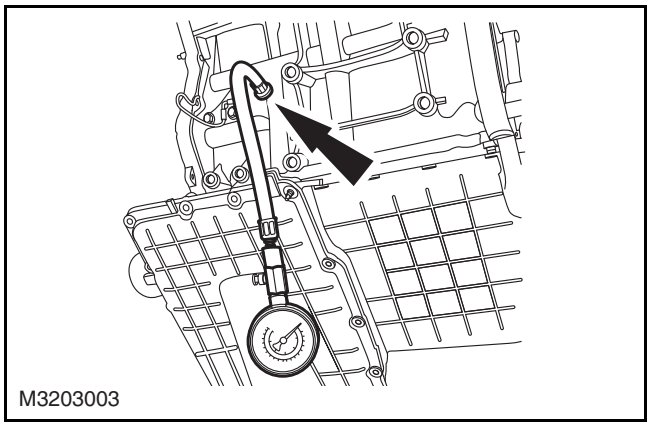
## General Inspection

# Oil Pressure Inspection

**WARNING: The rats in lab suffers from skin cancer due to a long-term contact with the used oil. Wash your hands with soap and water to protect your skin immediately after contacting with oil.**

**WARNING: High temperature engine and oil will lead to serious scalding. Turn off engine to wait until the engine and oil cools down.**

1. Park the vehicle on level ground.
2. Turn off the ignition switch and inspect the engine oil level and viscosity. Fill or replace if necessary.
3. Remove the oil pressure alarm assembly.
4. Install the oil pressure gauge testing joint to the bolt hole of oil pressure alarm and tighten it.



M3203003

5. Start the engine and warm it up to normal work temperature.
6. After the engine is warmed up, increase the engine speed to 3000 r/min and measure the oil pressure.

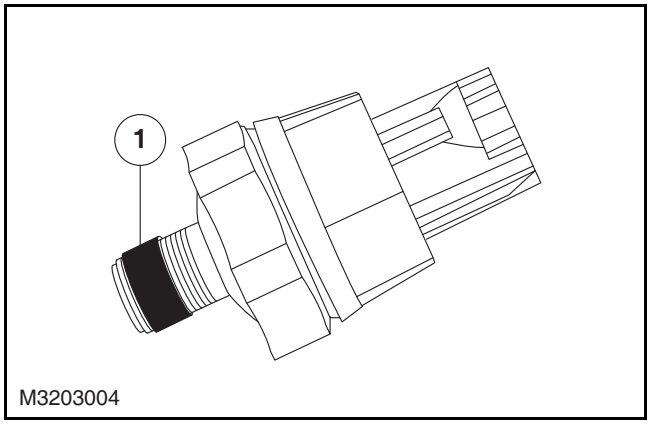
Relevant requires about standard oil pressure are as follows:

| | |
|---|---|
| Idling | 52 kPa and higher |
| 3000 r/min | 200 ~ 480 kPa |
| Rated speed | 320 ~ 500 kPa |

7. Turn off the engine and remove the oil pressure gauge after oil pressure inspection.
8. Remove the sealant (1) on the oil pressure alarm assembly threads, and reapply Loctite 516 sealant as long as 4 ~ 5 mm to the position with 1 ~ 2 threads from thread top. Then reinstall the oil pressure alarm assembly into the mounting hole and tighten it to the specified torque.

   Torque: 21 ± 2 Nm

**CAUTION: The edge of sealing tape (1) should be aligned without bump.**




M3203004

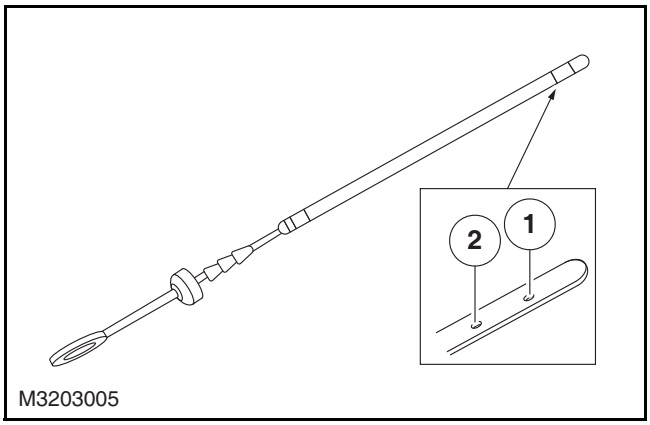
9. Start the engine to check the oil pressure alarm assembly for oil leaks.
10. Turn off the engine, and connect the wiring harness terminal with the oil pressure alarm terminal.

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## Oil Level Inspection

1. Park the vehicle on level ground.
2. Verify that the vehicle is at a cold state.
3. Remove the oil level gauge and inspect if the oil level is between MAX and MIN marks.




1 Low oil level mark

2 High oil level mark

Add engine oil if the oil level is below the MIN mark.

## Engine Oil Change

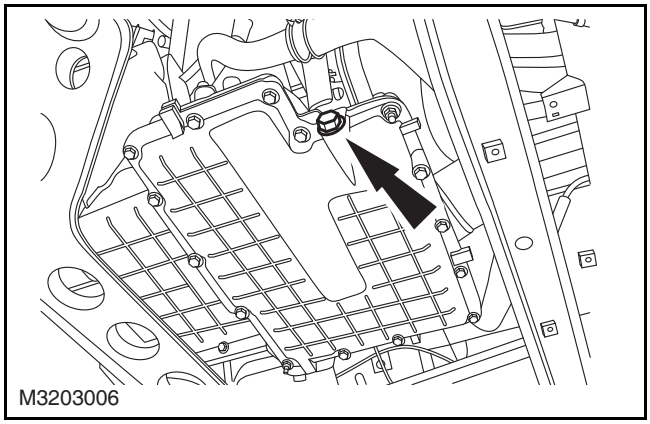
**WARNING: Disassemble or assemble all components after the engine cools down, otherwise, the components may lead to serious burn or personal injury.**

**WARNING: A vehicle which is jacked up by a jack but not securely supported on the bracket is very dangerous. It may slip or fall off, which leads to death or serious injury. Do not work near a vehicle which is jacked up by a jack but not securely supported on the bracket.**

**WARNING: The rats in lab suffers from skin cancer due to a long-term contact with used oil. After you use oil, immediately wash the skin with soap and water for protection.**

**CAUTION: Wipe the oil off completely in case you spread it over the exhaust system. If the splashed oil is not wiped off completely, it would cause smog due to high temperature.**

1. Park the vehicle on level ground.
2. Remove the oil filler cap.
3. Remove the oil pan drain plug and gasket.




4. Drain the oil into a container.
5. Install the oil pan drain plug and gasket, and tighten it to the specified torque immediately.

   Torque: 45 ± 2 Nm
6. Fill engine oil with specified type and amount in the table.

**CAUTION: The amount of residual oil in engine varies with change methods and oil temperature etc. Verify the oil level after oil change.**

7. Install the oil filler cap.
8. Start the engine and verify that there is no oil leaks.
   - Find the reasons and repair or replace the related components if any oil leak occurs.
9. Inspect the oil level.

**Refer to: Oil Level Inspection (3.2.3 Lubrication System, General Inspection).**

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# Oil Filter Replacement

**WARNING: Disassemble or assemble all components after the engine cools down, otherwise, the components may lead to serious burn or personal injury.**

**WARNING: A vehicle which is jacked up by a jack but not securely supported on the bracket is very dangerous. It may slip or fall off, which leads to death or serious injury. Do not work near a vehicle which is jacked up by a jack but not securely supported on the bracket.**

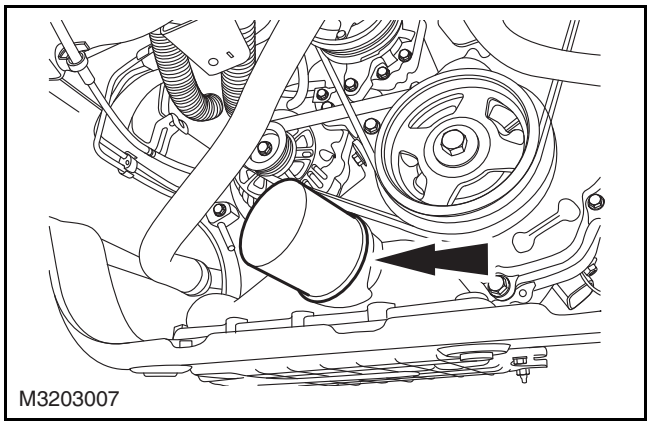
**WARNING: The rats in lab suffers from skin cancer due to a long-term contact with the used oil. The skin contact with used oil should be washed with soap and water immediately after using oil, to protect your skin.**

**CAUTION: Wipe the oil off completely in case you spread it over the exhaust system. If the splashed oil is not wiped off completely, it would cause smog due to high temperature.**

1. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Use a suitable tool to remove the oil filter.


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3. Use a clean rag to clean the installation surface.
4. Apply clean oil to the gasket of new oil filter.
5. Use a suitable tool to tighten the oil filter in accordance with the indication on the side or package.

   Torque (reference value): 14 ± 2 Nm

6. Start the engine and verify that there is no oil leaks.
   - Repair or replace the related components if any oil leak occurs.
7. Inspect the oil level.

   **Refer to: Oil Level Inspection (3.2.3 Lubrication System, General Inspection).**

8. Lower the vehicle.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Oil level gauge |
| Multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical fault or electrical damage.
3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Oil pan<br>• Oil filter | • Electrical connector |

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## Symptom Chart

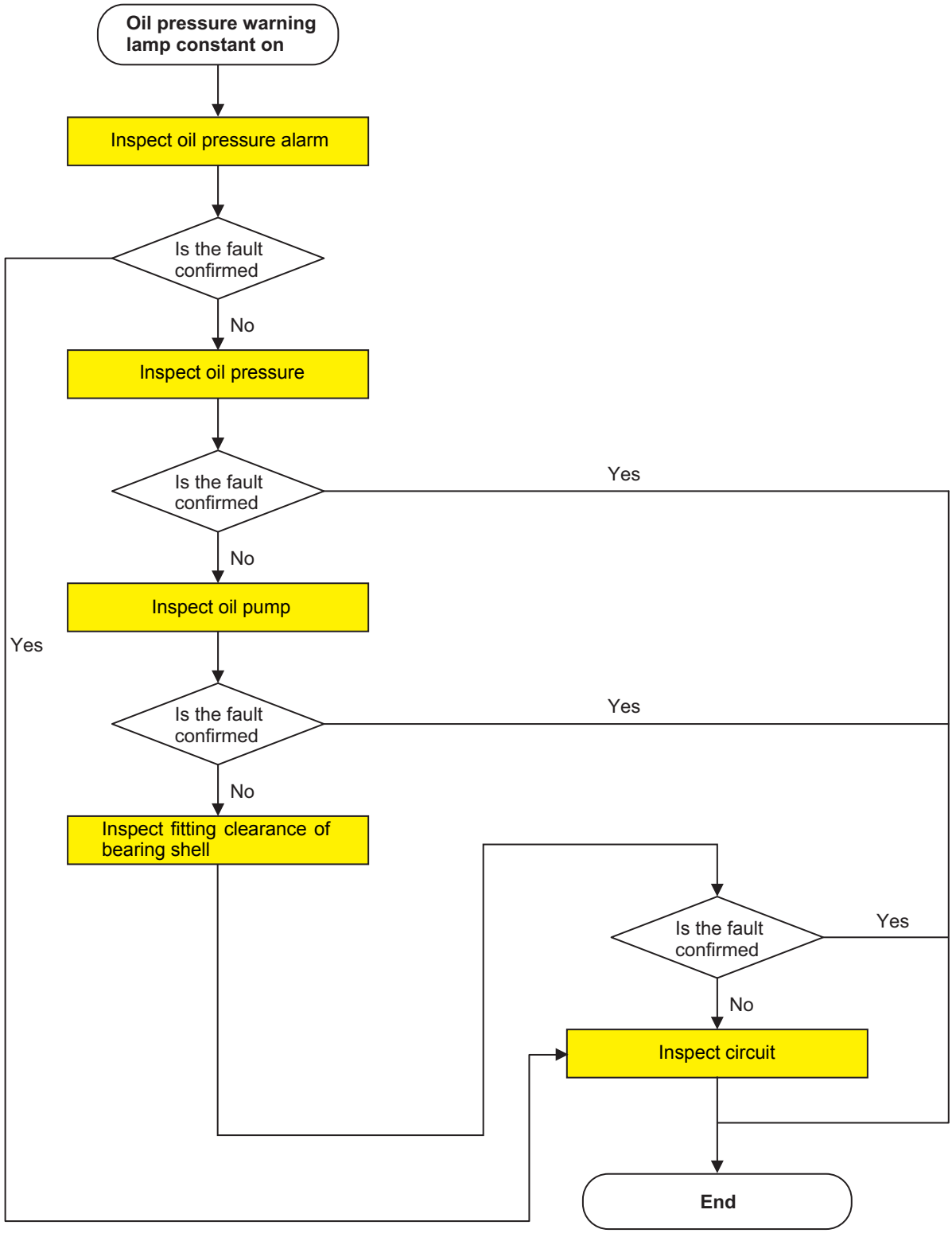
If the fault occurs, but there is no DTC stored in the ECM for this fault, and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Oil pressure warning lamp constant on | • Oil<br>• Oil pump<br>• Oil filter<br>• Oil pressure alarm<br>• Engine main bearing<br>• Connecting rod bearing shell<br>• Electrical | **Refer to: Diagnosis Procedure for Oil Pressure Warning Lamp Constant ON (3.2.3 Lubricating System, Symptom Diagnosis and Testing).** |
| Oil pressure warning lamp not on | • Oil pressure alarm<br>• Circuit<br>• Instrument cluster | **Refer to: Diagnosis Procedure for Oil Pressure Warning Lamp Not ON (3.2.3 Lubricating System, Symptom Diagnosis and Testing).** |
| Abnormal oil consumption | • Leak<br>• PCV gas leakage consumption<br>• Burning consumption in the combustion chamber | **Refer to: Diagnosis Procedure for Abnormal Oil Consumption (3.2.3 Lubricating System, Symptom Diagnosis and Testing).** |

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# Diagnosis Procedure for Oil Pressure Warning Lamp Constant ON



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**CAUTION: Make sure that the oil level, viscosity and quality are normal before diagnosis. Replace or add oil if necessary.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect oil pressure alarm | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the oil pressure alarm wiring harness connector E10a.<br>C. Turn the ignition switch to "ST", and start the engine.<br>Is the oil pressure warning lamp constant on?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 2. |
| 2. Inspect oil pressure | |
| | A. Perform the inspection procedures for oil pressure.<br>**Refer to: Oil Pressure Inspection (3.2.3 Lubrication System, General Inspection).**<br>Is the oil pressure normal?<br>**Yes**<br>Replace the oil pressure alarm.<br>**No**<br>Go to step 3. |
| 3. Inspect oil pump | |
| | A. Remove the oil pump.<br>**Refer to: Oil Pump (3.2.3 Lubrication System, Removal and Installation).**<br>B. Inspect the oil pump.<br>Is the oil pump normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the oil pump. |

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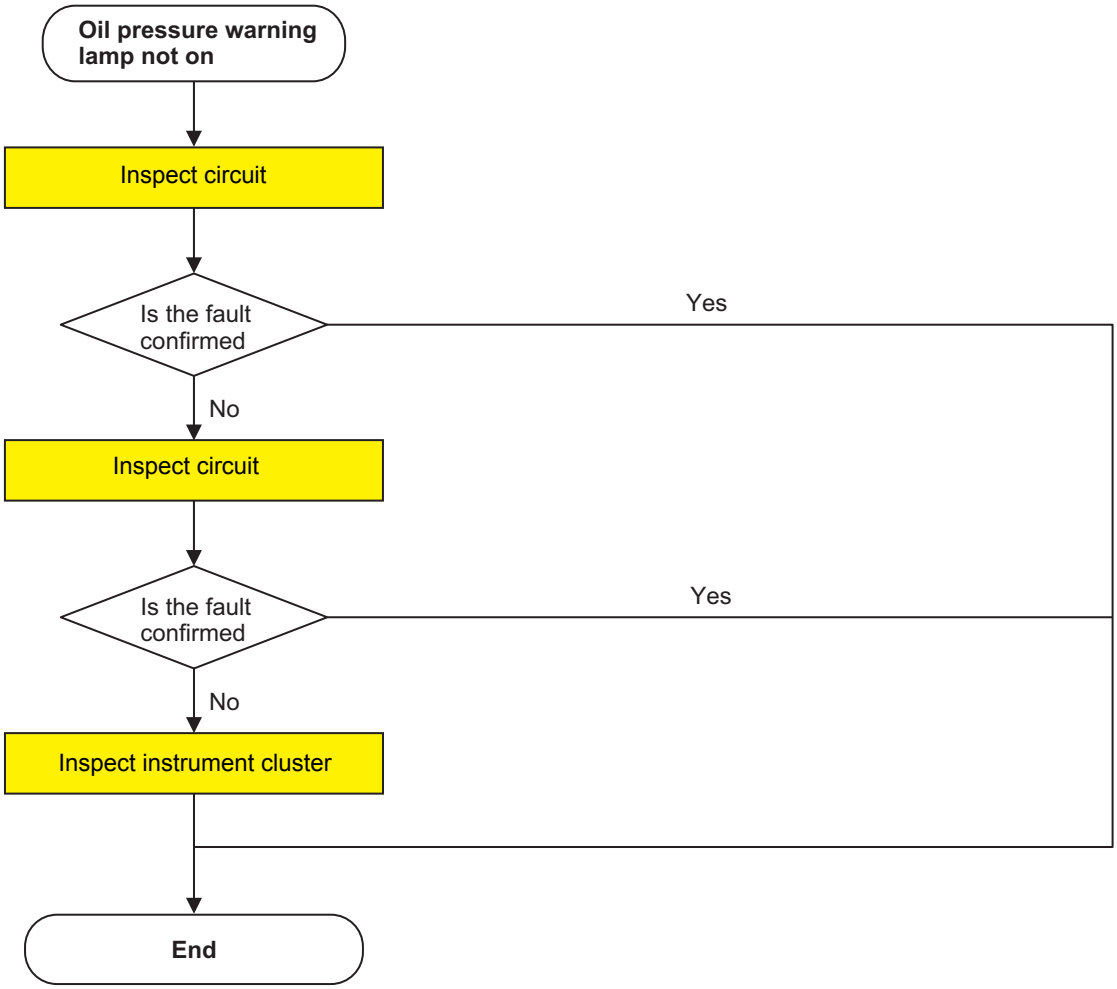


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fitting clearance of bearing shell | |
| | A. Disassemble the main bearing shell and connecting rod bearing shell.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.2.2 Mechanical System, Disassembly and Assembly).**<br>B. Inspect the fitting clearances of main bearing shell and connecting rod bearing shell.<br>Are the fitting clearances normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Adjust the fitting clearances of engine main bearing shell and connecting rod bearing shell until they return to normal.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.2.2 Mechanical System, Disassembly and Assembly).** |
| 5. Inspect circuit | |
| | A. Disconnect the oil pressure alarm wiring harness connector E10a. Keep the terminal 1 of E10a insulated from grounding.<br>B. Disconnect the instrument cluster wiring harness connector P21, and measure the resistance between terminal 23 of instrument cluster wiring harness connector P21 and reliable grounding with a multimeter.<br>Is the resistance less than 5 Ω?<br>**Yes**<br>Repair the short circuit fault between terminal 1 of oil pressure alarm connector E10a and terminal 23 of instrument cluster wiring harness connector P21.<br>**No**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).** |

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# Diagnosis Procedure for Oil Pressure Warning Lamp not on



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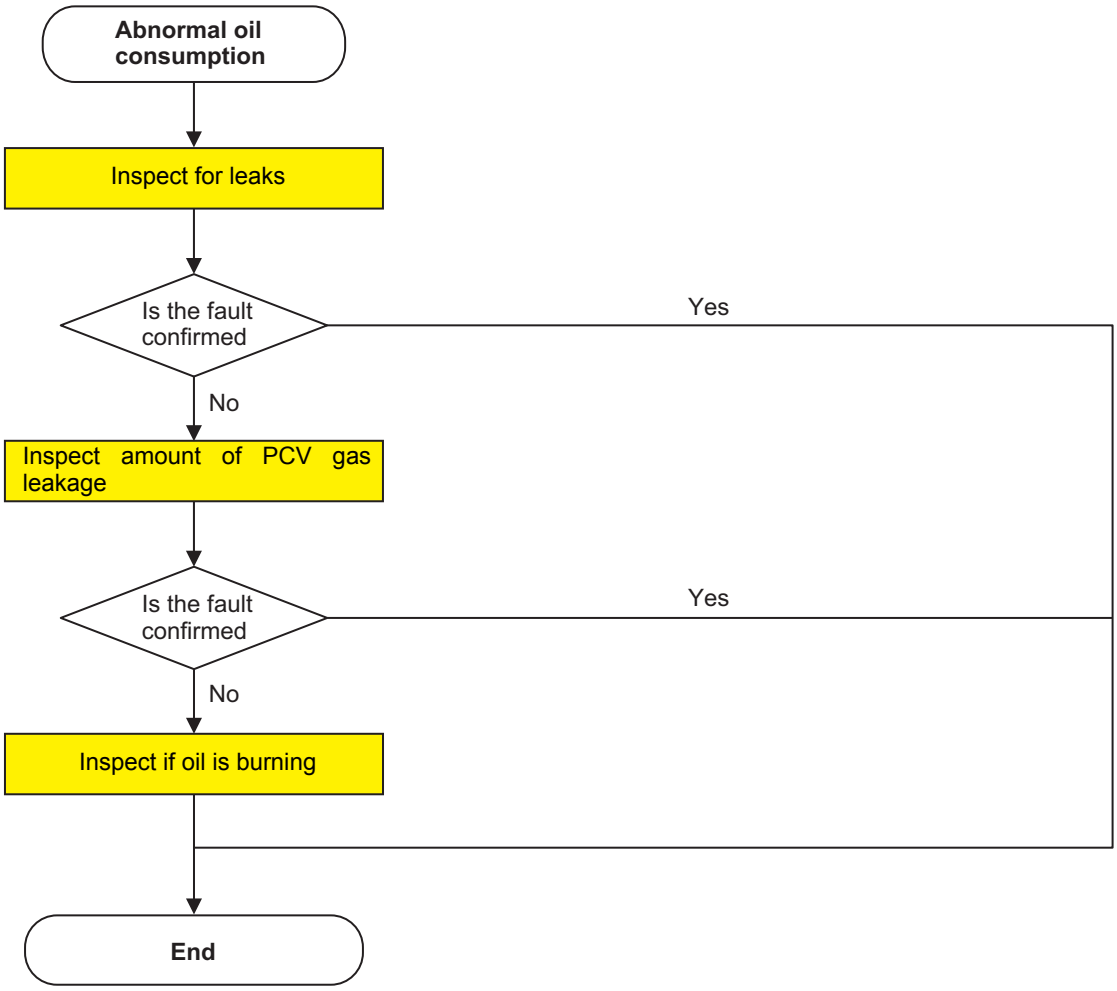


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the oil pressure alarm wiring harness connector E10a.<br>C. Use jumper wire to connect the terminal 1 of oil pressure alarm wiring harness connector E10a to reliable grounding.<br>D. Turn the ignition switch to "ON".<br>Does the oil pressure warning lamp turn on?<br>**Yes**<br>Replace the oil pressure alarm.<br>**No**<br>Go to step 2. |
| 2. Inspect circuit | |
| | A. Keep the terminal 1 of oil pressure alarm connector E10a grounded.<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 23 of instrument cluster wiring harness connector P21 and reliable grounding with a multimeter.<br>Is the resistance value less than 1 Ω?<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the open circuit fault between terminal 1 of oil pressure alarm wiring harness connector E10a and terminal 23 of instrument cluster wiring harness connector P21. |
| 3. Inspect instrument cluster | |
| | A. Remove the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>B. Inspect the instrument cluster.<br>Is it normal?<br>**No**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).** |

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# Diagnosis Procedure for Abnormal Oil Consumption



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect for leaks | |
| | A. Inspect each sealing portion of engine.<br>Does any oil leak exist?<br>**Yes**<br>Repair the leak point.<br>**No**<br>Go to step 2. |
| 2. Inspect amount of PCV gas leakage | |
| | A. Disconnect the PCV connecting pipe from the inlet pipe.<br>B. Start the engine and increase the speed to 4000 rpm.<br>Is there is excessive amount of exhaust gas from PCV connecting pipe?<br>**Yes**<br>Repair the engine piston and cylinder sealing.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>Go to step 3. |
| 3. Inspect if oil is burning | |
| | A. Start the engine.<br>B. Visually inspect the color of smoke exhausted from engine exhaust pipe.<br>Is the blue smoke from the engine exhaust pipe?<br>**Yes**<br>Repair the engine valve mechanism and adjust the fitting clearance between engine piston and cylinder.<br>**Refer to: Piston, Piston Ring, Connecting Rod and Cylinder (3.2.2 Mechanical System, Disassembly and Assembly).**<br>**No**<br>System is normal. |

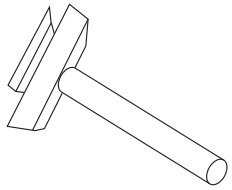
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## Removal and Installation

# Oil Pan Lower Part and Oil Strainer

### Special Tool

| | |
|---|---|
|  CA301-027 | Oil pan remover CA301-027 |

### Material

| Item | Specifications |
|---|---|
| Sealant | Tonsan 1591 |

## Removal

1. Disconnect the negative battery cable.

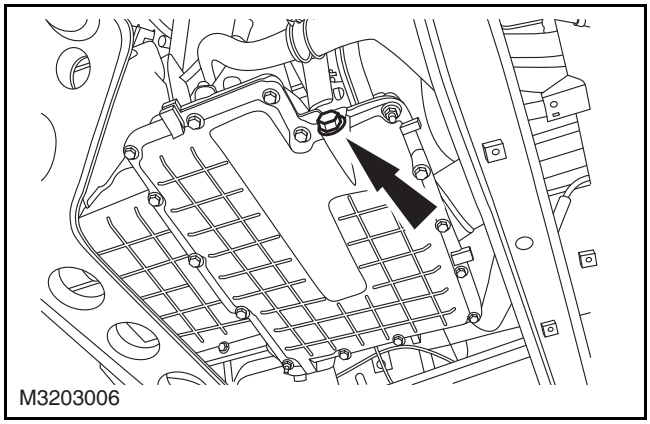
   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the drain bolt and drain the engine oil.

   Torque: 45 ± 2 Nm

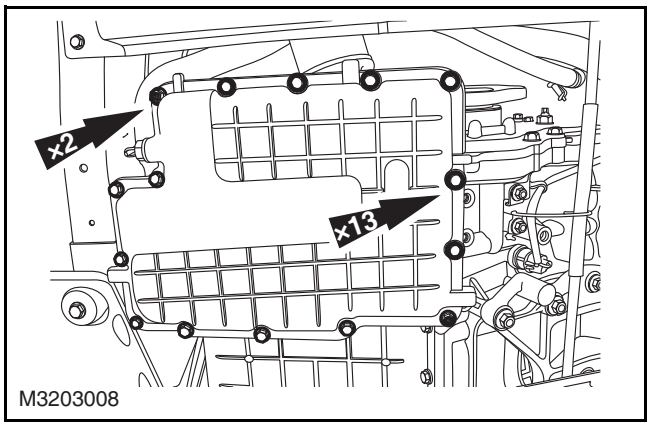

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**4.** Remove the oil pan lower part.

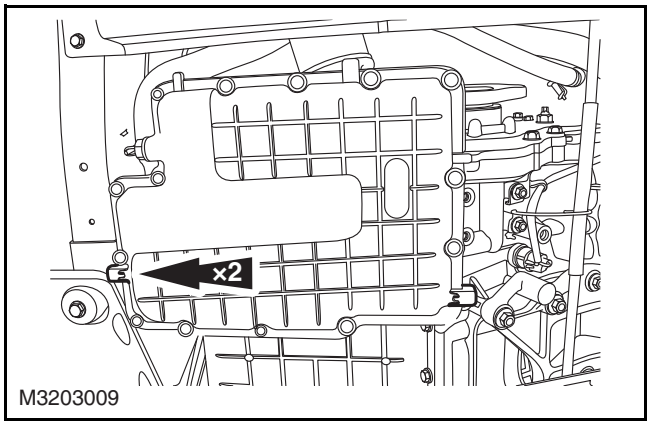
1 Remove 13 retaining bolts and 2 retaining nuts from the oil pan lower part.



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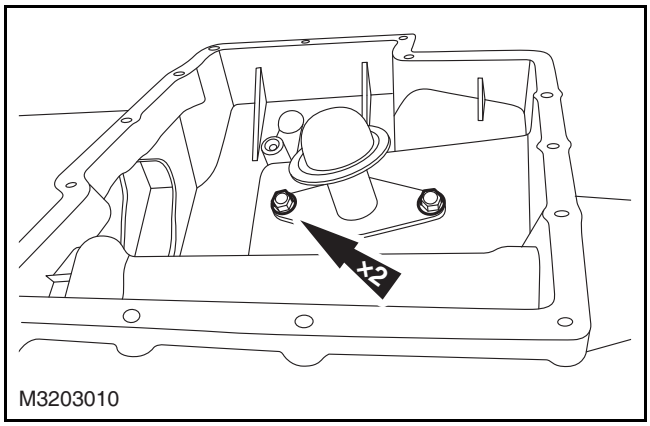
2 Use a suitable tool to separate the oil pan lower part and the oil pan upper part on 2 separate points.

**CAUTION: Avoid damaging the joint surface by the tool during separation.**



M3203009

**5.** Remove 2 retaining bolts from the oil strainer assembly.



M3203010

**6.** Remove the oil strainer O-ring.

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## Installation

**1.** Install the oil strainer assembly.

**CAUTION: Clean the oil strainer mesh.**

1 Install the oil strainer O-ring.

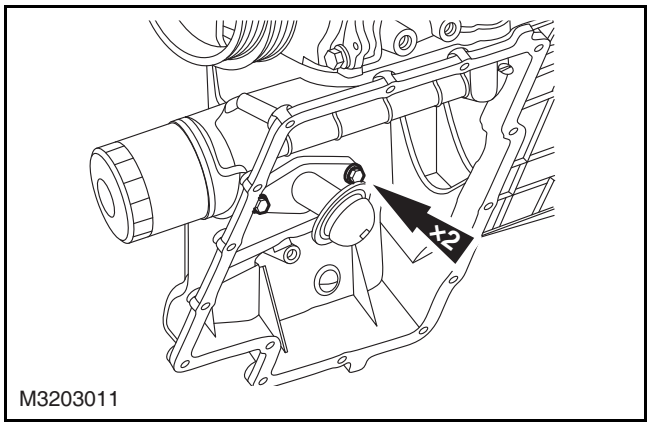
**CAUTION: Inspect if the oil strainer O-ring is still functioning, and replace it immediately if damaged.**

2 Install 2 retaining bolts to the oil strainer assembly.

Torque: 10 ± 1 Nm

**CAUTION: Inspect if the oil strainer assembly is still functioning, and replace it immediately if damaged.**

**CAUTION: Pay attention to the direction of oil strainer assembly during installation.**



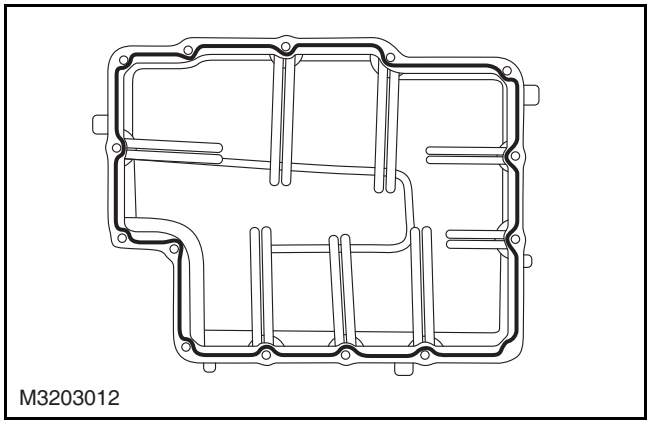
M3203011

**2.** Install the oil pan lower part.

**CAUTION: Clean the fitting surface between lower and upper parts of oil pan.**

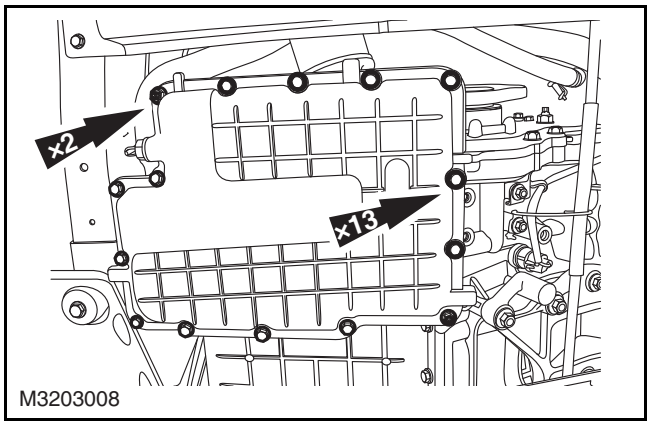
**CAUTION: Remove the oil, old sealant and dirt from the fitting surface, and clean the inside of oil pan.**

1 Apply sealant (Tonsan 1591) as shown in the figure and pay attention to the installation position of stub bolt which connects the lower and upper parts of oil pan.


M3203012

2 Install the oil pan lower part assembly, and tighten the bolts in diagonally opposite sequence before the sealant hardens (within 5 minutes).

Torque: 10 ± 1 Nm



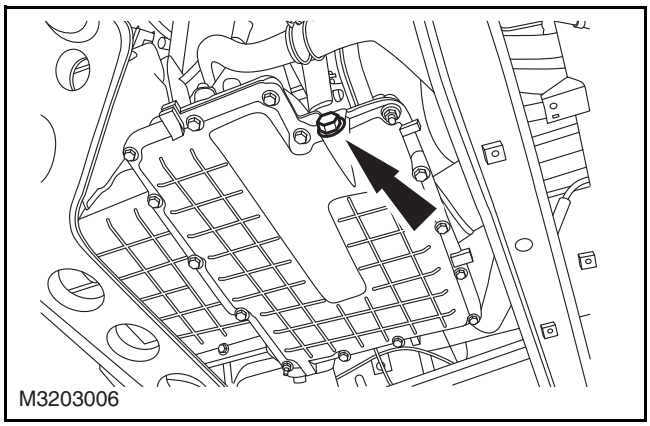
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3. Tighten the oil pan drain bolt.

   Torque: 45 ± 2 Nm




4. Refill engine oil.

   **Refer to: Engine Oil Change (3.2.3 Lubrication System, General Inspection).**

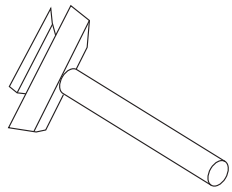
**CAUTION: Wait 20 minutes after installation (it takes 20 minutes for the sealant surface to harden, and if you refill oil before the sealant hardens, problems such as oil exudation and leakage may occur), and refill engine oil.**

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# Oil Pan Upper Part

## Special Tool

| | |
|---|---|
|  CA301-027 | Oil pan remover CA301-027 |

## Material

| Item | Specifications |
|---|---|
| Sealant | Tonsan 1591 |

## Removal

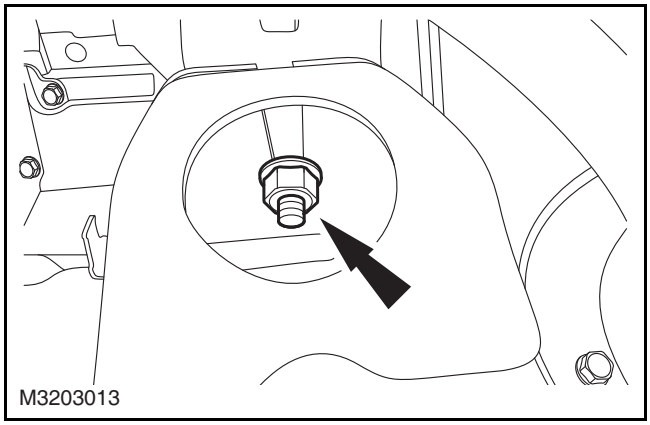
1. Remove the engine assembly.

   **Refer to: Engine Assembly (3.2.2 Mechanical System, Removal and Installation).**

2. Remove the engine bracket.

   1 Remove the connecting nut from the left side of engine bracket.

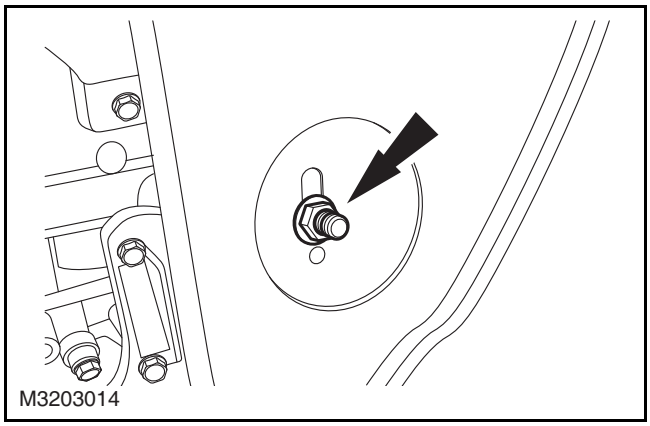
   Torque: 70 ± 5 Nm


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   2 Remove the connecting nut from the right side of engine bracket.

   Torque: 70 ± 5 Nm

   3 Remove the engine bracket.


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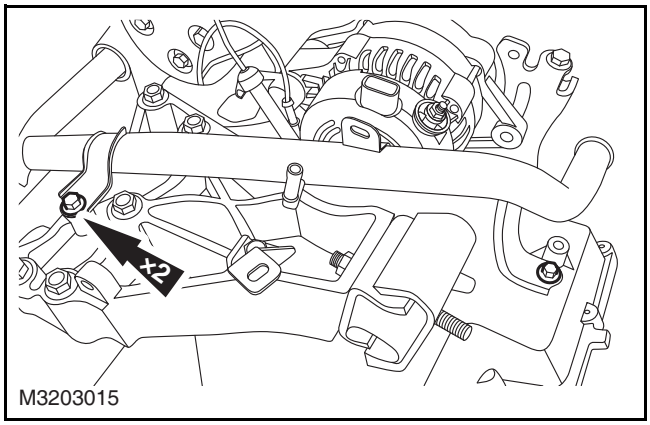
3. Remove the intake manifold.

   **Refer to: Intake Manifold (3.2.5 Air intake System, Removal and Installation).**

4. Remove the water inlet pipe assembly.

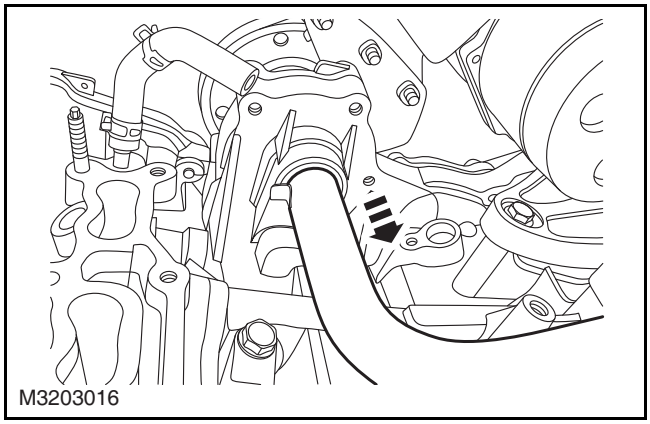
   1 Remove 2 retaining bolts from the water inlet pipe assembly.

   Torque: 10 ± 1 Nm



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   2 Pull out the water inlet pipe assembly from the engine cylinder block.


M3203016

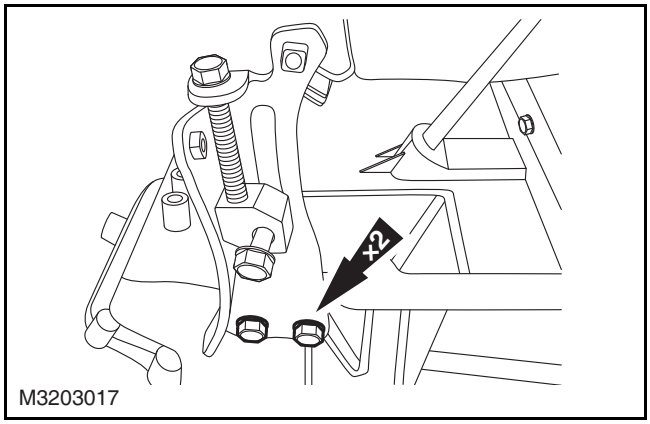
5. Remove the alternator.

   **Refer to: Alternator (3.2.10 Charging System, Removal and Installation).**

6. Remove the alternator adjusting bracket.

   1 Remove 2 retaining bolts from the alternator adjusting bracket.

   Torque: 23 ± 2 Nm



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   2 Remove the alternator adjusting bracket.

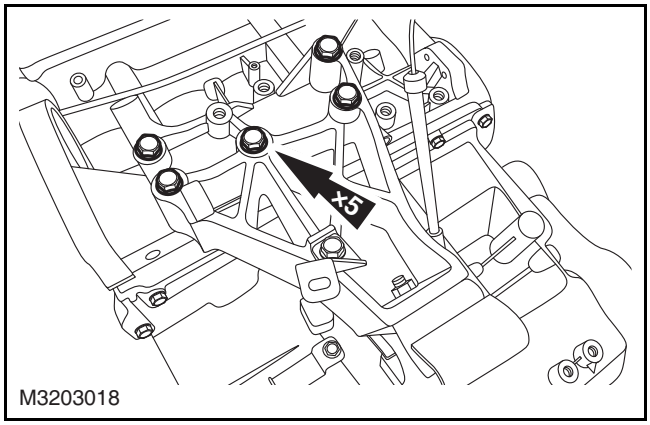
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**7.** Remove the right bracket and mounting bush.

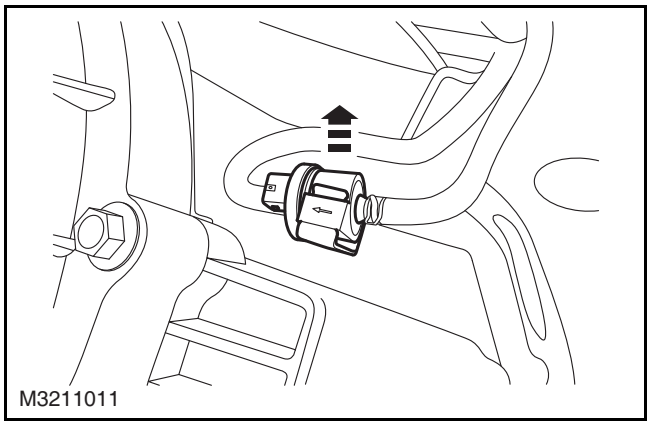
1 Remove 5 retaining bolts from the right bracket.

Torque: 70 ± 5 Nm



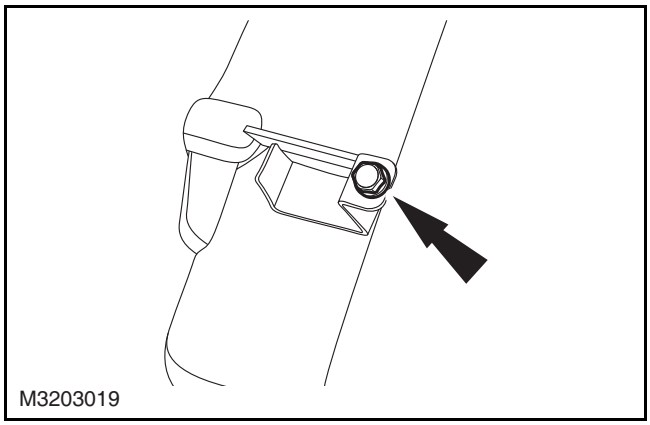

2 Remove the right bracket and mounting bush.

**8.** Remove the carbon canister control valve from the carbon canister control valve mounting bracket.




**9.** Remove the retaining bolt from the carbon canister control valve mounting bracket.

Torque: 10 ± 1 Nm

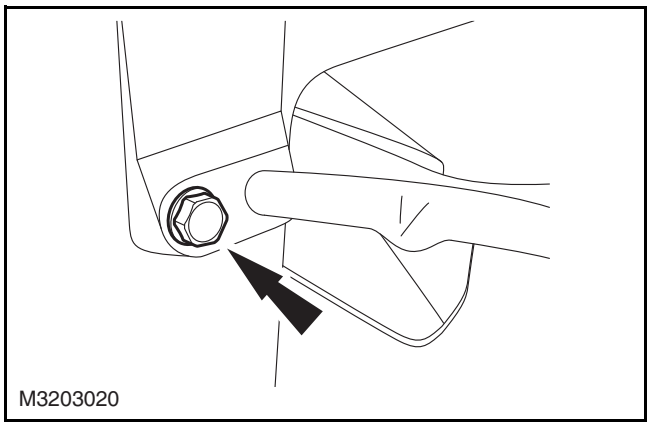


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**10.** Remove the oil level gauge pipe retaining bolt.

Torque: 10 ± 1 Nm

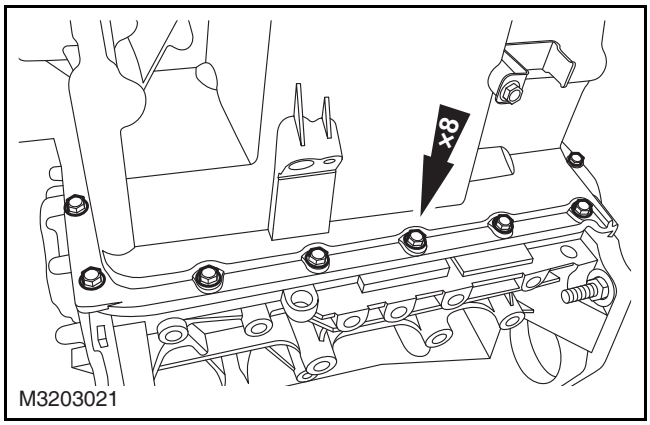


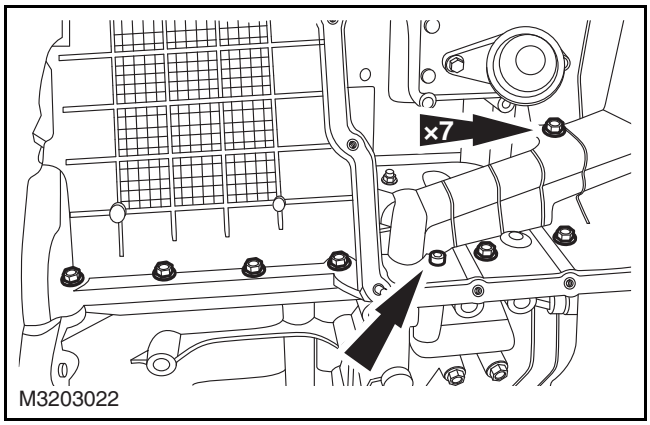

**11.** Remove the oil pan lower part.

**Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

**12.** Remove the oil pan upper part.

1 Remove 16 retaining bolts from the oil pan upper part.

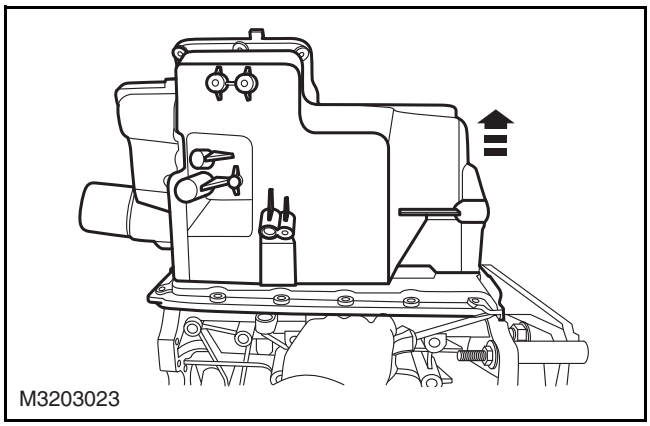


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2 Use a suitable tool to separate the oil pan upper part and the cylinder block.


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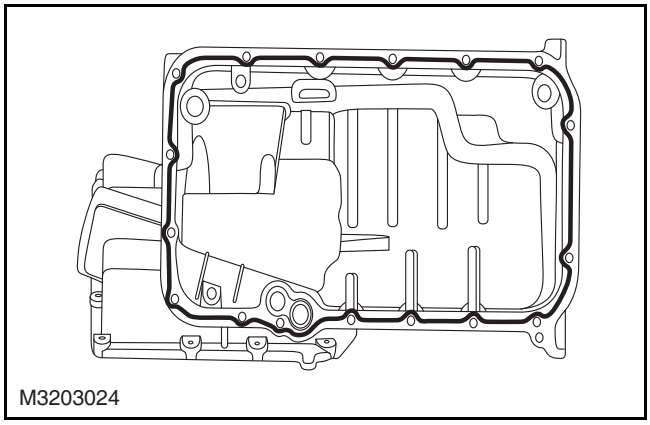
## Installation

**1.** Install the oil pan upper part.

1 Inspect the integrity of oil pan upper part dowel pin and oil way seal, the elasticity of the oil way seal, and replace if integrity or elasticity failed.

2 When replacing the oil pan upper part dowel pin, knock the pin into the upper part first, inspect and confirm that the mounting groove of oil filter oil way gasket is clean without foreign matter, and the bottom is flat, then install the oil way seal and perform the installation.

3 Apply sealant (Tonsan 1591) as shown in the figure, and install the oil pan upper part within 5 minutes after application.


M3203024

**2.** Install the oil pan lower part.

**Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

**3.** Removal of other components is in the reverse order of installation.

**CAUTION: Replace the water inlet and outlet pipe O-ring with a new one before installing the water pipe assembly.**

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# Oil Pump

## Removal

1. Remove the engine assembly.

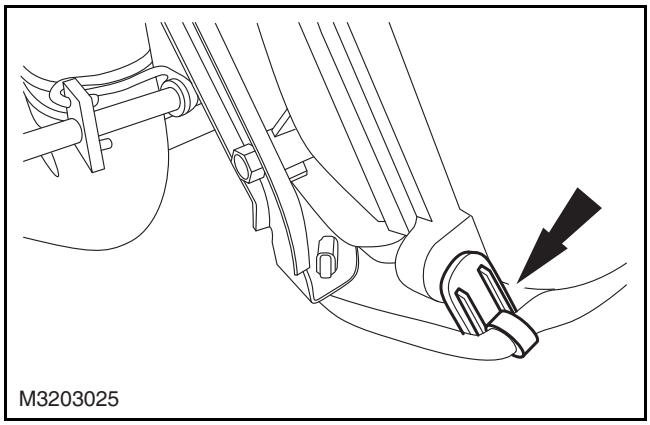
   **Refer to: Engine Assembly (3.2.2 Mechanical System, Removal and Installation).**

2. Remove the cylinder head cover.

   **Refer to: Cylinder Head Cover (3.2.2 Mechanical System, Removal and Installation).**

3. Remove the water pipe.

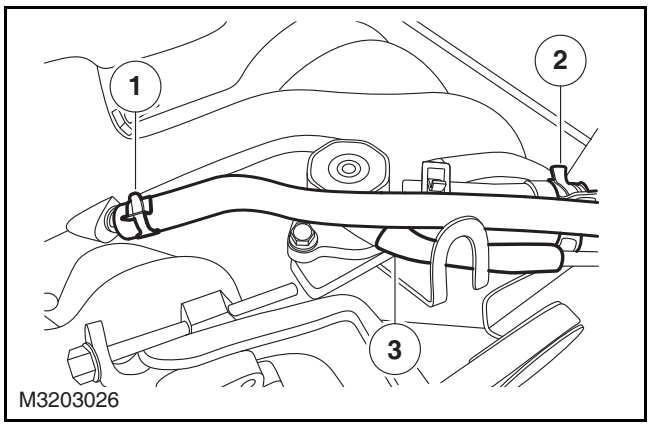
   1 Separate the engine wiring harness retaining clamp.


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   2 loosen the hoop, and disconnect the connection between intake manifold and vacuum booster hose (1).

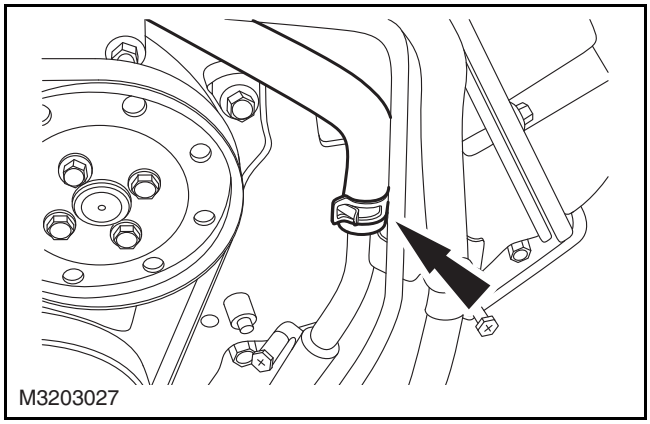
   3 Loosen the hoop, and disconnect the connection between water pipe and top radiator hose (2).

   4 Disconnect the connection between water pipe and No.2 water outlet pipe (3).



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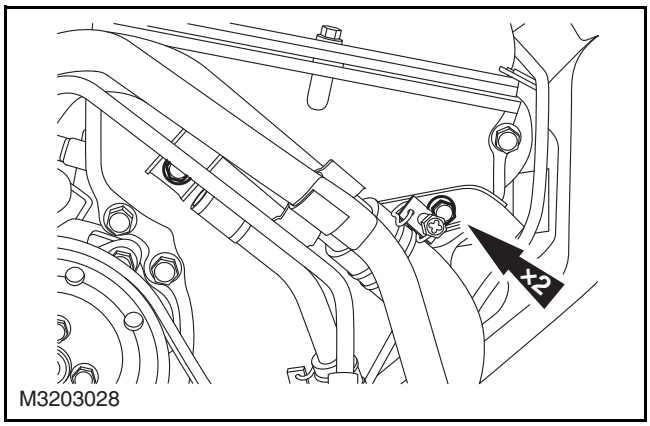
4. Loosen the hoop, and disconnect the connection between water pipe and A/C heater water outlet pipe.


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**5.** Remove 2 retaining bolts from the water pipe.



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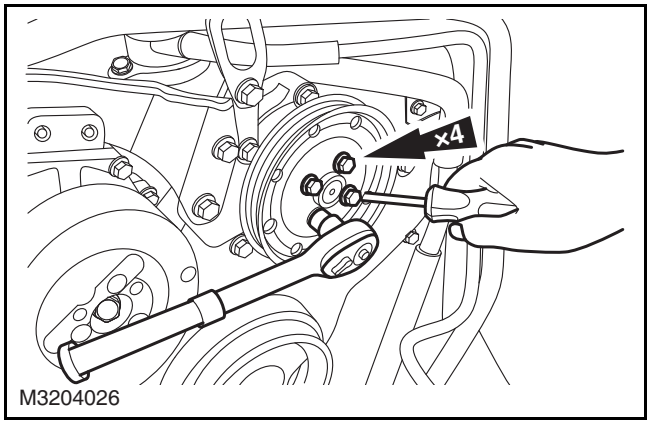
**6.** Remove the accessory drive belt.

**Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**

**7.** Remove the water pump pulley.

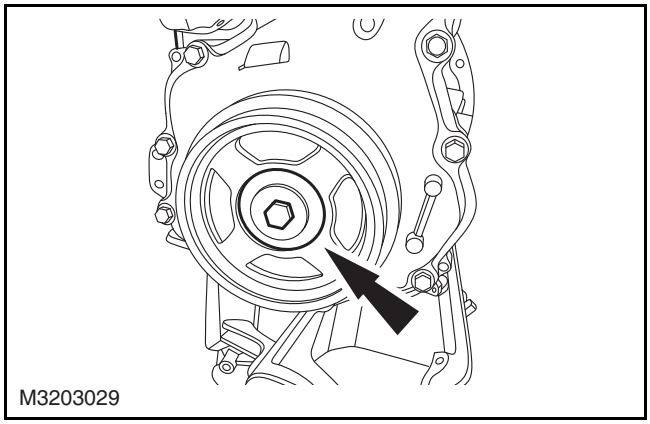
1 Use a screwdriver to position the water pump pulley, and use a ratchet wrench to remove the retaining bolts from the water pump pulley in sequence.

Torque: 10 ± 1 Nm



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**8.** Remove the crankshaft pulley.


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**9.** Remove the oil pan lower part.

**Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

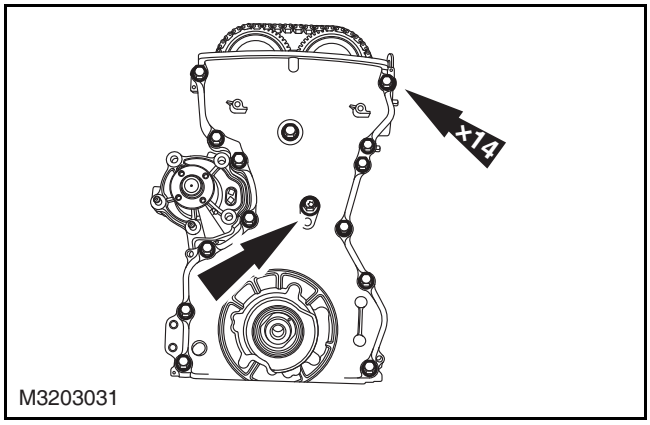
**10.** Remove the oil pan upper part.

**Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

**11.** Remove the oil pump timing chain housing.

1 Remove 14 retaining bolts and 1 connecting nut from the oil pump timing chain housing.

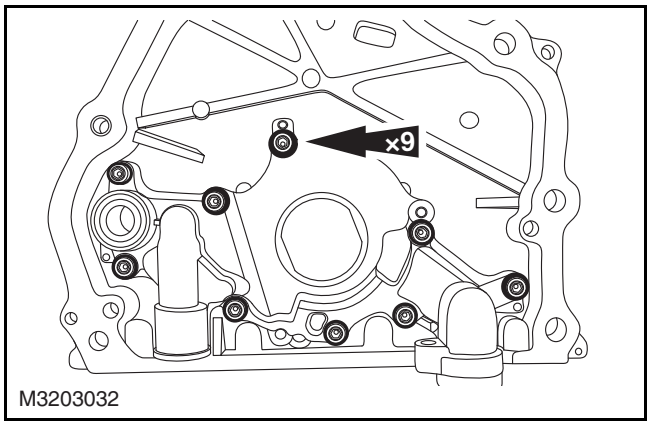
**CAUTION: Once removed, the crankshaft front oil seal cannot be reused, and replace it with a new one when installing.**



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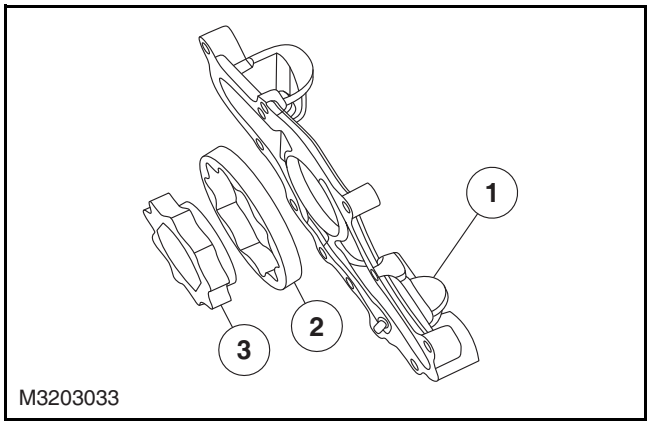
**12.** Remove the oil pump from the oil pump timing chain housing.

1 Remove 9 retaining bolts from the oil pump.



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2 Remove the oil pump housing (1), outer rotor (2) and inner rotor (3) in sequence.



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## Inspection

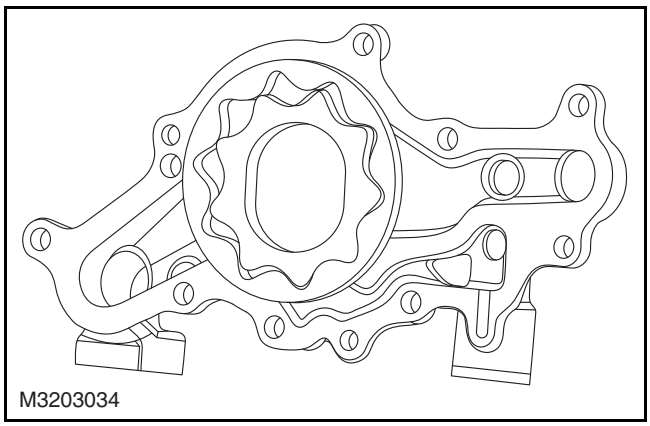
1. Inspect the oil pump inner and outer rotor, rotor cap and oil pump housing for wear or damage.

**CAUTION: Replace the oil pump timing chain housing assembly if the oil pump is damaged.**

2. Measure the radial clearance.

   Use a feeler gauge to measure the engaging clearance of inner and outer rotors. Replace the oil pump if clearance exceeds limit.

   Engaging clearance of inner and outer rotor: 0.030 ~ 0.099 mm.


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3. Measure the side clearance.

   Use the straight scale and feeler gauge to measure the side clearance.

   Side clearance limit: 0.31 mm

## Installation

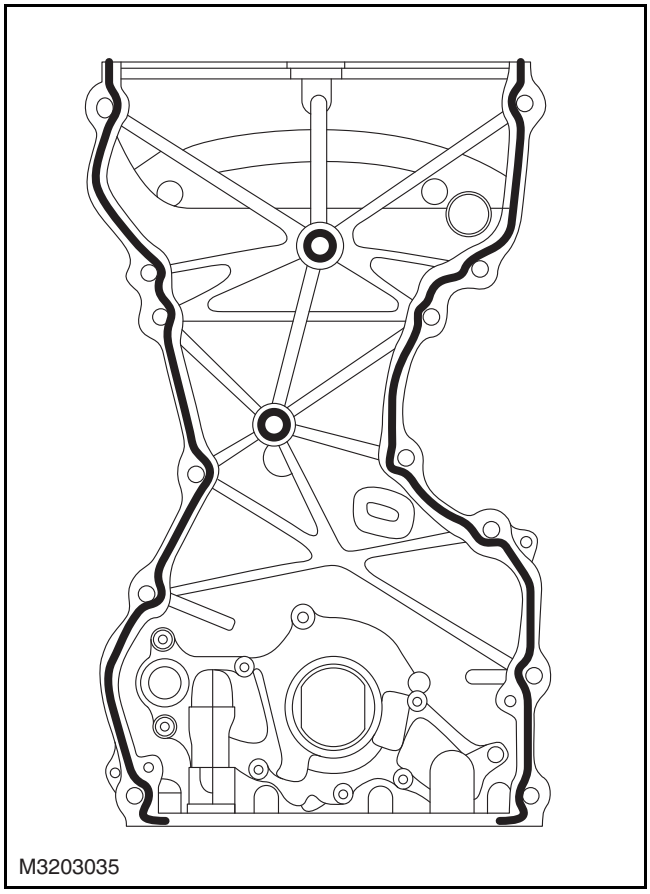
1. Install the oil pump to the timing chain housing, and tighten the bolts.
2. When installing the oil pump to the crankshaft, install the special tool (oil seal guide) to the crankshaft and apply engine oil to the special tool to prevent the lip of oil seal from damaging or rolling up.

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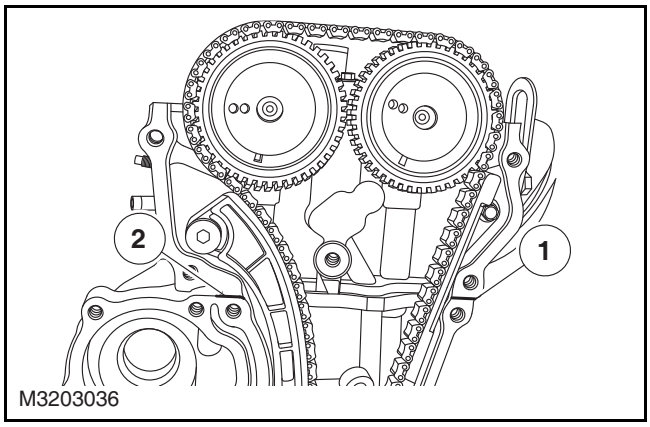


**3.** Install the oil pump timing chain housing.

1 Apply sealant (Tonsan 1596Fa) as shown in the figure. Install the oil pump timing chain housing assembly within 5 minutes after application.


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**CAUTION: Apply sealant to the connections (1 and 2) of cylinder head and cylinder block.**

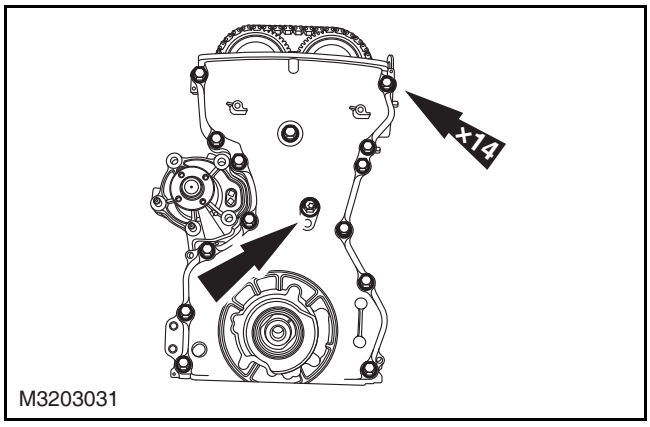


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2 Tighten the retaining bolts and nut of oil pump timing chain housing.

Bolt torque: 23 ± 2 Nm

Nut torque: 50 ± 3 Nm



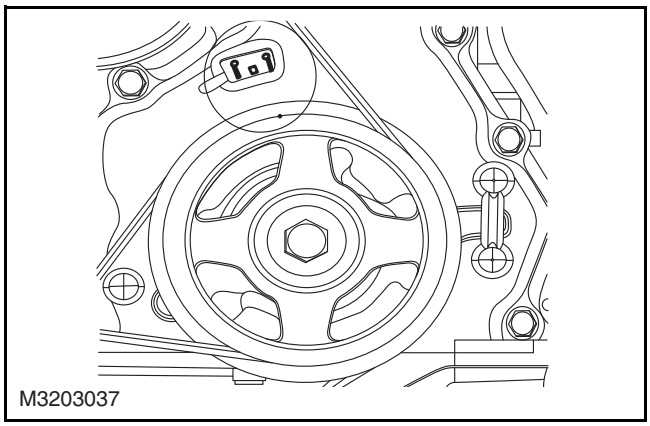
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**4.** Install the crankshaft pulley.

1 Observe the mark position on the crankshaft pulley. Align the mark 0 on the oil pan timing chain housing assembly as shown in the figure.

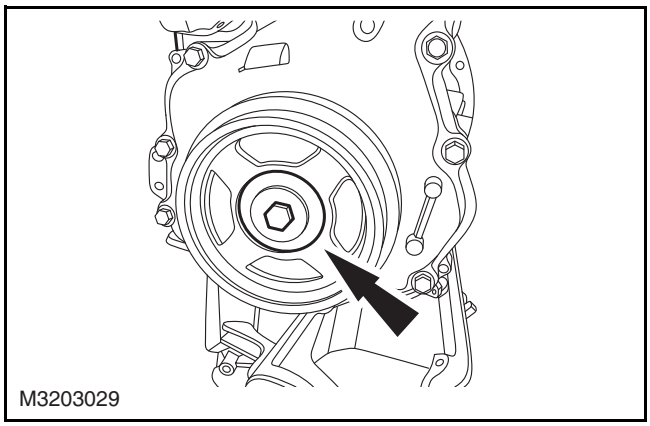

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2 Tighten the crankshaft pulley bolt.

Torque: 90 Nm + 90°

**CAUTION: First tighten it to 90 Nm, and further turn it 90°.**

**CAUTION: When installing the crankshaft pulley, replace the bolt with a new one.**


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3 Installation of other components is in the reverse order of removal.

4 Adjust the accessory drive belt tension.

**Refer to: Accessory Drive Belt Tension Adjustment (3.2.2 Mechanical System, General Inspection).**

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# Oil Pan Baffle Plate

## Removal

1. Remove the oil pan lower part.

   **Refer to: Oil Pan Lower Part and Oil Strainer (3.2.3 Lubrication System, Removal and Installation).**

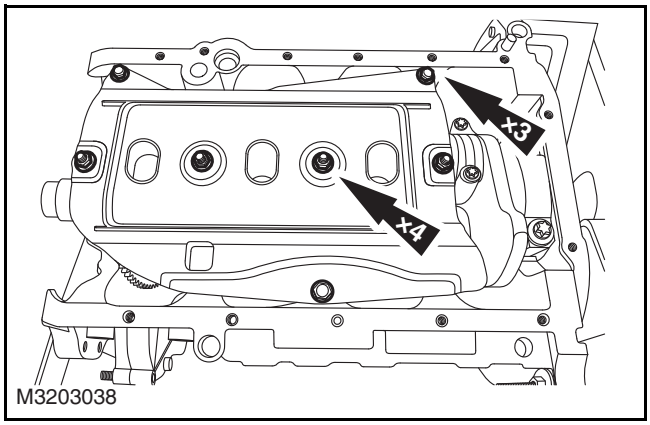
2. Remove the oil pan upper part.

   **Refer to: Oil Pan Upper Part (3.2.3 Lubrication System, Removal and Installation).**

3. Remove the oil pan baffle plate.

   1 Remove 3 retaining bolts and 4 retaining nuts from the oil pan baffle plate.

   Torque: 10 ± 1 Nm




   2 Remove the oil pan baffle plate.

## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Component Specifications

| Item | Specifications |
|---|---|
| Thermostat type | Paraffin type |
| Water pump type | Centrifugal impeller pump |
| Number of water pump vanes | 7 |

# General Specifications

| Item | Specifications |
|---|---|
| Cooling type | Water cooling |
| Coolant capacity (including water reservoir) | 5.8 ± 0.2 L |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Coolant temperature sensor | 15 ± 2 | - | - |
| Water pump pulley retaining bolt | 10 ± 1 | - | - |
| Water pump retaining bolt | 10 ± 1 | - | - |
| Thermostat cap retaining bolt | 23 ± 2 | - | - |
| Radiator fan bracket retaining bolt | 10 ± 1 | - | - |

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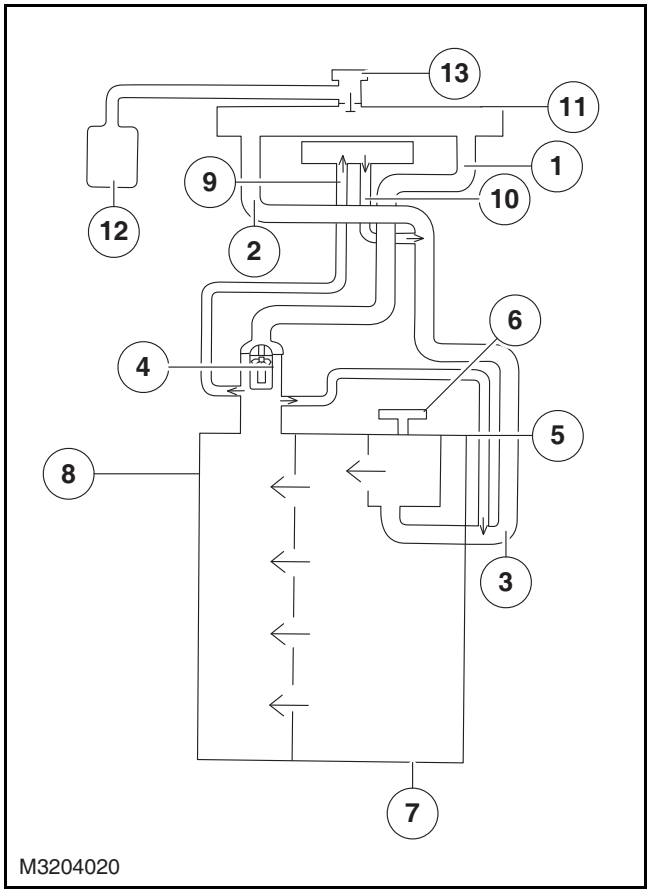


## Description and Operation

# System Overview

Cooling system consists of radiator filler cap, radiator, water reservoir, hose, water pump, cooling fan, and thermostat. The radiator is a flat pipe structure. When the engine is cold: the normal working temperature of engine is around 95°C (203°F), and within this range, all engine components work in optimal state. It will increase the mechanical wear if the ideal working temperature cannot be reached for a long time. Due to low temperature, the mixed gas burns inadequately in the combustion chamber, which leads to serious carbon deposit. Therefore, the engine is required to run at low temperature.

The normal working temperature should be reached as soon as possible, and the heat produced by engine should be kept away from exchanging with the outside as much as possible. At this moment, the thermostat controls the coolant in the engine to circulate in the engine only. The heat produced around engine wall is brought to other components of engine to heat them rapidly. The water pump circulates the engine coolant and then the coolant circulates through water jacket, throttle body assembly and cylinder head. Such state is called "minor cycle".

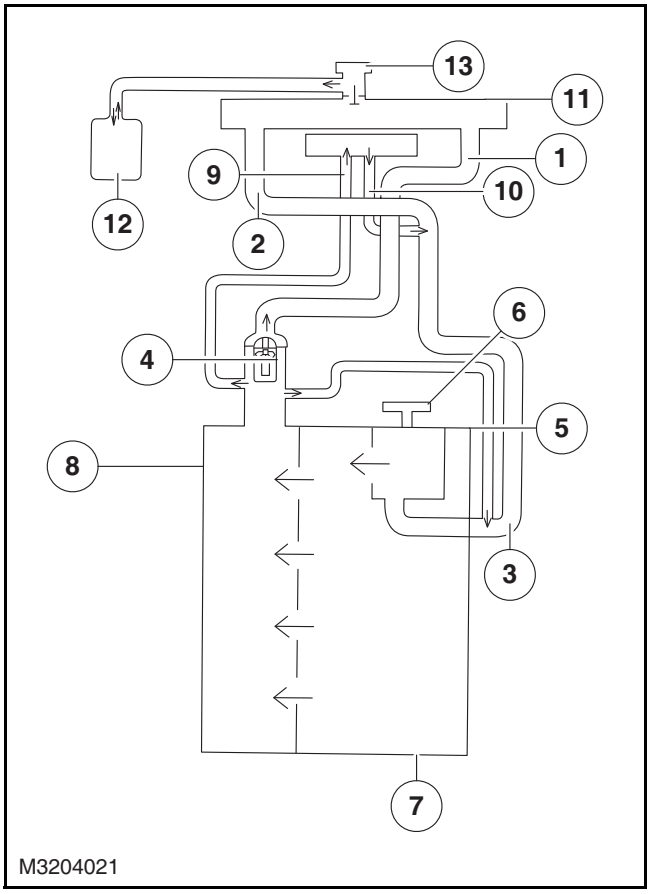


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When the temperature is 86°C (179.6°F), the coolant is pumped by the water pump to the engine water jacket, intake manifold, cylinder head and radiator. Such state is called "major cycle".

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| Item | Description |
|---|---|
| 1 | Radiator inlet hose |
| 2 | Radiator outlet hose |
| 3 | Inlet hose |
| 4 | Thermostat |
| 5 | Water pump |
| 6 | Water pump pulley |
| 7 | Cylinder block |
| 8 | Cylinder head |
| 9 | Heater radiator inlet hose |
| 10 | Heater radiator outlet hose |
| 11 | Radiator water reservoir |
| 12 | Water reservoir |
| 13 | Radiator filler cap |

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# Components Description

## Coolant

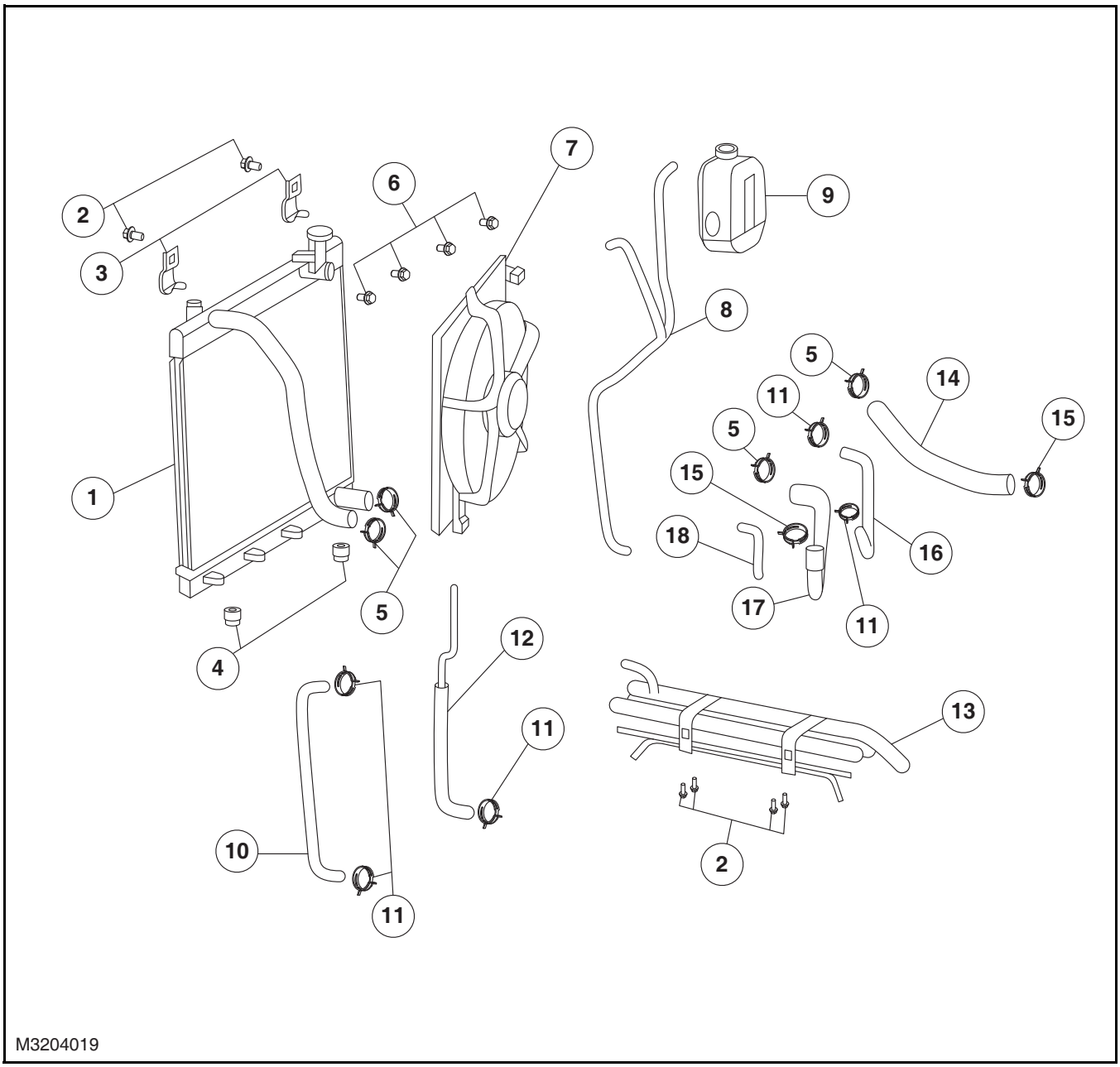
When engine reaches a normal working temperature: Coolant in engine gets warm rapidly with engine running. The cooling system works normally when it reaches the thermostat cooling cycle standard (major cycle starts operating). The coolant in radiator will swell when it is heated and overflow to the water reservoir. The coolant flows back to the radiator when system cools down.

**CAUTION: Coolant such as alcohol, methanol or water alone cannot be used for the cooling system, which may cause system malfunction.**

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# Components Location View

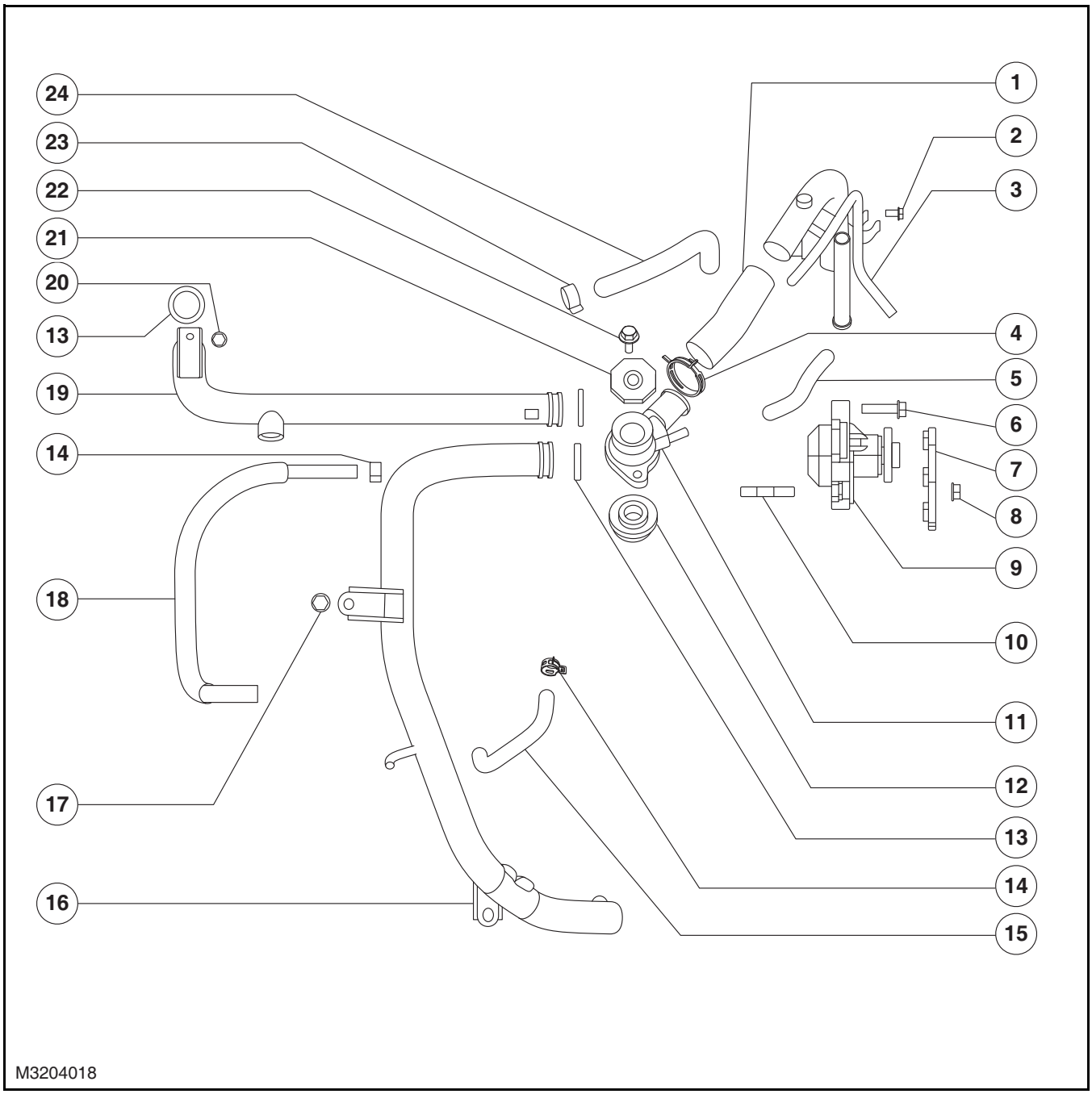



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Radiator assembly | 10 | Heater outlet hose |
| 2 | Screw | 11 | Clamp |
| 3 | Radiator upper bracket | 12 | Heater joint with hose assembly |
| 4 | Radiator mounting bracket | 13 | Floor water pipe accessory assembly |
| 5 | Clamp | 14 | Engine inlet hose |
| 6 | Screw | 15 | Clamp |
| 7 | Radiator fan | 16 | Engine to heater hose |
| 8 | 3-way with accessory assembly | 17 | Engine outlet hose |
| 9 | Water reservoir assembly | 18 | Engine reservoir hose |

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# Components Exploded View



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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Top radiator hose | 13 | Inlet and outlet hose O-ring |
| 2 | Bolt | 14 | Throttle body water hose hoop |
| 3 | No.2 water outlet hose assembly | 15 | Throttle body water outlet hose |
| 4 | Water outlet hose hoop | 16 | Water inlet hose assembly |
| 5 | Expansion hose | 17 | Bolt |
| 6 | Bolt | 18 | Throttle body water inlet hose |
| 7 | Bolster plate of compressor tension bracket | 19 | No.1 water outlet hose assembly |
| 8 | Nut | 20 | Bolt |
| 9 | Water pump assembly | 21 | Thermostat chamber lock assembly |
| 10 | Intake manifold long stud bolt | 22 | Bolt |
| 11 | Thermostat cap assembly | 23 | Bleed hose hoop |
| 12 | Thermostat assembly | 24 | Hot air hose |

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## General Inspection

**CAUTION: Coolant such as alcohol, methanol or water alone cannot be used for the cooling system, which may cause system malfunction.**

**CAUTION: Even though the ambient temperature cannot be expected to reach the freezing point, an antifreeze (antifreezing and rust prevention coolant) mixed with water and glycol in a proportion of 70% and 30% should be used as the coolant.**

**WARNING: Disassemble or assemble all components when the engine cools down, otherwise, the components may lead to serious burn or personal injury.**

**WARNING: Turn off engine and wait until it cools down. Be very careful when removing the reservoir cap even if the engine has cooled down. Cover a thick cloth around it, and turn it 2.5 turns counterclockwise slowly. Step back while pressure is releasing.**

**WARNING: After confirming that all pressure has been released, turn the cap with cloth and remove it.**

**WARNING: Use coolant with concentration suitable for the driving ambient conditions. Otherwise, the engine may be damaged.**

**WARNING: The engine has some components made of aluminium which must need the protection from ethylene glycol based coolant to prevent erosion and freeze.**

**WARNING: Only use soft water (demineralized) in the coolant mixture. Water containing mineral reduces the effectiveness of the coolant.**

**WARNING: Engine coolant will damage the paintwork. Wash the engine coolant immediately if it adheres to any painted surfaces.**

## Coolant Level Inspection

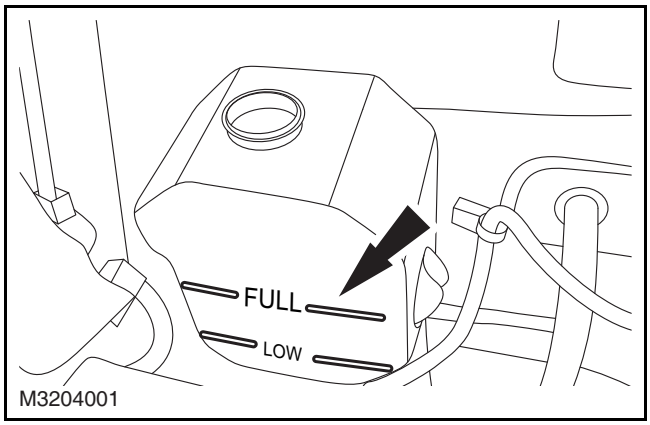
**WARNING: To avoid the danger of being scalded, do not open the water reservoir cap and radiator filler cap when the coolant is "boiling".**

**WARNING: To avoid the danger of being scalded, do not open the water reservoir cap and radiator filler cap when engine and radiator still hot.**

**WARNING: The boiling liquid and steam may spurt out under the pressure since the water reservoir cap opens earlier.**

Inspect the coolant level in the water reservoir when the engine cools down. The normal coolant level should be between "FULL" and "LOW" marks on the water reservoir.

When the coolant level is below "LOW" mark, open the water reservoir cap and add an appropriate amount of coolant to the "FULL" mark, and then close the cap again.

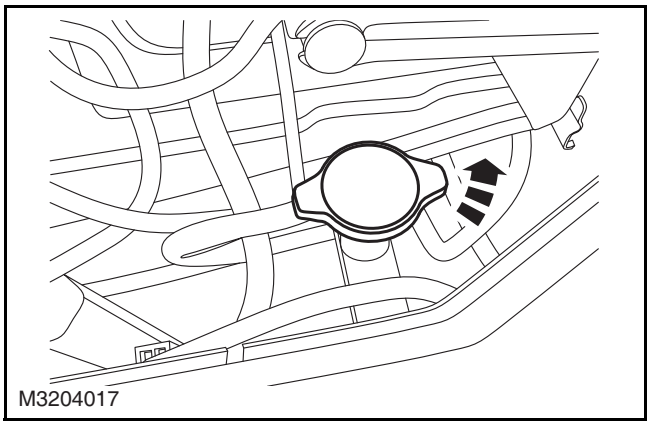


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## Coolant Leak(s) Inspection

1. Inspect engine coolant level.
2. When the engine is cooling, remove the radiator filler cap, and clean the filler cap and filler port with clean water.


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3. Install the tester to the water reservoir filler port.
4. Apply pressure with a tester, and make the pressure reach 110 kPa.

**CAUTION: Be aware that the pressure in radiator must not more than 110 kPa, or it may cause damage.**

5. Observe the tester for pressure changes.

Standard: hold pressure for 2 minutes when it reaches 110 kPa.

It shows that there may be leaks if the pressure indicated by pressure gauge needle begins to drop. Repair or replace the related components.

## Drive Belt Tension Inspection

**WARNING: Disconnect the negative wiring harness before inspecting and adjusting the belt tension.**

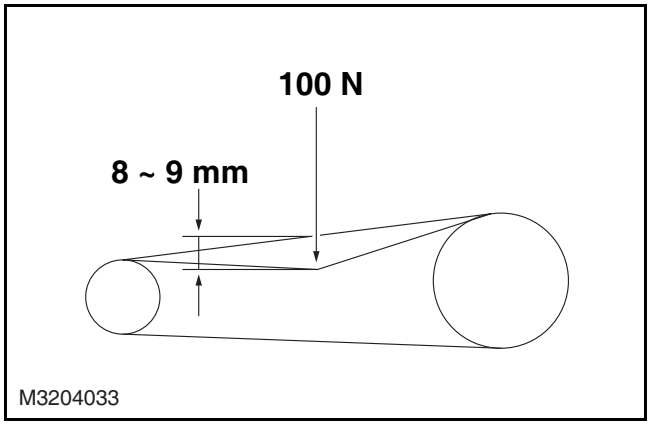
**WARNING: Read the "WARNING" contents of 3.2.4 "Cooling System".**

1. Inspect the belt for any cracks, cuts, deformation, wear and dirt. Replace the belt with a new one if necessary.

   **Refer to: Accessory Drive Belt (3.2.2 Mechanical System, Removal and Installation).**

2. Inspect the belt tension. (Method 1)

   If pressing the belt with thumb (about 100 N) and it sags 8 ~ 9 mm, this indicates that the belt tension is proper.



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3. Inspect the belt tension. (Method 2)

   1 Inspect the belt tension with sonic tension meter (in the center position of belt tight side span, vertical to the belt, and about 10 mm away from it).

**CAUTION: Do not touch the belt before inspecting belt tension.**

   2 The compressor belt tension should be controlled within 600 ± 50 N (before igniting the engine).

   3 If the belt tension is not as specified, readjust the compressor belt tension, until it meets the requirement.

   Compressor - Gates Unitta Sonic Tension Meter Test

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| | |
|---|---|
| Parameter setting | MASS = 4.4 g/m |
| | WIDTH = 14.25 mm/R |
| | SPAN = 181.5 mm |

4. Connect the negative terminal cable.

## Thermostat Test

1. Remove the thermostat.

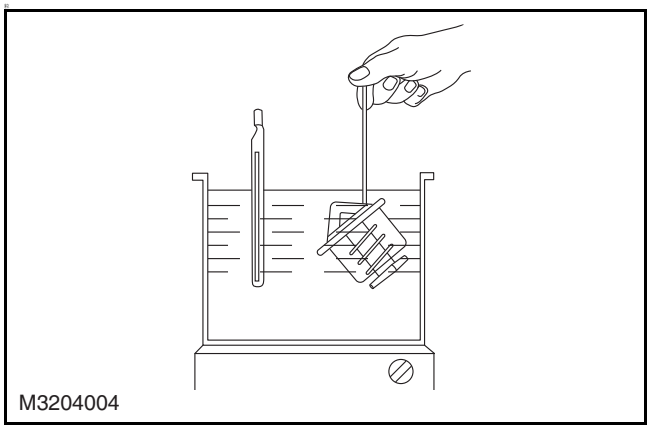
   **Refer to: Thermostat (3.2.4 Cooling System, Removal and Installation).**

2. Soak the thermostat in the heatable water.
3. Place a thermometer in the water.
4. Observe if the thermostat state is normal or not while warming up the water.

   Thermostat opening temperature is 88 ± 1.5°C.

   Thermostat maximum lift is more than 8 mm.

   Thermostat full opening temperature is 100°C.


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## Coolant Draining and Filling

1. Remove the water reservoir cap after the engine cools down. And turn the cap counterclockwise slowly until the pressure has been released, then press it down and continue to turn it counterclockwise.

**WARNING: To avoid the danger of being scalded, do not open the water reservoir cap when the engine and radiator still hot. The boiling liquid and steam may spurt out under the pressure since the water reservoir cap opens earlier.**

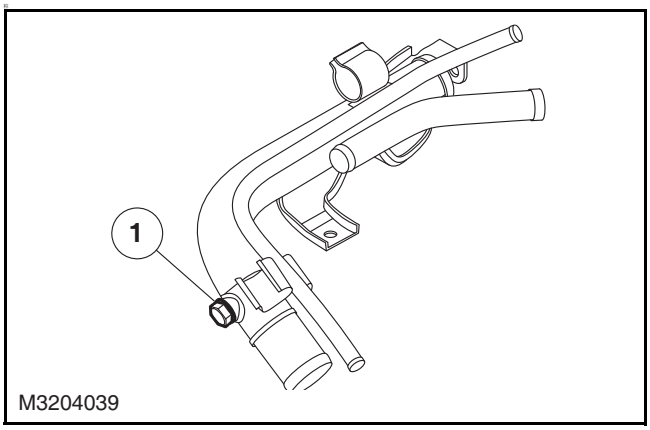
2. After opening the water reservoir cap, run the engine until the radiator upper hose gets warm (which shows that the thermostat has been opened and the coolant has begun to flow through the system).
3. Stop the engine and drain the coolant.
4. Tighten the drain plug. Fill the cooling system full with water and run the engine, until the radiator upper hose gets warm again.
5. Repeat steps (3) and (4) several times until the liquid drained is almost colorless.
6. Drain the cooling system, and tighten the radiator drain plug.
7. Remove the water reservoir and open its cap, then remove the water reservoir and pour out the liquid. Use soap water to clean the inside and flush it with clean water and drain the water, then install the water reservoir and hose again.
8. A coolant mixed with high-quality glycol and water in a proportion of 50 and 50 should be added to the maximum level of radiator and water reservoir.
9. Run the engine for a while, and observe the coolant level, if the coolant is invisible at the radiator filler port, top up the radiator, and tighten the radiator filler cap.

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**10.** During repair or maintenance, if the vacuuming filling coolant method is impossible, pay attention to loosen the drain bolt (1) on the No.2 water outlet hose assembly (as shown in the figure below) when filling coolant, and run the engine after filling, until here comes "water", then tighten the drain bolt as required (torque: 6 ± 1 Nm).

**CAUTION: If water leakage occurs on the drain bolt, it is necessary to replace the drain bolt washer.**



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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |
| Diagnostic tool |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Coolant leaks<br>• Washer or sealing<br>• Hose or hose joint<br>• Water reservoir cap and sealing<br>• Water reservoir<br>• Radiator<br>• Water pump<br>• Thermostat cap<br>• Thermostat chamber lock<br>• Heater radiator<br>• Compressor belt<br>• Coolant output connector | • Fuse<br>• Wiring harness<br>• Electrical connector<br>• Coolant temperature sensor<br>• Radiator fan<br>• Engine control module (ECM) |

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Loss of coolant | • Hose or hose joint | • Inspect each connecting hose and its joint for aging or leaks. Repair or replace if necessary. |
| | • Radiator | • Inspect the heater radiator for any leaks. |
| | • Water pump | • Inspect the water pump for any leaks. Perform the pressure test in 3.2.4 Cooling System. Install a new set of water pump and water pump washer if necessary. **Refer to: Water Pump (3.2.4 Cooling System, Removal and Installation).** |
| | • Thermostat cap | • Inspect the thermostat cap for any leaks. Perform the pressure test in 3.2.4 Cooling System. Install a new set of thermostat cap and cap washer if necessary. **Refer to: Thermostat (3.2.4 Cooling System, Removal and Installation).** |
| | • Thermostat chamber lock | • Inspect if the thermostat chamber lock is always locked or damaged. Install a new set of thermostat chamber lock if necessary. |
| | • Radiator filler cap or sealing | • Inspect if the radiator filler cap is always locked or damaged. Install a new set of radiator filler cap if necessary. |
| | • Water reservoir | • Inspect the water reservoir for any damage. Install a new set of coolant tank if necessary. |
| | • Heater radiator | • Inspect the heater radiator for any leaks. |
| | • Engine | • Inspect the engine, cylinder head, cylinder block and cylinder head gasket. |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine cannot reach the normal working temperature | • Radiator fan | **Refer to: Diagnosis Procedure for Radiator Fan Constantly Running (3.2.4 Cooling System, Symptom Diagnosis and Testing).** |
| | • Thermostat | • Perform the thermostat testing in 3.2.4 Cooling System. Install a new set of thermostat cap and cap washer if necessary.<br>**Refer to: Thermostat (3.2.4 Cooling System, Removal and Installation).** |
| Engine overheating (signs of boiling coolant) | • Cooling system cannot maintain the pressure | • Inspect the water reservoir for any damage. Install a new set of radiator filler cap if necessary.<br>• Inspect the water pump or water pump washer for any damage. Install a new set of water pump and water pump washer if necessary.<br>**Refer to: Water Pump (3.2.4 Cooling System, Removal and Installation).**<br>• Inspect the engine, cylinder head, cylinder block and cylinder head gasket.<br>• Inspect if each connecting hose and its joint for aging or leaks. Repair or replace if necessary. |
| | • Air in the cooling system | • Bleed the cooling system. |
| | • Radiator filler cap or sealing | • Inspect if the radiator filler cap is locked or damaged. Install a new set of radiator filler cap if necessary. |
| | • Water reservoir | • Inspect the water reservoir for any damage. Install a new set of water reservoir if necessary. |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine overheating (signs of boiling coolant) | • Coolant level or condition | • Inspect the coolant level. Refill the coolant if necessary.<br>**Refer to: Coolant Draining and Filling (3.2.4 Cooling System, General Inspection).**<br>• Inspect the coolant condition. Drain the old coolant and add new coolant if the old coolant is abnormal.<br>**Refer to: Coolant Draining and Filling (3.2.4 Cooling System, General Inspection).** |
| | • Coolant contaminated | • Replace the coolant. |
| | • Radiator grille | • Inspect the radiator grille for any blockage or damage. Repair or replace if necessary. |
| | • Water pump | • Perform the pressure test in 3.2.4 Cooling System. Inspect the water pump for any leaks. Install a new set of water pump and water pump washer if necessary.<br>**Refer to: Water Pump (3.2.4 Cooling System, Removal and Installation).** |
| | • Thermostat | • Perform the thermostat testing in 3.2.4 Cooling System. Install a new set of thermostat cap and cap washer if necessary.<br>**Refer to: Thermostat (3.2.4 Cooling System, Removal and Installation).** |
| | • Compressor belt | • Inspect the compressor belt condition.<br>**Refer to: Accessory Drive Belt Inspection (3.2.2 Mechanical System, General Inspection).** |

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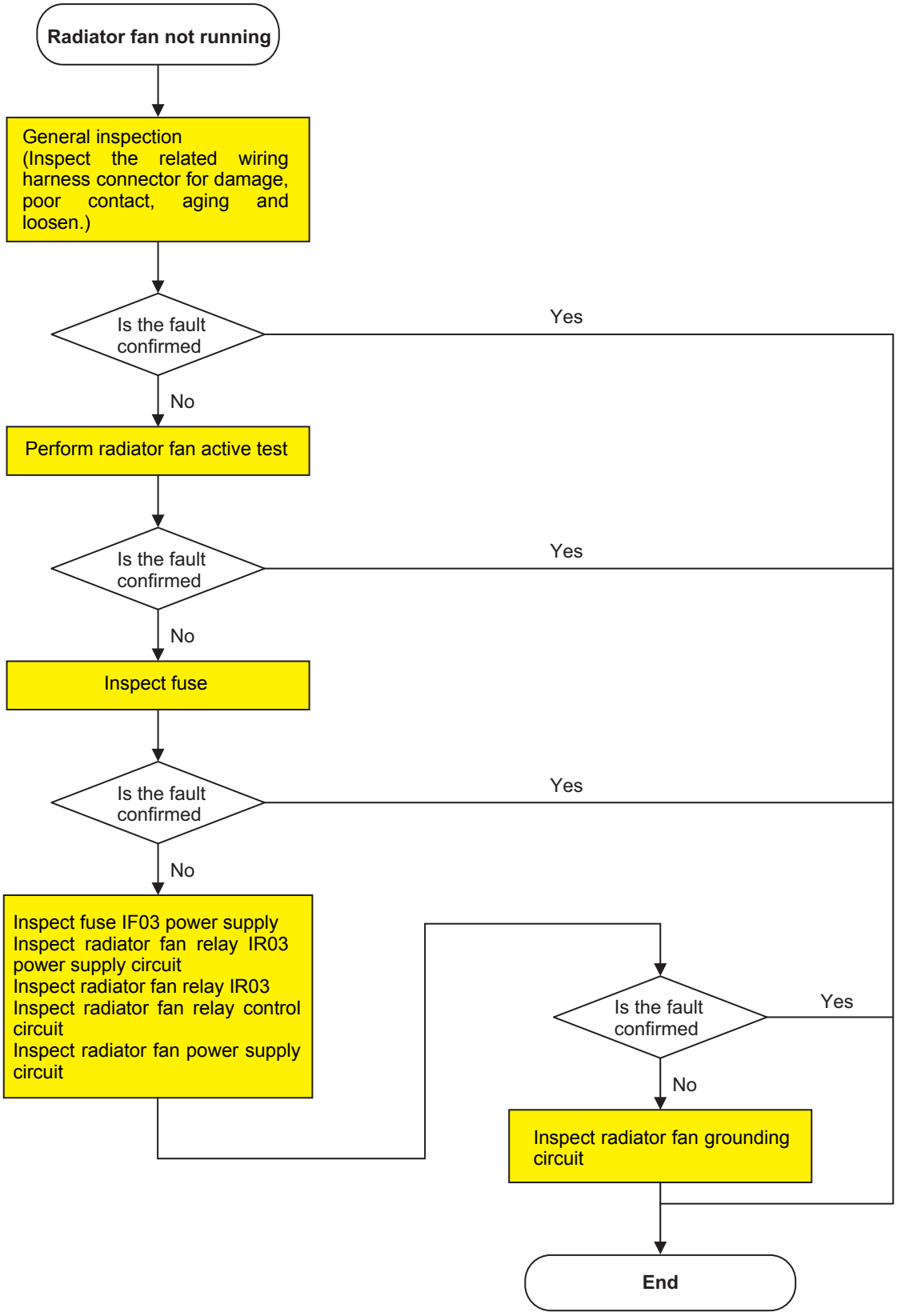
| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine overheating (signs of boiling coolant) | • Radiator fan | **Refer to: Diagnosis Procedure for Radiator Fan Not Running (3.2.4 Cooling System, Symptom Diagnosis and Testing).** |
| | • Engine | • Inspect the engine, cylinder head, cylinder block and cylinder head gasket. |

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# Diagnosis Procedure for Radiator Fan Not Running

**CAUTION: The radiator fan works is based on the premise that the main relay IR05 of engine control module is working normally. Therefore, make sure the main relay IR05 of engine control module is working normally before inspection. If the vehicle can start normally, this indicates that the main relay IR05 is normal.**



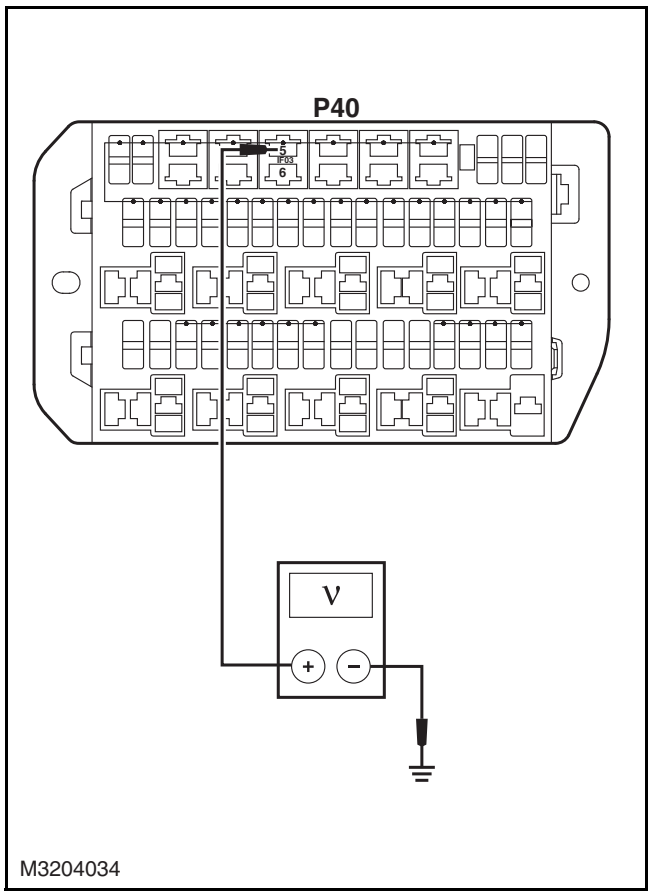
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect each related wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault point. |
| 2. Perform radiator fan active test | |
| | A. Connect diagnostic tool.<br>B. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>Does the fan rotate?<br>**Yes**<br>Inspect the coolant temperature sensor.<br>**Refer to: DTCs P0116, P0117, P0118 (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Inspect fuse | |
| | A. Inspect the radiator fan fuse IF03.<br>Fuse rated capacity: 30 A<br>Is the fuse normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

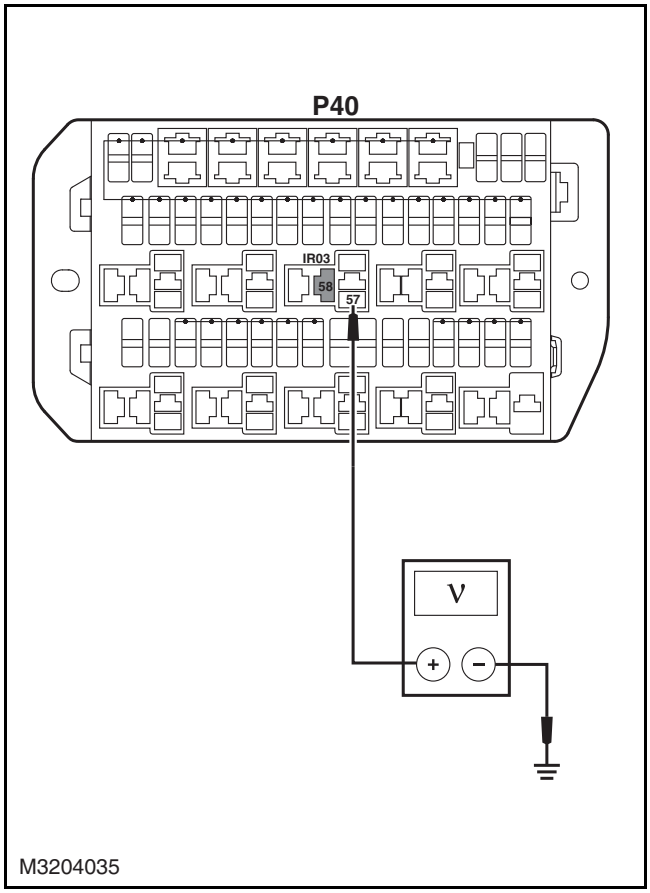
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuse IF03 power supply | |
|  M3204034 | • Measure the voltage between terminal 5 of instrument panel fuse box P40 fuse IF03 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of instrument panel fuse box P40 and battery. |

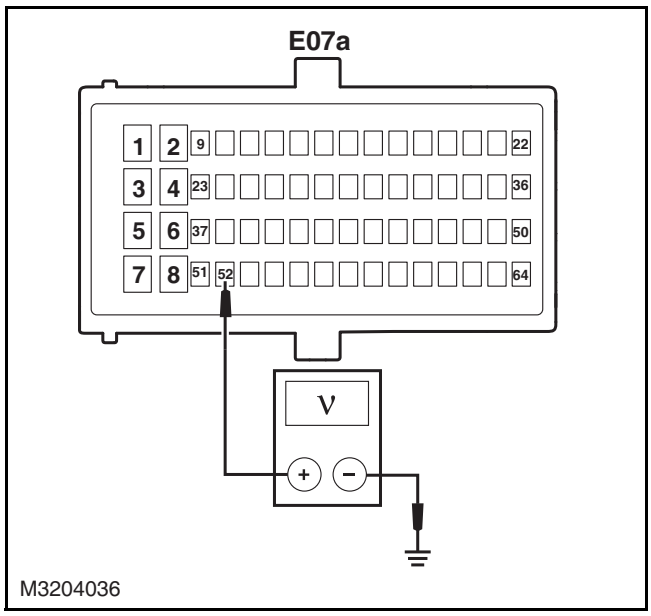
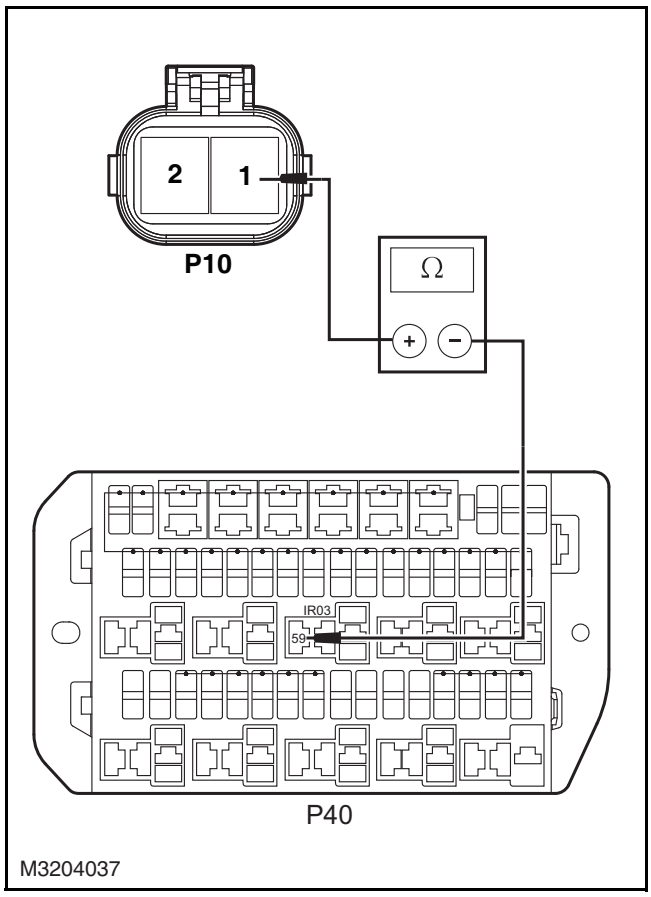
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect radiator fan relay IR03 power supply circuit | |
|  | A. Remove the radiator fan relay.<br>B. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>C. At the same time, measure the voltage between terminals 57, 58 of radiator fan relay IR03 and reliable grounding with a multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 58 of radiator fan relay IR03 and terminal 6 of instrument panel fuse box.<br>Inspect and repair the open circuit fault between terminal 57 of radiator fan relay IR03 and terminal 69 of main relay IR05. |
| 6. Inspect radiator fan relay IR03 | |
| | A. Remove the radiator fan relay.<br>B. Replace it with a normal one of same type.<br>Is the system normal?<br>**Yes**<br>Replace the radiator fan relay.<br>**No**<br>Go to step 7. |

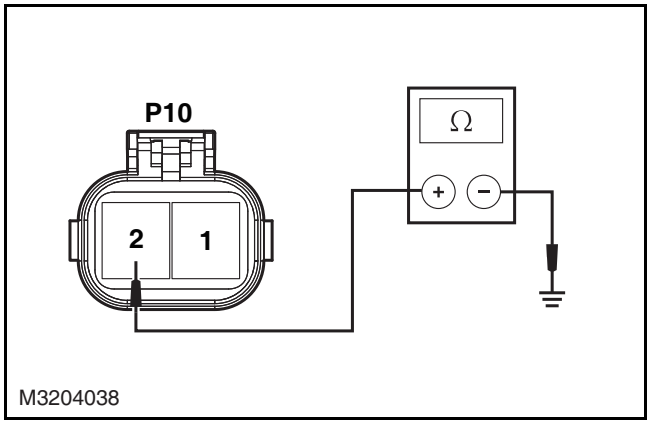
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect radiator fan relay control circuit | |
|  M3204036 | A. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>B. At the same time, measure the voltage between terminal 52 of engine control module wiring harness connector E07a and reliable grounding with a multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 52 of engine control module wiring harness connector E07a and terminal 85 of radiator fan relay IR03. |
| 8. Inspect radiator fan power supply circuit | |
|  M3204037 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radiator fan wiring harness connector P10.<br>C. Remove the radiator fan relay IR03.<br>D. Measure the resistance between terminal 1 of radiator fan wiring harness connector P10 and terminal 59 of radiator fan relay IR03.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of radiator fan wiring harness connector P10 and terminal 59 of radiator fan relay IR03. |

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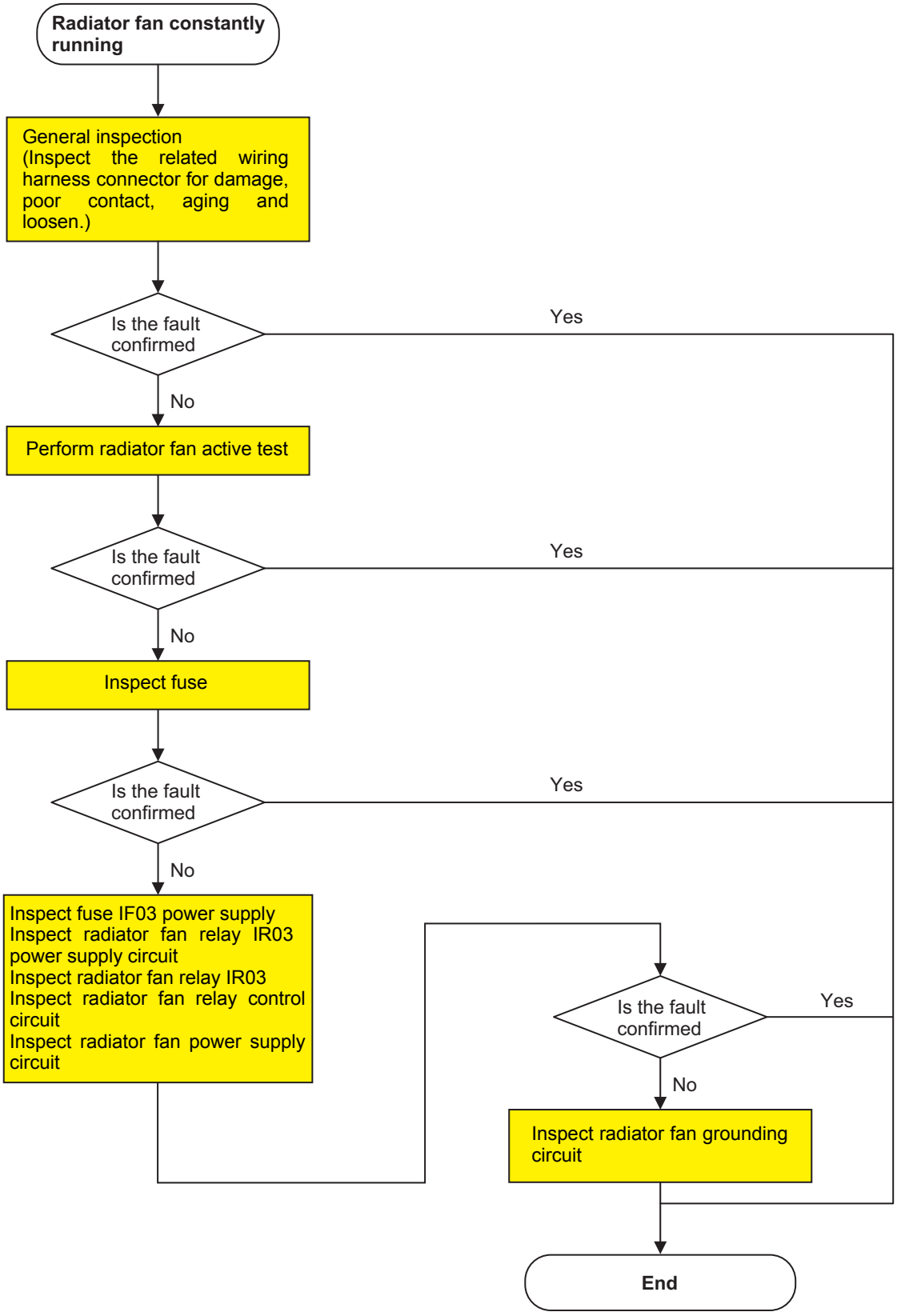


| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect radiator fan grounding circuit | |
|  <br>M3204038 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radiator fan wiring harness connector P10.<br>C. Measure the resistance between terminal 2 of radiator fan wiring harness connector P10 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the radiator fan.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of radiator fan wiring harness connector P10 and reliable grounding. |

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# Diagnosis Procedure for Radiator Fan Constantly Running



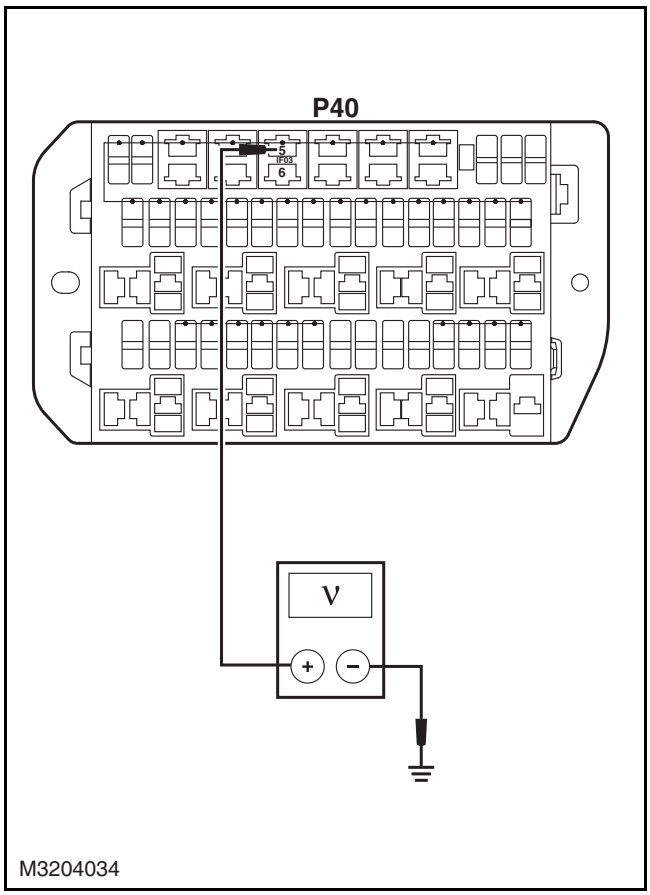
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the each related wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault point. |
| 2. Perform radiator fan active test | |
| | A. Connect diagnostic tool.<br>B. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>Does the fan rotate?<br>**Yes**<br>Inspect the coolant temperature sensor.<br>**Refer to: DTCs P0116, P0117, P0118 (3.2.12 Electronic control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Inspect fuse | |
| | A. Inspect the radiator fan fuse IF03.<br>**Fuse rated capacity: 30 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

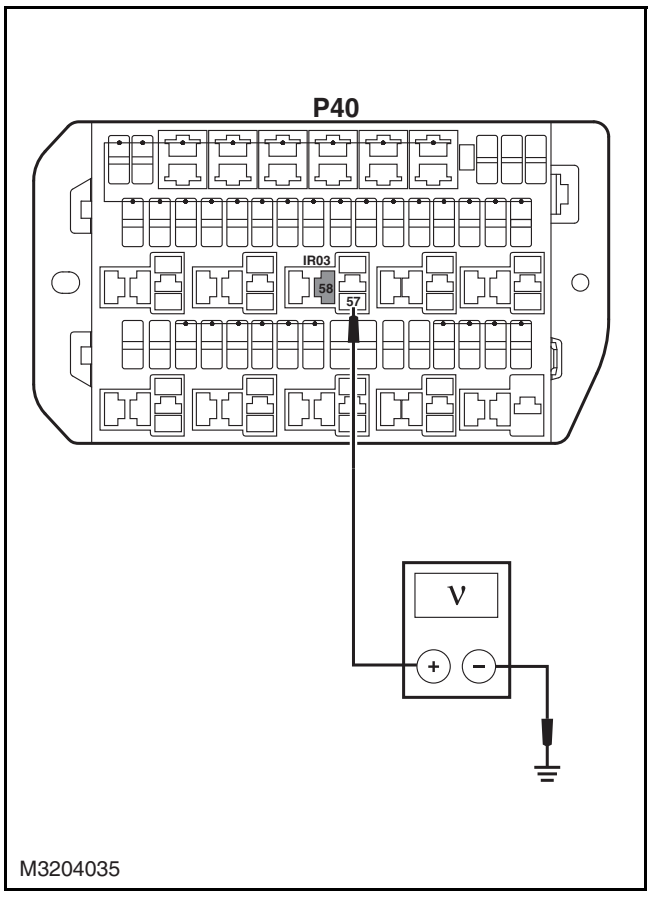
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuse IF03 power supply | |
|  M3204034 | A. Measure the voltage between terminal 5 of instrument panel fuse box P40 fuse IF03 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of instrument panel fuse box P40 and battery. |

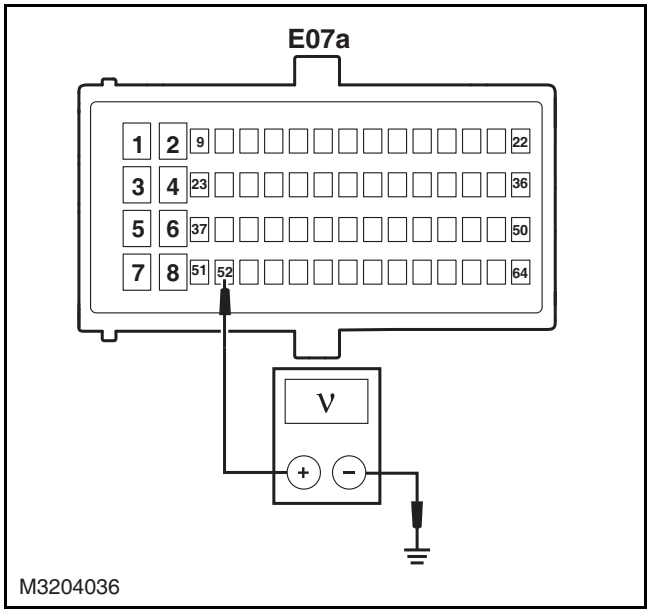
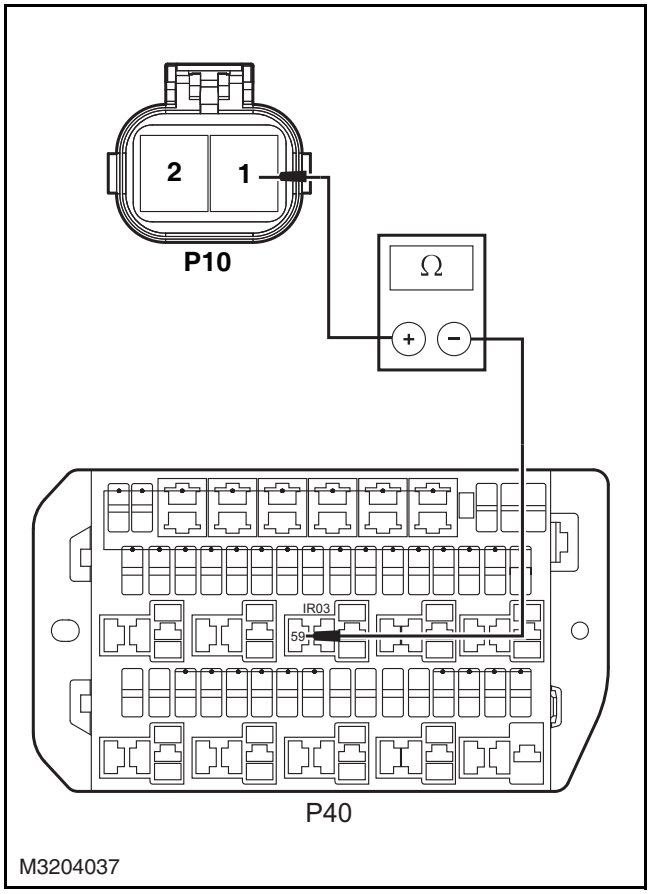
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect radiator fan relay IR03 power supply circuit | |
|  | A. Remove the radiator fan relay.<br>B. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>C. At the same time, measure the voltage between terminals 57, 58 of radiator fan relay IR03 and reliable grounding with a multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 58 of radiator fan relay IR03 and terminal 6 of instrument panel fuse box.<br>Inspect and repair the open circuit fault between terminal 57 of radiator fan relay IR03 and terminal 69 of main relay IR05. |
| 6. Inspect radiator fan relay IR03 | |
| | A. Remove the radiator fan relay.<br>B. Replace it with a normal one of same type.<br>Is the system normal?<br>**Yes**<br>Replace the radiator fan relay.<br>**No**<br>Go to step 7. |

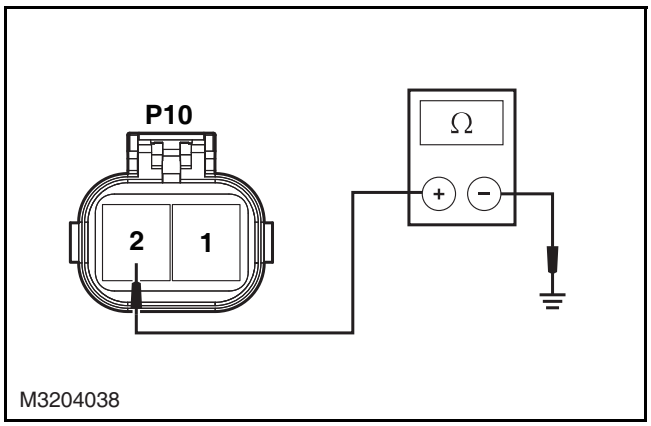
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect radiator fan relay control circuit | |
|  M3204036 | A. Turn the ignition switch to "ON", and execute "Actuators" test - "Fan" with a diagnostic tool.<br>B. At the same time, measure the voltage between terminal 52 of engine control module wiring harness connector E07a and reliable grounding with a multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 52 of engine control module wiring harness connector E07a and terminal 85 of radiator fan relay IR03. |
| 8. Inspect radiator fan power supply circuit | |
|  M3204037 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radiator fan wiring harness connector P10.<br>C. Remove the radiator fan relay IR03.<br>D. Measure the resistance between terminal 1 of radiator fan wiring harness connector P10 and terminal 59 of radiator fan relay IR03.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of radiator fan wiring harness connector P10 and terminal 59 of radiator fan relay IR03. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect radiator fan grounding circuit | |
|  M3204038 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radiator fan wiring harness connector P10.<br>C. Measure the resistance between terminal 2 of radiator fan wiring harness connector P10 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the radiator fan.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of radiator fan wiring harness connector P10 and reliable grounding. |

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## Removal and Installation

# Radiator Fan

### Removal

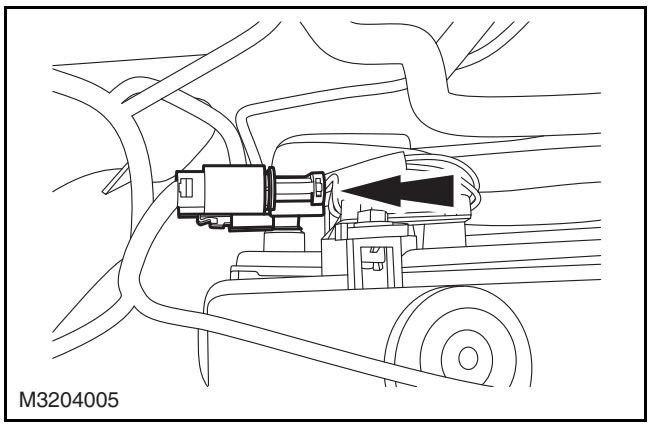
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Remove the front bumper upper grille.

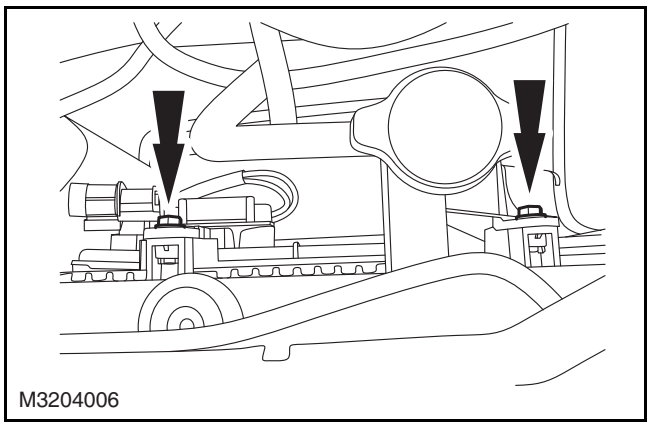
   **Refer to: Front Bumper (5.1.7 Bumper, Removal and Installation).**

3. Disconnect the radiator fan wiring harness connector.


M3204005

4. Remove 2 retaining bolts from the radiator fan.

   Torque: 10 Nm


M3204006

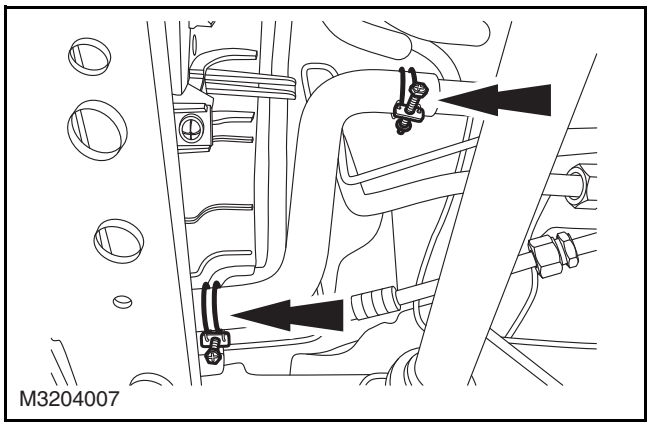
5. Remove the front wind guiding cover.

   **Refer to: Front Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

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6. Loosen 2 clamps, and disconnect the radiator lower water pipe.




7. Remove the radiator fan.

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Be aware that the clip at the lower part of radiator fan must be seized in the holder at the lower part of radiator when installing the radiator fan.**

**CAUTION: Start engine to inspect cooling system for any leaks.**

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# Radiator

## Removal

1. Disconnect the negative battery cable.

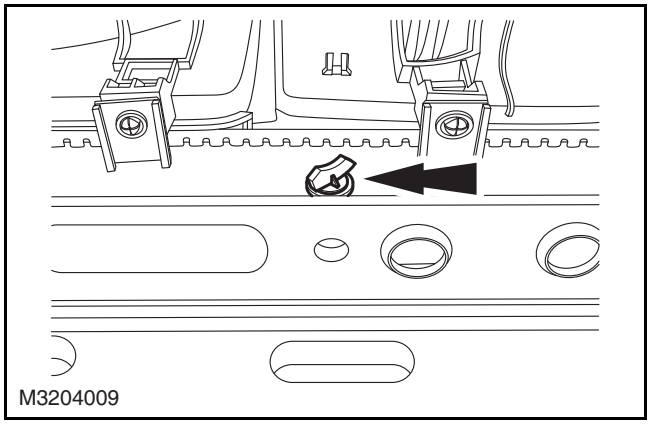
   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Remove the front wind guiding cover.

   **Refer to: Front Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

3. Loosen the radiator drain plug to drain the cooling system.

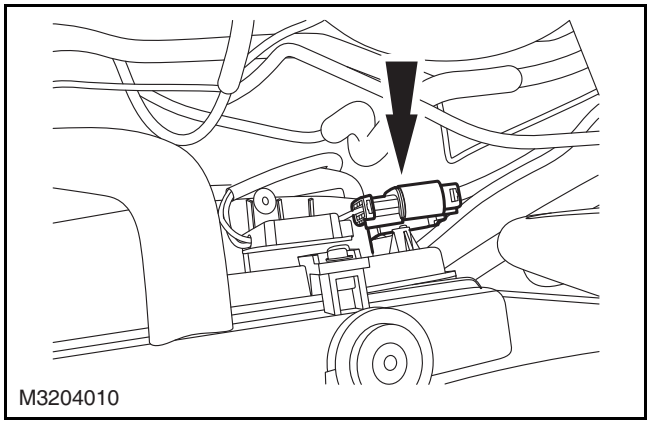
**WARNING: To avoid the danger of being scalded, do not drain the cooling system when engine and radiator still hot. The boiling liquid and steam may spurt out under the pressure since the reservoir cap opens earlier.**


M3204009

4. Remove the radiator fan.

   **Refer to: Radiator Fan (3.2.4 Cooling System, Removal and Installation).**

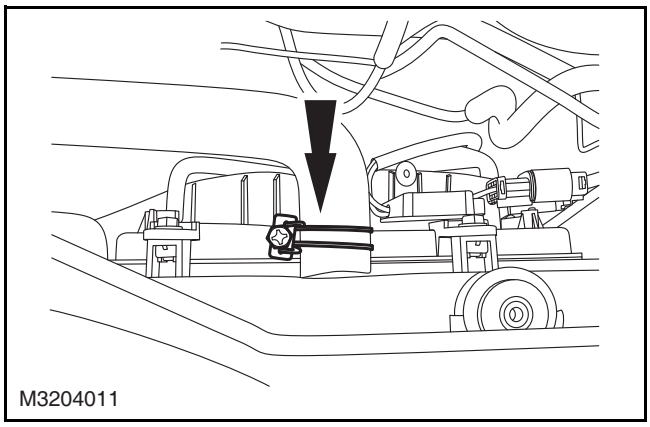
5. Disconnect the condenser fan wiring harness connector.


M3204010

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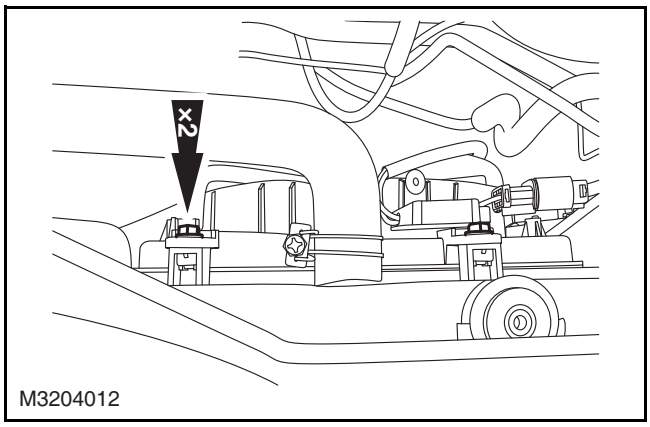


**6.** Loosen the clamp, and separate the radiator upper water pipe from the radiator.


M3204011

**7.** Remove 2 retaining bolts from the condenser fan.

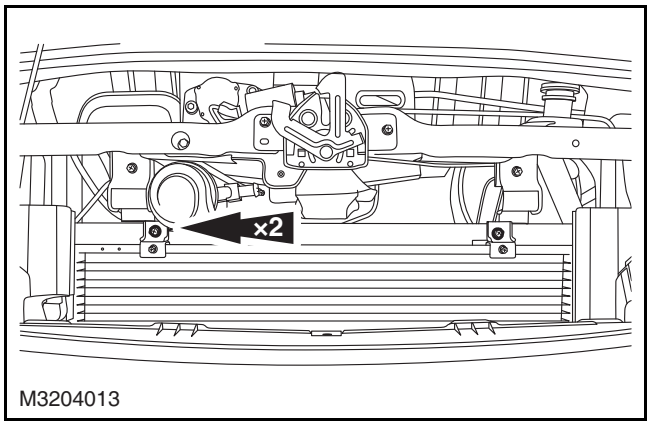
Torque: 10 Nm



M3204012

**8.** Lift the vehicle, and remove the condenser fan from the lower part of vehicle.

**9.** Remove 2 connecting screws between condenser and radiator.



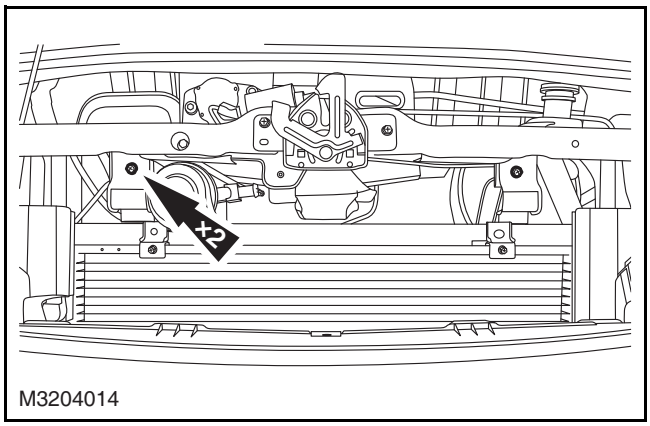
M3204013

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**10.** Remove 2 retaining bolts from the radiator upper bracket.

Torque: 9 Nm

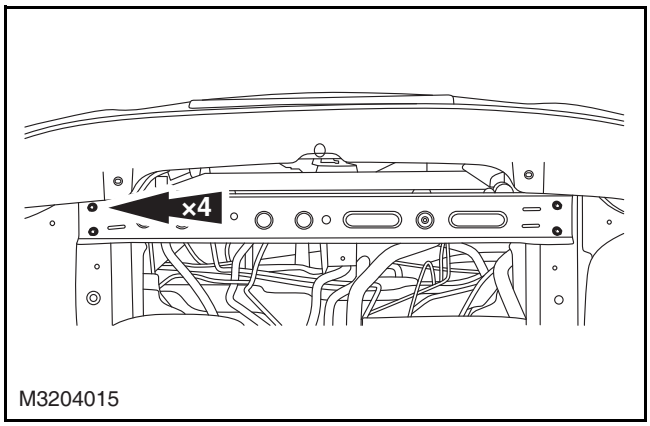



M3204014

**11.** Remove 4 retaining bolts from the radiator bracket assembly.

Torque: 20 Nm

**CAUTION: Secure the condenser to the body before removing the radiator bracket assembly to prevent damaging the A/C pipe.**




M3204015

**12.** Remove the radiator.

## Installation

**1.** Installation is in the reverse order of removal.

**CAUTION: Be aware that the clip at the lower part of radiator must be seized in the holder of radiator bracket assembly when installing the radiator.**

**CAUTION: Start engine to inspect cooling system for any leaks.**

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# Thermostat

## Removal

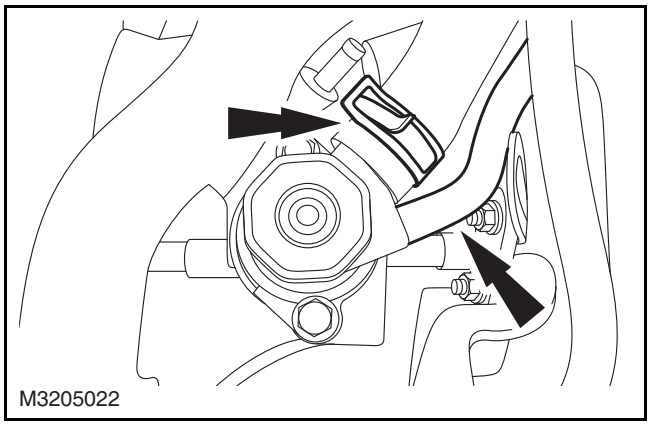
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Loosen the radiator drain plug to drain the cooling system.

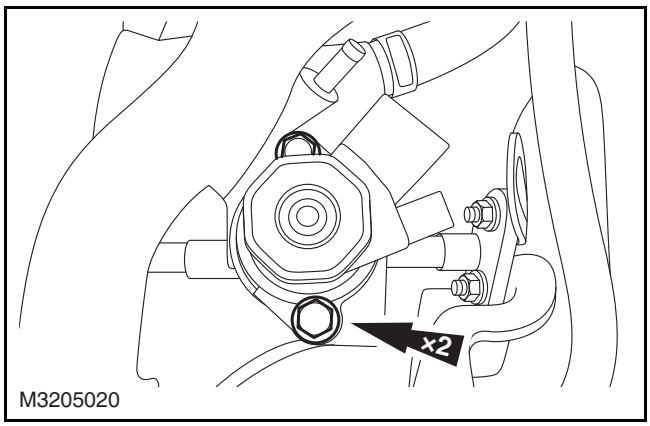
   **Refer to: Coolant Draining and Filling (3.2.4 Cooling System, General Inspection).**

3. Disconnect the connection between No.2 water outlet pipe and thermostat cap.
4. Loosen the hoop, and disconnect the connection between the top radiator hose and thermostat cap.

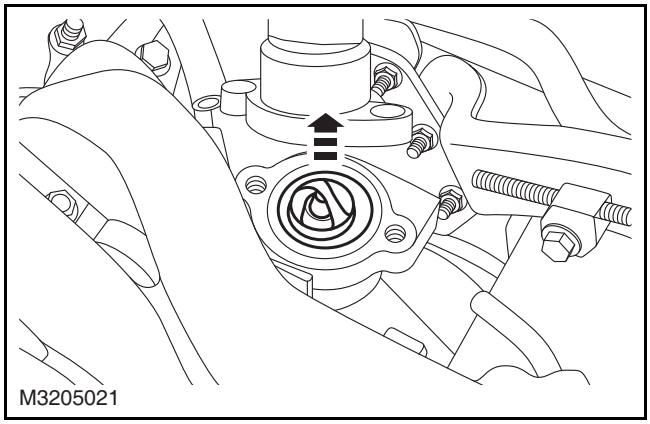



5. Remove 2 retaining bolts from the thermostat.

   Torque: 23 ± 2 Nm




6. Remove the thermostat.



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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: The thermostat paraffin inductor faces towards the engine side.**

**CAUTION: Falling out of thermostat seal ring is not allowed.**

**CAUTION: Fully turn the thermostat cap.**

**CAUTION: Start engine to inspect cooling system for any leaks.**

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# Water Pump

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the front wind guiding cover.

   **Refer to: Front Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

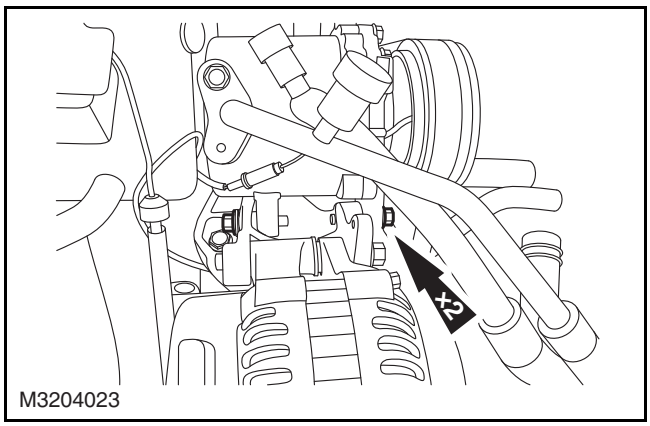
4. Loosen the radiator drain plug to drain the cooling system.

   **Refer to: Coolant Draining and Filling (3.2.4 Cooling System, General Inspection).**

5. Remove the compressor belt. (Vehicle with A/C)

   1 Loosen 2 compressor connecting bolts.

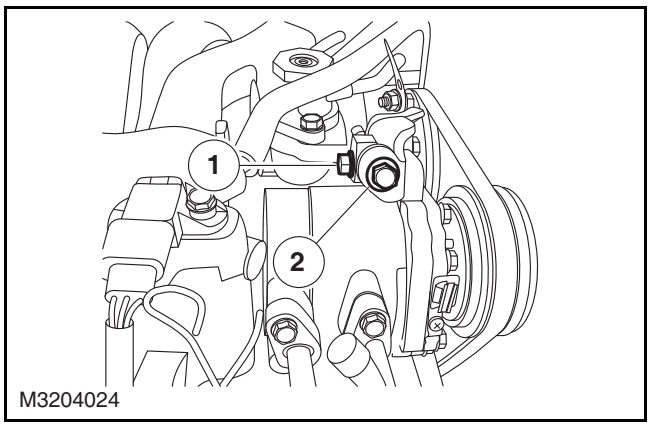
   Torque: 25 ~ 30 Nm



M3204023

   2 Loosen the compressor adjusting bracket bolts (1) and (2) in order.

   Torque for bolt (1) : 25 ± 1 Nm

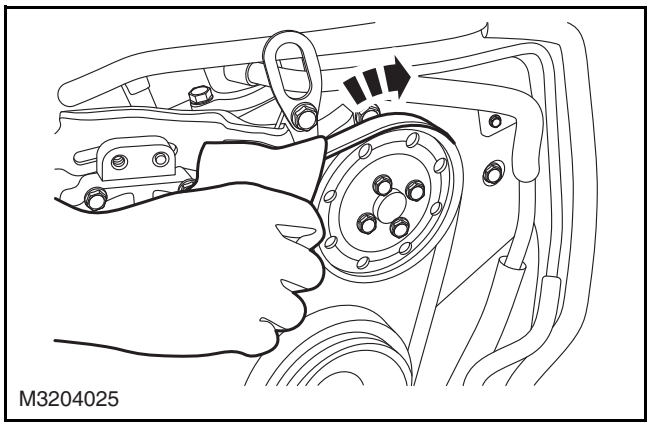


M3204024

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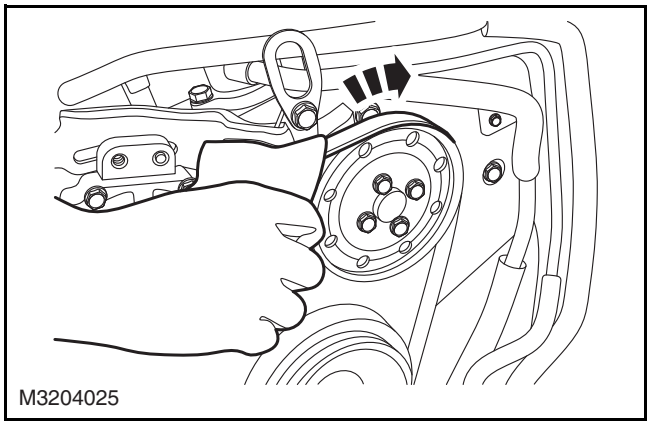


3 Turn the water pump pulley toward the engine side until the compressor belt can be removed.


M3204025

**6.** Remove the elastic belt. (Vehicle without A/C)

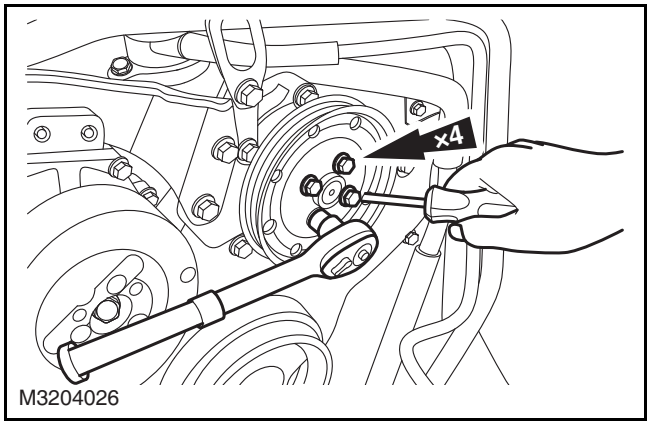
1 Turn the water pump pulley toward the engine side until the compressor belt can be removed.


M3204025

**7.** Remove the water pump.

1 Use a screwdriver to position the water pump pulley, and use a ratchet wrench to remove the retaining bolts from the water pump pulley in order.

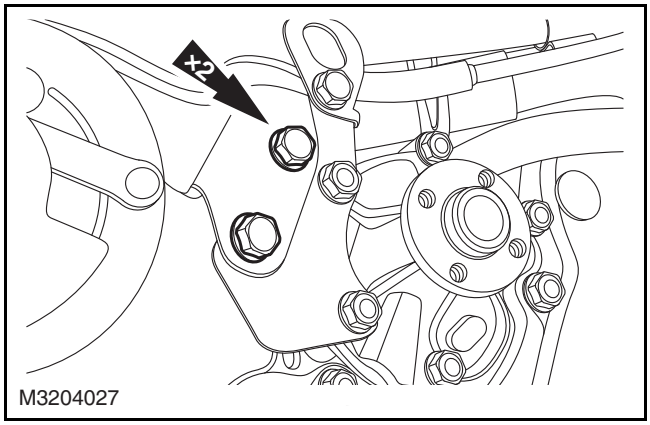
Torque: 10 ± 1 Nm



M3204026

2 Remove 2 retaining bolts from the bolster plate of compressor tension bracket. (Vehicle with A/C)

Torque: 23 ± 2 Nm



M3204027

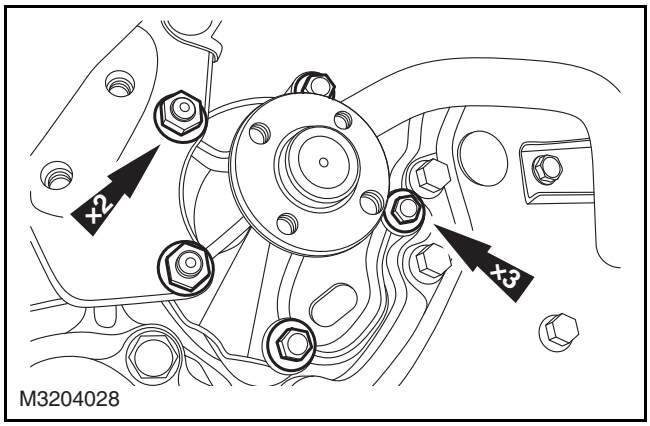
https://truckmanualshub.com/



3 Move the compressor adjusting bracket away. (Vehicle with A/C)

4 Remove 3 retaining bolts and 2 nuts from the water pump, and remove the water pump.

Torque: 20 ± 5 Nm



M3204028

5 Clean the joint surface of engine cylinder block and water pump.

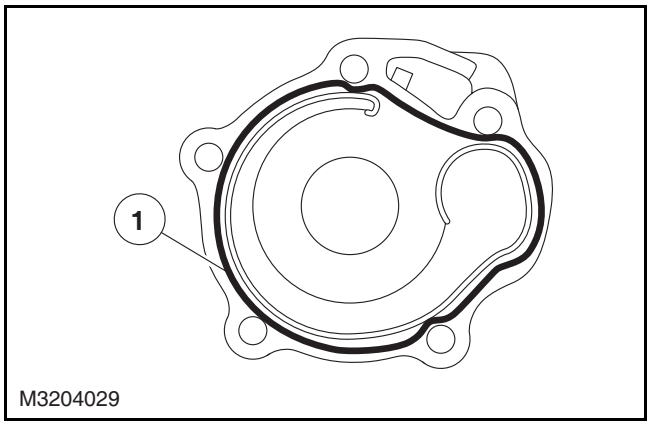
## Inspection

Inspect the water pump for damage; inspect if the water pump is stuck by turning it. Replace the water pump if any defect is found.

## Installation

Install the water pump assembly and the bolster plate of compressor tension bracket. Apply sealant when installing the water pump, and make sure that the smear surface is clean without oil contamination and scratches before smearing. The smear area is shown in the figure, and install the water pump assembly within 5 minutes after application.

Sealant type: Tonsan 1596Fa



M3204029

**CAUTION: Inspect the drive belt tension.**

**Refer to: Drive Belt Tension Inspection (3.2.4 Cooling System, General Inspection).**

**CAUTION: After installing the water pump, do not add coolant within 20 minutes to avoid the sealant to enter the water pump turbine.**

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# Floor Water Pipe

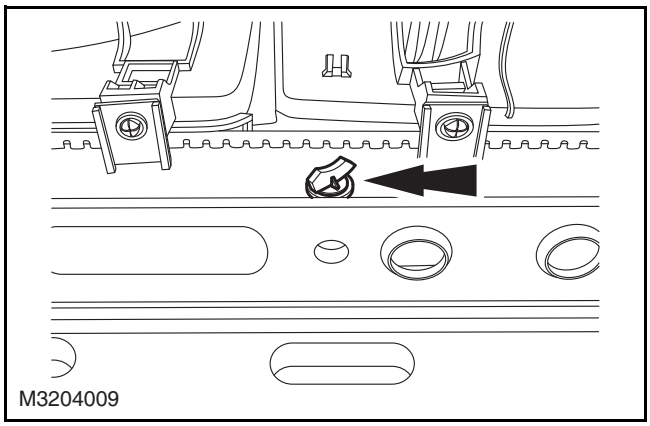
## Removal

1. Remove the front wind guiding cover.

   **Refer to: Front Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

2. Loosen the radiator drain plug to drain the cooling system.

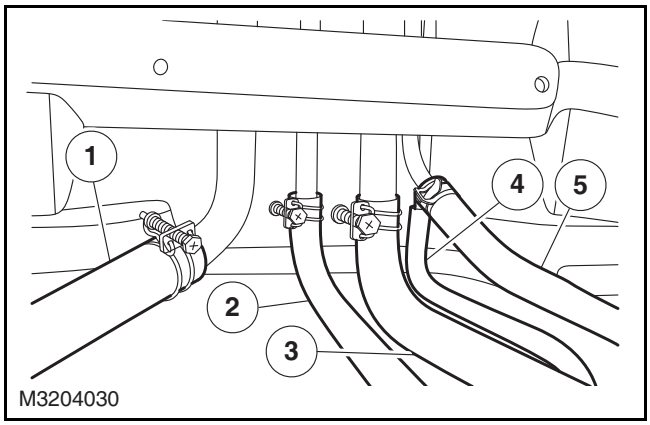
**WARNING: To avoid the danger of being scalded, do not drain the cooling system when engine and radiator still hot. The boiling liquid and steam may spurt out under the pressure since the reservoir cap opens earlier.**


M3204009

3. Remove the rear wind guiding cover.

   **Refer to: Rear Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

4. Loosen the clamp, and disconnect the connecting hose (1) between floor water pipe rear end and engine inlet hose.
5. Loosen the clamp, and disconnect the connecting hose (2) of floor water pipe rear end to A/C heater core.
6. Loosen the clamp, and disconnect the connecting hose (3) between floor water pipe rear end and engine outlet hose.
7. Disconnect the connecting hose (4) between floor water pipe rear end and water reservoir.
8. Loosen the hoop, and disconnect the connecting hose (5) between floor water pipe rear end and intake manifold.

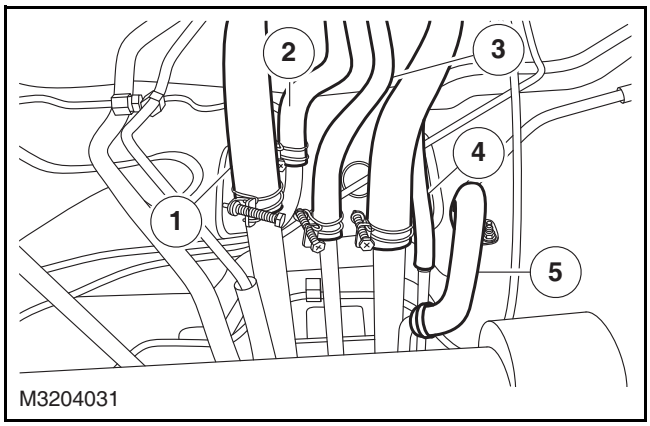


M3204030

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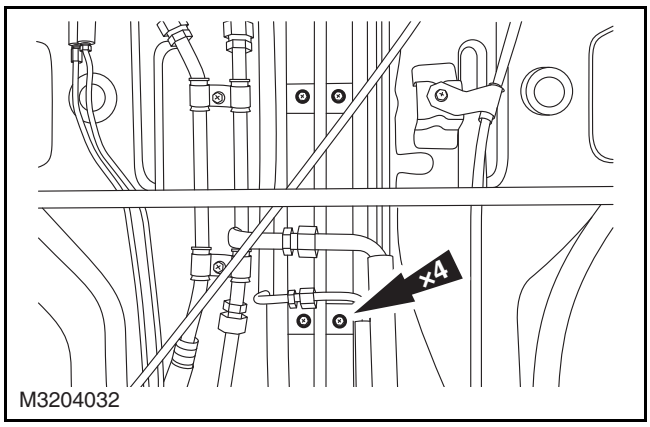
9. Loosen the clamp, and disconnect the connecting hose (1) between floor water pipe front end and radiator outlet hose.
10. Loosen the clamp, and disconnect the connecting hose (2) between floor water pipe front end and A/C heater core.
11. Loosen the clamp, and disconnect the connecting hose (3) between floor water pipe front end and radiator inlet hose.
12. Disconnect the connecting hose (4) between floor water pipe front end and water reservoir.
13. Loosen the hoop, and disconnect the connecting hose (5) between floor water pipe front end and vacuum booster.



M3204031

14. Remove 4 retaining screws from the floor water pipe, and remove the floor water pipe.

    Torque: 10 ± 1 Nm



M3204032

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Start engine to inspect cooling system for any leaks.**

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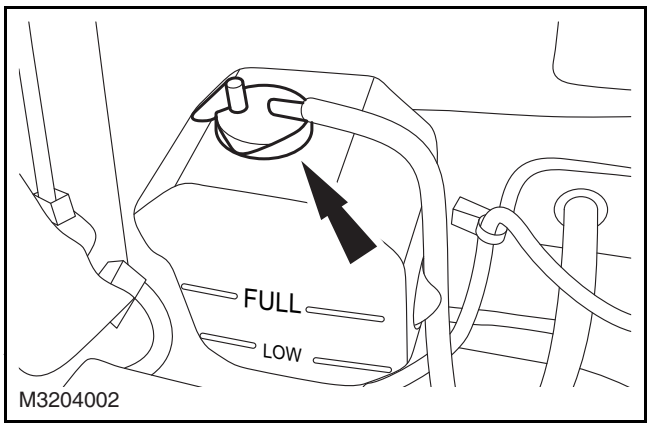
# Water Reservoir

## Removal

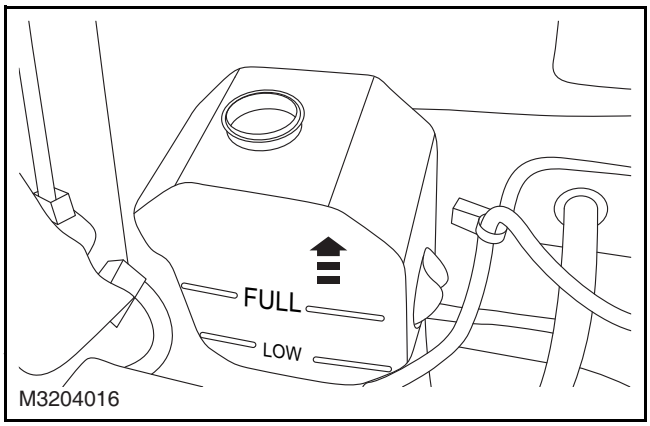
1. Remove the water pipe and water reservoir cap.

**WARNING: To avoid the danger of being scalded, do not drain the cooling system when engine and radiator still hot. The boiling liquid and steam may spurt out under the pressure since the reservoir cap opens earlier.**

2. Pull up the water reservoir to remove it.



M3204002



M3204016

## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| Vacuum degree of intake manifold under engine idling | 330 ± 20 kPa |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Intake manifold retaining bolt | 23 ± 2 | - | - |
| Throttle body retaining bolt | 10 ± 1 | - | - |
| Air filter retaining bolt | 10 ± 1 | - | - |
| Retaining bolt of air intake pressure/ temperature sensor | 10 ± 1 | - | - |

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## Description and Operation

# System Overview

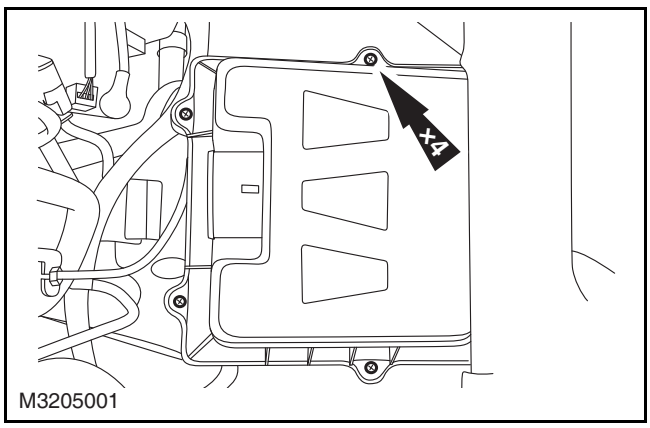
Ambient air enters the air filter first and then the cylinder through the intake pipe, throttle body and intake manifold after it has been filtered by air filter element. The intake pipe is connected with a crankcase vent pipe through which the exhaust gas from the crankcase enters the cylinder with fresh air.

# Components Description

Air filter

The air filter consists of the following items:

- Air filter upper case
- Air filter element
- Air filter lower case

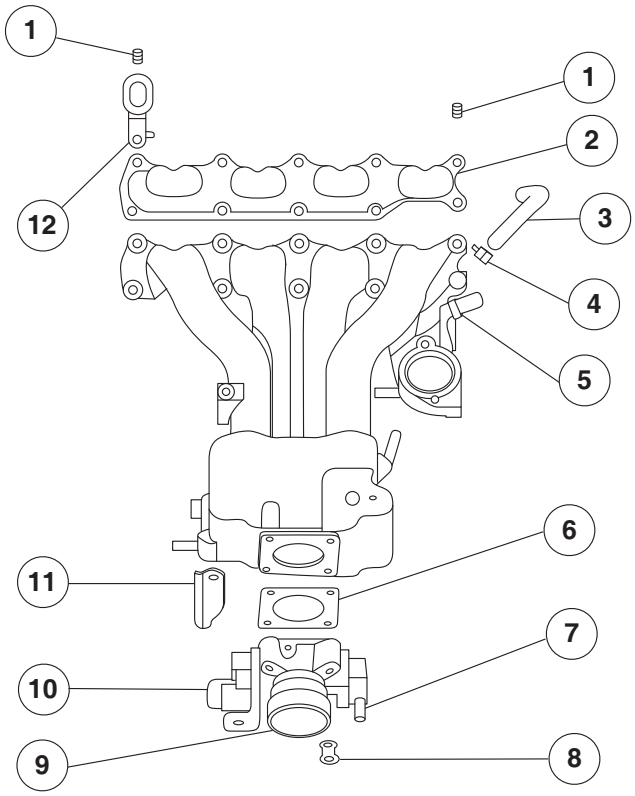



The dry air enters the air filter base and through air filter element and then the clean air flows from the air filter upper case.

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# Components Exploded View




M3205002

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Intake manifold stud bolt | 7 | Throttle position sensor |
| 2 | Intake manifold gasket | 8 | No.4 wiring harness bracket |
| 3 | Small return hose | 9 | Throttle body assembly |
| 4 | Throttle body hoop | 10 | Idling stepper motor assembly |
| 5 | Intake manifold assembly | 11 | Intake manifold stiffener |
| 6 | Throttle body gasket | 12 | No.1 engine hook |

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## General Inspection

### General Equipment

| |
|---|
| Vacuum gauge |

**CAUTION: The components of engine are at high temperature when the engine is running. Pay attention to the components at high temperature during removal. Otherwise, serious scalding will be caused.**

## Vacuum Degree of Air Intake System Inspection

1. Stop the engine and turn off the ignition switch.
2. Detach the brake booster vacuum hose from the intake manifold.
3. Connect 3-way connector, hose and special tool (vacuum gauge and connector) between intake manifold and vacuum hose detached.
4. Start the engine and measure the vacuum degree of air intake system under engine idling.

   **Standard value: 330 ± 20 kPa**
5. Remove the vacuum gauge and reconnect the vacuum hose.
6. If an observed or reported problem is obvious and its cause has been found, solve the fault before proceeding to the next step.
7. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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# Symptom Diagnosis and Testing

## General Equipment

| |
|---|
| Vacuum gauge |

## Visual Inspection Chart

| Mechanical |
|---|
| • Air filter set |
| • Air filter inlet pipe |
| • Air filter outlet pipe |
| • Throttle body |
| • Intake manifold |

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## Symptom Chart

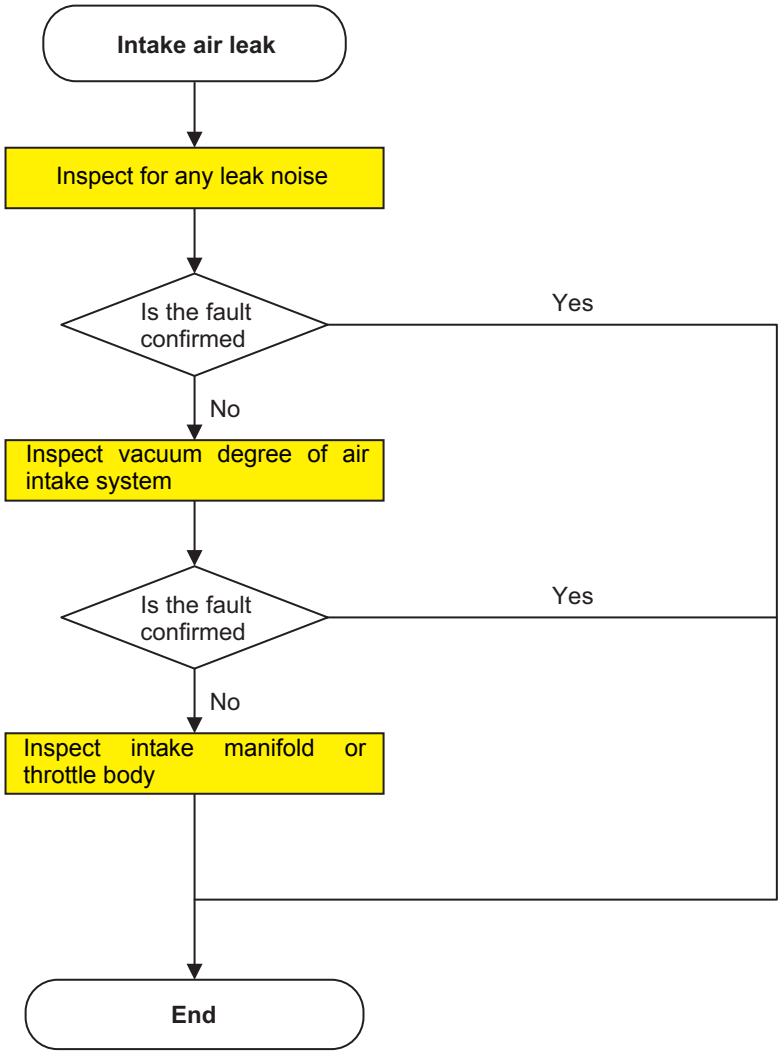
If the fault occurs, but there is no DTC stored in ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Intake air leak | • Air filter<br>• Intake manifold<br>• Throttle body<br>• Crankcase vent pipe<br>• Component connections | **Refer to: Diagnosis Procedure for Intake Air Leak (3.2.5 Air Intake System, Symptom Diagnosis and Testing).** |
| Intake blocking | • Air filter element | • Inspect the air filter and replace when necessary.<br>**Refer to: Air Filter Element (3.2.5 Air Intake System, Removal and Installation).** |
| | • Foreign matters in intake pipe | • Disassemble the air filter case and inspect the air filter and intake pipe for any possible foreign matters and remove.<br>**Refer to: Air Filter Element (3.2.5 Air Intake System, Removal and Installation).** |

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# Diagnosis Procedure for Intake Air Leak



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect for any leak noise | |
| | A. Start the engine.<br>B. Inspect for any leak noise by listening.<br>Is there any leak noise like hiss?<br>**Yes**<br>Inspect the leaking point(s) and repair the leaked component(s).<br>**No**<br>Go to step 2. |
| 2. Inspect vacuum degree of air intake system | |
| | A. Carry out the inspection procedures for vacuum degree of air intake system.<br>Is the vacuum degree normal?<br>**Standard vacuum degree: 330 ± 20 kPa**<br>**Refer to: Vacuum Degree of Air Intake System Inspection (3.2.5 Air Intake System, General inspection).**<br>**Yes**<br>Normal.<br>**No**<br>Go to step 3. |
| 3. Inspect intake manifold or throttle body | |
| | A. Inspect the intake manifold or throttle body for leak tightness.<br>Does the intake manifold or throttle body leak?<br>**Yes**<br>Repair the seal of intake manifold or throttle body.<br>**No**<br>Inspect the engine valve train.<br>**Refer to: Timing System (3.2.2 Mechanical System, Removal and Installation).** |

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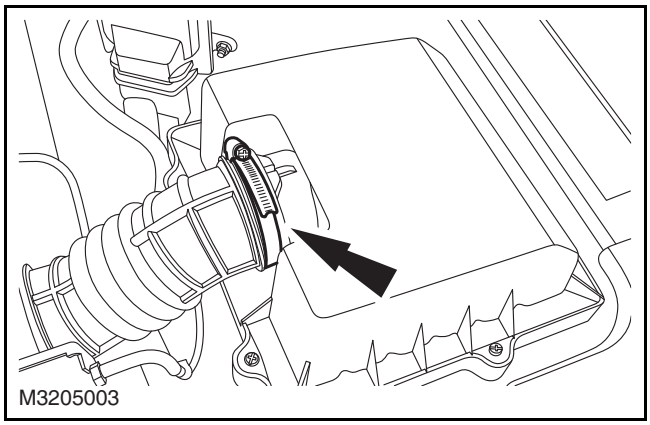


## Removal and Installation

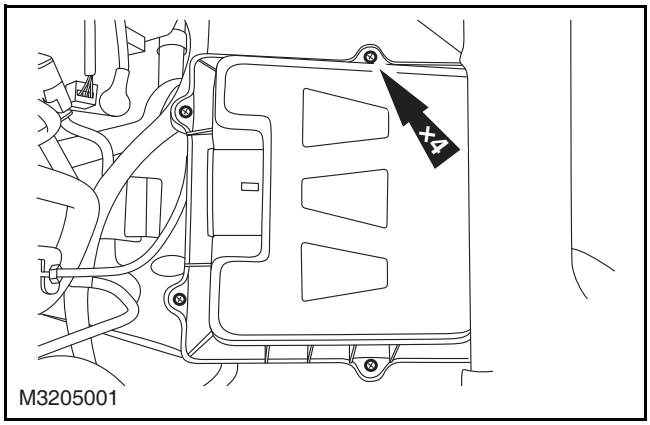
# Air Filter Element

### Removal

**1.** Loosen the pipe clip, and disconnect the air filter outlet pipe from the air filter.

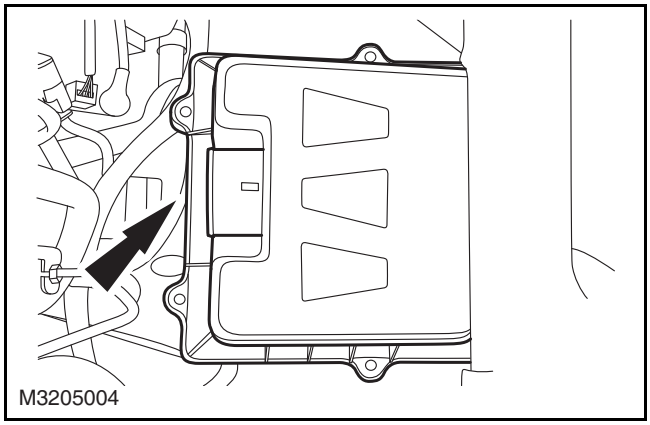

M3205003

**2.** Remove 4 retaining screws from the air filter upper case.



M3205001

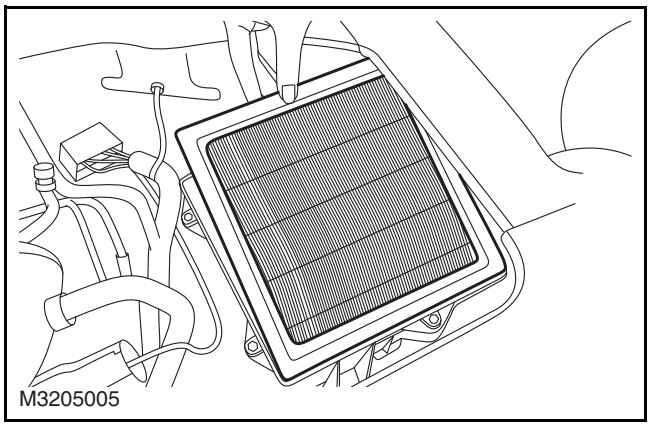
**3.** Remove the air filter upper case.


M3205004

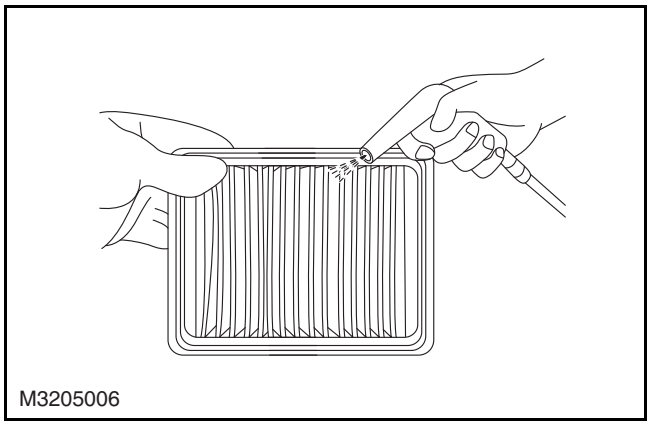
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4. Remove the air filter element from the lower case.


M3205005

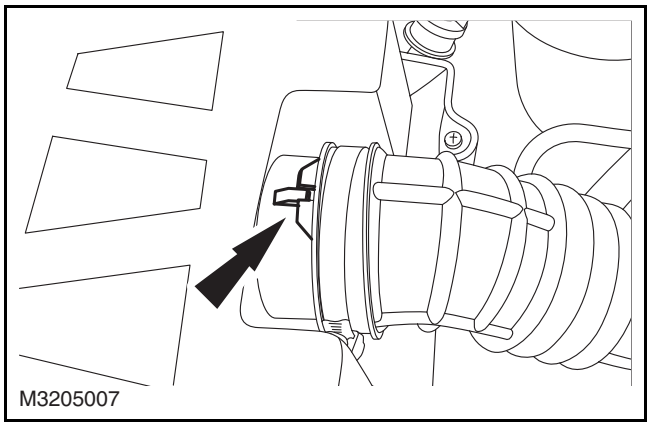
5. Inspect the air filter element for any dirt.
6. Blow away the dirt from the air outlet of element with compressed air if necessary. If it is excessively dirty, replace the element.


M3205006

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Align the bulge of air filter case with the groove of air filter outlet pipe.**


M3205007

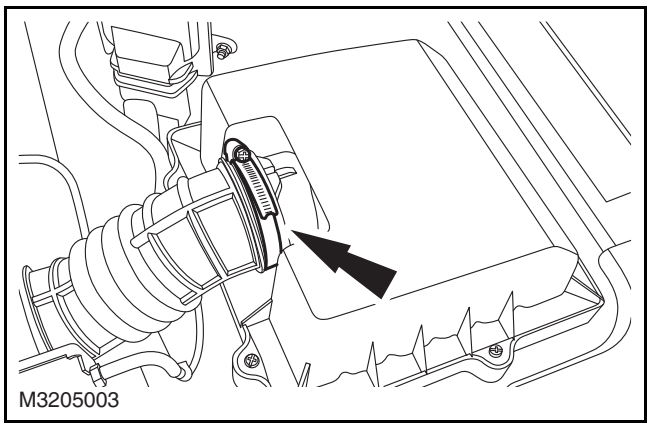
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# Air Filter

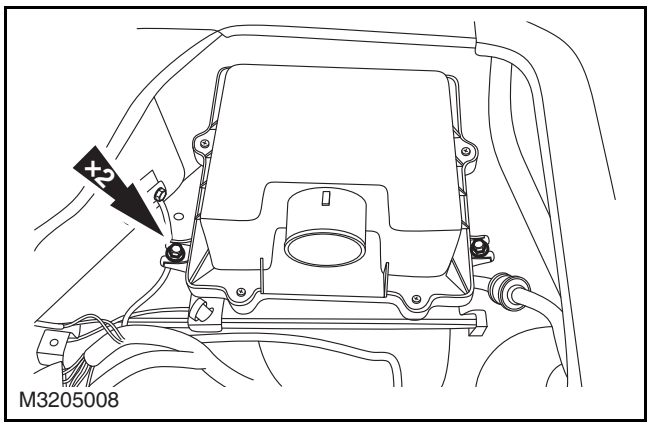
## Removal

1. Loosen the clamp, and disconnect the air filter outlet pipe from the air filter.


M3205003

2. Remove 2 retaining bolts from the air filter.

   Torque: 10 ± 1 Nm

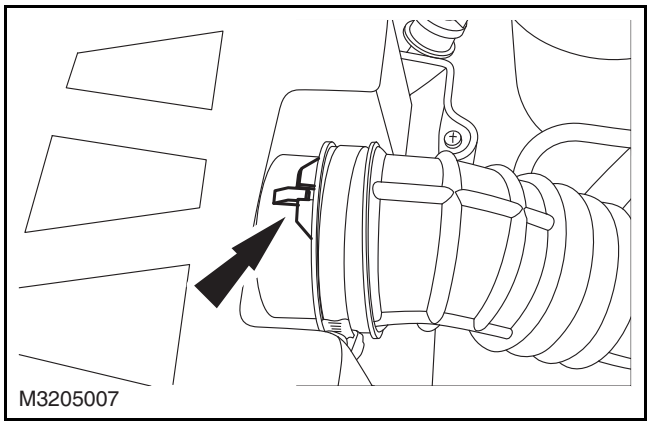


M3205008

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Align the bulge of air filter case with the groove of air filter outlet pipe.**


M3205007

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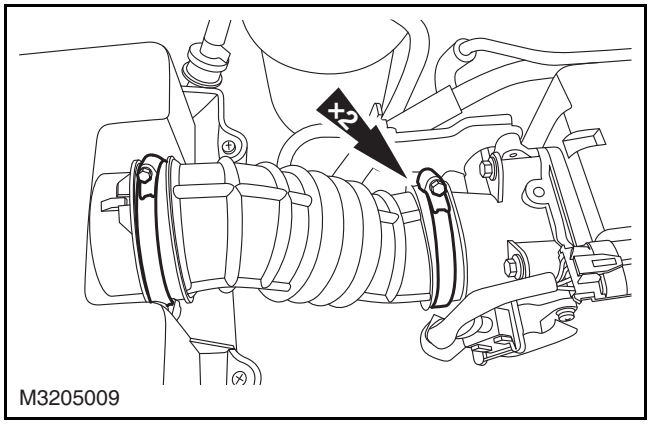
# Throttle Body

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Loosen the clamps, and disconnect the air filter outlet pipe from the throttle body and air filter separately.

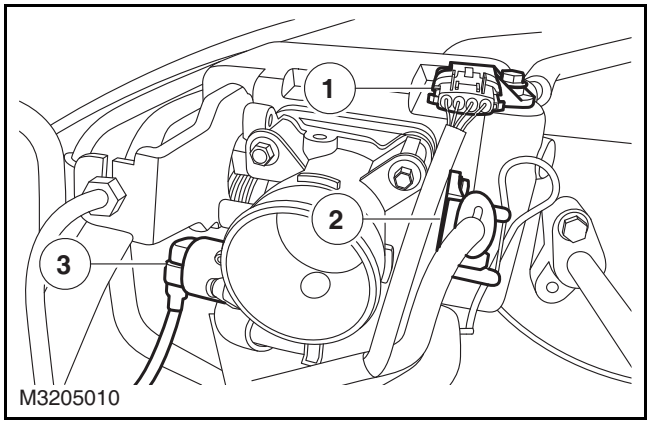



3. Disconnect the wiring harness connector from the throttle body.

   1 Disconnect the air intake pressure/ temperature sensor wiring harness connector (1).

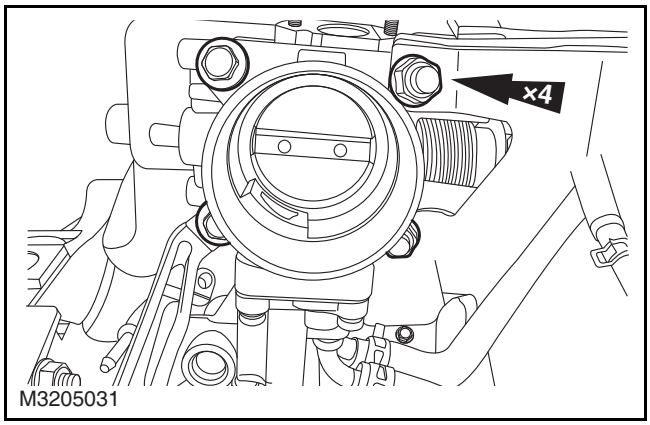
   2 Disconnect the throttle position sensor wiring harness connector (2).

   3 Disconnect the idling stepper motor wiring harness connector (3).




4. Remove 4 retaining bolts from the throttle body, and remove the throttle body and gasket.

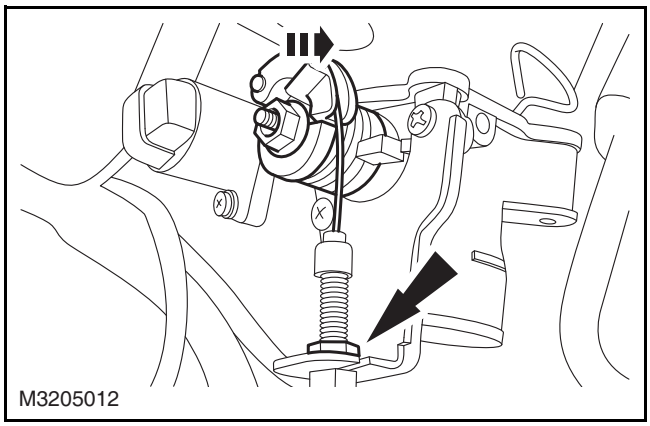
   Torque: 10 ± 1 Nm



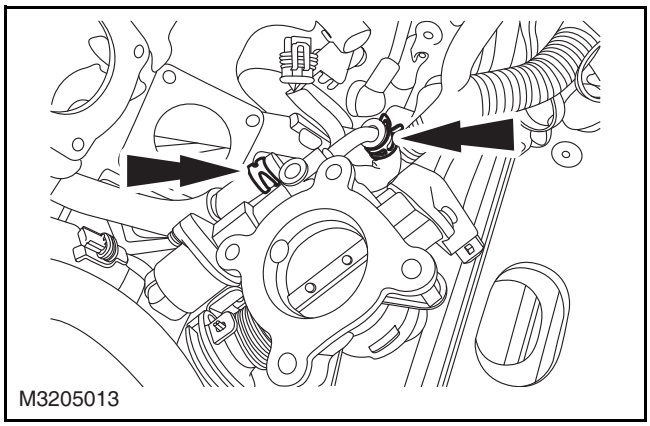
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5. Separate the accelerator cable and throttle body.


M3205012

6. Loosen the hoops, and remove the preheating water pipe of throttle body.

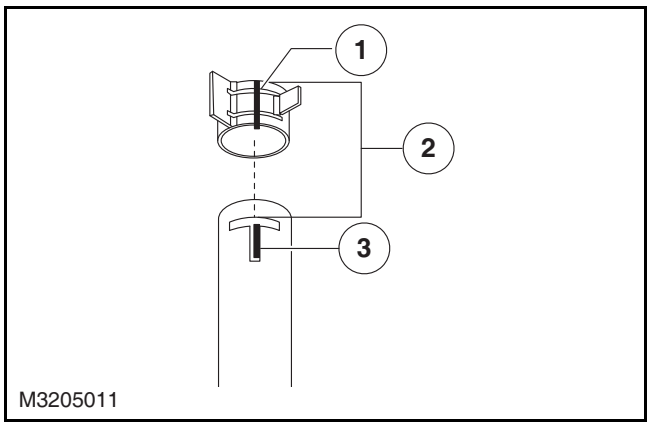

M3205013

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Ensure that new parts are used for sealing between throttle body and intake manifold.**

**CAUTION: As shown in the figure, ensure that the hoop closed line (1) overlaps with T-mark line (3) of hose, and the hoop outer line 2 is aligned with T-mark line (2) of hose when tightening the hose.**



M3205011

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# Intake Manifold

## Removal

1. Release the fuel pressure.

   **Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**

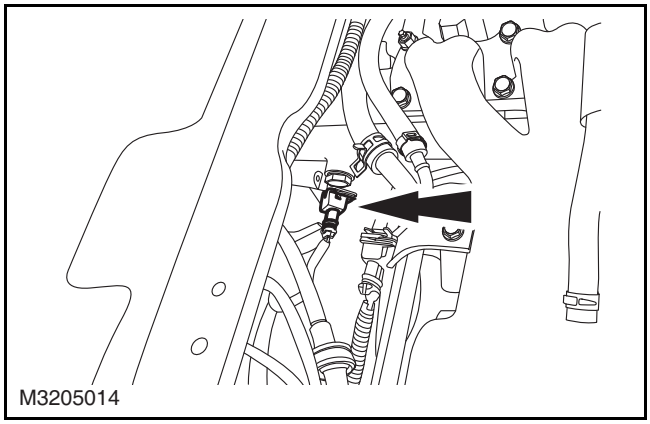
2. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

3. Remove the gearshift mechanism.

   **Refer to: Gearshift Mechanism (3.3.4 Manual Transmission External Control, Removal and Installation).**

4. Disconnect the coolant temperature sensor wiring harness connector.


M3205014

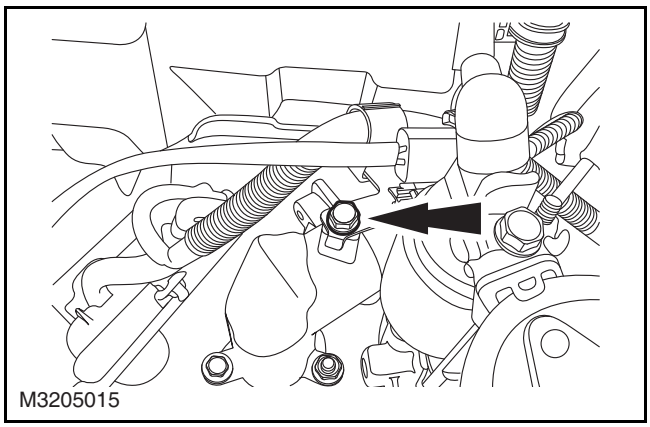
5. Loosen the radiator drain plug to drain the cooling system.

   **Refer to: Coolant Draining and Filling (3.2.4 Cooling System, General Inspection).**

6. Remove the water outlet pipe holder and No.1 water outlet pipe.

   1 Remove the retaining bolt of wiring harness bracket from the water outlet pipe holder.

   Torque: 10 ± 1 Nm

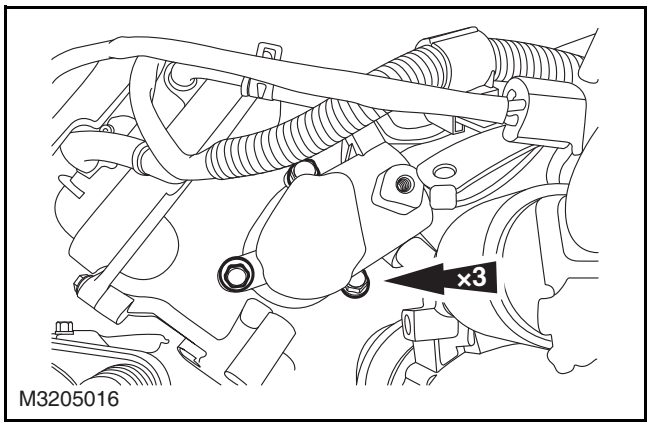

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2 Remove 3 retaining bolts from the water outlet pipe holder.

Torque: 20 ± 5 Nm



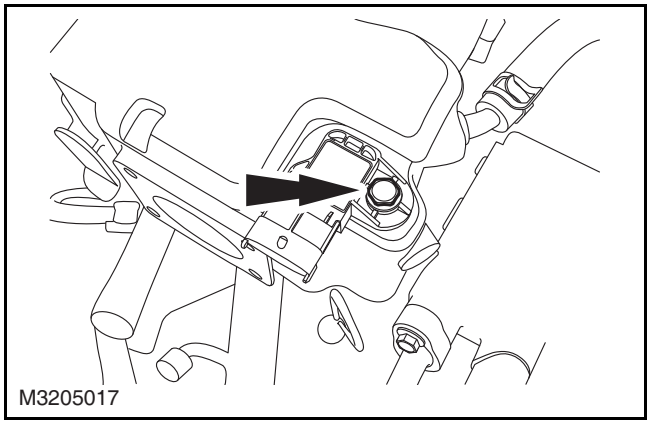

3 Pull out the water outlet holder and No.1 water outlet pipe to separate the No.1 water outlet pipe and intake manifold.

7. Remove the throttle body.

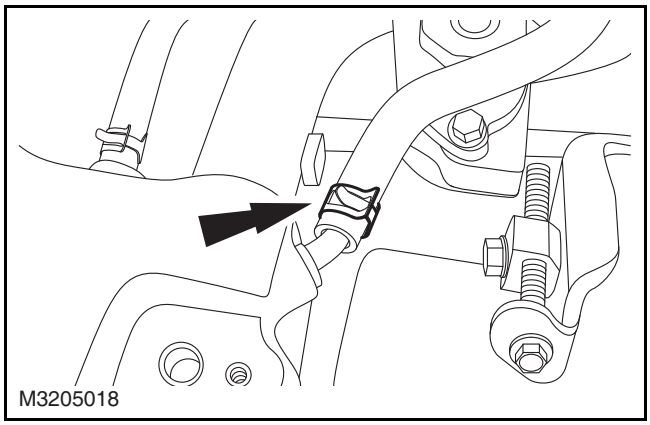
**Refer to: Throttle Body (3.2.5 Air intake System, Removal and Installation).**

8. Remove the retaining bolt from the air intake pressure/temperature sensor.

Torque: 8 ± 2 Nm



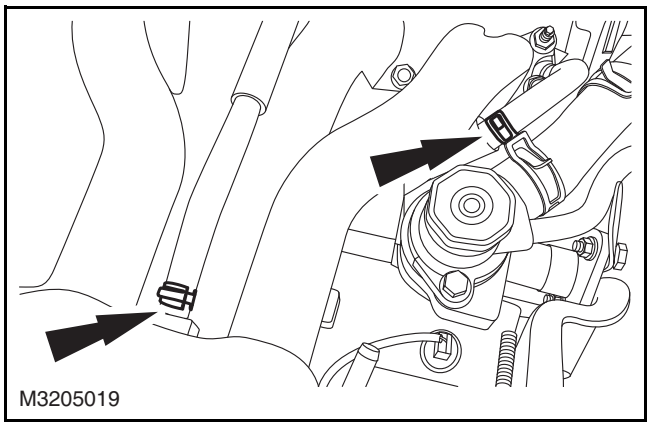

9. Loosen the hoop, and disconnect the vacuum booster hose.



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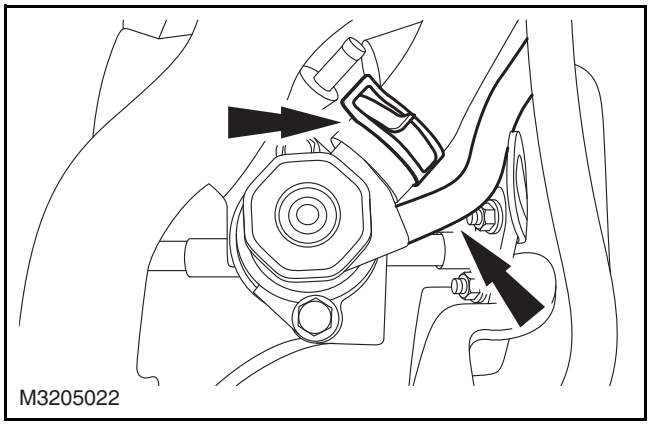
**10.** Loosen the hoop, and disconnect the crankcase vent hose and hot air hose separately.


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**11.** Remove the thermostat.

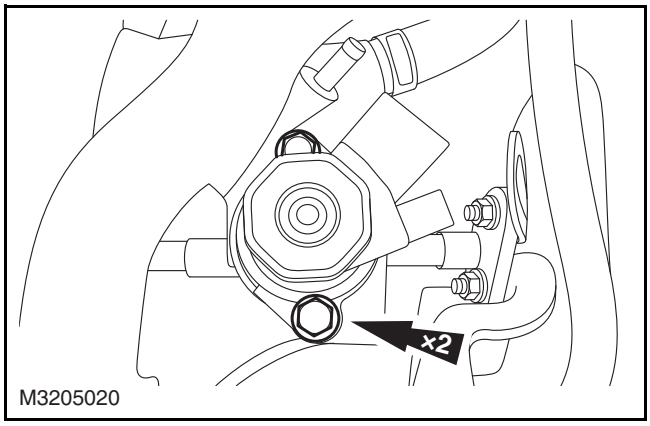
1 Disconnect the No.2 water outlet pipe from the thermostat cap.

2 Loosen the hoop, and disconnect the connecting hose between top radiator hose and thermostat cap.


M3205022

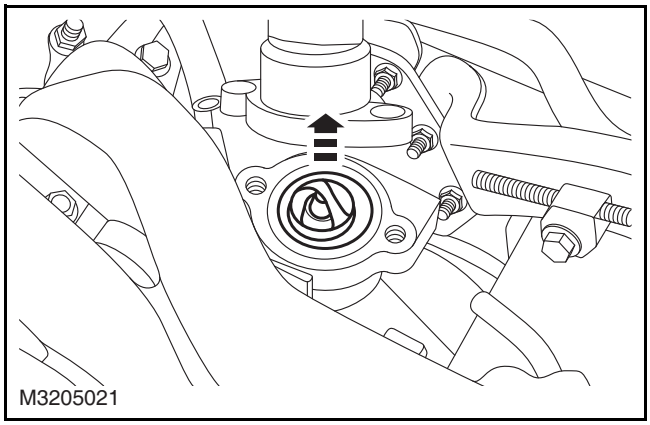
3 Remove 2 retaining bolts from the thermostat.

Torque: 23 ± 2 Nm



M3205020

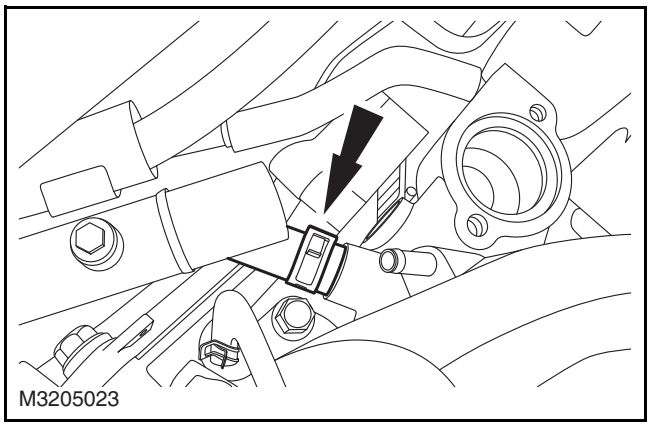
4 Remove the thermostat.


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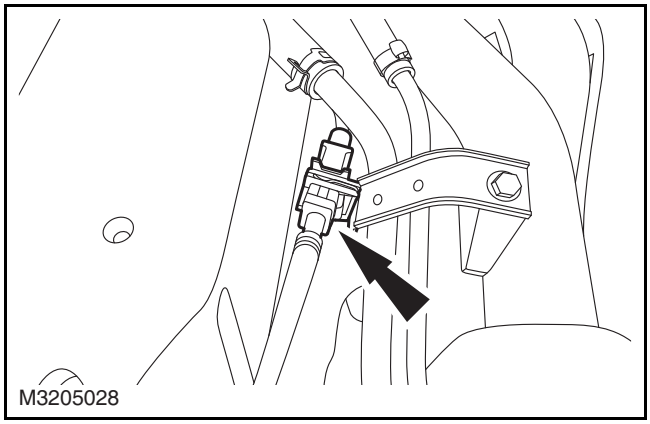
**12.** Loosen the hoop, and disconnect the connecting hose between A/C warm water outlet pipe and intake manifold.




**13.** Remove the fuel main pipe.

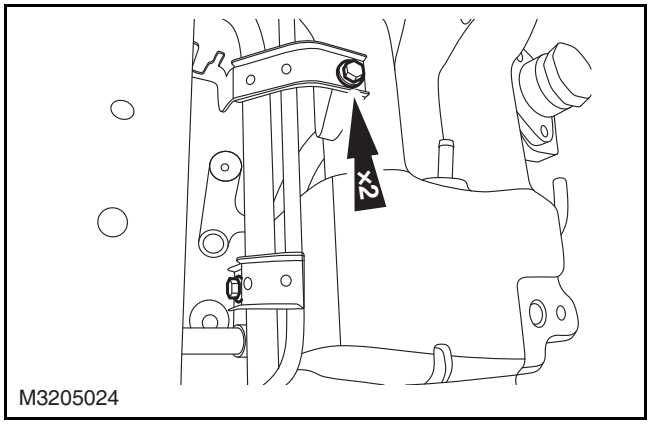
**Refer to: Fuel Main Pipe (3.2.7 Fuel System, Removal and Installation).**

**14.** Separate the knock sensor wiring harness connector from the crankcase vent pipe and fuel main pipe.




**15.** Remove 2 retaining bolts between crankcase vent pipe and fuel pipe, and move the crankcase vent pipe and fuel main pipe away.

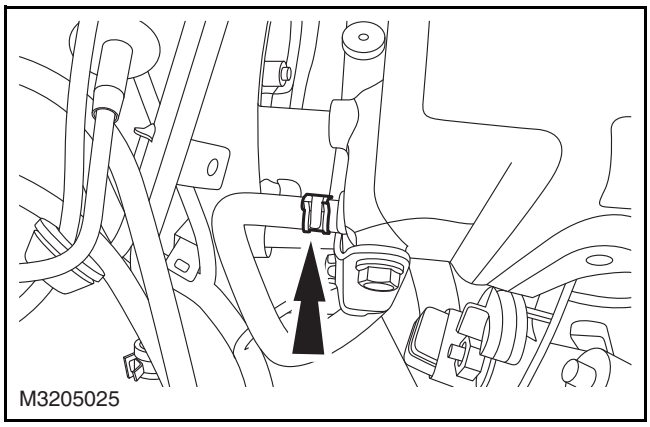
Torque: 10 ± 1 Nm



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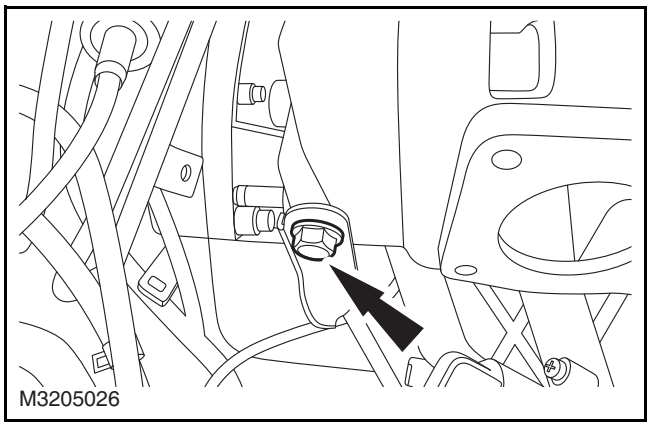


**16.** Loosen the hoop, and disconnect the connecting hose between carbon canister control valve and intake manifold.


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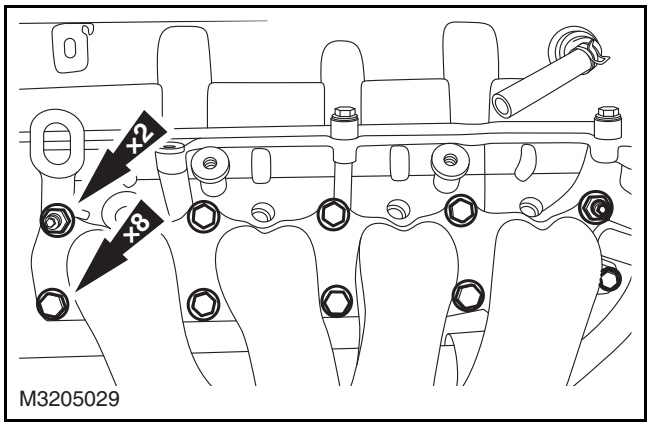
**17.** Remove the retaining bolt from the intake manifold bracket.

Torque: 23 ± 2 Nm


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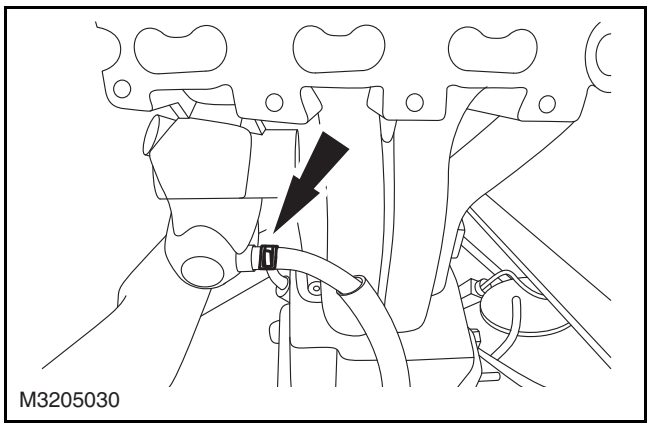
**18.** Remove the retaining bolts and nuts from the intake manifold.

Torque: 23 ± 2 Nm



M3205029

**19.** Loosen the hoop, and disconnect the preheating water pipe of throttle body from the intake manifold.


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## Inspection

1. Inspect and clean the installing end face between intake manifold and cylinder head.
2. Inspect the intake manifold end face. Using a straight scale and a feeler gauge, inspect the surface deformation at no less than 6 positions. If the deformation exceeds the limit value, correct the surface or replace a new intake manifold.

   Deformation limit: 0.07 mm

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect the intake manifold for any possible leaks after installation.**

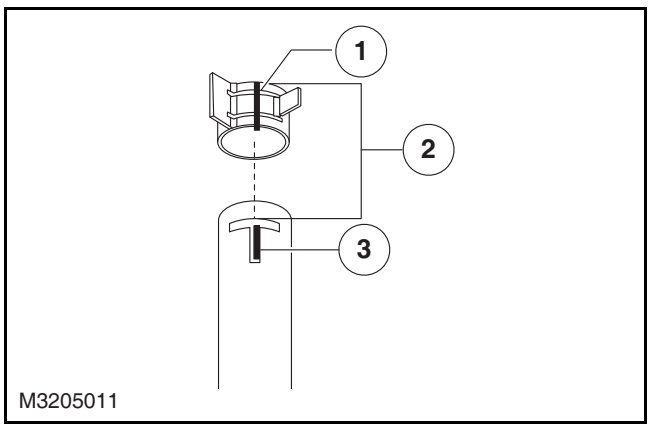
**Refer to: Diagnosis Procedure for Intake Air Leak (3.2.5 Air Intake System, Symptom Diagnosis and Testing).**

**CAUTION: Inspect the fuel for leakage after installation.**

**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**

**CAUTION: Inspect the coolant for leakage after installation.**

**CAUTION: As shown in the figure, ensure that the hoop closed line (1) overlaps with T-mark line (3) of hose, and the hoop outer line (2) is aligned with T-mark line (2) of hose when tightening the hose.**



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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| Exhaust backpressure with engine full load speed (engine speed 6000 rpm, throttle full open) | 36 kPa or less |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Exhaust manifold retaining bolt | 23 ± 2 | - | - |
| Exhaust manifold heat insulator | 10 ± 1 | - | - |
| Connecting bolt between three-way catalytic converter and exhaust manifold | 55 ± 5 | - | - |
| Connecting bolt between muffler and three-way catalytic converter | 55 ± 5 | - | - |
| Oxygen sensor tightening torque | 50 ± 10 | - | - |
| Retaining bolt between engine left mounting and engine | 45 | 33 | - |
| Retaining nut between engine left mounting and engine bracket | 45 | 33 | - |

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## Description and Operation

# System Overview

### Three-way Catalytic Converter Poisoning

If fuel contains 5 mg or more lead per liter, it will lead to the catalytic converter poisoning. Therefore, strictly forbid using leaded gas for vehicle equipped with a three-way catalytic converter.

The zinc and phosphorus in the engine oil will lead to catalytic converter poisoning if the engine oil consumption is too high. $H_2S$ exhausted from the three-way catalytic converter can be perceived easily. It smells like a rotten egg. Such problem can be solved by using other brands of fuel. To reduce $H_2S$ emission, make sure that CO emission at idle speed meets the standard and the engine exhaust system works normally.

**WARNING: The catalyst carrier will melt if the temperature exceeds 900°C. The fault should be fully analyzed and repaired to prevent such fault occurrence.**

Due to excessive backpressure, the melting of catalyst often comes along with the power reduction.

# Components Description

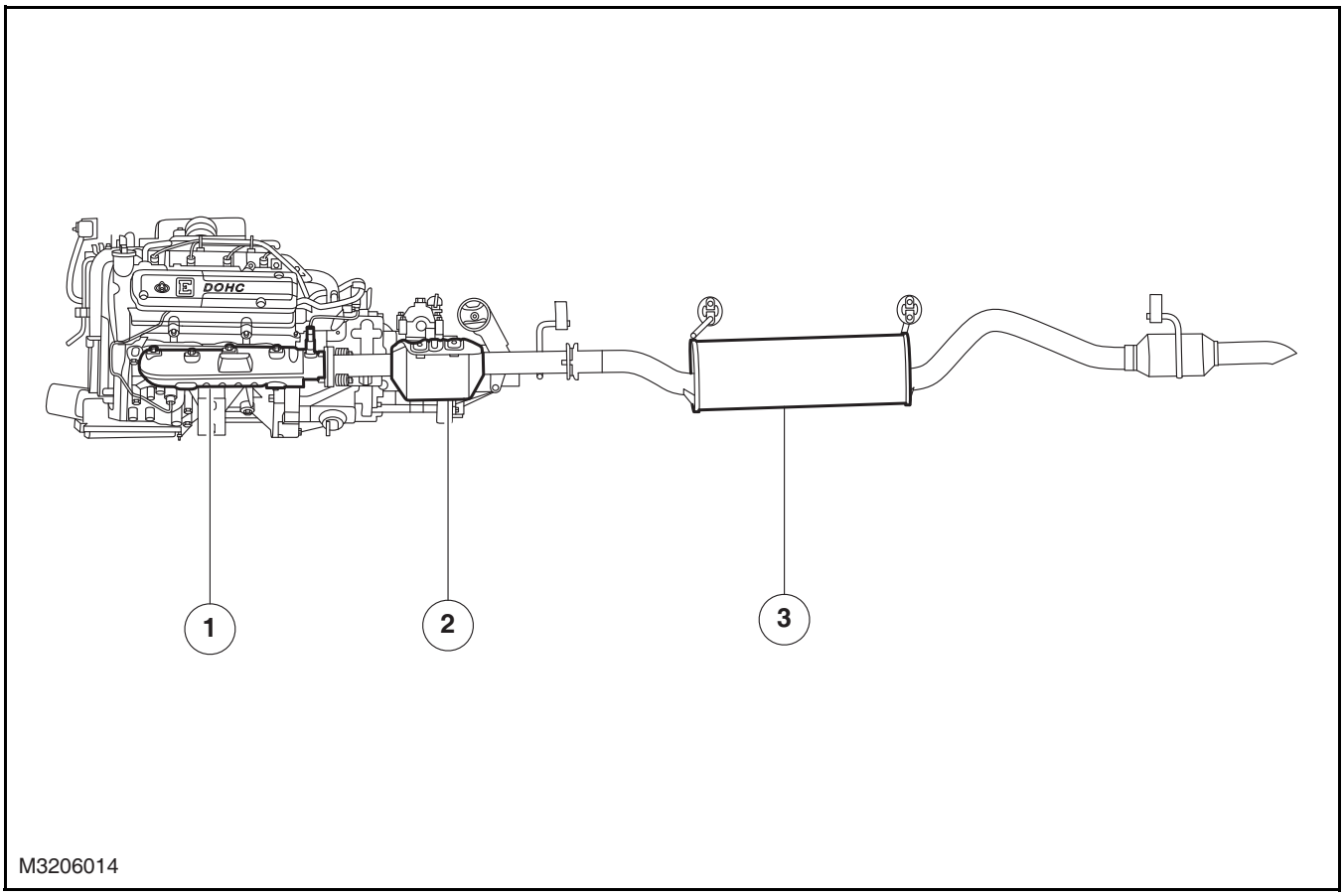
### Three-way Catalytic Converter

The three-way catalytic converter is shaped like a small muffler. Due to the high working temperature, the bodywork near the three-way catalytic converter has been protected with heat insulated panel. The three-way catalytic converter controls three emissions: HC, CO and NOx.

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# Components Location View




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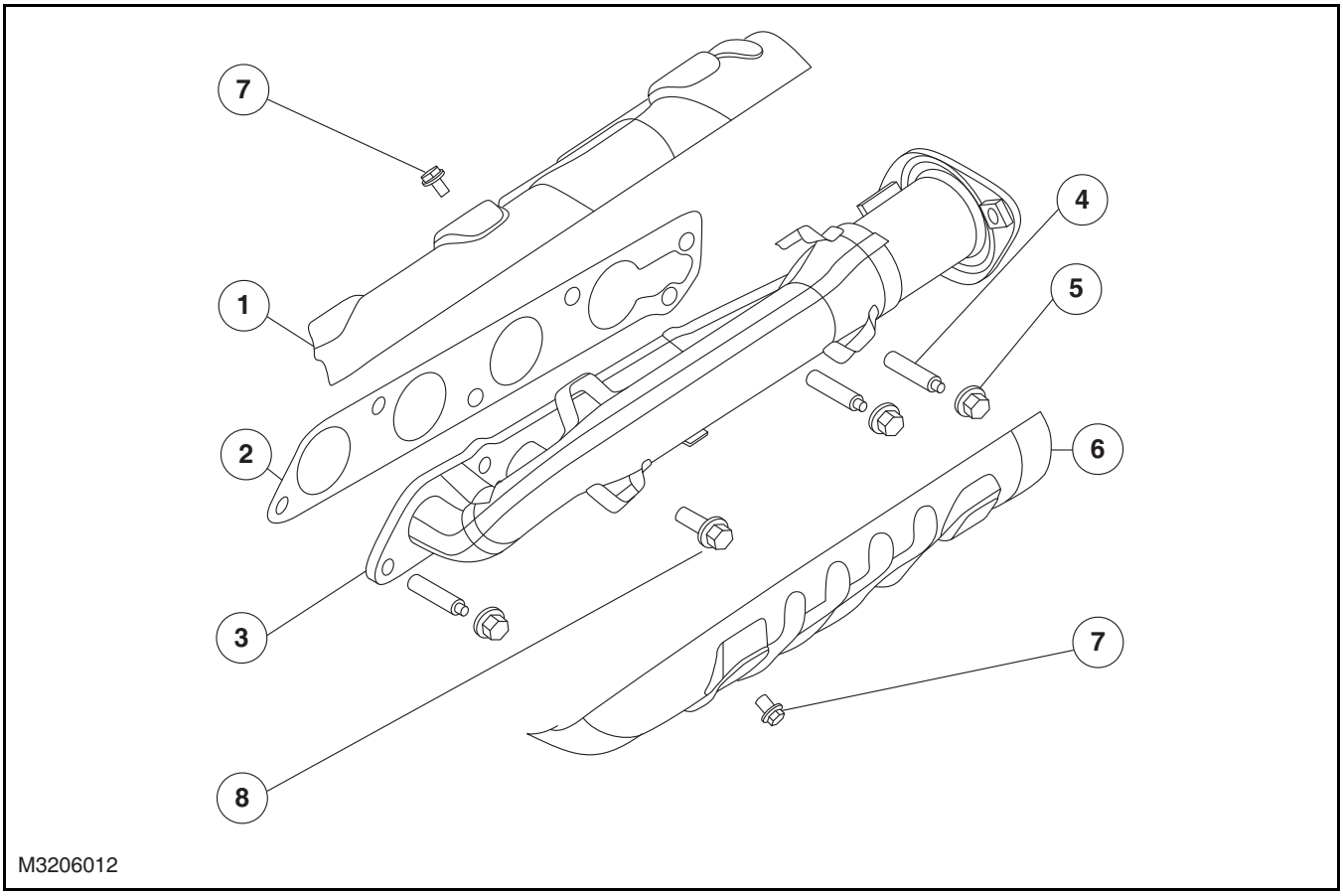
| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Exhaust manifold | 3 | Muffler |
| 2 | Three-way catalytic converter | | |

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# Components Exploded View

## Exhaust Manifold

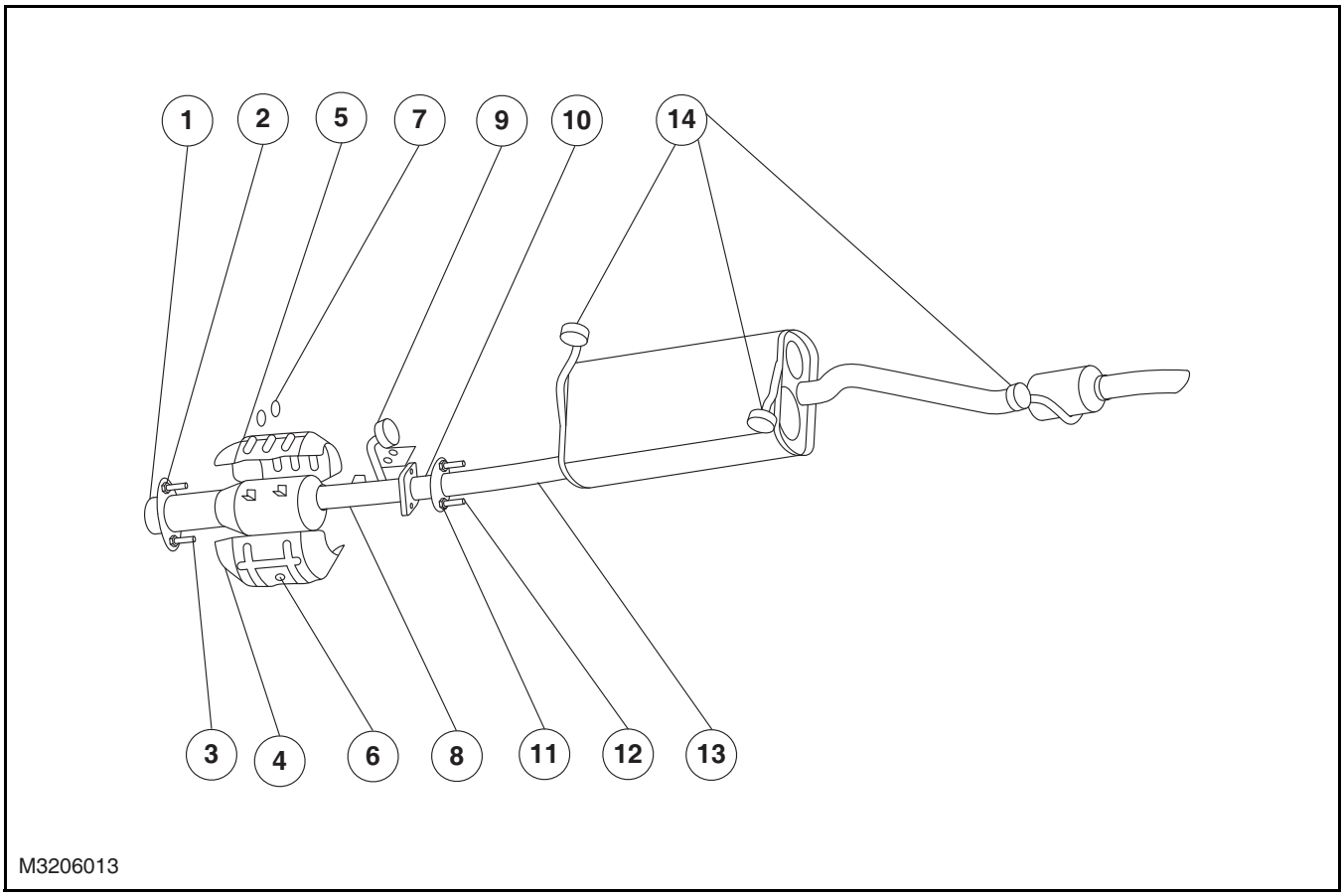



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Exhaust manifold upper heat insulator assembly | 5 | Hexagon flange nut |
| 2 | Exhaust manifold gasket | 6 | Exhaust manifold lower heat insulator assembly |
| 3 | Exhaust manifold assembly | 7 | Hexagon flange bolt |
| 4 | Exhaust manifold assembly stud bolt | 8 | Hexagon flange bolt |

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## Three-Way Catalytic Converter and Muffler




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Charcoal ring (cermet coating) | 8 | Three-way catalytic converter assembly |
| 2 | Pressure spring | 9 | Rubber shackle |
| 3 | Pressure spring bolt | 10 | Charcoal ring (cermet coating) |
| 4 | Three-way catalytic converter lower cover assembly | 11 | Pressure spring |
| 5 | Three-way catalytic converter upper cover assembly | 12 | Pressure spring bolt |
| 6 | Nut | 13 | Muffler with accessory assembly |
| 7 | Hexagon head bolt | 14 | Rubber shackle |

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## General Inspection

### General Equipment

| |
|---|
| Exhaust backpressure gauge |

# Exhaust Backpressure Test

1. Remove the front oxygen sensor.
2. Install the exhaust backpressure gauge.
3. Start the engine.
4. Measure the exhaust backpressure when the engine is idling.
5. Measure the exhaust backpressure with engine full load speed (engine speed 6000 rpm, throttle full open).

### Exhaust backpressure standard

| Engine Speed (rpm) | Exhaust Backpressure (kPa) |
|---|---|
| 6000 | 36 kPa |

6. Turn the ignition switch off and the engine stops.
7. Remove the exhaust backpressure gauge and install the oxygen sensor.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Exhaust backpressure gauge |

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical or electrical damage.
3. If an observed or reported problem is obvious and its cause has been found, solve the fault before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Damage or leakage of exhaust system pipe<br>• Damage of three-way catalytic converter<br>• Looseness of exhaust pipe bolt<br>• Aging or damage of exhaust pipe gasket | • Oxygen sensor circuit fault<br>• Oxygen sensor fault |

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# Symptom Chart

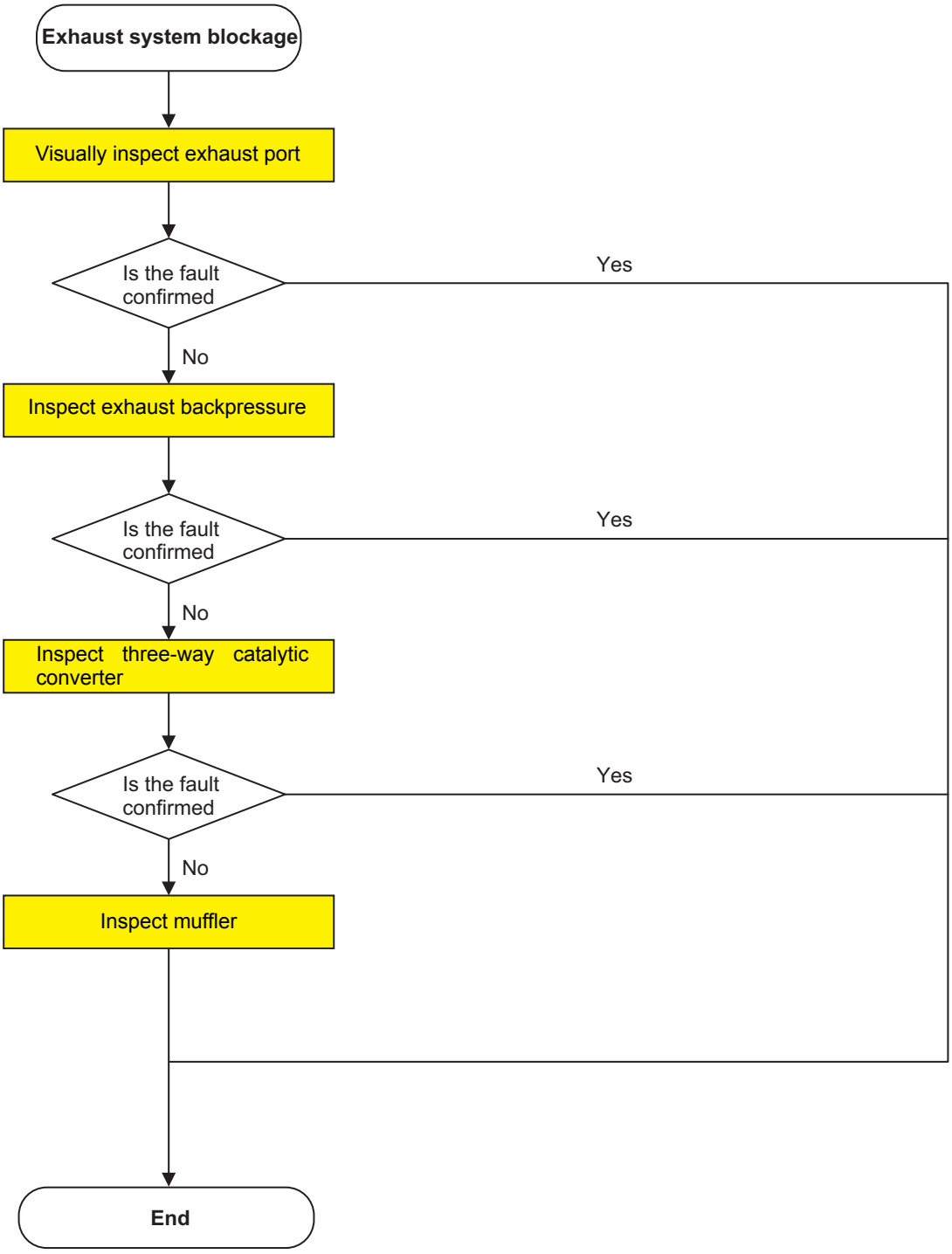
If the fault occurs, but there is no DTC stored in ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Exhaust system blockage | • Exhaust pipe<br>• Three-way catalytic converter<br>• Muffler<br>• Exhaust port is blocked as rust heavy inside exhaust pipe<br>• Exhaust system component connections | Refer to: Diagnosis Procedure for Exhaust System Blockage (3.2.6 Exhaust System, Symptom Diagnosis and Testing). |
| Exhaust system leak(s) | • Component misalignment or wrong installation of exhaust system<br>• Sealing or gasket leak(s)<br>1. Exhaust manifold and cylinder head<br>2. Exhaust manifold and three-way catalytic converter assembly<br>3. Three-way catalytic converter assembly and muffler assembly<br>• Irregular joint surface of flange joint connection<br>• Cracked or disconnected exhaust manifold<br>• Welded joint of exhaust system component leak(s) | • Position and tighten each exhaust system component to the specified torques.<br>Refer to: Torque Specifications (3.2.6 Exhaust system, Specification).<br>• Make sure that the exhaust pipe shackle is located correctly and tightly.<br>• Replace the leaking sealing or gaskets with new ones.<br>• Repair or replace the related components when necessary.<br>• Replace the exhaust manifold.<br>Refer to: Exhaust manifold (3.2.6 Exhaust System, Removal and Installation).<br>• Replace the leaking parts. |

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# Diagnosis Procedure for Exhaust System Blockage



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Visually inspect exhaust port | |
| | A. Inspect exhaust port for any foreign matters.<br>Is the exhaust port normal?<br>**Yes**<br>Clear foreign matters.<br>**No**<br>Go to step 2. |
| 2. Inspect exhaust backpressure | |
| | A. Execute the inspection of exhaust backpressure.<br>**Refer to: Exhaust Backpressure Inspection (3.2.6 Exhaust System, General Inspection).**<br>Is the exhaust backpressure normal?<br>**Yes**<br>Normal.<br>**No**<br>Go to step 3. |
| 3. Inspect three-way catalytic converter | |
| | A. Remove the three-way catalytic converter.<br>**Refer to: Three-way Catalytic Converter (3.2.6 Exhaust System, Removal and Installation).**<br>B. Inspect the three-way catalytic converter.<br>Is the three-way catalytic converter normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the three-way catalytic converter.<br>**Refer to: Three-way Catalytic Converter (3.2.6 Exhaust System, Removal and Installation).** |
| 4. Inspect muffler | |
| | A. Remove the muffler.<br>B. Inspect the muffler.<br>Is the muffler normal?<br>**Yes**<br>Inspect the exhaust system component joints and test the system for normal operation.<br>**No**<br>Replace the muffler. |

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## Removal and Installation

# Exhaust Manifold

### Removal

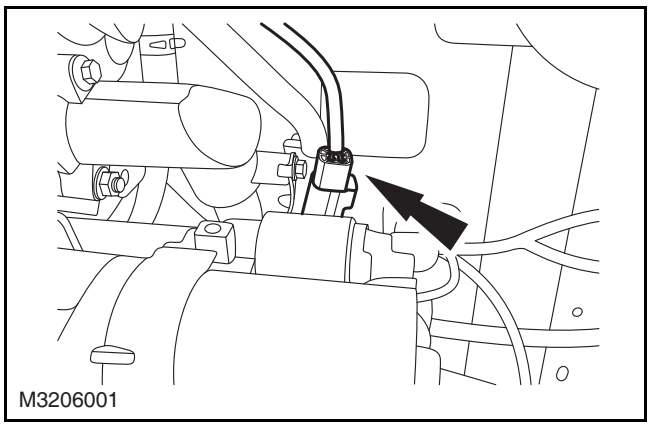
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

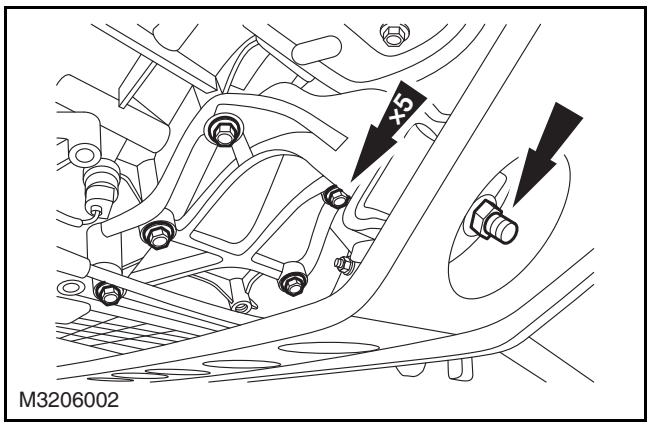
3. Disconnect the front oxygen sensor wiring harness connector.




4. Use the engine bracket to hold engine and remove the left bracket retaining bolts and mounting pad assembly nut.

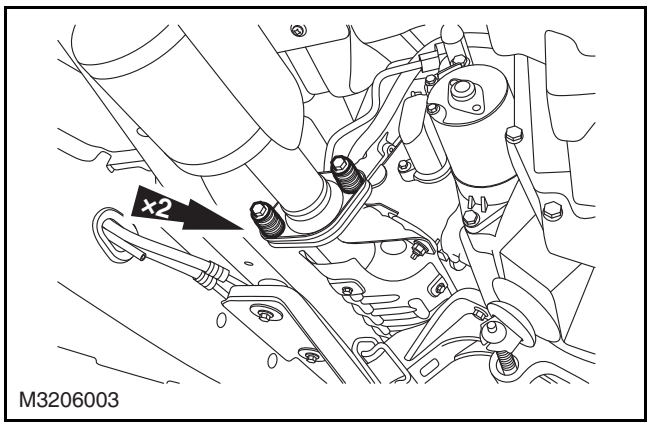
   Bolt torque: 45 Nm

   Nut torque: 70 ± 5 Nm




5. Remove 2 connecting bolts between exhaust manifold and three-way catalytic converter.

   Torque: 55 ± 5 Nm



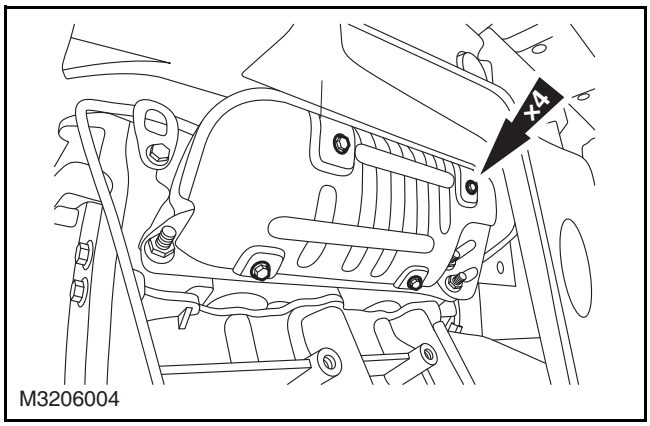
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**6.** Remove the exhaust manifold lower heat insulator.

1 Remove 4 retaining bolts from the exhaust manifold lower heat insulator.

Torque: 10 ± 1 Nm



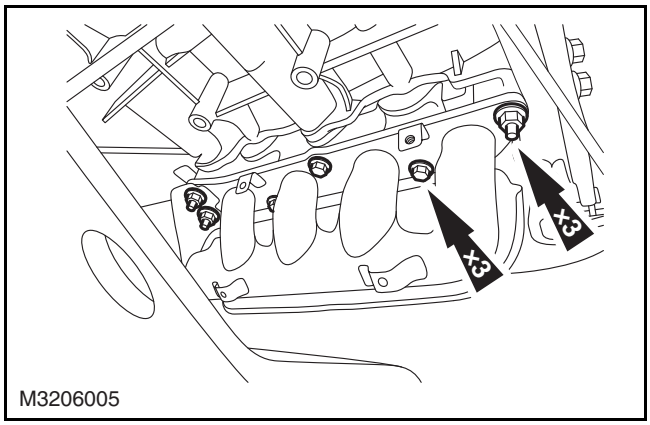

2 Remove the exhaust manifold lower heat insulator.

**7.** Remove the exhaust manifold assembly.

1 Remove 3 retaining bolts and 3 retaining nuts between exhaust manifold assembly and engine.

Bolt Torque: 23 ± 2 Nm

Nut torque: 50 ± 5 Nm

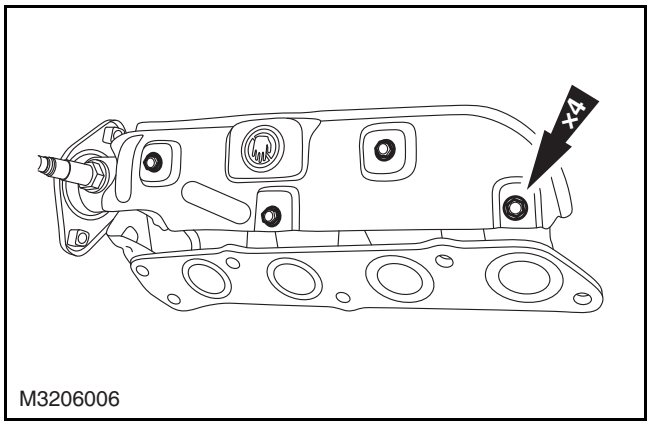



2 Remove the exhaust manifold assembly with upper heat insulator.

**8.** Remove the exhaust manifold upper heat insulator.

1 Remove 4 retaining bolts from the exhaust manifold upper heat insulator.

Torque: 10 ± 1 Nm




2 Remove the exhaust manifold upper heat insulator.

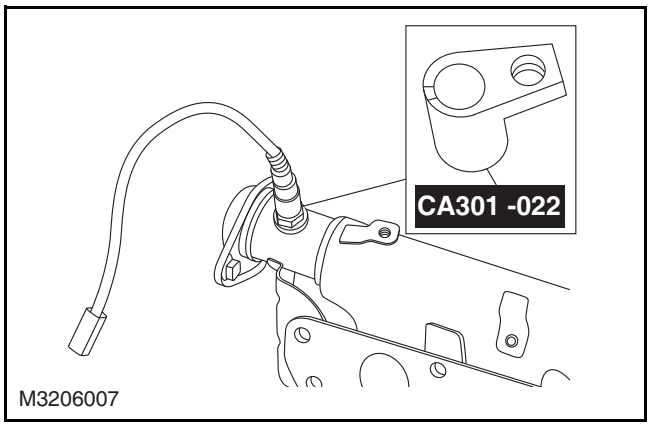
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9. Use the special tool to remove the front oxygen sensor.

   Torque: 50 ± 10 Nm

   Special tool: Oxygen sensor sleeve CA301-022




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect for exhaust gas leakage, and tighten the trouble part to prevent leakage if leakage is present. Replace the damaged components when necessary.**

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# Three-way Catalytic Converter

## Removal

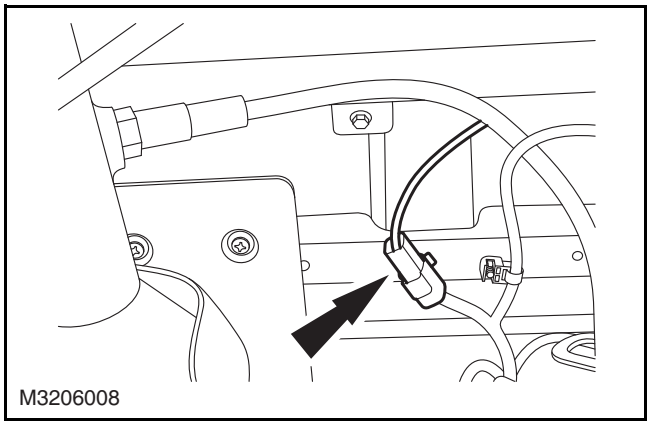
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

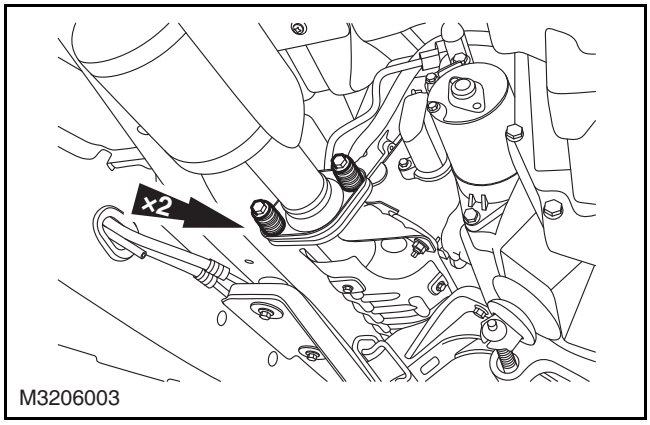
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Disconnect the rear oxygen sensor wiring harness connector.


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4. Remove 2 connecting bolts between exhaust manifold and three-way catalytic converter.

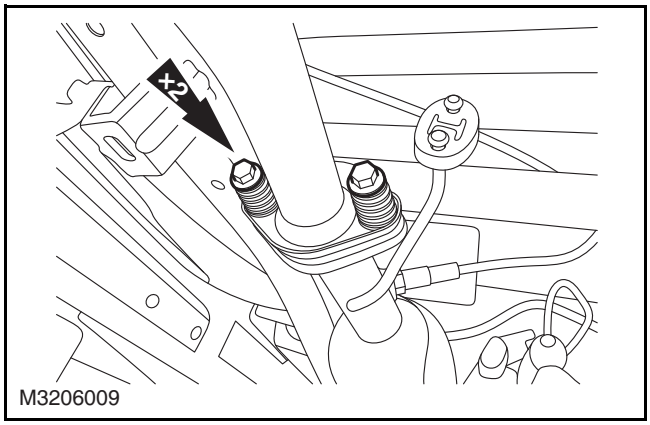
   Torque: 55 ± 5 Nm



M3206003

5. Remove 2 connecting bolts between three-way catalytic converter and muffler.

   Torque: 55 ± 5 Nm



M3206009

6. Remove the three-way catalytic converter shackle and remove the three-way catalytic converter.

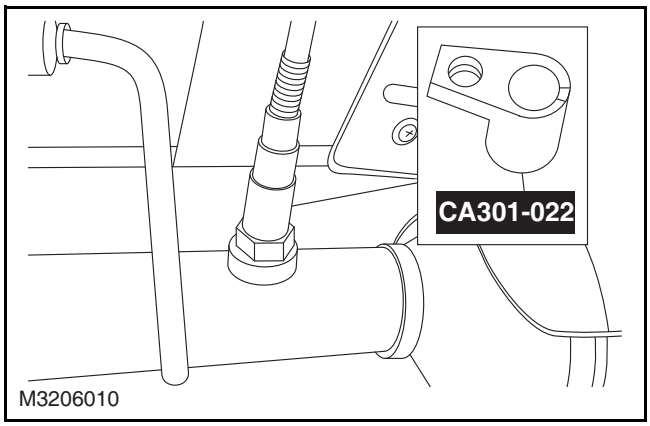
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7. Use the special tool to remove the rear oxygen sensor.

   Torque: 50 ± 10 Nm

   Special tool: Oxygen sensor sleeve CA301-022




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect for exhaust gas leakage, and tighten the trouble part to prevent leakage if leakage is present. Replace the damaged components when necessary.**

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# Muffler

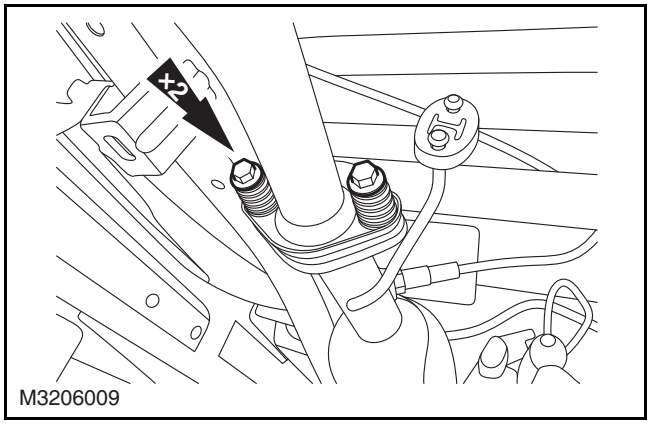
## Removal

1. Lift the vehicle.

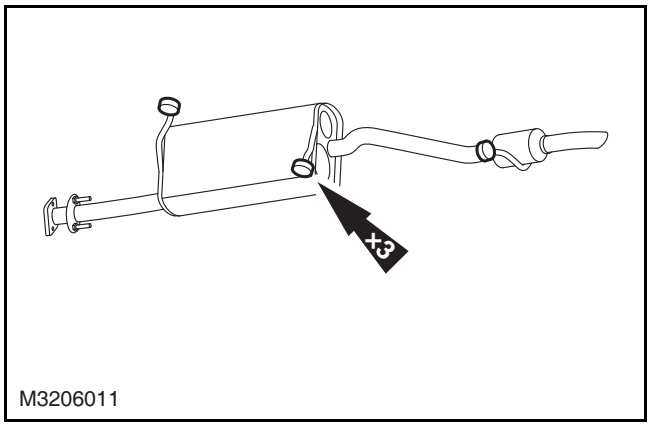
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Remove 2 connecting bolts between three-way catalytic converter and muffler.

   Torque: 55 ± 5 Nm




3. Remove 3 rubber shackles between muffler and vehicle body.




4. Remove the muffler.

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect for exhaust gas leakage, and tighten the trouble part to prevent leakage if leakage is present. Replace the damaged components when necessary.**

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## Specifications

# Component Specifications

| Item | Specifications |
|---|---|
| Fuel injector resistance | 11.5 ~ 12.6 Ω at 20°C |

# General Specifications

| Item | Specifications |
|---|---|
| Fuel pipe pressure | 0.4 MPa |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Fuel tank retaining bolt | 25 | 18 | - |
| Fuel filter bracket bolt | 10 | - | 89 |
| Fuel pump flange bolt | 10 | - | 89 |
| Fuel main pipe retaining bolt | 23 ± 2 | - | - |
| Accelerator pedal retaining bolt | 10 ± 1 | - | - |

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## Description and Operation

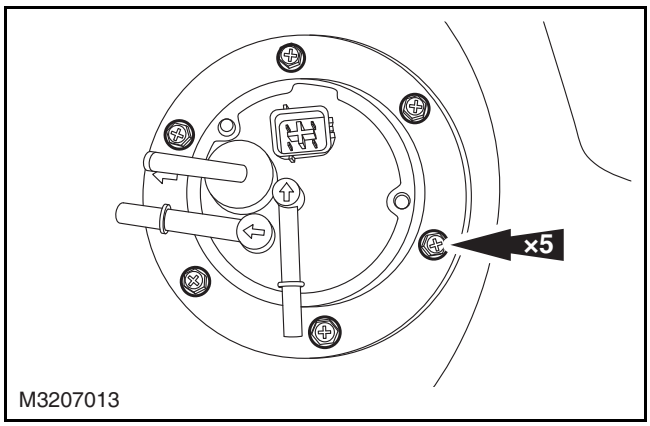
# System Overview

Fuel supply system with fuel pressure regulator adopts the pressure differential adjusting method. The fuel pump is installed in the fuel tank, and form an assembly together with the fuel pump level sensor. The engine control module controls the fuel pump through the fuel pump relay. After the fuel pump starts working, it supplies the fuel injector rail with fuel of specified pressure. The fuel system maintains a certain pressure when the fuel pump stops working, to ensure that the engine can start normally. Fuel supply system is composed of fuel pump, fuel pipe, fuel filter, fuel pressure regulator, fuel injector rail, fuel pump relay and so on.

# Components Description

## Fuel Pump

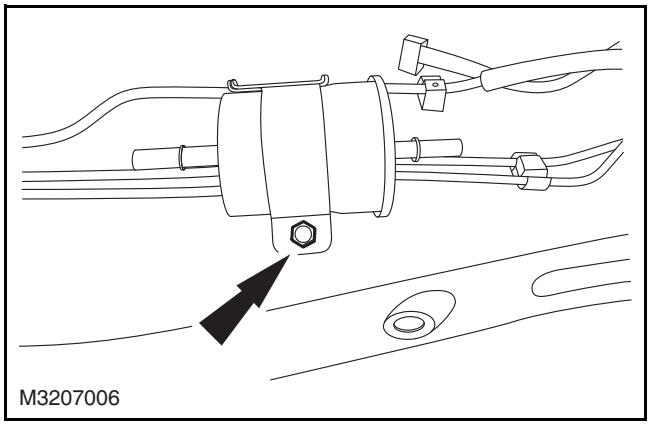
The fuel pump is installed in the fuel tank, and form an assembly together with the fuel level sensor. It is installed through plastic locking ring and sealed by rubber washer.



M3207013

## Fuel Filter

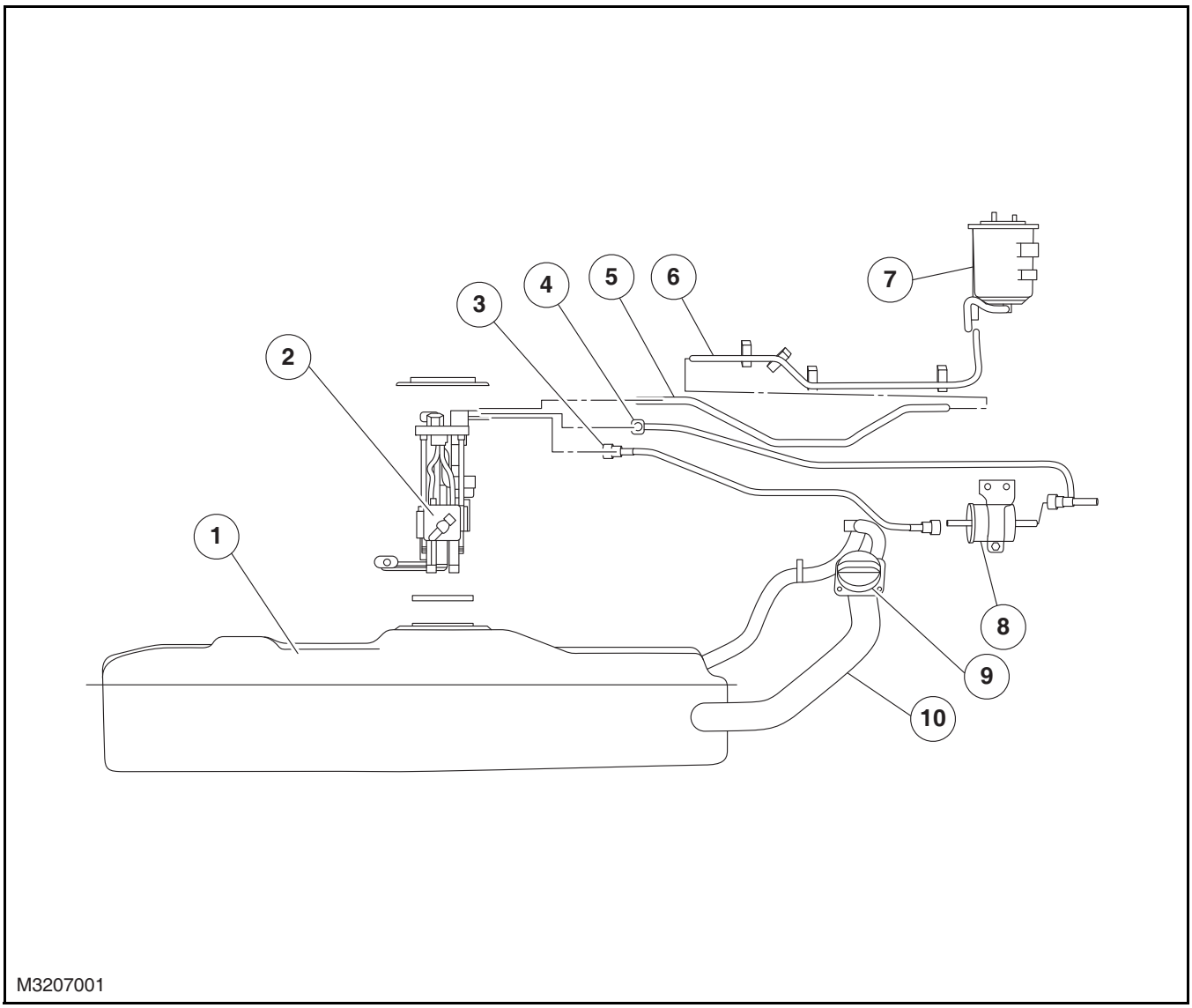
The fuel filter adopts a tank structure, and is installed on the frame of engine side with bolts.


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# Components Location View




M3207001

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Fuel tank | 7 | Carbon canister with accessory assembly |
| 2 | Fuel pump assembly | 8 | Fuel filter assembly |
| 3 | Nylon fuel pipe assembly | 9 | Fuel filler cap assembly |
| 4 | Nylon return pipe assembly | 10 | Fuel filler pipe assembly |
| 5 | Fuel vapor hose | | |

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## General Inspection

### General Equipment

| |
|---|
| Diagnostic tool |
| Fuel pressure gauge |

**WARNING: Gasoline or gasoline vapors is highly flammable. In order to avoid fire or explosion, please keep away from fire. During this procedure, operation staffs are prohibited to use mobile phones. Never drain or store gasoline in open container. Please prepare a dry chemical fire extinguisher nearby during this procedure.**

## Fuel System Pressure Testing

**WARNING: Fuel pipe overflowing and fuel system leakage are extremely dangerous. Fuel will catch fire, which leads to serious injury and damage. To avoid this situation, carry out the following inspection when the engine stops.**

1. Remove the fuel pump relay, start and run the engine until the engine stalls.
2. Install the fuel pump relay.
3. Disconnect the negative battery cable.
4. Connect the fuel pressure gauge to the fuel pipe.

**WARNING: Wrap the joint between fuel pressure gauge and fuel distribution pipe with a cleaning cloth to absorb the leaking fuel as connecting the pressure gauge, so as to reduce the risk of fire and personal injury. Place the cleaning cloth into the specified container after test is completed. Clean the fuel pipe joint before removing the fuel pipe.**

5. Connect the negative battery cable.
6. Connect a diagnostic tool to the diagnosis connector.
7. Turn the ignition switch to "ON".
8. Select the Active Test function of the engine menu on the diagnostic tool, and then select "Fuel pump relay" to run the fuel pump and keep it running for 10 s.
9. Measure the fuel pipe pressure.

   **Standard fuel pressure: 0.4 MPa**
10. Stop the fuel pump.
11. Measure the fuel holding pressure after 5 minutes.

    **Standard fuel holding pressure: 0.4 MPa**
12. Remove the fuel pressure tester from the fuel system.
13. Reconnect the fuel pipe, inspect the fuel pipe for reliable connection.

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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.

**Visual Inspection Chart**

| Mechanical | Electrical |
|---|---|
| • Fuel pipe damage<br>• Fuel leakage<br>• Fuel tank filler cap damage<br>• Fuel tank filler pipe damage<br>• Fuel line joint damage<br>• Fuel pressure regulator damage<br>• Fuel filter incorrect installation | • Fuel pump circuit<br>• Fuel pump relay<br>• Fuel pump |

3. If an observed or reported problem is obvious and the cause has been found, solve the fault before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

If the fault occurs, but there is no DTC stored in ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Fuel pump fault | • Fuel pump relay<br>• Fuel Pump<br>• Circuit<br>• Engine control module (ECM) | **Refer to: Diagnosis Procedure for Fuel Pump Fault (3.2.7 Fuel System, Symptom Diagnosis and Testing).** |
| Low pressure in fuel system | • Fuel pump<br>• Pipe leakage | • Replace the fuel pump.<br>• Repair the fuel line. |
| Low holding pressure in fuel system | • Fuel pump<br>• Fuel pipe leakage | • Replace the fuel pump.<br>• Repair the fuel line. |
| High pressure in fuel system | • Fuel pipe clogging<br>• Fuel pressure regulator | • Repair the fuel line.<br>• Replace the fuel pressure regulator. |
| Heavy fuel smell | • Filler cap<br>• Fuel filter<br>• Fuel tank vent hole<br>• Purge solenoid<br>• Carbon canister<br>• Fuel system leakage<br>• Fuel pressure | **Refer to: Diagnosis Procedure for Heavy Fuel Smell (3.2.7 Fuel System, Symptom Diagnosis and Testing).** |

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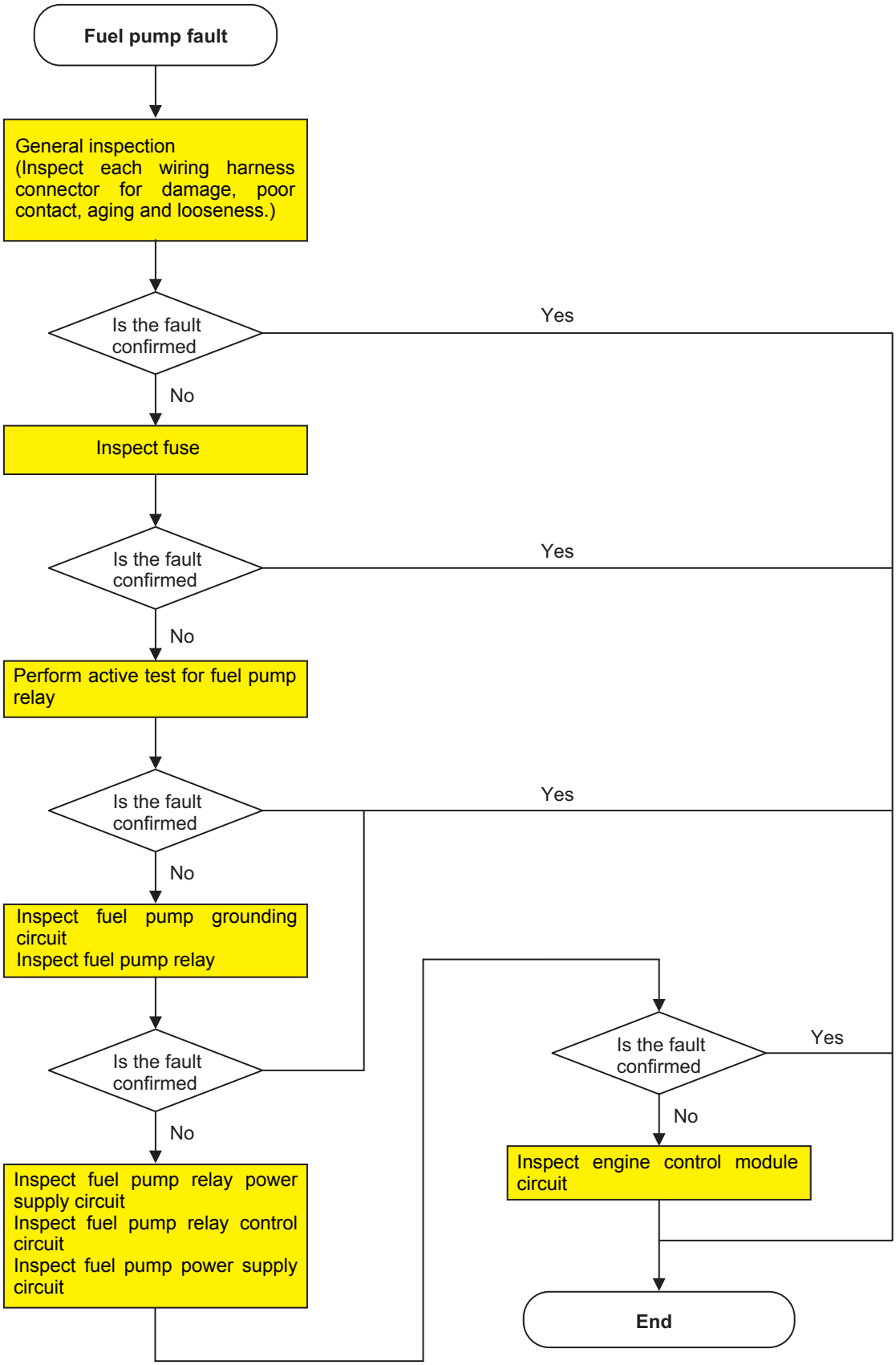


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Surging during driving | • MAP intake pressure sensor<br>• Incorrect A/C system operation<br>• Air intake system component leakage<br>• Purge solenoid fault<br>• Unstable signal from CKP sensor<br>• Vacuum leakage<br>• Poor fuel quality<br>• Intermittent fault of main relay and fuel pump relay<br>• Throttle body fault<br>• Engine overheating<br>• Spark plug fault<br>• Ignition timing<br>• Exhaust system restrictions<br>• Inadequate fuel pressure<br>• Fuel pump mechanical fault<br>• Fuel injector<br>• Unstable signal from TP sensor | **Refer to: Diagnosis Procedure for Emergency during Driving (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |

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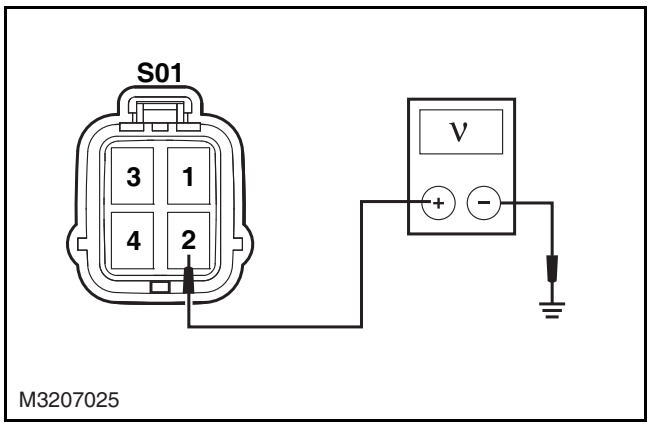


# Diagnosis Procedure for Fuel Pump Fault



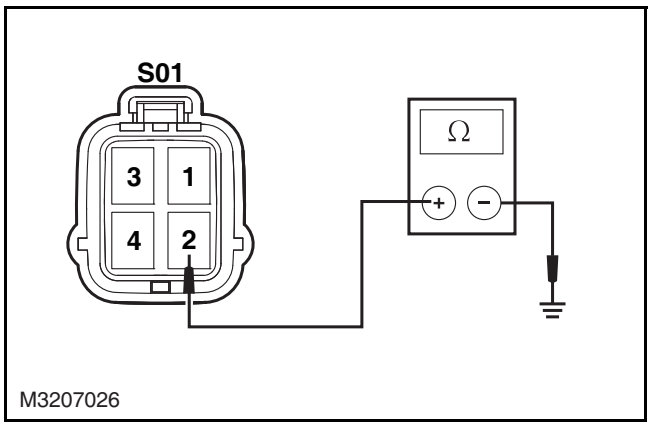
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect each relative wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the faulty area. |
| 2. Inspect fuse | |
| | A. Inspect the fuse IF19 in the instrument panel fuse box P40.<br>**Fuse rated capacity: 15 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, replace the fuse. |
| 3. Perform active test for fuel pump relay | |
|  | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON".<br>C. Select the engine system on the diagnostic tool to perform "Executor test" - "Fuel pump".<br>D. Measure the voltage between terminal 2 of fuel pump wiring harness connector S01 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 5. |

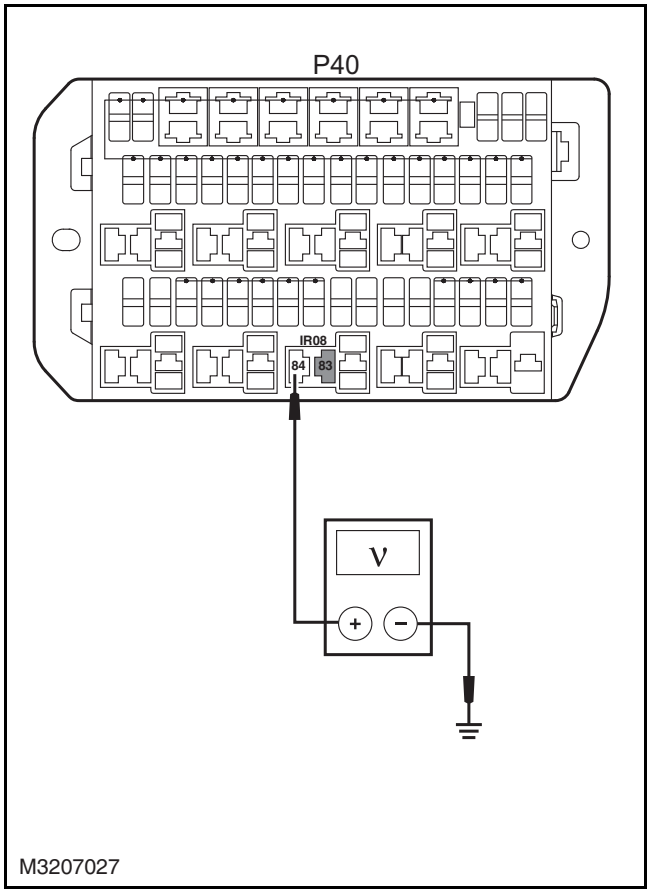
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuel pump grounding circuit | |
|  M3207026 | A. Measure the resistance between terminal 2 of fuel pump wiring harness connector S01 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the fuel pump.<br>**Refer to: Fuel Pump (3.2.7 Fuel System, Removal and Installation).**<br>**No**<br>Repair the wiring harness between terminal 2 of fuel pump wiring harness connector S01 and grounding. |
| 5. Inspect fuel pump relay | |
| | A. Replace the fuel pump relay with a normal one.<br>Is the fuel pump normal?<br>**Yes**<br>Replace the relay.<br>**No**<br>Go to step 6. |

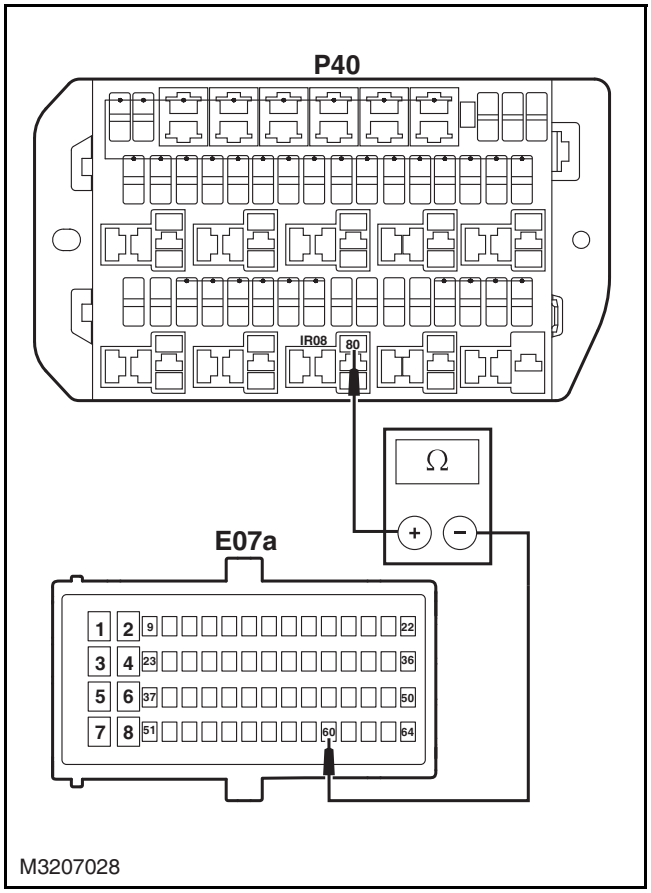
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect fuel pump relay power supply circuit | |
|  M3207027 | A. Turn the ignition switch to "ON".<br>B. Measure the voltage between terminals 83, 84 of fuel pump relay IR08 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the faulty circuit between terminal 82 of feul pump relay IR08 and terminal 69 of main relay IR05.<br>Inspect and repair the faulty circuit between terminal 83 of fuel pump relay IR08 and battery. |

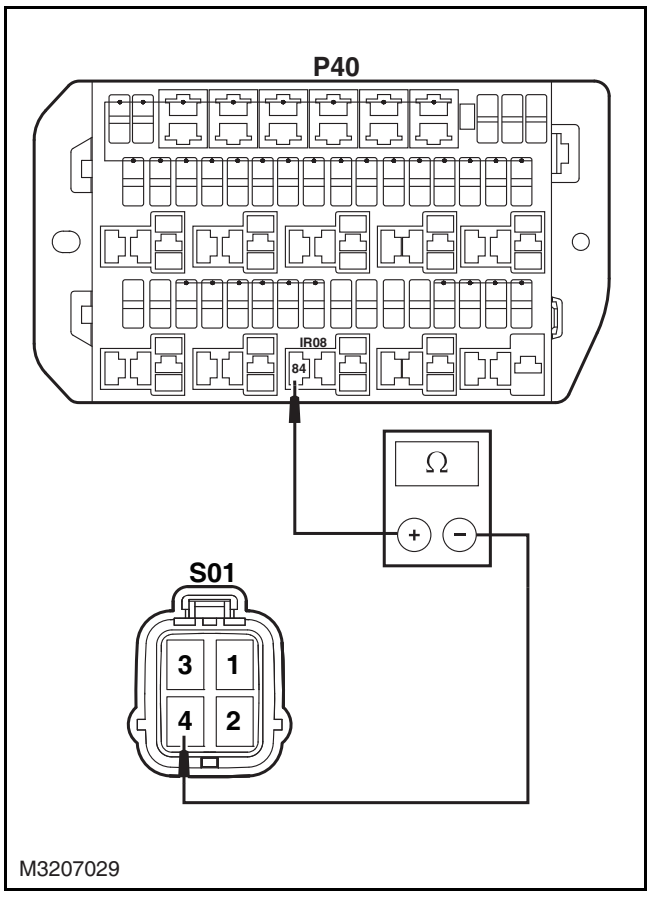
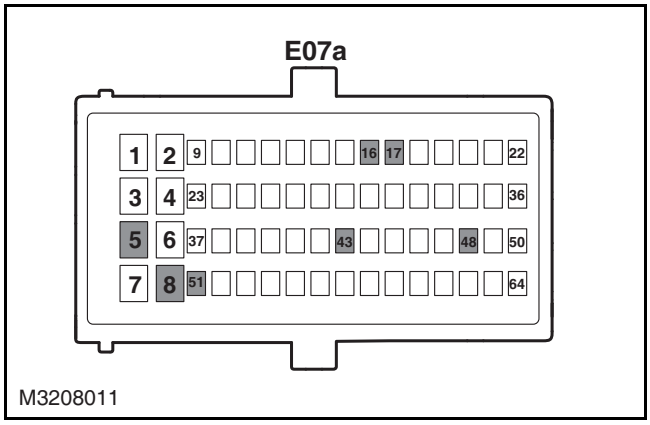
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect fuel pump relay control circuit | |
|  <br>M3207028 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the engine control module wiring harness connector E07a.<br>C. Remove the fuel pump relay.<br>D. Measure the circuit resistance between terminal 60 of ECM wiring harness connector E07a and terminal 80 of fuel pump relay IR08.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the faulty circuit. |

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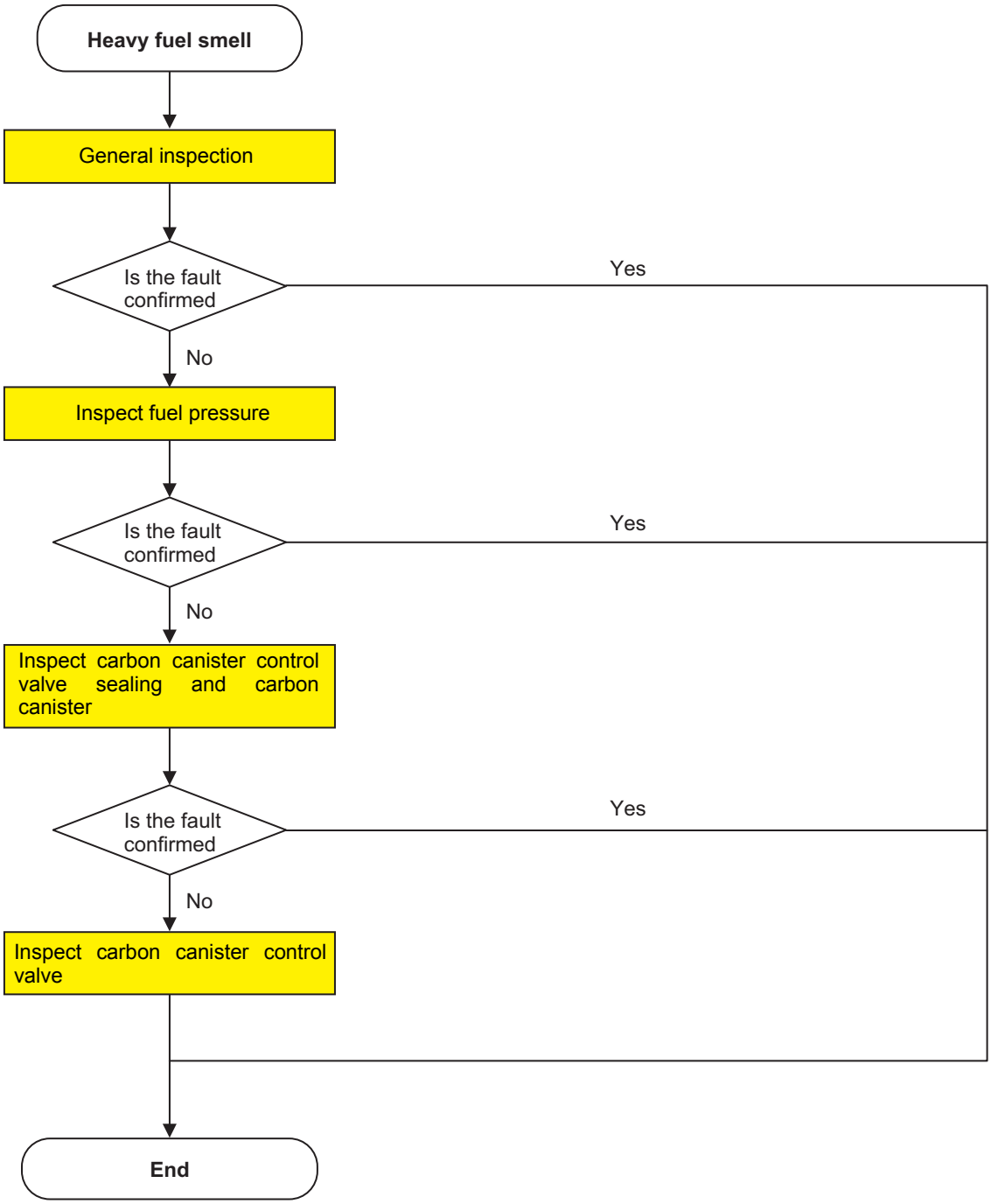
| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect fuel pump power supply circuit | |
|  <br>M3207029 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the fuel pump wiring harness connector S01.<br>C. Remove the fuel pump relay.<br>D. Measure the circuit resistance between terminal 4 of fuel pump wiring harness connector S01 and terminal 84 of fuel pump relay IR08.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the faulty circuit. |
| 9. Inspect engine control module circuit | |
|  <br>M3208011 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the ECM wiring harness connector E07a.<br>C. Turn the ignition switch to "ON", inspect whether power supply of terminals 8, 16, 17 and 51 is normal.<br>D. Turn the ignition switch to "LOCK", inspect whether grounding of terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Heavy Fuel Smell

**WARNING: The following inspection flow chart includes the diagnosis and repair procedures for fuel system. Read the following precautions before repairing the fuel system: fuel vapor is very dangerous. It is highly inflammable to lead to serious injury and damage. Please always keep fuel far away from spark and flames.**



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Visually inspect the fuel injector, O-ring and fuel pipe for oil leaks.<br>B. Inspect the fuel filter sealing area and filter pipe connecting area for leakage.<br>C. Inspect if the O-ring is fitted with the filler pipe assembly correctly after the filler cap is properly installed.<br>Is the inspection normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the faulty part. |
| 2. Inspect fuel pressure | |
| | A. Perform fuel system pressure inspection.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the fuel pressure too high?<br>**Yes**<br>Repair the clogged fuel pipe, repair or replace the fuel pressure regulator.<br>**No**<br>Go to step 3. |
| 3. Inspect carbon canister control valve sealing and carbon canister | |
| | A. Inspect if the pipe connected with the carbon canister control valve leaks.<br>B. Inspect if the carbon canister leaks.<br>Is inspection normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the leaking part, repair or replace the carbon canister. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect carbon canister control valve | |
| | A. Inspect the carbon canister control valve.<br>**Refer to: DTC P0444, P0458, P0459 (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>Is the carbon canister control valve normal?<br>**Yes**<br>Repair the fuel tank breather hole.<br>**No**<br>Repair or replace the carbon canister control valve and the circuit. |

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## Removal and Installation

# Fuel Filter

### Removal

**WARNING: During operation of fuel components, all types of open fire are prohibited. High-flammable gas mixture generated during the operation may be ignited. Improper operation may cause personal injury accident.**

1. Release the fuel pressure.

   **Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**

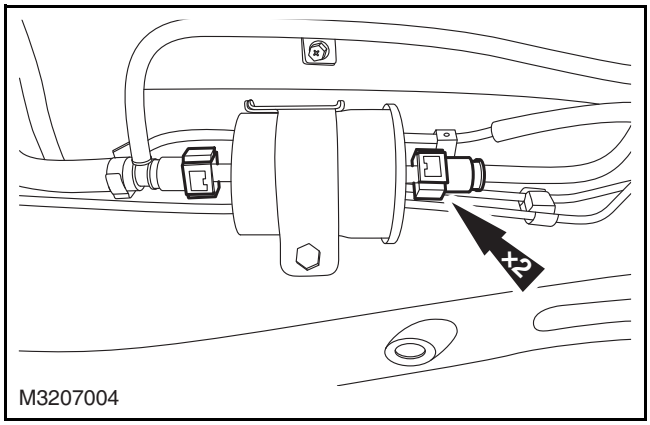
2. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

3. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

4. Disconnect the fuel pipe wiring harness connectors on both sides of fuel filter in sequence.

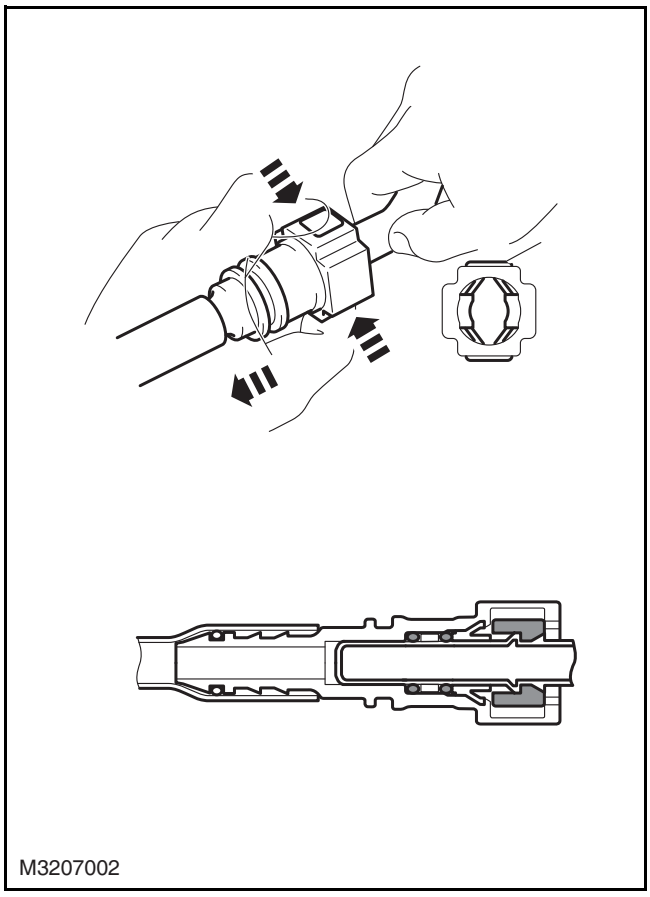


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1 Before disconnecting, inspect and confirm that there is no dirt or other foreign matter around the fuel pipe and wiring harness connectors. Clean if necessary.

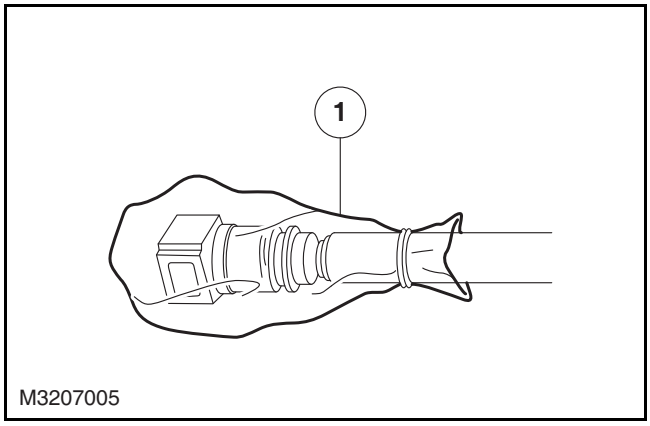
2 Remove the fuel connecting hose.



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3 Inspect and confirm that there is no dirt or other foreign matter on the sealing surface of disconnected fuel pipe. Clean if necessary.

4 Do not damage the disconnected fuel pipe or wiring harness connectors, wrap them with plastic bag (1) to prevent the entry of foreign matter.



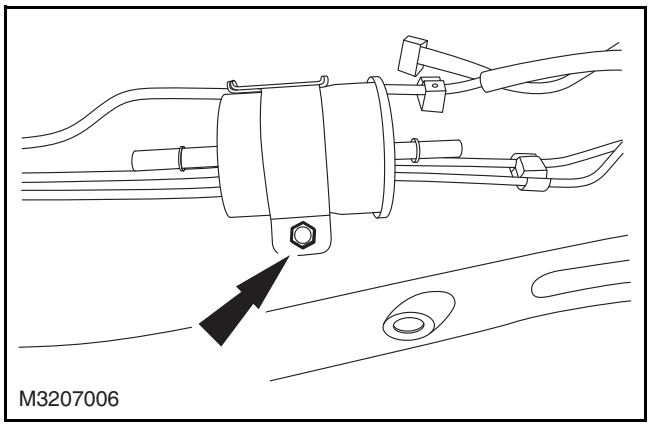

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5. Remove the fuel filter retaining bolt and then remove the fuel filter.

   Torque: 10 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Do not reverse the installation direction of fuel filter.**

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# Fuel Tank

### General Equipment

| |
|---|
| Flat jack |

## Removal

**WARNING: This working process includes fuel disposal. At any time, be aware of fuel overflowing and follow the disposal precautions, or it may cause personal injury.**

**WARNING: During operation of fuel components, all types of open fire are prohibited. High-flammable gas mixture generated during the operation may be ignited. Improper operation may cause personal injury accident.**

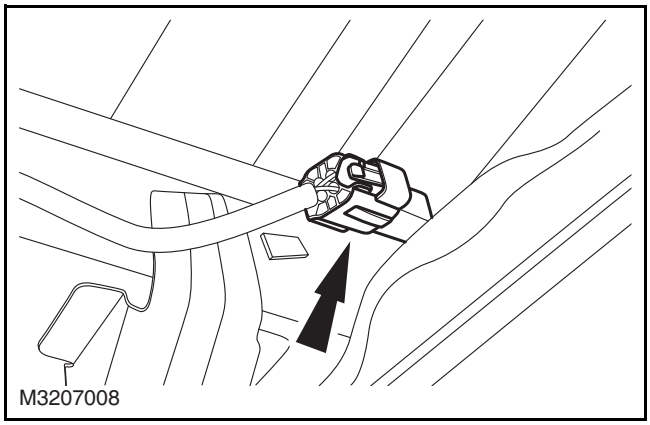
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Drain the fuel tank.
3. Lift the vehicle.

   **Refer to: Lifting Vehicle (1.1.3 Traction and Lifting).**

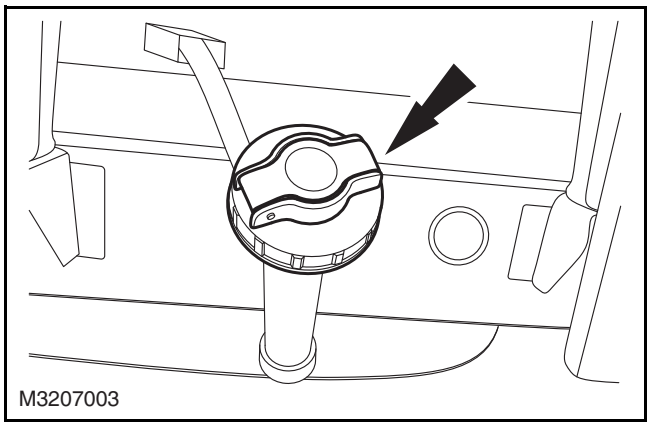
4. Disconnect the fuel pump wiring harness connector.



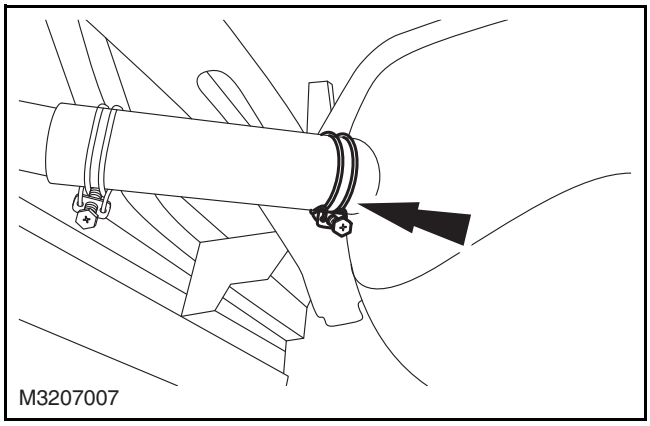
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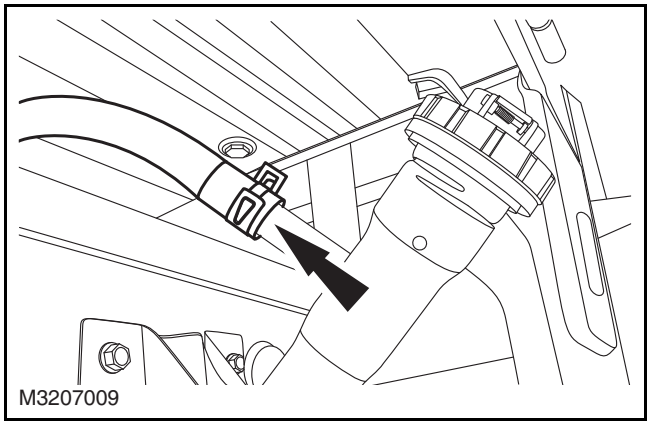
**5.** Open the fuel tank cap and release the air in fuel tank.


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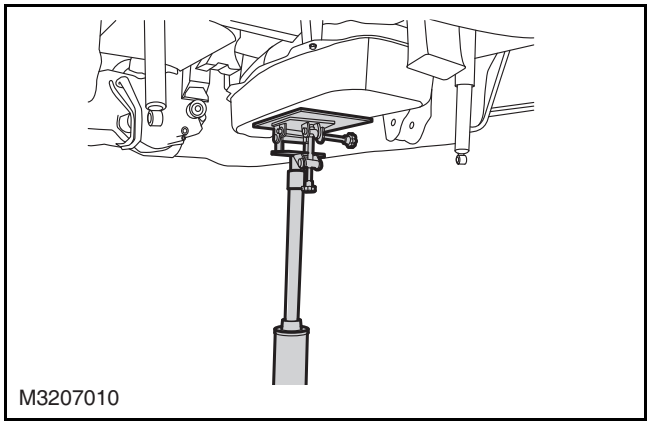
**6.** Loosen the clamp and remove the fuel tank filler hose.


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**7.** Loosen the hoop and disconnect the fuel tank vent hose.


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**8.** Use a flat jack to support the fuel tank.


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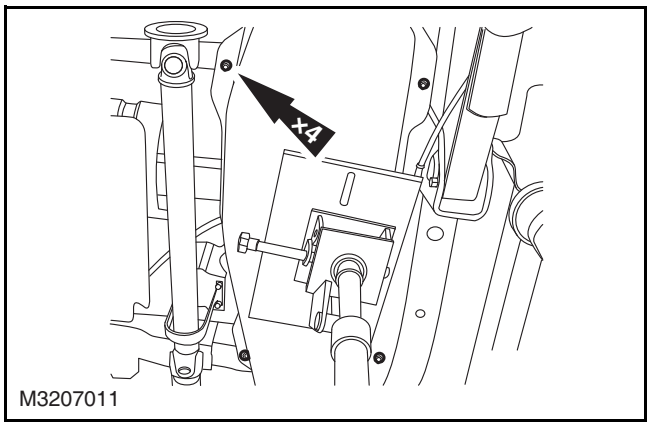
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**9.** Remove 4 retaining bolts from the fuel tank.

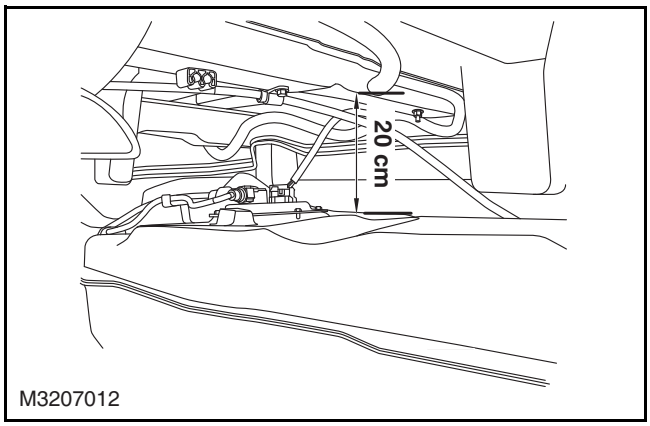
Torque: 25 Nm

**WARNING: When removing the fuel tank, do not apply excessive strain force on the fuel line and wiring harness.**



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**10.** Slowly lower the fuel tank about 20 cm to expose the joints of fuel pump, fuel outlet and return pipe on the top of fuel tank.



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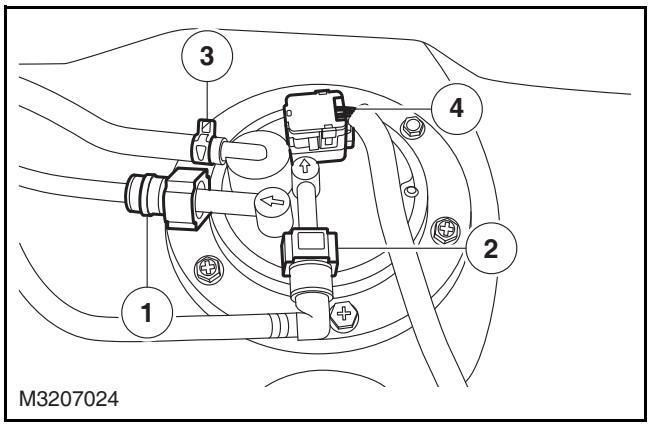


**11.** Disconnect the joint (1) connecting fuel outlet pipe and fuel pump.

**12.** Disconnect the joint (2) connecting fuel return pipe and fuel pump.

**13.** Disconnect the joint (3) connecting carbon canister and fuel pump end cap.

**14.** Disconnect the fuel pump wiring harness connector (4).




**WARNING: There maybe a little fuel flowing out after disconnecting the fuel pipe. In order to reduce the possibility of personal injury, wrap the nylon pipe with cloth. After completing the disconnection, be sure to put the cloth into a safe container.**

**CAUTION: Before disconnecting the joint, clear all dirt and foreign matters on the retainer.**

**CAUTION: Do not apply excessive force to bend or twist the fuel pipe.**

**CAUTION: Use plastic bags to wrap the joint ends to avoid damage and contamination.**

**15.** Slowly lower the bracket to remove the fuel tank.

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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Reinstall the fuel pipe and fuel tank vent hose to original position. Otherwise, the friction caused by vehicle vibration will damage fuel pipes and lead to fuel leak.**

**CAUTION: Inspect if fuel pipes are connected securely after installing the fuel tank.**

**CAUTION: During installation, push fuel pipe wiring harness connector until a "click" sound is heard, and then inspect and confirm that the fuel pipe joint clips are located in fuel pipe joint collar. After installing the fuel pipe joint clips, inspect and confirm that the fuel pipe joint cannot be pulled out. Be care not to damage the joint. Replace with new ones if the clips are damaged.**

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# Fuel Pump

## Removal

**WARNING: Please release the pressure of fuel supply system before repairing fuel supply system components. When repairing the vehicle or components related to fuel supply system in a location with well ventilation, smoking and carrying lighted cigarette or open fire are prohibited. High-flammable gas mixture may appear anytime, any violation of rules may lead to serious personal injury or death. When operating related components or working around the fuel supply system, please do not carry personal electrical devices (such as mobile phones, BP or audio devices). High-flammable gas mixture may appear anytime, any violation of rules may lead to serious personal injury or death.**

**WARNING: Operation precautions for fuel supply system should be observed when operating the fuel supply system. Make preparation for accidental fuel leakage. The leaking fuel may be ignited by hot vehicle components or other fire sources. Violating above descriptions may cause serious personal injury or death.**

**CAUTION: Because the fuel pump assembly is cooled through fuel, the low fuel level in fuel tank will directly shorten the service life of fuel pump.**

**CAUTION: When replacing the fuel pump assembly, please keep fuel pump assembly and working area clean, otherwise, fuel pump filter element will be blocked.**

**CAUTION: The new components of fuel pump must have the same part number with that of original fuel pump.**

**CAUTION: Do not operate the fuel pump when it is free of fuel or in water, otherwise, fuel pump will be damaged.**

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**CAUTION: Keep fuel tank and line clean; if the fuel pump has been replaced, replace the fuel filter at the same time.**

1. Release the fuel system pressure.

   **Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**

2. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

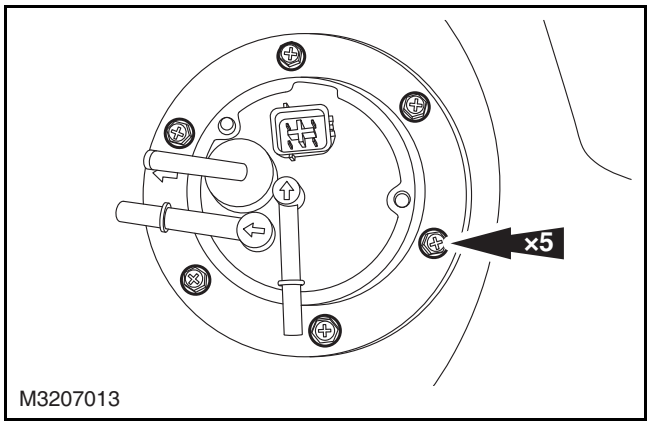
3. Remove the fuel tank.

   **Refer to: Fuel Tank (3.2.7 Fuel System, Removal and Installation).**

4. Remove the fuel pump.

   1 Remove 6 retaining bolts from the fuel pump pressure cover.

   Torque: 10 Nm




   2 Pull upward the fuel pump to pull out the fuel tank.

## Inspection

1. Inspect the operating condition of fuel pump.

   1 Remove the fuel pump.

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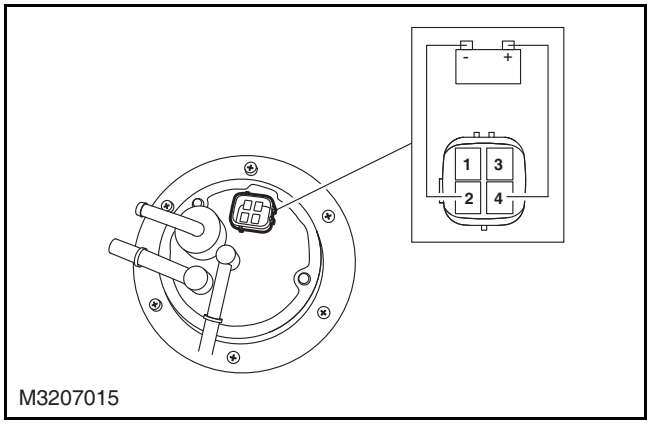


2 Apply battery voltage to terminal 2 and 4. Inspect if the fuel pump works within 10 s.

**Note: The test must be finished within 10 s to avoid burning coils.**

**Note: Keep fuel pump away from battery as far as possible.**

**Note: Always turned on and off battery voltage from the battery side (not on the fuel pump side).**



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| Test Conditions | Specifications |
|---|---|
| Battery positive (+) to terminal 4<br>Battery negative (-) to terminal 2 | Fuel pump operates |

Replace the fuel pump if it does not operate.

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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect and confirm that there is no scratch or foreign matter on connecting components.**

**CAUTION: Inspect and confirm that fuel pipe joint is securely inserted into the pipe.**

**CAUTION: Turn the ignition switch to "ON" (do not start engine) to apply fuel pressure to fuel supply system, and then inspect the connecting part for leakage.**

**CAUTION: During installation, push fuel pipe wiring harness connector until a "click" sound is heard, and then inspect and confirm that the fuel pipe joint clips are located in fuel pipe joint collar. After installing the fuel pipe joint clips, inspect and confirm that the fuel pipe joint clips cannot be pulled out. Be care not to damage the joint. Replace with new ones if the clips are damaged.**

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# Fuel Main Pipe

## Removal

**WARNING: Please release the pressure of fuel supply system before repairing fuel supply system components.**

**WARNING: After releasing the fuel system pressure, some pressure still remains in fuel line. When disconnecting the fuel line, use a piece of cloth or equivalent to wrap the joint so as to prevent fuel spilling out.**

**WARNING: Repair the vehicle in a location with well ventilation and avoid fire source.**

**WARNING: No smoking when repairing vehicle, otherwise, personal injury or death may be caused.**

**CAUTION: Fuel injector is a high precision component with good anti-blocking, anti-contamination and anti-fogging performance.**

1. Disconnect the negative battery cable.

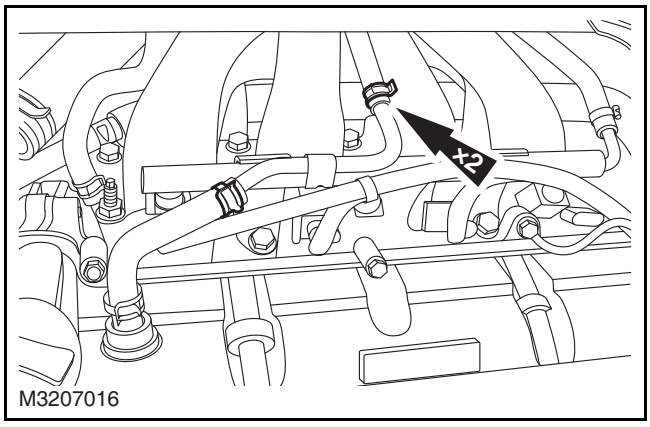
   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Release the fuel system pressure.

   **Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**

3. Turn over the driver side seat.
4. Remove the fuel main pipe.

   1 Loosen the hoop, and then disconnect 2 crankcase vent hoses.

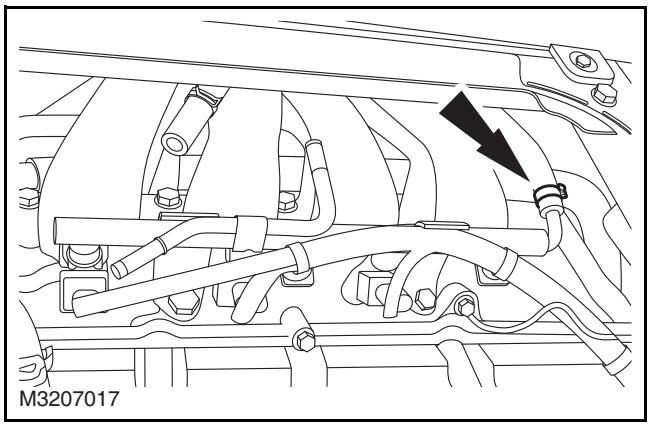


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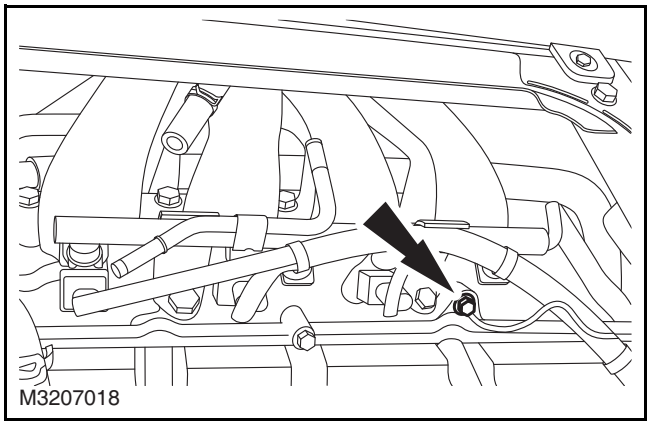


2 Loosen the hoop, disconnect fuel main pipe joint.

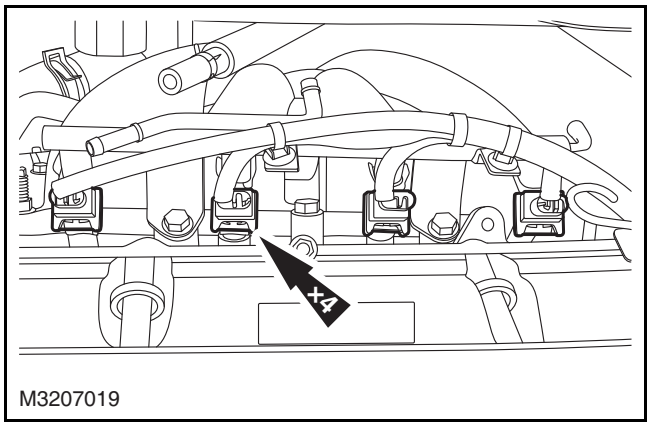

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3 Remove the retaining bolt from fuel injector wiring harness grounding point.

Torque: 10 ± 1 Nm

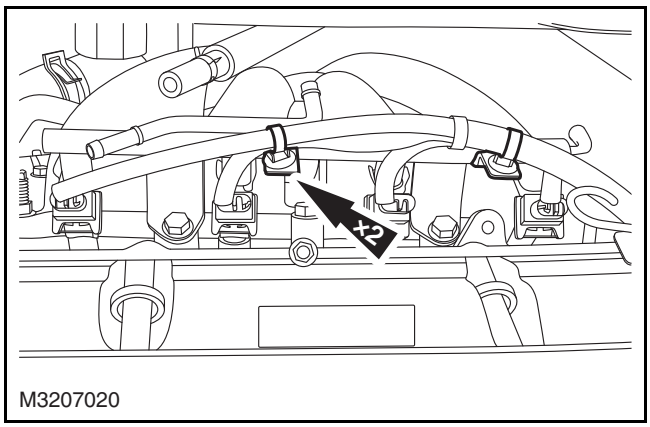

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4 Disconnect the fuel injector wiring harness connectors in sequence.



M3207019

5 Disconnect 2 fuel injector wiring harness retaining clamps in sequence.



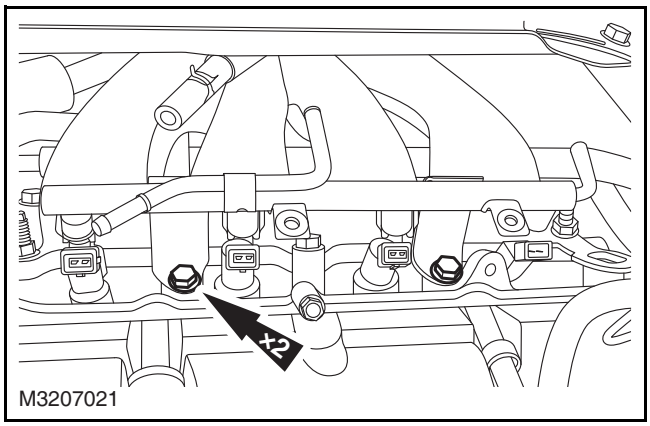
M3207020

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6 Remove the fuel main pipe retaining bolt and then remove the fuel main pipe.

Torque: 23 ± 2 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect and confirm that fuel pipe joint is securely inserted into the pipe.**

**CAUTION: Turn the ignition switch to "ON" (do not start engine) to apply fuel pressure to fuel supply system, and then inspect the connecting part for leakage.**

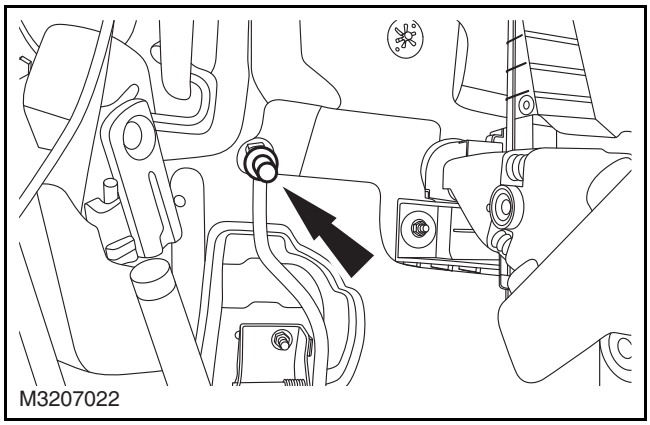
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# Accelerator Pedal Assembly

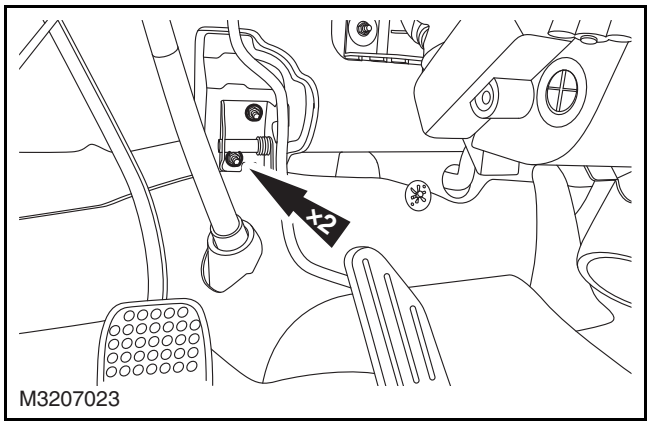
## Removal

1. Pull the accelerator cable, and then separate accelerator cable and accelerator pedal assembly.


M3207022

2. Remove 2 retaining bolts from accelerator pedal assembly and then remove the accelerator pedal assembly.

   Torque: 10 ± 1 Nm



M3207023

## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Component Specifications

| Item | Specifications |
|---|---|
| Spark plug type | YR7DE HU10A70P |
| Spark plug clearance | 0.85 ~ 0.95 mm |
| Ignition coil primary resistance | 1 ± 0.1 Ω at 23°C ± 3°C |

# General Specifications

| Item | Specifications |
|---|---|
| Ignition type | Sub-cylinder independent ignition |
| Ignition sequence | 1 - 3 - 4 - 2 |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Engine trim cover | 10 ± 1 | - | - |
| Spark plug tightening torque | 22 ± 2 | - | - |
| Ignition coil retaining bolt | 10 ± 1 | - | - |

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## Description and Operation

# System Overview

The ECM in electrical ignition system transmits signals from each sensor to the electrical ignition trigger (ignition module) inside the ECM. After the signal generated by ignition controller is processed by generator, it flows to control the high-power transistors of igniter in ECM to switch ON/OFF the primary current of ignition coil, thus enhancing the ignition reliability, extend the service life of spark plug and improving the dynamic performance and economy of engine. This secondary windings of the engine directly connect to a spark plug.

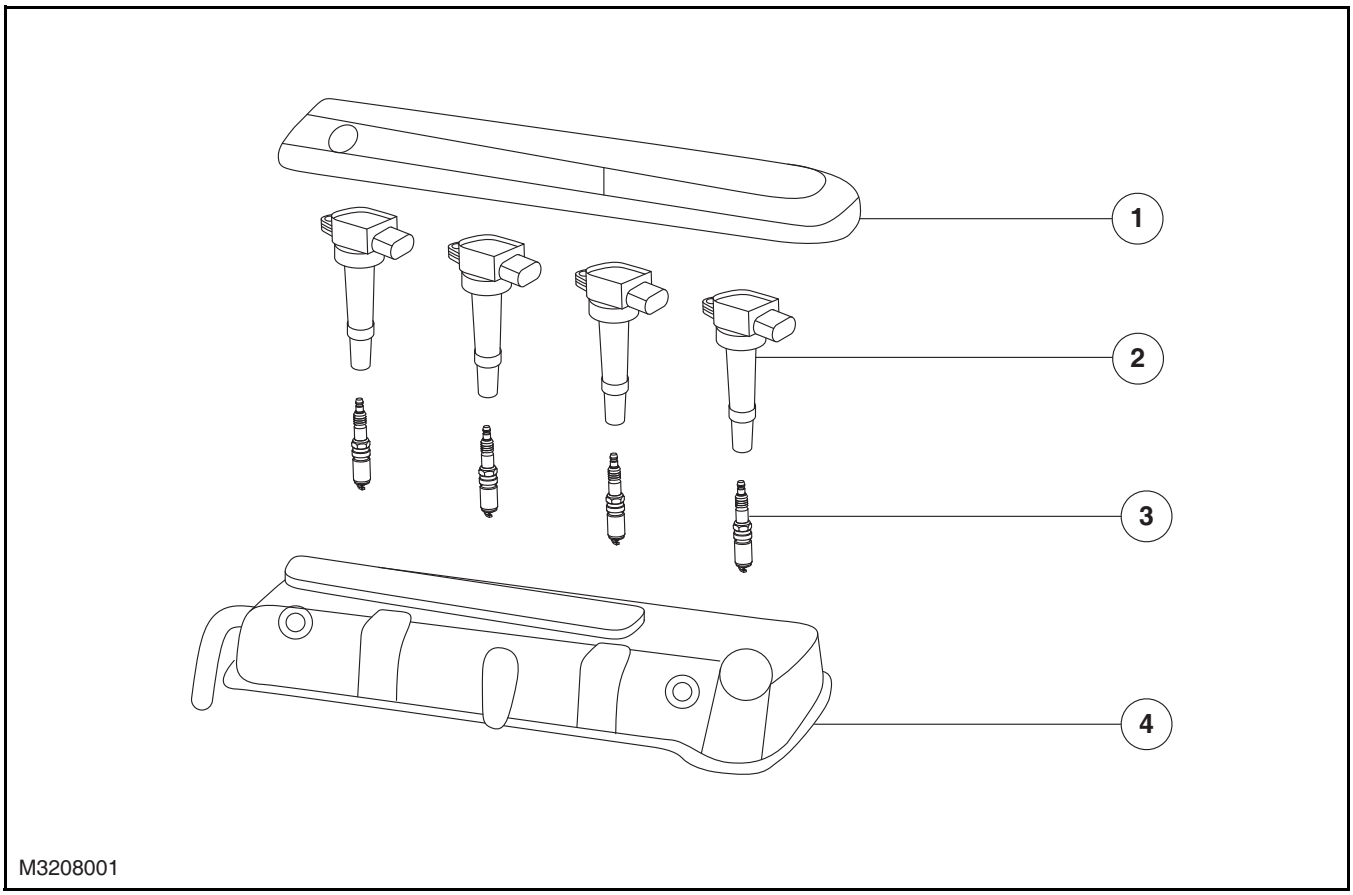
The ignition system consists of following components:

- ECM
  ECM detects the engine and vehicle conditions according to signals from each sensor, and ignition trigger within ECM determines the most appropriate ignition timing and ignition duration based on ignition signal transmitted within ECM, which is output from ECM to switch on or off the current flowing into the primary coil.
- Ignition coil assembly
  Ignition coil consists of primary winding, secondary winding, iron core and housing. The primary winding energized when the grounding is connected, and power is off once the circuit is cut off by ECM. Meanwhile, high voltage generated in secondary winding make the spark plug discharge.
- Spark plug
  PG sensor (phase sensor) and DG sensor (speed sensor) use induction type speed sensor to coordinate with pulse wheel to provide the information of engine speed and crankshaft top dead center in the ignition system.

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# Components Location View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Engine trim cover | 3 | Spark plug |
| 2 | Ignition coil | 4 | Cylinder head cover |

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## General Inspection

# Ignition Spark Test

1. When the transmission shift lever is at "Neutral", apply parking brake to prevent the wheel turning.
2. Disconnect the fuel injector connector and ignition coil connector.

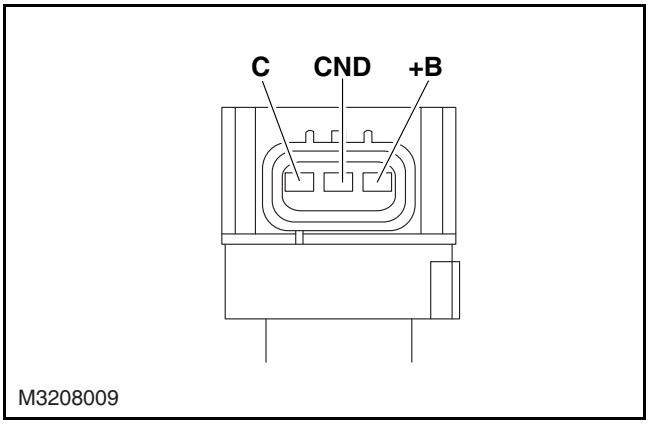
**WARNING: If the fuel injector connector is not disconnected, the inflammable gas will rush out from the spark plug hole during testing, possibly leading to vehicle fire.**

3. Remove the spark plug and inspect its state and type.
4. If normal, connect the ignition coil connector, and connect the spark plug to high voltage connecting pipe and ground the spark plug.
5. Start engine to inspect if the sparks of spark plugs is normal, if not (no sparking or sparking abnormal), inspect related components according to "Diagnosis".
6. After inspection, install the spark plugs and ignition coil.
7. Connect the fuel injector wiring harness connectors.

# Ignition Coil

1. Disconnect the negative battery cable.
2. Remove the bolts and take out the ignition coil from cylinder head cover.
3. Use the ohmmeter range of multimeter to measure the resistance of ignition coil (terminal C and +B shown in the following figure).

**Coil primary resistance: 1 ± 0.1 Ω (23°C ± 3°C)**



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4. Install ignition coil assembly to cylinder head and connect wiring harness connectors, and connect the negative battery cable.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Electrical |
|---|
| • Return circuit |
| • Wiring harness |
| • Electrical connector |
| • Spark plug |
| • Ignition coil |
| • Engine control module (ECM) |

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# Symptom Chart

If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | | Causes | Solutions |
|---|---|---|---|
| Engine cannot start | Rotate engine crankshaft but cannot or difficult to start the engine; or the engine stalls during working and does not work when restarting | • Battery is depleted | • Inspect the battery fault. |
| | | • Battery binding post looseness or poor contact | • Inspect if the wiring harness connection is secured. |
| | | • Ignition coil damage | • Replace |
| | | • Ignition coil wiring harness connector falls off | • Inspect if the wiring harness connection is secured. |
| | | • ECM fault | • Inspect the ECM fault or replace. |
| Certain cylinder fault | Blasting sound can be heard and black smog can be seen from exhaust pipe when engine is working at different speed | • Ignition coil wiring harness connector loose | • Replace or reassembly. |
| | | • Certain spark plug poor working | • Adjust, clean or replace. |
| Insufficient engine power | Engine is difficult to start and power is insufficient in accelerating and climbing | • Certain cylinder fault | • Refer to the last fault diagnosis. |
| | | • gnition coil wiring harness connector loose | • Replace |
| | | • Ignition coil wiring harness connector loose | • Replace or reassembly. |
| | | • Severe spark plug carbon deposit | • Adjust, clean or replace. |

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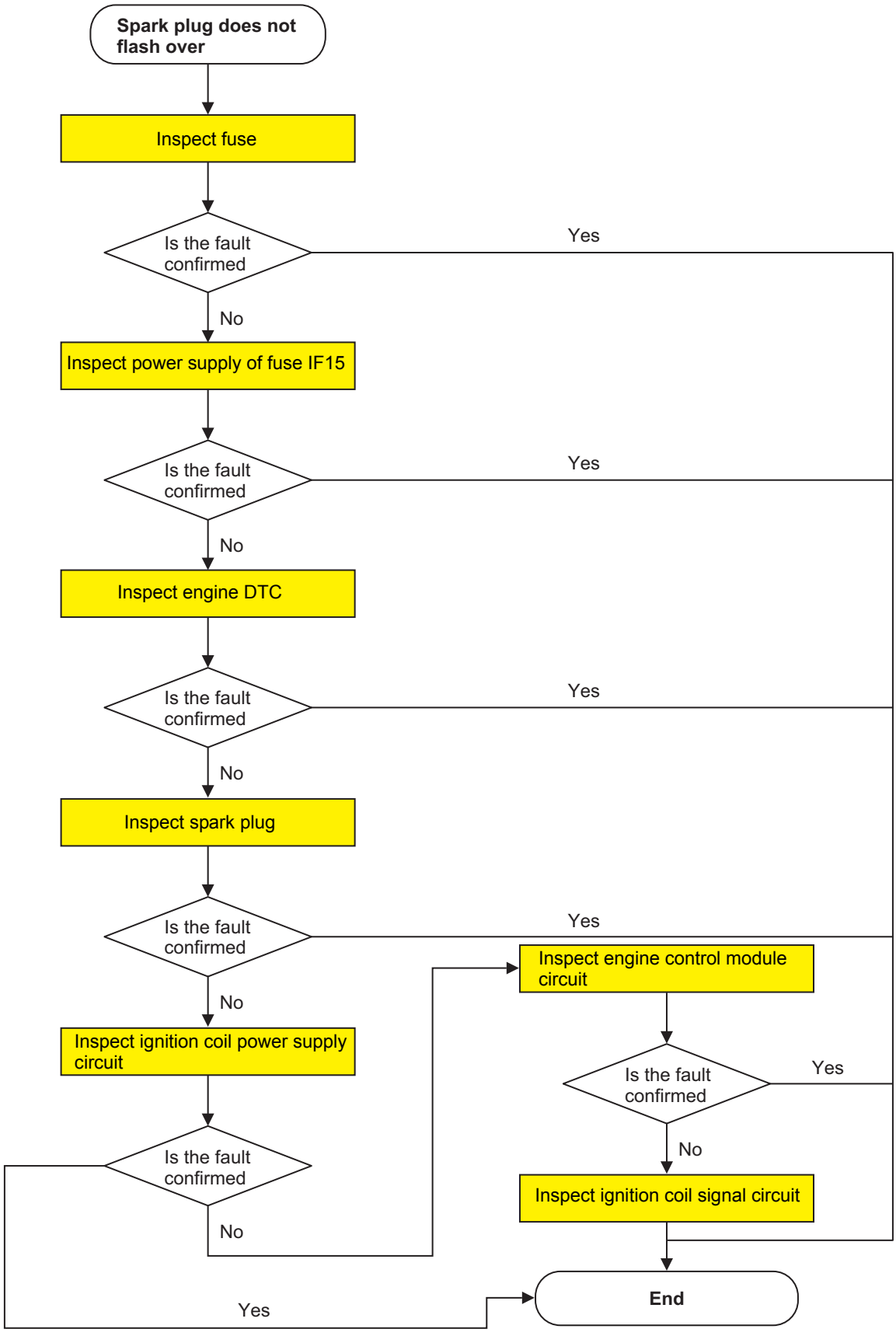
**Fault Diagnosis Procedure Chart**

| Step | Operation | Yes | No |
|---|---|---|---|
| 1 | Is the inspection based on diagnosis procedure for engine fault | Go to step 2 | Go to the diagnosis procedure for engine fault |
| 2 | Is the fault lamp on | Go to step 3 | Go to the diagnosis procedure for engine fault |
| 3 | DTC inspection<br>Read DTC through the diagnostic tool to inspect if there is "misfire" fault indication | Go to step 4 | Go to the diagnosis procedure for engine fault |
| 4 | After repairing fault, restart the engine to inspect if there is "misfire" fault indication | Go to step 5 | Go to the diagnosis procedure for engine fault |
| 5 | Electrical connection inspection<br>1. Inspect if the connection of ignition coil wiring harness connector is reliable and check the continuity of wiring harness<br>2. Inspect if the high voltage coil is securely connected with spark plug | Go to step 6 | Reconnect |
| 6 | Ignition coil inspection<br>Inspect the coil one by one and inspect if the results are consistent with requirements | Go to step 7 | Replace the faulty ignition coil |
| 7 | Spark plug inspection<br>Inspect the spark plug one by one and inspect if the results are consistent with requirements | Ignition system is in good condition | Replace the faulty ignition coil |

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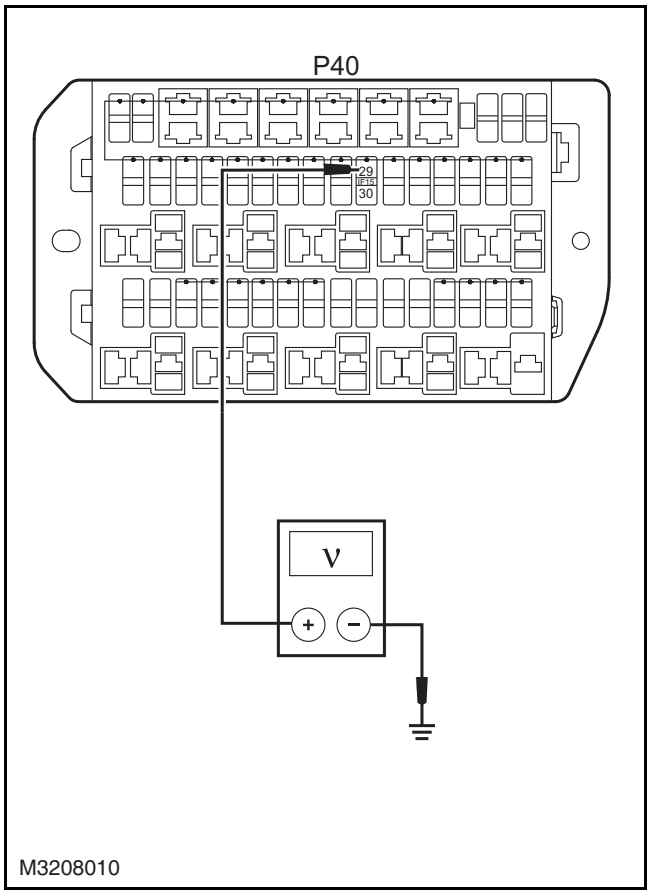


# Diagnosis Procedure for Spark Plug does not Flash Over



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect fuse | |
| | A. Inspect the fuse of fuse box IF15.<br>Fuse rated capacity: 15 A<br>Is the fuse normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 2. Inspect power supply of fuse IF15 | |
|  | A. Turn the ignition switch to "ON".<br>B. Use multimeter to measure the voltage between terminal 29 of fuse IF15 and reliable grounding.<br>Standard voltage: 11 ~ 14 V<br>Is the voltage value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the ignition switch and fuse power supply circuit. |

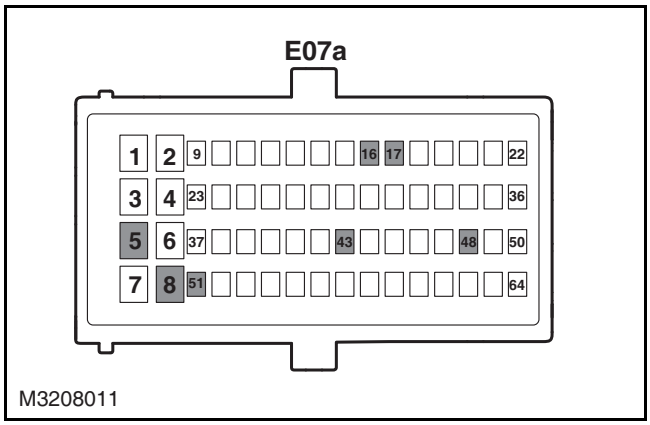
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect engine DTC | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Turn the ignition switch to "ON".<br>D. Diagnose the engine system.<br>Is there any DTC?<br>**Yes**<br>**Refer to: DTC Diagnosis Procedure Index (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 4. |
| 4. Inspect spark plug | |
| | A. Turn the ignition switch to "LOCK".<br>B. Remove the spark plug.<br>C. Execute the testing procedure for spark plug.<br>**Refer to: Spark Plug Test (3.2.8 Ignition System, General Inspection).**<br>Is the spark plug normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the spark plug. |
| 5. Inspect ignition coil | |
| | A. Carry out ignition coil inspection procedure.<br>**Refer to: Ignition Coil Test (3.2.8 Ignition System, General Inspection).**<br>Is the ignition coil normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the ignition coil. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect ignition coil power supply circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the ignition coil wiring harness connector.<br>C. Turn the ignition switch to "ON". Measure the voltage between terminal 1 of ignition coil wiring connector and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the open circuit fault between instrument panel fuse box fuse IF01 terminal and terminal 1 of ignition coil wiring harness connector. |
| 7. Inspect engine control module circuit | |
|  <br>M3208011 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the ECM wiring harness connector E07a.<br>C. Turn the ignition switch to "ON". Inspect if the power supply of terminals 8, 16, 17 and 51 is normal.<br>D. Turn the ignition switch to "LOCK". Inspect if the grounding of terminals 5, 43 and 48 is normal.<br>Is the circuit of engine control module normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Repair the circuit. |

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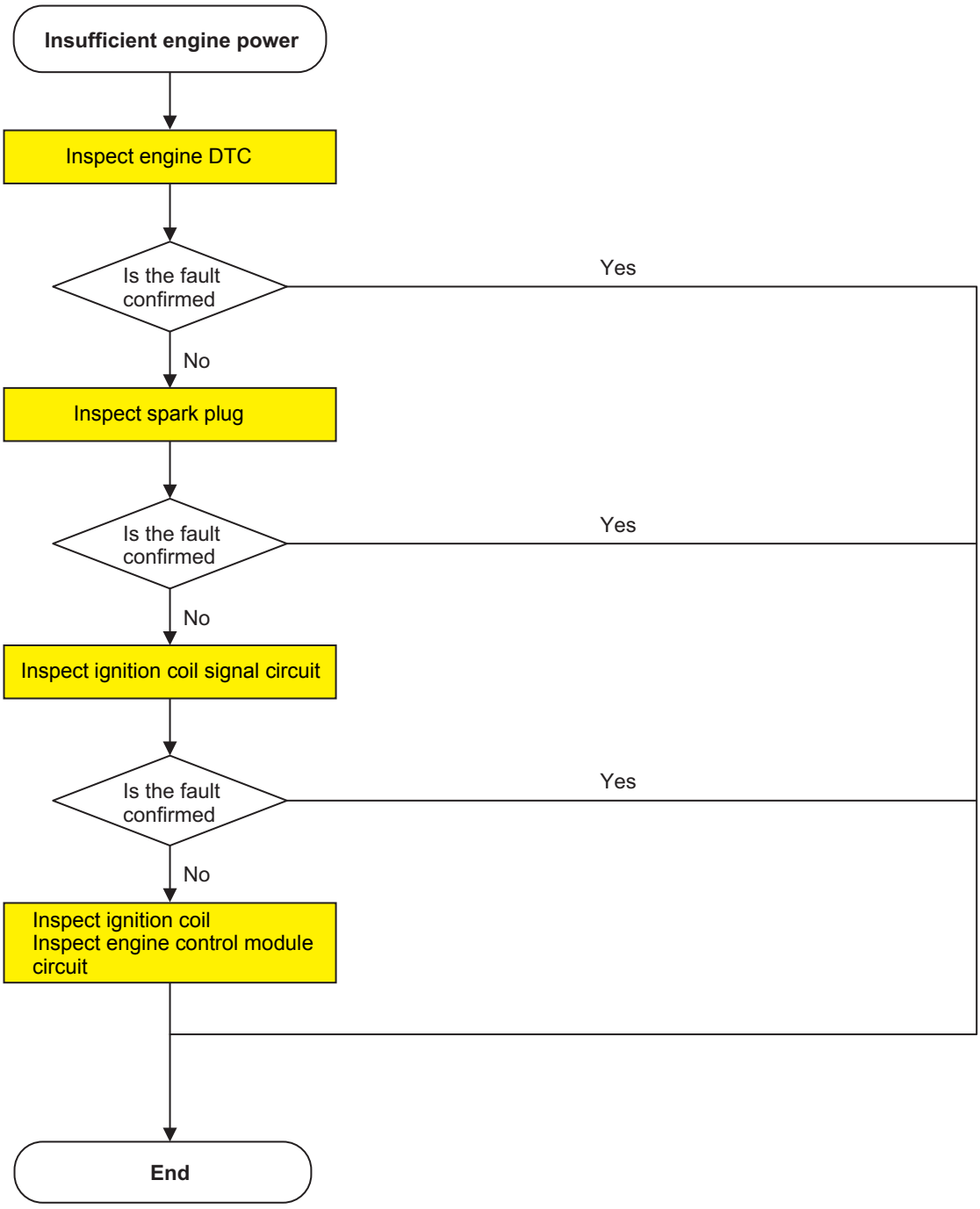
| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect ignition coil signal circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the negative battery cable.<br>C. Disconnect the engine ignition coil wiring harness connectors E19a, E18a, E17a and E16a.<br>D. Disconnect the engine control module wiring harness connector E07a.<br>E. Measure the resistance between terminal 3 of engine control module wiring harness connector E07a and the terminal 1 of engine ignition coil wiring harness connector E19a, the resistance between terminal 7 of engine control module wiring harness connector E07a and the terminal 1 of engine ignition coil wiring harness connector E18a, the resistance between terminal 6 of engine control module wiring harness connector E07a and the terminal 1 of engine ignition coil wiring harness connector E17a and the resistance between terminal 1 of engine control module wiring harness connector E07a and the terminal 1 of engine ignition coil wiring harness connector E16a.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Inspect and repair the circuit. |

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# Diagnosis Procedure for Insufficient Engine Power

Verify that the engine cylinder pressure is normal, ignition timing mark is correct, and no mechanical damages of engine. Otherwise, repair the fault part first.



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect engine DTC | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Turn the ignition switch to "ON".<br>D. Diagnose the engine system.<br>Is there any DTC?<br>**Yes**<br>**Refer to: DTC Diagnosis Procedure (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect spark plug | |
| | A. Execute the testing procedure of spark plug<br>**Refer to: Spark Plug Test (3.2.8 Ignition System, General Inspection).**<br>Is the spark plug normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the spark plug. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect ignition coil signal circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the negative battery cable.<br>C. Disconnect the engine ignition coil wiring harness connectors E19a, E18a, E17a and E16a.<br>D. Disconnect the engine control module wiring harness connector E07a.<br>E. Measure the resistance between terminal 3 of engine control module wiring harness connector E07a and the terminal 1 of engine ignition coil wiring harness connector E19a, the resistance between terminal 7 of engine control module wiring harness connector E07a and the terminal 1 of engine ignition coil wiring harness connector E18a, the resistance between terminal 6 of engine control module wiring harness connector E07a and the terminal 1 of engine ignition coil wiring harness connector E17a and the resistance between terminal 1 of engine control module wiring harness connector E07a and the terminal 1 of engine ignition coil wiring harness connector E16a.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Inspect and repair the circuit. |
| 4. Inspect ignition coil | |
| | A. Carry out ignition coil testing procedure.<br>**Refer to: Ignition Coil Test (3.2.8 Ignition System, General Inspection).**<br>Is the ignition coil normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the ignition coil.<br>**Refer to: Ignition Coil (3.2.8 Ignition System, Removal and Installation).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect engine control module circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the ECM wiring harness connector.<br>C. Turn the ignition switch to "ON".<br>D. Inspect whether power supply of terminals 8, 16, 17 and 51 is normal.<br>E. Turn the ignition switch to "LOCK". Inspect if the grounding of terminals 5, 43 and 48 is normal.<br>Is the circuit of the engine control module normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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## Removal and Installation

# Ignition Coil

### Removal

1. Remove the battery.

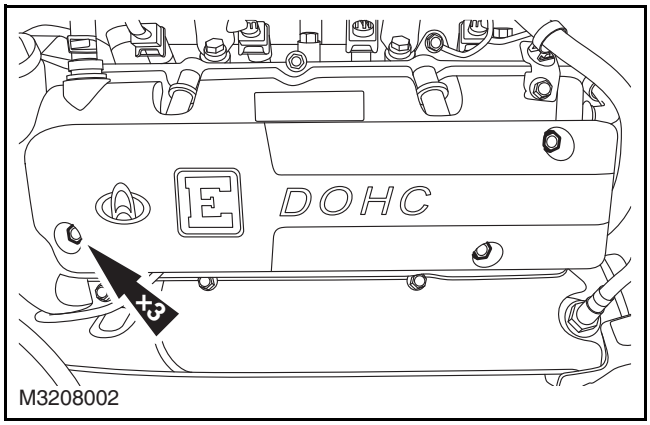
   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Remove the engine trim cover.

   1 Remove 3 retaining bolts from the engine trim cover.

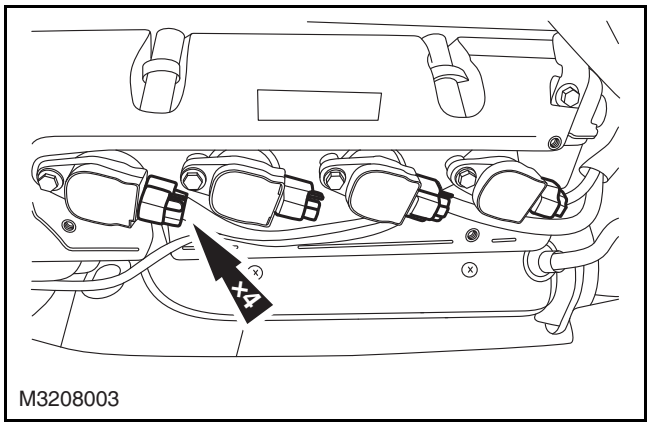
   Torque: 10 ± 1 Nm

   2 Remove the engine trim cover.



M3208002

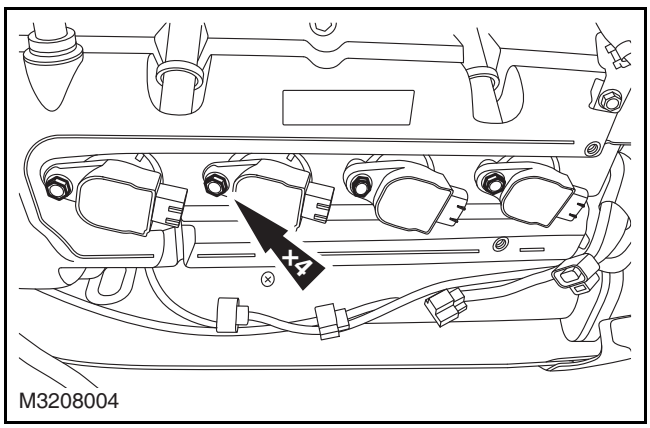
3. Disconnect 4 ignition coil wiring harness connectors in sequence.



M3208003

4. Remove 4 retaining bolts from the ignition coil.

   Torque: 8 ± 2 Nm



M3208004

5. Disconnect 4 ignition coils in sequence.

### Installation

1. Installation is in the reverse order of removal.

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# Spark Plug

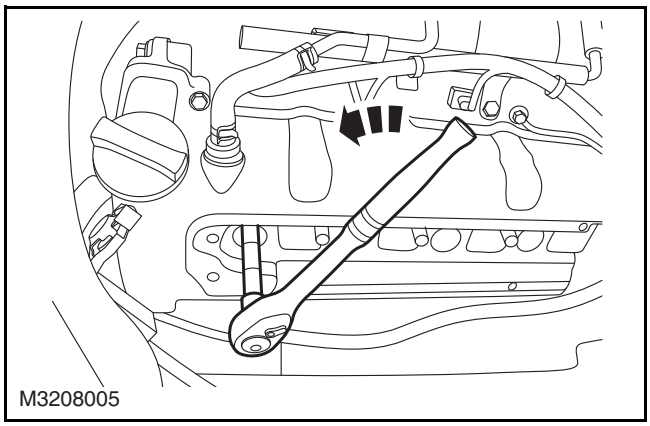
## Removal

1. Remove the ignition coil.

   **Refer to: Ignition Coil (3.2.8 Ignition System, Removal and Installation).**

2. Use spark plug remover to remove 4 spark plugs in sequence.

   Torque: 22 ± 2 Nm


M3208005

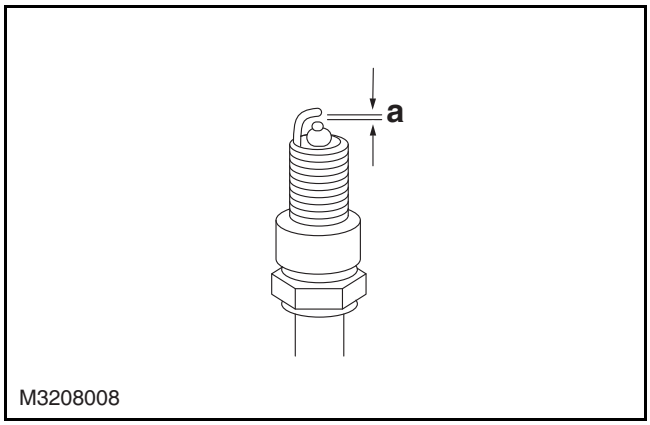
## Inspection

Inspect the spark plugs.

- Electrode wear
- Carbon deposit
- Insulator damage

If abnormal condition has been found, adjust the spark plug electrode clearance, use spark plug cleaner to clean the spark plug or replace with a corresponding specification one.

Spark plug electrode clearance "a": 0.85 mm ~ 0.95 mm



M3208008

## Installation

**CAUTION: The junction surface of spark plug and installation hole must be absolutely free of foreign matters.**

1. Installation is in the reverse order of removal.

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# Ignition Switch

## Removal

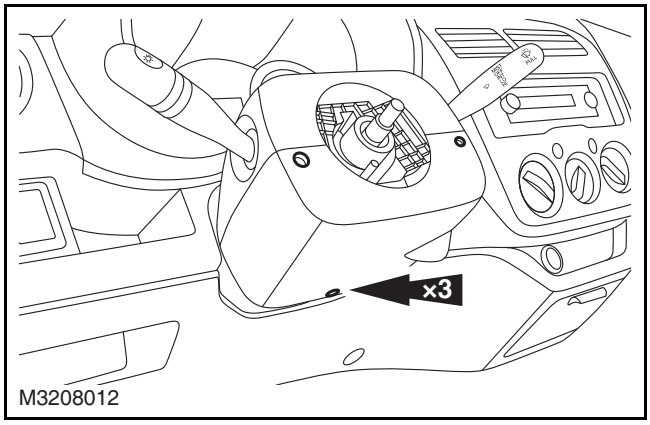
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Remove the steering wheel.

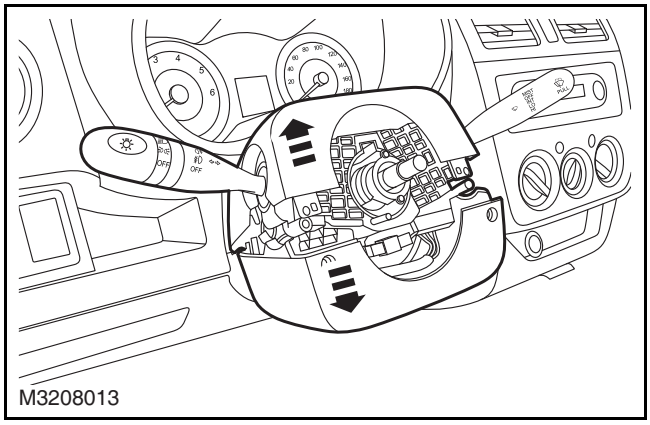
   **Refer to: Steering Wheel (2.4.3 Steering Column, Removal and Installation).**

3. Remove 3 retaining screws from the steering lock upper and lower housings.

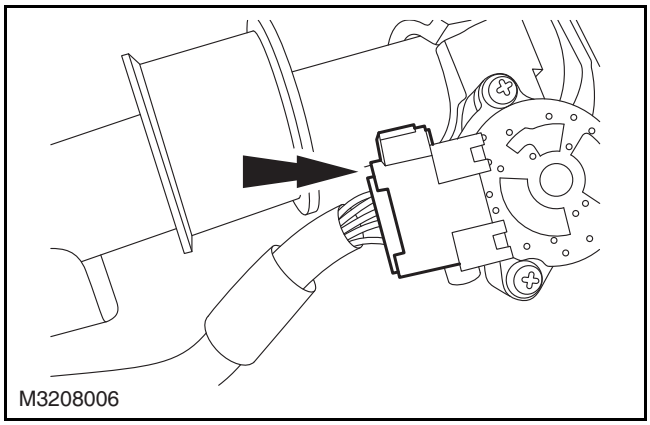


M3208012

4. Separate the upper and lower housings of steering lock.


M3208013

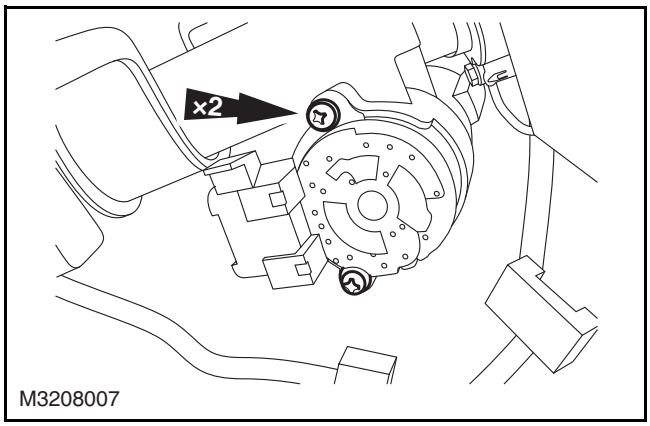
5. Disconnect the ignition switch wiring harness connector.


M3208006

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6. Remove 2 retaining screws from the ignition switch.




## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Starting motor retaining bolt | 23 ± 2 | - | - |
| Starting motor main power supply wiring harness retaining nut | 10 ± 2 | - | - |
| Starting motor magnetic clutch wiring harness retaining nut | 7 ± 1 | - | - |

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## Description and Operation

# System Overview

Turn the start switch (ignition switch) to start position (ST), so that a little current flows into the retention and traction coils of the magnetic switch while starting. One circuit: battery positive → starting switch → retention coil → grounding (battery negative); Another circuit: battery positive → start switch → traction coil → starting motor → grounding (battery negative). The motor starts to operate since current flows into armature and field windings. Due to current passes through the magnetic switch, traction and retention coils generate magnetic force, by which the core overcomes return spring force to move right. Motor rotates at a slower speed as the current is smaller. When the core is pushed to right, the left terminal moves drive lever to push clutch to the left, so that the driving gear engages with flywheel ring gear. The current from traction coil flows into armature and field windings to produce certain magnetic torque, so gears are engaged in slow rotating process. The magnetic switch master contactor on the core's right side is closed to connect starting motor to battery directly while gear and flywheel ring gear are fully engaged. Large current provided by battery passes through armature and field windings of the starting motor to generate normal turning torque, and then the gear and flywheel engages to rotate engine crankshaft to start the engine. AT this point, the traction coil is shorted and moving core position is supported by the retention coil suction force, and the drive lever still pushes gear by overcoming spring force to make it engage with flywheel ring gear.

Disconnect the starter switch and cut off retention coil current after the engine is started. So magnetic force disappears and the core moves left quickly to its original position by the action of return spring. Drive lever separates the drive gear from flywheel ring gear by the action of torsional spring, then master contactor is disconnected, starter circuit is cut off. So the starting motor stops running and the starting process of engine is finished.

# Components Description

## Starting Motor

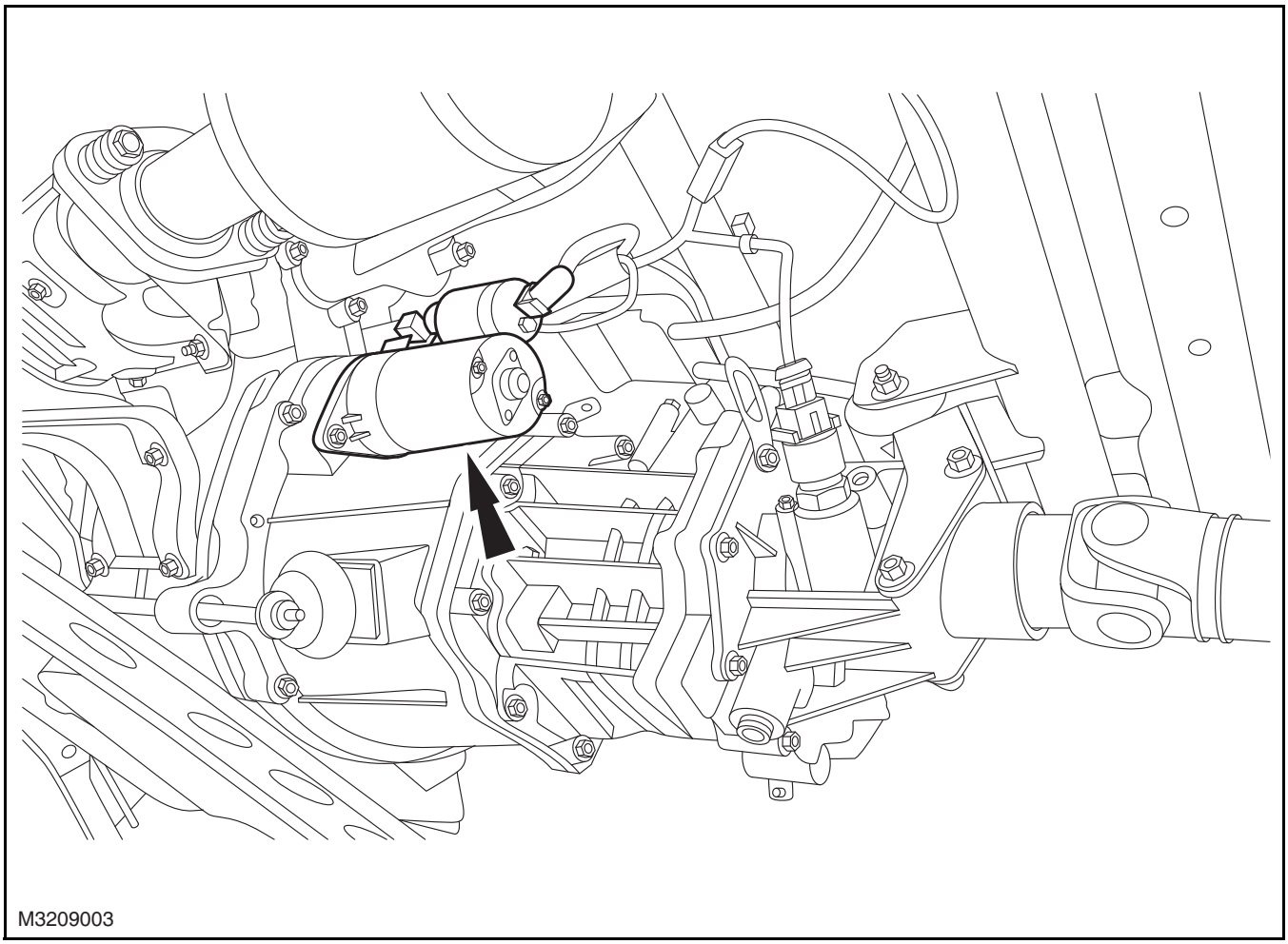
Starting motor includes the stator assembly, armature assembly, overdrive clutch assembly, magnetic switch assembly, front/rear housing, brush holder and drive lever. Magnetic switch assembly and its components on the starting motor are packaged inside the housing to prevent dirt and splashing.

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# Components Location View

## Starting Motor

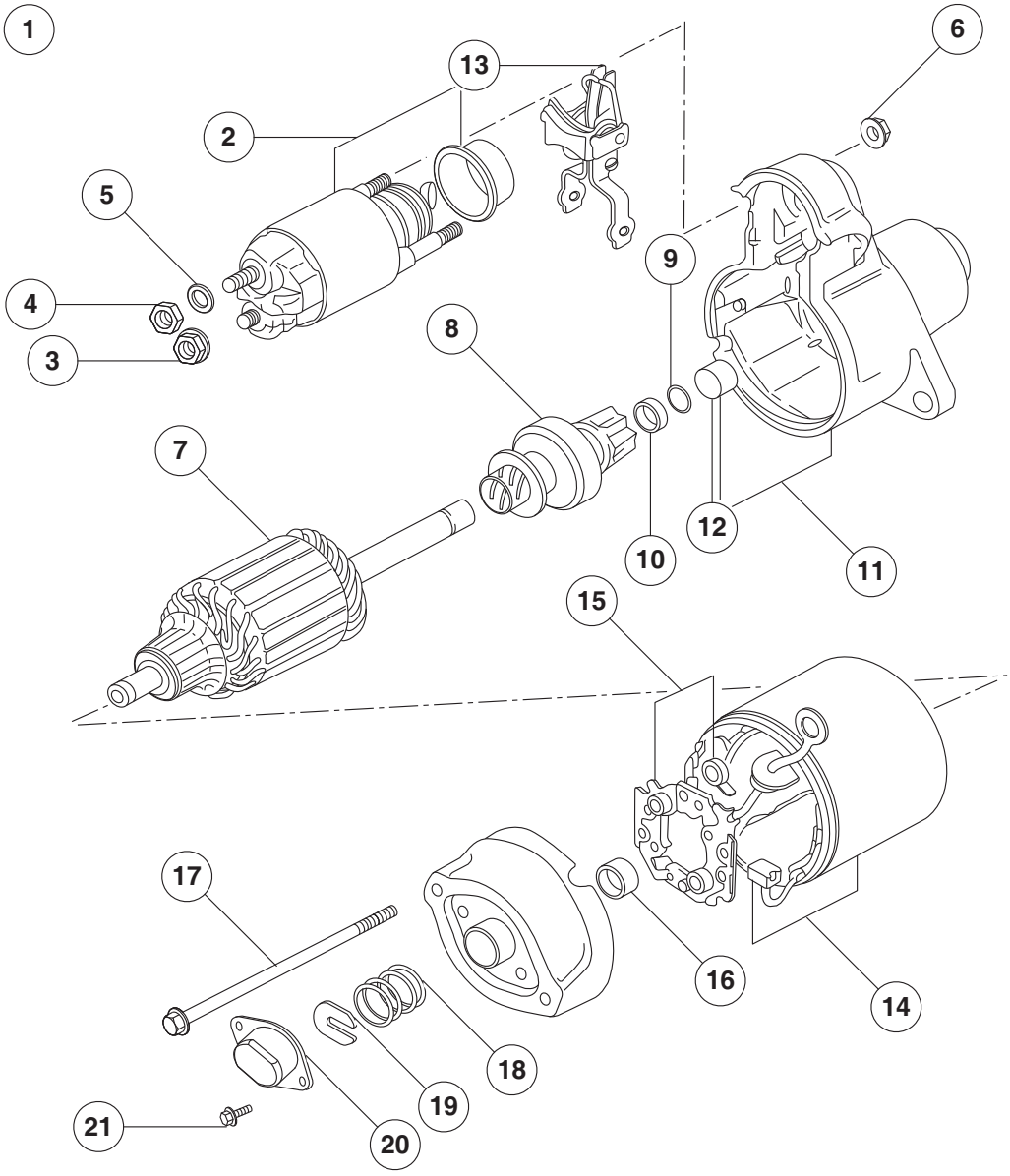


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# Components Exploded View




M3209004

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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Starting motor assembly | 12 | Bushing |
| 2 | Magnetic switch assembly | 13 | Drive lever |
| 3 | Nut | 14 | Housing |
| 4 | Nut | 15 | Brush holder plate |
| 5 | Spring washer | 16 | Bushing |
| 6 | Nut | 17 | Retaining screw |
| 7 | Rotor assembly | 18 | Spring |
| 8 | Overdrive clutch assembly | 19 | Retainer ring |
| 9 | Retainer ring | 20 | Protective cover |
| 10 | Special washer | 21 | Screw |
| 11 | Rotor front bracket assembly | | |

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## General Inspection

### General Equipment

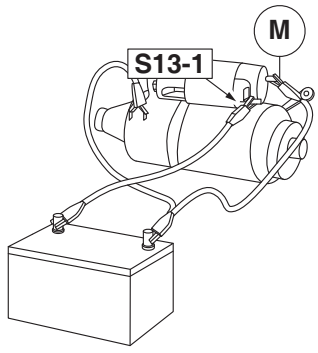
| |
|---|
| Multimeter |

**WARNING: Each test must be completed within 3 ~ 5 s to avoid coil burnout.**

## Magnetic Switch Test

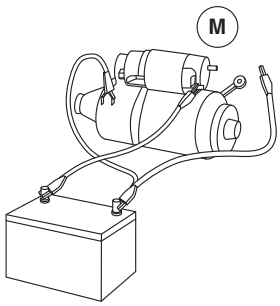
**CAUTION: Before testing, disconnect the field coils from terminal "M".**

1. Remove the starting motor armature wiring harness from the magnetic switch.
2. Use a jumper wire to connect the starting motor housing and magnetic switch housing to the battery negative securely.
3. Connect one end of another jumper wire to the battery positive and the other end to the terminal 1 of starting motor wiring harness connector S13.
4. Starting motor pinion should move out.
5. Remove the "M" terminal negative cable, and starting motor pinion should not return to the original position.




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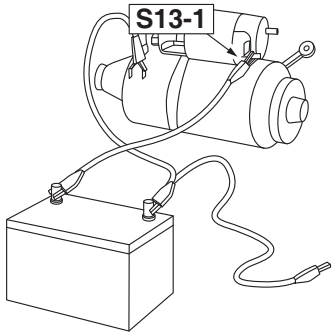
6. As mentioned above, connect the cable and pinion moves outward, then remove the "M" terminal negative wire, inspect whether the pinion moves outward, otherwise, replace the magnetic switch.




M3209006

## Pinion Return Test

1. Use a jumper wire to connect the starting motor housing and magnetic switch housing to the battery negative securely.
2. Connect one end of another jumper wire to the battery positive and the other end to the terminal 1 of starting motor wiring harness connector S13.
3. Starting motor pinion should move out.
4. Disconnect the jumper wire from the positive battery, and the pinion should quickly return.




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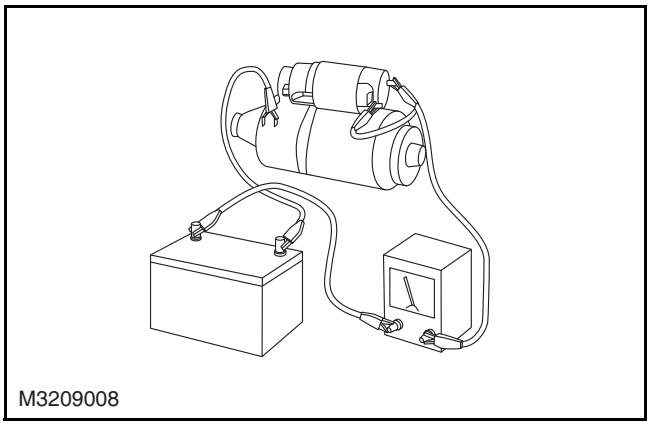


# Test without Load

1. Ensure the battery is fully charged.
2. Connect the starting motor, battery and tester as shown in the figure.
3. Start the starting motor and confirm that it rotates smoothly.

If the starting motor does not rotate smoothly, inspect starting motor device.

4. When the starting motor operates, measure voltage and current.
5. If either of them is not within the specified range, replace the starting motor.



M3209008

| Item | Specifications |
|---|---|
| Current without load | 78 A |
| Voltage drop without load | 11.6 V |

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Starting motor | • Fuse<br>• Battery<br>• Wiring harness<br>• Connectors loose or corroded |

3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

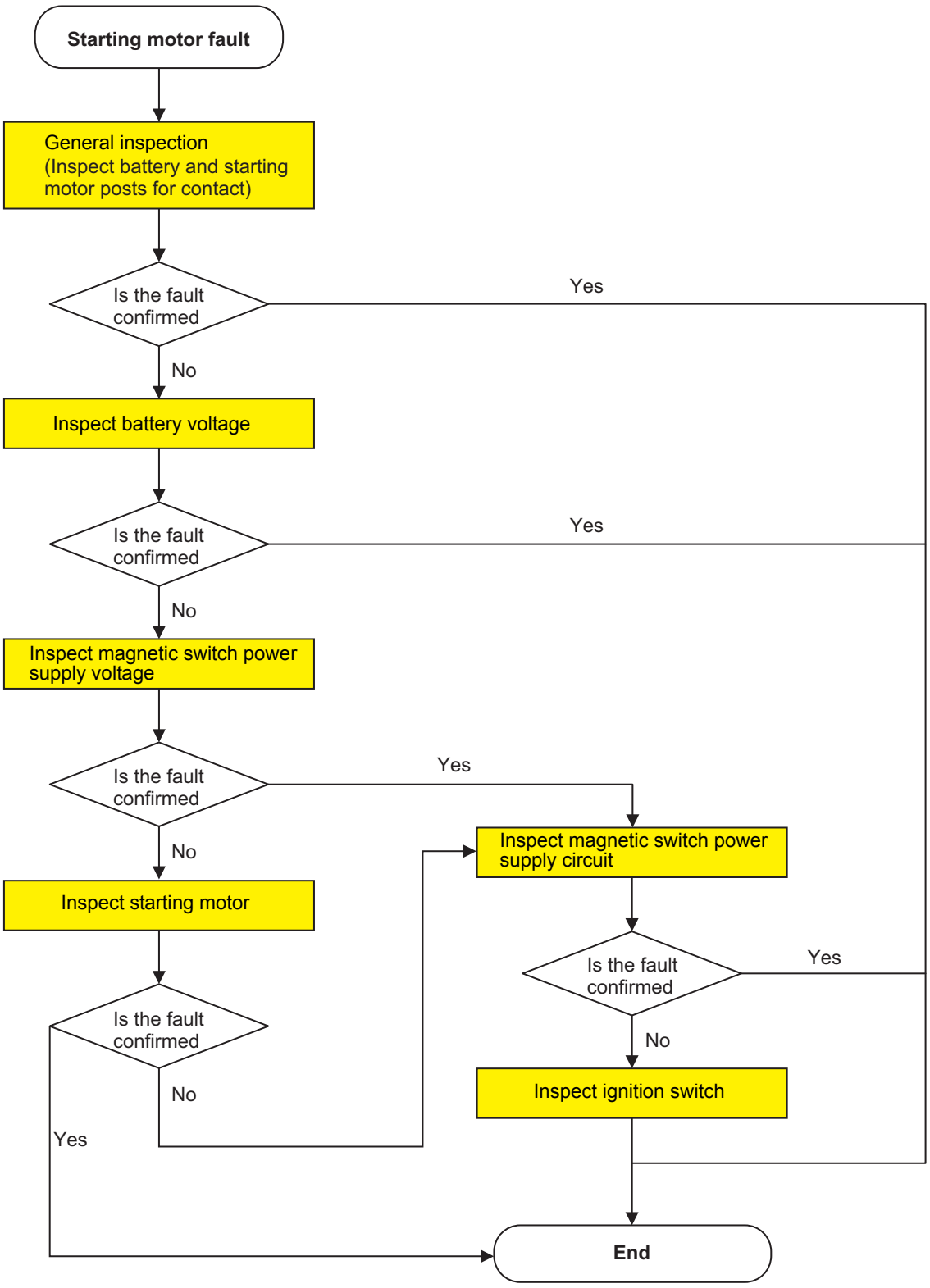
If the fault occurs, but there is no DTC stored in ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Starting motor does not operate | • Battery<br>• Return circuit<br>• Starting motor<br>• Ignition switch | • Diagnosis procedure for starting motor fault.<br>**Refer to: Diagnosis Procedure for Starting Motor Fault (3.2.9 Starting System, Symptom Diagnosis and Testing).** |
| Starting motor fails to stop | • Ignition switch<br>• Starting motor | • Diagnosis procedure for starting motor fails to stop.<br>**Refer to: Diagnosis Procedure for Starting Motor Fails to Stop (3.2.9 Starting System, Symptom Diagnosis and Testing).** |
| Starting motor runs slowly | • Battery<br>• Return circuit<br>• Starting motor | • Diagnosis procedure for starting motor slow run.<br>**Refer to: Diagnosis Procedure for Starting Motor Slow Run (3.2.9 Starting System, Symptom Diagnosis and Testing).** |
| Starting motor rotates but engine does not run | • Starting motor<br>• Flywheel ring gear | • Inspect the flywheel ring gear for tooth missing.<br>• Inspect whether the starting motor is correctly secured. If the problem continues, install a new starting motor.<br>**Refer to: Starting Motor (3.2.9 Starting System, Removal and Installation).** |
| Starting motor abnormal noise | • Starting motor<br>• Flywheel ring gear | • Inspect the flywheel ring gear.<br>• Inspect whether the starting motor is properly aligned or the housing is cracked. Ensure all the retaining bolts are well locked. If necessary, replace new starting motor or retaining bolts. |

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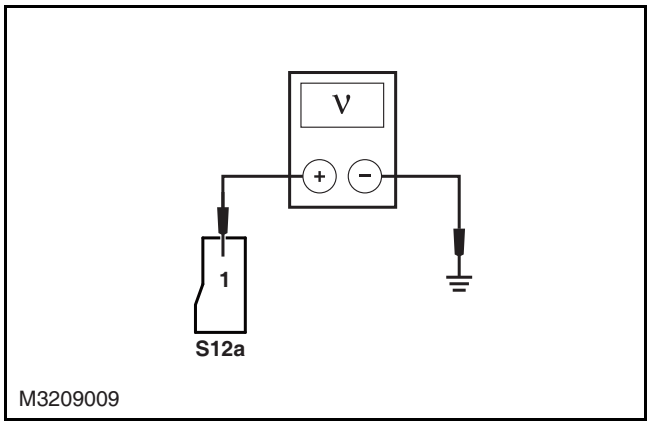


# Diagnosis Procedure for Starting Motor Fault



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect whether the battery positive & negative wiring harness connectors and positive & negative cables are damaged, oxidized, poorly contacted or loose.<br>B. Inspect whether the starting motor wiring harness connector and starting motor positive cable are damaged, oxidized, poorly contacted or loosen.<br>Is the inspection result normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect battery voltage | |
| | A. Inspect the battery starting voltage.<br>Is the starting voltage higher than 10.5 V?<br>**Yes**<br>Go to step 3.<br>**No**<br>Charge the battery.<br>**Refer to: Battery Charging (3.2.10 Charging System, General Inspection).**<br>Or replace with new battery.<br>**Refer to: Battery (3.2.10 Charging System, Removal and Installation).** |
| 3. Inspect magnetic switch power supply voltage | |
|  | A. Turn the ignition switch to "ST".<br>B. Measure the grounding voltage of terminal 1 of starting motor magnetic switch wiring harness connector S12a.<br>Is the voltage higher than 10 V?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 5. |

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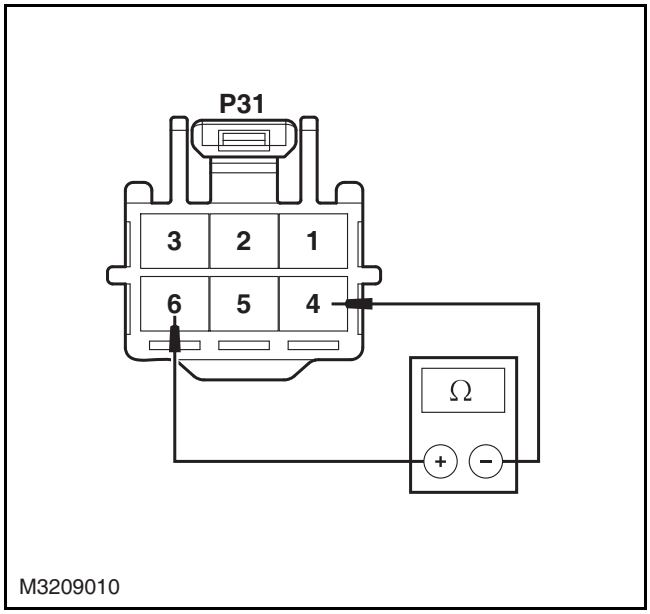


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect starting motor | |
| | A. Test the magnetic switch.<br>**Refer to: Magnetic Switch Test (3.2.9 Starting System, General inspection).**<br>Is the starting motor testing normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the starting motor.<br>**Refer to: Starting Motor (3.2.9 Starting System, Removal and Installation).** |
| 5. Inspect magnetic switch power supply circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the ignition switch wiring harness connector P31.<br>C. Create a short circuit between terminal 6 of ignition switch wiring harness connector P31 and reliable power supply.<br>Is the starting motor normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of wiring harness connector P31 and terminal 1 of starting motor wiring harness connector S12a. |

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6. Inspect ignition switch




M3209010

A. Disconnect the ignition switch connector.

B. Turn the ignition switch to "ST".

C. Measure the resistance between terminal 4 and terminal 6 of the ignition switch wiring harness connector P31.

Is the resistance value lower than 1 Ω?

**Yes**

Repair the high resistance faults in the following circuits.

- Circuit between terminal 1 of starting motor wiring harness connector S13 and terminal 1 of battery wiring harness connector S15.
- Circuit between terminal 1 of battery wiring harness connector S16 and grounding.

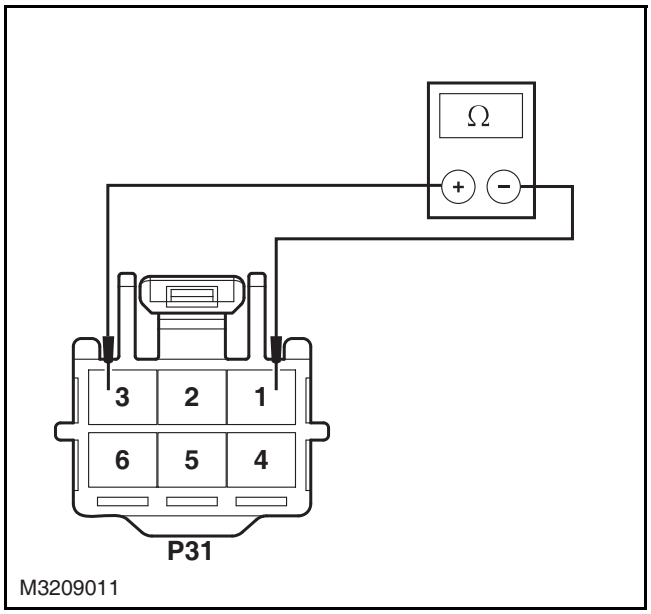
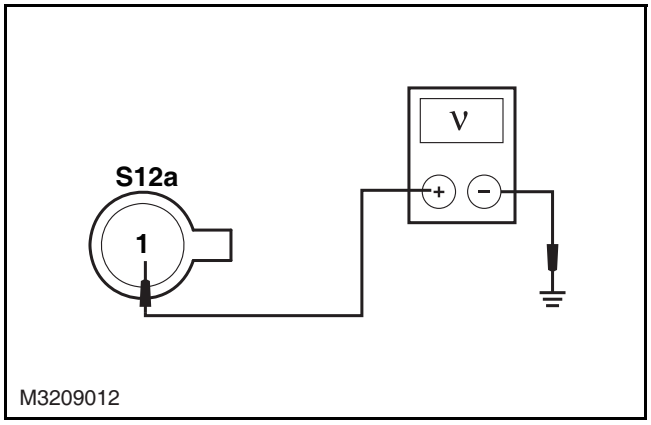
**No**

Replace the ignition switch.

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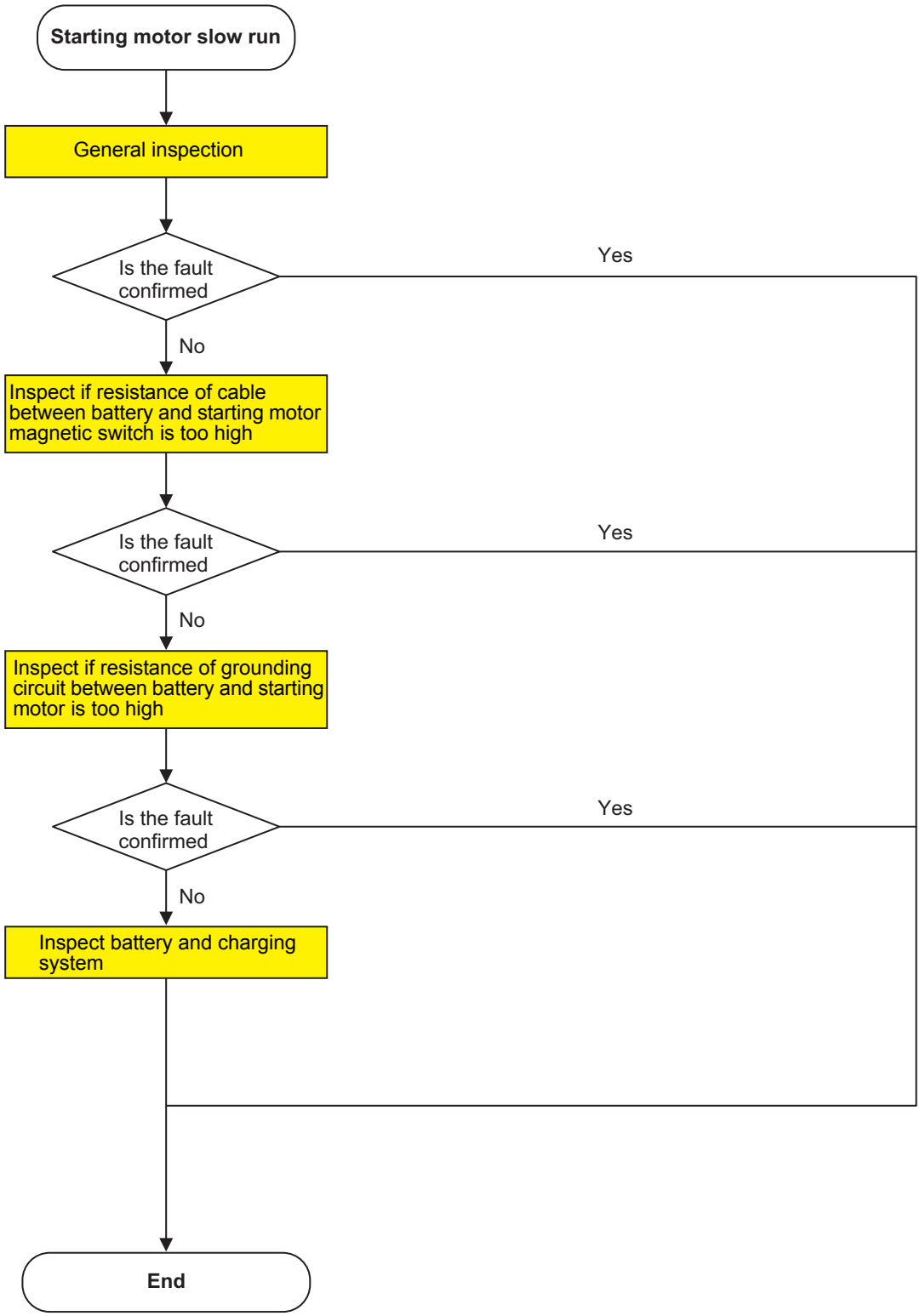
# Diagnosis Procedure for Starting Motor Fails to Stop

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect ignition switch | |
|  M3209011 | A. Disconnect the ignition switch connector.<br>B. Turn the ignition switch to "ACC".<br>C. Measure the resistance between terminal 1 and terminal 3 of the ignition switch wiring harness connector P31.<br>Is the resistance value lower than 1 Ω?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the ignition switch. |
| 2. Inspect if there is short to power supply in magnetic switch circuit | |
|  M3209012 | A. Disconnect the starting motor magnetic switch wiring harness connector S12a.<br>B. Use multimeter to measure the voltage between terminal 1 of starting motor magnetic switch wiring harness connector S12a and reliable grounding.<br>**Standard voltage value: 0 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the starting motor.<br>**Refer to: Starting Motor (3.2.9 Starting System, Removal and Installation).**<br>**No**<br>Repair the power supply short circuit between terminal 6 of ignition switch wiring harness connector P31 and terminal 1 of starting motor magnetic switch wiring harness connector S12a. |

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# Diagnosis Procedure for Starting Motor Slow Run



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect whether the battery positive & negative wiring harness connectors and positive & negative cables are damaged, oxidized, poorly contacted or loose.<br>B. Inspect whether the starting motor wiring harness connector and starting motor positive cable are damaged, oxidized, poorly contacted or loose.<br>Is the inspection result normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect if resistance of cable between battery and starting motor magnetic switch is too high | |
| | A. Turn the ignition switch to "OFF" to measure the resistance between starting motor housing and battery negative terminal.<br>Is the resistance value lower than 1 Ω?<br>**Yes**<br>Go to step 4.<br>**No**<br>**Refer to: Starting Motor (3.2.9 Starting System, Removal and Installation).**<br>**No**<br>Clean and lock all the battery negative connectors and tie band among starting motor holder, body and engine grounding. Test if the system works normally. If the problem continues, install new negative battery cable. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect if resistance of grounding circuit between battery and starting motor is too high | |
| | A. Inspect the battery voltage.<br>Is the starting voltage higher than 10.5 V?<br>**Yes**<br>Go to step 4.<br>**No**<br>Charge the battery.<br>**Refer to: Battery Charging (3.2.10 Charging System, General Inspection).**<br>Or replace with new battery.<br>**Refer to: Battery (3.2.10 Charging System, Removal and Installation).** |
| 4. Inspect battery and charging system | |
| | A. Inspect the battery and charging system.<br>Is the starting voltage higher than 10.5 V?<br>**Refer to: Battery Inspection (3.2.10 Charging System, General Inspection).**<br>Is the fault solved?<br>**Yes**<br>Replace or repair the battery, repair the charging system. |

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## Removal and Installation

# Starting Motor

### Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

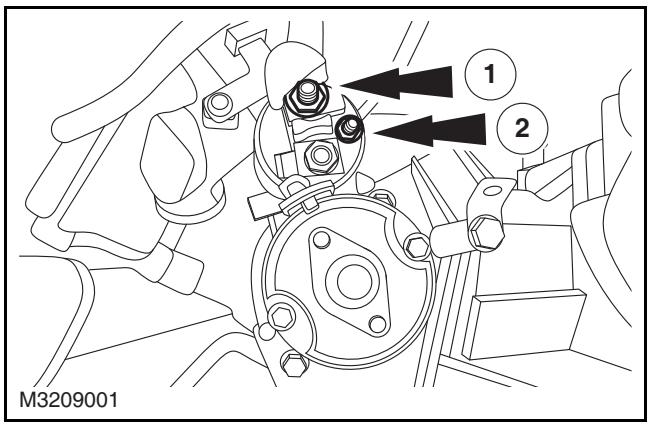
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Remove the retaining nut (1) from starting motor main power supply wiring harness.

   Torque: 10 ± 2 Nm

4. Remove the retaining nut (2) from starting motor magnetic switch wiring harness.

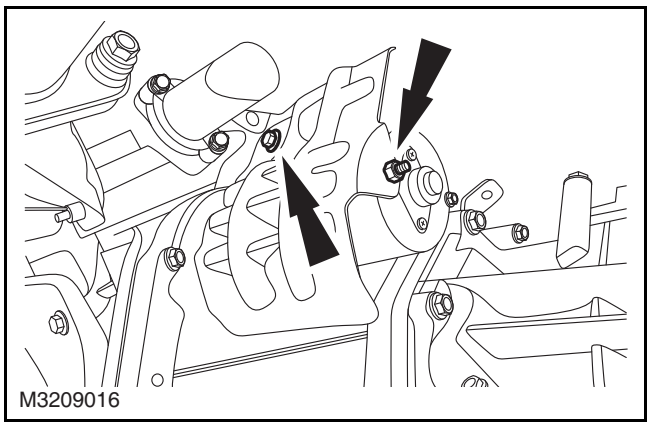
   Torque: 7 ± 1 Nm




5. Remove the starting motor insulator.

   1 Remove the retaining bolt and nut from the starting motor insulator.

   2 Remove the starting motor insulator.

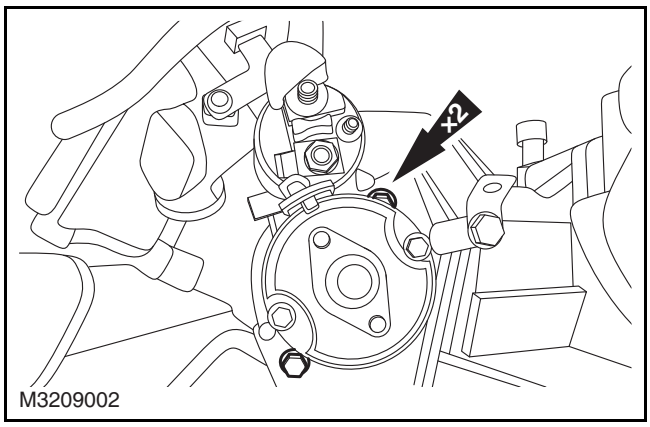



6. Remove the starting motor insulator.

   1 Remove the retaining bolt and nut from the starting motor insulator.

   2 Remove the starting motor insulator.

   Torque: 32 ± 2 Nm



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7. Remove the starting motor from the vehicle.

## Installation

1. Installation is in the reverse order of removal.

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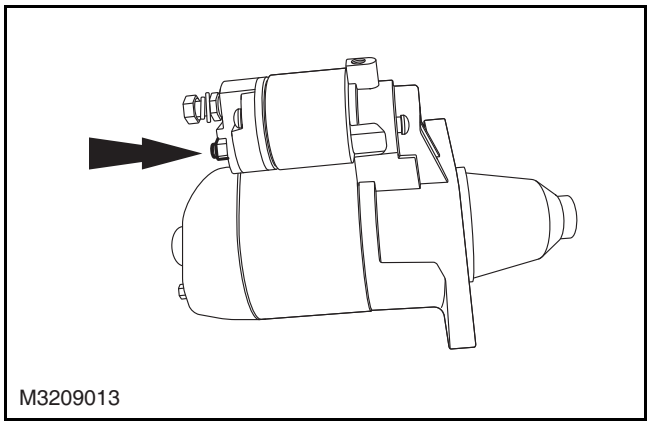


## Disassembly and Assembly

# Starting Motor

### Disassembly

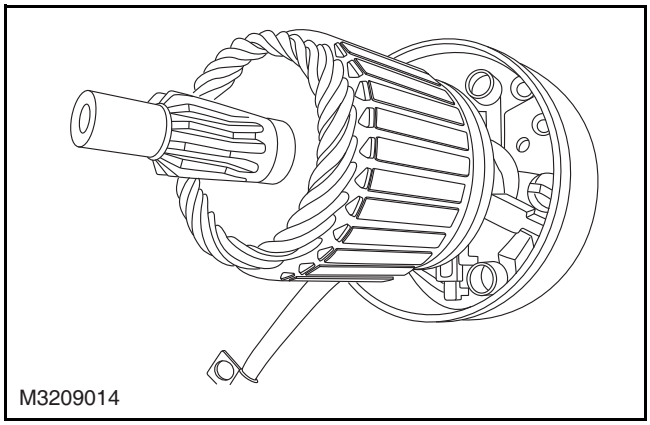
1. Remove the nut from magnetic switch and disconnect the wiring harness.


M3209013

2. Remove 2 nuts, then pull the back part of magnetic switch to remove it to disengage the inner hook from drive lever.

**CAUTION: Do not remove the magnetic switch; replace in assembling process if necessary.**

3. Remove the housing bolts and pull out the commutator end cap.
4. Remove the insulator and brush spring, then remove the brush holder.
5. Remove the stator, armature and drive lever.
6. Use snap ring pliers and screwdriver to remove the armature pressure plate, and then pull out the pinion snap ring and overdrive clutch.


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## Assembly

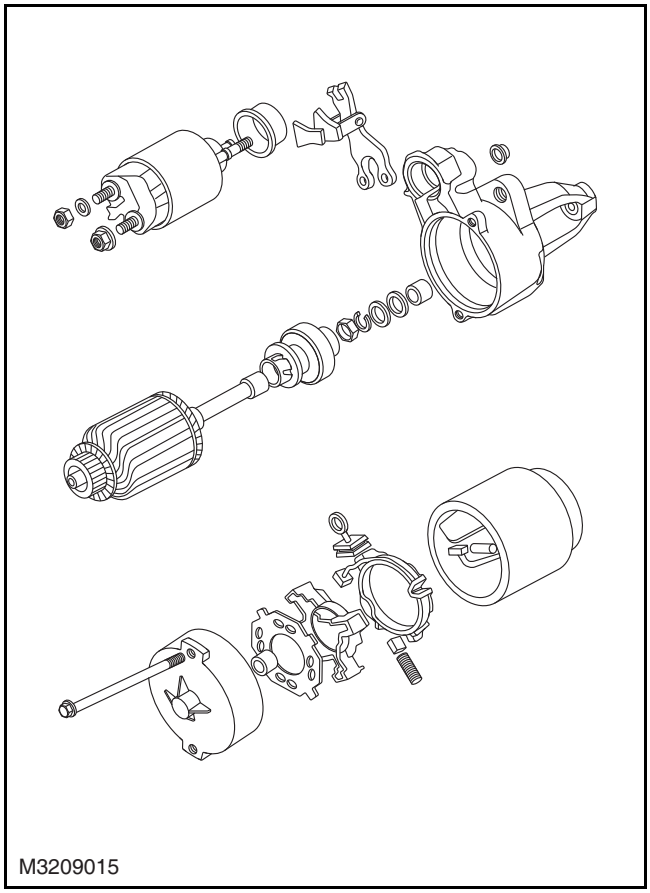
1. Inspect the components, and replace the corresponding components if necessary.

   **Refer to: (3.2.9 Starting System, General Inspection).**

2. Be sure to apply grease before installing the overdrive clutch, then use the circlip to fix the snap ring.
3. Apply grease to the drive lever and install it together with the armature and then with the drive end cover.
4. Install the stator and brush holder, and then fix the four brushes with spring, and then install the insulator.

**CAUTION: When installing the brush, make sure to remove the grease from the brush and commutator completely.**

**CAUTION: Make sure that there is no unnecessary contact between the brush and other component.**



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## Specifications

# Component Specifications

### Battery Specifications

| Item | Specifications |
|---|---|
| Type | Maintenance free |
| Nominal voltage | DC 12 V |

### Alternator Specifications

| Item | Specifications |
|---|---|
| Rated working speed | 5000 rpm |
| Voltage specifications | 14 V |
| Rated current | 70 A |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Battery retaining pressure plate retaining nut | 8 | - | 71 |
| Positive battery cable nut | 9 | - | 80 |
| Negative battery cable nut | 8 | - | 71 |
| Alternator upper retaining bolt | 50 | 37 | - |
| Alternator adjusting bracket bolt (2) | 23 | 17 | - |
| Alternator charging cable retaining nut | 9 | - | 80 |

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## Description and Operation

# System Overview

### Battery Self-discharge

Battery self-discharge is inevitable in theory. For the maintenance-free battery, self-discharge is much less than ordinary battery, but still has a certain of self-discharge. The battery power will reduce significantly even if not powered on for a long time. Battery self-discharge is mainly affected by factors as follows:

1. The higher the temperature is, the higher the self-discharge rate is. Generally, when the temperature rises for every 10°C, the self-discharge rate would also increase by about 2.7 times. The self-discharge rate of the battery is different for the vehicle in summer and winter.
2. The battery self-discharging may become serious due to the storage place conditions, such as high humidity and heavy dust.

### Battery Capacity Loss after Loading

After loading, the power loss of the battery is mainly in the following aspects:

1. Power loss in commissioning.
2. Power loss of some constant ON electrical equipments in the vehicle, such as anti-theft alarm.
3. Electricity leakage caused by poor insulation of the vehicle electrical components.
4. Without disconnecting the negative cable, power loss caused by static current and current leakage in circuit.

**CAUTION: The standing time of battery depends on many factors. Generally, fully charged battery with the negative cable disconnected can start the vehicle after standing for 6 months.**

### Charging System

Alternator is characterized by built-in solid state regulator. All components of the regulator are installed in an sealed box. The regulator and brush holder assembly are installed on the slip ring and frame, the set voltage of alternator cannot be adjusted.

Alternator rotor bearing with sufficient grease, and does not require regular lubrication. Two brushes make the current go to the rotor field coil through two slip rings. In normal circumstances, the brush can be free of maintenance for a long time.

The stator winding is assembled within the laminated iron core which is the alternator frame component. The rectifier connected to the stator winding has six diodes, which converted the AC voltage on the stator into DC voltage on the alternator output terminal. The central diode is used to convert the neutral point voltage into DC to increase the alternator output.

The capacitor that installed in the regulator assembly protects the diode voltage and suppresses the radio wave interference.

# Components Description

### Battery

The vehicle adopts maintenance-free battery. Without vent plug on the battery cover, it is completely sealed besides the two small vent holes on both sides of the battery, which is different from the conventional battery.

Compared with conventional battery, this battery has the following advantages:

1. Refilling liquid is not required within the battery service life.
2. Overcharging protection.
3. Electric leakage is not as easy as conventional battery.
4. Weight and volume is smaller, but with more capacity.

If the battery test is normal, but such faults as battery has insufficient voltage and vehicle cannot be started after the night occur, the causes can be considered from the following aspects:

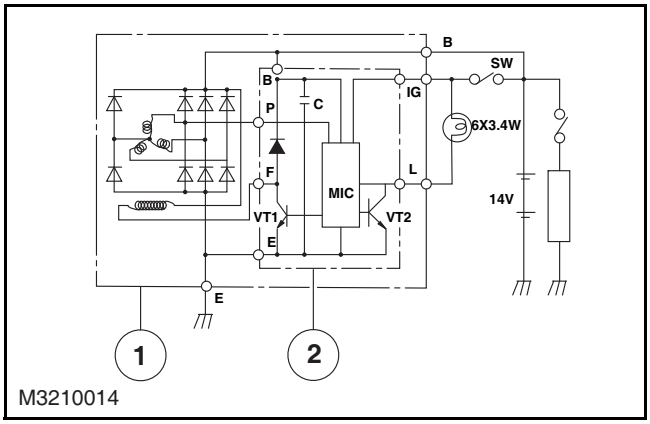
1. Electrical equipment in the vehicle is not turned off over the whole night.
2. Slow speed and stop and go.

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3. Vehicle electrical load exceeds the alternator output, especially when the vehicle is equipped with after-sale devices.
4. Charging system has faults, such as short circuit, alternator belt slipping, alternator or regulator fault.
5. Improper use of the battery, including fail to keep the battery cable terminals clean and tightened, or the pressure plate is loose.
6. Mechanical fault of the electrical system, such as wiring harness short circuit or damaged.

## Integrated Alternator Assembly operating Principle



M3210014

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Alternator | 2 | Voltage regulator |

1. When turn the ignition switch on with key, do not start engine, but battery voltage is applied on IG. After MIC detected that the IG voltage is the battery voltage, turn the triode VT1 on to energize primary field current through the rotor coil, thus making preparation for generating electricity. At this time, the alternator has not generated electricity, and regulator P point is 0. MIC sends signals to turn VT2 on to illuminate the charging indicator. When charge indicator on the meter is on, it shows the energizing of motor is normal.
2. After turn the ignition switch to ON with key to start the engine, the alternator voltage is lower than the regulating voltage, and alternator starts to operate. At this time the P point is rising; MIC turns on the VT1 from DCM to CCM, which increase the magnetic field current and raises the alternator voltage. When MIC cuts VT2 off, the charging indicator is off. Under the condition of vehicle running and the alternator operating normally, if the alternator voltage exceeds the specified regulating voltage, regulator MIC sends control signal quickly to cut VT1 off. As cut off the magnetic field circuit, the magnetic field current reduced quickly, and then the alternator voltage is dropped. when the B point voltage reduced the voltage falling below the specified value, MIC turns VT1 on to energize the magnetic circuit and raise the alternator voltage, then VT1 cut off again. Repeated operation in cycles makes alternator work normally.

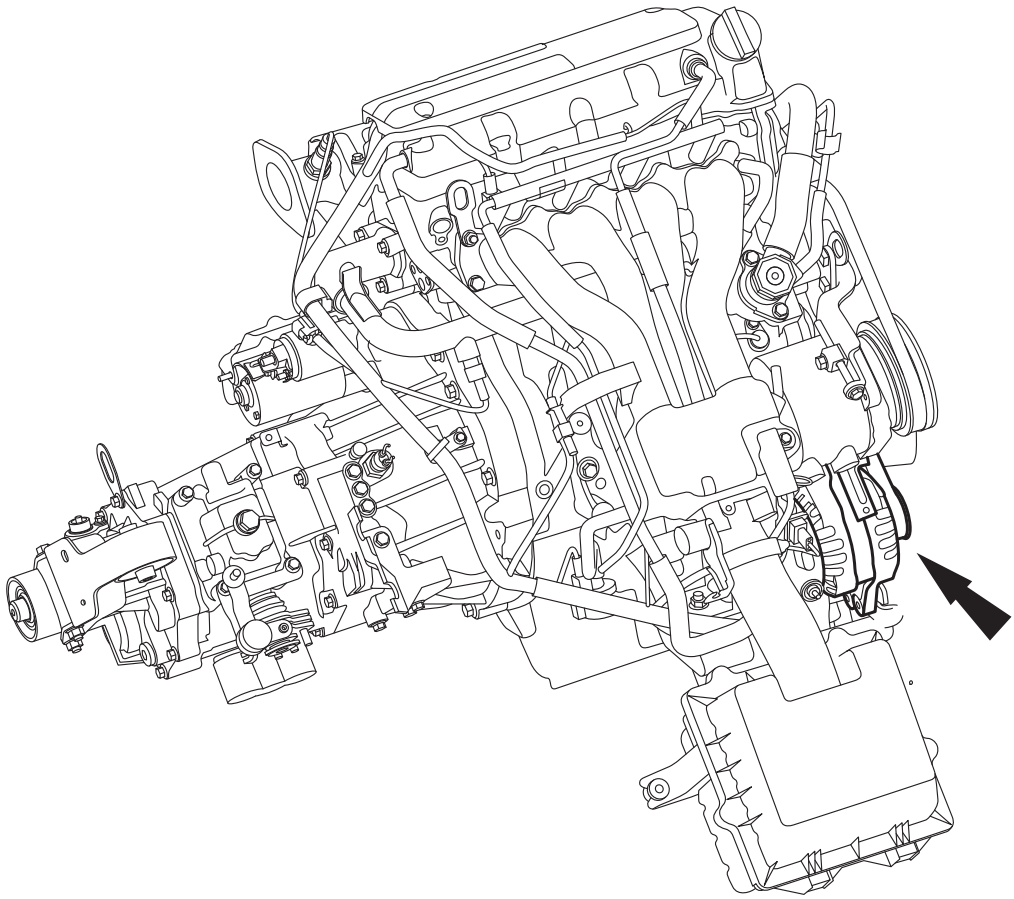
## Integrated Alternator Assembly Basic Parameter

| Index | Conventional Alternator |
|---|---|
| Rated working speed | 5000 rpm |
| Generating voltage specifications | 14 V |
| Rated current | 70 A |

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# Components Location View



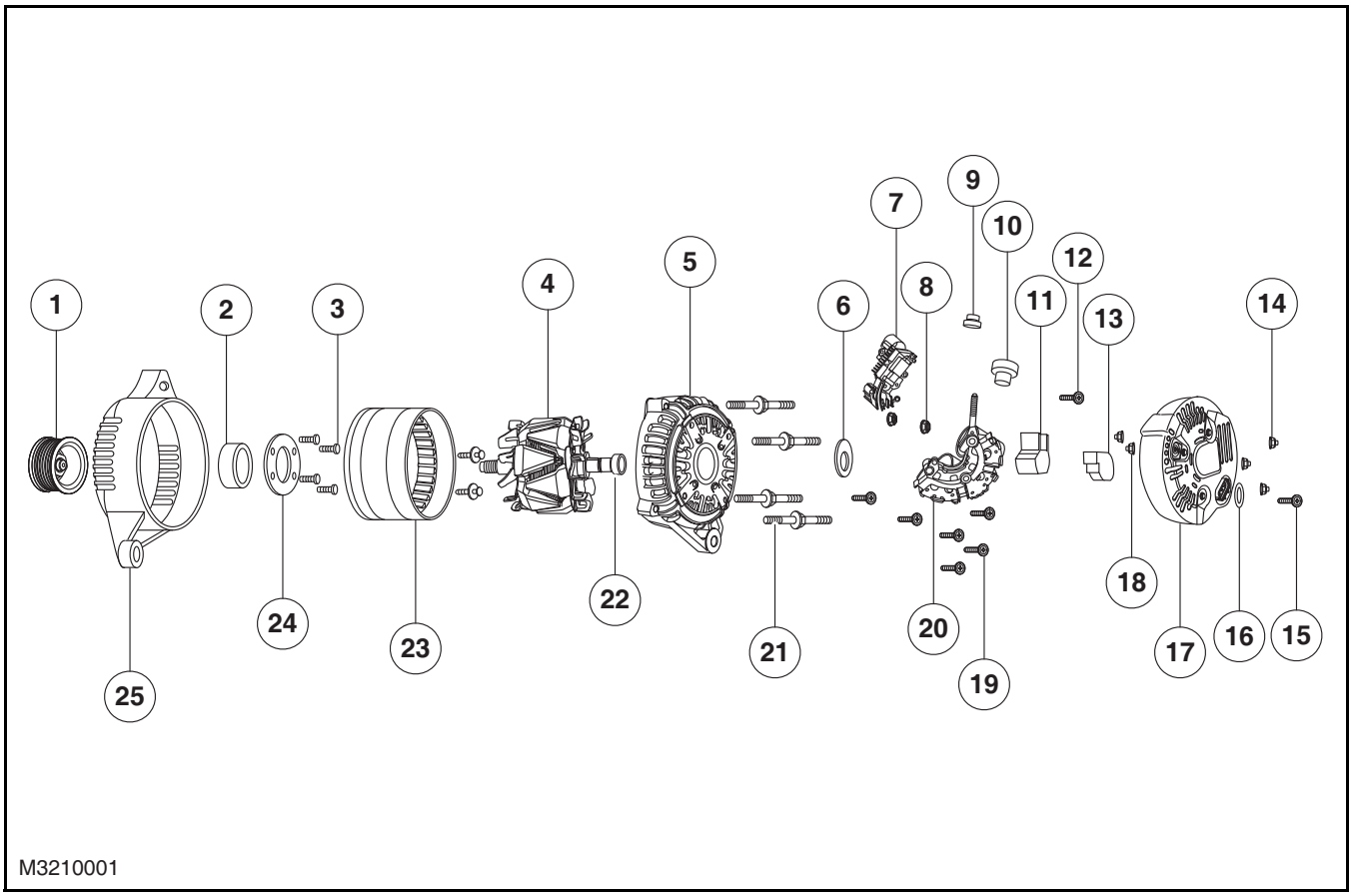
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# Components Exploded View

## Alternator

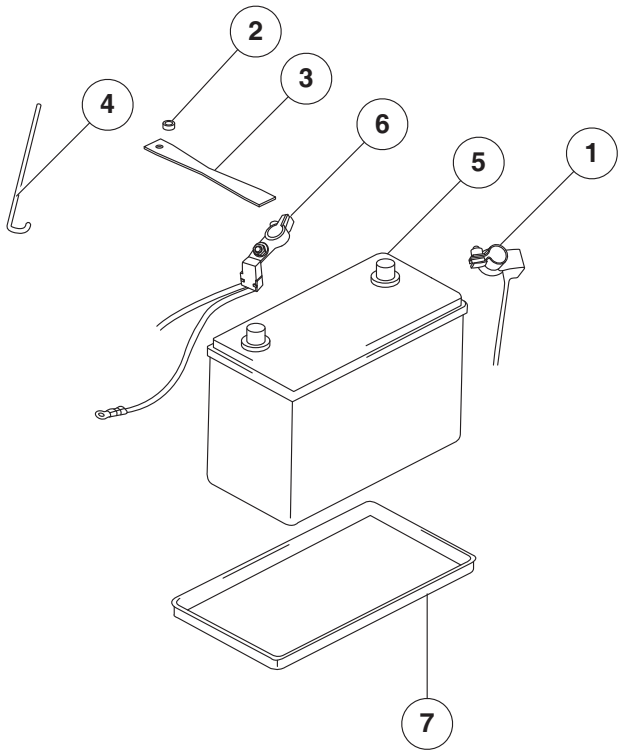



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Pulley | 14 | M5 nut |
| 2 | Front bearing | 15 | M5 bolt |
| 3 | Screw | 16 | Conducting plate |
| 4 | Rotor | 17 | Cover |
| 5 | Rear cover | 18 | M4 screw |
| 6 | Washer | 19 | Screw |
| 7 | Regulator | 20 | Rectifier |
| 8 | M5 nut | 21 | Stud bolt |
| 9 | M8 nut | 22 | Rear bearing |
| 10 | Insulation sleeve | 23 | Stator |
| 11 | Brush | 24 | Cover |
| 12 | M4 screw | 25 | Front cover |
| 13 | Rubber cover | | |

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## Battery and Accessory




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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Negative battery grounding cable | 5 | Battery assembly |
| 2 | Battery retaining pressure plate retaining nut | 6 | Positive battery cable |
| 3 | Battery retaining pressure plate | 7 | Battery tray |
| 4 | Battery retaining screw | | |

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## General Inspection

### General Equipment

| |
|---|
| Multimeter |
| Battery charger |

## Battery Inspection

1. Battery appearance inspection: Battery should be free of leakage on the surface, crack and damage in the housing, corrosion on the electrode, and the electrode wire is connected securely.
2. Inspect with a discharge detector: Press the corresponding contact hardly on the battery negative and positive. When the discharge detector pointer is in the green range for about 2 seconds, it indicates that the battery capacity is sufficient to meet high current starting demands. When the discharge detector pointer in the red range and with no other abnormalities, it indicates the battery capacity is insufficient and charging is required.
3. Use the voltmeter to inspect with headlamp as the load: according to the battery voltage measuring method, connect the voltmeter to the battery, and read the battery voltage value, and then turn on the headlamp, if the battery voltage does not drop rapidly, and keeps at 10 V or higher, the battery can start the vehicle after the charging fully. If the headlamp is turned on and the battery voltage decreases rapidly, charge the battery to restore the function. If the standing time is too long, charge the battery for a relatively longer time. It is best to charge and discharge several times to make it fully activated.

**CAUTION: It is improper to inspect the battery that just is charging, discharging or has just completed charging with discharge detector. Because the process of charging will generate a lot of hydrogen gas, when the inspection is carried out by discharging detector or resistance wire, it will generate spark and cause the gas exploded causing injury and damage.**

## Battery Charging

**WARNING: Keep the battery away from children. The battery includes sulphuric acid. Keep it away from skin, eye or clothes. Wear the goggles to avoid acidic dissolution fluid spraying into the eyes when working near the battery. In case of acid solvent spraying to the skin or eyes, wash immediately for at least 15 minutes and seek for medical treatment immediately. If acid solution is swallowed, please seek medical treatment immediately. Failure to comply with the instructions may cause serious injury and death.**

**WARNING: Battery may produce explosive gases to cause personal injury and death. So keep the flame, spark or other inflammable materials away from the battery. When getting close to the charging battery or working in that area, wear protective mask to protect face and eyes. Put the battery in a ventilated location. Failure to comply with the instructions may cause serious injury and death.**

**WARNING: When using any charging device, comply with all the manufacturers' instructions. Failure to comply with the instructions may cause serious injury and death.**

**WARNING: The battery charger switch must not be ON before connecting to the battery. Failure to comply with the instructions may cause serious injury and death.**

**WARNING: Turn off the switch before removing the battery charger from the battery. Failure to comply with the instructions may cause serious injury and death.**

**CAUTION: Do not charge the battery in the vehicle.**

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**CAUTION: Do not only use the alternator to charge the completely discharged battery, as charging system must work continuously more than 8 hours without electrical load.**

1. Remove the battery, and then put it in the water.
2. Connect the battery charger to the battery, charging as the following method.

   Constant voltage current:

   Constant voltage 14.8 V. When the charging current drop to 3 A, continue to charge for 3 hours to complete the charging process. Note that the charging current should not exceed 25 A.

   Constant voltage current:

   Charge it with 6 A until the voltage is 14.8 V, then with 3 A for 3 hours, and then the charging is completed.

## Battery Parasitic Current Test

If the battery is out of power for a long time, perform the following testing procedure to inspect whether the battery generates parasitic current.

1. Disconnect the negative battery cable.
2. Connect the positive probe of the multimeter to positive battery cable and negative probe to the negative battery cable.
3. Ensure all electrical equipment are shut down.
4. Select the mA range of the multimeter to measure current.
5. Wait for vehicle module sleep, measure the parasitic current.

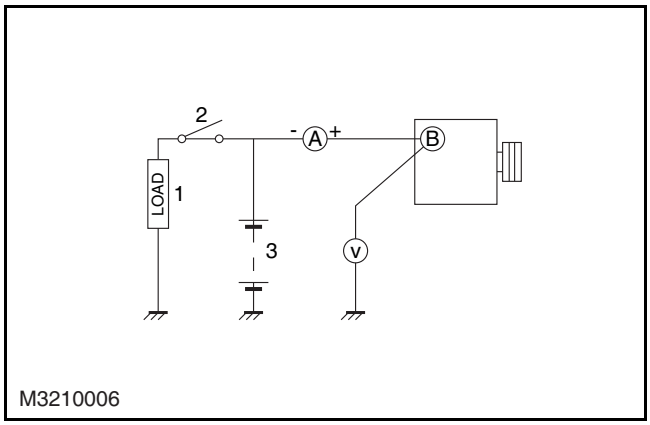
**CAUTION: The module sleep time is different depending on vehicles with different configuration.**

**Parasitic current standard value: 0.02 A or less**

## Alternator Test

1. Connect the test equipment and select the appropriate range, connect the voltmeter between alternator B terminal and grounding.

   Connect the ammeter between alternator B terminal and battery positive terminal.




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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Load | A | Ammeter measuring range: 100 A |
| 2 | Load switch | V | Voltmeter measuring range: 20 V |
| 3 | Battery | B | Alternator output terminal |

2. Test without load

   Start the engine and run it from idle speed to 2000 rpm, and then read the meter readings.

**CAUTION: The voltage will be different as the temperature of voltage regulator varies should be considered. Do not carry out this test with the discharged battery. Before the test, ensure that the battery is fully charged.**

**CAUTION: When the engine running, do not disconnect the battery terminal, otherwise you may damage the electrical components.**

**Standard current: 10 A (Max.)**

**Standard voltage: 14.2 ~ 14.8 V at 25°C**

3. Test with load

   Running the engine at 2000 rpm, turn on the headlamp and HVAC motors. Measure the current, if it is less than 20 A, repair or replace the motor.

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# Alternator Belt Tension Inspection

**WARNING: Disconnect the negative cable before inspecting and adjusting the belt tension.**

**WARNING: Read the "WARNING" content of 3.2.4 Cooling System.**

1. Inspect the belt for any cracks, cuts, deformation, wear and dirty. Replace with a new belt if necessary.

   **Refer to: Accessory Belt (3.2.2 Mechanical System, Removal and Installation).**

2. Inspect the belt tension.

   1 Inspect the belt tension with the sonic tension meter (the sonic tension meter should be located in the middle of the belt tension side span, perpendicular to the belt, and about 10 mm away from the belt).

   **CAUTION: Do not touch the belt before inspecting the tension.**

   2 The alternator belt tension should be controlled within 750 ± 50 N (before the engine is starting).

   3 If the belt tension is not as specified, readjust the alternator belt tension until it is within the specified range.

| | |
|---|---|
| Parameter setting | MASS = 4.4 g/m |
| | WIDTH = 17.8 mm/R |
| | SPAN = 208 mm |

3. Connect the negative battery cable.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, solve the fault before proceeding to the next step.
4. If there is no obvious cause, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Accessory drive belt<br>• Alternator | • Fuse<br>• Wiring harness<br>• Electrical connector<br>• Battery<br>• Battery circuit<br>• Charging system warning lamp |

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# Symptom Chart

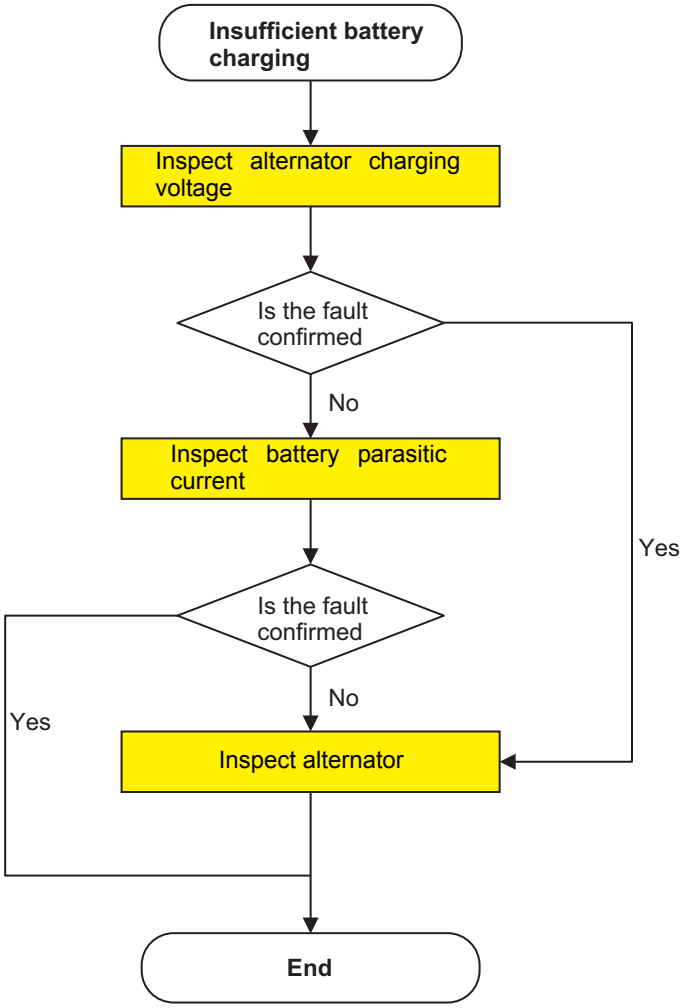
If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Insufficient battery charging | • Alternator belt<br>• Alternator regulator<br>• Alternator | • Diagnosis Procedure for Insufficient Battery Charging |
| Battery overcharging | • Alternator regulator<br>• Alternator | • Diagnosis Procedure for Battery Overcharging |
| Charging indicator constant on | • Drive belt loose or worn<br>• Alternator<br>• Circuit fault | • Diagnosis Procedure for Charging Indicator Constant ON |
| Charging indicator not on | • Instrument cluster LED<br>• Instrument cluster<br>• Circuit fault<br>• Poor contact between brushes and slip rings<br>• Voltage regulator | • Diagnosis Procedure for Charging Indicator Not ON |
| Alternator noise | • Belt<br>• Bearing<br>• Stator and rotor | • Diagnosis Procedure for Alternator Noise |

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# Diagnosis Procedure for Insufficient Battery Charging



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect alternator charging voltage | |
| | A. Start the engine and run it from idle speed to 2000 rpm.<br>B. Use a multimeter to measure the voltage between battery positive cable and negative.<br>Is the voltage not less than 14.2 V?<br>**Yes**<br>Go to step 2.<br>**No**<br>Go to step 3. |
| 2. Inspect battery parasitic current | |
| | A. Perform the inspection procedure of battery parasitic current.<br>**Refer to: Battery Parasitic Current Test (3.2.10 Charging System, General Inspection).**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Charge the battery.<br>**Refer to: Battery Charging (3.2.10 Charging System, General Inspection) or Battery (3.2.10 Charging System, Removal and Installation).** |
| 3. Inspect alternator | |
| | A. Perform the alternator test procedures.<br>Is it normal?<br>**Yes**<br>Charge the battery.<br>**No**<br>Inspect the alternator.<br>**Refer to: Diagnosis Procedure for Charging Indicator Constant ON (3.2.10 Charging System, Symptom Diagnosis and Testing).** |

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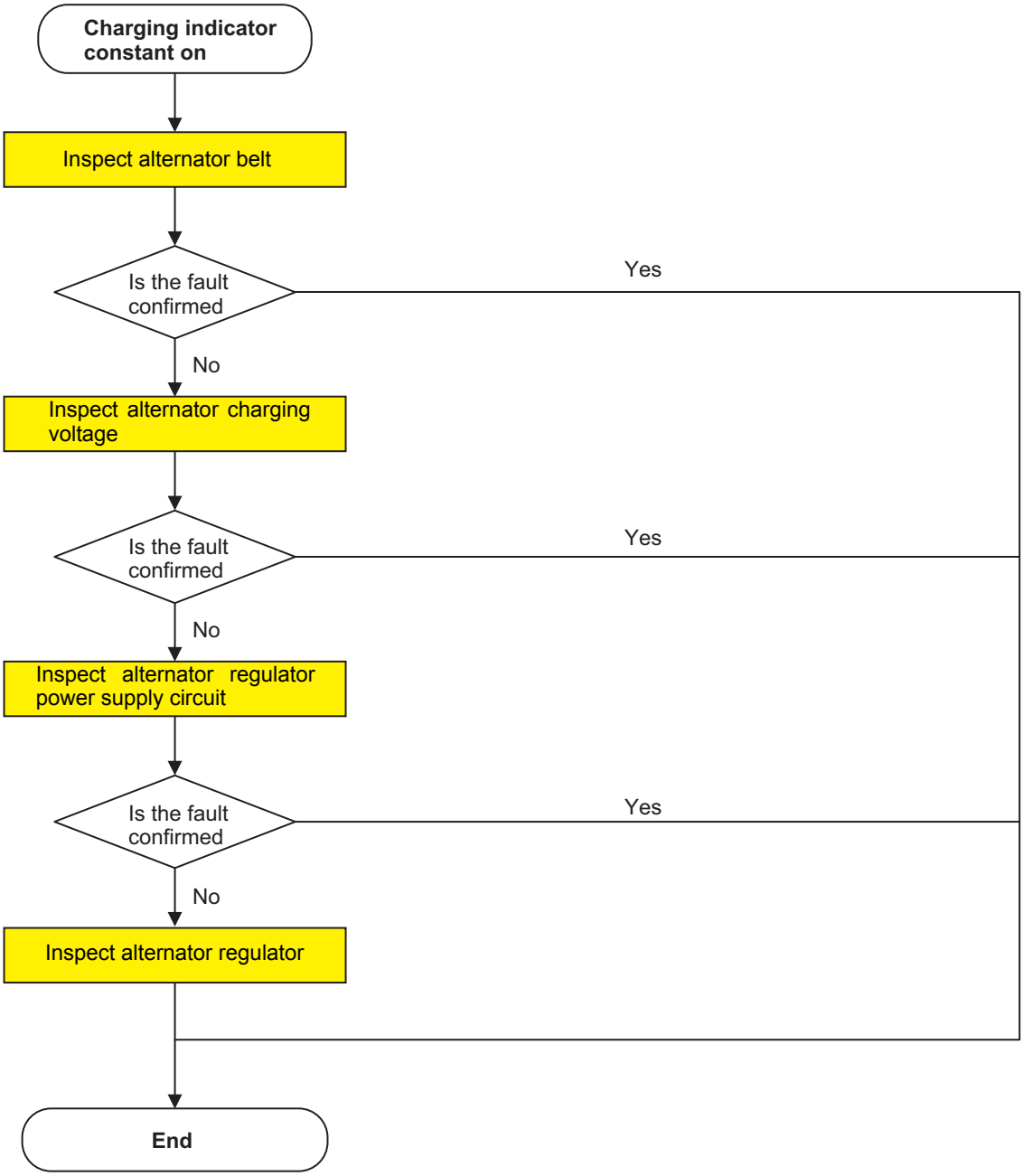
# Diagnosis Procedure for Battery Overcharging

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect alternator charging voltage | |
| | A. Start the engine and run it from idle speed to 2000 rpm.<br>B. Use a multimeter to measure the voltage between battery positive cable and negative.<br>Is the voltage higher than 14.8 V?<br>**Yes**<br>Go to step 2.<br>**No**<br>The system is normal. |
| 2.Inspect alternator regulator | |
| | A. Replace the alternator regulator.<br>Is the alternator charging voltage normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Disassemble and inspect the alternator.<br>**Refer to: Alternator (3.2.10 Charging System, Disassembly and Assembly).** |

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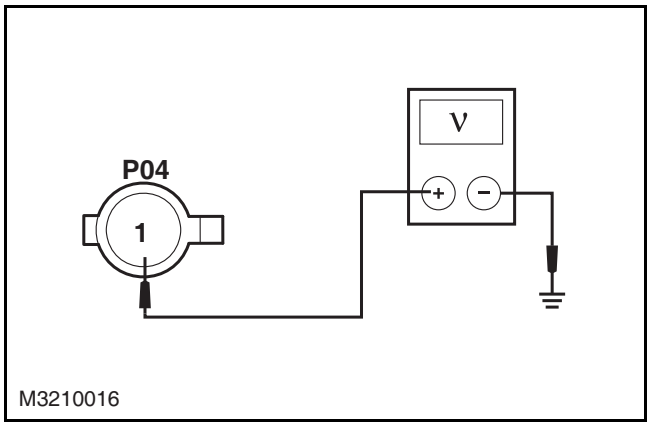
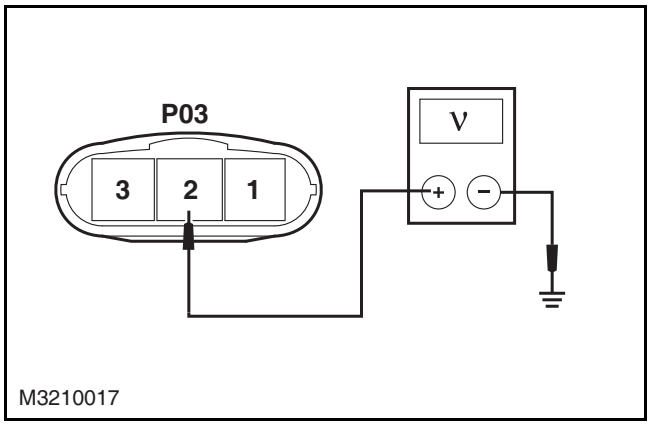


# Diagnosis Procedure for Charging Indicator Constant ON



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect alternator belt | |
| | A. Inspect the alternator belt installation.<br>B. Inspect the tension of the alternator belt.<br>**Refer to: Alternator Belt Tension Inspection (3.2.10 Charging System, General Inspection).**<br>Is the alternator belt normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Adjust or replace the accessory drive belt or tension pulley. |
| 2. Inspect alternator charging voltage | |
|  M3210016 | A. Start the engine and run it at 2000 rpm.<br>B. Use a multimeter to measure the voltage between terminal 1 of alternator output wiring harness connector P04 and grounding.<br>Is the output voltage between 14.2 and 14.8 V?<br>**Yes**<br>Repair the circuit between terminal 3 of alternator wiring harness connector P03 and terminal 24 of instrument cluster wiring harness connector P21.<br>**No**<br>Go to step 3. |
| 3. Inspect alternator regulator power supply circuit | |
|  M3210017 | A. Turn the ignition switch to "OFF".<br>B. Inspect the fuse IF33 and IF36.<br>C. Disconnect the alternator wiring harness connector P03.<br>D. Measure the voltage between terminal 2 of alternator wiring harness connector P03 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>E. Connect the alternator wiring harness connector P03.<br>Is the voltage value within the standard range?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the alternator regulator power supply circuit. |

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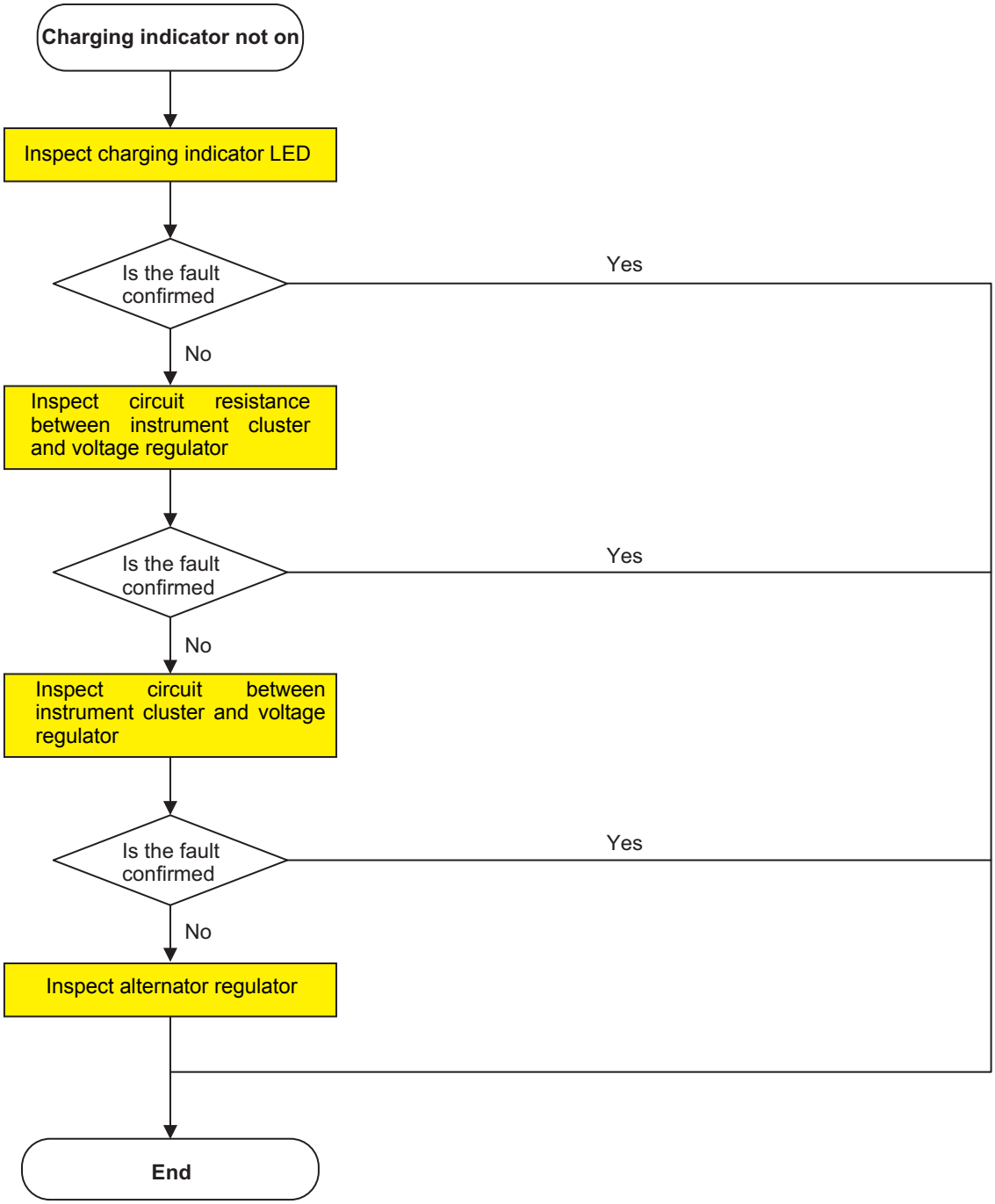


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect alternator regulator | |
| | A. Replace the alternator regulator.<br>Is the alternator charging voltage normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the alternator. |

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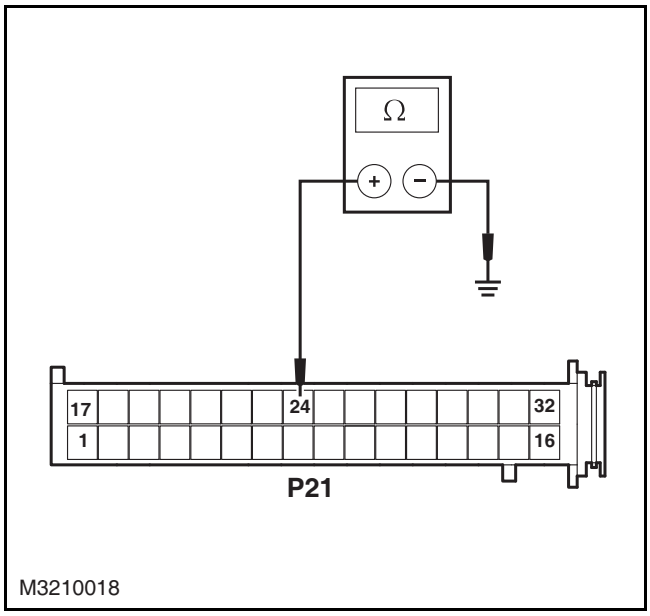


# Diagnosis Procedure for Charging Indicator not ON



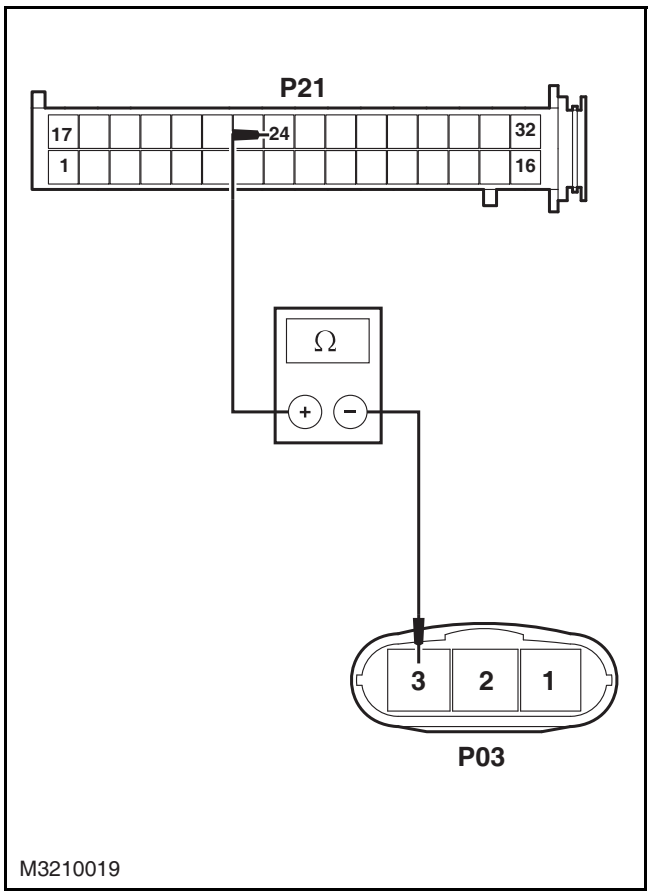
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect charging indicator LED | |
| | A. Turn the ignition switch to "ON".<br>B. Visually inspect the charging indicator.<br>If it turns off after 2 seconds?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 2. |
| 2. Inspect circuit resistance between instrument cluster and voltage regulator | |
|  | A. Turn the ignition switch to "LOCK".<br>Disconnect the instrument cluster wiring harness connector P21, and measure the resistance between terminal 24 and grounding.<br>Is the resistance value less than 1 Ω?<br>**Yes**<br>Repair or replace instrument cluster.<br>**No**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect circuit between instrument cluster and voltage regulator | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the instrument cluster wiring harness connector P21, and measure the resistance between terminal 24 and the terminal 3 of alternator regulator wiring harness connector P03;<br>Is the resistance value less than 1 Ω?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the circuit between regulator and instrument cluster. |
| 4. Inspect alternator regulator | |
| | A. Replace the alternator regulator.<br>**Refer to: Alternator (3.2.10 Charging System, Disassembly and Assembly).**<br>Does the fault solved?<br>**Yes**<br>End.<br>**No**<br>Replace the brush.<br>**Refer to: Alternator (3.2.10 Charging System, Disassembly and Assembly).** |

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# Diagnosis Procedure for Alternator Noise

Diagnosis Tips: Alternator noise may be caused by electrical or mechanical noise. Electrical noise (electromagnetic vroom) usually varies with the alternator's electrical load. This is the normal operating characteristics of all alternators, pay attention to distinguish them from each other, otherwise it will cause unnecessary customer complaints. When diagnosing the alternator with mechanical noise, first inspect if there are loose components around the alternator, mutual interference or other abnormal problems. In some cases even if the light noise inside the cabin will be transferred into the passenger compartment, if so, the alternators replacement cannot solve the fault, which lead to misjudgment.

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect alternator belt | |
| | A. Inspect the alternator belt installation.<br>B. Inspect the tension of the alternator belt.<br>**Refer to: Alternator Belt Tension Inspection (3.2.10 Charging system, General Inspection).**<br>Is the alternator belt normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Adjust or replace the alternator belt or tension pulley. |
| 2. Inspect alternator charging voltage | |
| | A. Remove the alternator belt.<br>B. Start the engine.<br>Does the alternator noise still exist?<br>**Yes**<br>Inspect the noise from compressor and booster pump.<br>**No**<br>Repair the alternator.<br>**Refer to: Alternator (3.2.10 Charging System, Disassembly and Assembly).** |

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## Removal and Installation

# Alternator

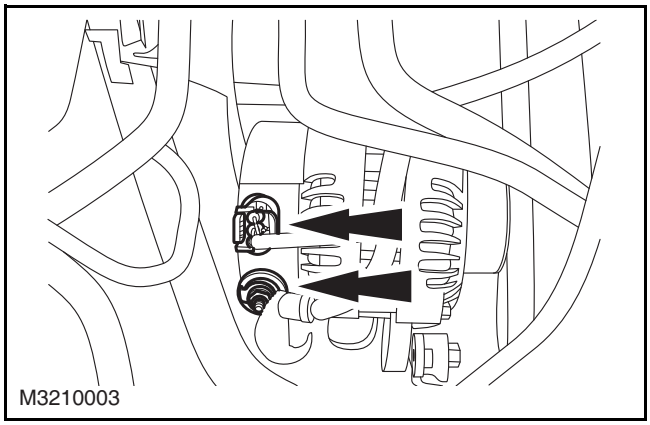
### Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

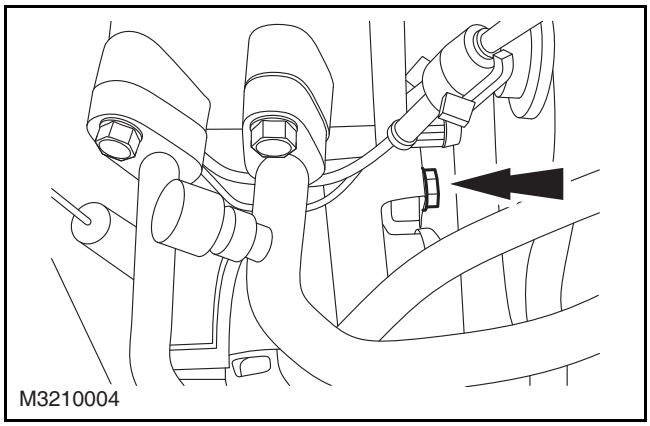
2. Disconnect the alternator wiring harness connector and remove the alternator charging cable bolt.

   Torque: 9 Nm

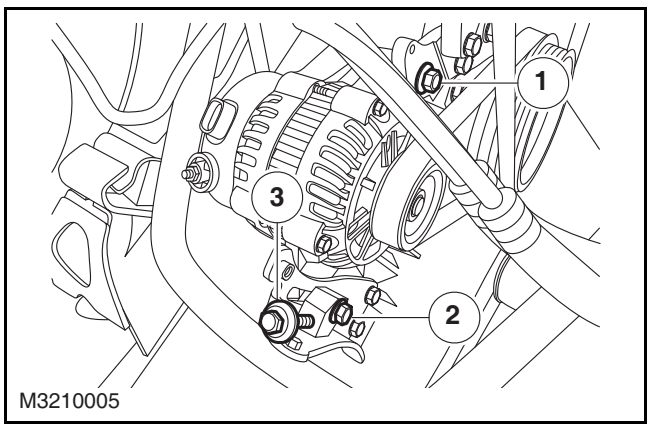

M3210003

3. Remove the alternator wiring harness bracket retaining bolt.

   Torque: 8 Nm


M3210004

4. Loosen the alternator upper retaining bolt (1), and loosen the alternator adjusting bracket bolt (2) and bolt (3) in sequence.

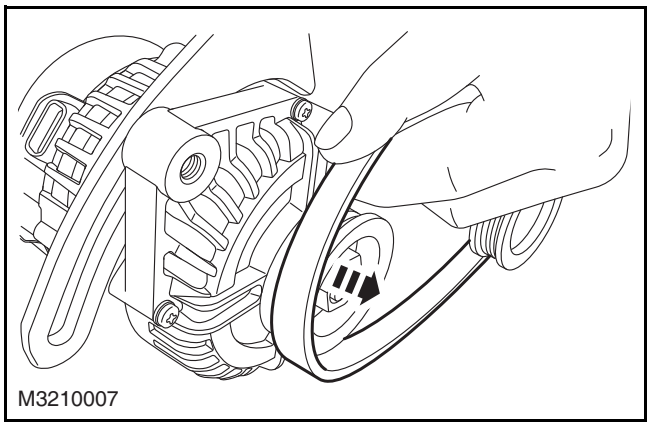


M3210005

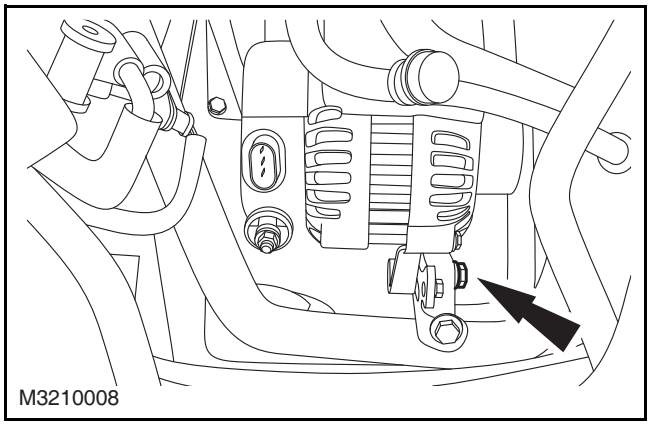
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5. Rotate the alternator belt toward the engine side until the belt can be disengaged, and then remove it.

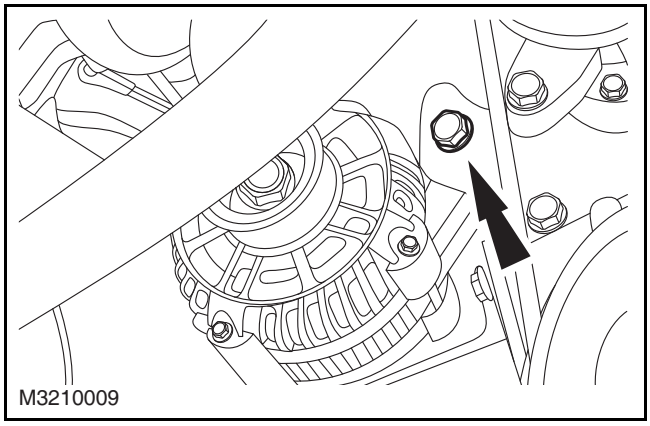

M3210007

6. Remove the connecting bolt between alternator and alternator adjusting bracket.


M3210008

7. Remove the alternator upper retaining bolt.

   Torque: 50 Nm


M3210009

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Inspect the alternator belt tension.**

**Refer to: Alternator Belt Tension Inspection (3.2.10 Charging system, General Inspection).**

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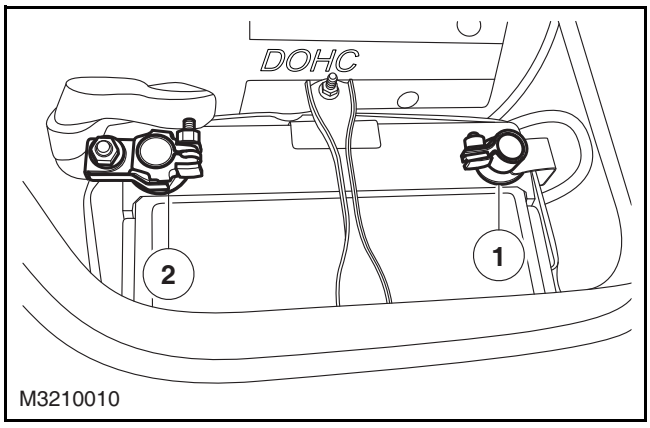
# Battery

## Removal

1. Disconnect the negative battery cable (1) and positive cable (2).

   Torque for positive cable: 9 Nm

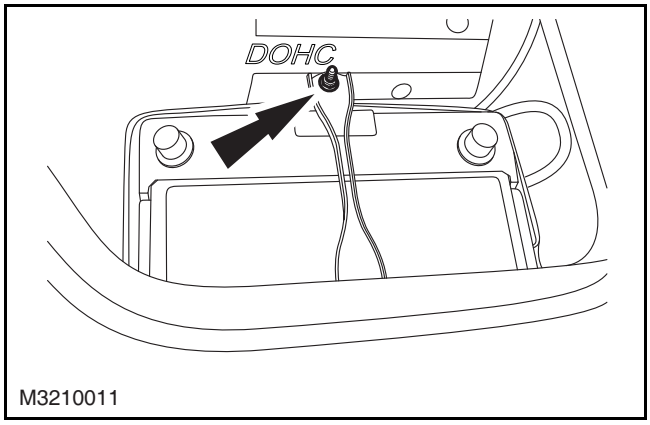
   Torque for negative cable: 8 Nm



M3210010

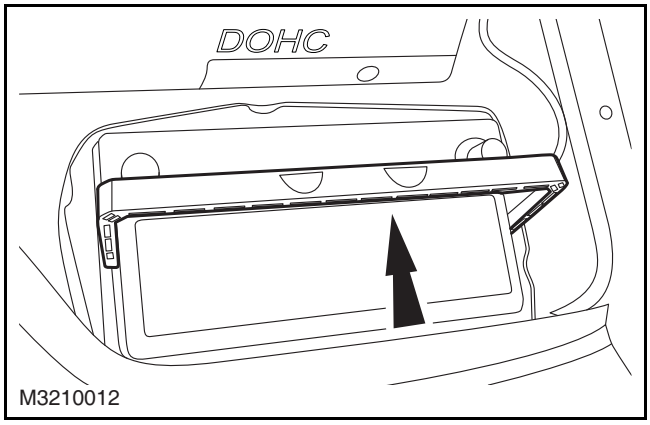
2. Remove the battery pressure plate retaining nut.

   Torque: 8 Nm



M3210011

3. Remove the battery.

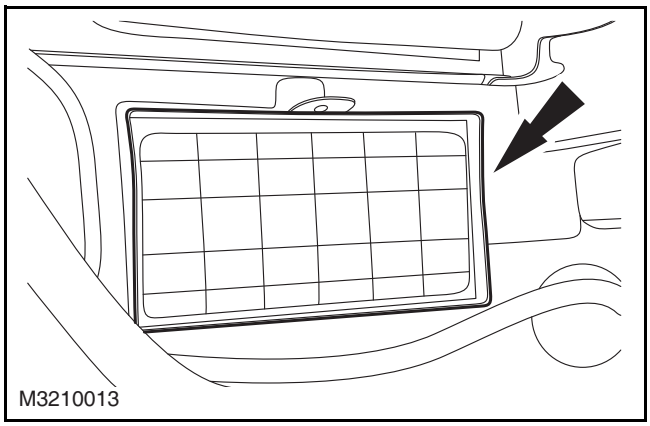


M3210012

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4. Remove the battery tray.




## Installation

1. Installation is in the reverse order of removal.

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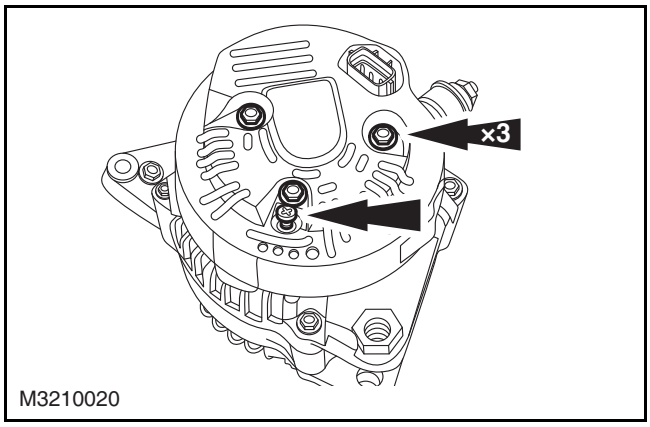


## Disassembly and Assembly

# Alternator

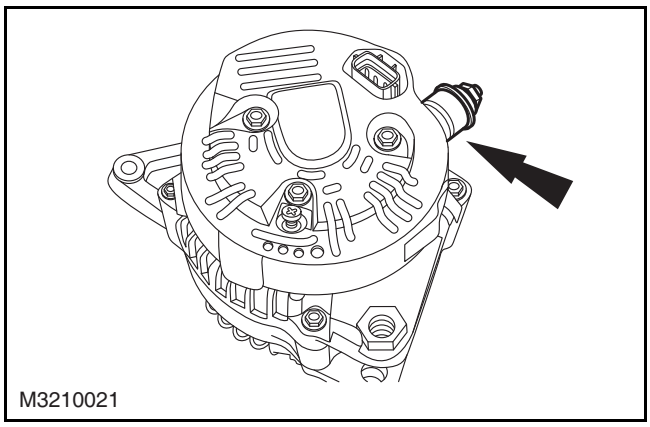
### Disassembly

**1.** Remove the retaining bolts and conducting plate at the rear cover.



M3210020

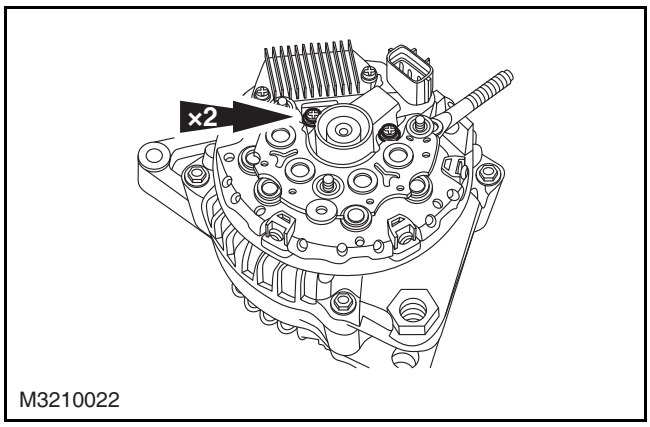
**2.** Remove the alternator output terminal insulation sleeve.


M3210021

**3.** Remove the brush.

1 Remove the brush dustproof cover.

2 Remove the brush retaining bolts.

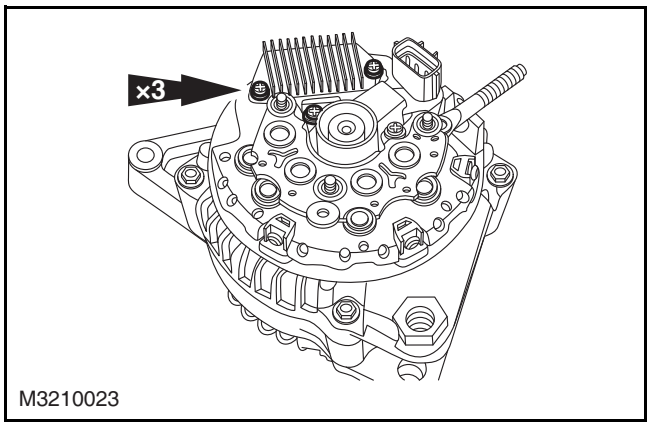


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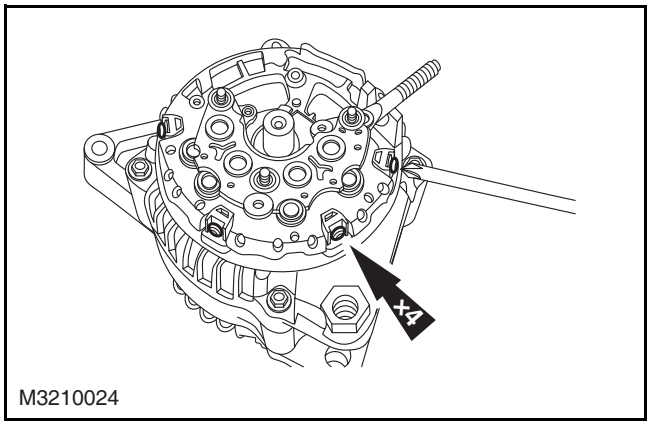


**4.** Remove the regulator retaining bolts, and remove the regulator.



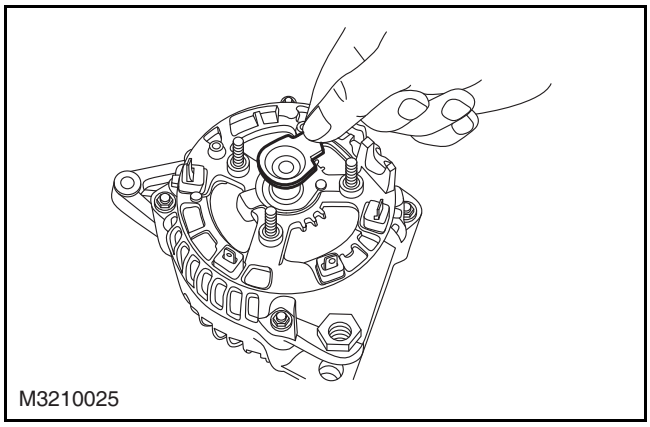
M3210023

**5.** Remove the retaining screws from stator output terminal and rectifier.

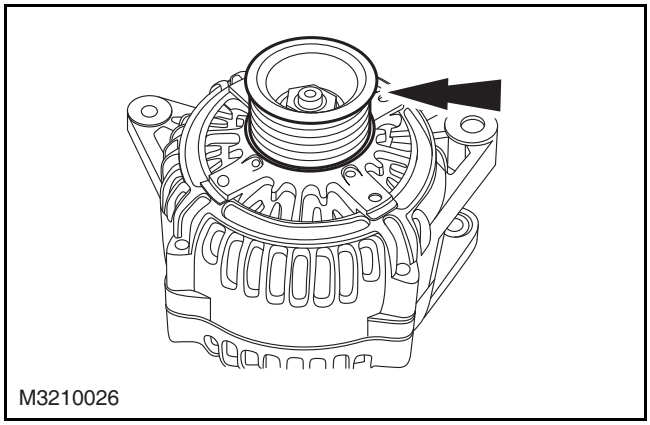


M3210024

**6.** Remove the rubber cover.


M3210025

**7.** Remove the alternator pulley.


M3210026

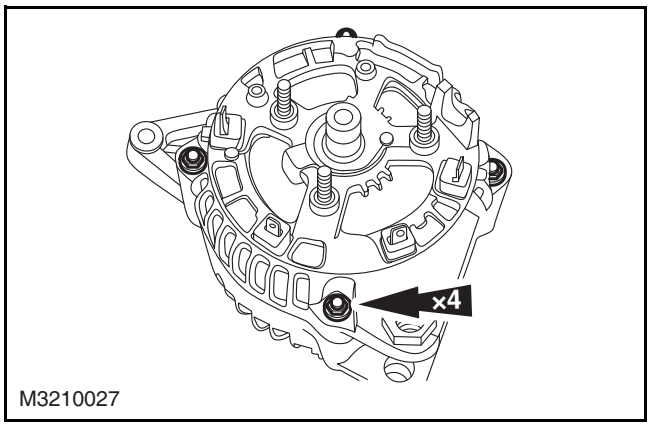
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**8.** Separate the front and rear covers.

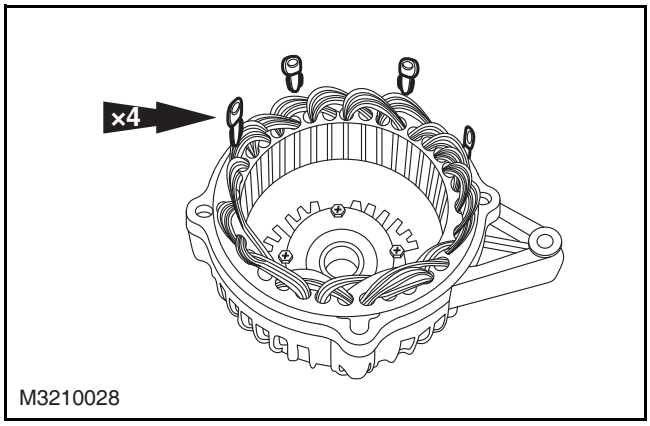
1 Remove the retaining nuts from the front and rear covers.

2 Separate the front and rear covers.



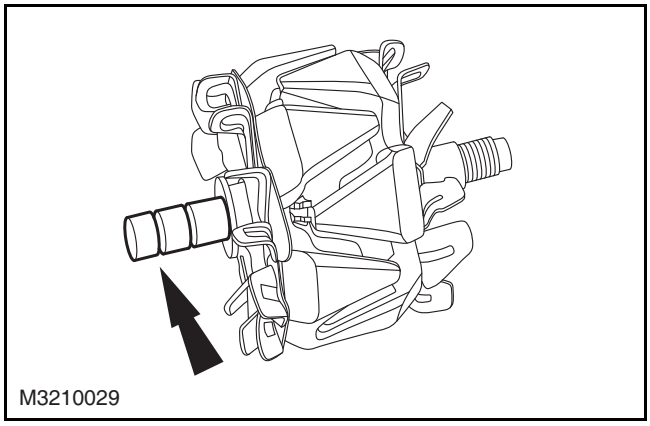
M3210027

**9.** Remove the stator, and measure the resistance between stator output terminals and alternator housing. It should be infinite, if the resistance value is abnormal, replace the stator coil.



M3210028

**10.** Measure the resistance between rotor conducting ring and rotor housing. It should be infinite, if the resistance value is abnormal, replace the rotor assembly.


M3210029

## Assembly

**1.** Assembly is in the reverse order of disassembly.

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## Description and Operation

# System Overview

### Positive Crankcase Ventilation (PCV) System

At the end of the combustion stroke, some unburned mixture gas leaks from the piston rings into the crankcase under high pressure, which is called "blow-by gas". The blow-by gas contains nitrogen oxides, carbon monoxide and hydrocarbons. If the mixed gas is not exhausted, the oil in crankcase will be diluted and deteriorated to cause premature engine component wear. The blow-by gas will escape into atmosphere from the crankcase to cause pollution. In order to avoid emission deterioration, blow-by gas getting into atmosphere and oil deterioration, positive crankcase ventilation system is adopted to conduct the blow-by gas in crankcase back to the air intake system, which go through the PCV valve and intake manifold into the combustion chamber for burning.

Positive crankcase ventilation system consists of the following components:

- Positive crankcase ventilation valve
- Crankcase ventilation vacuum tube
- Hose and joint

The main control unit of engine crankcase blow-by gas is the positive crankcase ventilation (PCV) valve. Positive crankcase ventilation valve measures the blow-by gas flow based on the manifold vacuum signal. Positive crankcase ventilation valve allows some vacuum pressure to go through the internal orifice inside the valve to form low pressure condition in the crankcase. The blow-by gas in crankcase then is inhaled into the air intake system and combusted during normal combustion. The blow-by gas inhaled into intake manifold is precisely controlled to maintain idle quality. Use precisely calibrated positive crankcase ventilation valve. The relationship between flow rate of blow-by gas and vacuum degree of engine manifold is shown in the following table:

| Manifold Vacuum Degree | Positive Crankcase Ventilation Valve Opening | Blow-by Gas Flow |
|---|---|---|
| Low | Large | Large |
| High | Small | Small |

### Evaporative Emission (EVAP) Control System

Due to temperature, shaking and other factors, the fuel stored in fuel tank will generate fuel vapor, which will escape from the fuel tank into atmosphere to cause pollution. In order to avoid this situation, fuel evaporative emission (EVAP) control system, which is an active carbon tank storage method, is adopted to control fuel vapor emission. This method can transfer fuel vapor from fuel tank to the active carbon canister, namely fuel vapor is transferred from the fuel tank to the fuel vapor recovery pipe, which will be absorbed by carbon canister and stored when the vehicle is not running. When the engine is running for a required period and the cleaning working condition is met, engine control module provides a grounding circuit, so that carbon canister control valve energized to make the air inhaled into carbon canister and mixed with fuel vapor. Then the mixture of fuel vapor is sucked out from the carbon core into the intake manifold, and consumed in the combustion stroke inside cylinder. The carbon canister control valve is controlled by the pulse width modulation (PWM) signal to open or close. The PWM duty ratio of carbon canister control valve changes according to the operating conditions determined by air flow, fuel regulator and intake air temperature.

# Components Description

### Positive Crankcase Ventilation Valve (PCV)

Positive crankcase ventilation valve includes valve body, valves, valve cover and spring.

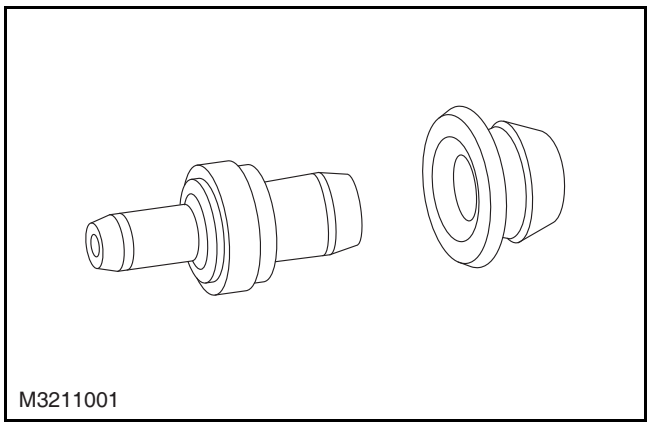
The positive crankcase ventilation valve below the lower O-ring are partially exposed in the intake manifold vacuum. The part between lower and upper O-ring is exposed in the crankcase

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gas. As these conditions occur, the leakage beyond system capacity (caused by severe worn engine, continuous overload, etc.) enters the air intake pipe, and then is brought into the engine.

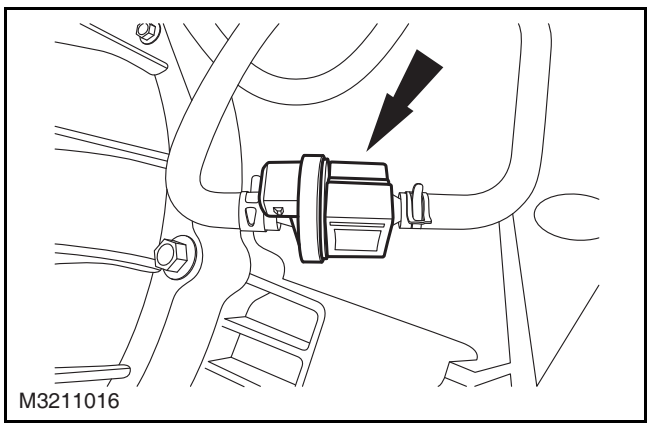
The correct operation of crankcase ventilation system depends on engine seals. If normal oxidation or dilution and crankcase ventilation system is observed, inspect the engine to determine the possible cause. Repair the manifold vacuum degree problem.


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## Carbon Canister Control Valve

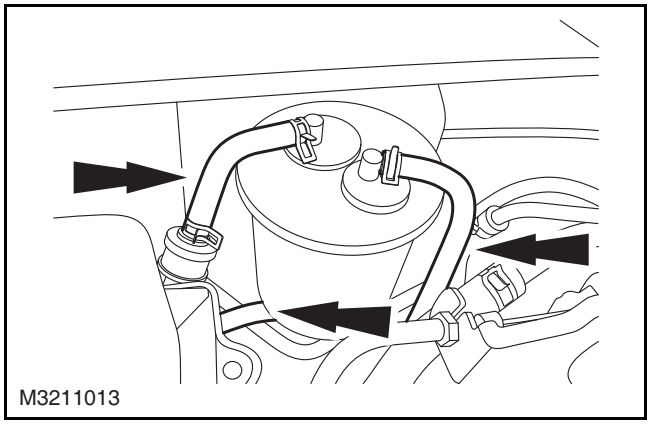
Carbon canister control valve, which is a normal close solenoid, controls the vapor flowing from the evaporative emission system into the intake manifold. The valve is controlled by the engine control module through pulse width modulation (PWM) to precisely control the fuel vapor flowing into the engine.

In some testing processes of evaporative emissions system, this valve will open to make the engine vacuum enter the evaporative emissions system.


M3211016

## Evaporative Emission Carbon Canister

Evaporative emission carbon canister is an emission control device with active carbon particles, which is used to absorb and store the fuel vapor. Fuel vapor is always stored in the carbon canister. When meeting certain conditions, the engine control module will make the carbon canister control valve energized to make the fuel vapor inhaled into cylinder for combustion.


M3211013

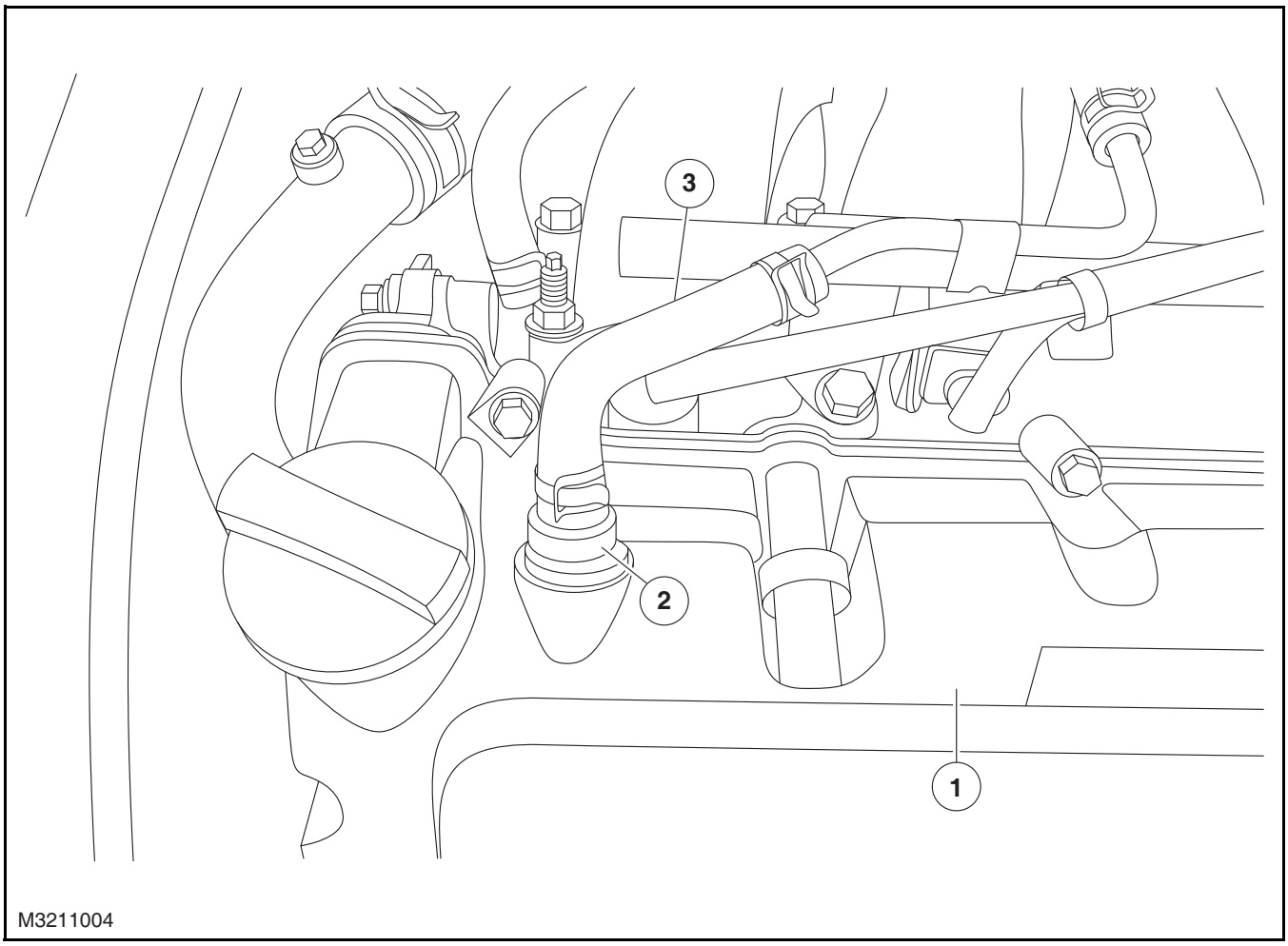
The following conditions can lead to poor engine idle, stalling and poor driving performance:

- Carbon canister solenoid does not work.
- The carbon canister is damaged.
- Hose is broken, cracked, or not properly connected to the pipe.

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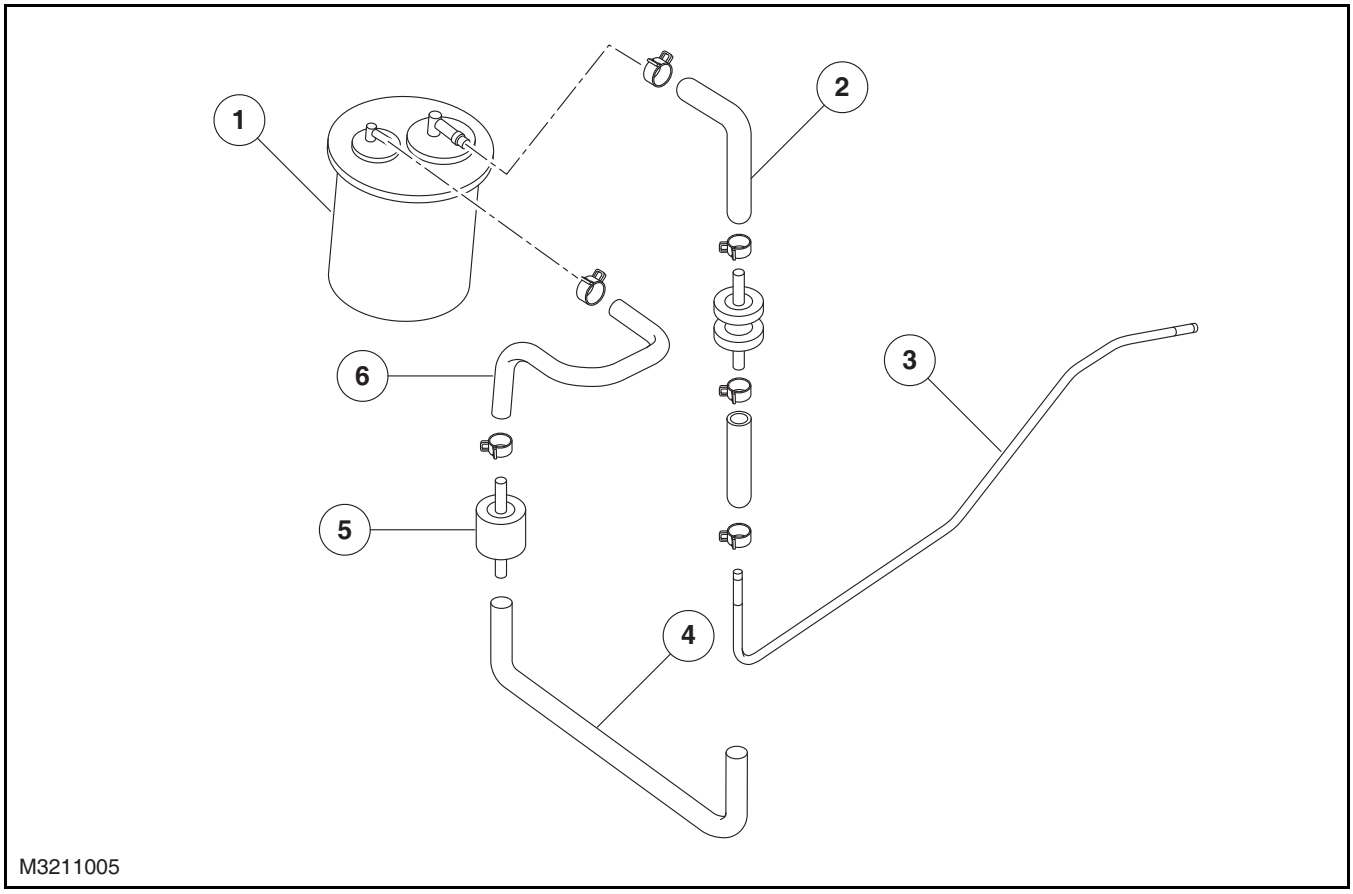
# Components Location View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Engine assembly | 3 | Air intake hose |
| 2 | PCV valve | | |

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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Carbon canister | 4 | Carbon canister control valve emission outlet hose |
| 2 | Carbon canister gas outlet hose | 5 | Carbon canister control valve |
| 3 | Fuel vapor pipe | 6 | Carbon canister control valve inlet hose |

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## General Inspection

**General Equipment**

| |
|---|
| Digital multimeter |

# PCV Valve Inspection

If the engine idle is unstable, inspect the crankcase ventilation valve for blockage, the air filter element for excessive dirty or the hose for blockage. Perform the following procedures:

1. Remove the crankcase ventilation valve from the cylinder head cover.
2. Run the engine at idle speed.
3. Put finger on the valve end to inspect for vacuum. If there is no vacuum, inspect for the following faults:
   - Hose blocked
   - Manifold port blocked
   - Crankcase ventilation valve blocked

Clogged PCV valve or hose may cause the following faults:

- Engine idle is unstable
- Engine stall or idle speed is too low
- Engine oil leakage
- Oil into the air filter
- Oil dirt in engine
- Engine crankcase pressure is too high

Clogged PCV valve or hose may cause the following faults:

- Engine idle is unstable
- Engine stalling
- Engine idle speed is too high
- Engine oil leakage

# Carbon Canister Control Valve Inspection

Perform the following procedures:

1. Remove the vacuum hose from carbon canister control valve.
2. Run the engine at idle speed.
3. Put finger on the farther end of vacuum hose, inspect whether the tube is vacuum. If there is no vacuum, inspect for the following faults:
   - Vacuum hose blocked
   - Vacuum hose cracked
4. Use appropriate gas source to blow from the inlet of solenoid, the solenoid channel should be blocked, if there is leakage, replace the solenoid.
5. Use a diagnostic tool to drive the solenoid, then use appropriate gas source to blow from the inlet of solenoid, the solenoid channel should be unblocked, otherwise, inspect and repair the solenoid fault.

# Carbon Canister Inspection

1. Inspect the filter on carbon canister ventilation pipe for blockage, crack, or deformation, replace the filter.
2. Carbon canister visual inspection: replace if there is crack or deformation.
3. Remove and shake the carbon canister, replace if there is abnormal noise.
4. Inspect the connecting hose on the carbon canister, replace if blocked or damaged is found.
5. Use suitable air source to blow from one pipe inlet of the carbon canister, gas should flow out from the other two orifices, otherwise, replace the carbon canister.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical or electrical damage.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Hose/hose joint<br>• Washer<br>• Positive crankcase ventilation valve (PCV)<br>• Vacuum tube<br>• Evaporative emission carbon canister<br>• Evaporative emission system pipe | • Electrical connector<br>• Wiring harness<br>• Fuse<br>• Relay<br>• Carbon canister control valve<br>• Engine control module (ECM) |

3. If an obvious cause for an observed or reported concern is found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the ECM for this fault, and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Crankcase pressure is too high | • PCV valve or hose blocked or damaged<br>• Crankcase ventilation oil separator blocked | • Inspect PCV system set for blockage, clean or replace when necessary. |
| | • Engine set worn or damaged | **Refer to: (3.2.2 Mechanical System, Disassembly and Assembly).** |
| Evaporative emission system leakage | • Purge pipe cracked<br>• Carbon canister broken | • Replace the purge pipe.<br>• Replace the carbon canister. |
| Evaporative emission system is blocked | • Ventilation pipe blocked | • Clean the ventilation pipe.<br>• Replace the ventilation pipe.<br>• Replace the ventilation pipe filter. |
| | • Purge pipe blocked | • Clean the purge pipe port.<br>• Replace the purge pipe. |
| | • Solenoid pipe blocked | • Clean the solenoid pipe.<br>• Replace the solenoid. |
| Carbon canister control valve fault | • Circuit fault<br>• Carbon canister control valve fault<br>• ECM fault | • Diagnose the DTC.<br>• Inspect and repair the circuit.<br>• Replace the carbon canister control valve.<br>• Replace the ECM. |

## Diagnosis Procedure for Carbon Canister Control Solenoid Fault

**Refer to: DTC P0444, P0458, P0459 (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**

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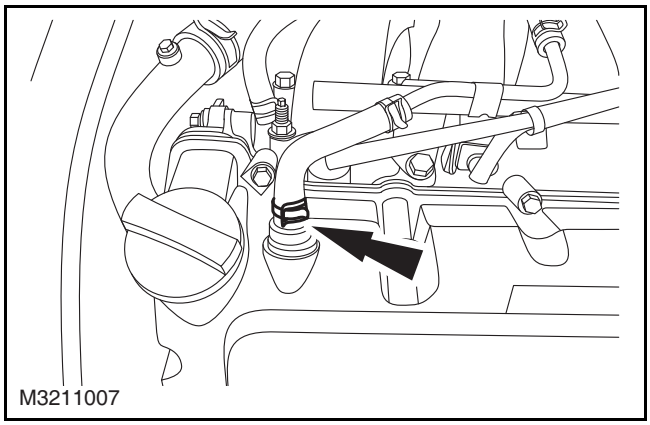


## Removal and Installation

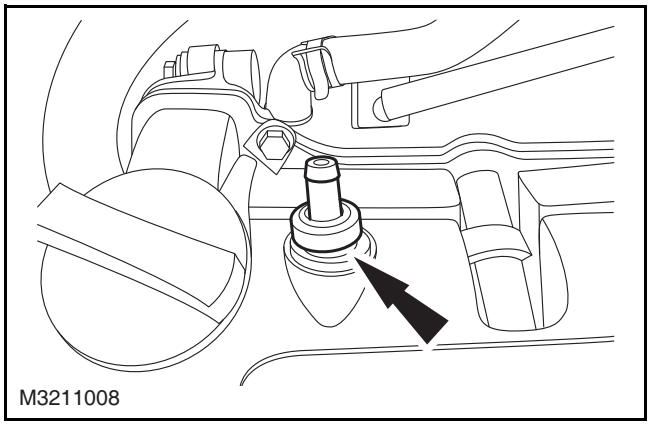
# PCV Valve

### Removal

**1.** Loosen the PCV valve vacuum tube hoop, disconnect the PCV valve vacuum tube.

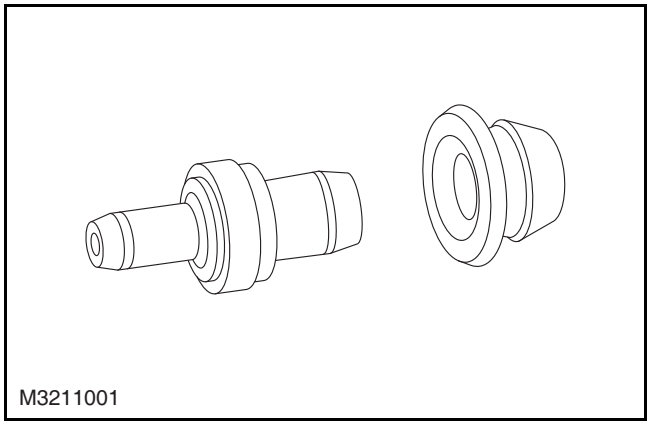

M3211007

**2.** Remove the PCV valve.


M3211008

**3.** Remove the PCV valve seal boot.

**4.** Inspect the PCV valve seal boot, replace when necessary.


M3211001

### Installation

**1.** Installation is in the reverse order of removal.

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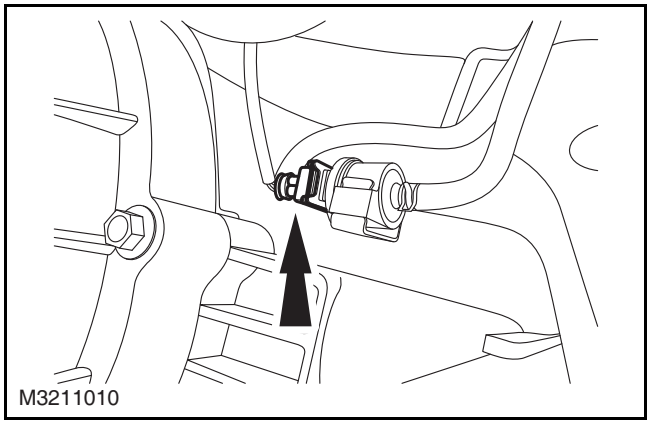
# Carbon Canister Control Valve

## Removal

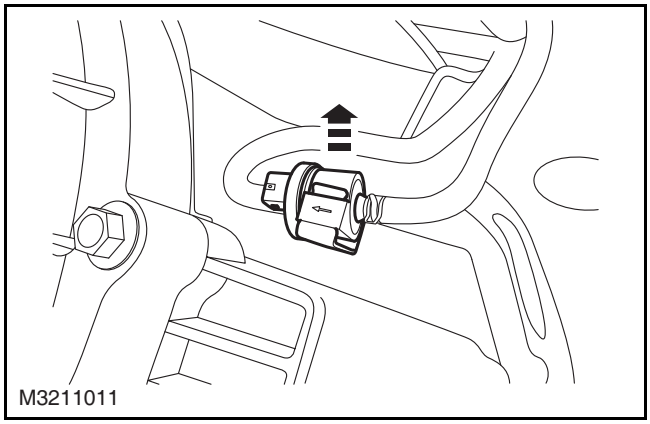
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Disconnect the carbon canister control valve wiring harness connector.




3. Disconnect the carbon canister control valve from carbon canister control valve support.




4. Loosen the carbon canister control valve hose retaining clamp and disconnect the carbon canister control valve hose.

## Installation

1. Installation is in the reverse order of removal.

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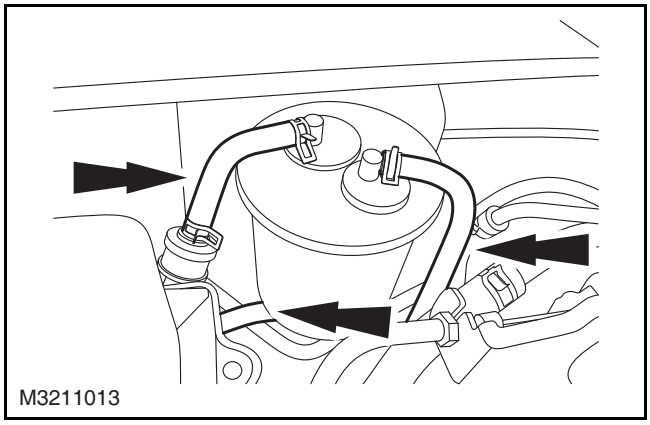
# Active Carbon Canister

## Removal

1. Disconnect the negative battery cable.

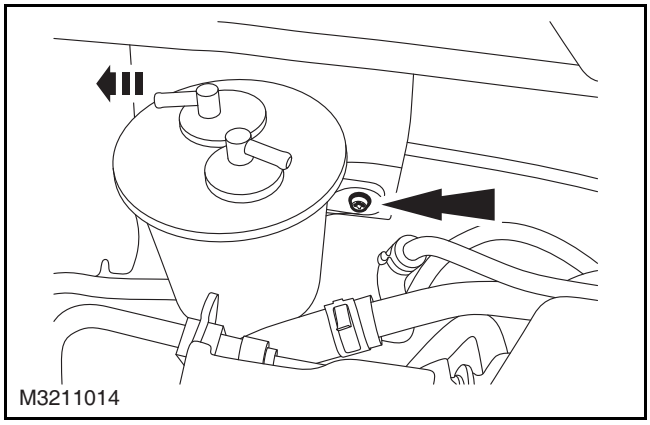
   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Disconnect the active carbon canister hose.


M3211013

3. Remove the active carbon canister retaining bolt, and then remove the active carbon canister in the direction as shown in the figure.

   Torque: 10 ± 1 Nm


M3211014

## Installation

**CAUTION: When installing the active carbon canister, it should not be installed reversely and the airflow direction must be as specified. Besides take appropriate measures such as filtration or purification, to prevent foreign objects (particles, etc.) entering the carbon canister control valve from carbon canister or hose.**

1. Installation is in the reverse order of removal.

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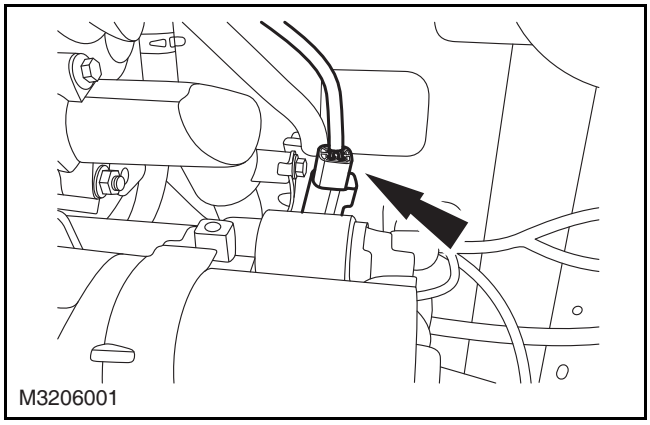
# Front Oxygen Sensor

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

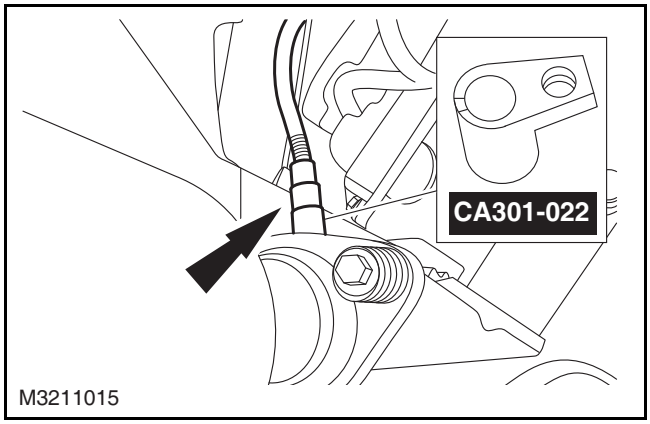
2. Disconnect the front oxygen sensor wiring harness connector.




3. Use the special tool to remove the front oxygen sensor.

   Torque: 50 ± 10 Nm

   Special tool: oxygen sensor sleeve CA301-022




## Installation

1. Installation is in the reverse order of removal.

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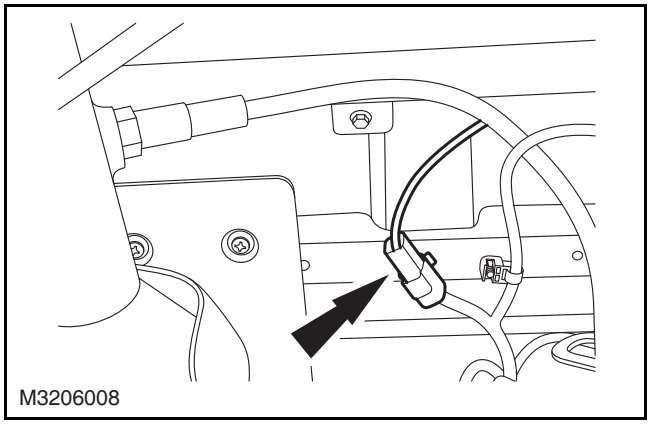
# Rear Oxygen Sensor

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

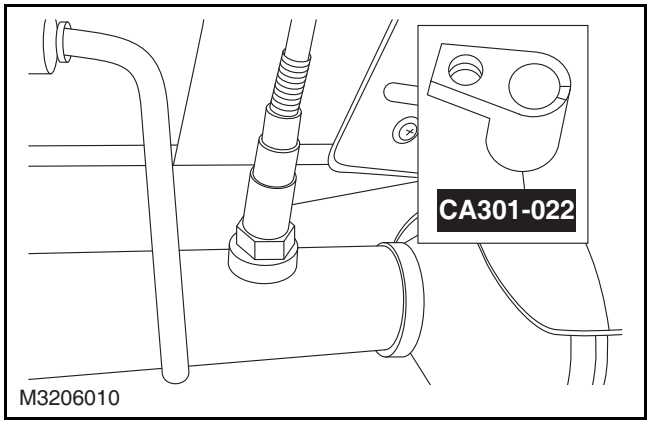
2. Disconnect the rear oxygen sensor wiring harness connector.


M3206008

3. Use the special tool to remove the rear oxygen sensor.

   Torque: 50 ± 10 Nm

   Special tool: oxygen sensor sleeve CA301-022



M3206010

## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Engine control module retaining nut | 8 ± 2 | - | - |
| Crankshaft position sensor retaining bolt | 10 ± 2 | - | - |
| Throttle position sensor retaining bolt | 1.5 - 2.5 | - | - |
| Idling stepper motor retaining bolt | 4 ± 0.4 | - | - |
| Coolant temperature sensor | 20 or less | 15 or less | - |
| Retaining bolt of intake pressure/temperature sensor | 8 ± 2 | - | - |
| Front oxygen sensor | 50 ± 10 | - | - |
| Rear oxygen sensor | 50 ± 10 | - | - |
| Knock sensor retaining bolt | 20 ± 5 | - | - |

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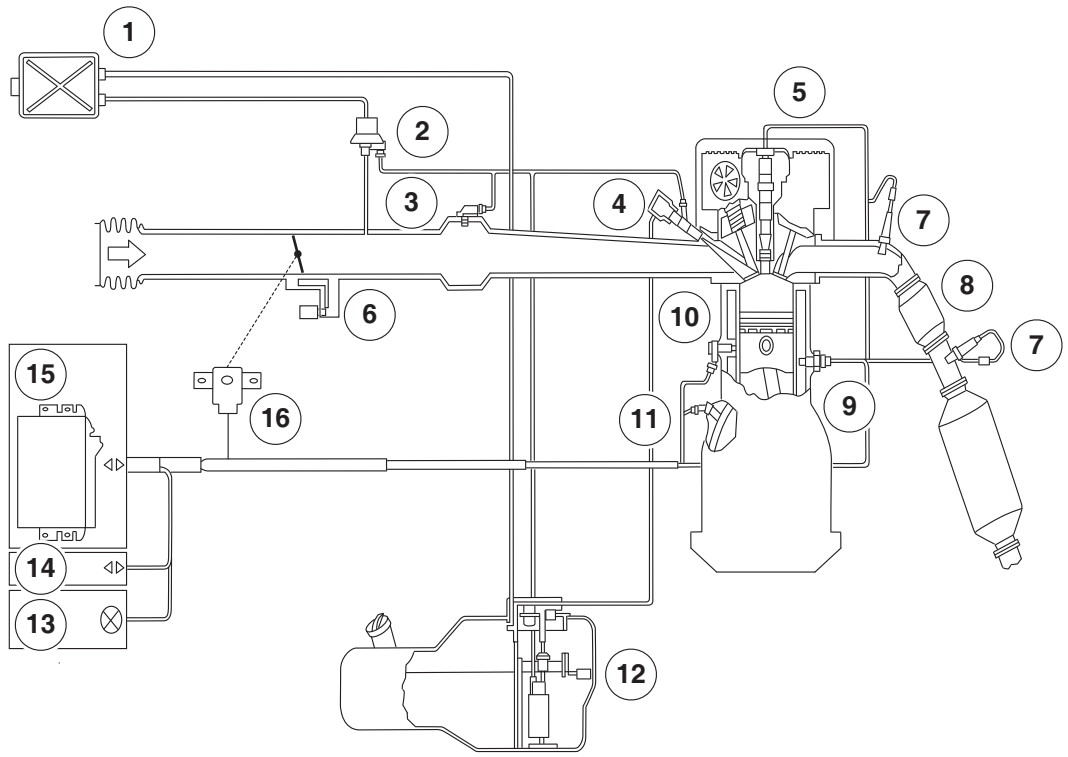


## Description and Operation

# System Overview

Engine electronic control system consists of the followings:

- Sensors that detect engine condition and operation.
- Engine control module that controls each actuator for electronic injection system according to signals from each sensor.
- Electronically controlled actuators.




M3212001

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Carbon canister | 9 | Coolant temperature sensor |
| 2 | Carbon canister control valve | 10 | Knock sensor |
| 3 | Air intake pressure/temperature sensor | 11 | Crankshaft position sensor |
| 4 | Fuel injector | 12 | Electrical fuel pump |
| 5 | Ignition coil | 13 | Malfunction indicator |
| 6 | Stepper motor | 14 | Data link connector |
| 7 | Oxygen sensor | 15 | ECM |
| 8 | Three-way catalytic converter | 16 | Throttle position sensor |

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# Control System Function Overview

## M7 System Input/Output Signals

The main sensor input signals of ECM in M7 system include:

- Air pressure and temperature signal
- Throttle rotation angle signal
- Coolant temperature signal
- Engine speed signal
- Knock sensor signal
- Oxygen sensor signal
- A/C pressure signal

After the above information goes into ECM, they are processed and then the required actuator control signals are generated, which are amplified in the output drive circuit, and are transmitted to corresponding actuator. These control signals include:

- Injection timing and injection duration
- Fuel pump relay
- Carbon canister control valve opening
- Ignition coil close angle and ignition advance angle
- A/C compressor relay
- Fan relay

Electronic control system can be divided into the following subsystems:

- Fuel injection control system
- Idle speed control system
- Fuel pump control system
- Ignition timing control system
- Radiator-fan control system
- Fuel evaporative emission control system
- Heating, ventilation and air conditioning system

## Fuel Injection Control

ECM controls the injection duration and injection timing based on various sensor signals, to ensure that appropriate gas mixture is provided in different driving conditions. There are two forms of injection timing, one is synchronous injection, which always injects at the same crankshaft angle; the other is non-synchronous injection, which is controlled based on signals from the air intake pressure/temperature sensor and other sensors.

**1.** Synchronous injection

When the engine starts, air in the intake manifold is static, the internal pressure of intake manifold shows as the surrounding atmospheric pressure. The 4 injectors will inject synchronously in each cycle of engine rotation. Fuel injection amount varies according to the engine temperature. Before the engine reaches a certain speed, the mixture needs to be enriched. Once the engine is running, the system immediately begins to reduce the cranking enrichment, and it will be completely canceled until the end of starting (600 ~ 700 rpm).

When a cylinder is in exhaust stroke after the engine starts, the injector only in that cylinder injects. ECM follows the order of cylinders 1, 3, 4, 2 to control the injection order of injectors.

**2.** Non-synchronous injection

All the injectors will not be controlled by the pressure/temperature sensor after the engine starts and meets the following two conditions.

- Fuel injection system starts to inject when fuel is cut off.
- When the throttle opening rate is higher than the specified value (throttle opens too fast).

Non-synchronous injection is generated quickly under the above two situations.

**3.** Injection time

The main factor of identifying the fuel injection time is the basic injection time value that calculated according to the engine speed, the intake manifold pressure and temperature (air intake flow), and the compensation value that is determined by signals from various sensors used for detecting the engine and operating conditions.

**4.** Fuel cut-off

The injection stops (by stopping injector) while slowing down (for example, when throttle is on idling position and engine is running at high speed). It ensures that unburned gas will not be discharged and be started again under above different conditions.

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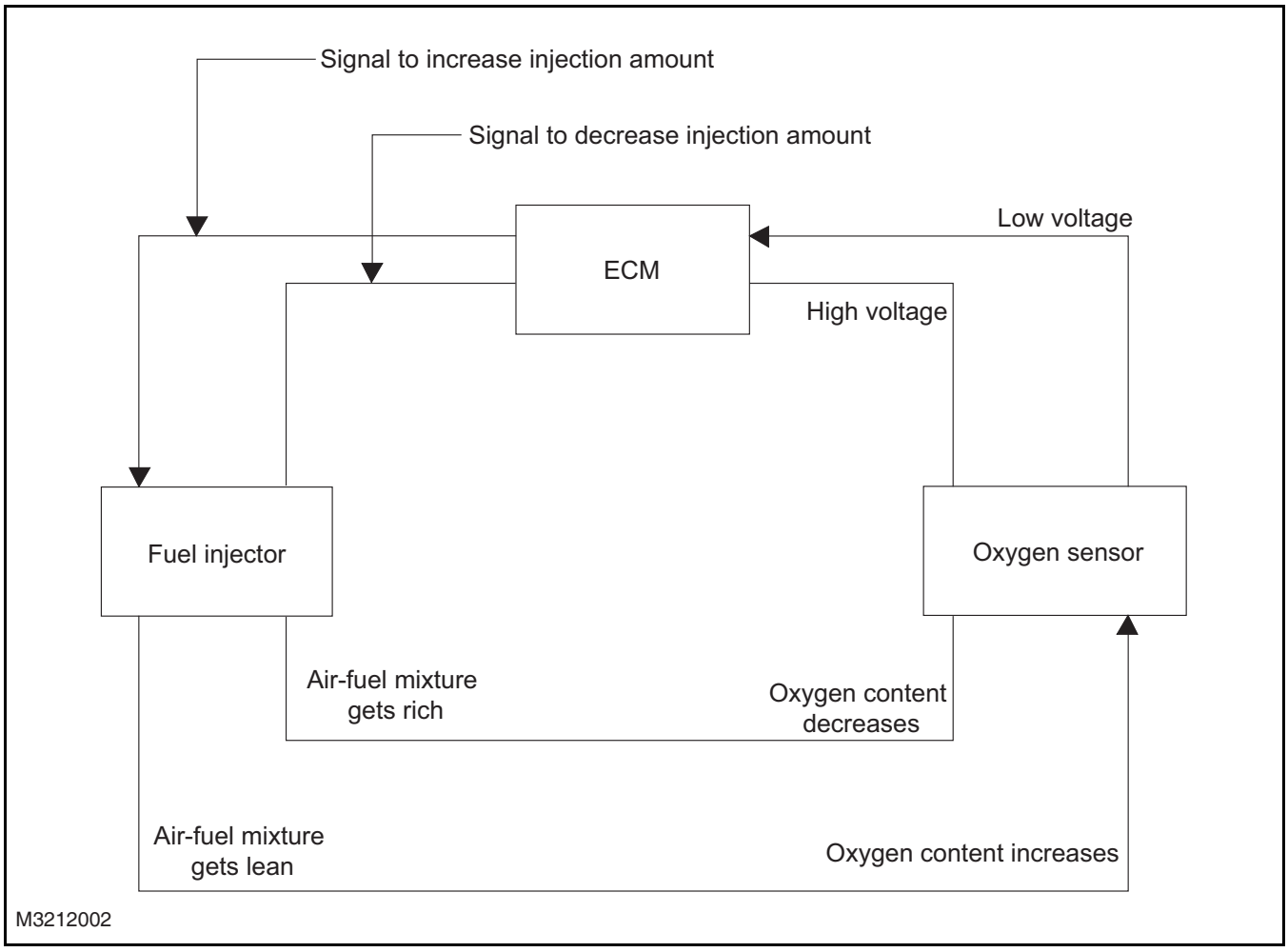
## Air-fuel Ratio Feedback Compensation (Closed-loop System)

The air-fuel mixture must be close to stoichiometric air-fuel ratio (14.7) to ensure that the three-way catalytic conversion process is fully performed and high purification rate of CO, HC and NOx in exhausting is reached.

λ closed loop control system can work only with oxygen sensor equipped. Oxygen sensor monitors the oxygen content in the exhaust gas at the up/down location of three-way catalytic converter. Lean mixture (λ is more than 1) generates about 100 mV sensor voltage and rich mixture (λ is less than 1) generates about 800 mV sensor voltage. When λ is equal to 1, the sensor voltage will change greatly. The λ closed-loop control responds to the input signal (λ is 1 or greater for too lean mixture, and 1 or less for too rich mixture) to modify the control variables, resulting in correction factor as a multiplier to correct the fuel injection duration.

When any of the following conditions is met, ECM exits from closed-loop control.

- When the engine starts and injection amount is increased after the engine starts.
- When the engine coolant temperature is too low.
- When the load is high and injection amount increases.
- When the fuel is cut off.
- When the oxygen sensor is cooled.



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## Idle Speed Control

The control system uses ECM and idling stepper motor to achieve control purposes as follows: Engine always keeps a certain speed under idling status. The idling speed of engine varies with reasons as follows:

- Add load to the engine (electrical load, for example, turn on A/C switch).
- Engine itself changes with time.
- Improve the engine start performance.
- Adjust the air-fuel ratio during deceleration (reduction buffer function).
- When engine warms up, improve its performance.

Operation:

Idle speed control operates in accordance with effective information output from ECM, which detects operation status of engine with sensors and switch signals, and controls air flow through idling stepper motor.

## Fuel Pump Control

ECM controls the fuel pump ON/OFF. In either of the following cases, it energizes the fuel pump through fuel pump relay.

- Two seconds after the ignition switch is turned off.
- When engine starts (engine start signal output to ECM).

## Ignition Timing Control

The system adopts distributorless, single-cylinder direct ignition, and each ignition coil is connected to one spark plug directly. ECM controls the internal high power transistor of injector according to the signals from sensors to cut on or off the ignition coil primary winding circuit, increasing the ignition reliability and ignition coil life and improving the engine dynamic property and economy. The control includes the following three different forms:

- Ignition timing when the engine starts (initial ignition timing)
- Engine after-start control
- Charge current time control

**1.** The ignition time after engine starts can be confirmed as follows, then the ignition occurs in the most appropriate moment under different conditions of engine.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ignition time | = | Initial ignition timing | + | Ignition timing | + | Basic ignition advance angle | + | Various compens-ation advance angles |

When the throttle is at idle speed position, ignition time is calculated based on the initial ignition timing, plus the basic ignition advance angle that is determined by engine speed and engine cooling compensation, and the idle stability related advance compensation angle.

When the throttle opening is larger than that at idle speed position, it is also calculated based on the initial ignition timing, plus the basic ignition advance angle that is determined by engine speed, air intake pressure and engine cooling compensation, and the idle stability related advance compensation angle.

## Radiator-fan Control

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The system controls radiator-fan motor ON/OFF, which is achieved through a relay controlled by ECM. When air conditioning is running or stopped, the radiator-fan motor should be turned on or off accordingly.

## Fuel Evaporative Emission Control

Fuel evaporative emission control system is used to prevent fuel vapor from evaporating. This vapor, generated from the fuel during engine run or stop, goes into the carbon canister through the tank pressure control valve, and is absorbed or stored by carbon canister. Carbon canister control valve is controlled by ECM based on various sensor signals.

Only when the following conditions are met, ECM will open the vacuum channel of carbon canister control valve.

- When the engine is at normal operating temperature.
- When the engine speed is higher than the specified value.
- When the throttle opening is larger than that at idle speed position (throttle close position).
- When the engine is running within the required load.
  The result is that the carbon canister is purified due to the air flow going through the carbon filter located at the bottom of the canister.

Fuel tank pressure control valve is used to maintain constant tank pressure. This valve opens so that the vapor goes into the carbon canister. On the contrary, when the tank pressure becomes negative and reaches its specified value, the valve opens so that air goes into the tank.

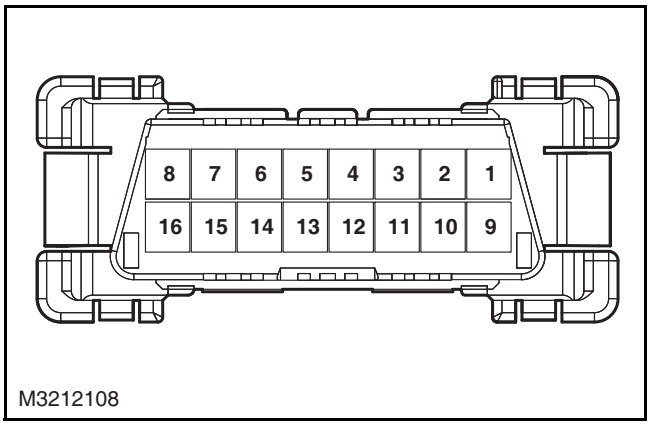
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# Fault Diagnosis Function Overview

## Diagnostic Tool and Connection

This system applies standard Data Link Connector (DLC), which is installed under the ashtray of instrument panel in the cab. Terminals 12 and 13 of DLC are connected to ground wire; terminal 15 is connected to terminal 15 of ECM, i.e. engine data K-line; and terminal 8 is connected to battery positive.



M3212108

The diagnostic tool communicates with ECM via K-line, and the following operations can be performed with it (for details, refer to diagnostic tool instruction manual):

## Engine Parameter Display

1. Speed, coolant temperature, throttle opening, ignition advance angle, injection pulse width, intake pressure, intake temperature, vehicle speed, system voltage, injection trim, carbon canister scour rate, idle speed air control, oxygen sensor wave.
2. Target speed, engine relative load, ambient temperature, ignition close time, evaporator temperature, intake flow, signal voltage of throttle position sensor, signal voltage of coolant temperature sensor, signal voltage of intake temperature sensor, signal voltage of intake pressure sensor.

## Electronic Injection System Condition Display

Cooling system condition, stable condition, dynamic condition, emission control condition, oxygen sensor condition, idle speed condition, malfunction indicator condition, A/C system condition.

## Active Test Function

Malfunction indicator, fuel pump, A/C relay, fan, ignition, injection (single cylinder with fuel cut-off).

## Odometer Display

Running mileage, running time.

## Edition Information Display

Vehicle Identification Number (VIN) (for vehicle with VIN code), ECM hardware number, ECM software number.

## Fault Display

Intake pressure sensor, intake temperature sensor, engine coolant temperature sensor, throttle position sensor, oxygen sensor, oxygen sensor heating wires, air-fuel ratio correction, fuel injector of each cylinder, fuel pump, knock sensor, crankshaft position sensor, carbon canister control valve, cooling fan relay, vehicle speed signal, idle speed, idle stepper motor, system voltage, ECM, A/C compressor relay, evaporator temperature sensor, malfunction indicator.

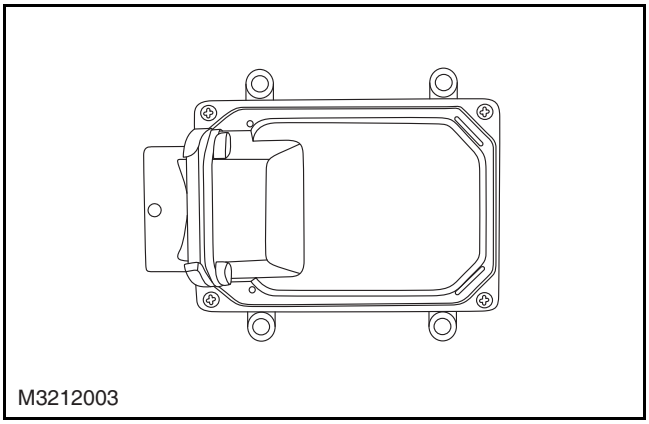
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# Components Description

## Engine Control Module

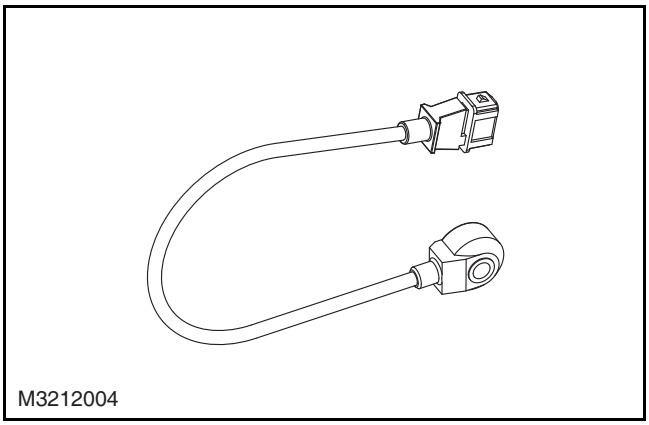
Engine Control Module (ECM), installed under the front passenger seat, receives input signals, output control signals, detects system conditions, record trouble code and illuminates the malfunction indicator when a malfunction occurs.



M3212003

## Knock sensor

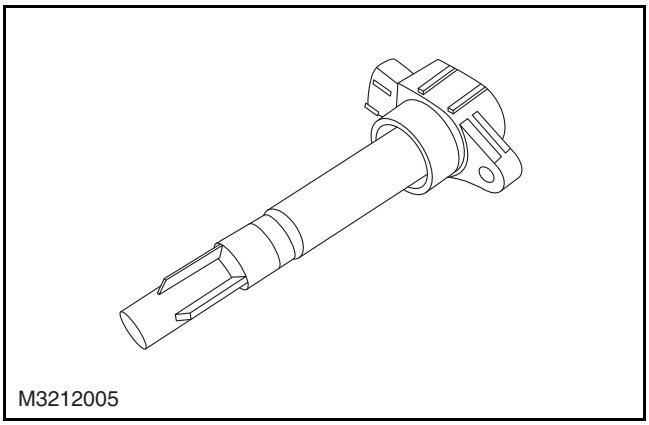
The knock sensor is directly installed on the engine block and located at the bottom of intake manifold. The knock sensor will record the vibration when engine knocking happens. ECM adjusts the ignition timing by using the knock sensor signal to avoid knocking.



M3212004

## Ignition coil

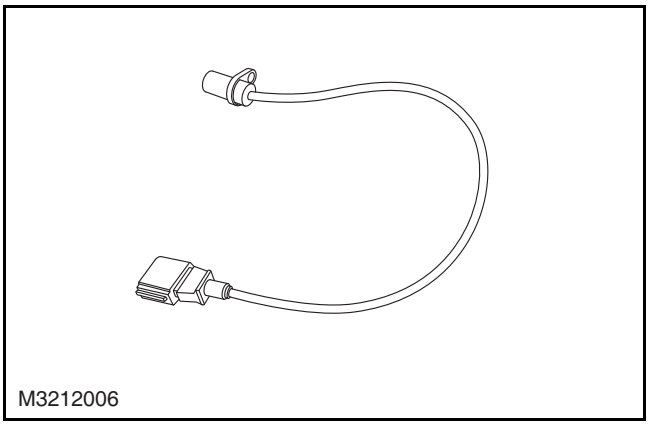
The ignition coils are located on the cylinder head cover. Each cylinder adopts an independent ignition coil, which is connected to the spark plug directly. The ignition coil transforms the low voltage of primary winding into high voltage of secondary winding, and the spark is discharged through the spark plug, igniting the mixture of air and fuel in the cylinder. ECM controls the ground of primary ignition coil.



M3212005

## Crankshaft position sensor

Crankshaft position sensor is located on the engine block, between water pump and A/C compressor. The sensor is an electromagnetic induction sensor, and detects the position and speed of crankshaft by the sensor plate on it.



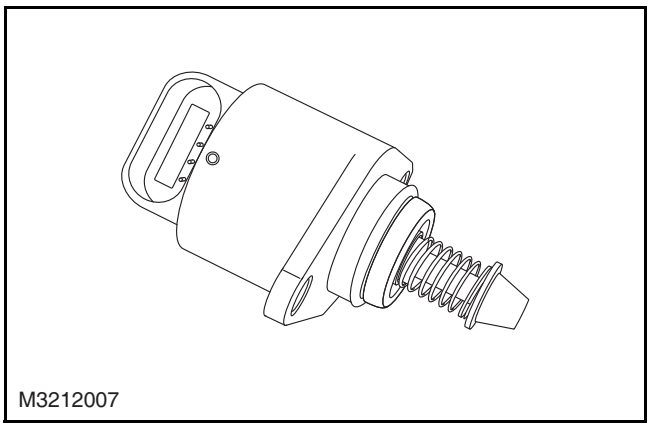
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## Idling stepper motor

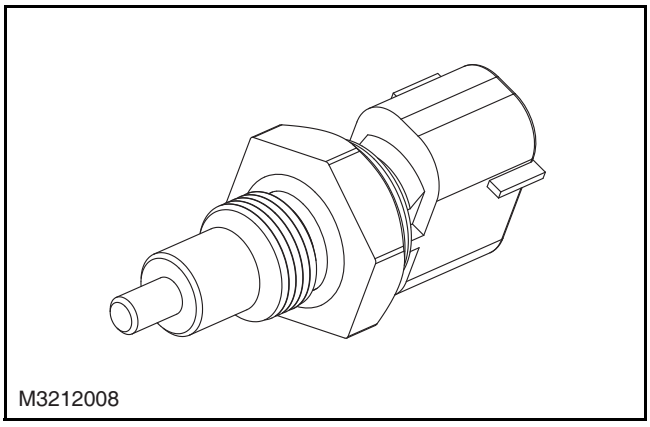
Idling stepper motor, installed on the air passage of throttle body, can change the flow area of air by-pass passage through controlling the adjustable head forward and backward on the basis of signals from ECM to regulate the air amount entering the engine, thus controlling the engine idle speed.



M3212007

## Coolant temperature sensor

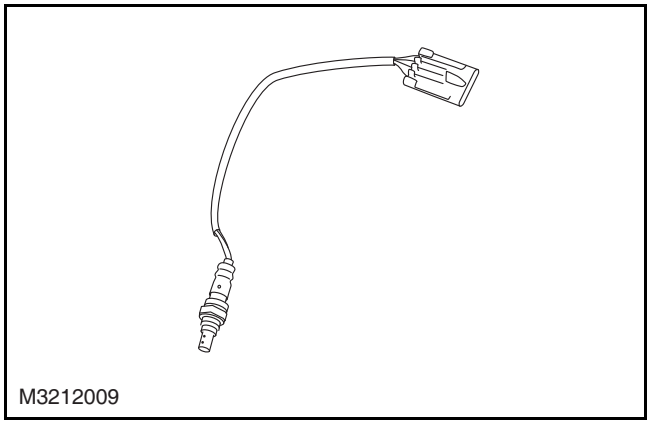
Coolant temperature sensor is mounted on the water outlet pipe of thermostat. The sensor, in which a thermistor with negative temperature coefficient is built, transforms the change of coolant temperature to that of thermistor resistance value using the temperature sensitive characteristic of thermistor, and then transforms it to voltage signal by voltage division circuit, to output to ECM.



M3212008

## Oxygen sensor

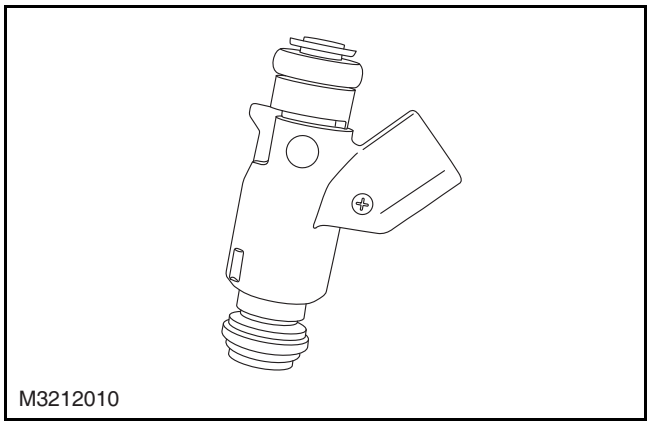
The vehicle is equipped with two oxygen sensors, which are located in the front and rear of three-way catalytic converter respectively. The oxygen sensor can detect the oxygen content in the exhaust gas, by which ECM determines whether the fuel mixture is lean or rich and performs feedback control. A heater is built into the oxygen sensor and used to heat the sensor to working temperature when the cold engine is started.



M3212009

## Fuel injector

Injector is located on the fuel rail and can inject atomized fuel to intake duct based on the command from ECM.



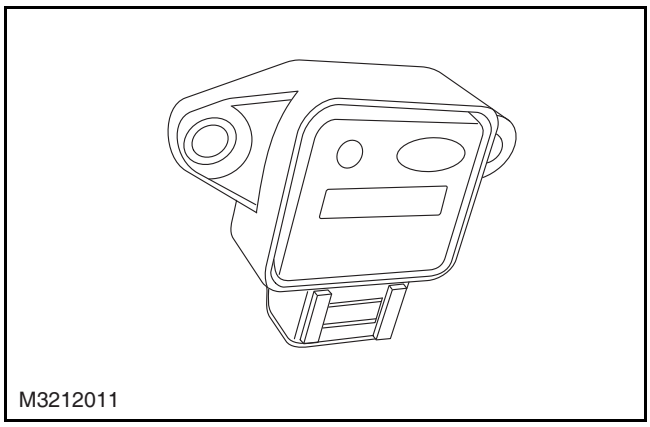
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## Throttle position sensor

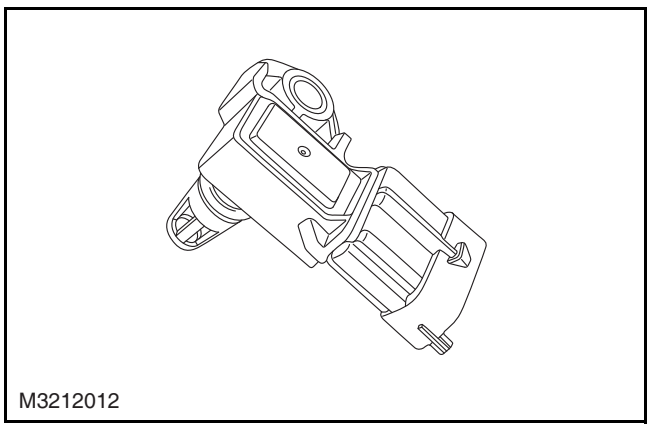
Throttle position sensor, located on the throttle body, is used to detect the throttle opening angle and output the voltage signal to ECM as engine load signal, thus making a judgment of engine operation.



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## Air intake pressure/temperature sensor

Air intake pressure/temperature sensor is located on the intake manifold and integrated with pressure sensor and temperature sensor. Based on sensor signals and other information, ECM regulates the injection amount.

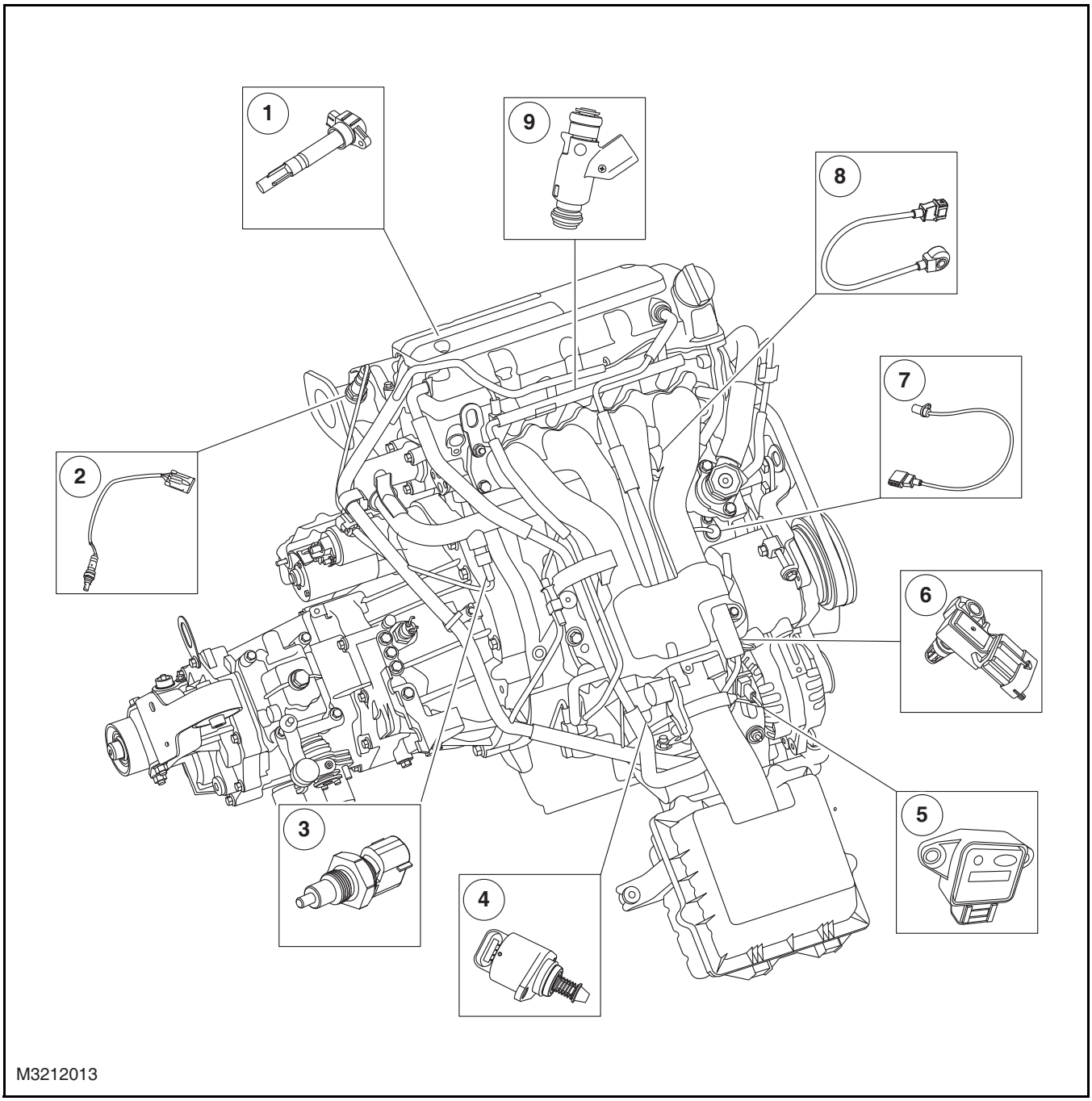


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# Components Location View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Ignition coil | 6 | Air intake pressure/temperature sensor |
| 2 | Oxygen sensor | 7 | Crankshaft position sensor |
| 3 | Coolant temperature sensor | 8 | Knock sensor |
| 4 | Idling stepper motor | 9 | Fuel injector |
| 5 | Throttle position sensor | | |

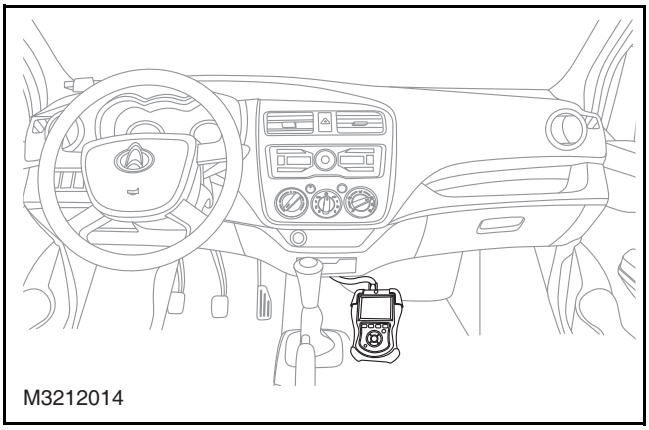
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## General Inspection

### General Tool

| |
|---|
| Diagnostic tool |
| Multimeter |



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## DTC Read Procedure

1. Carry out necessary vehicle preparation and appearance inspection.
2. Connect the diagnostic tool to data link connector in the cab.
3. Use the diagnostic tool to read the DTC.

## Data Flow Read Procedure

1. Carry out necessary vehicle preparation and appearance inspection.
2. Connect the diagnostic tool to data link connector in the cab.
3. Use diagnostic tool to enter the engine system to read the data flow.

## Active Test Procedure

1. Carry out necessary vehicle preparation and appearance inspection.
2. Connect the diagnostic tool to data link connector in the cab.
3. Use the diagnostic tool to enter Actuators menu, and carry out the desired active test.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Multimeter |
| Diagnostic tool |
| Exhaust backpressure gauge |
| Cylinder pressure gauge |
| Fuel pressure gauge |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and diagnose the system with diagnostic tool.

### Visual Inspection Chart

| Electrical |
|---|
| • Fuse<br>• Relay<br>• Wiring harness<br>• Electrical connector<br>• Sensor<br>• Switch<br>• Engine Control Module (ECM) |

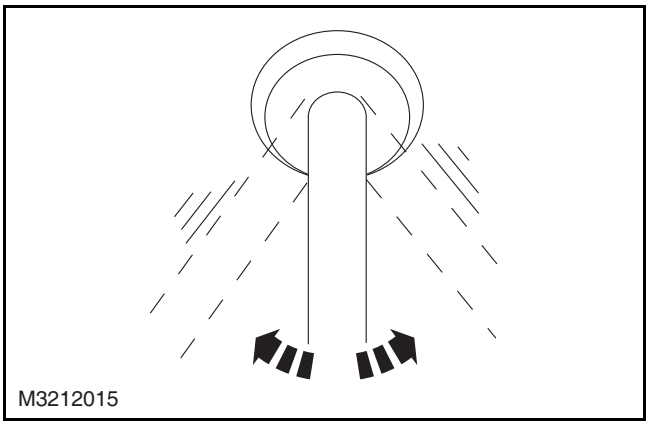
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# Intermittent Malfunction Diagnosis Procedure

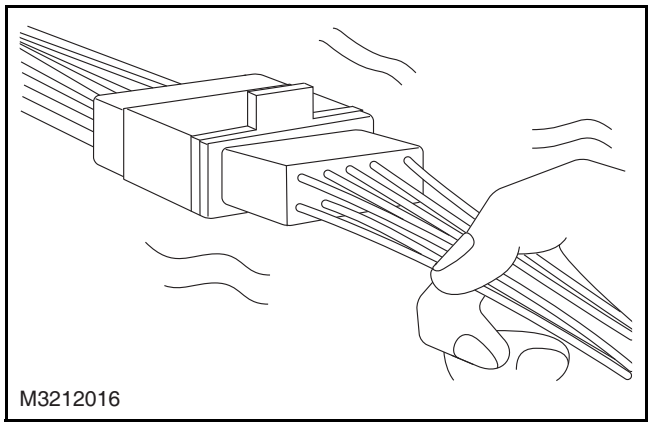
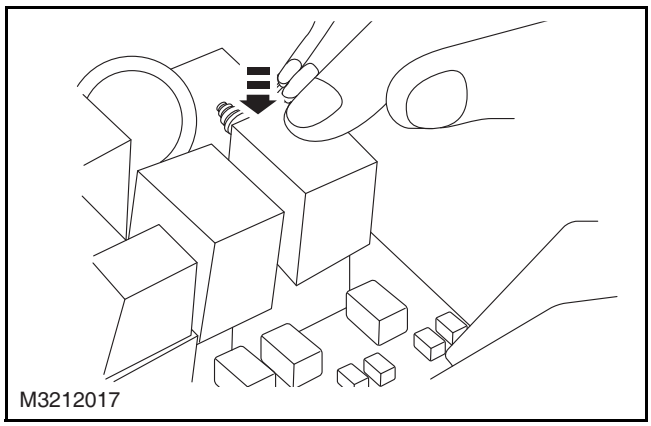
If the fault cannot be confirmed via DTC check, the symptom only occurs during application occasionally. At this point, confirm all wires and parts that may cause fault. Mostly, fault area can be determined quickly and effectively through basic inspection as shown in the diagram below. Especially the symptom, such as poor contact of wiring harness connector.

Malfunction definition: This malfunction currently does not appear, but the historical DTC record indicates that the malfunction occurred before. Or customer reports the malfunction, but as the malfunction is not related to the diagnostic trouble code, and currently the malfunction symptom cannot recur.

| Test Conditions | Details/Results/Actions |
|---|---|
| 1.Vibration method | |
| | A. If driving on a rough road, a malfunction occurs or becomes more serious, or engine starts to vibrate, perform the following steps.<br>B. Electrical faults may be caused by vehicle or engine vibration for some reasons. Inspect the following items:<br>• Connector is not fully in position.<br>• Wiring harness does not have enough space.<br>• Wiring harness comes across the supports or moving components.<br>• Wiring harness too close to the high temperature components.<br>C. Incorrect wiring layout, tight or loose wiring harness will cause itself to be squeezed between the components.<br>D. Connector joint, vibration location and wiring harness location are all items for focus inspection, such as: wiring harness through firewall and body panels. |
| 2. Inspection method for switch connector or wiring harness | |
|  <br>M3212015 | A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>**Note: If the malfunction occurs when engine is running, carry out the following procedure with the engine idling.**<br>C. Access to the data flow of switch that you are inspecting.<br>D. Turn on the switch manually.<br>E. When monitoring the data flow, gently shake the connector or wiring harness of switch.<br>If the data flow value is unstable, please inspect if there is a poor connection. |

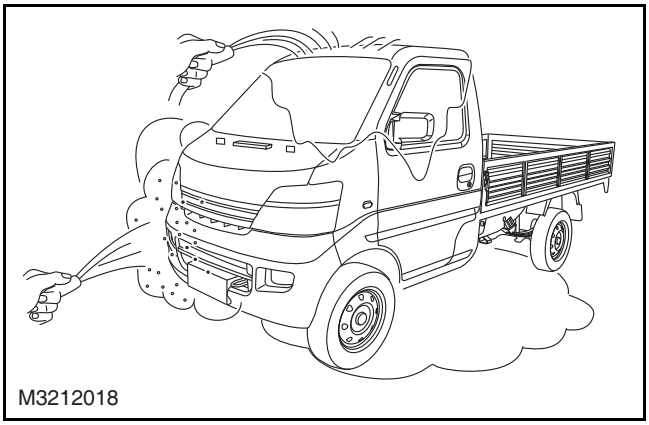
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspection method for sensor connector or wiring harness | |
|  M3212016 | A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>**Note: If the malfunction occurs when engine is running, carry out the following procedure with the engine idling.**<br>C. Access to the data flow of sensor that you are inspecting.<br>D. When monitoring the data flow, gently shake the connector or wiring harness of sensor.<br>If the data flow value is unstable, please inspect if there is a bad connection. |
| 4. Inspect method for actuator or relay | |
|  M3212017 | A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>**Note: If the malfunction occurs when engine is running, carry out the following procedure with the engine idling.**<br>C. By diagnostic tool, turn on the actuator or relay that you are inspecting.<br>D. Vibrate the actuator or relay with fingers for 3 seconds.<br>If you hear unstable "clicking" sound, inspect if there are poor connections or abnormal installation.<br>**CAUTION: Strong vibration of relay may open it.** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Water sprinkling method | |
|  M3212018 | If the malfunction only occurs in high humidity, or snow/rain weather, the following steps should be performed:<br>Spray water on the face of radiator to indirectly change the temperature and humidity. If the vehicle easily leaks, it may damage the control module. In detecting the existence of vehicle leaking problem, special precautions must be taken.<br>A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>**Note: If the malfunction occurs when engine is running, carry out the following procedure with the engine idling.**<br>C. Access to the data flow of sensor or switch.<br>D. If you want to inspect the switch, manually turn on it.<br>E. Spray water onto the vehicle, or drive the vehicle through the car wash.<br>If the data flow value is unstable or fails, please repair or replace the parts when necessary. |

## Symptom Chart

If the fault occurs, but there is no DTC stored in the ECM for this fault and the causes cannot be verified in basic inspection, diagnose and repair in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine cannot start at normal start speed | • Crankshaft position sensor<br>• Fuel pump<br>• Ignition coil<br>• Exhaust system blocked<br>• Engine mechanical<br>• ECM | **Refer to: Diagnosis Procedure for Engine not Starting at Normal Start Speed (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| Cold start problem | • Coolant temperature sensor<br>• Spark plug<br>• Fuel pump<br>• Fuel injector<br>• Throttle body<br>• Engine mechanical<br>• Engine control module circuit | **Refer to: Diagnosis Procedure for Cold Start Problem (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Hot start problem | • Coolant temperature sensor<br>• Ignition system<br>• Fuel pump<br>• Engine control module circuit | Refer to: Diagnosis Procedure for Hot Start Problem (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |
| Start normal but idle speed unstable at any time | • Air intake system<br>• Ignition system<br>• Throttle body<br>• Ignition timing<br>• Fuel system<br>• Engine mechanical<br>• Engine control module circuit | Refer to: Diagnosis Procedure for Start Normal but Idle Speed Unstable at Any Time (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |
| Start normal, idle speed unstable or flameout with partial load | • Heating, ventilation and air conditioning<br>• Throttle body<br>• Fuel injector | Refer to: Diagnosis Procedure for Start Normal but Idle Speed Unstable or Flameout with Partial Load (A/C ON) (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |
| Start normal, idle speed too high | • Coolant temperature sensor<br>• Throttle body<br>• Vacuum tube<br>• Ignition timing<br>• Engine control module circuit | Refer to: Diagnosis Procedure for Start Normal, Idle Speed Too High (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |
| Speed does not increase or flameout at acceleration<br>Acceleration problem<br>Acceleration slow reaction<br>Acceleration weak, poor performance | • Air intake system<br>• Air intake pressure sensor<br>• Throttle body<br>• Fuel injector<br>• Spark plug<br>• Ignition timing<br>• Fuel<br>• Exhaust blockage<br>• Engine control module circuit | Refer to: Diagnosis Procedure for Acceleration Fault (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing). |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Unstable engine operation | • Oxygen sensor<br>• Fuel injector<br>• Spark plug<br>• Ignition timing<br>• Fuel pressure<br>• Retaining bolts loose or engine mounting components damaged<br>• Engine control module circuit | **Refer to: Diagnosis Procedure for Unstable Engine Operation (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| Easy flameout at start | • Crankshaft position sensor<br>• Fuel injector<br>• Spark plug<br>• Ignition timing<br>• Fuel pressure<br>• A/C compressor<br>• Engine control module circuit | **Refer to: Diagnosis Procedure for Easy Flameout at Start (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| Emergency during vehicle running | • MAP sensor<br>• Incorrect A/C system operation<br>• Intake system components leakage<br>• Carbon canister control valve<br>• Unstable signal from CKP sensor<br>• Vacuum leakage<br>• Poor fuel quality<br>• Main relay and fuel pump relay intermittent fault<br>• Throttle body<br>• Engine overheating<br>• Spark plug<br>• Ignition timing<br>• Exhaust system restriction<br>• Fuel pressure inadequate<br>• Fuel pump mechanical<br>• Fuel injector | **Refer to: Diagnosis Procedure for Emergency During Vehicle Running (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |

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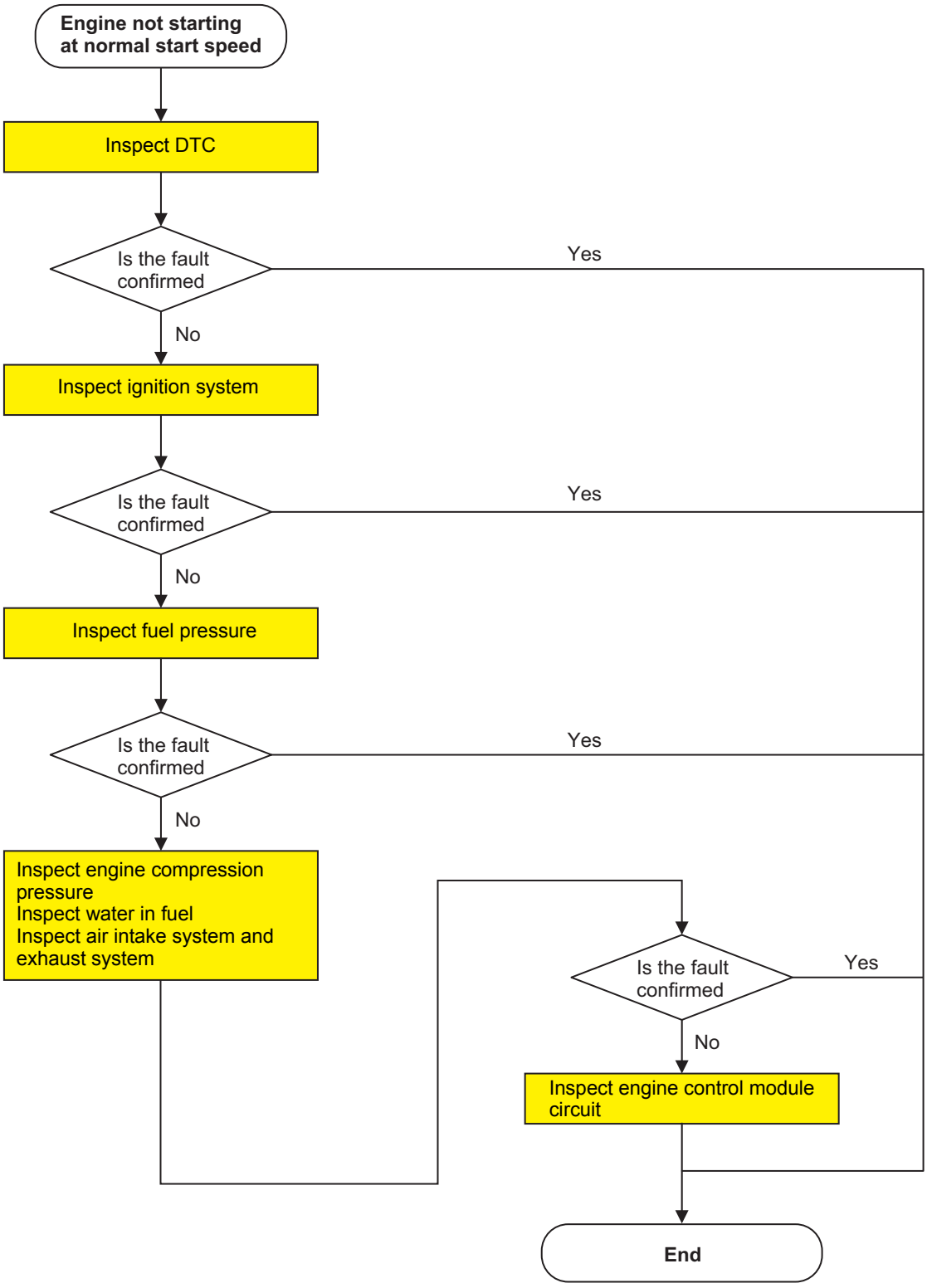


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Flameout during coasting | • Vacuum leakage<br>• Intake system leakage<br>• Air/fuel mixing ratio improper control<br>• Fuel evaporative emission control system<br>• TPS sensor or related circuit<br>• MAP sensor or related circuit<br>• Incorrect operation of A/C magnetic clutch<br>• Fuel injector<br>• Spark plug<br>• Ignition timing<br>• Fuel<br>• Exhaust blockage | **Refer to: Diagnosis Procedure for Flameout During Coasting (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| MIL indicator is always on | • Instrument cluster circuit<br>• Instrument cluster<br>• ECM<br>• ECM circuit | **Refer to: Diagnosis Procedure for DTC P0650 (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| MIL indicator is not on | • MIL indicator bulb<br>• Instrument cluster circuit<br>• Instrument cluster<br>• ECM | **Refer to: Diagnosis Procedure for DTC P0650 (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |

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# Diagnosis Procedure for Engine not Starting at Normal Start Speed



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect ignition system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Carry out the ignition spark test.<br>**Refer to: Ignition Spark Test (3.2.8 Ignition System, General Inspection).**<br>Is the ignition spark test normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect the ignition system.<br>**Refer to: Diagnosis Procedure for Spark Plugs not Flashing Over (3.2.8 Ignition System, Symptom Diagnosis and Testing).** |
| 3. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect the fuel system. |

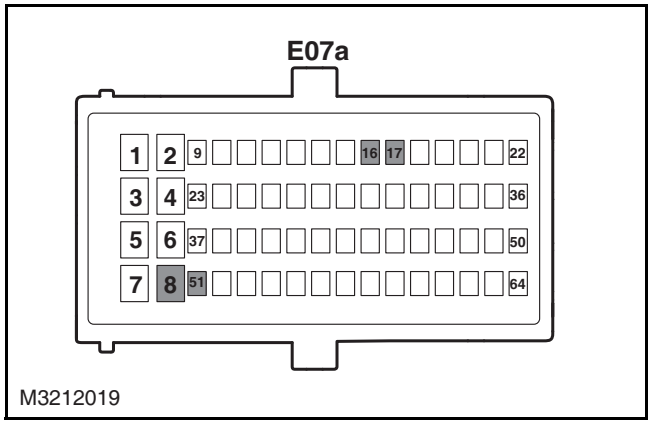
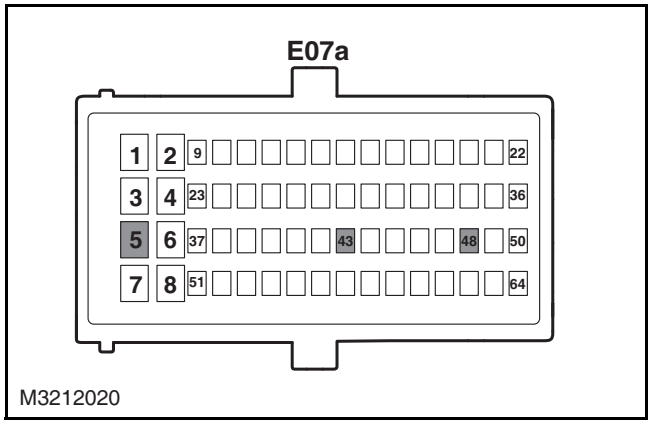
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect engine compression pressure | |
| | A. Inspect the engine compression pressure.<br>**Refer to: Cylinder Compression Pressure Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the compression pressure normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect the engine mechanical system. |
| 5. Inspect water in fuel | |
| | A. Remove the fuel filter joints.<br>**Refer to: Fuel Filter (3.2.7 Fuel System, Removal and Installation).**<br>B. Discharge the fuel in the filter and inspect the water in the fuel.<br>Is there any water in the fuel?<br>**Yes**<br>Clean the fuel tank, and add qualified fuel.<br>**No**<br>Go to step 6. |
| 6. Inspect air intake system and exhaust system | |
| | A. Remove intake system hose in front of throttle and idling stepper motor, and inspect for dirt or clog due to foreign matter.<br>B. Remove the exhaust pipe and three-way catalytic converter, and inspect if there is foreign matter or three-way catalytic converter which comes off due to damage to get the emission system clogged.<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Clean or replace the fault parts. |

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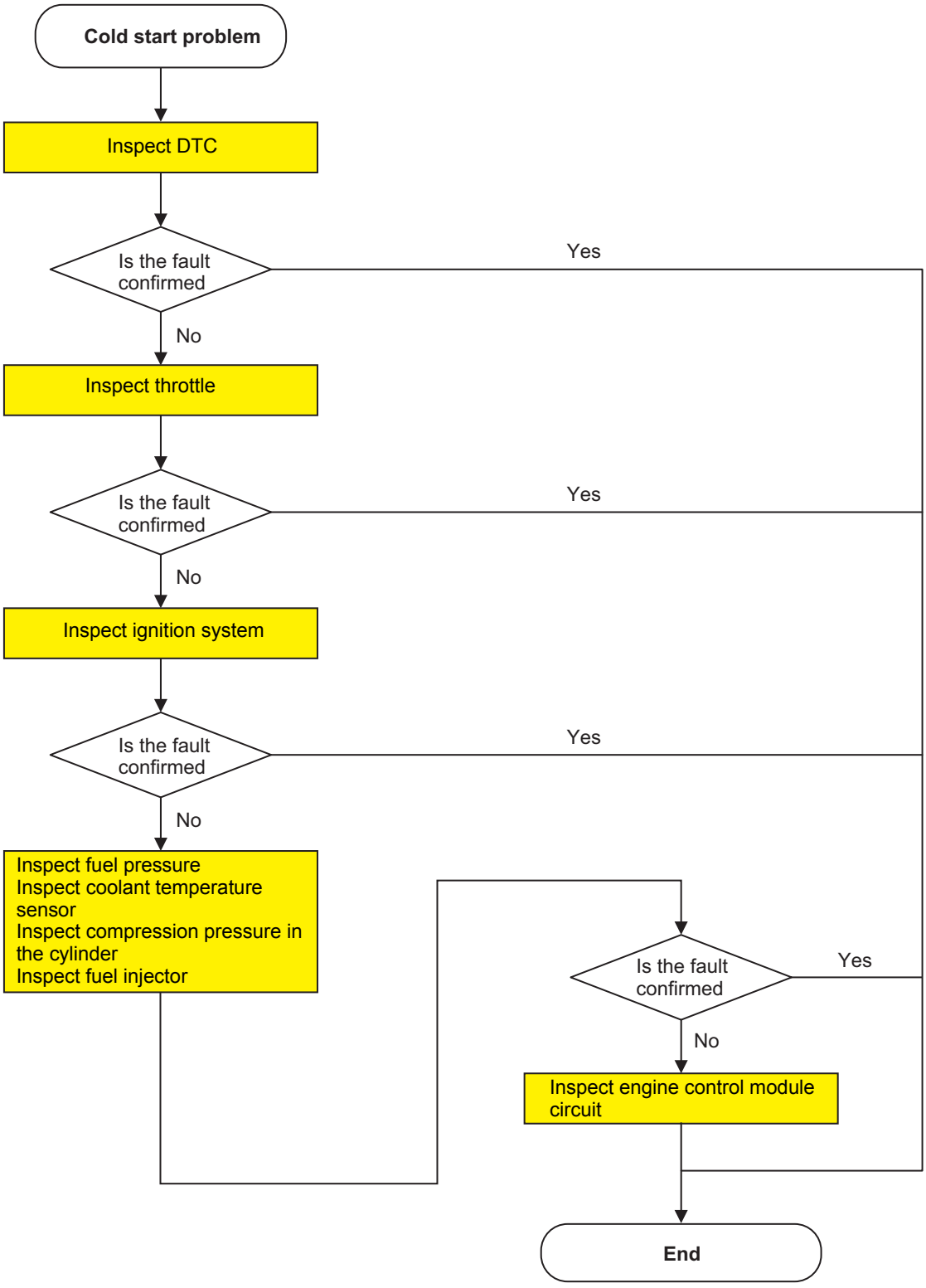


| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Cold Start Problem



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect throttle | |
| | A. Start the engine by depressing the accelerator pedal slightly.<br>Can the engine be started easily?<br>**Yes**<br>Clean the throttle, idling stepper motor. If the intake system has thick carbon deposit, clean the throttle and intake duct.<br>**No**<br>Go to step 3. |
| 3. Inspect ignition system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Carry out the ignition spark test.<br>**Refer to: Ignition Spark Test (3.2.8 Ignition System, General Inspection).**<br>Is the ignition spark test normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect the ignition system.<br>**Refer to: Diagnosis Procedure for Spark Plugs not Flashing Over (3.2.8 Ignition System, Symptom Diagnosis and Testing).** |

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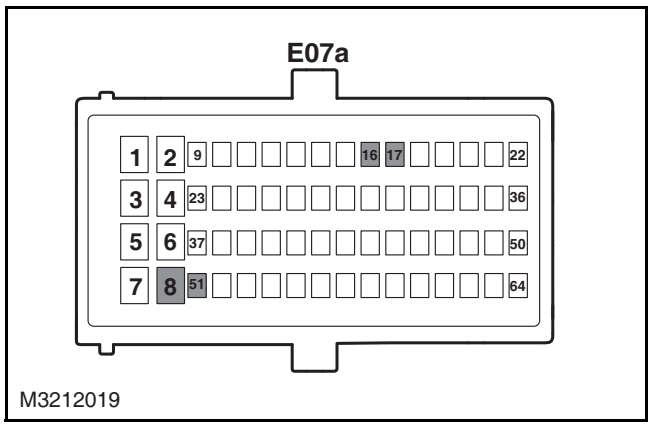


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect the fuel system fault. |
| 5. Inspect coolant temperature sensor | |
| | A. Disconnect the coolant temperature sensor connector.<br>B. Connect a 2.5 kΩ resistor in series substituted for coolant temperature sensor at the sensor connector.<br>C. Start the cold engine.<br>Is the start smooth?<br>**Yes**<br>Replace the coolant temperature sensor.<br>**No**<br>Go to step 6. |
| 6. Inspect compression pressure in the cylinder | |
| | A. Inspect the compression pressure in the cylinder.<br>**Refer to: Cylinder Compression Pressure Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the pressure insufficient in any cylinder?<br>**Yes**<br>Inspect the engine mechanical system.<br>**No**<br>Go to step 7. |
| 7. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage or blockage.<br>Are they normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Replace the fuel injector. |

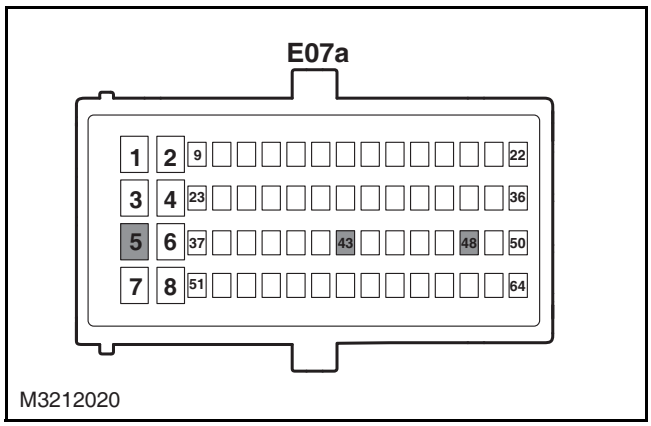
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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect engine control module circuit | |



M3212019



M3212020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**

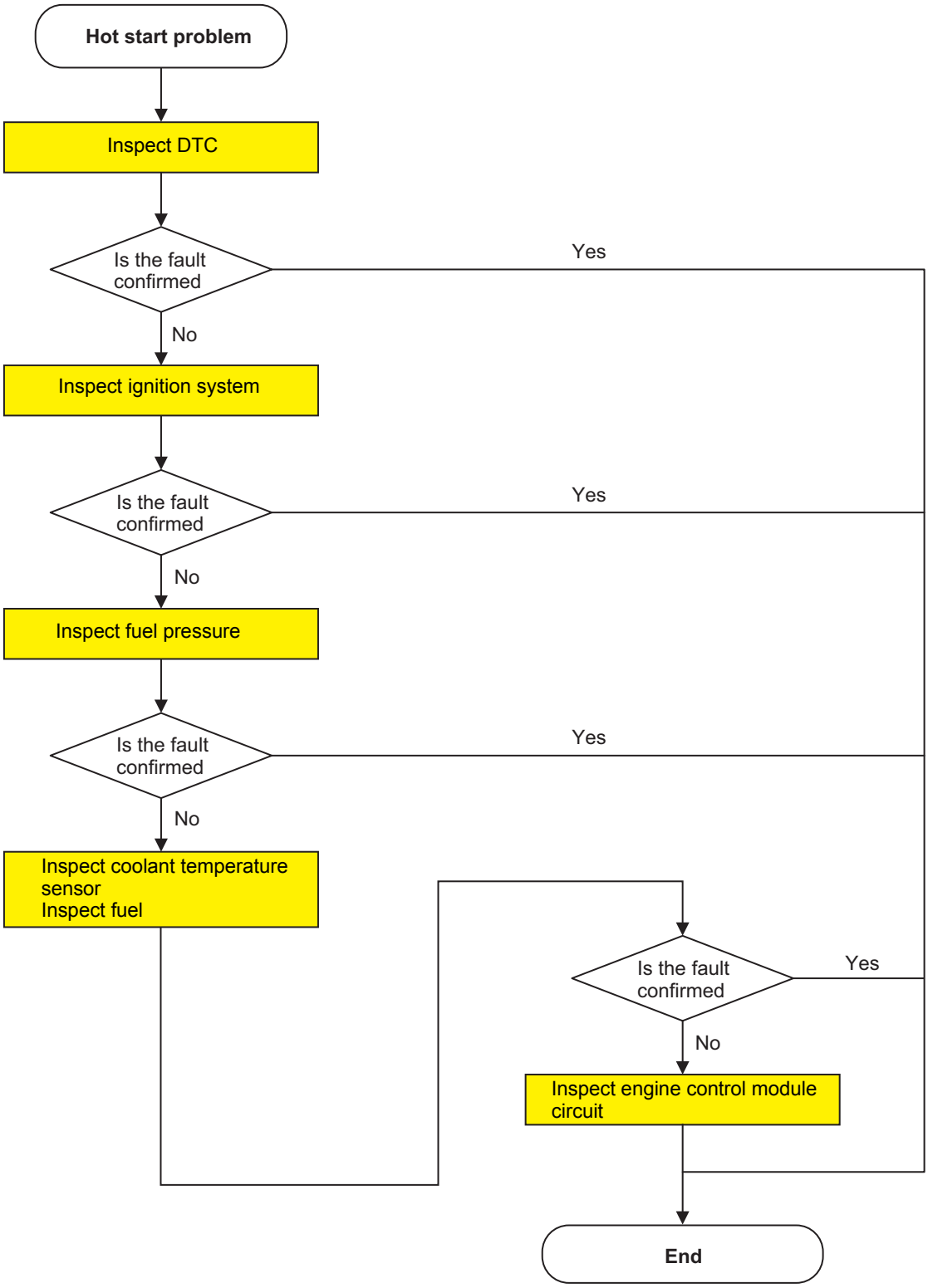
**No**

Repair the circuit.

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# Diagnosis Procedure for Hot Start Problem



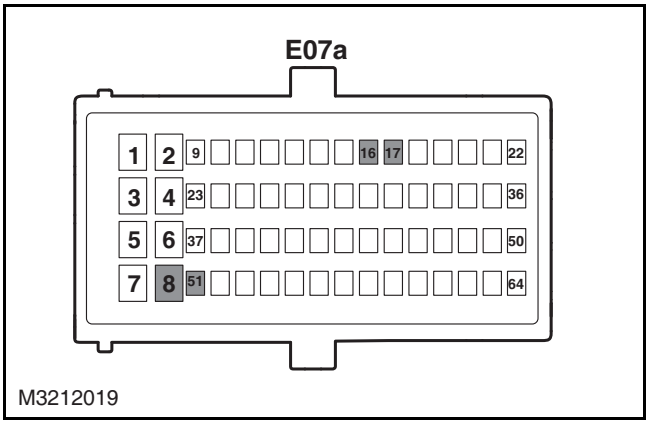
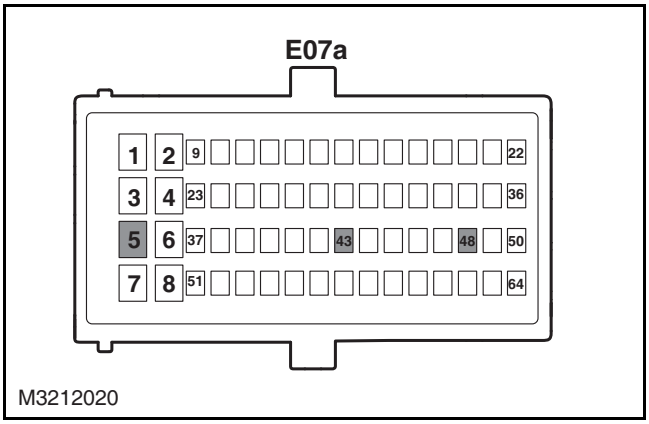
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect ignition system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Carry out the ignition spark test.<br>**Refer to: Ignition Spark Test (3.2.8 Ignition System, General Inspection).**<br>Is the ignition spark test normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect the ignition system.<br>**Refer to: Diagnosis Procedure for Spark Plugs not Flashing Over (3.2.8 Ignition System, Symptom Diagnosis and Testing).** |
| 3. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect the fuel system fault. |

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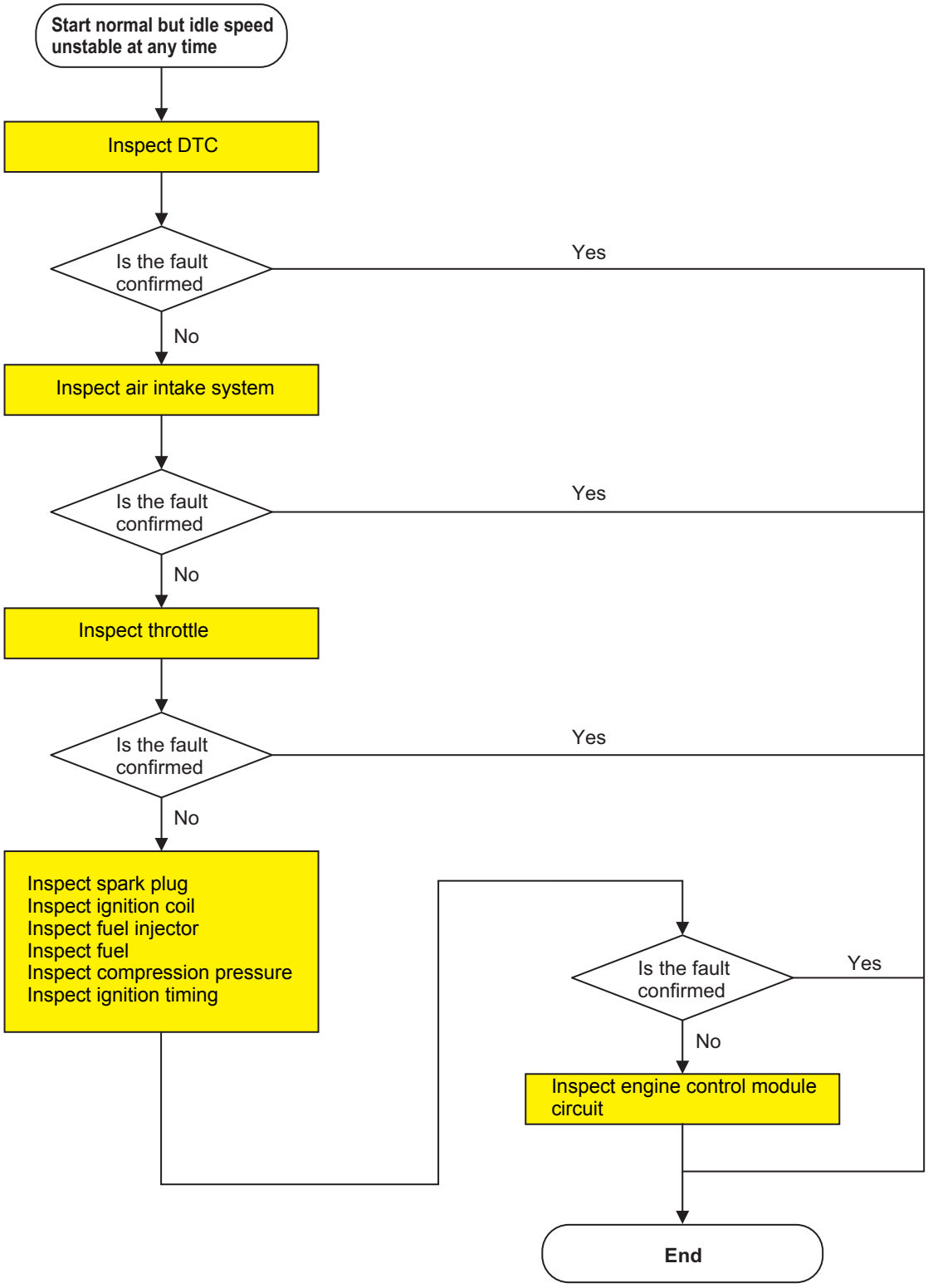


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect coolant temperature sensor | |
| | A. Disconnect the coolant temperature sensor connector.<br>B. Connect a 300 Ω resistor in series substituted for coolant temperature sensor at the sensor connector.<br>C. Start the engine.<br>Is the start smooth?<br>**Yes**<br>Replace the coolant temperature sensor.<br>**No**<br>Go to step 5. |
| 5. Inspect fuel | |
| | A. Is the fault caused by just refueling?<br>**Yes**<br>Replace the fuel.<br>**No**<br>Go to step 6. |
| 6. Inspect engine control module circuit | |
|  <br>M3212019<br>  <br>M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Start Normal but Idle Speed Unstable at Any Time



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect air intake system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the air intake system for blockage.<br>C. Inspect the air intake system for leakage.<br>**Refer to: Diagnosis Procedure for Intake Air Leak (3.2.5 Air Intake System, Symptom Diagnosis and Testing).**<br>Is the air intake system normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the air intake system. |
| 3. Inspect throttle | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the throttle is stuck.<br>Is the throttle normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Clean the throttle, idling stepper motor or replace the throttle. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.2.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the spark plug. |
| 5. Inspect ignition coil | |
| | A. Carry out the ignition coil inspection procedure.<br>**Refer to: Ignition Coil Test (3.2.8 Ignition System, General Inspection).**<br>Is the ignition coil normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the fuel injector. |
| 6. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace the fuel injector. |
| 7. Inspect fuel | |
| | A. Is the fault caused by just refueling?<br>**Yes**<br>Replace the fuel.<br>**No**<br>Go to step 8. |

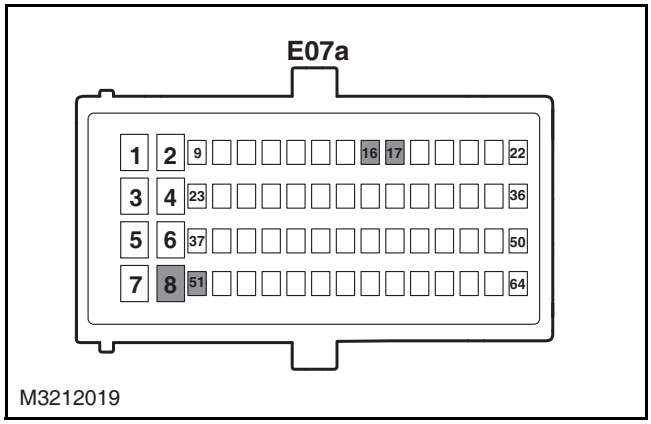
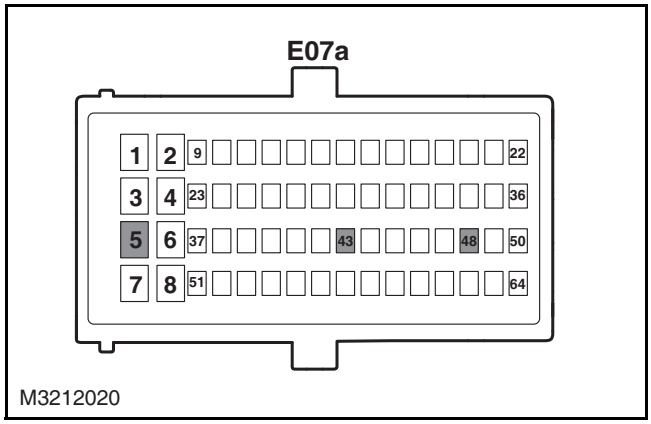
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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect compression pressure | |
| | A. Inspect the compression pressure in the cylinder.<br>**Refer to: Cylinder Compression Pressure Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is there insufficient pressure or large difference among cylinders?<br>**Yes**<br>Inspect the engine mechanical system.<br>**No**<br>Go to step 9. |
| 9. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Adjust the ignition timing. |

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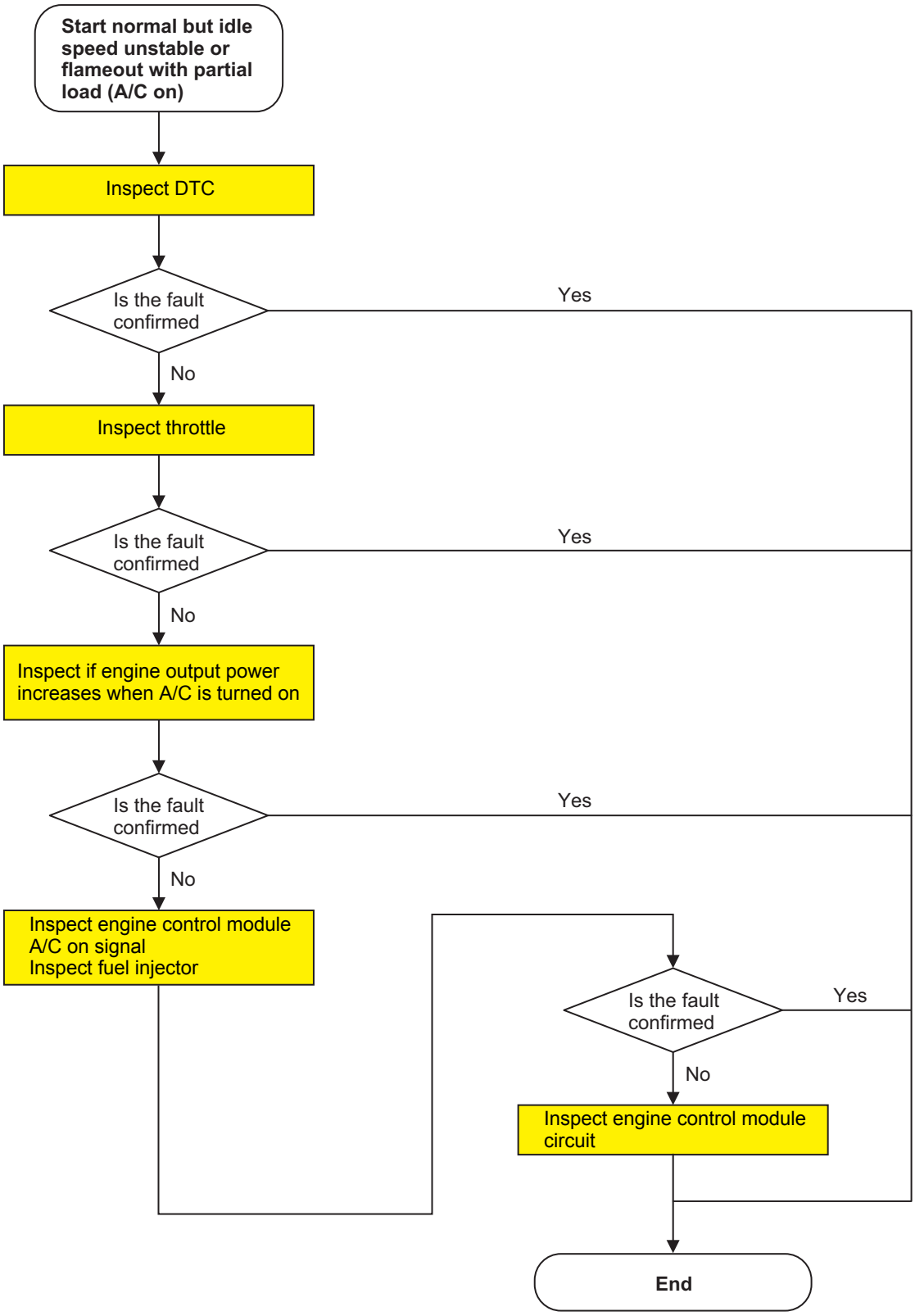


| Test Conditions | Details/Results/Actions |
|---|---|
| 10. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Start Normal but Idle Speed Unstable or Flameout with Partial Load (A/C ON)



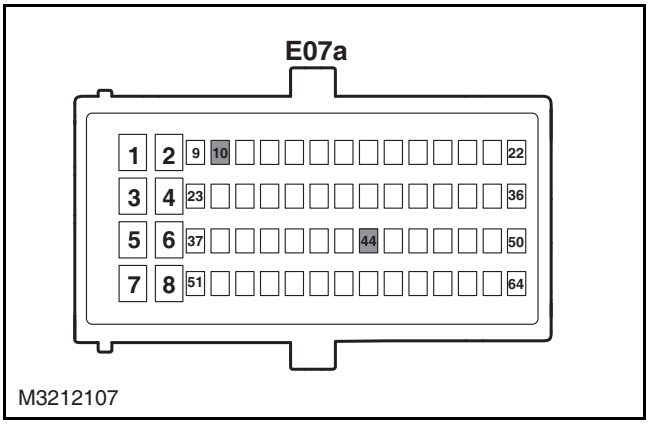
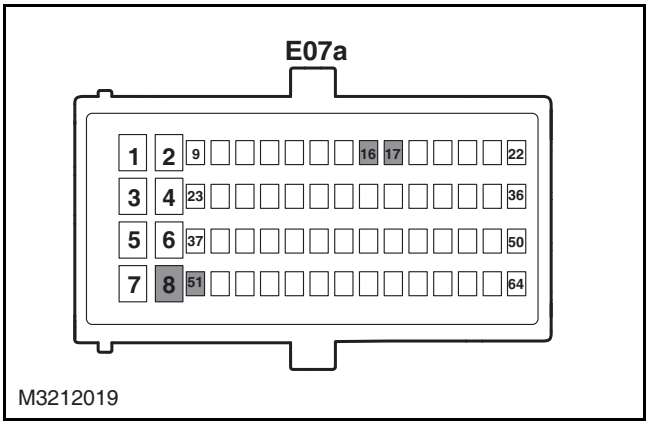
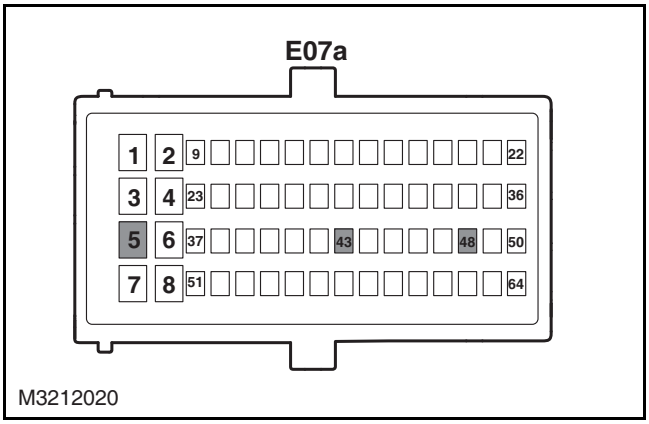
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect throttle | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the throttle is stuck.<br>C. Inspect the throttle and idling stepper motor for carbon deposit.<br>Is the throttle normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Clean the throttle, idling stepper motor or replace the throttle. |
| 3. Inspect if engine output power increases when A/C is turned on | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start the engine, access to engine data flow menu, select the parameters such as ignition advance angle, fuel injection pulse width and intake pressure sensor.<br>D. Turn on the A/C, observe the change of data flow parameters.<br>Are there changes?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect the A/C system.<br>**Refer to: Diagnosis Procedure for Insufficient A/C Refrigeration (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing).** |

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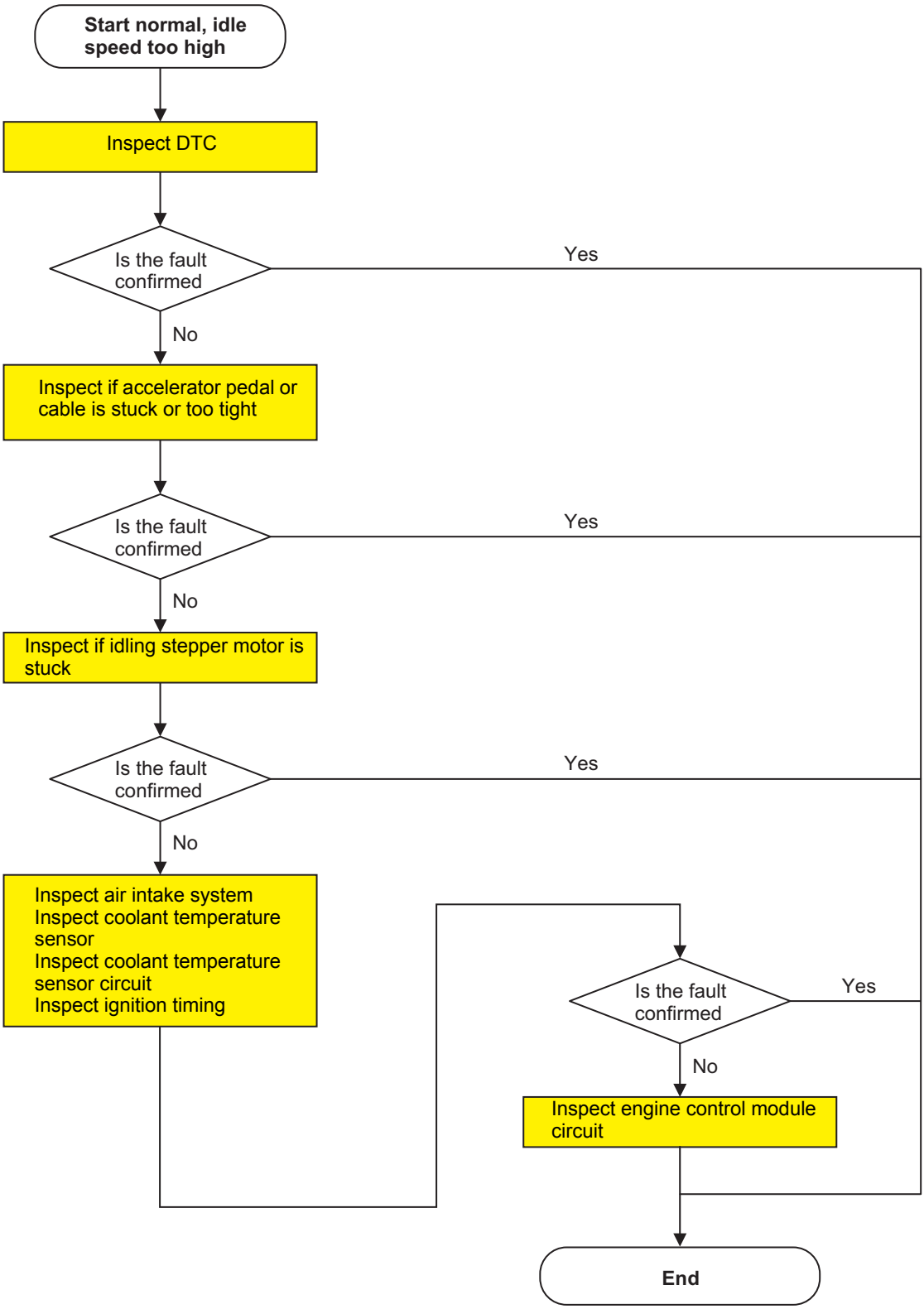


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect engine control module A/C on signal | |
|  M3212107 | A. Turn the ignition switch to "ON".<br>B. Turn on the A/C. Measure the voltages of terminals 10, 44 of engine control module wiring harness connector E07a with the multimeter.<br>Are the voltages of terminals 10 and 44 about 12 V when A/C is turned on?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair the circuit. |
| 5. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the fuel injector. |
| 6. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Start Normal, Idle Speed too High



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect if accelerator pedal or cable is stuck or too tight | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the accelerator pedal is stuck or too tight.<br>C. Inspect if the accelerator cable is stuck or too tight.<br>Are they stuck or too tight?<br>**Yes**<br>Repair or replace the accelerator pedal or cable.<br>**No**<br>Go to step 3. |
| 3. Inspect if idling stepper motor is stuck | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the idling stepper motor has too much carbon deposit.<br>C. Inspect if the idling stepper motor is stuck.<br>**Yes**<br>Clean the idling stepper motor, throttle or replace the idling stepper motor.<br>**No**<br>Go to step 4. |
| 4. Inspect air intake system | |
| | A. Inspect the air intake system for leakage.<br>Does the air intake system leak?<br>**Yes**<br>Repair the air intake system.<br>**Refer to: Diagnosis Procedure for Intake Air Leak (3.2.5 Air Intake System, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 5. |

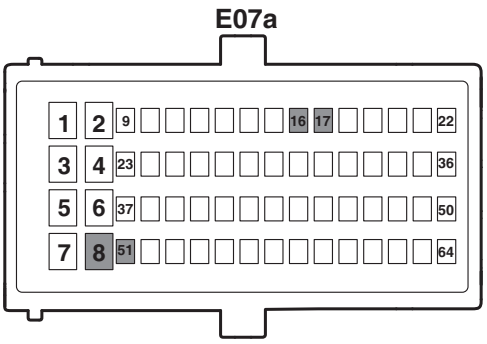
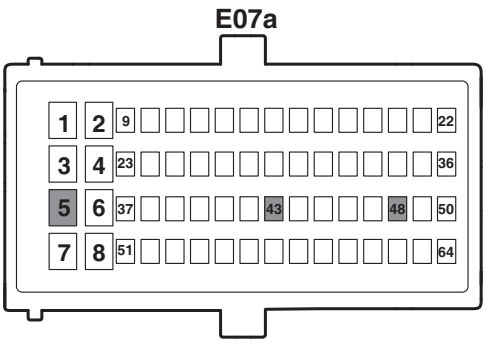
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect coolant temperature sensor | |
| | A. Disconnect the coolant temperature sensor wiring harness connector.<br>B. Start the engine, and observe it.<br>Is the engine idle speed too high?<br>**Yes**<br>Go to step 7.<br>**No**<br>Go to step 6. |
| 6. Inspect coolant temperature sensor circuit | |
| | A. Replace the coolant temperature sensor.<br>B. Start the engine, and observe it.<br>Is the engine idle speed too high?<br>**Yes**<br>Repair the coolant temperature sensor circuit.<br>**No**<br>The system is normal. |
| 7. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Adjust the ignition timing. |

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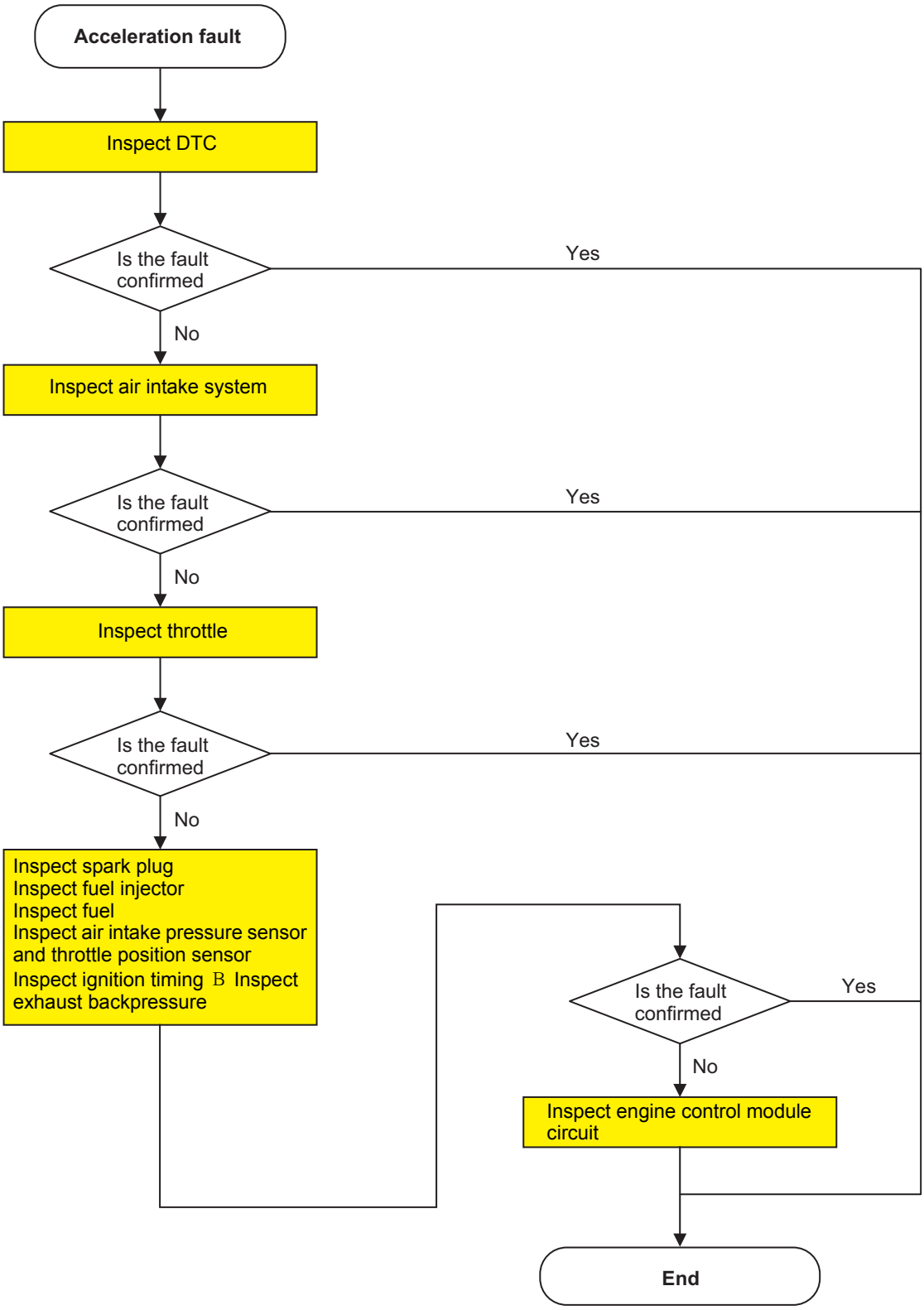


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Acceleration Fault



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect air intake system | |
| | A. Inspect the air intake system for blockage.<br>B. Inspect the air intake system for leakage.<br>Is the air intake system normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the air intake system. |
| 3. Inspect throttle | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect if the throttle is stuck.<br>C. Inspect the throttle for carbon deposit.<br>Is the throttle normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Clean or replace the throttle. |
| 4. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.2.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the spark plug. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the fuel injector. |
| 6. Inspect fuel | |
| | A. Is the fault caused by just refueling?<br>**Yes**<br>Replace the fuel.<br>**No**<br>Go to step 7. |
| 7. Inspect air intake pressure sensor and throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start engine and inspect the data flow for air intake pressure sensor and throttle position sensor.<br>Are their data flows normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Replace the air intake pressure sensor and throttle position sensor, or repair the sensor circuit.<br>**Refer to: (3.2.12 Electronic Control System - M7, Removal and Installation).** |

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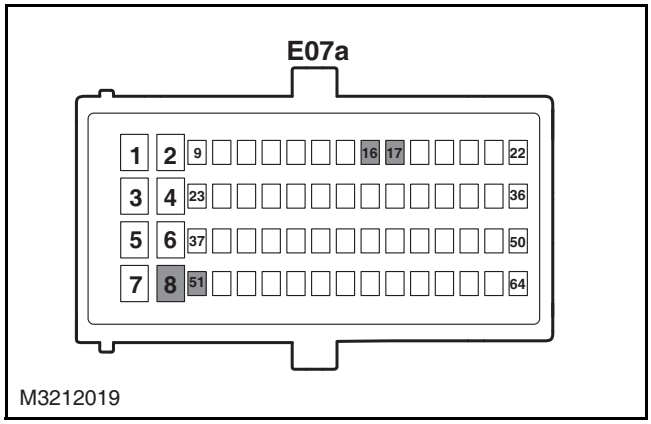


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Adjust the ignition timing. |
| 9. Inspect exhaust backpressure | |
| | A. Inspect the exhaust backpressure.<br>**Refer to: Exhaust Backpressure Test (3.2.6 Exhaust System, General Inspection).**<br>Is the exhaust backpressure normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Repair the exhaust system. |

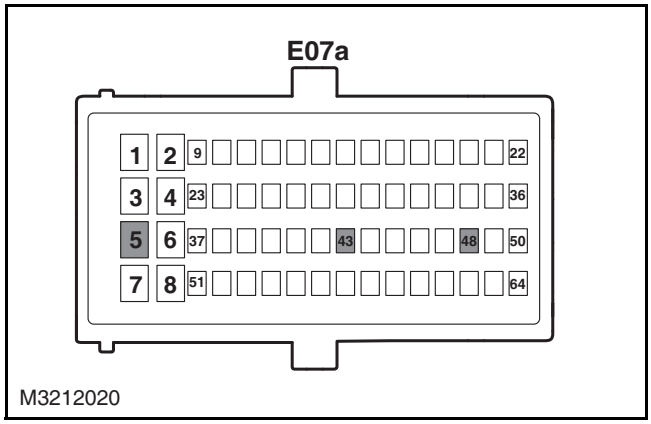
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| Test Conditions | Details/Results/Actions |
|---|---|
| 10. Inspect engine control module circuit | |



M3212019



M3212020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**

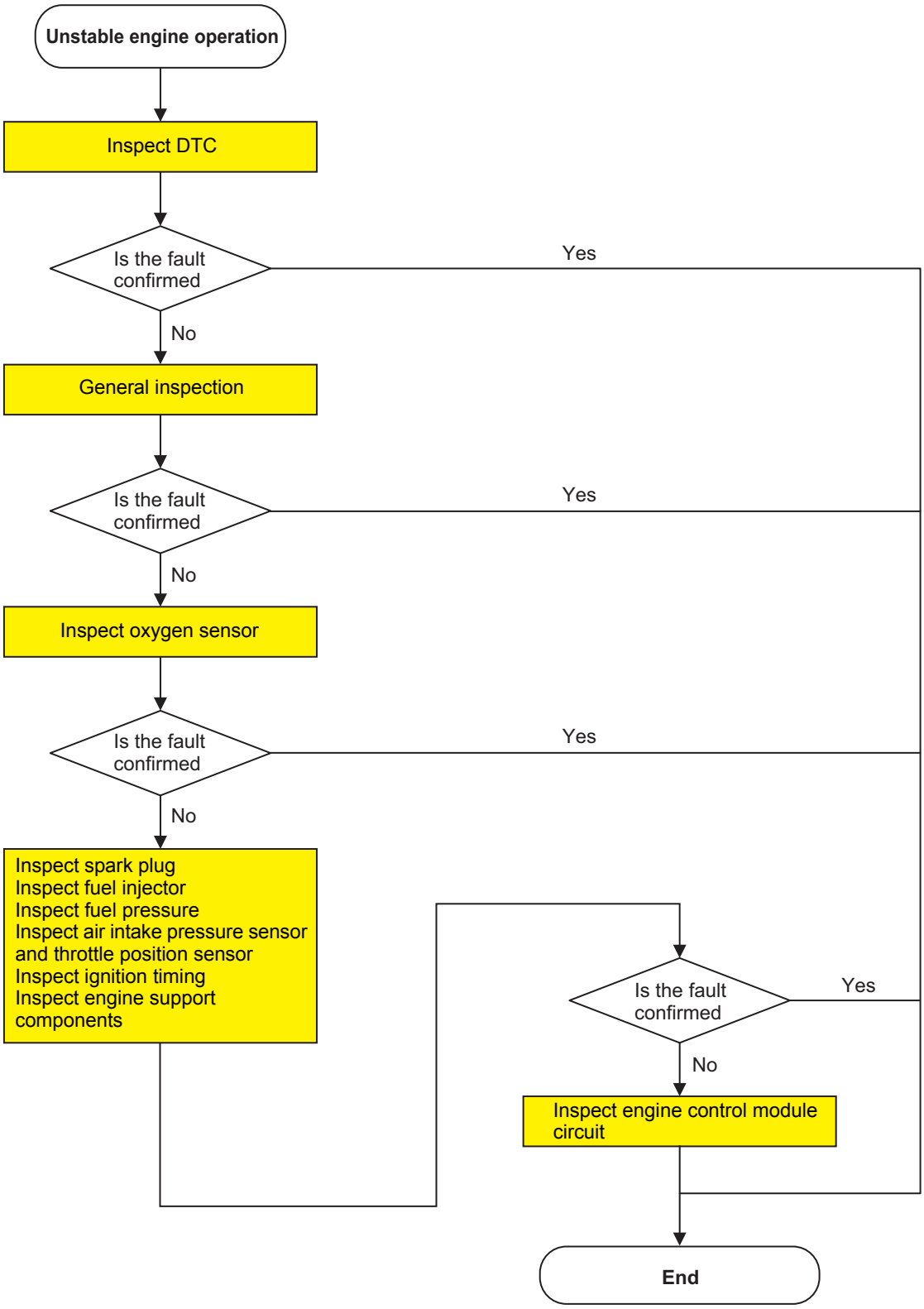
**No**

Repair the circuit.

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# Diagnosis Procedure for Unstable engine operation



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. General inspection | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the air intake system for blockage.<br>C. Inspect the air intake system for leakage.<br>**Refer to: Diagnosis Procedure for Intake Air Leak (3.2.5 Air Intake System, Diagnosis and Testing).**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the fault parts. |
| 3. Inspect oxygen sensor | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", operate the diagnostic tool to access to the engine data flow and read "O2 sensor voltage bank1 sensor 1, O2 sensor voltage bank1 sensor 2".<br>Is the data flow normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair or replace the oxygen sensor or circuit. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.2.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the spark plug. |
| 5. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the fuel injector. |
| 6. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect the fuel system. |

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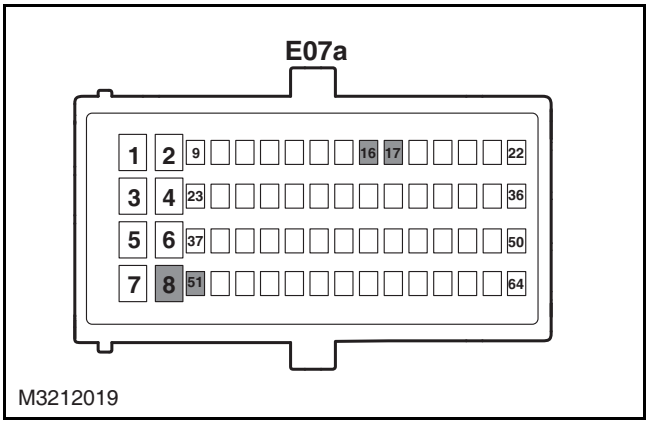


| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect air intake pressure sensor and throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start engine and inspect the data flow for air intake pressure sensor and throttle position sensor.<br>Are their data flows normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Replace the air intake pressure sensor and throttle position sensor, or repair the sensor circuit.<br>**Refer to: (3.2.12 Electronic Control System - M7, Removal and Installation).** |
| 8. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Adjust the ignition timing. |
| 9. Inspect engine support components | |
| | A. Inspect the engine support components.<br>Is there crack, damage, or loose or lost bolt on the engine support components?<br>**Yes**<br>Repair the fault parts.<br>**No**<br>Go to step 10. |

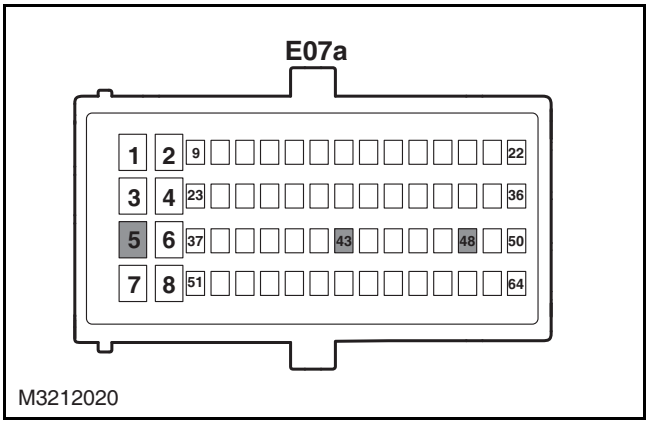
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| Test Conditions | Details/Results/Actions |
|---|---|
| 10. Inspect engine control module circuit | |



M3212019



M3212020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**

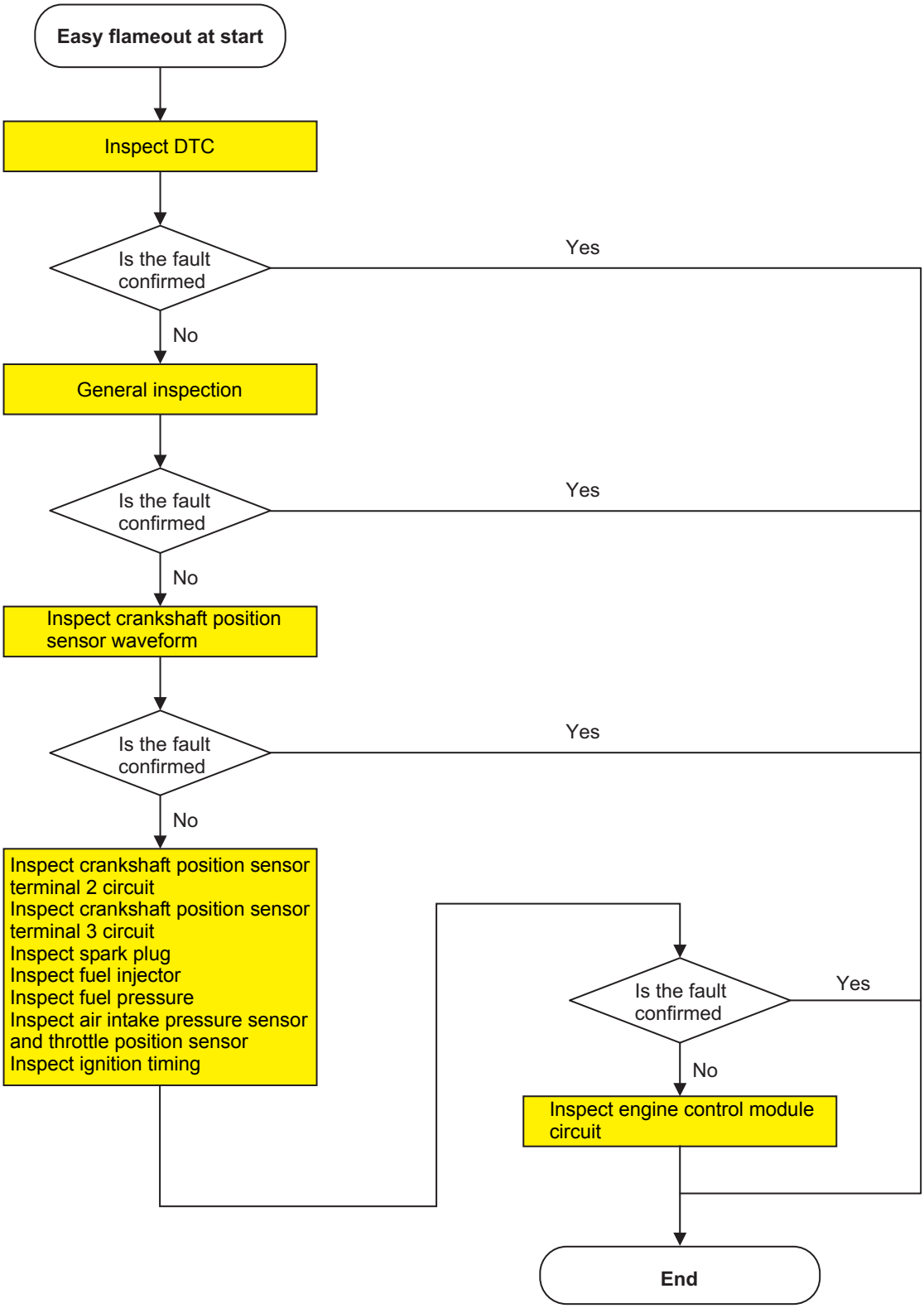
**No**

Repair the circuit.

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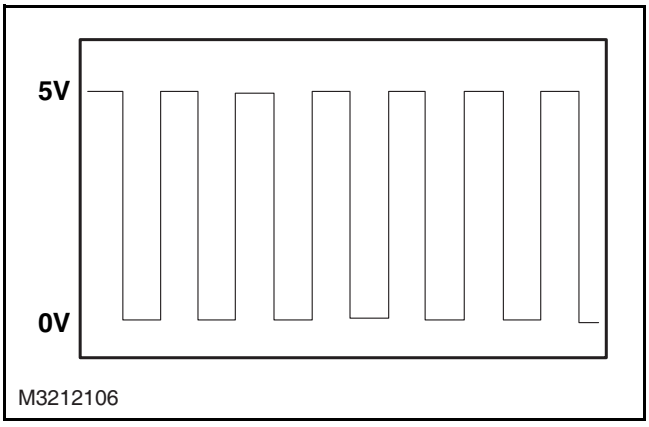


# Diagnosis Procedure for Easy Flameout at Start



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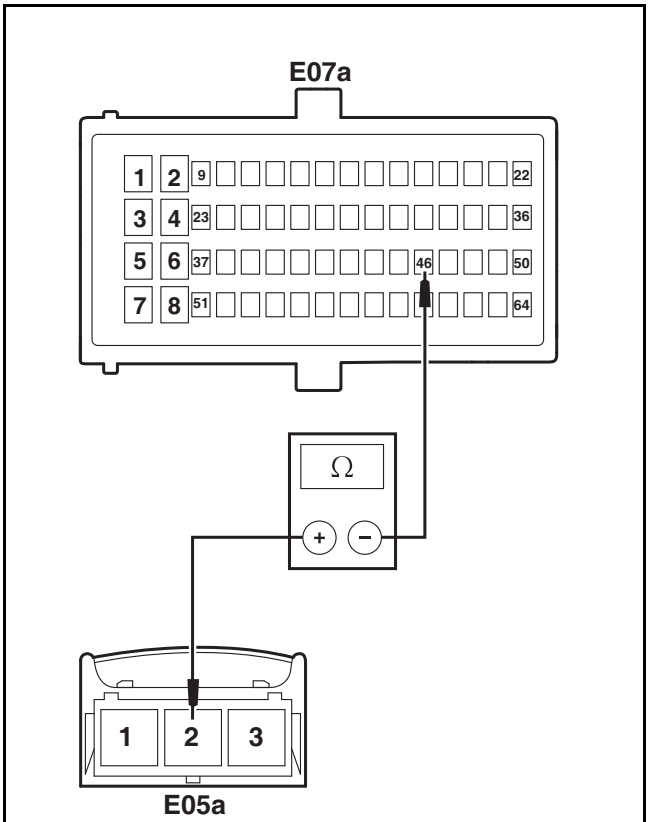


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. General inspection | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the air intake system for blockage.<br>C. Inspect the air intake system for leakage.<br>D. Inspect wiring harness connectors of oxygen sensor, fuel injector, crankshaft position sensor and ignition coil for disconnection, looseness or damage.<br>Are they normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the fault parts. |
| 3. Inspect crankshaft position sensor waveform | |
|  <br>M3212106 | A. Measure the waveform between terminals 2 and 3 of sensor with an oscilloscope when engine idling. Standard waveform is as shown in left figure.<br>Is it normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Go to step 4. |

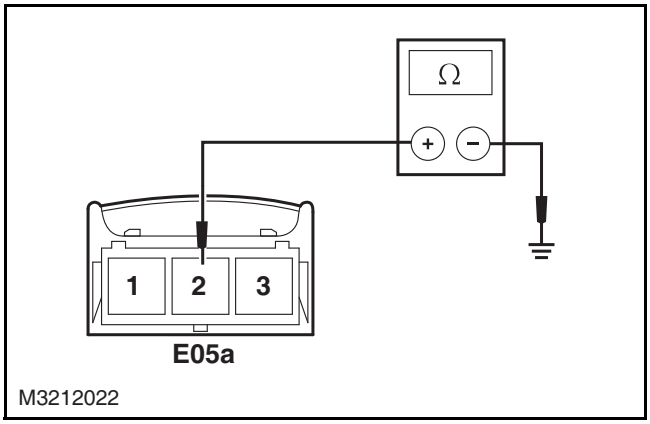
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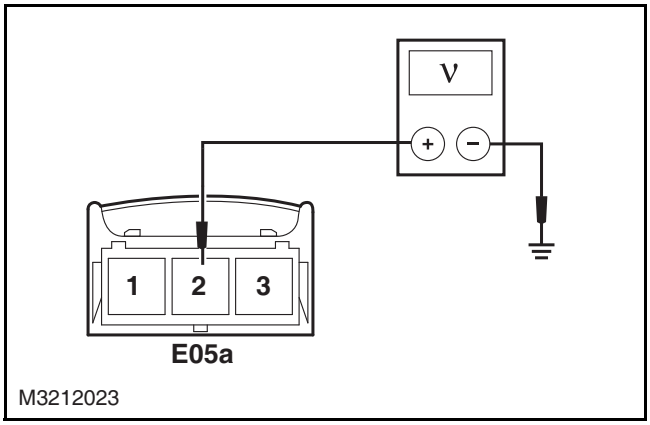
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect crankshaft position sensor terminal 2 circuit | |




M3212021




M3212022




M3212023

A. Turn the ignition switch to "LOCK".

B. Disconnect the crankshaft position sensor wiring harness connector E05a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 2 of crankshaft position sensor wiring harness connector E05a and terminal 47 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of crankshaft position sensor wiring harness connector E05a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of crankshaft position sensor wiring harness connector E05a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is the circuit normal?

**Yes**

Go to step 5.

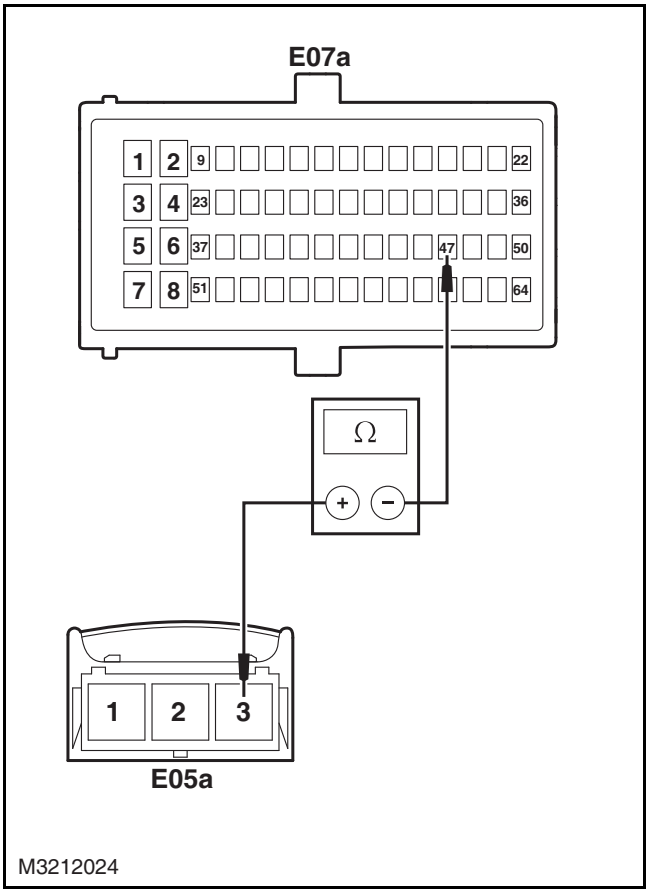
**No**

Repair the fault circuit between terminal 2 of crankshaft position sensor E05a and terminal 47 of engine control module E07a.

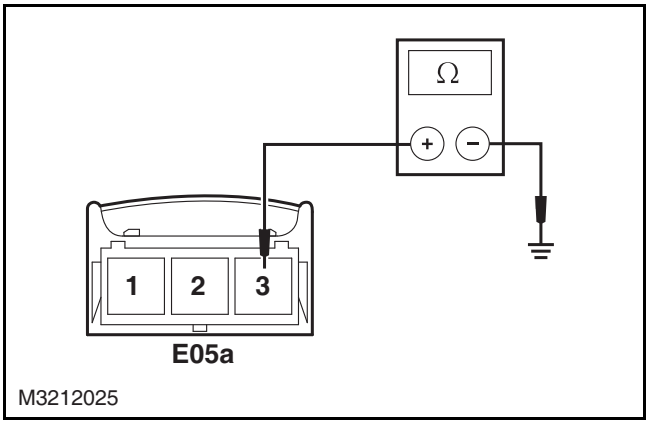
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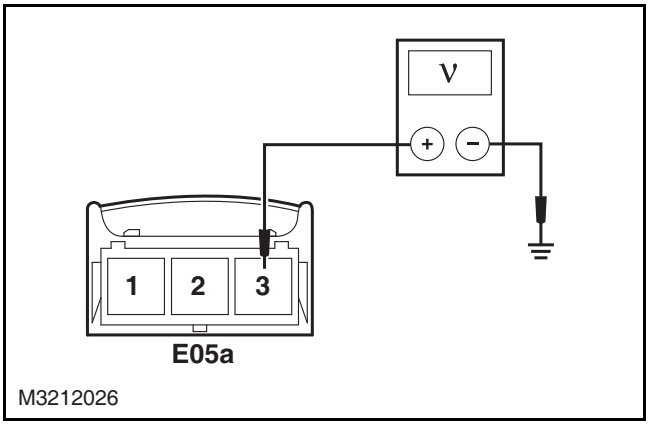
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect crankshaft position sensor terminal 3 circuit | |




M3212024




M3212025




M3212026

A. Turn the ignition switch to "LOCK".

B. Disconnect the crankshaft position sensor wiring harness connector E05a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 3 of crankshaft position sensor wiring harness connector E05a and terminal 40 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 3 of crankshaft position sensor wiring harness connector E05a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 3 of crankshaft position sensor wiring harness connector E05a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is the circuit normal?

**Yes**

Replace the crankshaft position sensor.

**Refer to: Crankshaft Position Sensor (3.2.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the fault circuit between terminal 3 of crankshaft position sensor E05a and terminal 40 of engine control module E07a.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.2.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace the spark plug. |
| 7. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Clean or replace the fuel injector. |
| 8. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect the fuel system. |

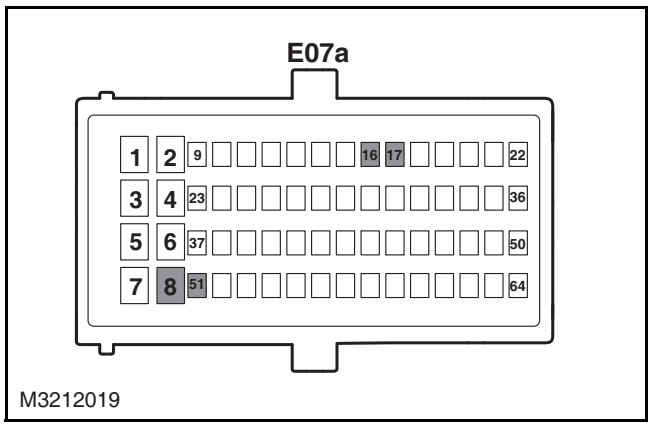
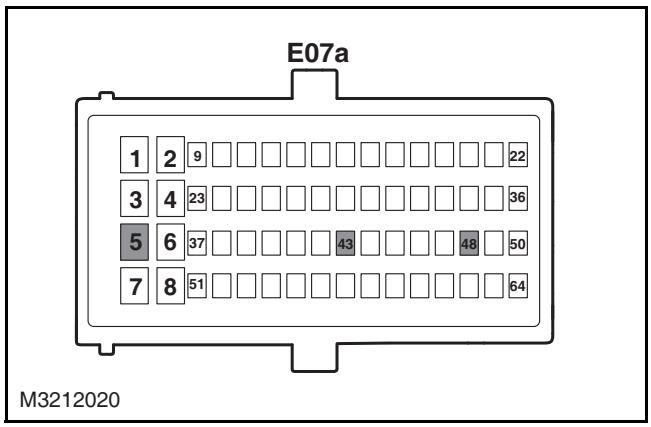
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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect air intake pressure sensor and throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start engine and inspect the data flow for air intake pressure sensor and throttle position sensor.<br>Are their data flows normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Replace the air intake pressure sensor and throttle position sensor, or repair the sensor circuit.<br>**Refer to: (3.2.12 Electronic Control System - M7, Removal and Installation).** |
| 10. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Adjust the ignition timing. |

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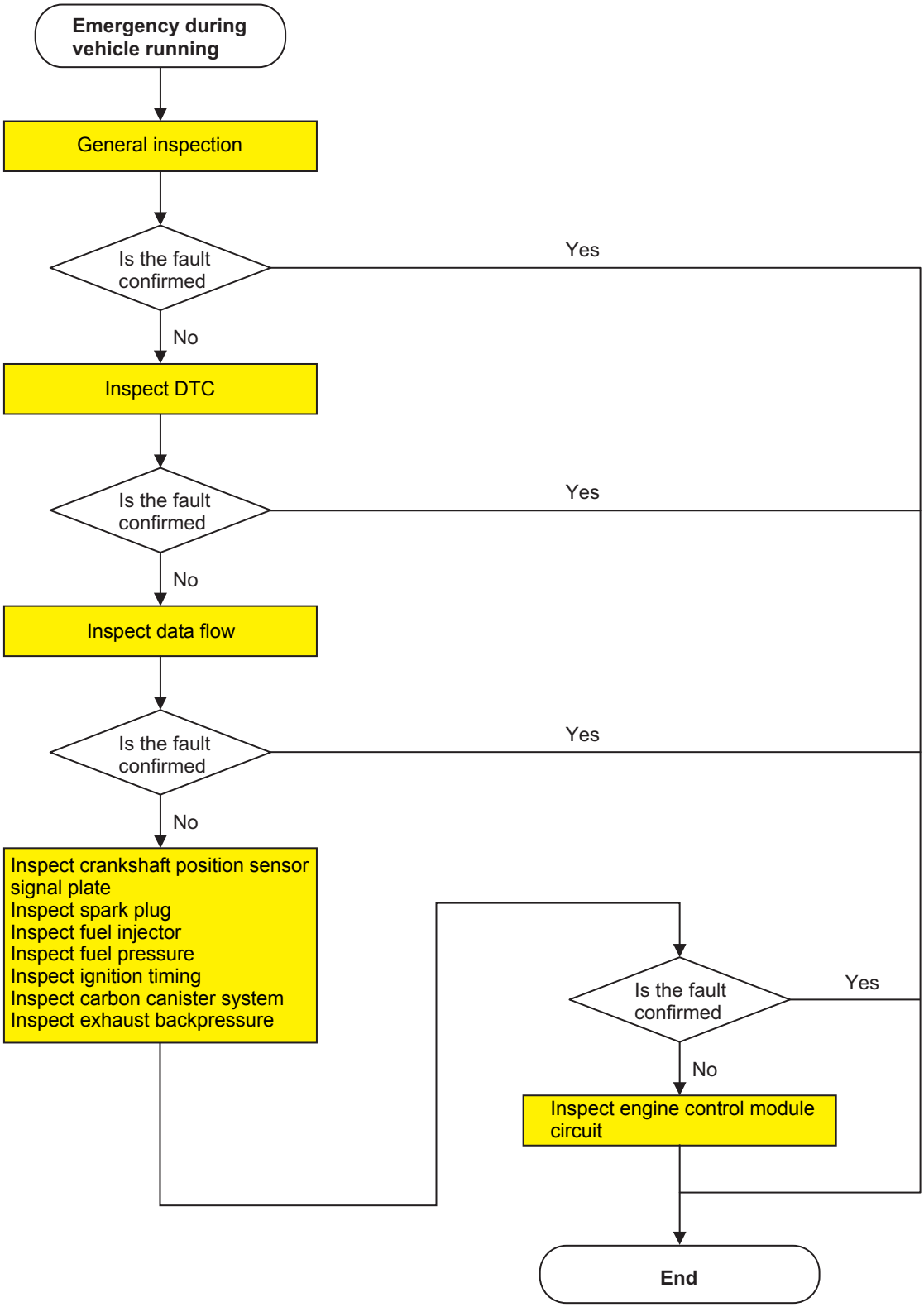


| Test Conditions | Details/Results/Actions |
|---|---|
| 11. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Emergency During Vehicle Running



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the following items:<br>• Vacuum pipeline connection<br>• Air cleaner element<br>• No leaks in air intake system<br>• No limitation for air intake system<br>• Proper seal for intake manifold and its installed components<br>• Ignition circuit<br>• Qualified fuel<br>• Electrical connection<br>• Smooth operation of throttle<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault parts. |
| 2. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 3. |
| 3. Inspect data flow | |
| | A. Connect the diagnostic tool.<br>B. Use the diagnostic tool to inspect the following data flow of engine:<br>• Engine speed<br>• Actual intake manifold pressure<br>• Throttle position angle signal<br>• Knock sensor signal 1<br>• Knock sensor signal 2<br>Does the data flow change normally in the specified range?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the corresponding fault. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect crankshaft position sensor signal plate | |
| | A. Visually inspect the crankshaft position sensor signal plate.<br>Is it normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the crankshaft position sensor signal plate. |
| 5. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.2.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the spark plug. |
| 6. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error.<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace the fuel injector. |

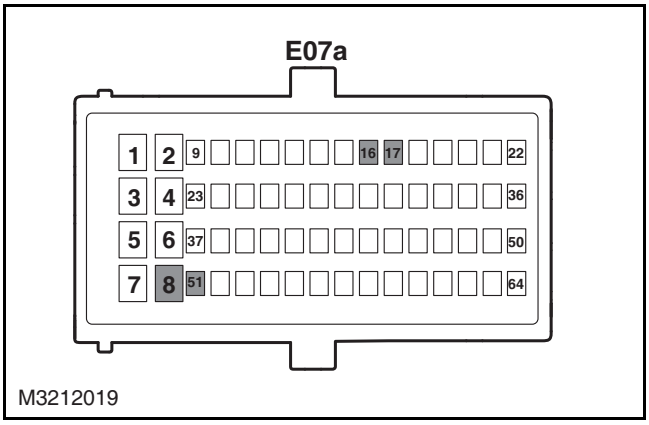
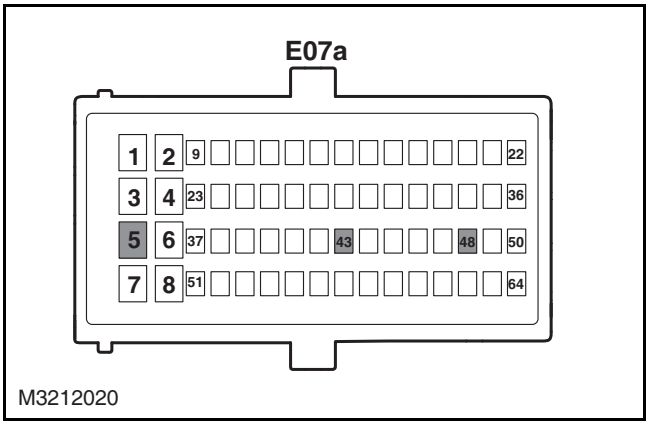
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect the fuel system. |
| 8. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Adjust the ignition timing. |
| 9. Inspect carbon canister system | |
| | A. Inspect the carbon canister system.<br>**Refer to: Carbon Canister Inspection (3.2.11 Emission Control System, General Inspection).**<br>Is the carbon canister system normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Repair the carbon canister system. |

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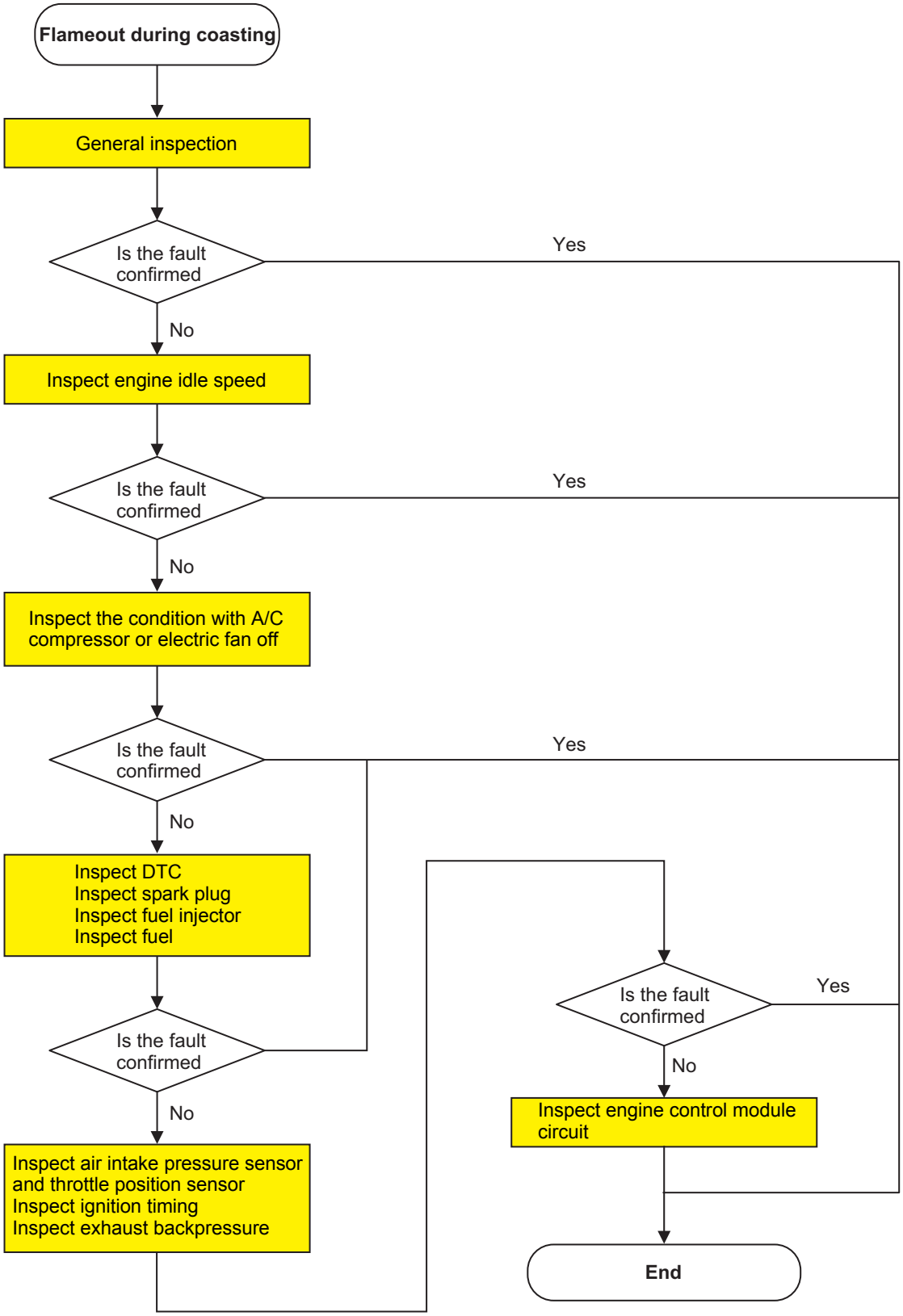


| Test Conditions | Details/Results/Actions |
|---|---|
| 10. Inspect exhaust backpressure | |
| | A. Inspect the exhaust backpressure.<br>**Refer to: Exhaust Backpressure Test (3.2.6 Exhaust System, General Inspection).**<br>Is the exhaust backpressure normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Repair the exhaust system. |
| 11. Inspect engine control module circuit | |
|  <br>M3212019<br>  <br>M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# Diagnosis Procedure for Flameout During Coasting



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect that the vacuum pipeline is correctly positioned without any damage.<br>B. Inspect that the intake system has no leakage.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault parts. |
| 2. Inspect engine idle speed | |
| | A. Inspect the engine idle speed.<br>Is the engine idle speed unstable?<br>**Yes**<br>**Refer to: Diagnosis Procedure for Start Normal but Idle Speed Unstable at Any Time (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Inspect the condition with A/C compressor or electric fan off | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the A/C compressor magnetic clutch wiring harness connector.<br>C. Disconnect the electric fan wiring harness connector.<br>D. Is the A/C system normal?<br>Is the system normal after disconnecting the magnetic clutch and fan wiring harness connectors?<br>**Yes**<br>Repair magnetic clutch connection fault.<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON", and diagnose the engine system.<br>Is there DTC?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 5. |
| 5. Inspect spark plug | |
| | A. Remove the spark plug.<br>B. Inspect the spark plug in each cylinder, and observe whether the model and clearance meet the standard.<br>**Refer to: Spark Plug (3.2.8 Ignition System, removal and Installation).**<br>Is the spark plug in each cylinder normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the spark plug. |
| 6. Inspect fuel injector | |
| | A. Remove the fuel injectors.<br>B. Inspect the fuel injectors for leakage, blockage or flow error. Are they normal?<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace or clean the fuel injector. |
| 7. Inspect fuel | |
| | A. Is the fault caused by just refueling?<br>**Yes**<br>Replace the fuel.<br>**No**<br>Go to step 8. |

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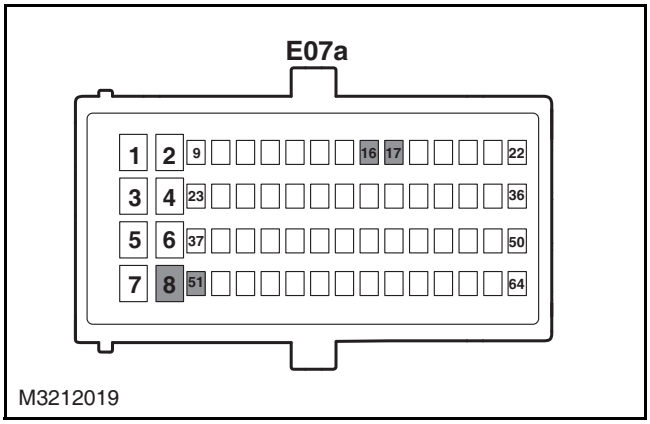


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect air intake pressure sensor and throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start engine and inspect the data flow for air intake pressure sensor and throttle position sensor.<br>Are their data flows normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Replace the air intake pressure sensor and throttle position sensor, or repair the sensor circuit.<br>**Refer to: (3.2.12 Electronic Control System - M7, Removal and Installation).** |
| 9. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Adjust the ignition timing. |
| 10. Inspect exhaust backpressure | |
| | A. Inspect the exhaust backpressure.<br>**Refer to: Exhaust Backpressure Test (3.2.6 Exhaust System, General Inspection).**<br>Is the exhaust backpressure normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Repair the exhaust system. |

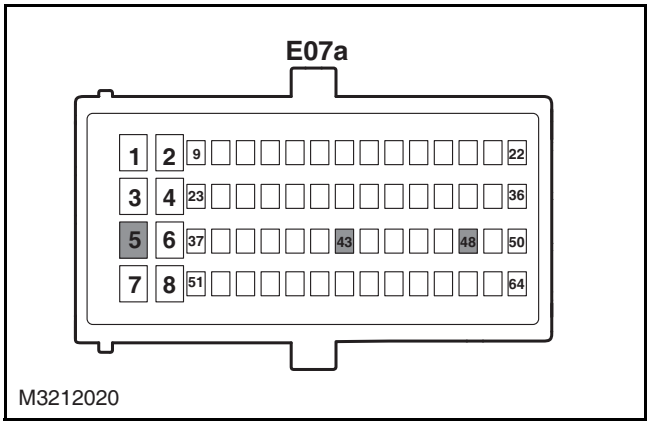
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| Test Conditions | Details/Results/Actions |
|---|---|
| 11. Inspect engine control module circuit | |



M3212019



M3212020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**

**No**

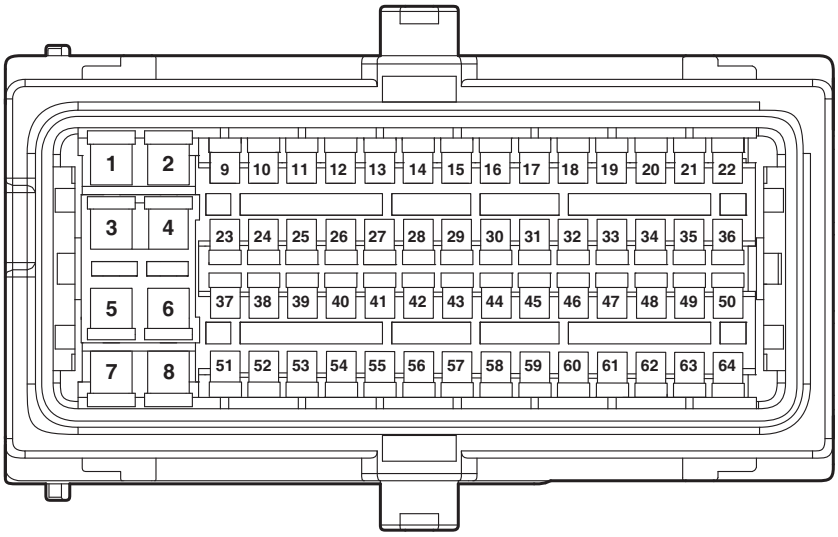
Repair the circuit.

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## DTC Diagnosis and Testing

# Engine Control Module Terminal List




M3212027

| Terminal No. | Wire Diameter/Color | Definition |
|---|---|---|
| 1 | 1.25 BK/RD | Ignition coil of cylinder 4 |
| 2 | 0.85 YE/WH | Front oxygen sensor heating |
| 3 | 1.25 BK/YE | Ignition coil of cylinder 1 |
| 4 | 0.85 WH | Rear oxygen sensor heating |
| 5 | 2.0 BK | Ignition GND |
| 6 | 1.25 BK/VT | Ignition coil of cylinder 2 |
| 7 | 1.25 BK/BU | Ignition coil of cylinder 3 |
| 8 | 1.25 RD/BU | Non-continuous power supply |
| 9 | 0.5 WH/BU | Engine speed output |
| 10 | 0.5 BU/BK | A/C medium pressure switch |
| 11 | - | - |
| 12 | 0.5 LG/RD | Blower switch |
| 13 | 0.5 LG/BK | A/C temperature sensor |
| 14 | - | - |
| 15 | 0.5 LG/WH | Diagnosis K-line |
| 16 | 0.5 PK/BU | Continuous power supply |
| 17 | 0.5 BU | Ignition switch |
| 18 | 0.5 BU/BN | 5 V power supply 2 |
| 19 | 0.5 YE/BK | 5 V power supply 1 |

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| Terminal No. | Wire Diameter/Color | Definition |
|---|---|---|
| 20 | 0.5 VT/YE | MIL indicator |
| 21 | 0.5 GY/YE | Stepper motor phase B |
| 22 | 0.5 GY/GN | Stepper motor phase A |
| 23 | - | - |
| 24 | 0.5 RD/YE | Headlamp switch |
| 25 | 0.5 BU/GN | Air intake temperature sensor |
| 26 | 0.5 BU/WH | Throttle position sensor |
| 27 | - | - |
| 28 | - | - |
| 29 | 0.5 YE | Rear oxygen sensor |
| 30 | 0.5 RD | Knock sensor A side |
| 31 | 0.5 GN | Knock sensor B side |
| 32 | 0.5 BN/WH | Main relay |
| 33 | - | - |
| 34 | - | - |
| 35 | 0.5 GY | Stepper motor phase C |
| 36 | 0.5 GY/BK | Stepper motor phase D |
| 37 | 0.5 RD/WH | Carbon canister control valve |
| 38 | - | - |
| 39 | 0.5 YE/GN | Sensor GND 1 |
| 40 | 0.5 BU/RD | Sensor GND 2 |
| 41 | 0.5 BN/YE | Coolant temperature sensor |
| 42 | - | - |
| 43 | 0.5 BK | Electrical GND 1 |
| 44 | 0.5 PK/BK | A/C switch |
| 45 | 0.5 BK/OG | Front oxygen sensor |
| 46 | - | - |
| 47 | 0.5 BU/WH | Crankshaft position sensor |
| 48 | 0.5 BK | Power GND 1 |
| 49 | 0.5 WH/GN | Cylinder 3 fuel injector |
| 50 | 0.5 WH/BN | Cylinder 1 fuel injector |
| 51 | 0.5 RD/BU | Non-continuous power supply |
| 52 | 0.5 BK/WH | Radiator-fan relay |
| 53 | - | - |

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| Terminal No. | Wire Diameter/Color | Definition |
|---|---|---|
| 54 | - | - |
| 55 | - | - |
| 56 | 0.5 YE/WH | Coolant temperature output |
| 57 | 0.5 YE/GN | Vehicle speed signal |
| 58 | - | - |
| 59 | 0.5 YE/BN | Air intake pressure sensor |
| 60 | 0.5 YE/RD | Fuel pump relay |
| 61 | 0.5 BK/YE | A/C compressor relay |
| 62 | 0.5 BK/RD | A/C condenser-fan relay |
| 63 | 0.5 WH/YE | Cylinder 2 fuel injector |
| 64 | 0.5 WH/BK | Cylinder 4 fuel injector |

# Diagnostic Trouble Code (DTC) Type

| DTC Type | Definition |
|---|---|
| Type 0 | If the DTC type is 0, no lamp is on and the system makes no diagnosis. |
| Type 2 | Diagnosis for misfire related failure generally is defined as 2. For the misfire fault that will cause damage to catalytic converters, MIL will immediately flash to warn the driver; for the misfire fault that may cause the deterioration of emissions, if in 3 consecutive driving cycles, the relative level of misfire is all fully detected, then MIL will come on; the fault will be deleted after 40 continuous trouble-free warm-up cycles. |
| Type 3 | After the fault is detected in 3 consecutive driving cycles, MIL will come on; then off if it is detected to be repaired in 3 consecutive driving cycles; and the fault will be deleted after 40 continuous trouble-free warm-up cycles. |
| Type 4 | MIL will come on 2.5 seconds after the fault occurs; if it is detected to be repaired in 3 consecutive driving cycles, MIL will go off; and the fault will be deleted after 40 continuous trouble-free warm-up cycles. |
| Type 5 | If the fault is detected in 3 consecutive driving cycles, it will be confirmed but without lamp on; if the fault is detected to be repaired in 3 consecutive driving cycles, it proves to be repaired; then deleted after 40 continuous trouble-free warm-up cycles. |
| Type 6 | Once the fault occurs, it will be confirmed immediately; then deleted after 40 continuous trouble-free warm-up cycles. No lamp will come on and universal scan tool is unreadable for the fault. |
| Type 7 | The external test tools can activate the fuel supply system fault diagnosis and are generally used only for offline test or repair station. No lamp will come on and universal scan tool is unreadable for the fault. |
| Type 11 | It is a special diagnostic path for fuel supply system. After the fault is detected in 3 consecutive driving cycles, MIL will come on; then off if it is detected to be repaired in 4 consecutive driving cycles; and the fault will be deleted after 40 continuous trouble-free warm-up cycles. |

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| DTC Type | Definition |
|---|---|
| Type 12 | Once the fault occurs, it will be confirmed immediately and SVS will come on; then off if the fault is repaired; and it will be deleted after 40 continuous trouble-free warm-up cycles. The universal scan tool is unreadable. |
| Type 13 | Once the fault occurs, SVS will come on, then off if the fault is repaired; or when the fault is detected in 3 consecutive driving cycles and is confirmed, SVS will go off and MIL will come on; then off if the fault is detected to be repaired in 4 consecutive driving cycles; and the fault will be deleted after 40 continuous trouble-free warm-up cycles. |
| Type 35 | Once the fault occurs, it will be confirmed immediately and SVS will flash; then off if the fault is repaired; and it will be deleted after 20 continuous trouble-free warm-up cycles. |
| Type 36 | Once the fault occurs, it will be confirmed immediately but without SVS on; and it will be deleted after 20 continuous trouble-free warm-up cycles. |
| Type 38 | Once the fault occurs, it will be confirmed immediately and SVS will flash; then off if it is repaired; and the fault memory will not record this fault. |
| Type 39 | Once the fault occurs, it will be confirmed immediately but without SVS on; the fault memory will not record this fault. |

# DTC Code List

| DTC Code | Description | DTC Type | MIL ON |
|---|---|---|---|
| P0030 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) | 3 | √ |
| P0031 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) Low | 3 | √ |
| P0032 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) High | 3 | √ |
| P0036 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) | 3 | √ |
| P0037 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) Low | 3 | √ |
| P0038 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) High | 3 | √ |
| P0053 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 1) | 3 | √ |
| P0054 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 2) | 3 | √ |
| P0105 | Manifold Absolute Pressure/Barometric Pressure Circuit | 3 | √ |
| P0106 | Manifold Abs.Pressure or Bar. Pressure Range/ Performance | 3 | √ |
| P0107 | Manifold Abs. Pressure or Bar. Pressure Low Input | 3 | √ |
| P0108 | Manifold Abs. Pressure or Bar. Pressure High Input | 3 | √ |
| P0112 | Intake Air Temp. Circ. Low Input | 3 | √ |
| P0113 | Intake Air Temp. Circ. High Input | 3 | √ |
| P0117 | Engine Coolant Temp. Circ. Low Input | 3 | √ |

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| DTC Code | Description | DTC Type | MIL ON |
|---|---|---|---|
| P0118 | Engine Coolant Temp. Circ. High Input | 3 | √ |
| P0122 | Throttle/Pedal Pos. Sensor A Circ. Low Input | 3 | √ |
| P0123 | Throttle/Pedal Pos. Sensor A Circ. High Input | 3 | √ |
| P0130 | O2 Sensor Circ., Bank1-Sensor1 Malfunction | 3 | √ |
| P0131 | O2 Sensor Circ., Bank1-Sensor1 Low Voltage | 3 | √ |
| P0132 | O2 Sensor Circ., Bank1-Sensor1 High Voltage | 3 | √ |
| P0133 | O2 Sensor Circ., Bank1-Sensor1 Slow Response | 3 | √ |
| P0134 | O2 Sensor Circ., Bank1-Sensor1 No Activity Detected | 3 | √ |
| P0136 | O2 Sensor Circ., Bank1-Sensor2 Malfunction | 3 | √ |
| P0137 | O2 Sensor Circ., Bank1-Sensor2 Low Voltage | 3 | √ |
| P0138 | O2 Sensor Circ., Bank1-Sensor2 High Voltage | 3 | √ |
| P0140 | O2 Sensor Circ., Bank1-Sensor2 No Activity Detected | 3 | √ |
| P0170 | Fuel Trim, Bank1 Malfunction | 7 | × |
| P0171 | Fuel Trim, Bank1 System too Lean | 7 | × |
| P0172 | Fuel Trim, Bank1 System too Rich | 7 | × |
| P0201 | Cylinder 1 - Injector Circuit | 3 | √ |
| P0202 | Cylinder 2 - Injector Circuit | 3 | √ |
| P0203 | Cylinder 3 - Injector Circuit | 3 | √ |
| P0204 | Cylinder 4 - Injector Circuit | 3 | √ |
| P0261 | Cylinder 1 - Injector Circuit Low | 3 | √ |
| P0262 | Cylinder 1 - Injector Circuit High | 3 | √ |
| P0264 | Cylinder 2 - Injector Circuit Low | 3 | √ |
| P0265 | Cylinder 2 - Injector Circuit High | 3 | √ |
| P0267 | Cylinder 3 - Injector Circuit Low | 3 | √ |
| P0268 | Cylinder 3 - Injector Circuit High | 3 | √ |
| P0270 | Cylinder 4 - Injector Circuit Low | 3 | √ |
| P0271 | Cylinder 4 - Injector Circuit High | 3 | √ |
| P0300 | Random/Multiple Cylinder Misfire Detected | 2 | √ or flash |
| P0301 | Cyl.1 Misfire Detected | 2 | √ or flash |
| P0302 | Cyl.2 Misfire Detected | 2 | √ or flash |
| P0303 | Cyl.3 Misfire Detected | 2 | √ or flash |
| P0304 | Cyl.4 Misfire Detected | 2 | √ or flash |
| P0321 | Ign./Distributor Eng. Speed Inp. Circ. Range/ Performance | 3 | √ |

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| DTC Code | Description | DTC Type | MIL ON |
|---|---|---|---|
| P0322 | Ign./Distributor Eng. Speed Inp. Circ. No Signal | 4 | √ |
| P0327 | Knock Sensor 1 Circ. Low Input | 3 | √ |
| P0328 | Knock Sensor 1 Circ. High Input | 3 | √ |
| P0420 | Catalyst System, Bank1 Efficiency Below Threshold | 3 | √ |
| P0444 | Evaporative Emiss. System Purge Control Valve Circ. Open | 3 | √ |
| P0458 | Evaporative Emission System Purge Control Valve Circuit Low | 3 | √ |
| P0459 | Evaporative Emission System Purge Control Valve Circuit High | 3 | √ |
| P0480 | Cooling Fan 1 Control Circuit | 5 | × |
| P0481 | Cooling Fan 2 Control Circuit | 5 | × |
| P0501 | Vehicle Speed Sensor Range/Performance | 3 | √ |
| P0506 | Idle Control System RPM Lower than Expected | 3 | √ |
| P0507 | Idle Control System RPM Higher than Expected | 3 | √ |
| P0508 | Idle Air Control System Circuit Low | 3 | √ |
| P0509 | Idle Air Control System Circuit High | 3 | √ |
| P0511 | Idle Air Control Circuit | 3 | √ |
| P0537 | A/C Evaporator Temperature Sensor Circuit Low | 5 | × |
| P0538 | A/C Evaporator Temperature Sensor Circuit High | 5 | × |
| P0560 | System Voltage Malfunction | 5 | × |
| P0562 | System Voltage Low Voltage | 5 | × |
| P0563 | System Voltage High Voltage | 5 | × |
| P0602 | Control Module Programming Error | 3 | √ |
| P0627 | Fuel Pump "A" Control Circuit/Open | 3 | √ |
| P0628 | Fuel Pump "A" Control Circuit Low | 3 | √ |
| P0629 | Fuel Pump "A" Control Circuit High | 3 | √ |
| P0645 | AC Clutch Relais Circuit | 5 | × |
| P0646 | A/C Clutch Relay Control Circuit Low | 5 | × |
| P0647 | A/C Clutch Relay Control Circuit High | 5 | × |
| P0650 | Malfunction Indicator Lamp Control Circ. | 3 | √ |
| P0691 | Cooling Fan 1 Control Circuit Low | 5 | × |
| P0692 | Cooling Fan 1 Control Circuit High | 5 | × |
| P0693 | Cooling Fan 2 Control Circuit Low | 5 | × |
| P0694 | Cooling Fan 2 Control Circuit High | 5 | × |

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| DTC Code | Description | DTC Type | MIL ON |
|---|---|---|---|
| P2177 | System Too Lean Off Idle | 11 | √ |
| P2178 | System Too Rich Off Idle | 11 | √ |
| P2187 | System Too Lean at Idle | 11 | √ |
| P2188 | System Too Rich at Idle | 11 | √ |
| P2195 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 1 | 3 | √ |
| P2196 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 1 | 3 | √ |
| P2270 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 2 | 3 | √ |
| P2271 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 2 | 3 | √ |

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# Failure Protection List

| DTC Code | Description | Failure-Protection Operation | Prerequisite of Releasing Failure Protection |
|---|---|---|---|
| P0262, P0261, P0201 | Cylinder 1 injector circuit fault | - | Repair the circuit fault or replace the injector. |
| P0268, P0267, P0203 | Cylinder 2 injector circuit fault | - | Repair the circuit fault or replace the injector. |
| P0271, P0270, P0204 | Cylinder 3 injector circuit fault | - | Repair the circuit fault or replace the injector. |
| P0265, P0264, P0202 | Cylinder 4 injector circuit fault | - | Repair the circuit fault or replace the injector. |
| P0038, P0037, P0036 | Rear oxygen sensor heating circuit fault | • Rear oxygen sensor internal resistance reasonable diagnosis off | Repair the rear oxygen circuit fault or replace the rear oxygen sensor. |
| P0032, P0031, P0030 | Front oxygen sensor heating circuit fault | • Turn off rear oxygen sensor function and diagnose | Repair the front oxygen circuit fault or replace the front oxygen sensor. |
| P0647, P0646, P0645 | A/C circuit fault | - | Repair the circuit fault. |
| P0629, P0628, P0627 | Fuel pump relay circuit fault | - | Repair the circuit fault. |
| P0692, P0691, P0480 | Low speed fan control circuit fault | - | Repair the circuit fault. |
| P0694, P0693, P0481 | High speed fan control circuit fault | - | Repair the circuit fault. |
| P0650 | MIL circuit fault | - | Repair the circuit fault. |

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| DTC Code | Description | Failure-Protection Operation | Prerequisite of Releasing Failure Protection |
|---|---|---|---|
| P0459, P0458, P0444 | Carbon canister valve control circuit fault | • Turn rear oxygen control function off<br>• Turn catalytic converter diagnosis off<br>• Turn idle diagnosis off<br>• Turn front oxygen sensor aging diagnosis off<br>• Turn rear oxygen sensor aging diagnosis off<br>• Turn front oxygen sensor internal resistance reasonable diagnosis off<br>• Turn rear oxygen sensor internal resistance reasonable diagnosis off<br>• Turn misfire detection fuel supply self-learning function off | Repair the circuit fault. |
| P0602 | Diagnose the Diagnostic Data Identification (DDI) code programming | - | Repair the fault or update the data. |
| P0300, P0301, P0302, P0303, P0304 | One cylinder or multi-cylinder misfire | 1. Misfire fault (E_md = 1)<br>• Turn misfire detection fuel supply self-learning function off<br>2. B_mdarv set due to misfire<br>• Turn off rear oxygen control %LRHK<br>• Misfire detection fuel supply self-learning<br>• Forbid air-fuel ratio self-learning<br>• Forbid carbon canister flushing<br>3. Maximum misfire fault is detected and cylinder cut-off operation is performed:<br>• Turn off Lambda closed loop control | Repair the fault and inspect the ignition system and fuel supply system. |

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| DTC Code | Description | Failure-Protection Operation | Prerequisite of Releasing Failure Protection |
|---|---|---|---|
| P2177, P2178 | Fuel supply system | • Forbid catalytic converter diagnosis<br>• Forbid front/rear oxygen sensor aging diagnosis<br>• Forbid carbon canister passive detection<br>• Forbid rear oxygen closed loop<br>• Forbid misfire detection fuel supply self-learning | Repair the fault, and inspect the fuel supply components and oxygen sensor circuit. |
| P0054 | Rear oxygen sensor heating | • Forbid front oxygen sensor aging diagnosis<br>• Forbid catalytic converter diagnosis<br>• Forbid rear oxygen closed loop control | Repair the fault or replace the rear oxygen sensor. |
| P0053 | Front oxygen sensor heating | • Forbid front oxygen sensor aging diagnosis<br>• Forbid catalytic converter diagnosis<br>• Forbid rear oxygen closed loop control<br>• Forbid fuel supply system self-learning | Repair the fault or replace the front oxygen sensor. |
| P2270, P2271 | Rear oxygen sensor aging | • Forbid catalytic converter diagnosis<br>• Forbid rear oxygen sensor closed loop control | Repair the fault or replace the oxygen sensor |
| P0133, P2195, P2196 | Front oxygen sensor aging | • Forbid catalytic converter diagnosis | Repair the fault or replace the oxygen sensor |
| P0138, P0137, P0136, P0140 | Rear oxygen sensor circuit | • Forbid catalytic converter diagnosis<br>• Forbid rear oxygen sensor aging diagnosis | Repair the fault, inspect the sensor circuit or replace the oxygen sensor. |

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| DTC Code | Description | Failure-Protection Operation | Prerequisite of Releasing Failure Protection |
|---|---|---|---|
| P0130, P0131, P0132, P0134 | Front oxygen sensor circuit | • Forbid catalytic converter diagnosis<br>• Forbid fuel supply system self-learning<br>• Forbid front oxygen sensor closed loop<br>• Forbid oxygen sensor aging diagnosis | Repair the fault, inspect the sensor circuit or replace the oxygen sensor. |
| P0420 | Catalytic converter | • Forbid rear oxygen closed loop<br>• Forbid front oxygen sensor rational curves drift diagnosis | Repair the fault, replace the catalytic converter. |
| P0327 | Knock sensor open fault | • Ignition angle of each cylinder is retarded for - 9 degrees when entering knock control | Repair the fault, and inspect the knock sensor connection. |
| P0328 | Knock sensor short fault | • Ignition angle of each cylinder is retarded for - 9 degrees when entering knock control | Repair the fault, and inspect the knock sensor connection. |

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# Data Flow List

By reading the "Actual values" displayed on the diagnostic tool, the working state of switches, sensors, and actuators can be inspected without removing any components. Before the fault diagnosis of electronic control system, observing and analyzing the data first in troubleshooting can shorten the troubleshooting time.

**CAUTION: The following table lists the data under normal conditions, only for reference. Do not depend solely on these reference values when deciding whether a part is faulty or not. Generally, compare a normal vehicle to the diagnosing vehicle under the same state, to determine whether the data of diagnosing vehicle under the current state is normal or not.**

1. Allow the engine to reach normal operating temperature.
2. Turn the ignition switch to "LOCK".
3. Connect the diagnostic tool.
4. Turn the ignition switch to "ON", and turn on the diagnostic tool.
5. Select "CHANA Star Trunk/UAES M788 (EA12)/Actual values".
6. Refer to the chart below to inspect each item.

| Item | Ignition Switch "ON" | Idling | Engine Speed 2000 rpm |
|---|---|---|---|
| Battery voltage | 11.62 V | 13.65 V | 13.65 V |
| Engine speed | 0 rpm | 902 r/min | 2112 rpm |
| Desired idle speed [without offset] | 900 r/min | 900 r/min | 900 r/min |
| Desired idle speed [with offset] | 900 r/min | 900 r/min | 900 r/min |
| Vehicle speed | 0 km/h | 0 km/h | 0 km/h |
| vehicle acceleration | 0.0 $m/s^2$ | 0.0 $m/s^2$ | 0.0 $m/s^2$ |
| Engine coolant temperature sensor voltage | 0.88 V | 0.66 V | 0.68 V |
| Engine coolant temperature | 66°C | 78°C | 78°C |
| Intake air temperature sensor voltage | 2.38 V | 2.38 V | 2.38 V |
| Intake air temperature | 27°C | 27°C | 27°C |
| Ambient temperature | 9°C | 9°C | 9°C |
| AC sensor | 1.74 V | 1.74 V | 1.74 V |
| AC temperature | 16.4°C | 16.4°C | 16.4°C |
| Actual intake manifold pressure sensor voltage | 4.0 V | 1.07 V | 0.7 V |
| Actual intake manifold pressure | 1010 hPa | 340 hPa | 260 hPa |
| Air mass flow filtered | 0.0 kg/h | 9.1 kg/h | 13.6 kg/h |
| Desired position of stepper motor | 122 | 64 | 47 |
| ADC-signal throttle angle | 0.52 V | 0.52 V | 0.68 V |

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| Item | Ignition Switch "ON" | Idling | Engine Speed 2000 rpm |
|---|---|---|---|
| Throttle position angle signal | 10.45% | 10.45% | 13.67% |
| Calculated throttle position | 0.0% | 0.0% | 3.5% |
| Throttle motor PWM control signal | 0.0% | 0.0% | 0.0% |
| Control valve canister purge valve | 0.0% | 0.0% | 5.9% |
| Dwell time | 4.4 ms | 2.6 ms | 3.3 ms |
| Average injector base pulse width | 0.0 ms | 2.9 ms | 2.8 ms |
| Ignition timing advance cylinder 1 | 0.0° | 5.0° | 30.5° |
| Volumetric flow of fuel in l/h | 0.0 L/h | 0.75 L/h | 1.174 L/h |
| Knock sensor signal bank1 | 0.0 V | 0.0 V | 0.0 V |
| Knock sensor signal bank2 | 0.0 V | 0.0 V | 0.0 V |
| Ignition retard knock control cylinder 1 | -0.0 | -0.0 | -0.0 |
| Ignition retard knock control cylinder 2 | -0.0 | -0.0 | -0.0 |
| Ignition retard knock control cylinder 3 | -0.0 | -0.0 | -0.0 |
| Ignition retard knock control cylinder 4 | -0.0 | -0.0 | -0.0 |
| O2 sensor integrator bank 1 [short term fuel trim] | 1.00 | 0.9 | 1.04 |
| O2 sensor voltage bank 1, sensor 1 | 0.5 V | 0.57 V | 0.1 V |
| O2 sensor voltage bank 1, sensor 2 | 0.5 V | 0.49 V | 0.6 V |
| O2 sensor integrator bank 1 [long term fuel trim] | 1.0 | 1.0 | 1.0 |
| Final long term corr. factor bank 1 | 0.0% | 0.0% | 0.0% |
| Modeled temperature at inlet valve | 46.5°C | 46.5°C | 46.5°C |
| Relative engine load | 100.0% | 21.1% | 16.2% |
| Idle torque control adapt | -0.7% | 2.6% | 0.9% |
| Idle speed control desired torque change | 0.0% | -0.8% | 0.0% |
| Relative fuel part of the purge control | 0.0% | 0.0% | 1.2% |
| Canister purge rate | 0.0% | 0.0% | 0.0% |
| Charcoal canister charge | 0.0 | 0.0 | 12.6 |
| Operating time since prime start | 0 min | 0 min | 0 min |

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# Active Test List

Through the "Actuators" in the diagnostic tool, the working state of relays and actuators controlled by ECM can be tested without removing any components. Before the fault diagnosis of electronic control system, performing the active test first in troubleshooting can shorten the troubleshooting time.

**CAUTION: The following table lists the data under normal conditions, only for reference. Do not depend solely on these reference values when deciding whether a part is faulty or not. Generally, compare a normal vehicle to the diagnosing vehicle under the same state, to determine whether the data of diagnosing vehicle under the current state is normal or not.**

1. Allow the engine to reach normal operating temperature.
2. Turn the ignition switch to "LOCK".
3. Connect the diagnostic tool.
4. Turn the ignition switch to "ON", and turn on the diagnostic tool.
5. Select "CHANA Star Trunk/UAES M788 (EA12)/Actuators".
6. Refer to the chart below to perform active test.

| Diagnostic Tool Display | Description | Control Range | Diagnosis Description |
|---|---|---|---|
| Engine Indicator Lamp (MIL) | Enable the engine indicator lamp | On/Off | - |
| Fuel Pump Relay | Enable the fuel pump | On/Off | Test conditions: The vehicle speed must be equal to zero. There must not be any vehicle speed sensor malfunction detected. |
| Cooling Fan Relay #1 | Enable the cooling fan #1 | On/Off | Test conditions for Fan Relay Off: The engine coolant temperature must be below a unique calibration threshold (lower than 100°C). Otherwise, the ECM should turn on the fan to prevent engine from overheating. Air conditioning request is not allowed.<br>Test condition for Fan Relay On: No device control limit for this case. |
| Cooling Fan Relay #2 | Enable the cooling fan #2 | On/Off | Test conditions for Fan Relay Off: The engine coolant temperature must be below a unique calibration threshold (lower than 100°C). Otherwise, the ECM should turn on the fan to prevent engine from overheating. Air conditioning request is not allowed.<br>Test condition for Fan Relay On: No device control limit for this case. |
| Spark Retard | Retard the ignition coil ignition angle | 0-7 | - |
| Set Stepper Position | Set the stepper motor position | 0-255 | Test condition: No stepper actuator test active. |

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| Diagnostic Tool Display | Description | Control Range | Diagnosis Description |
|---|---|---|---|
| Canister Purge Solenoid | Control the carbon canister control valve duty ratio | 0-100 | - |
| Air Condition Clutch | Engage the A/C clutch | On/Off | Test condition: Engine is not running. |
| Fuel Injector Disable | Disable the injector fuel injection | Cylinder 1/ Cylinder 2/ Cylinder 3/ Cylinder 4 | Test conditions: The vehicle speed must be equal to zero. There must not be any vehicle speed sensor malfunction detected. The oxygen sensor state must be in "lean". |
| Idle Speed Control | Control the idle speed | 0-2550 | Test condition: The engine idle speed must be less than 1000 rpm. |
| Stepper Actuator Test | Test the stepper motor | On/Off | Test condition: No set stepper position active. |

# DTC Diagnosis Procedure Index

| DTC Code | Description | Diagnosis Procedures |
|---|---|---|
| P0030 | O2 Sensor Heater Contr. Circ. (Bank1(1) Sensor 1) | Refer to: DTCs P0030, P0031, P0032, P0053 |
| P0031 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) Low | |
| P0032 | O2 Sensor Heater Contr. Circ. (Bank1(1) Sensor 1) High | |
| P0036 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) | Refer to: DTCs P0036, P0037, P0038, P0054 |
| P0037 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) Low | |
| P0038 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) High | |
| P0053 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 1) | Refer to: DTCs P0030, P0031, P0032, P0053 |
| P0054 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 2) | Refer to: DTCs P0036, P0037, P0038, P0054 |
| P0105 | Manifold Absolute Pressure/Barometric Pressure Circuit | Refer to: DTCs P0105, P0106, P0107, P0108 |
| P0106 | Manifold Abs. Pressure or Bar. Pressure Range/Performance | |
| P0107 | Manifold Abs. Pressure or Bar. Pressure Low Input | |
| P0108 | Manifold Abs. Pressure or Bar. Pressure High Input | |

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| DTC Code | Description | Diagnosis Procedures |
|---|---|---|
| P0112 | Intake Air Temp. Circ. Low Input | Refer to: DTCs P0112, P0113 |
| P0113 | Intake Air Temp. Circ. High Input | |
| P0117 | Engine Coolant Temp.Circ. Low Input | Refer to: DTCs P0117, P0118 |
| P0118 | Engine Coolant Temp.Circ. High Input | |
| P0122 | Throttle/Pedal Pos. Sensor A Circ. Low Input | Refer to: DTCs P0122, P0123 |
| P0123 | Throttle/Pedal Pos. Sensor A Circ. High Input | |
| P0130 | O2 Sensor Circ., Bank1-Sensor1 Malfunction | Refer to: DTCs P0130, P0131, P0132, P0133, P0134, P2195, P2196 |
| P0131 | O2 Sensor Circ., Bank1-Sensor1 Low Voltage | |
| P0132 | O2 Sensor Circ., Bank1-Sensor1 High Voltage | |
| P0133 | O2 Sensor Circ., Bank1-Sensor1 Slow Response | |
| P0134 | O2 Sensor Circ., Bank1-Sensor1 No Activity Detected | |
| P0136 | O2 Sensor Circ., Bank1-Sensor2 Malfunction | Refer to: DTCs P0136, P0137, P0138, P0140, P2270, P2271 |
| P0137 | O2 Sensor Circ., Bank1-Sensor2 Low Voltage | |
| P0138 | O2 Sensor Circ., Bank1-Sensor2 High Voltage | |
| P0140 | O2 Sensor Circ., Bank1-Sensor2 No Activity Detected | |
| P0201 | Cylinder 1 - Injector Circuit | Refer to: DTCs P0201, P0261, P0262 |
| P0202 | Cylinder 2 - Injector Circuit | |
| P0203 | Cylinder 3 - Injector Circuit | |
| P0204 | Cylinder 4 - Injector Circuit | |
| P0261 | Cylinder 1 - Injector Circuit Low | |
| P0262 | Cylinder 1 - Injector Circuit High | |
| P0264 | Cylinder 2 - Injector Circuit Low | |
| P0265 | Cylinder 2 - Injector Circuit High | |
| P0267 | Cylinder 3 - Injector Circuit Low | |
| P0268 | Cylinder 3 - Injector Circuit High | |
| P0270 | Cylinder 4 - Injector Circuit Low | |
| P0271 | Cylinder 4 - Injector Circuit High | |
| P0300 | Random/Multiple Cylinder Misfire Detected | Refer to: DTCs P0300, P0301, P0302, P0303, P0304 |
| P0301 | Cyl.1 Misfire Detected | |
| P0302 | Cyl.2 Misfire Detected | |
| P0303 | Cyl.3 Misfire Detected | |
| P0304 | Cyl.4 Misfire Detected | |

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| DTC Code | Description | Diagnosis Procedures |
|---|---|---|
| P0321 | Ign./Distributor Eng. Speed Inp. Circ. Range/ Performance | Refer to: DTCs P0321, P0322 |
| P0322 | Ign./Distributor Eng. Speed Inp. Circ. No Signal | |
| P0327 | Knock Sensor 1 Circ. Low Input | Refer to: DTCs P0327, P0328 |
| P0328 | Knock Sensor 1 Circ. High Input | |
| P0420 | Catalyst System, Bank1 Efficiency Below Threshold | Refer to: DTC P0420 |
| P0444 | Evaporative Emiss. System Purge Control Valve Circ. Open | Refer to: DTCs P0444, P0458, P0459 |
| P0458 | Evaporative Emission System Purge Control Valve Circuit Low | |
| P0459 | Evaporative Emission System Purge Control Valve Circuit High | |
| P0480 | Cooling Fan 1 Control Circuit | Refer to: DTCs P0480, P0691, P0692 |
| P0481 | Cooling Fan 2 Control Circuit | |
| P0506 | Idle Control System RPM Lower than Expected | Refer to: DTCs P0506, P0507 |
| P0507 | Idle Control System RPM Higher than Expected | |
| P0508 | Idle Air Control System Circuit Low | Refer to: DTCs P0508, P0509, P0511 |
| P0509 | Idle Air Control System Circuit High | |
| P0511 | Idle Air Control Circuit | |
| P0560 | System Voltage Malfunction | Refer to: DTCs P0560, P0562, P0563 |
| P0562 | System Voltage Low Voltage | |
| P0563 | System Voltage High Voltage | |
| P0602 | Control Module Programming Error | Refer to: DTC P0602 |
| P0627 | Fuel Pump "A" Control Circuit/Open | Refer to: DTCs P0627, P0628, P0629 |
| P0628 | Fuel Pump "A" Control Circuit Low | |
| P0629 | Fuel Pump "A" Control Circuit High | |
| P0645 | AC Clutch Relais Circuit | Refer to: DTCs P0645, P0646, P0647 |
| P0646 | A/C Clutch Relay Control Circuit Low | |
| P0647 | A/C Clutch Relay Control Circuit High | |
| P0650 | Malfunction Indicator Lamp Control Circ. | Refer to: DTC P0650 |

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| DTC Code | Description | Diagnosis Procedures |
|---|---|---|
| P0691 | Cooling Fan 1 Control Circuit Low | Refer to: DTCs P0480, P0691, P0692 |
| P0692 | Cooling Fan 1 Control Circuit High | |
| P0693 | Cooling Fan 2 Control Circuit Low | |
| P0694 | Cooling Fan 2 Control Circuit High | |
| P2177 | System Too Lean Off Idle | Refer to: DTCs P2177, P2178, P2187, P2188 |
| P2178 | System Too Rich Off Idle | |
| P2187 | System Too Lean at Idle | |
| P2188 | System Too Rich at Idle | |
| P2195 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 1 | Refer to: DTCs P0130, P0131, P0132, P0133, P0134, P2195, P2196 |
| P2196 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 1 | |
| P2270 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 2 | Refer to: DTCs P0136, P0137, P0138, P0140, P2270, P2271 |
| P2271 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 2 | |

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# DTCs P0030, P0031, P0032, P0053

### 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0030 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) | The working voltage of front oxygen sensor heater is provided by the main relay that is controlled by ECM. When the ignition switch is turned to "ON", battery voltage is applied to the terminal 4 of front oxygen sensor connector E01a. ECM controls the working time of heater by the terminal 2 of ECM connector E07a. |
| P0031 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) Low | |
| P0032 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 1) High | |
| P0053 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 1) | |

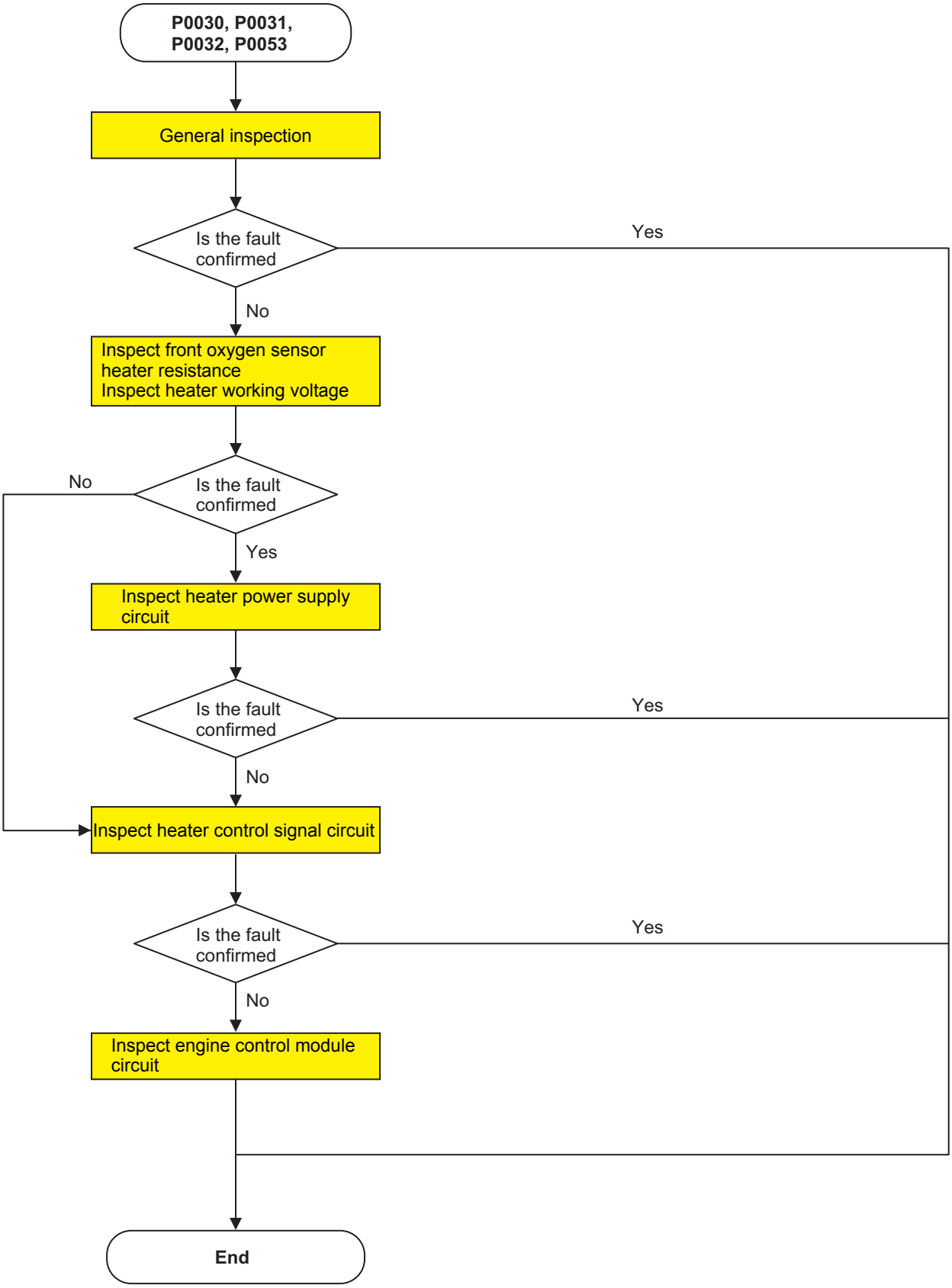
### 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0030 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Sensor circuit<br>• Sensor<br>• ECM |
| P0031 | | | |
| P0032 | | | |
| P0053 | Present resistance value is greater than threshold value | • Exhaust temperature is within 250°C ~ 550°C<br>• Front oxygen sensor internal resistance value is higher than about 1600 Ω | |

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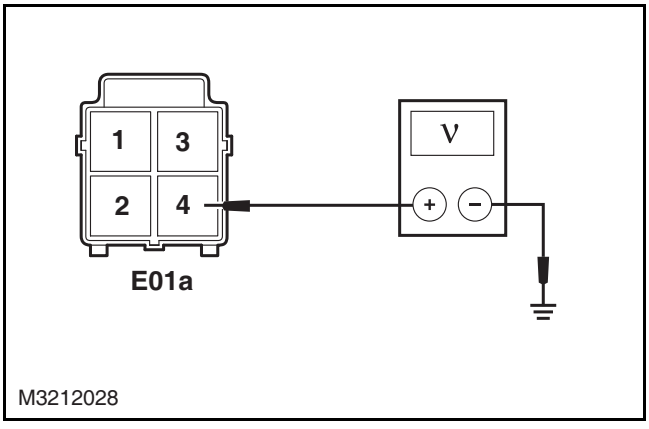


### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wire harness connector related to the front oxygen sensor for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect front oxygen sensor heater resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front oxygen sensor wiring harness connector.<br>C. Measure the resistance of heater between terminals 4 and 3 of front oxygen sensor .<br>**Standard resistance: 7 ~ 14 Ω (normal temperature)**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the front oxygen sensor. Make sure the system is normal. |
| 3. Inspect heater working voltage | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front oxygen sensor wiring harness connector E01a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 4 of front oxygen sensor wiring harness connector E01a and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 4. |

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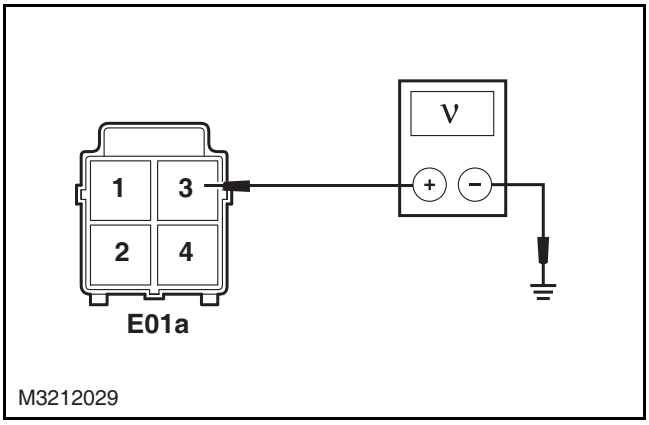


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect heater power supply circuit | |
| | A. Remove the fuse IF30.<br>B. Inspect the fuse.<br>Is the fuse normal?<br>**Yes**<br>Inspect and repair the conductivity between terminal 4 of front oxygen sensor wiring harness connector E01a and terminal 60 of fuse IF30 in the instrument panel fuse box P40.<br>**No**<br>Replace the fuse. Go to step 5. |

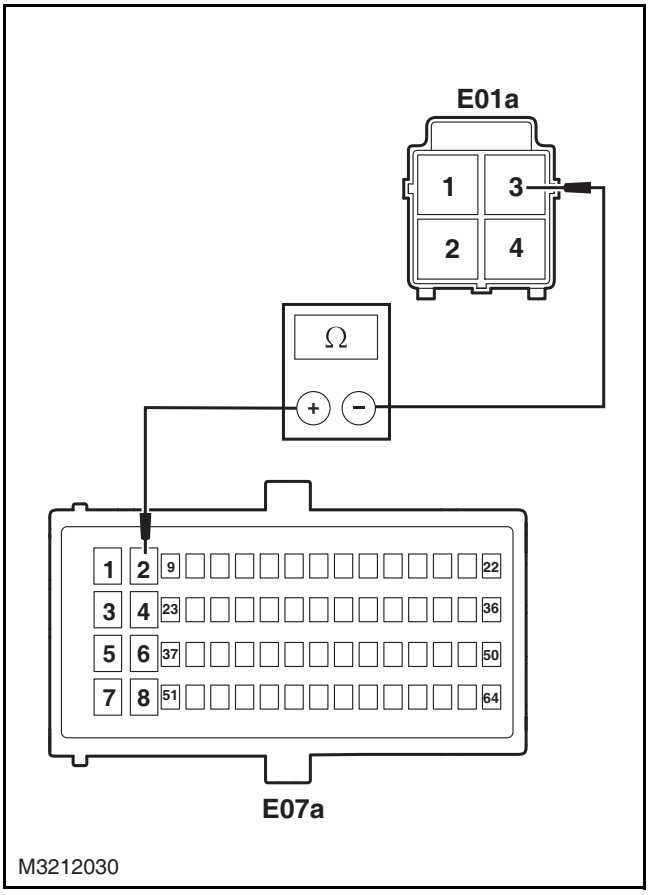
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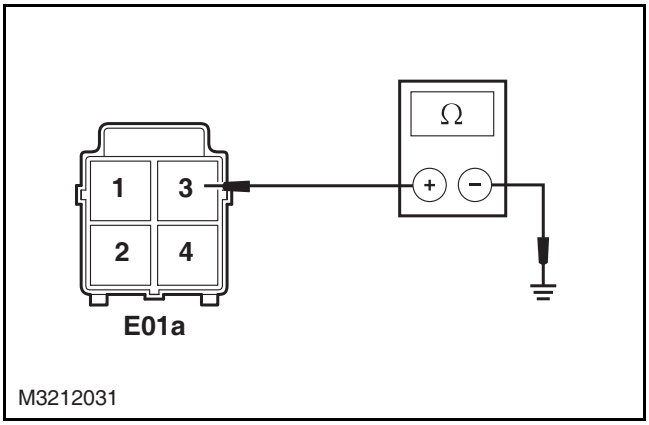
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect heater control signal circuit | |




M3212029




M3212030




M3212031

A. Turn the ignition switch to "LOCK".

B. Disconnect the front oxygen sensor wiring harness connector E01a.

C. Measure the voltage between terminal 3 of E01a and reliable grounding.

**Standard voltage: 0 V**

D. Disconnect the ECM wiring harness connector E07a.

E. Measure the resistance between terminal 3 of front oxygen sensor wiring harness connector E01a and terminal 2 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 3 of E01a and reliable grounding.

**Standard resistance: 10 MΩ or more**

Are they normal?

**Yes**

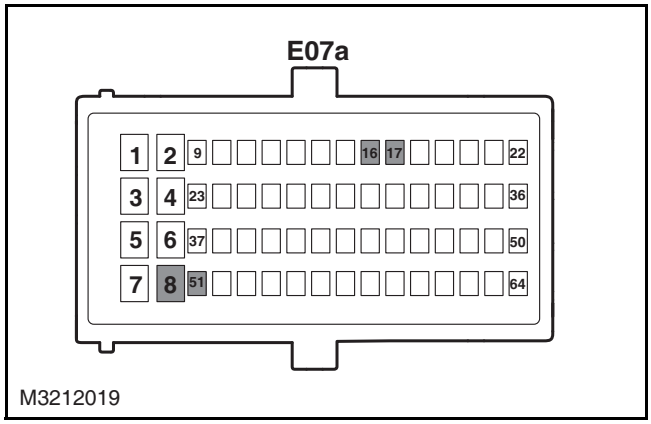
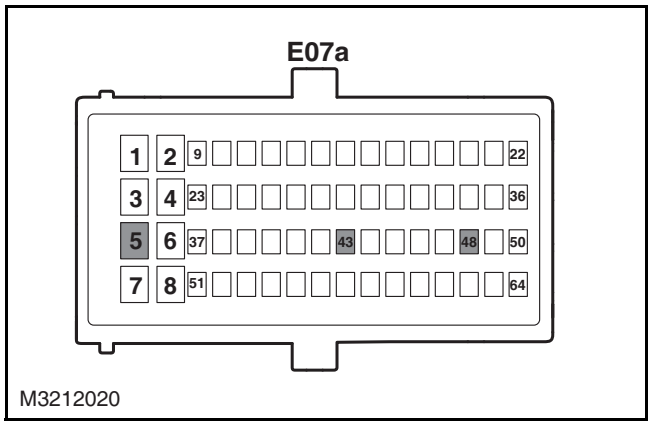
Go to step 6.

**No**

Repair the fault circuit between terminal 3 of front oxygen sensor wiring harness connector E01a and terminal 2 of ECM wiring harness connector E07a. Verify that the system is normal.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0036, P0037, P0038, P0054

### 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0036 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) | The working voltage of rear oxygen sensor heater is provided by the main relay that is controlled by ECM. When the ignition switch is turned to "ON", battery voltage is applied to the terminal 3 of rear oxygen sensor connector S10. ECM controls the working time of heater by the terminal 4 of ECM wiring harness connector E07a. |
| P0037 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) Low | |
| P0038 | O2 Sensor Heater Contr. Circ. (Bank1 (1) Sensor 2) High | |
| P0054 | O2 Sensor Heater Resistance (Bank1 (1) Sensor 2) | |

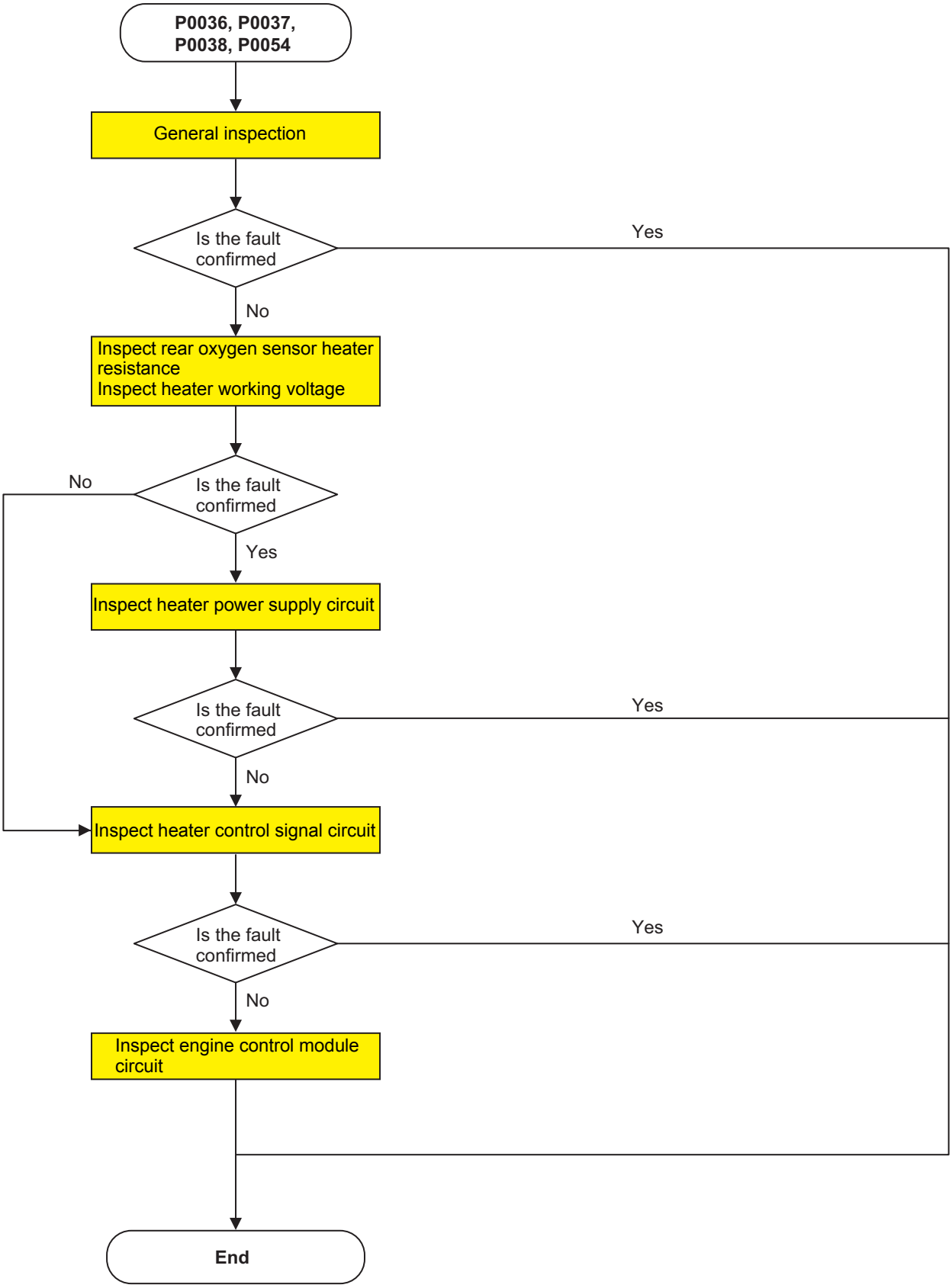
### 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0036 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Sensor circuit<br>• Sensor<br>• ECM |
| P0037 | | | |
| P0038 | | | |
| P0054 | Present resistance value is greater than threshold value | • Exhaust temperature is within 250°C ~ 550°C<br>• Rear oxygen sensor internal resistance value is higher than about 2200 Ω | |

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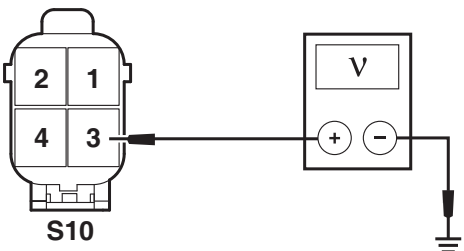


### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wire harness connector related to the rear oxygen sensor for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect rear oxygen sensor heater resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the rear oxygen sensor wiring harness connector S10.<br>C. Measure the resistance of heater between terminals 1 and 3 of rear oxygen sensor.<br>**Standard resistance: 7 ~ 14 Ω (normal temperature)**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the rear oxygen sensor. Make sure the system is normal. |
| 3. Inspect heater working voltage | |
|  <br>M3212032 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the rear oxygen sensor wiring harness connector S10.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 3 of rear oxygen sensor wiring harness connector S10 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 4. |

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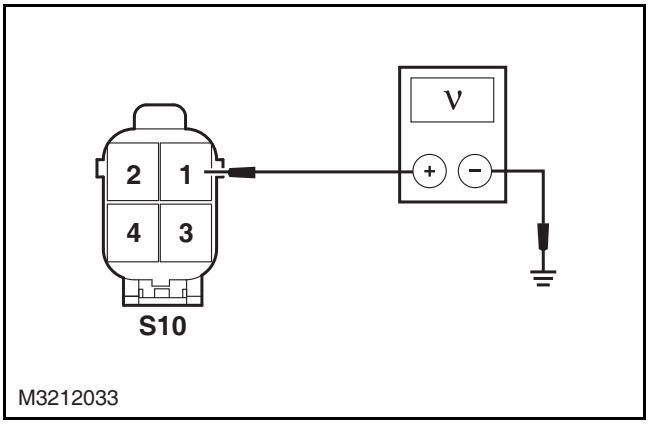


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect heater power supply circuit | |
| | A. Remove the fuse IF30.<br>B. Inspect the fuse.<br>**Standard resistance: less than 5 Ω**<br>Is the fuse normal?<br>**Yes**<br>Inspect and repair the conductivity between terminal 3 of rear oxygen sensor wiring harness connector S10 and terminal 60 of fuse IF30 in the instrument panel fuse box P40.<br>**No**<br>Replace the fuse. Go to step 5. |

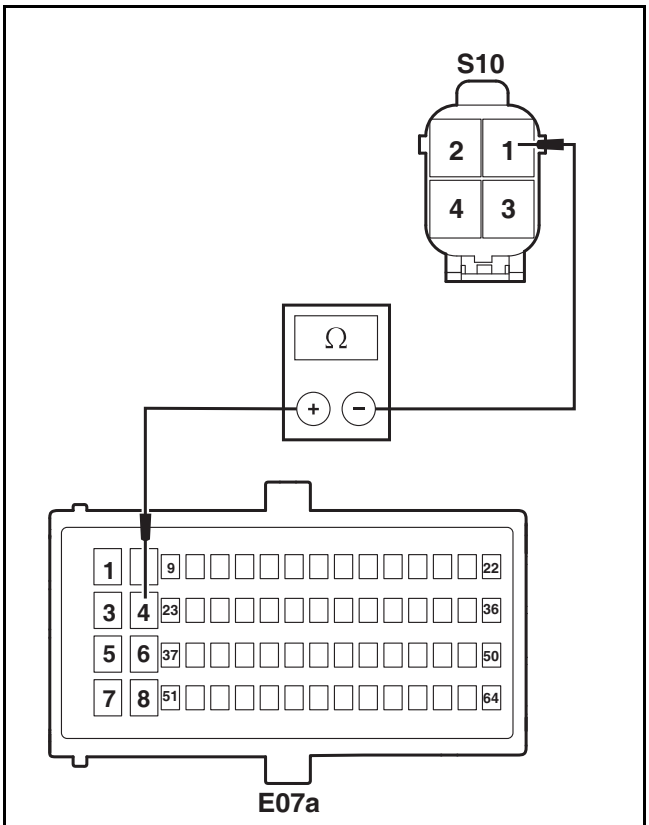
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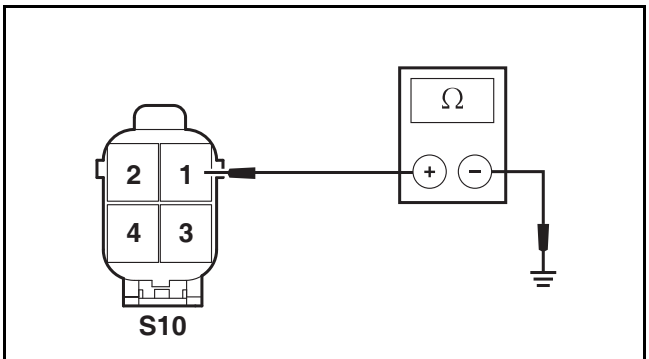
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect heater control signal circuit | |




M3212033




M3212034




M3212035

A. Turn the ignition switch to "LOCK".

B. Disconnect the rear oxygen sensor wiring harness connector S10.

C. Measure the voltage between terminal 1 of S10 and reliable grounding.

**Standard voltage: 0 V**

D. Disconnect the ECM wiring harness connector E07a.

E. Measure the resistance between terminal 1 of rear oxygen sensor wiring harness connector S10 and terminal 4 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 1 of S10 and reliable grounding.

**Standard resistance: 10 MΩ or more**

Is it normal?

**Yes**

Go to step 6.

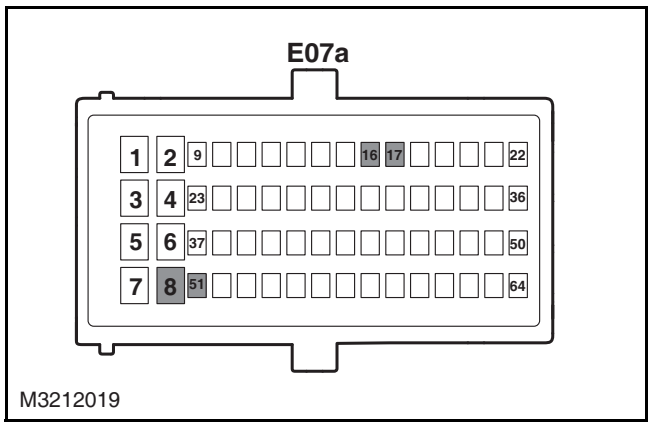
**No**

Repair the fault circuit between the terminal 1 of rear oxygen sensor wiring harness connector S10 and terminal 4 of ECM wiring harness connector E07a.

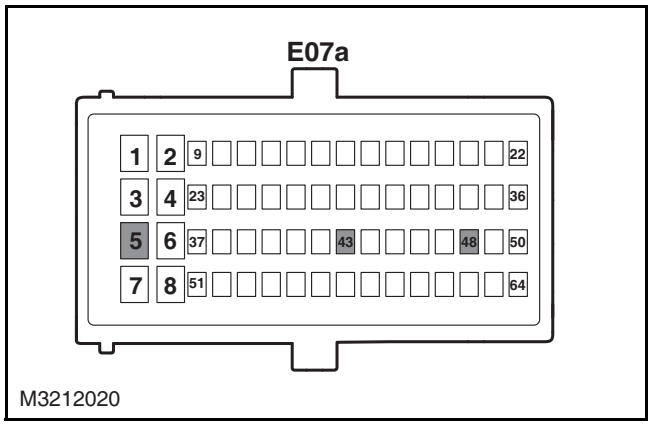
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect engine control module circuit | |



M3212019



M3212020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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# DTCs P0105, P0106, P0107, P0108

### 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0105 | Manifold Absolute Pressure/ Barometric Pressure Circuit | Air intake pressure/temperature sensor has four terminals. When the ignition switch is turned to "ON", the ECM provides 5 V to the terminal 3 of sensor through terminal 19 of connector E07a; the terminal 40 of E07a enables the terminal 1 of sensor grounding; and the terminal 4 of sensor provides an signal that changes according to the air intake pressure to terminal 59 of ECM connector E07a. |
| P0106 | Manifold Abs.Pressure or Bar. Pressure Range/Performance | |
| P0107 | Manifold Abs. Pressure or Bar.Pressure Low Input | |
| P0108 | Manifold Abs. Pressure or Bar. Pressure High Input | |

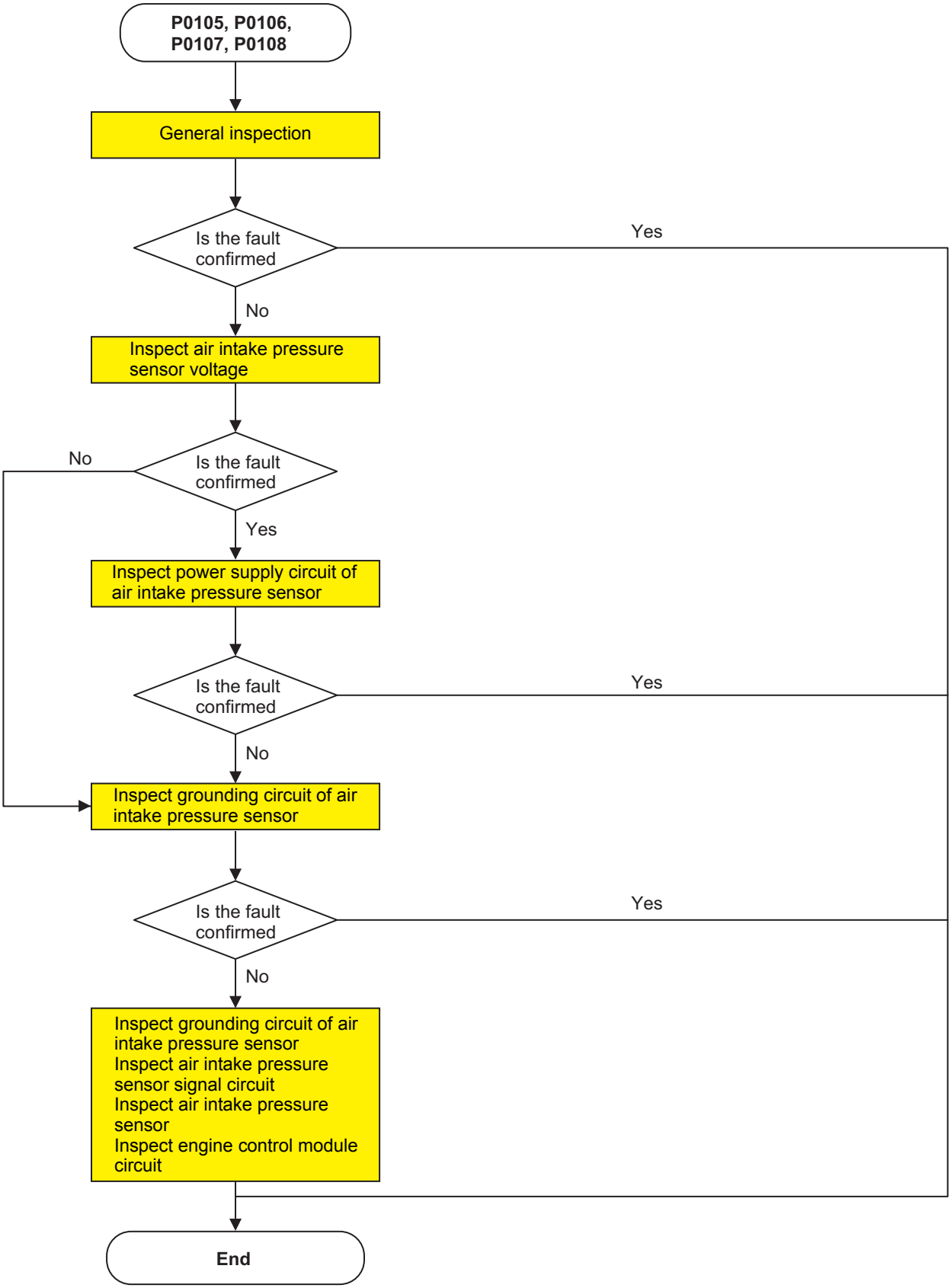
### 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0105 | Signal inspection: no pressure drop after start | • Engine speed is more than 800 rpm<br>• Pressure drops less than 20 hPa after starting<br>• Last for more than 1 s | • Sensor circuit<br>• Sensor<br>• ECM |
| P0106 | signal non-plausible | • Depend on engine speed and throttle opening<br>• Last for more than 1 s | |
| P0107 | Circuit inspection, lower limit exceeded | • Pressure sensor voltage is lower than 0.195 V<br>• Last for more than 1 s | |
| P0108 | Circuit inspection, upper limit exceeded | • 1 s after start<br>• Pressure sensor voltage is more than 4.883 V<br>• Last for more than 1 s | |

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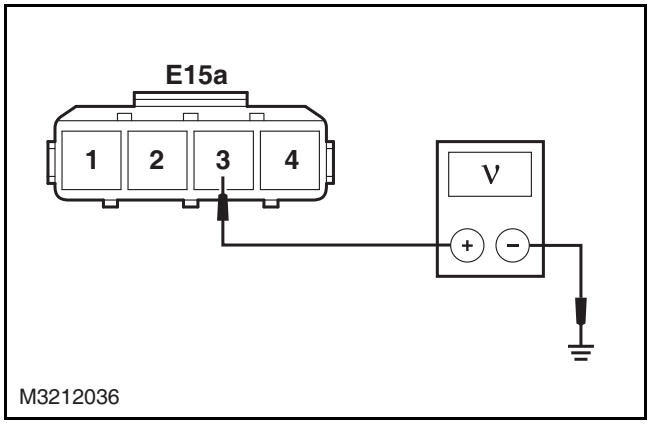


### 3. Diagnosis Procedure



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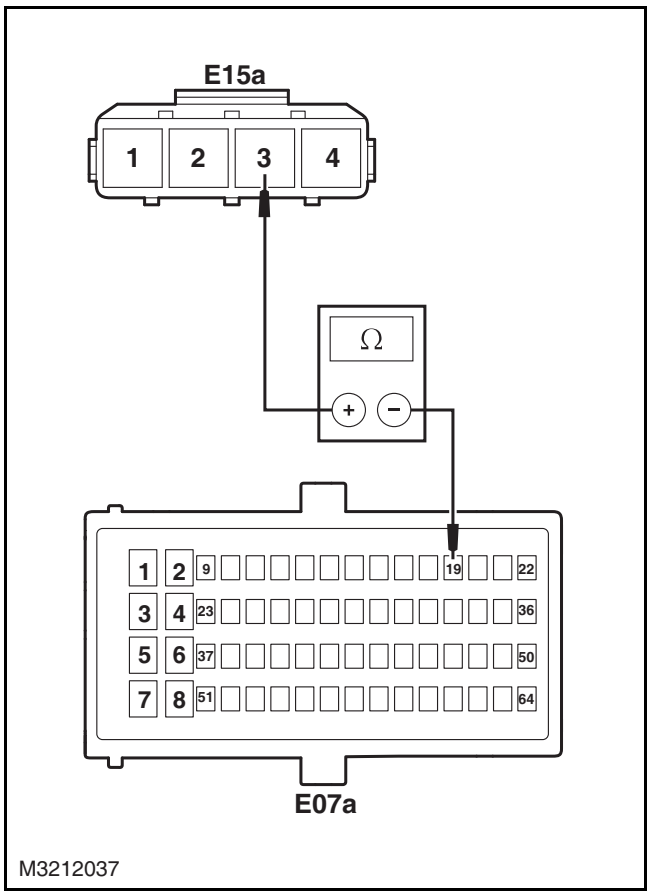


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect for the following conditions:<br>• Sensor housing damaged, and vacuum tube cracked<br>• Sensor sealing damaged<br>• Sensor loose or improperly installed<br>• Sensor vacuum tube blocked<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault, and verify that the system is normal. |
| 2. Inspect air intake pressure sensor voltage | |
|  <br>M3212036 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 3 of air intake pressure/temperature sensor wiring harness connector E15a and reliable grounding.<br>**Standard voltage: 4.5 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 3. |

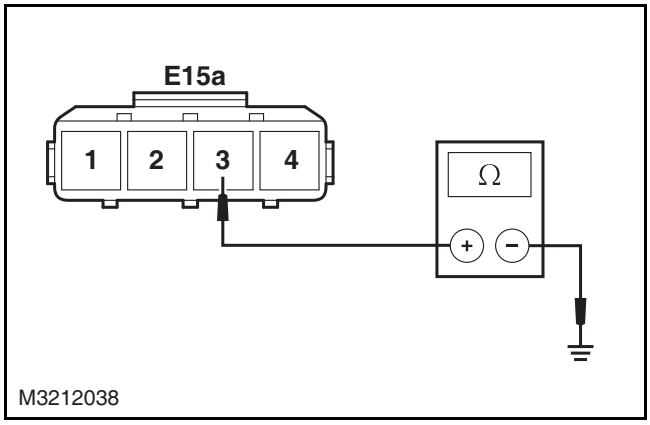
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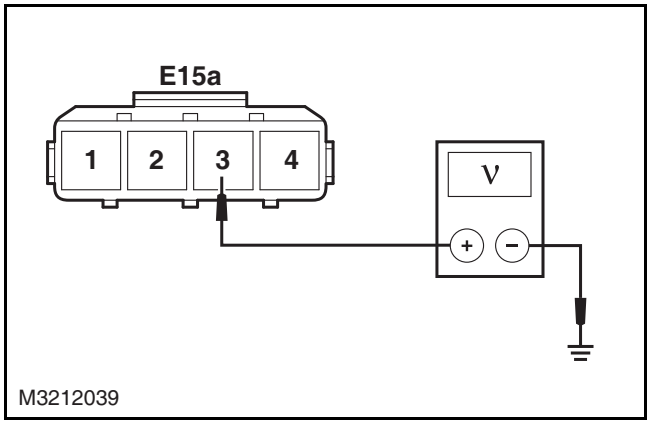
| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect power supply circuit of air intake pressure sensor | |



M3212037



M3212038



M3212039

A. Turn the ignition switch to "LOCK".

B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 3 of air intake pressure/temperature sensor wiring harness connector E15a and terminal 19 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 3 of air intake pressure/temperature sensor wiring harness connector E15a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 3 of air intake pressure/temperature sensor wiring harness connector E15a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

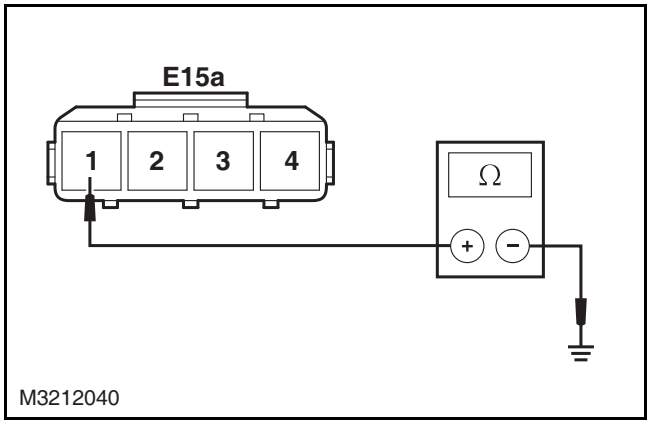
Go to step 4.

**No**

Repair the fault circuit between terminal 3 of E15a and terminal 19 of E07a, and verify that the system is normal.

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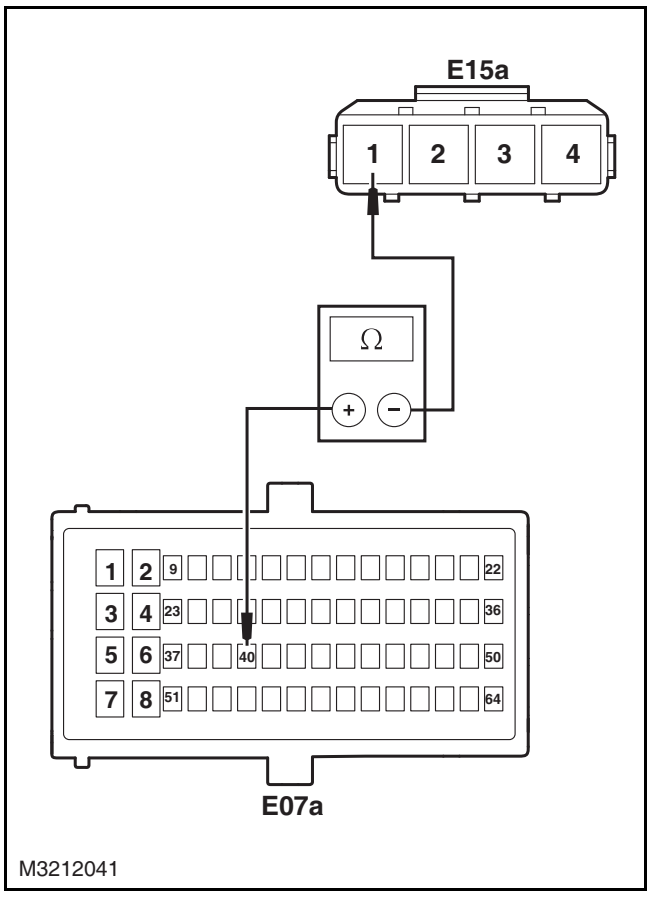


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect grounding circuit of air intake pressure sensor | |
|  M3212040 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 1 of air intake pressure/temperature sensor wiring harness connector E15a and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Go to step 5. |

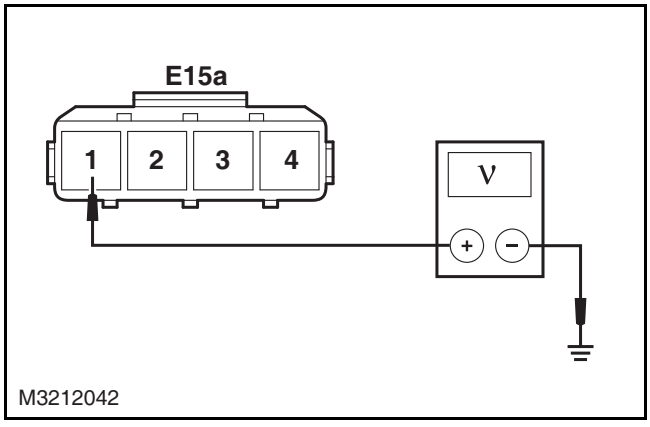
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect grounding circuit of air intake pressure sensor | |




M3212041




M3212042

A. Turn the ignition switch to "LOCK".

B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 1 of air intake pressure/temperature sensor wiring harness connector E15a and terminal 40 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the voltage between terminal 1 of air intake pressure/temperature sensor wiring harness connector E15a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

**Is the resistance value normal?**

**Yes**

Go to step 6.

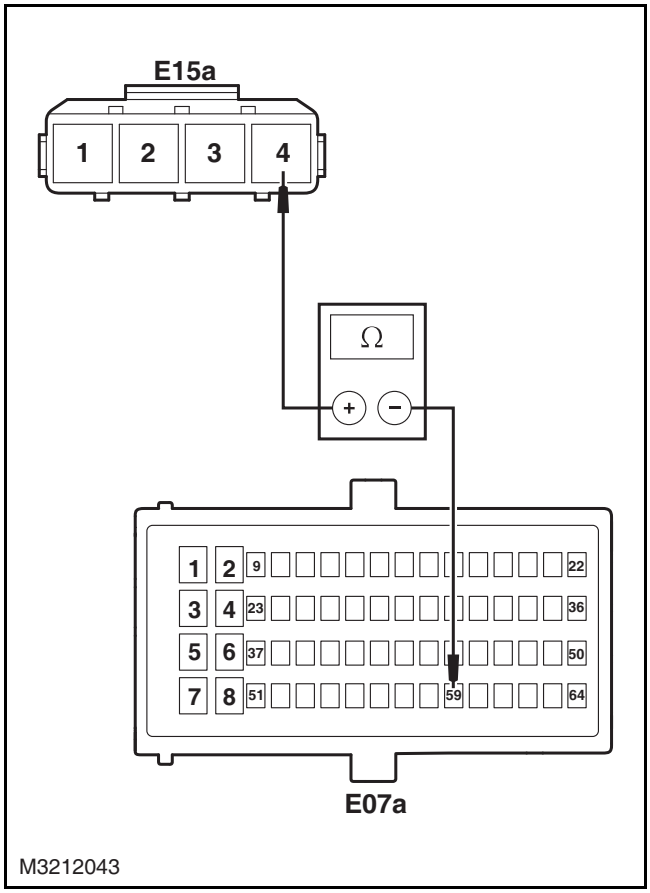
**No**

Repair the fault circuit, and verify that the system is normal.

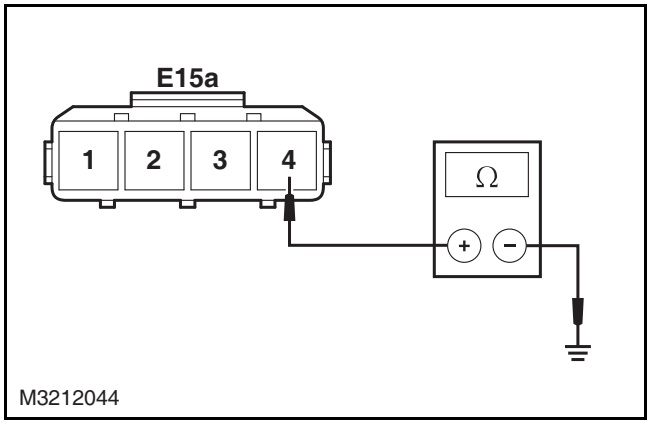
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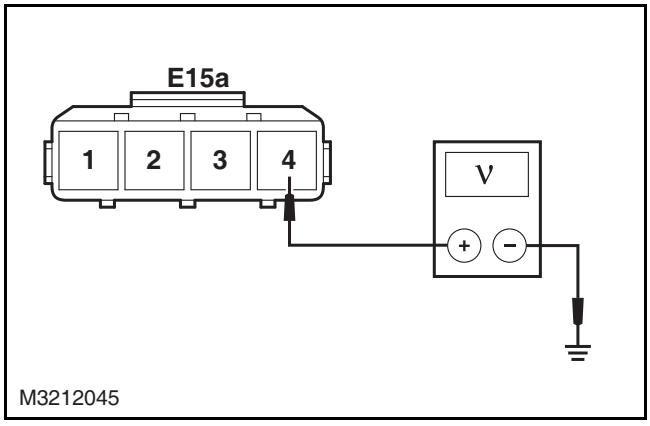
| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect air intake pressure sensor signal circuit | |




M3212043




M3212044




M3212045

A. Turn the ignition switch to "LOCK".

B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 4 of air intake pressure/temperature sensor wiring harness connector E15a and terminal 59 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 4 of air intake pressure/temperature sensor wiring harness connector E15a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 4 of air intake pressure/temperature sensor wiring harness connector E15a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

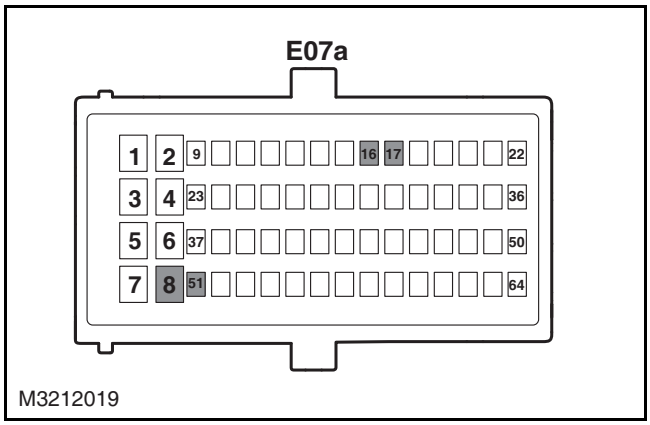
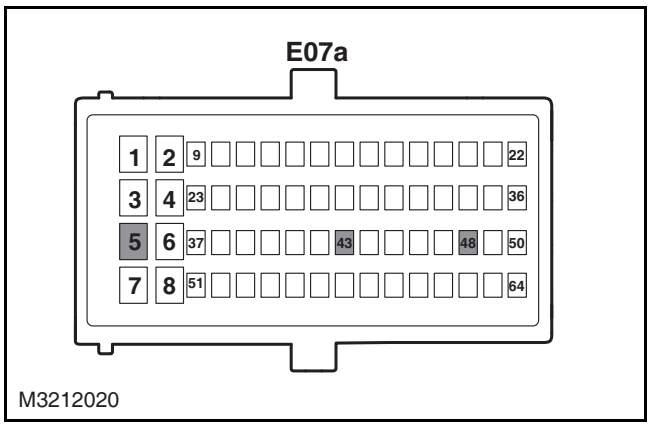
Go to step 7.

**No**

Repair the circuit, and verify that the system is normal.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect air intake pressure sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15a.<br>C. Turn the ignition switch to "ON".<br>D. Connect a jumper cable with 5 A fuse between terminals 3 and 4 of E15a.<br>E. Connect the diagnostic tool and enter engine data flow and read the "actual intake manifold pressure" parameter.<br>**Standard parameter: 1050 kPa**<br>Is the data normal?<br>**Yes**<br>Replace the air intake pressure sensor.<br>**No**<br>Go to step 8. |
| 8. Inspect engine control module circuit | |
|  <br>M3212019 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |
|  <br>M3212020 | |

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# DTCs P0112, P0113

### 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0112 | Intake Air Temp. Circ. Low Input | Air intake temperature sensor is integrated into the engine air intake pressure/temperature sensor to measure the temperature of air that goes into the engine. ECM internal pressure regulator circuit provides 5 V reference voltage to terminal 2 of air intake pressure/temperature sensor wiring harness connector E15a via terminal 25 of ECM wiring harness connector E07a. The air intake temperature sensor voltage-drop signal can be obtained in this circuit. Set terminal 1 of intake pressure/temperature sensor E15a to low potential via terminal 40 of E07a. |
| P0113 | Intake Air Temp. Circ. High Input | |

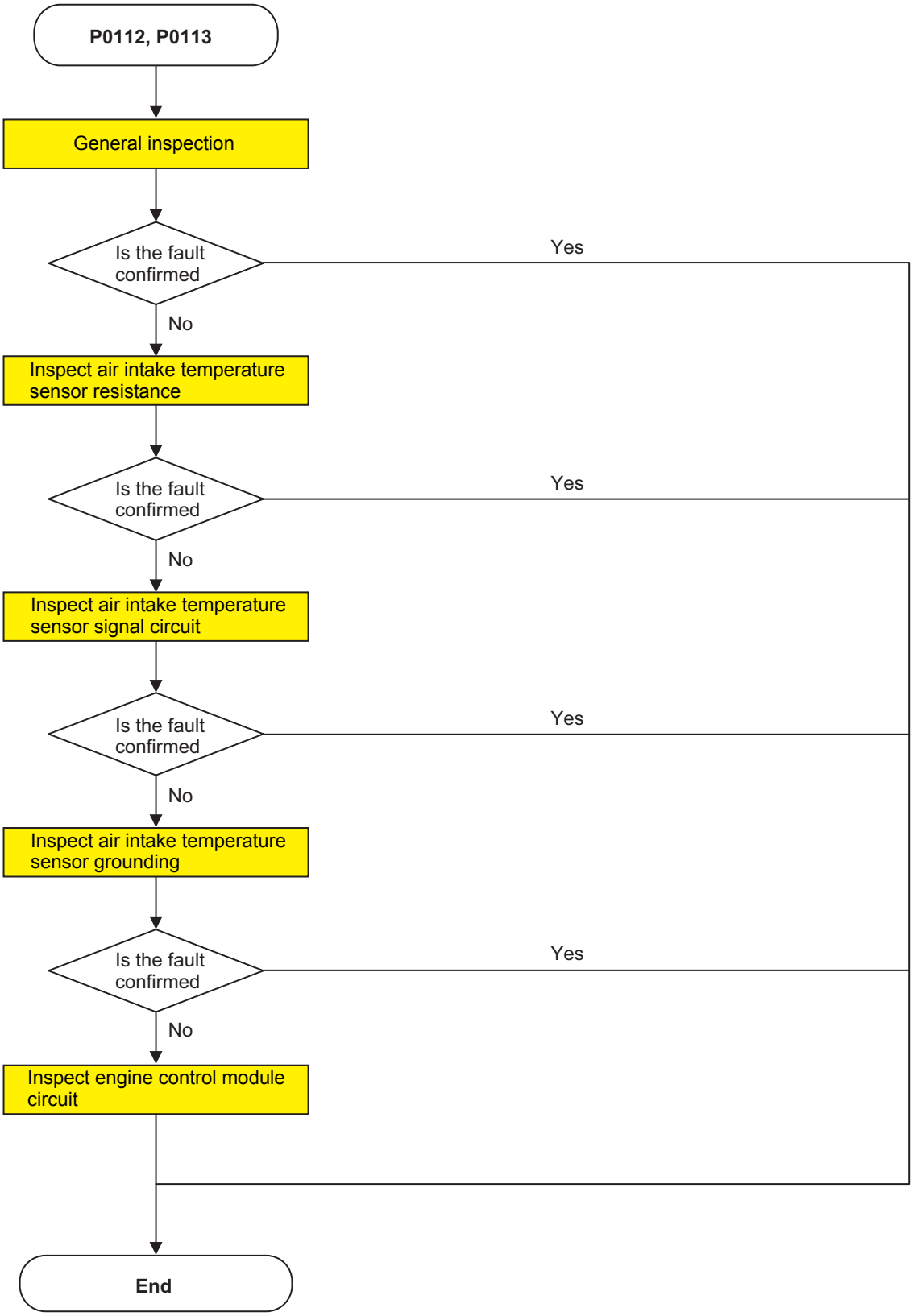
### 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0112 | Upper limit exceeded, short to ground | • Air intake temperature is higher than 128.25°C<br>• Last for more than 1 s | • Sensor circuit<br>• Sensor<br>• ECM |
| P0113 | Lower limit exceeded, short to power supply | • 240 s after start<br>• Air intake temperature is lower than -38.25°C<br>• Last for more than 10 s | |

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### 3. Diagnosis Procedure



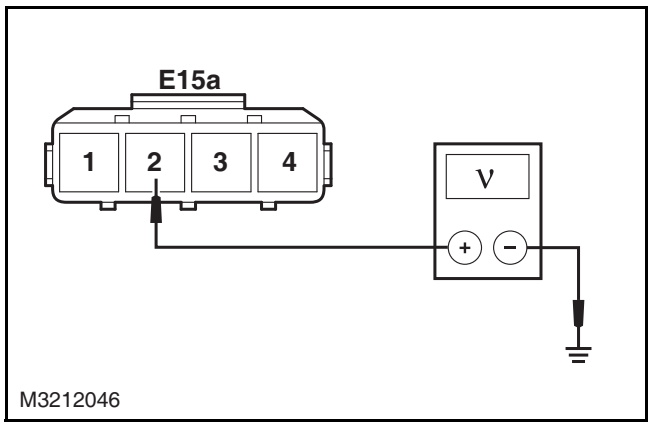
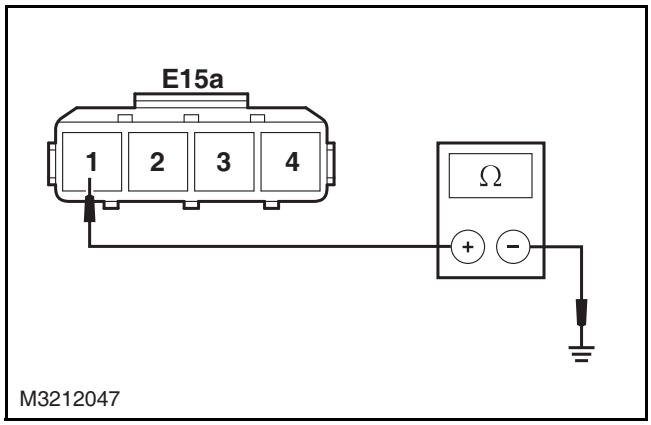
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect for the following conditions:<br>• Sensor housing damaged, and vacuum tube cracked<br>• Sensor sealing damaged<br>• Sensor loose or improperly installed<br>• Sensor vacuum tube blocked<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault, and verify that the system is normal. |
| 2. Inspect air intake temperature sensor resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15a.<br>C. Measure the resistance of air intake temperature sensor (terminals 1 to 2).<br>**Standard resistance:**<br>**2.5 kΩ ± 5% at 20°C**<br>D. Connect the air intake pressure/temperature sensor wiring harness connector.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the air intake pressure/temperature sensor. |

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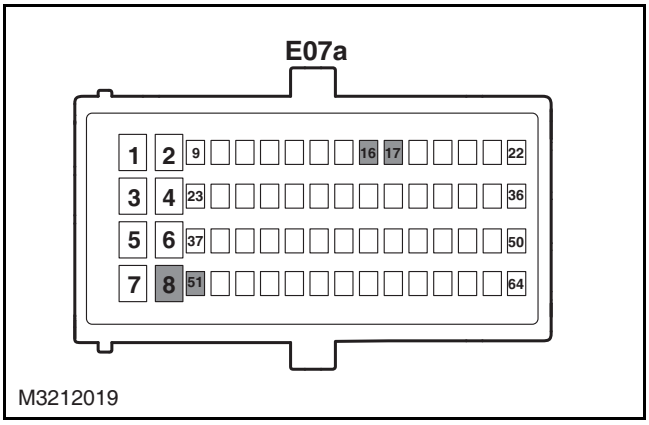


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect air intake temperature sensor signal circuit | |
|  M3212046 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 2 of air intake pressure/temperature sensor wiring harness connector E15a and reliable grounding.<br>**Standard voltage: 4.7 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the fault circuit between terminal 2 of air intake pressure/temperature sensor wiring harness connector E15a and terminal 25 of engine control module wiring harness connector E07a. Verify that the system is normal. |
| 4. Inspect air intake temperature sensor grounding | |
|  M3212047 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the air intake pressure/temperature sensor wiring harness connector E15a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 1 of air intake pressure/temperature sensor wiring harness connector E15a and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair the fault circuit between terminal 1 of air intake pressure/temperature sensor E15a and terminal 40 of engine control module wiring harness connector E07a. Verify that the system is normal. |

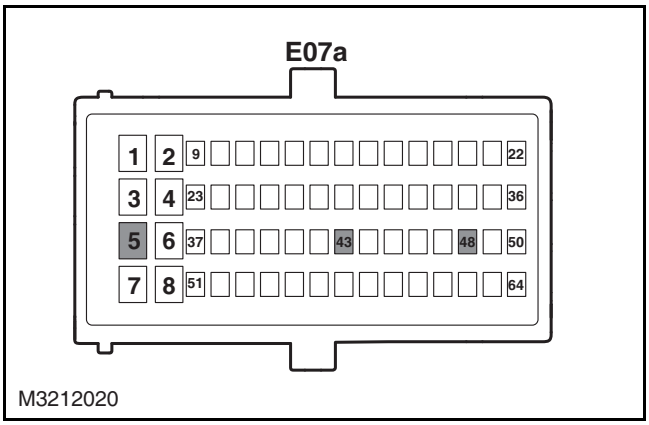
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect engine control module circuit | |



M3212019



M3212020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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# DTCs P0117, P0118

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0117 | Engine Coolant Temp.Circ. Low Input | Coolant temperature sensor, a variable resistor of negative temperature coefficient, is used for measuring engine coolant temperature. ECM provides 5 V to the terminal 2 of coolant temperature sensor wiring harness connector E11a via terminal 41 of ECM wiring harness connector E07a, and obtains sensor signals from terminal 41 of E07a. ECM sets terminal 1 of sensor connector E11a to low potential via terminal 40 of E07a. |
| P0118 | Engine Coolant Temp.Circ. High Input | |

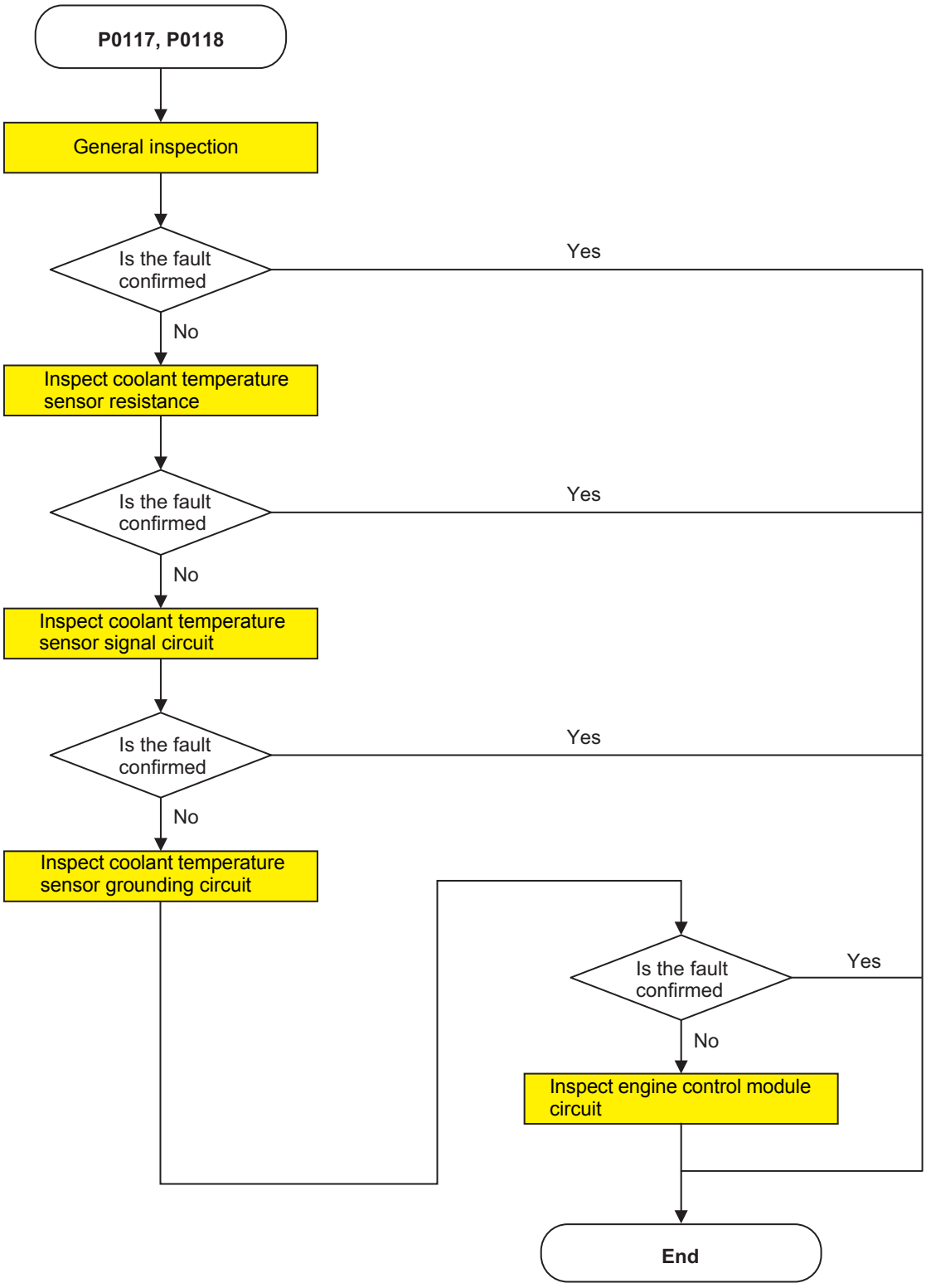
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0117 | Upper limit exceeded, short to ground | Coolant temperature measured value is higher than 135°C for 2 s | • Sensor circuit<br>• Sensor<br>• ECM |
| P0118 | Lower limit exceeded, short to power supply | Coolant temperature measured value is lower than -37.5°C for 2 s | |

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### 3. Diagnosis Procedure



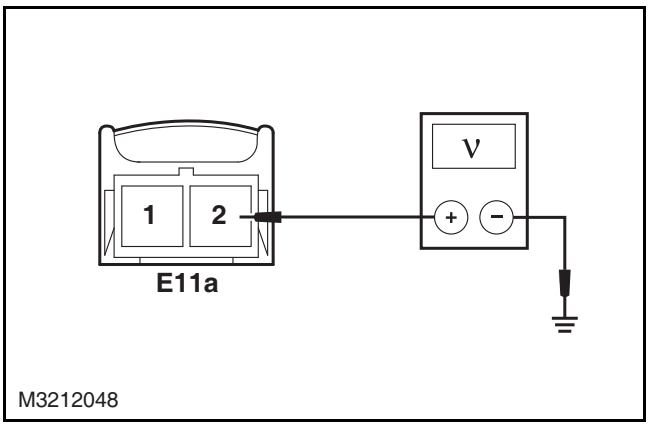
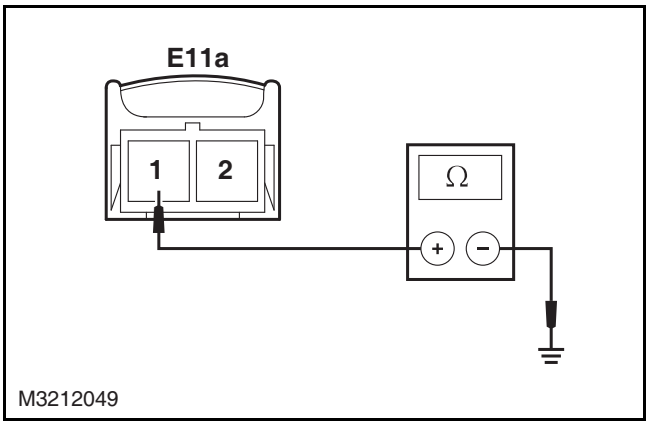
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect if the engine coolant temperature sensor is corroded, and if the coolant leaks through the sensor.<br>B. Inspect if the level of engine coolant in cooling system reservoir is proper.<br>C. Inspect the sensor for looseness or improper installation.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect coolant temperature sensor resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the coolant temperature sensor wiring harness connector E11a.<br>C. Measure the resistance of coolant temperature sensor with a multimeter.<br>**Standard resistance:**<br>**2.5 kΩ ± 5% for rated resistance at 20°C**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the coolant temperature sensor. |

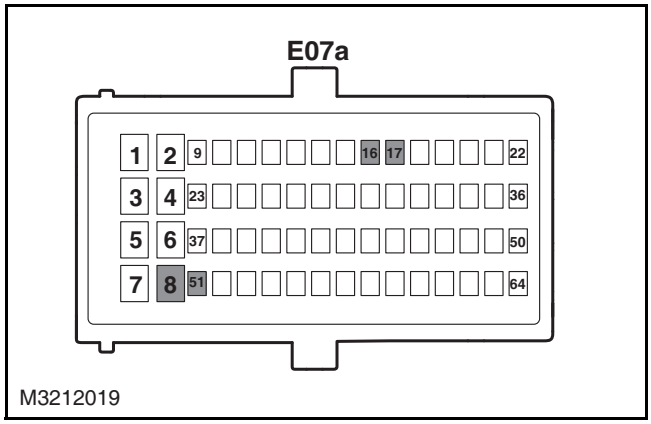
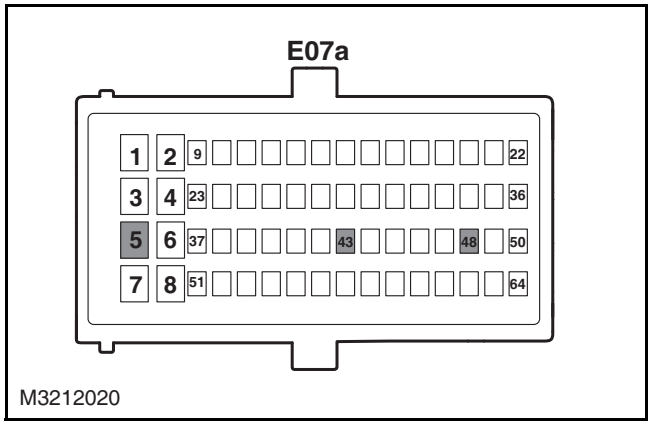
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect coolant temperature sensor signal circuit | |
|  M3212048 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the coolant temperature sensor wiring harness connector E11a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 2 of coolant temperature sensor wiring harness connector E11a and reliable grounding.<br>**Standard voltage: 4.7 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the fault circuit between terminal 2 of coolant temperature wiring harness sensor E11a and terminal 41 of engine control module wiring harness connector E07a. |
| 4. Inspect coolant temperature sensor grounding circuit | |
|  M3212049 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the coolant temperature sensor wiring harness connector E11a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 1 of coolant temperature sensor wiring harness connector E11a and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the fault circuit between terminal 1 of coolant temperature sensor wiring harness connector E11a and terminal 40 of engine control module wiring harness connector E07a. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0122, P0123

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0122 | Throttle/Pedal Pos.Sensor A Circ. Low Input | ECM provides 5 V reference voltage to terminal 2 of TPS sensor wiring harness connector E03a via terminal 18 of ECM wiring harness connector E07a. TPS sensor provides sensor signal voltage to terminal 26 of ECM wiring harness connector E07a via terminal 3 of E03a. ECM sets terminal 1 of TPS sensor wiring harness connector E03a to low potential via terminal 39 of ECM wiring harness connector E07a. |
| P0123 | Throttle/Pedal Pos.Sensor A Circ. High Input | |

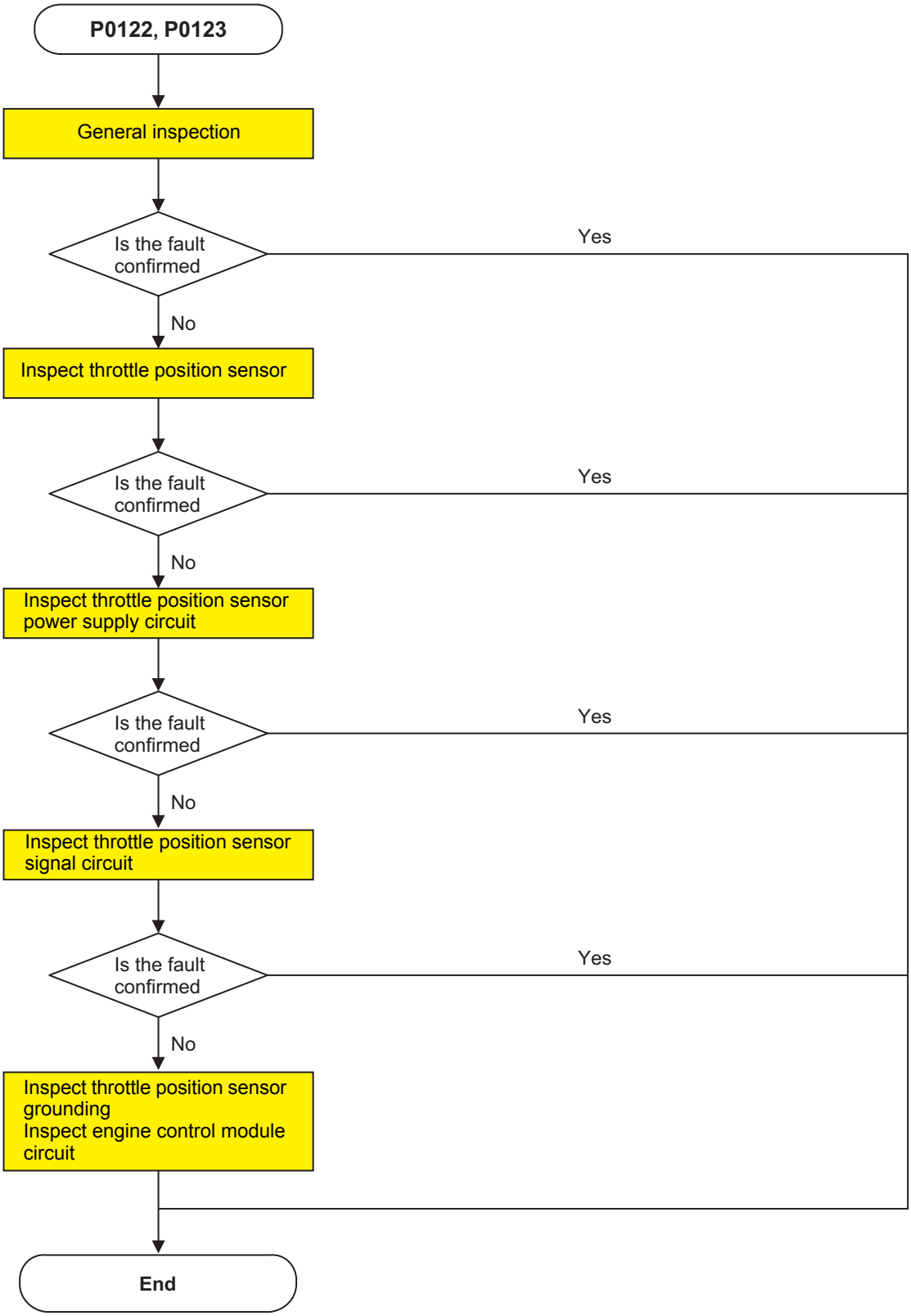
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0122 | Lower limit of throttle position angle signal exceeded | • Engine speed is more than 600 rpm<br>• Throttle position angle signal is less than 1% for 1 s | • Sensor circuit<br>• Sensor<br>• ECM |
| P0123 | Upper limit of throttle position angle signal exceeded | • Engine speed is more than 600 rpm<br>• Throttle position angle signal is more than 99% for 1 s | |

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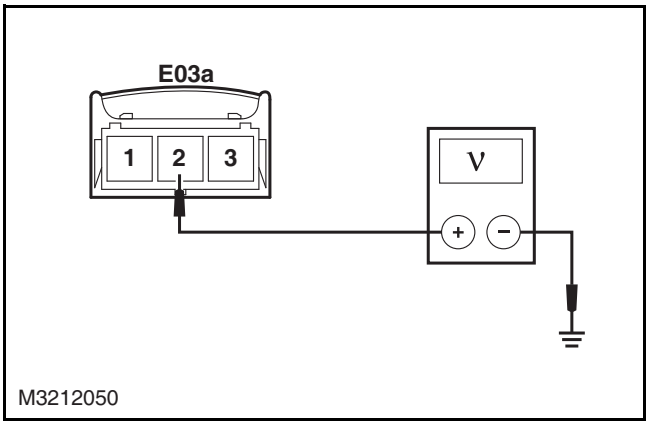


### 3. Diagnosis Procedure



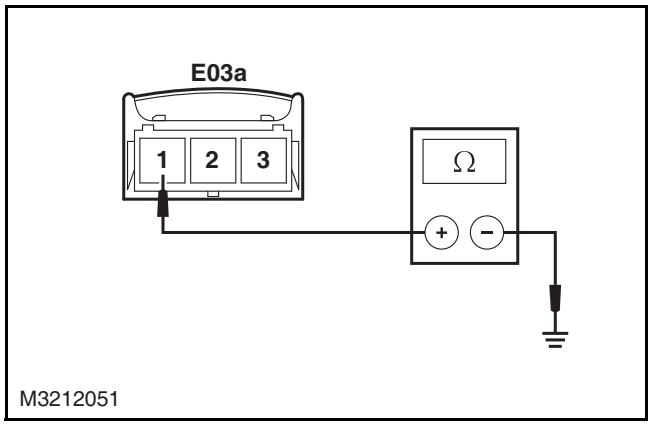
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the sensor wiring harness connector for looseness.<br>B. Visually inspect the sensor for damage.<br>C. Measure the resistance of throttle position sensor.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. Make sure the system is normal. |
| 2. Inspect throttle position sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the throttle position sensor wiring harness connector E03a.<br>C. Measure the resistance of throttle position sensor.<br>**Standard resistance:**<br>**2 kΩ ± 20% between terminals 1 and 2**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the throttle position sensor. |
| 3. Inspect throttle position sensor power supply circuit | |
|  <br>M3212050 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the throttle position sensor wiring harness connector E03a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 2 of throttle position sensor E03a and reliable grounding.<br>**Standard voltage: 4.5 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the fault circuit between terminal 2 of throttle position sensor wiring harness connector E03a and terminal 18 of engine control module wiring harness connector E07a. Verify that the system is normal. |

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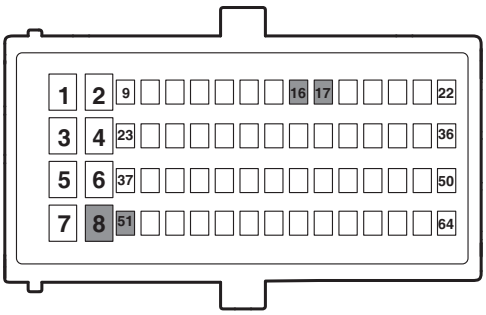
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect throttle position sensor signal circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the throttle position sensor wiring harness connector E03a.<br>C. Turn the ignition switch to "ON".<br>D. Connect a jumper cable with 5 A fuse between terminals 1 and 3 of E03a. Use the diagnostic tool to observe the "ADC-signal throttle angle" parameter.<br>**Standard voltage: 4.5 ~ 5.5 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair the fault circuit between terminal 3 of throttle position sensor wiring harness connector E03a and terminal 26 of engine control module wiring harness connector E07a. Verify that the system is normal. |
| 5. Inspect throttle position sensor grounding | |
|  <br>M3212051 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the throttle position sensor wiring harness connector E03a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 1 of throttle position sensor wiring harness connector E03a and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the fault circuit between terminal 1 of throttle position sensor wiring harness connector E03a and terminal 39 of engine control module wiring harness connector E07a. Verify that the system is normal. |

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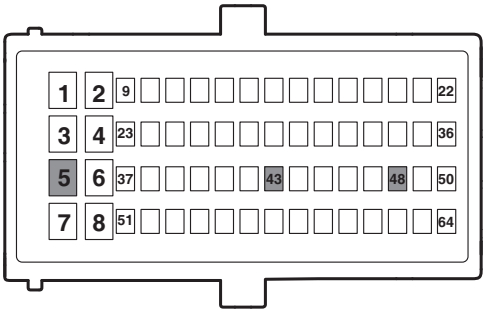
| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect engine control module circuit | |

E07a




M3212019

E07a




M3212020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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# DTCs P0130, P0131, P0132, P0133, P0134, P2195, P2196

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0130 | O2 Sensor Circ., Bank1-Sensor1 Malfunction | After vehicle starts, the control module works in open loop mode, and it will ignore the front oxygen sensor signal voltage in the calculation of air-fuel ratio. Control module provides approximately 450 mV reference voltage to the front oxygen sensor. When the engine is running, the front oxygen sensor starts heating and generating 0.1 ~ 0.9 V voltage. The voltage fluctuates up and down along the reference voltage. Once the control module detects that the front oxygen sensor voltage exceeds the set threshold, it will immediately enter closed loop mode. Control module determines the air-fuel ratio based on the front oxygen sensor voltage. If the front oxygen sensor voltage is higher than 0.45 V, it indicates that the mixture is too rich. If the front oxygen sensor voltage is lower than 0.45 V, it indicates that the mixture is too lean. ECM sets the terminal 2 of front oxygen sensor E01a to low potential via terminal 39 of E07a. When the oxygen sensor reaches normal working temperature, it transmits oxygen sensor signal to the ECM via terminal 1 of E01a connected to terminal 45 of E07a of ECM. |
| P0131 | O2 Sensor Circ., Bank1-Sensor1 Low Voltage | |
| P0132 | O2 Sensor Circ., Bank1-Sensor1 High Voltage | |
| P0133 | O2 Sensor Circ.,Bank1-Sensor1 Slow Response | |
| P0134 | O2 Sensor Circ., Bank1-Sensor1 No Activity Detected | |
| P2195 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 1 | |
| P2196 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 1 | |

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**2. Possible Causes**

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0130 | Front oxygen sensor coupled with heater line | • Front oxygen sensor reaches the working temperature<br>• Front oxygen sensor output voltage is higher than 2.0 V | • Sensor circuit<br>• Sensor<br>• ECM |
| P0131 | Signal short to ground | • Front oxygen sensor output voltage is less than 0.06 V | |
| P0132 | Front oxygen sensor voltage too high | • Battery voltage is higher than 10.68 V<br>• Engine speed is more than 25 rpm<br>• Target λ = 1<br>• Exhaust temperature is lower than 800°C<br>• Front oxygen sensor reaches working temperature for 150 s<br>• Front oxygen sensor output voltage is higher than 1.5 V | |

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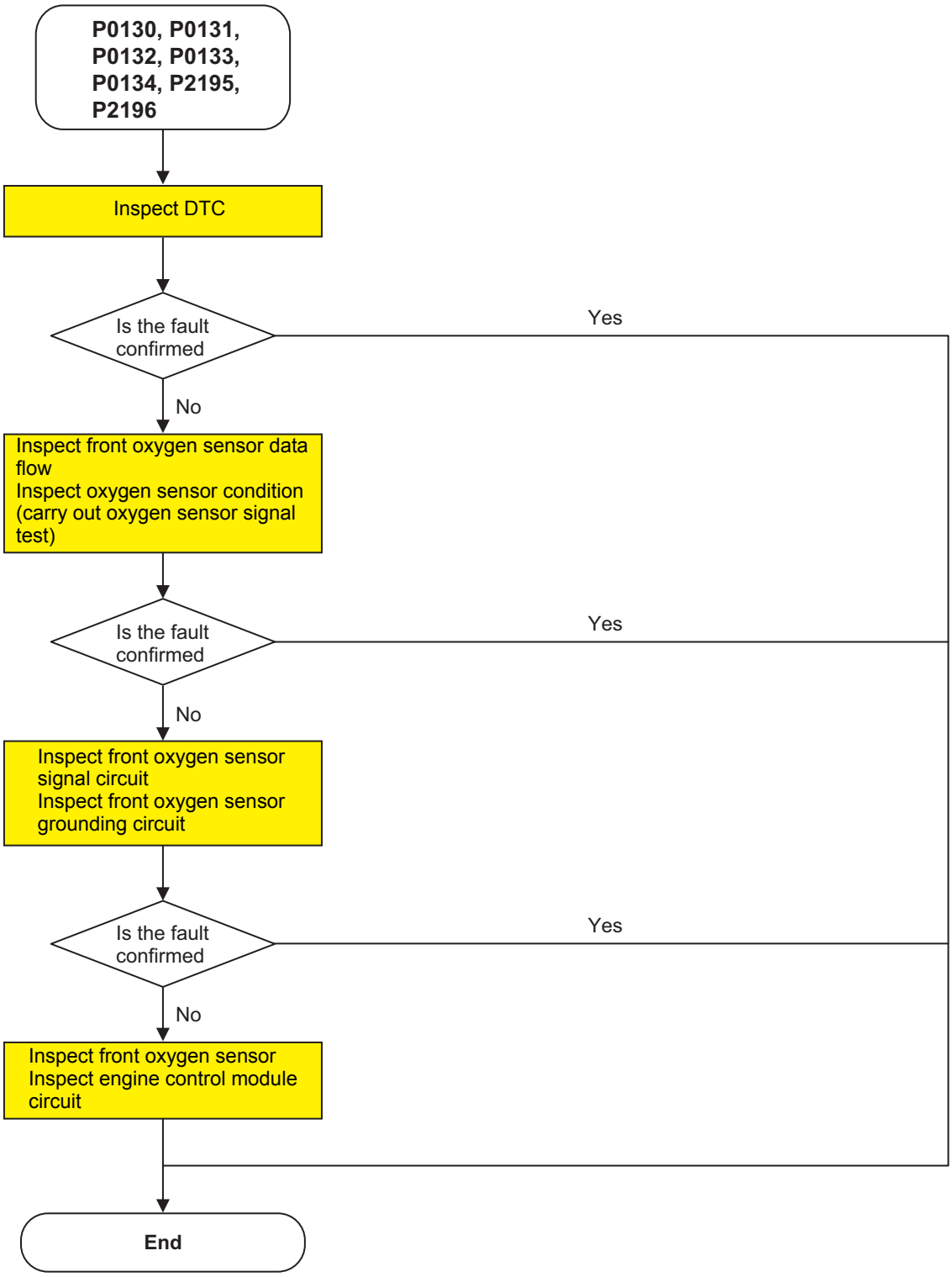


| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0133 | Cycle duration of front oxygen sensor signal filtered is more than threshold | • Cycle duration of front oxygen sensor signal filtered is more than 2.0 s<br>• Effective cycle count is more than 14<br>• Front oxygen sensor closed loop control active<br>• No pressure sensor fault<br>• No coolant temperature sensor fault<br>• No air intake temperature sensor fault<br>• Basic mixture adaptation not disabled<br>• No diagnosis stop condition<br>• Engine speed is within 1800 ~ 2840 rpm<br>• Engine load is within 25 ~ 50<br>• Exhaust temperature model value is greater than 500<br>• Front oxygen sensor heating diagnosis passed<br>• CDLATP diagnosis function on | • Sensor circuit<br>• Sensor<br>• ECM |
| P0134 | Signal open circuit | • Front oxygen sensor reaches the working temperature for 150 s<br>• Front oxygen sensor voltage is within 0.40 ~ 0.60 V | |
| P2195 | Rear oxygen control integrator value exceeds upper limit | • Diagnosis function on<br>• Rear oxygen control active<br>• Rear oxygen control integrator value is greater than 1.0 s | |
| P2196 | Rear oxygen control integrator value exceeds lower limit | • No catalytic converter fault<br>• No diagnosis stop condition<br>• Diagnosis time is 20 s<br>• Rear oxygen control integrator value is less than -1.0 s | |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect the diagnostic tool.<br>C. Start the engine, and use the diagnostic tool to inspect the engine system.<br>Is there any DTC besides P0130, P0131, P0132, P0133, P0134, P2195 and P2196?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Repair the fault. |
| 2. Inspect front oxygen sensor data flow | |
| | A. Start the engine, and run it till the engine coolant temperature reaches above 80°C.<br>B. Use diagnostic tool to access to engine data flow, and observe the "O2 sensor voltage bank 1, sensor 1" parameter.<br>**Standard voltage: fluctuates between 0.1 ~ 0.9 V**<br>Does the voltage of oxygen sensor fluctuate between 0.1 ~ 0.9 V?<br>**Yes**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 3. |

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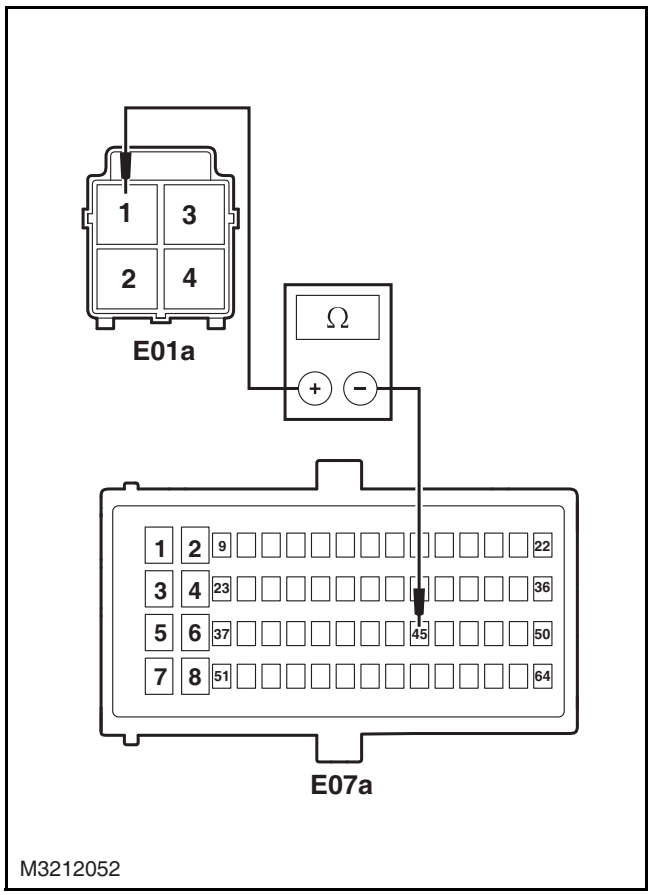


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect oxygen sensor condition (carry out oxygen sensor signal test) | |
| | A. If the voltage displayed in data flow remains below 0.45 V (mixture too lean), inspect according to the following steps:<br>• Jet a proper amount of propane into the inlet port.<br>• Observe if the front oxygen sensor voltage in data flow changes obviously and the signal voltage rises quickly.<br>B. If the voltage displayed in data flow remains above 0.45 V (mixture too rich), inspect according to the following steps:<br>• Position the transmission at neutral gear.<br>• Apply the parking brake.<br>• Depress the accelerator pedal until the engine speed suddenly increases to 4000 rpm and then quickly release the accelerator pedal.<br>• Repeat the previous step more than 3 times.<br>• Observe if the front oxygen sensor voltage in data flow changes obviously and the signal voltage drops quickly.<br>• In the implementation of above test, the oxygen sensor signal voltage should change significantly as the test continues.<br>Does it change significantly?<br>**Yes**<br>**Refer to: DTCs P2177, P2178, P2187, P2188 (3.2.12 Electronic control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect front oxygen sensor signal circuit | |




M3212052

A. Inspect the front oxygen sensor signal circuit.

B. Turn the ignition switch to "LOCK".

C. Disconnect the front oxygen sensor wiring harness connector E01a.

D. Disconnect the ECM wiring harness connector E07a.

E. Measure the resistance between terminal 1 of front oxygen sensor wiring harness connector E01a and terminal 45 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 1 of front oxygen sensor wiring harness connector E01a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

G. Measure the voltage between terminal 1 of front oxygen sensor wiring harness connector E01a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

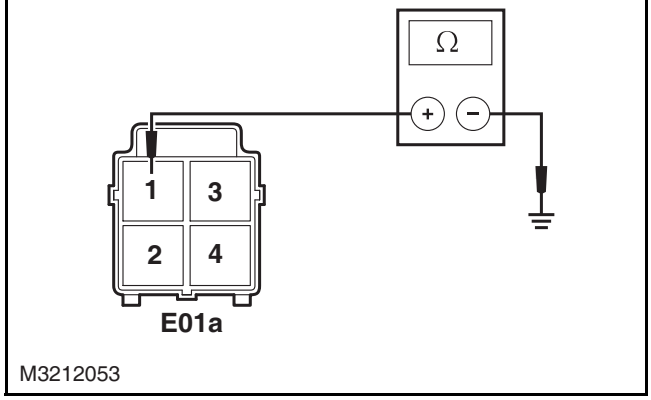
Is it normal?

**Yes**

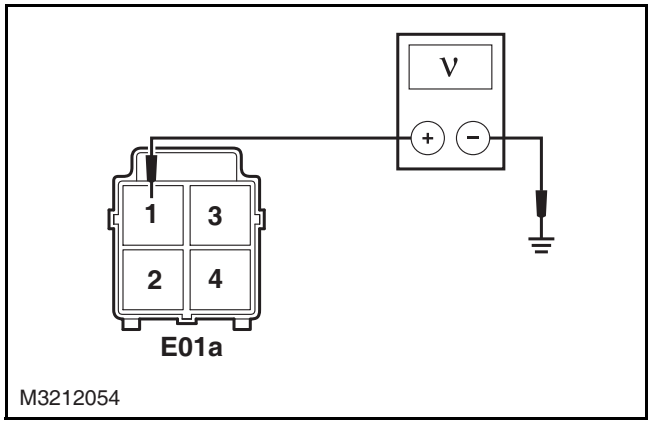
Go to step 5.

**No**

Repair the fault circuit between terminal 1 of front oxygen sensor wiring harness connector E01a and terminal 45 of ECM wiring harness connector E07a.



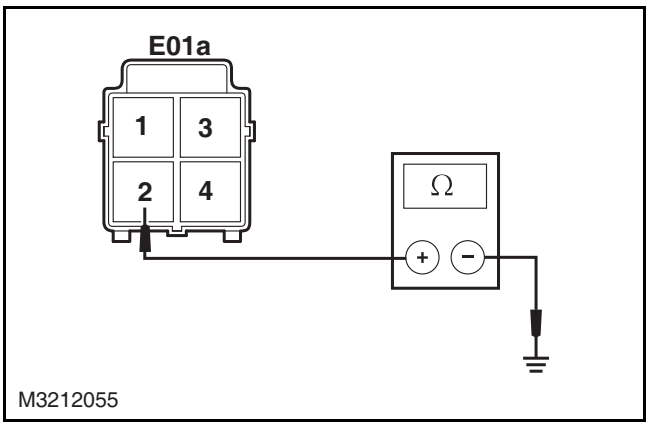

M3212053




M3212054

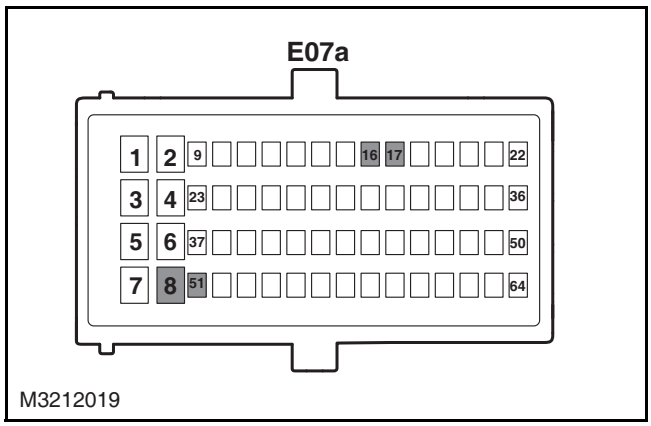
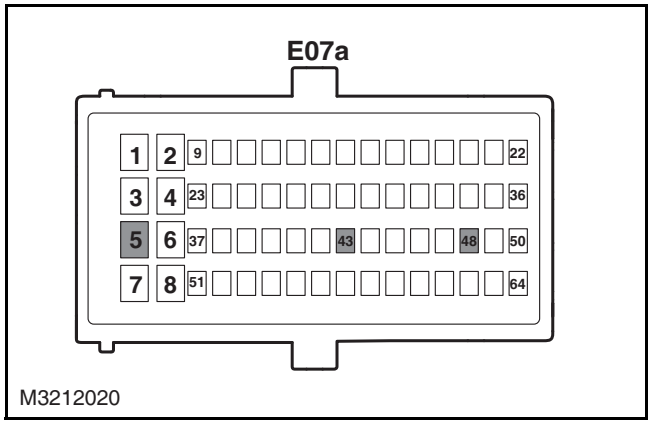
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect front oxygen sensor grounding circuit | |
|  M3212055 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front oxygen sensor wiring harness connector E01a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 2 of E01a and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the fault circuit between terminal 2 of front oxygen sensor wiring harness connector E01a and terminal 39 of ECM wiring harness connector E07a. |
| 6. Inspect front oxygen sensor | |
| | A. Replace the front oxygen sensor.<br>Is the fault repaired?<br>**Yes**<br>Diagnosis completes. The system is normal.<br>**No**<br>Go to step 7. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0136, P0137, P0138, P0140, P2270, P2271

### 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0136 | O2 Sensor Circ., Bank1-Sensor2 Malfunction | ECM sets the terminal 4 of rear oxygen sensor S10 to low potential via terminal 39 of E07a.<br>When the rear oxygen sensor reaches normal working temperature, it transmits oxygen sensor signal to the ECM via terminal 2 of S10 connected to terminal 29 of E07a of ECM. |
| P0137 | O2 Sensor Circ., Bank1-Sensor2 Low Voltage | |
| P0138 | O2 Sensor Circ., Bank1-Sensor2 High Voltage | |
| P0140 | O2 Sensor Circ., Bank1-Sensor2 No Activity Detected | |
| P2270 | O2 Sensor Signal Stuck Lean; Bank 1 Sensor 2 | |
| P2271 | O2 Sensor Signal Stuck Rich; Bank 1 Sensor 2 | |

### 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0136 | Rear oxygen sensor coupled with heater line | • Rear oxygen sensor reaches the working temperature<br>• Rear oxygen sensor output voltage is higher than 2.0 V | • Sensor circuit<br>• Sensor<br>• ECM |
| P0137 | Signal short to ground | • Rear oxygen sensor reaches the working temperature<br>• Rear oxygen sensor voltage signal is lower than 0.06 V | |
| P0138 | Rear oxygen sensor signal voltage too high | • Battery voltage is higher than 10.68 V<br>• Engine speed is more than 25 rpm<br>• Target λ = 1<br>• Catalytic converter temperature is higher than 250°C<br>• Rear oxygen sensor reaches the working temperature<br>• Rear oxygen sensor signal voltage is higher than 1.5 V | |
| P0140 | Rear oxygen sensor signal open circuit | • Rear oxygen sensor reaches the working temperature<br>• Rear oxygen sensor voltage is within 0.4 ~ 0.5 V | |

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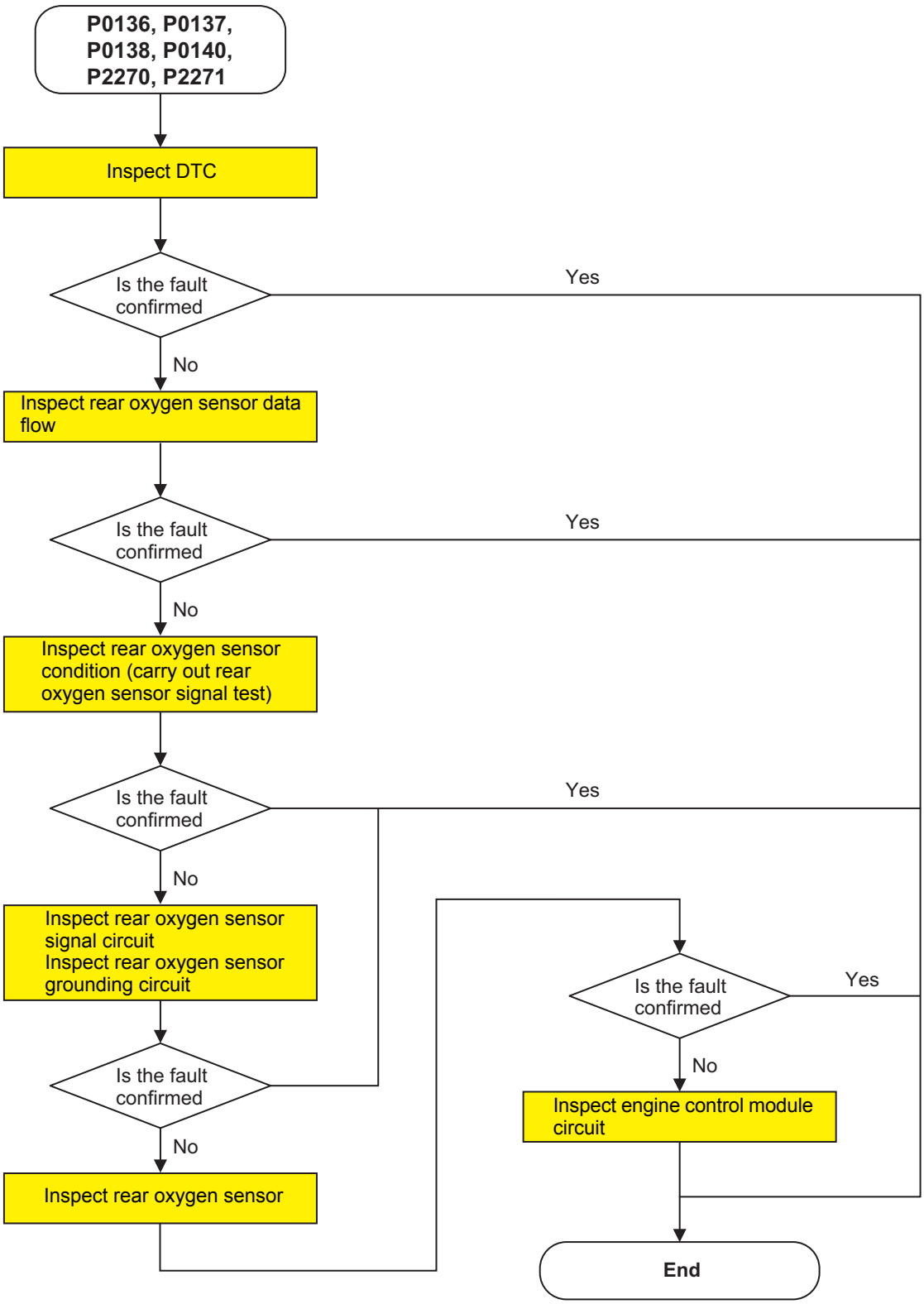


| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P2270 | Rear oxygen sensor voltage is always low | • Rear oxygen sensor voltage is lower than 0.582 V<br>• Access to diagnosis request | • Sensor circuit<br>• Sensor<br>• ECM |
| P2271 | Rear oxygen sensor voltage is always high | • Rear oxygen sensor voltage is higher than 0.619 V<br>• Access to diagnosis request | |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Turn off the ignition switch and connect the diagnostic tool.<br>B. Start the engine, and use the diagnostic tool to inspect the engine system.<br>Is there any DTC besides P0136, P0137, P0138, P0140, P2270 and P2271?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect rear oxygen sensor data flow | |
| | A. Start the engine, and run it till the engine coolant temperature reaches above 80°C.<br>B. Use diagnostic tool to access to engine data flow, and observe the "O2 sensor voltage bank 1, sensor 2" parameter.<br>**Standard voltage: fluctuates around 0.5 V**<br>Does the voltage of oxygen sensor fluctuate around 0.5 V?<br>**Yes**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 3. |

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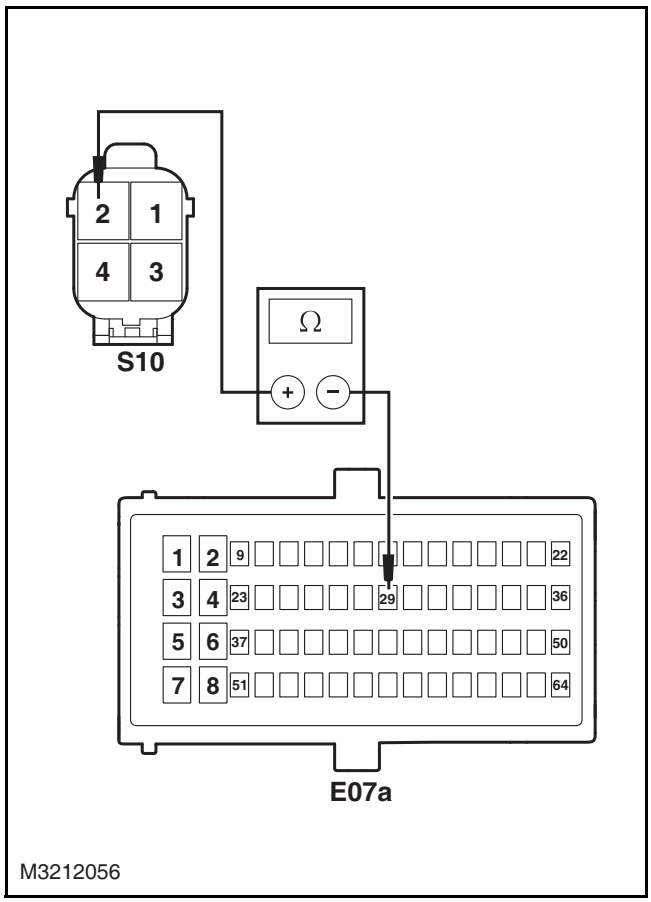


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect rear oxygen sensor condition (carry out rear oxygen sensor signal test) | |
| | A. If the voltage displayed in data flow remains below 0.45 V (mixture too lean), inspect according to the following steps:<br>• Jet a proper amount of propane into the inlet port.<br>• Observe if the rear oxygen sensor voltage in data flow changes obviously and the signal voltage rises quickly.<br>B. If the voltage displayed in data flow remains above 0.45 V (mixture too rich), inspect according to the following steps:<br>• Position the transmission at neutral gear.<br>• Apply the parking brake.<br>• Depress the accelerator pedal until the engine speed suddenly increases to 4000 rpm and then quickly release the accelerator pedal.<br>• Repeat the previous step more than 3 times.<br>• Observe if the rear oxygen sensor voltage in data flow changes obviously and the signal voltage drops quickly.<br>• In the implementation of above test, the oxygen sensor signal voltage should change significantly as the test continues.<br>Does it change significantly?<br>**Yes**<br>**Refer to: DTCs P2177, P2178, P2187, P2188 (3.2.12 Electronic control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect rear oxygen sensor signal circuit | |




M3212056

A. Turn the ignition switch to "LOCK".

B. Disconnect the rear oxygen sensor wiring harness connector S10.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 2 of rear oxygen sensor wiring harness connector S10 and terminal 29 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of rear oxygen sensor wiring harness connector S10 and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of rear oxygen sensor wiring harness connector S10 and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

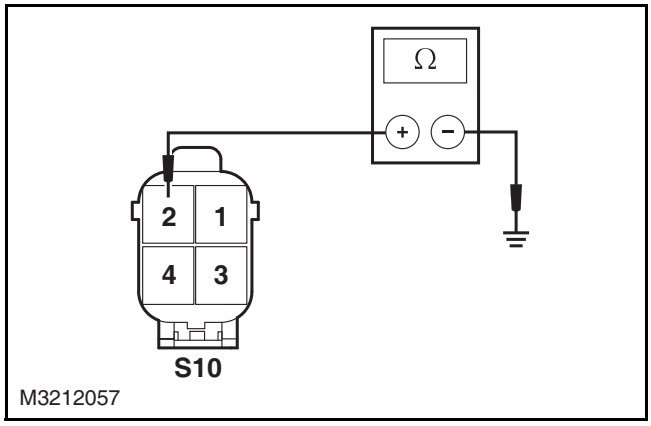
Is it normal?

**Yes**

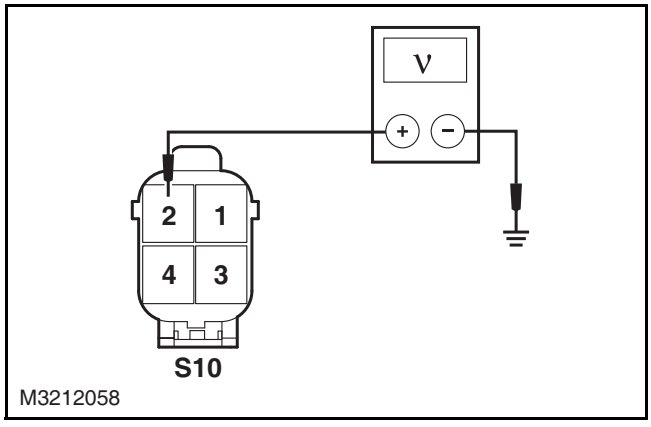
Go to step 5.

**No**

Inspect and repair the fault circuit between terminal 2 of rear oxygen sensor wiring harness connector S10 and terminal 29 of ECM wiring harness connector E07a. Verify that the system is normal.



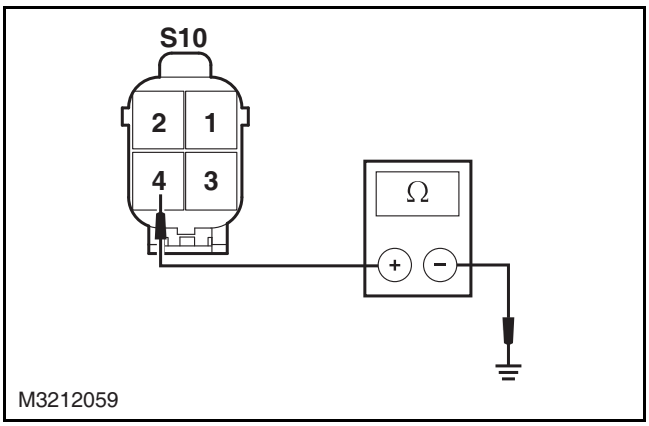

M3212057




M3212058

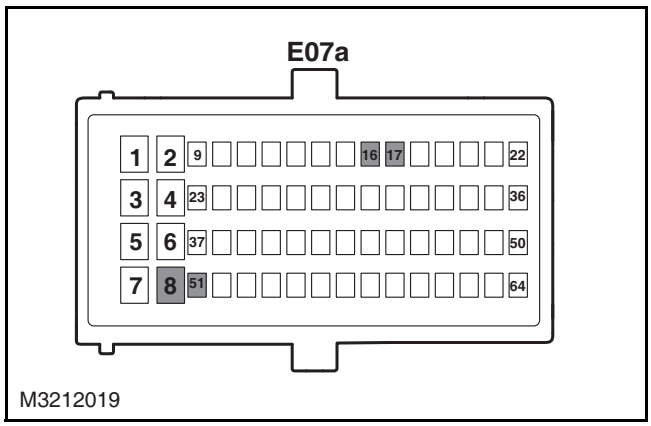
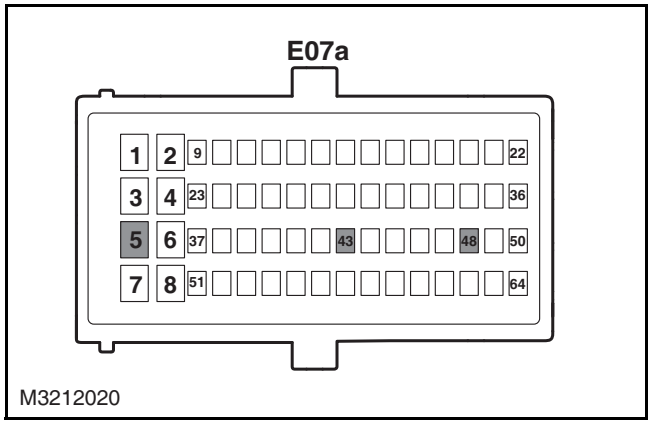
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect rear oxygen sensor grounding circuit | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the rear oxygen sensor wiring harness connector S10.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 4 of rear oxygen sensor S10 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the fault circuit between terminal 4 of rear oxygen sensor wiring harness connector S10 and terminal 39 of ECM wiring harness connector E07a. |
| 6. Inspect rear oxygen sensor | |
| | A. Replace the rear oxygen sensor.<br>**Refer to: Rear Oxygen Sensor (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>Make sure the system is normal.<br>**Yes**<br>Diagnosis completes.<br>**No**<br>Go to step 7. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0201, P0261, P0262

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0201 | Cylinder 1 - Injector Circuit | Injector operating voltage is provided by the main relay controlled by the ECM. Battery voltage is transmitted to terminal 1 of each injector wiring harness connector via terminal 69 of main relay IR05 of instrument panel fuse box P40. ECM controls the internal grounding of cylinder 1 injector via terminal 50 of ECM wiring harness connector E07a. ECM monitors the state of all injector drive circuits. If the ECM detects that the voltage corresponding to drive circuit command state is incorrect, it will set up a DTC indicating fuel injector control circuit fault. |
| P0261 | Cylinder 1 - Injector Circuit Low | |
| P0262 | Cylinder 1 - Injector Circuit High | |

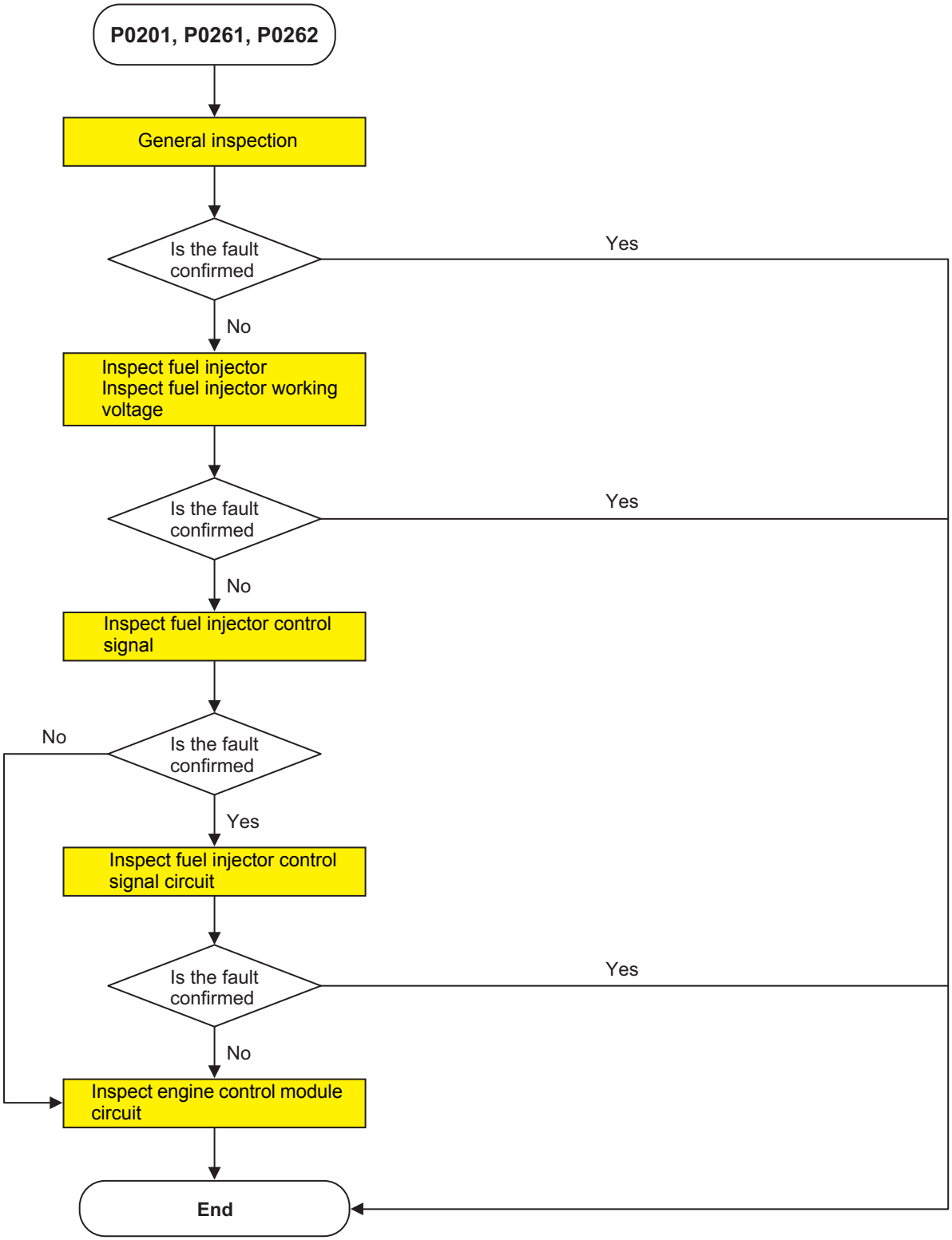
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0201 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Injector circuit<br>• Fuel injector<br>• ECM |
| P0261 | | | |
| P0262 | | | |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the fuel injectors for damage, poor contact, aging and looseness.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. Make sure the system is normal. |
| 2. Inspect fuel injector | |
| | A. Disconnect the fuel injector wiring harness connector E09a.<br>B. Measure the resistance between two terminals of fuel injector.<br>**Standard resistance: 11.5 ~ 12.6 Ω at 20°C**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the fuel injector. Make sure the system is normal. |
| 3. Inspect fuel injector working voltage | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the cylinder 1 injector wiring harness connector E09a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 1 of cylinder 1 injector wiring harness connector E09a and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the circuit fault between terminal 1 of fuel injector wiring harness connector E09a and terminal 69 of main relay IR05. |

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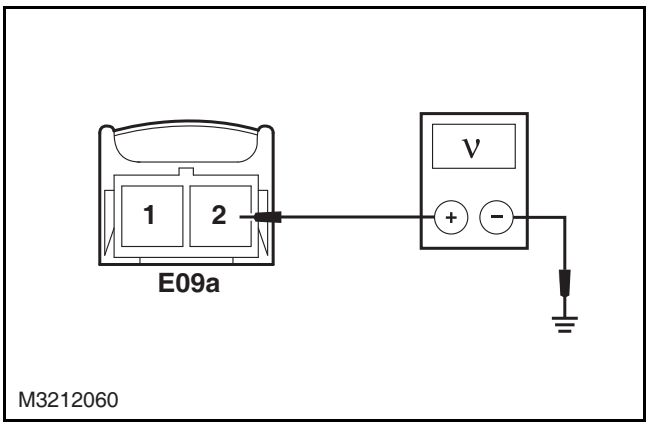


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuel injector control signal | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the cylinder 1 injector wiring harness connector E09a.<br>C. Connect the test pencil with LED to the terminals 1 and 2 of E09a according to specification.<br>**CAUTION: LED must connect with 1 ~ 2 kΩ resistor in series, otherwise the LED or ECM may be damaged.**<br>D. Start the engine.<br>E. Observe if the test lamp flashes normally.<br>Does the test lamp flash normally?<br>**Yes**<br>Go to step 6.<br>**No**<br>Go to step 5. |

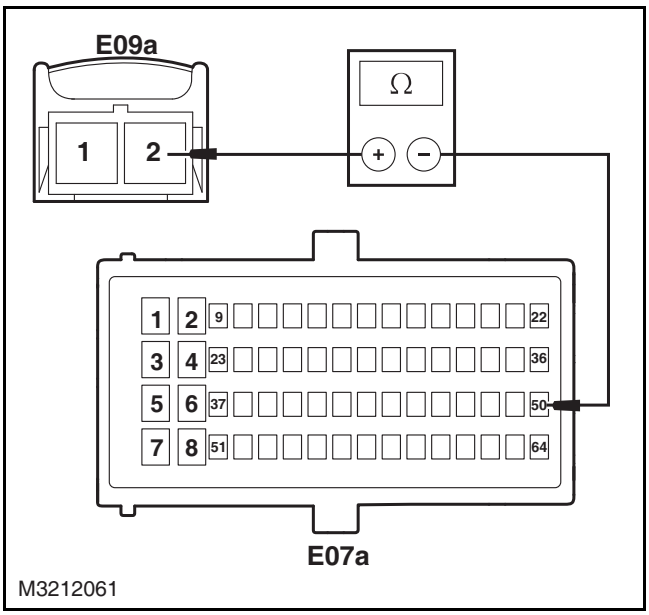
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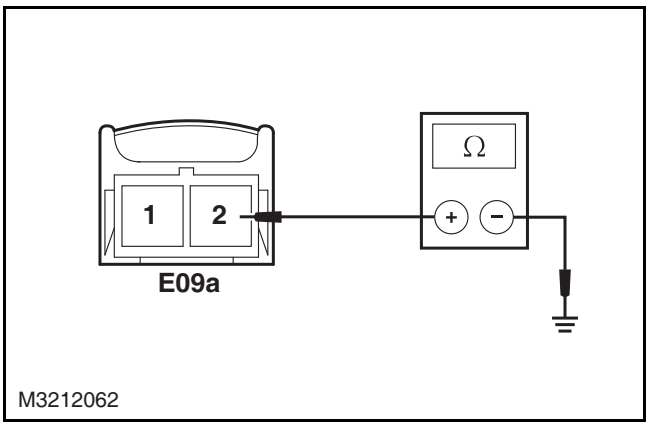
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect fuel injector control signal circuit | |




M3212060




M3212061




M3212062

A. Turn the ignition switch to "LOCK".

B. Disconnect the cylinder 1 injector wiring harness connector E09a.

C. Measure the voltage between terminal 2 of E09a and reliable grounding.

**Standard voltage: 0 V**

D. Disconnect the ECM wiring harness connector E07a.

E. Measure the resistance between terminal 2 of cylinder 1 injector wiring harness connector E09a and terminal 50 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 2 of E09a and reliable grounding.

**Standard resistance: 10 MΩ or more**

Is it normal?

**Yes**

Go to step 6.

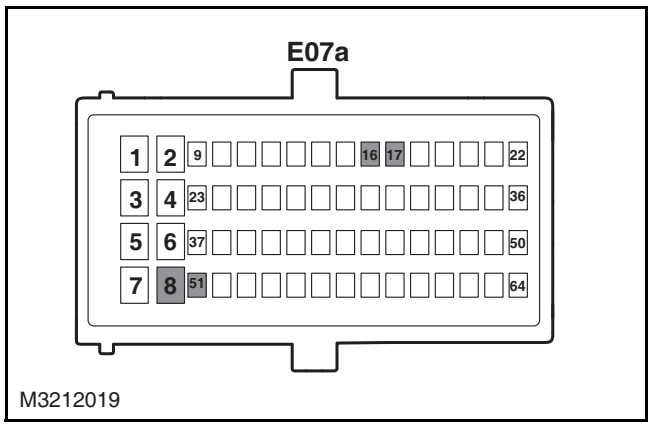
**No**

Repair the fault circuit between the terminal 2 of E09a and terminal 50 of ECM wiring harness connector E07a.

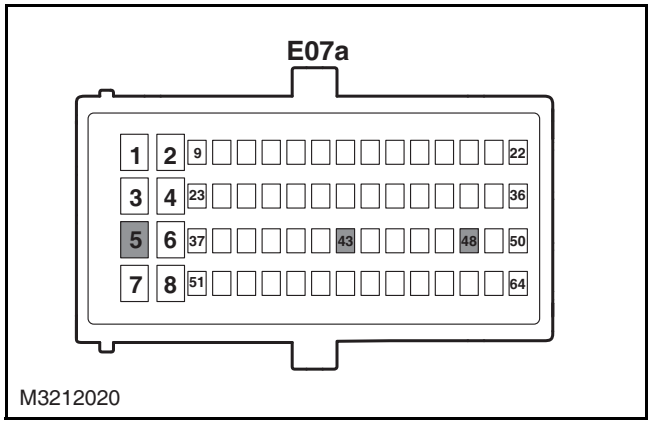
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect engine control module circuit | |



M3212019



M3212020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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# DTCs P0300, P0301, P0302, P0303, P0304

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0300 | Random/Multiple Cylinder Misfire Detected | ECM monitors the interval of CKP sensor input signal. ECM calculates the interval time change of each cylinder. If the interval time change exceeds preprogrammed standard, then ECM will detect poor ignition of corresponding cylinder. When the engine is running, ECM calculates the counts of ignition misfire at 200 and 1000 crankshaft revolutions, and the misfire rate per crankshaft revolution. If the misfire rate exceeds the preprogrammed standard, then ECM will determine the occurrence of poor ignition that can damage the catalytic converter or affect emission performance. |
| P0301 | Cyl.1 Misfire Detected | |
| P0302 | Cyl.2 Misfire Detected | |
| P0303 | Cyl.3 Misfire Detected | |
| P0304 | Cyl.4 Misfire Detected | |

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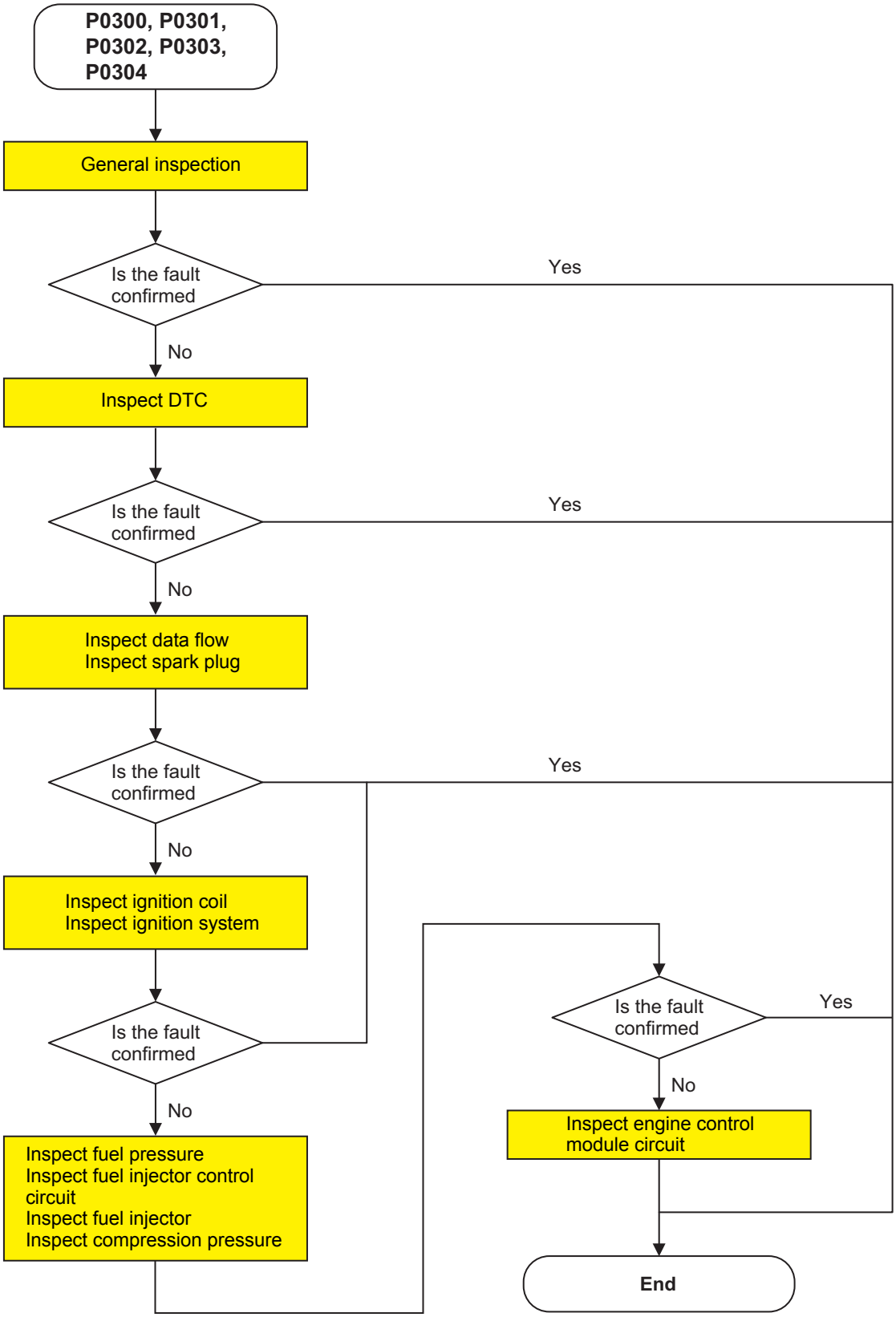
**2. Possible Causes**

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0300<br>P0301<br>P0302<br>P0303<br>P0304 | Misfire rate that damages catalytic converter | • Misfire rate that damages the catalytic converter is greater than 4% ~ 23%<br>• Bad circuit not detected<br>• Fuel cut-off not active<br>• Torque intervention not active | • Connector looseness, poor contact<br>• Vacuum hose broken, loose<br>• Ignition system<br>• Fuel injector<br>• Fuel pressure<br>• Air intake pressure sensor<br>• Engine coolant temperature sensor<br>• Cylinder compression pressure<br>• Valve clearance and timing<br>• Evaporative emission control system<br>• Positive crankcase ventilation system<br>• Air intake system<br>• Exhaust system air vent clog<br>• ECM |
| | Misfire rate that deteriorates the emission | • Misfire rate that deteriorates the emission is greater than 3.6%<br>• Engine speed is more than 600 rpm, less than 5200 rpm | |
| | Implausible fault | • Misfire rate that deteriorates the emission is greater than 3.6%<br>• Air intake temperature is higher than -25°C | |

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### 3. Diagnosis Procedure



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**CAUTION: If the engine electronic control system stores DTCs other than misfire DTCs, carry out troubleshooting for these DTCs first.**

**CAUTION: If misfire does not occur when the vehicle is taken to a service station, carry out road test again to reproduce the misfire fault. And use the diagnostic tool to record the ECM data when the misfire occurs in order to help analyze the cause of fault.**

**CAUTION: If the vehicle still stores no DTC related to misfire after long road test, the fault may be caused by the following:**
**1. Fuel tank is overfull, and fuel goes into the engine evaporative emission control system, causing misfire due to too rich mixture.**
**2. Misfire caused by insufficient combustion of improper fuel.**
**3. Misfire caused by ignition fault of contaminated spark plug.**
**4. Carry out basic inspection on the system according to the faulty area indicated by DTC.**

**CAUTION: After repair, road test the vehicle to confirm that no DTC is stored.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors for damage, poor contact, aging and looseness.<br>B. Inspect the vacuum tube for damage, looseness or leakage.<br>C. Inspect the air intake system for leakage.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault parts. Make sure the system is normal. |
| 2. Inspect DTC | |
| | A. Connect the diagnostic tool.<br>B. Start the engine and diagnose the engine system.<br>C. Inspect DTC.<br>Is there any DTC besides P0300, P0301, P0302, P0303 and P0304?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect data flow | |
| | A. Connect the diagnostic tool.<br>B. Start engine and access to the engine system data flow on diagnostic tool.<br>C. Inspect the data flow for coolant temperature sensor, air intake pressure sensor, engine speed and throttle position.<br>Is the data flow normal?<br>**Yes**<br>Repair the abnormal data flow fault.<br>**No**<br>Go to step 4. |
| 4. Inspect spark plug | |
| | A. Remove the spark plug from the misfire cylinder.<br>B. Inspect if the spark plug gap is too large or too small.<br>**Standard gap: 0.85 ~ 0.95 mm**<br>C. Inspect if the spark plug electrode is burnt or damaged.<br>D. Inspect spark plug skirt and electrode for moisture, serious smell of gasoline.<br>E. Reinstall the spark plug.<br>Is the spark plug normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair or replace the spark plug. |
| 5. Inspect ignition coil | |
| | A. Remove the ignition coil.<br>B. Inspect the ignition coil.<br>**Refer to: Ignition Coil Test (3.2.8 Ignition System, General Inspection).**<br>Is the ignition coil normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the ignition coil.<br>**Refer to: Ignition Coil (3.2.8 Ignition System, Remove and Installation).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect ignition system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Carry out the ignition spark test.<br>**Refer to: Ignition Spark Test (3.2.8 Ignition System, General Inspection).**<br>Is the ignition spark test normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect the ignition system.<br>**Refer to: Diagnosis Procedure for Spark Plugs not Flashing Over (3.2.8 Ignition System, Symptom Diagnosis and Testing).** |
| 7. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect the fuel system. |

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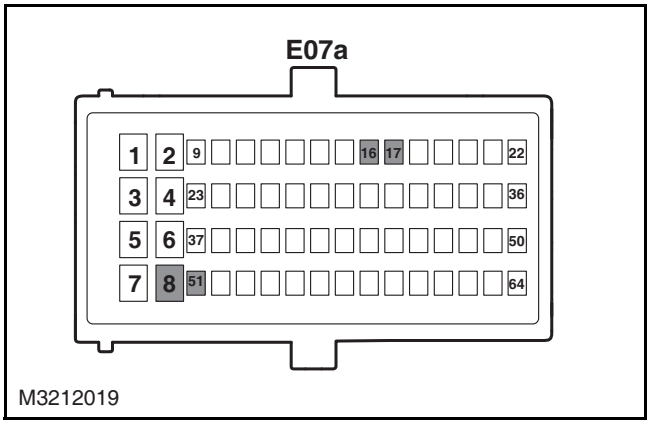


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect fuel injector control circuit | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the misfire cylinder fuel injector wiring harness connector.<br>C. Connect the test pen with LED to the terminals 1 and 2 of fuel injector connector according to specification.<br>⚠ **CAUTION: LED must connect with 1 ~ 2 kΩ resistor in series, otherwise the LED or ECM may be damaged.**<br>D. Start the engine.<br>E. Observe if the test lamp flashes normally.<br>Does the test lamp flash normally?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect the fuel injector wiring harness. Repair or replace if necessary. |
| 9. Inspect fuel injector | |
| | A. Remove the fuel injector from the misfire cylinder.<br>B. Use the fuel injectors on the other cylinders instead.<br>C. Start the engine and idle it.<br>Does the misfire DTC correspond to the fuel injector in trouble.<br>**Yes**<br>Replace the failure injector.<br>**No**<br>Go to step 10. |
| 10. Inspect compression pressure | |
| | A. Inspect the compression pressure in the cylinder.<br>**Refer to: Cylinder Compression Pressure Inspection (3.2.2 Mechanical System, General Inspection).**<br>B. Is the compression pressure normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Repair engine mechanical system fault. |

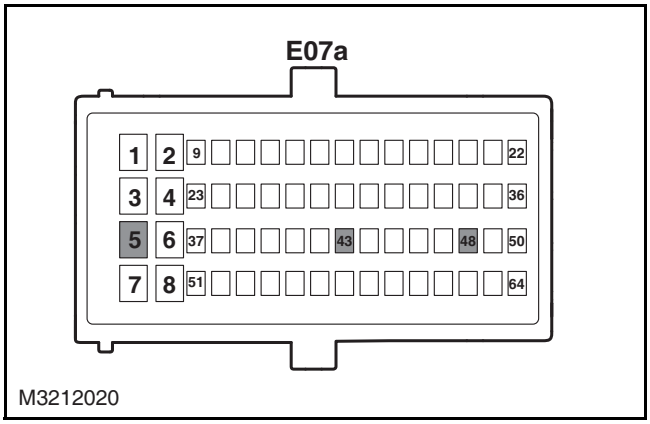
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| Test Conditions | Details/Results/Actions |
|---|---|
| 11. Inspect engine control module circuit | |



M3212019



M3212020

A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".

B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.

C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.

Is the engine control module circuit normal?

**Yes**

Replace the engine control module.

**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the circuit.

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# DTCs P0321, P0322

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0321 | Ign./Distributor Eng.Speed Inp.Circ. Range/Performance | CKP sensor signal informs ECM of the current speed and position of crankshaft. This sensor detects the teeth and grooves of ferromagnetic signal plate, and outputs the electric signals that indicate the speed and position of signal plate. ECM can calculate the ignition timing, injection timing and knock control according to input signals of CKP sensor. CKP sensor is also used for misfire detection and tachometer display. CKP sensor signal is connected to terminals 19, 47, 40 of ECM wiring harness connector E07a respectively via terminals 1, 2, 3 of CKP sensor wiring harness connector E05a. |
| P0322 | Ign./Distributor Eng.Speed Inp.Circ. No Signal | |

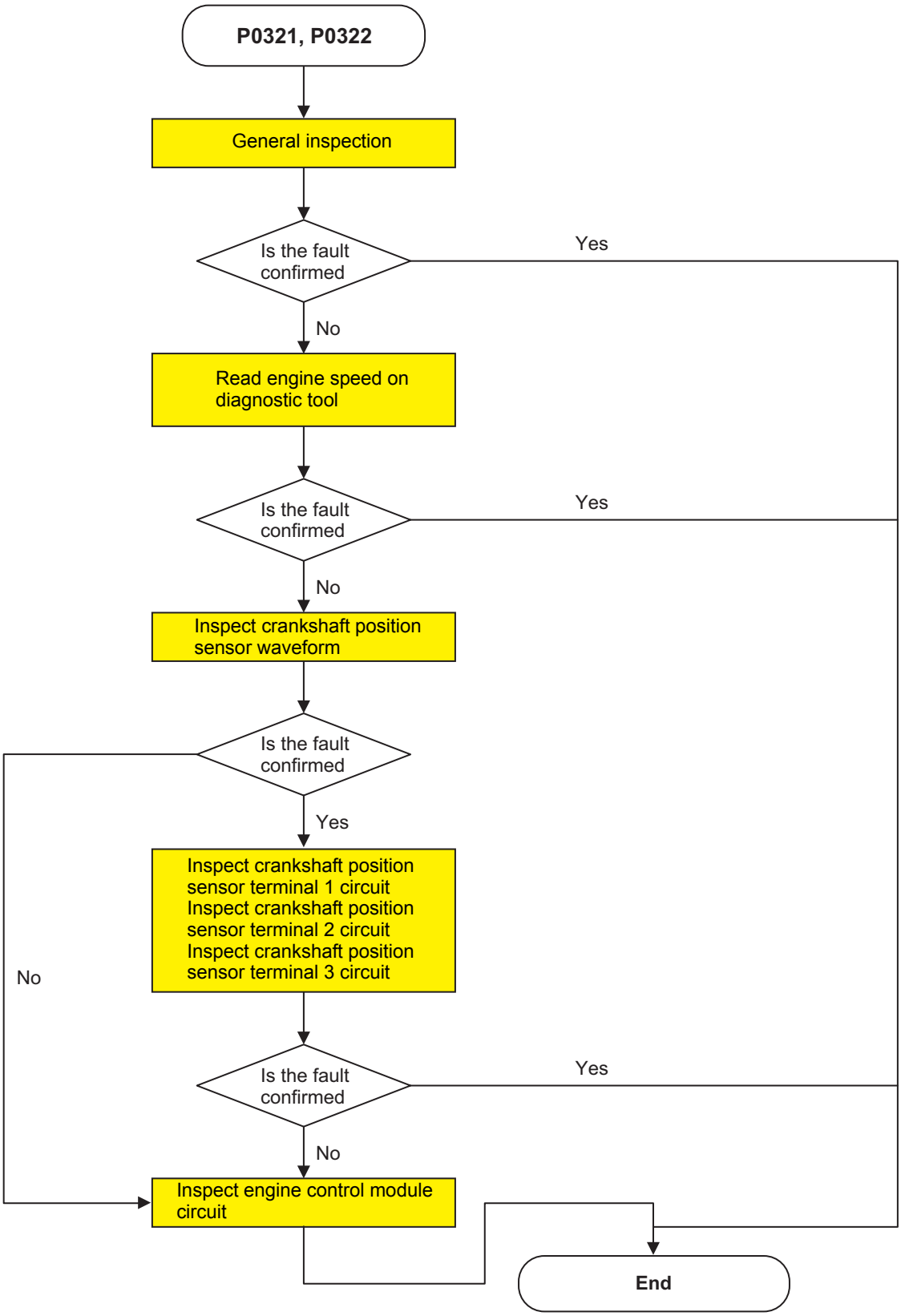
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0321 | • Frequent gap correction by plus one tooth<br>• Frequent gap correction by minus one tooth<br>• Speed sensor signal exists but no reference mark is found<br>• Frequent loss of reference mark | • Count of gap correction by plus one tooth is greater than 250<br>• Count of gap correction by minus one tooth is greater than 250<br>• Count of no reference gaps detected is greater than 6<br>• Count of lost reference gaps is greater than 2000 | • Crankshaft position sensor<br>• Crankshaft position sensor circuit<br>• ECM |
| P0322 | No speed signal detected after a certain quantity of phase sensor signal | • Count of phase signal hop is greater than 8<br>• Low engine speed | |

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### 3. Diagnosis Procedure



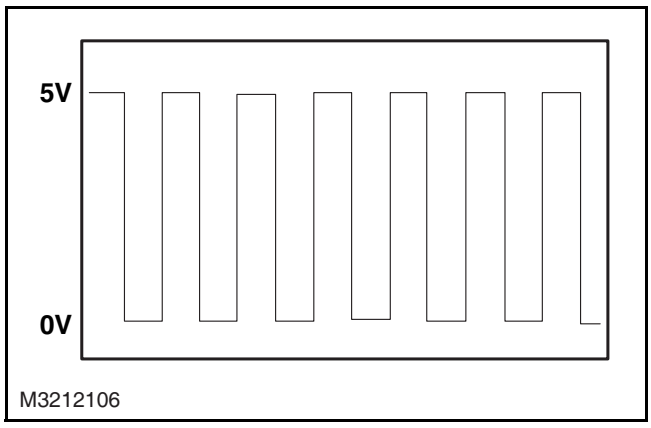
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the sensor wiring harness connector E05a for looseness or poor contact.<br>B. Inspect the sensor for proper installation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. Make sure the system is normal. |
| 2. Read engine speed on diagnostic tool | |
| | A. Connect the diagnostic tool.<br>B. Turn the ignition switch to "ON".<br>C. Select "UAES M788 (EA12)/Actual values/Engine speed".<br>D. Start the engine.<br>E. Read the engine speed data displayed on the diagnostic tool when the engine is running. Standard value: Refer to Data Flow List<br>F. If the engine cannot start, inspect the data when the engine is running.<br>G. If the engine speed displayed on the diagnostic tool is "0", it means the wiring harness between crankshaft position sensor and ECM has open or short circuit.<br>Is the data flow normal?<br>**Yes**<br>Intermittent fault.<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 3. |

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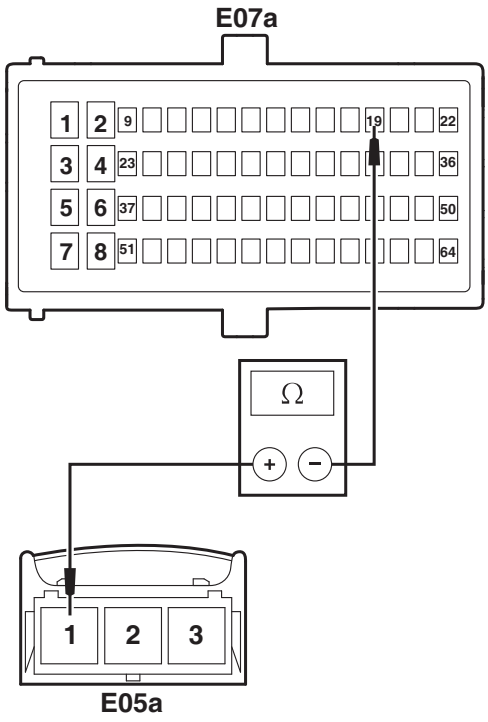


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect crankshaft position sensor waveform | |
|  <br>M3212106 | A. Measure the waveform between terminals 2 and 3 of sensor with an oscilloscope when engine idling.<br>Standard waveform is shown in left figure.<br>Is it normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Go to step 4. |

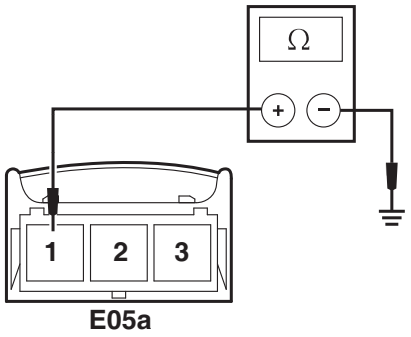
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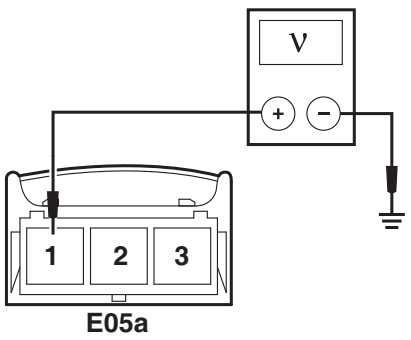
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect crankshaft position sensor terminal 1 circuit | |




M3212063




M3212064




M3212065

A. Turn the ignition switch to "LOCK".

B. Disconnect the crankshaft position sensor wiring harness connector E05a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 1 of crankshaft position sensor wiring harness connector E05a and terminal 19 of ECM wiring harness connector E07a.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 1 of crankshaft position sensor wiring harness connector E05a and reliable grounding.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 1 of crankshaft position sensor wiring harness connector E05a and reliable grounding.

**Standard voltage: 0 V**

Is the circuit normal?

**Yes**

Go to step 5.

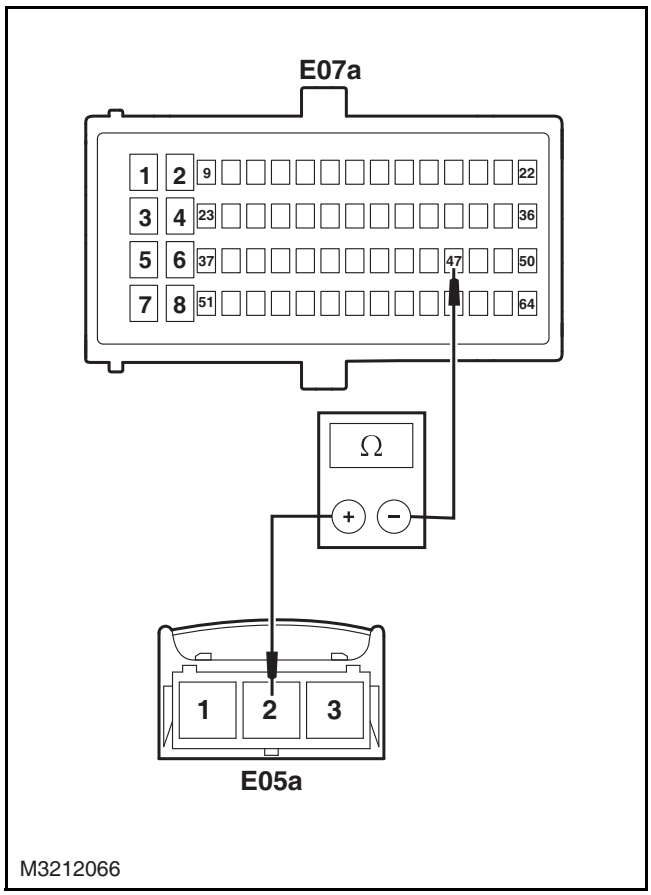
**No**

Repair the fault circuit between terminal 1 of crankshaft position sensor E05a and terminal 19 of ECM wiring harness connector E07a.

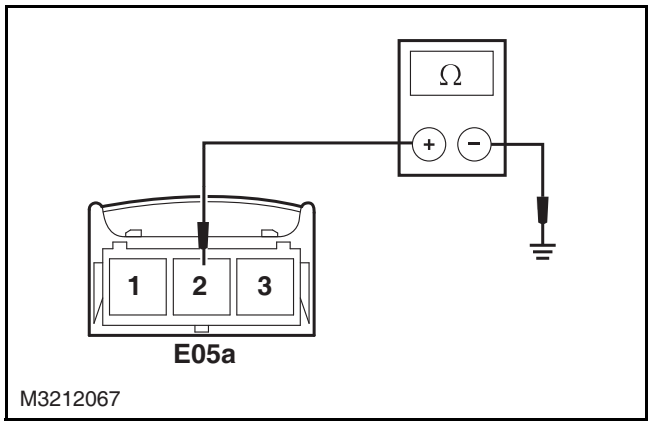
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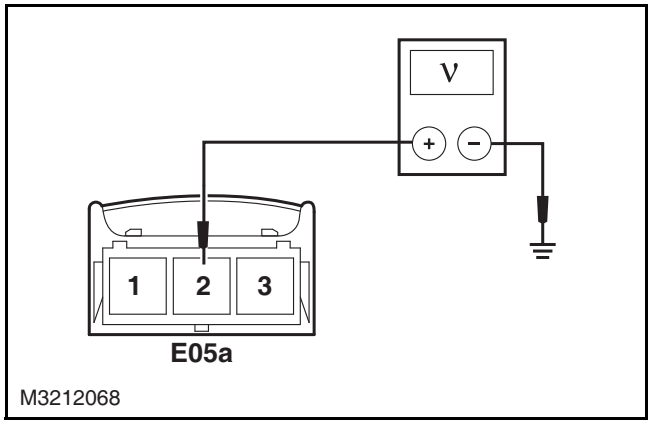
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect crankshaft position sensor terminal 2 circuit | |




M3212066




M3212067




M3212068

A. Turn the ignition switch to "LOCK".

B. Disconnect the crankshaft position sensor wiring harness connector E05a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 2 of crankshaft position sensor wiring harness connector E05a and terminal 47 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of crankshaft position sensor wiring harness connector E05a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of crankshaft position sensor wiring harness connector E05a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is the circuit normal?

**Yes**

Go to step 6.

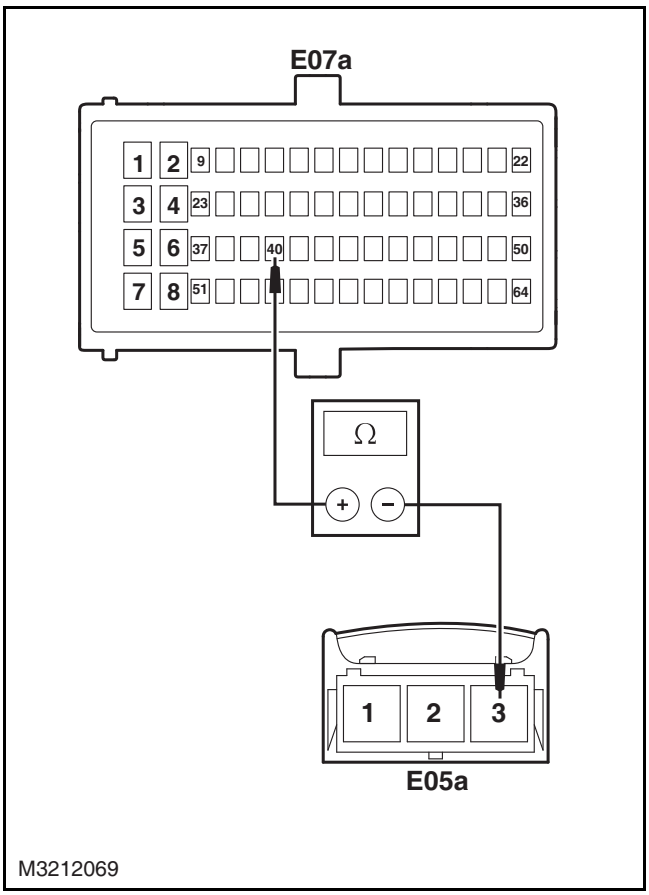
**No**

Repair the fault circuit between terminal 2 of crankshaft position sensor E05a and terminal 47 of engine control module E07a.

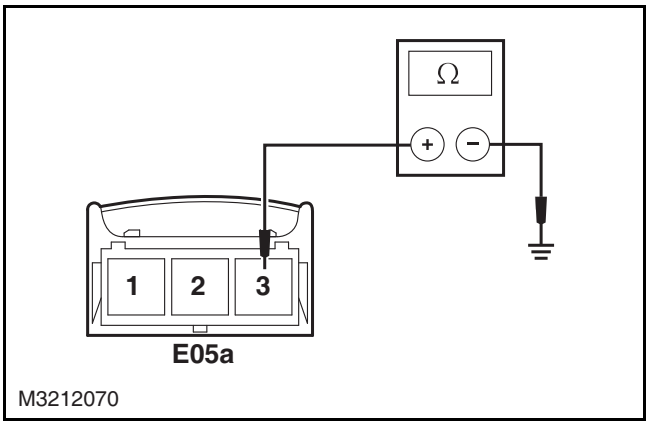
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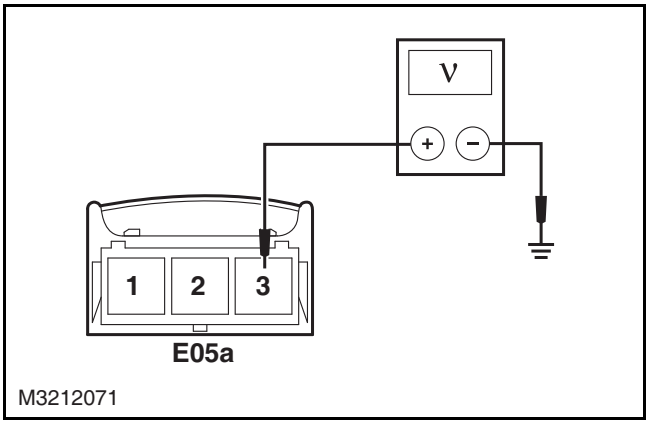
| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect crankshaft position sensor terminal 3 circuit | |




M3212069




M3212070




M3212071

A. Turn the ignition switch to "LOCK".

B. Disconnect the crankshaft position sensor wiring harness connector E05a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 3 of crankshaft position sensor wiring harness connector E05a and terminal 40 of ECM wiring harness connector E07a.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 3 of crankshaft position sensor wiring harness connector E05a and reliable grounding.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 3 of crankshaft position sensor wiring harness connector E05a and reliable grounding.

**Standard voltage: 0 V**

Is the circuit normal?

**Yes**

Replace the crankshaft position sensor.

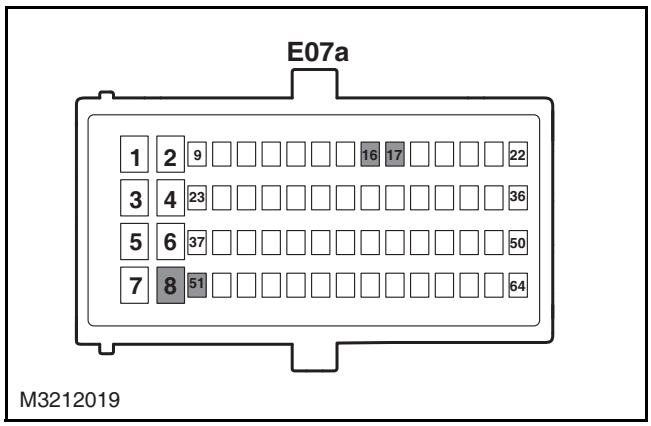
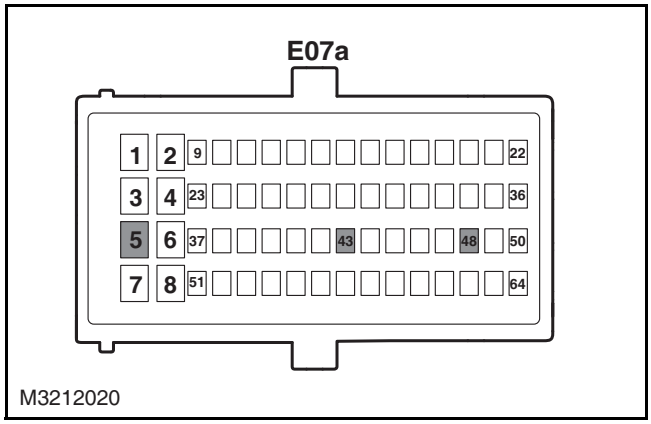
**Refer to: Crankshaft Position Sensor (3.2.12 Electronic Control System - M7, Removal and Installation).**

**No**

Repair the fault circuit between terminal 3 of crankshaft position sensor E05a and terminal 40 of ECM wiring harness connector E07a.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0327, P0328

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0327 | Knock Sensor 1 Circ. Low Input | A piezoelectric ceramic is built into the knock sensor. Using the special piezoelectric effect of piezoelectric ceramic, it generates output voltage with large amplitude when engine knocking occurs, and transmits it to the electronic controller. Terminals 1 and 2 of knock sensor provides knock signal to ECM, and terminal 3 is grounded by wire for shielding. |
| P0328 | Knock Sensor 1 Circ. High Input | |

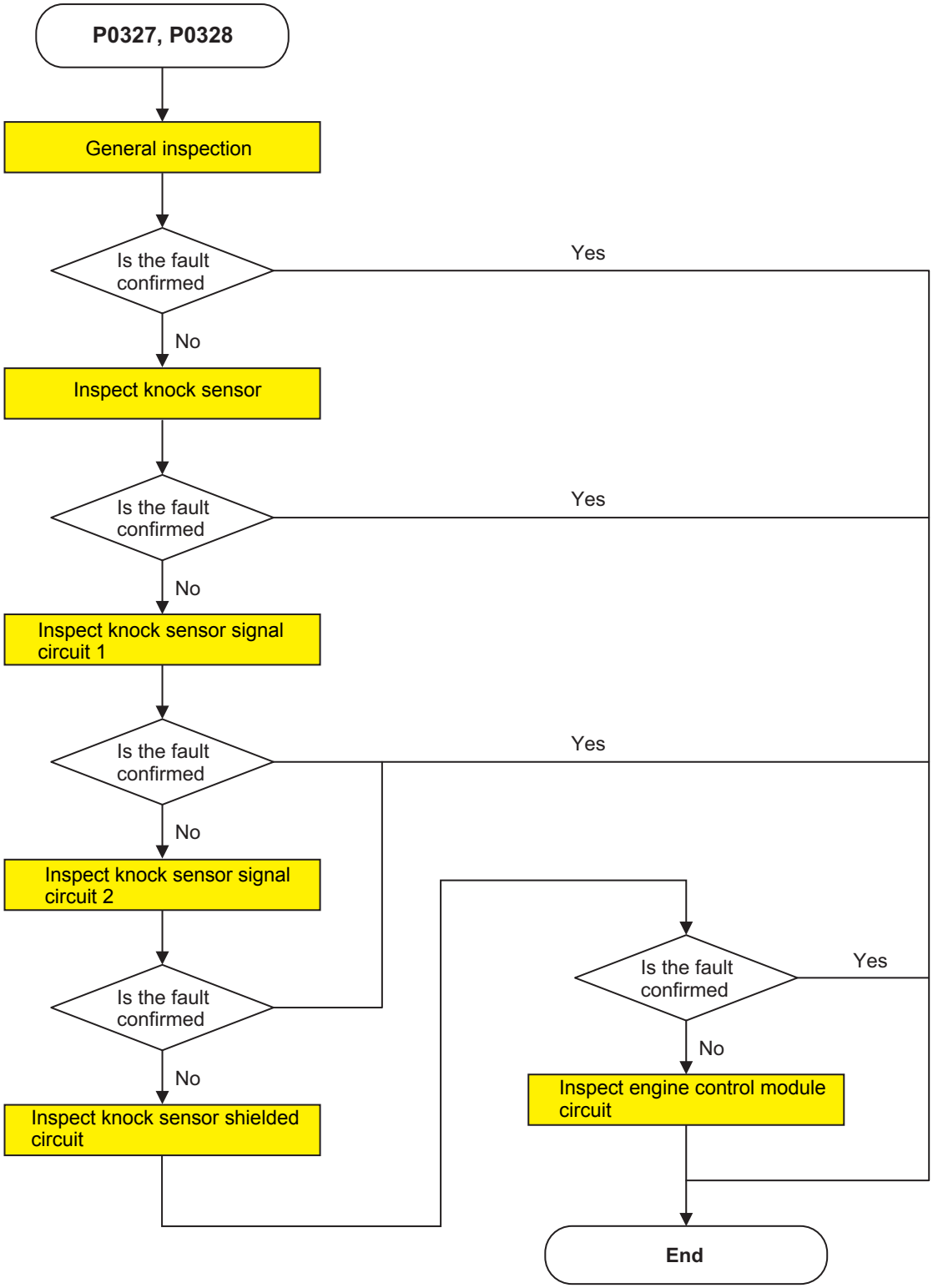
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0327 | Signal range check low | • Knock identification reference voltage is lower than 0.5 V 30 times in succession<br>• Coolant temperature is higher than 40°C<br>• Engine speed is higher than 2600 rpm<br>• cylinder 1 identification is possible | • Sensor circuit<br>• Sensor<br>• ECM |
| P0328 | Signal range check high | • Knock identification reference voltage is higher than 320 V 30 times in succession<br>• No dynamics in engine speed<br>• No dynamics in engine load<br>• No knock control circuit fault<br>• Limp home not active<br>• Engine load is greater than 39.8% | |

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### 3. Diagnosis Procedure



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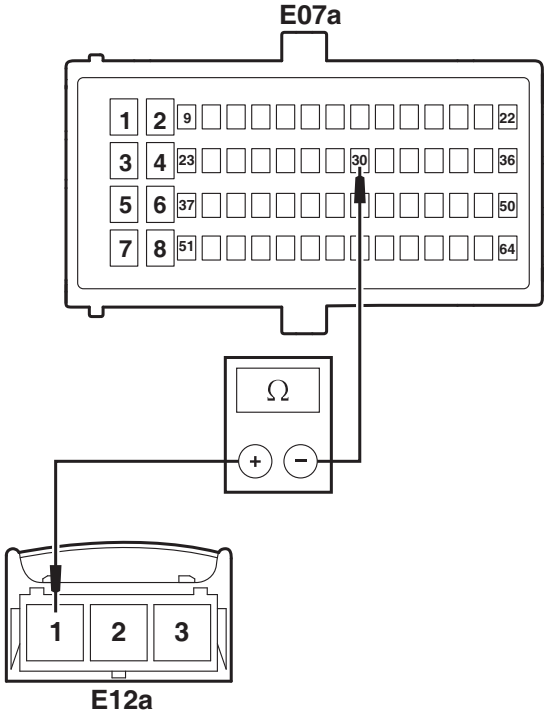


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the knock sensor wiring harness connector for looseness or damage.<br>B. Inspect the knock sensor for looseness or improper installation.<br>C. Inspect the knock sensor for corrosion.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect knock sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the knock sensor wiring harness connector E12a.<br>C. Measure the resistance between terminals 1 and 2 of knock sensor with a multimeter.<br>**Standard resistance: more than 1 MΩ**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the knock sensor. |

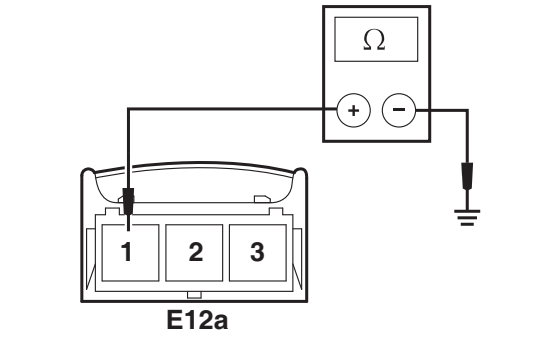
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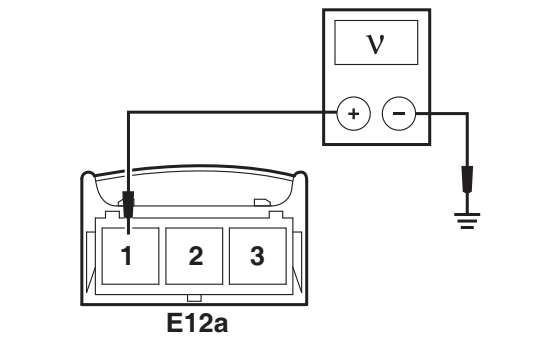
| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect knock sensor signal circuit 1 | |




M3212072




M3212073




M3212074

A. Turn the ignition switch to "LOCK".

B. Disconnect the knock sensor wiring harness connector E12a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 1 of knock sensor wiring harness connector E12a and terminal 30 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 1 of knock sensor wiring harness connector E12a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 1 of knock sensor wiring harness connector E12a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

Go to step 4.

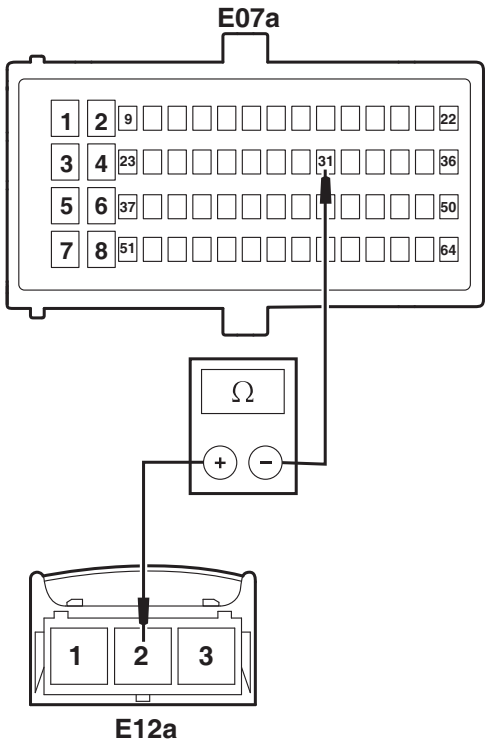
**No**

Repair the fault circuit between terminal 1 of knock sensor wiring harness connector E12a and terminal 30 of ECM wiring harness connector E07a. Verify that the system is normal.

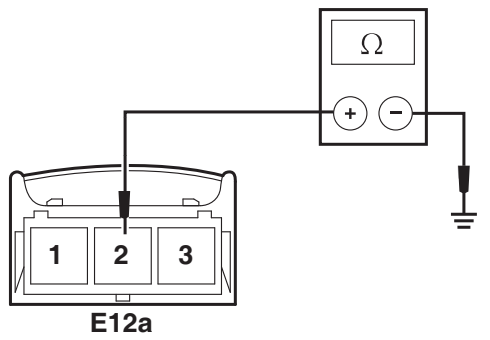
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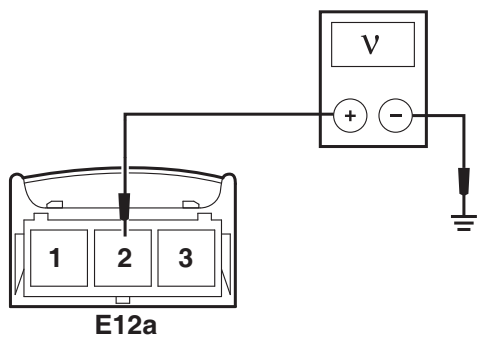
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect knock sensor signal circuit 2 | |




M3212075




M3212076




M3212077

A. Turn the ignition switch to "LOCK".

B. Disconnect the knock sensor wiring harness connector E12a.

C. Disconnect the ECM wiring harness connector E07a.

D. Measure the resistance between terminal 2 of knock sensor wiring harness connector E12a and terminal 31 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of knock sensor wiring harness connector E12a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of knock sensor wiring harness connector E12a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

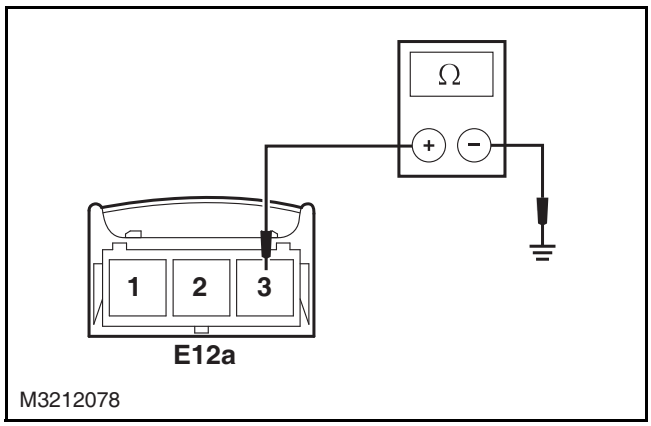
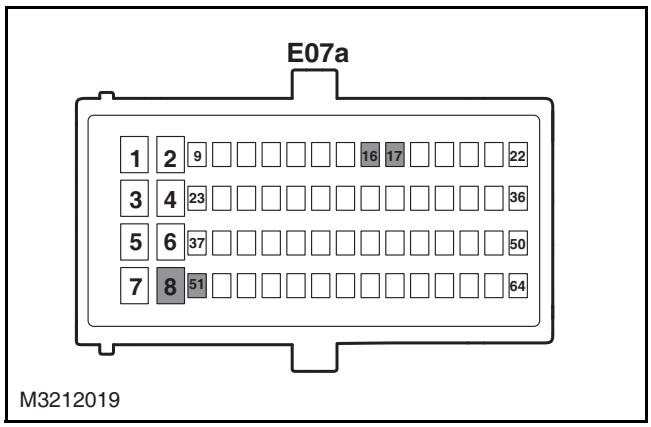
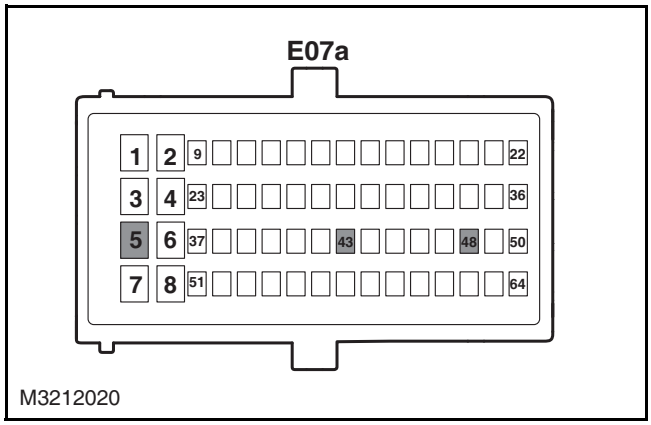
Go to step 5.

**No**

Repair the fault circuit between terminal 2 of knock sensor wiring harness connector E12a and terminal 31 of ECM wiring harness connector E07a. Verify that the system is normal.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect knock sensor shielded circuit | |
|  M3212078 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the knock sensor wiring harness connector E12a.<br>C. Measure the resistance between terminal 3 of knock sensor wiring harness connector E12a and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Repair the fault circuit between terminal 3 of knock sensor wiring harness connector E12a and grounding point G301. |
| 6. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTC P0420

## 1. DTC Description

**CAUTION: If oxygen sensor DTC and catalytic converter efficiency DTC are set simultaneously, diagnose the oxygen sensor DTC first before proceeding.**

**CAUTION: Inspect for contamination that damages the oxygen sensor and catalytic converter, such as dirty fuel, unqualified silicon resin, oil and coolant. Repair as necessary.**

| DTC Code | Description | Definition |
|---|---|---|
| P0420 | Catalyst System, Bank1 Efficiency Below Threshold | - |

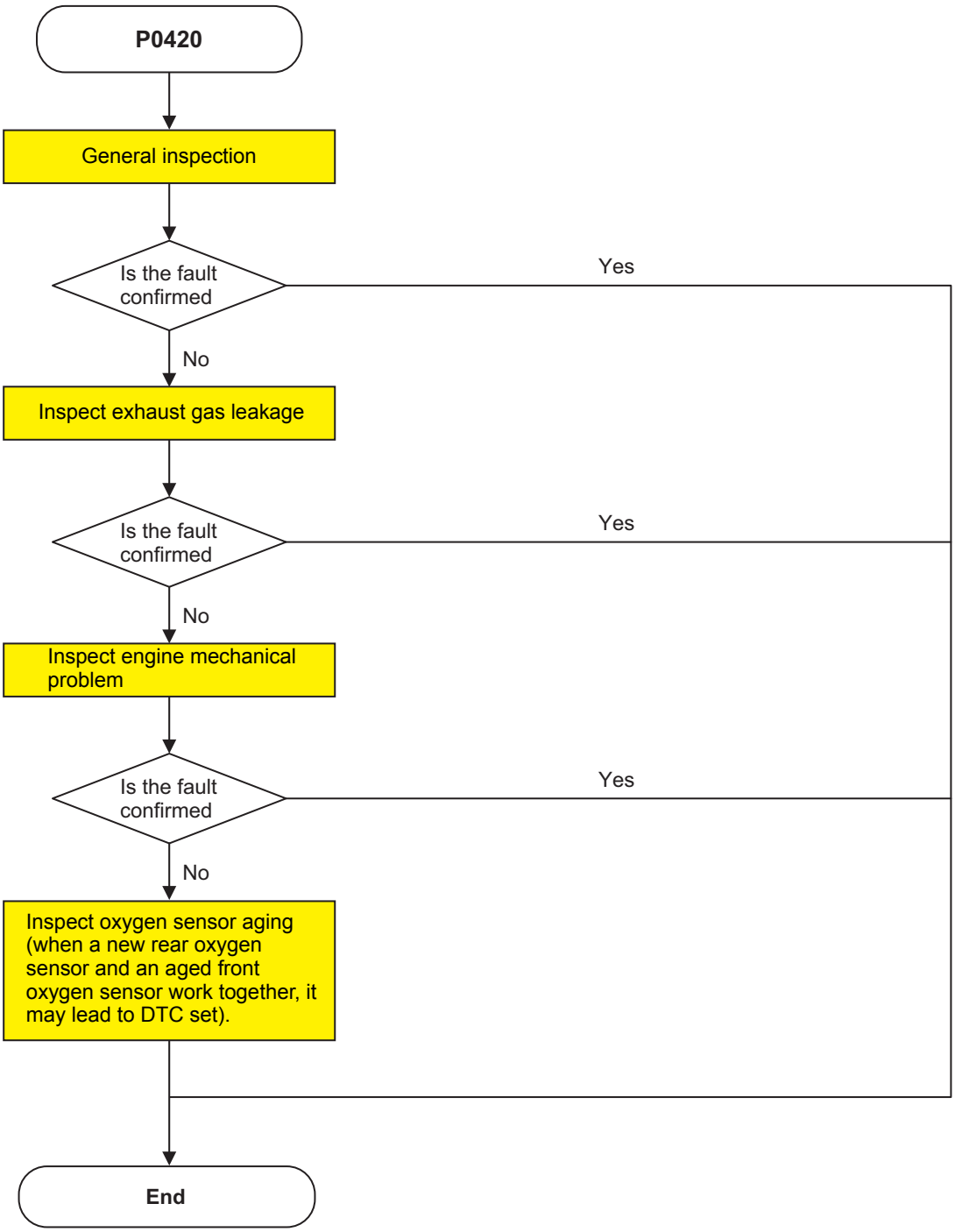
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0420 | Maximum limit exceeded | • Mean amplitude value of rear oxygen sensor signal after corrected by catalytic converter is greater than 0.60<br>• Active monitoring time for catalytic converter diagnosis is more than 40 s | • Catalytic converter<br>• Exhaust leakage<br>• Engine mechanical<br>• Oxygen sensor aging |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the catalytic converter for following defects.<br>Damage, dent or hole in catalytic converter.<br>Serious discoloration due to catalytic converter overheating.<br>Breakage inside the catalytic converter<br>Catalytic converter leakage<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the catalytic converter. Make sure the system is normal. |
| 2. Inspect exhaust gas leakage | |
| | A. Start the engine.<br>B. Inspect if there is exhaust gas leakage between engine and front oxygen sensor.<br>C. Inspect if there is exhaust gas leakage between engine and rear oxygen sensor.<br>Is there any exhaust gas leakage?<br>**Yes**<br>Repair the leakage fault. Make sure the system is normal.<br>**No**<br>Go to step 3. |
| 3. Inspect engine mechanical problem | |
| | A. Inspect the exhaust gas for excessive black smoke and blue smoke due to the internal problems of engine.<br>Is the exhaust gas with excessive black smoke and blue smoke?<br>**Yes**<br>Repair the engine mechanical.<br>Make sure the system is normal.<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect oxygen sensor aging (when a new rear oxygen sensor and an aged front oxygen sensor work together, it may lead to DTC set). | |
| | A. Inspect the repair record to see if the oxygen sensor has been replaced.<br>Has the rear oxygen sensor rather than front oxygen sensor been replaced?<br>**Yes**<br>Replace the front oxygen sensor as needed.<br>**No**<br>Replace the catalytic converter. |

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# DTCs P0444, P0458, P0459

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0444 | Evaporative Emiss.System Purge Control Valve Circ. Open | Carbon canister control valve circuit includes the following circuit:<br>• The operating voltage of carbon canister control valve is provided by the main relay controlled by the ECM. Battery voltage is transmitted to terminal 1 of carbon canister control valve wiring harness connector E13a via terminal 69 of main relay IR05 of instrument panel fuse box P40.<br>• Control circuit: ECM controls terminal 2 of carbon canister control valve wiring harness connector E13a to ground via terminal 37 of ECM wiring harness connector E07a. |
| P0458 | Evaporative Emission System Purge Control Valve Circuit Low | |
| P0459 | Evaporative Emission System Purge Control Valve Circuit High | |

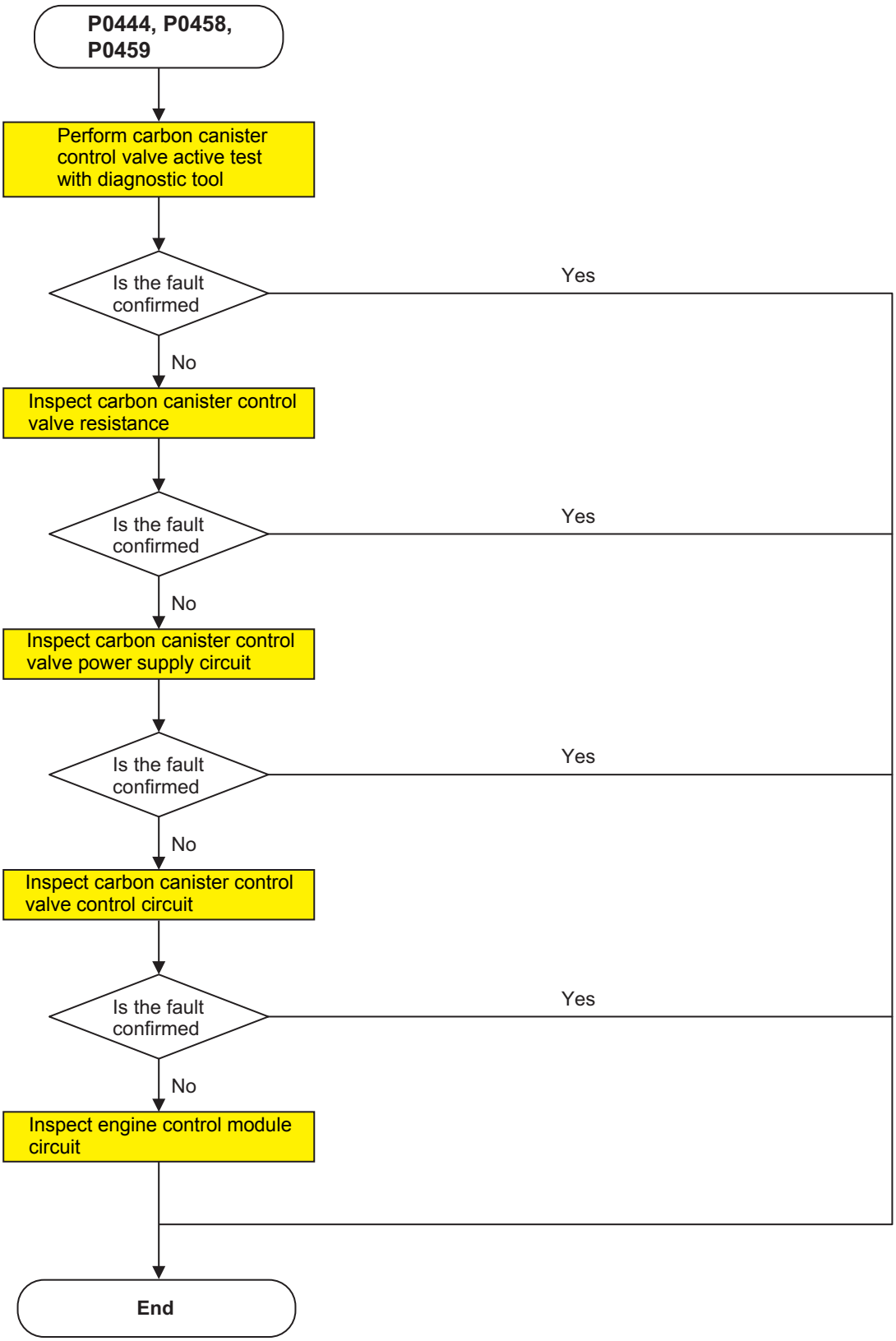
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0444 | Hardware circuit inspection | Open circuit | • Solenoid valve<br>• Solenoid valve circuit<br>• ECM |
| P0458 | | Short to ground | |
| P0459 | | Short to power supply | |

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### 3. Diagnosis Procedure



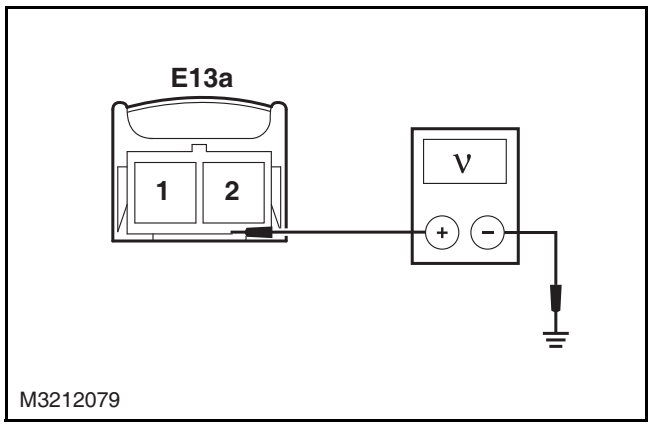
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Perform carbon canister control valve active test with diagnostic tool | |
| | A. Connect the diagnostic tool.<br>B. Disconnect the vacuum tube between carbon canister control valve and carbon canister.<br>C. Start the engine, and turn on the diagnostic tool.<br>D. Access to menu as follows: UAES M788 (EA12)/ Actuators/Carbon canister control valve".<br>E. Open the carbon canister control valve and cover the valve vacuum port with fingers.<br>Is there vacuum suction?<br>**Yes**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Go to step 2. |
| 2. Inspect carbon canister control valve resistance | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the carbon canister control valve wiring harness connector E13a.<br>C. Measure the resistance between two terminals of carbon canister control valve.<br>**Standard resistance: 26 ± 4 Ω at 20°C**<br>D. Connect the carbon canister control valve wiring harness connector E13a.<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the carbon canister control valve. |

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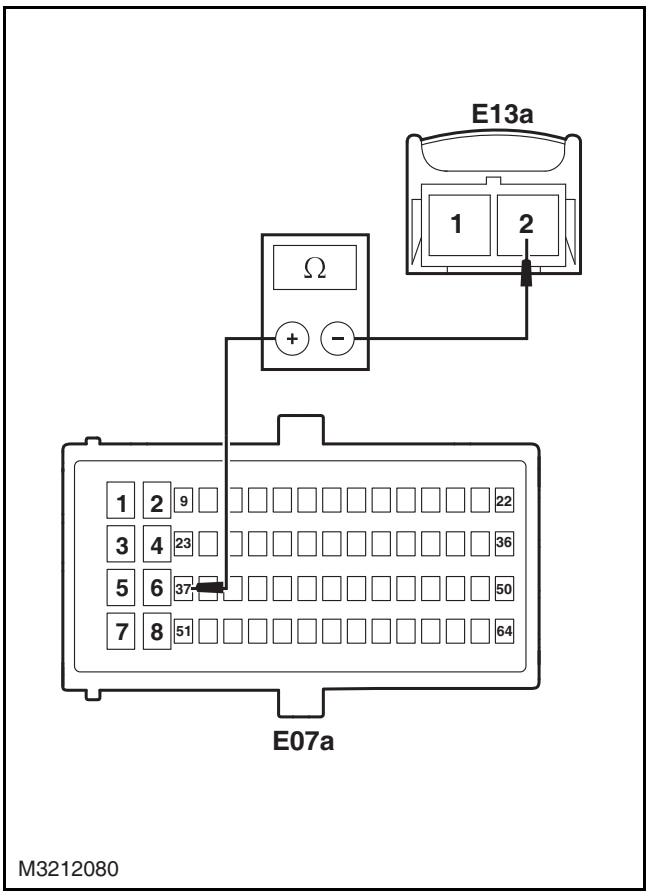


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect carbon canister control valve power supply circuit | |
|  M3212079 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the carbon canister control valve wiring harness connector E13a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 1 of carbon canister control valve wiring harness connector E13a and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the fault circuit between terminal 1 of carbon canister control valve wiring harness connector E13a and terminal 69 of main relay IR05 in the instrument panel fuse box P40. |

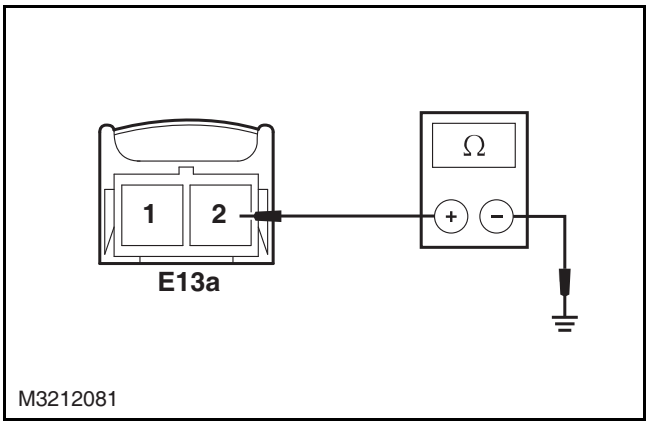
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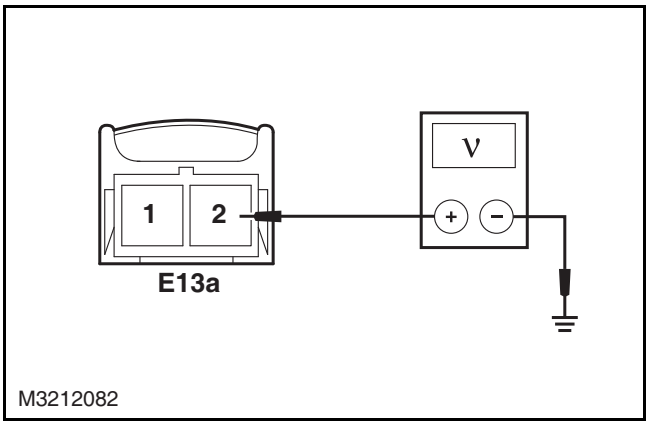
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect carbon canister control valve control circuit | |




M3212080




M3212081




M3212082

A. Turn the ignition switch to "LOCK".

B. Disconnect the carbon canister control valve wiring harness connector E13a.

C. Disconnect the engine control module wiring harness connector E07a.

D. Measure the resistance between terminal 2 of carbon canister control valve wiring harness connector E13a and terminal 37 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of carbon canister control valve wiring harness connector E13a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of carbon canister control valve wiring harness connector E13a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Is it normal?

**Yes**

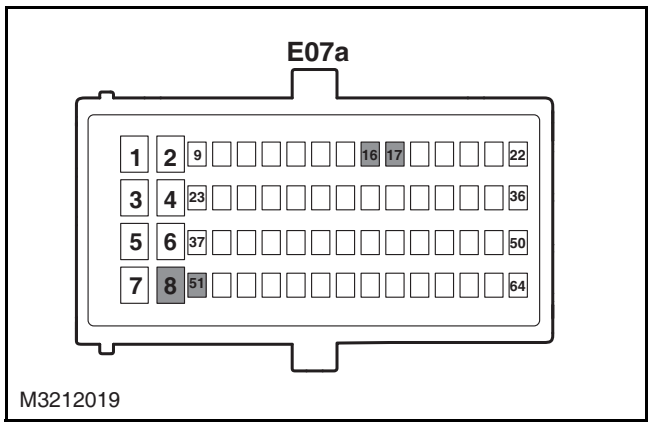
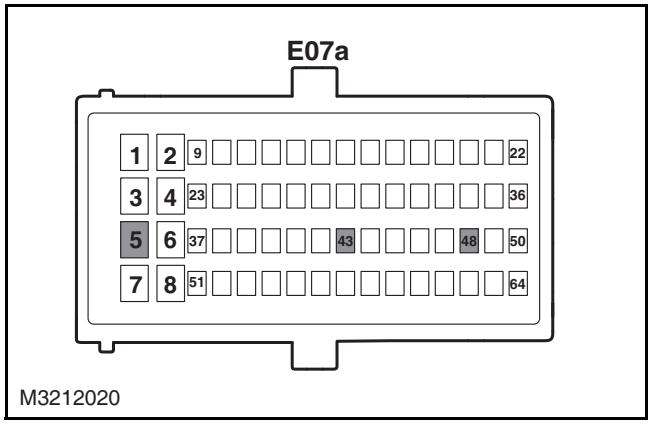
Go to step 5.

**No**

Repair the fault circuit between the terminal 2 of carbon canister control valve wiring harness connector E13a and terminal 37 of ECM wiring harness connector E07a. Replace when necessary.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0480, P0691, P0692

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0480 | Cooling Fan 1 Control Circuit | Operating power of cooling fan relay coil is supplied by the main relay controlled by ECM. ECM controls the relay to operate via terminal 52 of ECM wiring harness connector E07a. There is a drive circuit control relay coil equipped within the ECM for grounding. Drive circuit provides a feedback circuit to ECM, and ECM determines if an open circuit, short to ground or power supply occurs in control circuit by monitoring the feedback voltage. |
| P0691 | Cooling Fan 1 Control Circuit Low | |
| P0692 | Cooling Fan 1 Control Circuit High | |

## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0480 | Hardware circuit inspection | Open circuit | • Relay<br>• Relay circuit<br>• ECM |
| P0691 | | Short to ground | |
| P0692 | | Short to power supply | |

## 3. Diagnosis Procedure

Refer to: Diagnosis Procedure for Non-operation of Radiator-fan (3.2.4 Cooling System, Symptom Diagnosis and Testing).

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# DTCs P0506, P0507

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0506 | Idle Control System RPM Lower than Expected | Idling stepper motor is controlled by Engine Control Module (ECM). ECM controls the forward/backward movement and amount of stepper motor valve via digitized square signal to regulate the flow area of throttle body air passage to control the air volume entering the engine, thus realizing engine idling control. Engine Control Module (ECM) calculates and controls the engine target idle speed based on the coolant temperature, vehicle speed compensation, deceleration adjustment, voltage compensation.<br>Terminals 22, 21, 35, 36 of ECM wiring harness connector E07a are connected to terminals 1, 2, 3, 4 of idling stepper motor E14a respectively. |
| P0507 | Idle Control System RPM Higher than Expected | |

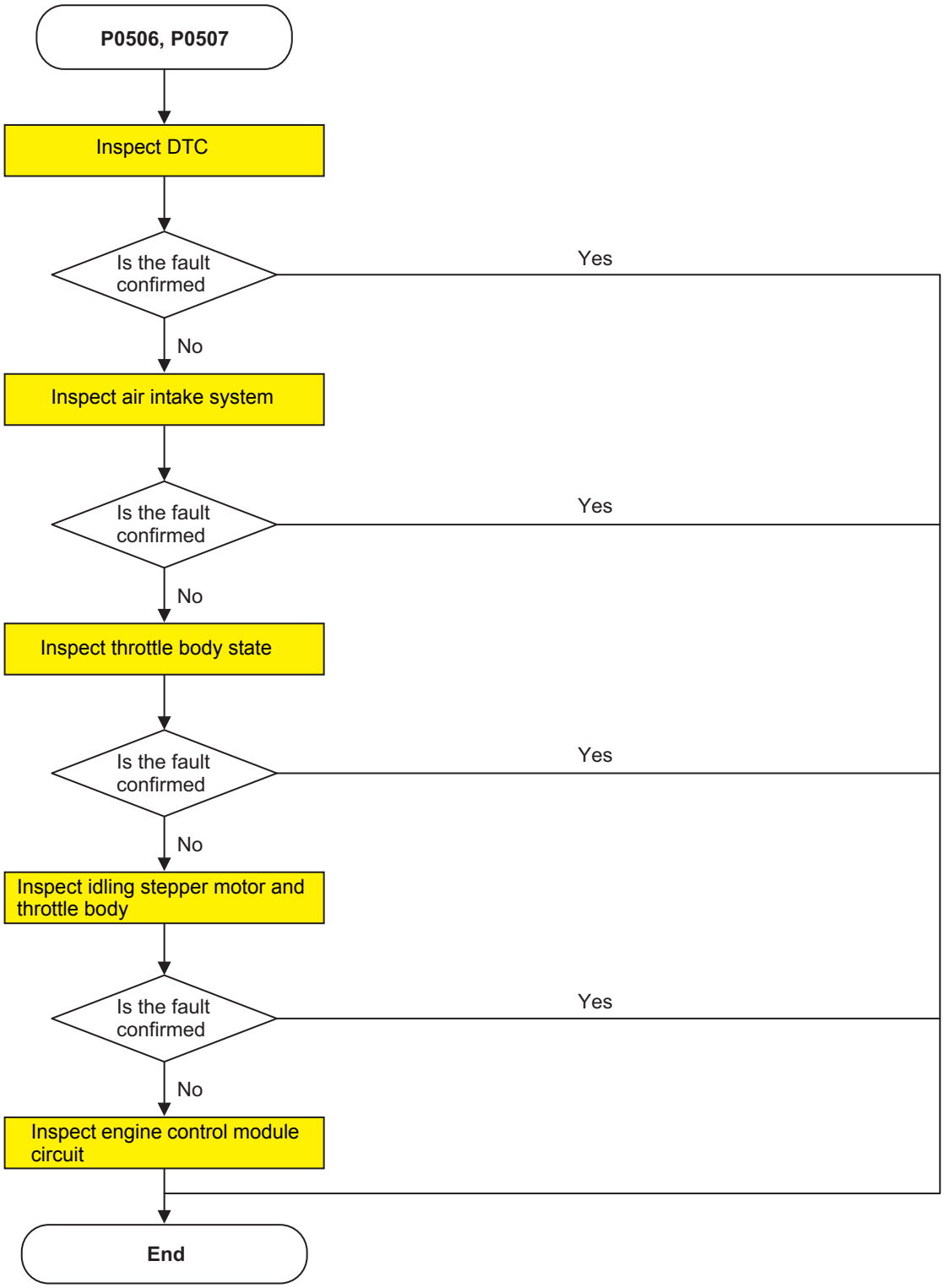
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0506 | Idling stepper motor stuck in the position with small opening | • Idle speed control integrator reaches the maximum value<br>• Difference between static idle speed and actual speed is less than 100 U/min for 8 s<br>• Engine coolant temperature is higher than 80.3°C<br>• Air intake temperature is higher than 20.3°C | • Air intake system<br>• Throttle body<br>• ECM |
| P0507 | Idling stepper motor stuck in the position with large opening | • Idle speed control integrator reaches the minimum value<br>• Difference between static idle speed and actual speed is less than -200 U/min for 10 s<br>• At idle state<br>• Carbon canister is not at high load<br>• Vehicle speed sensor diagnosis completes with no fault<br>• Vehicle speed is 0<br>• Altitude correction factor is greater than 0.703 | |

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### 3. Diagnosis Procedure



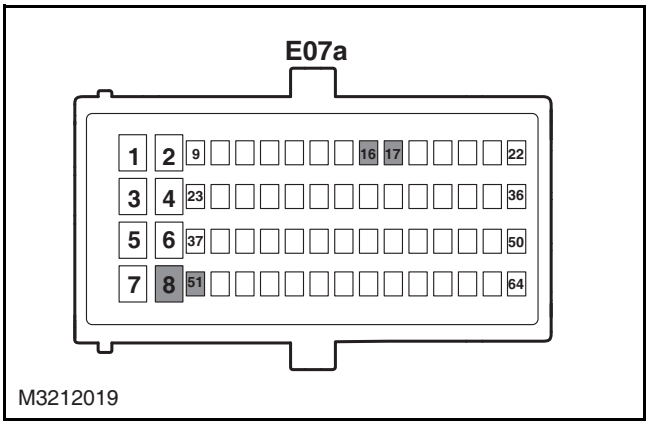
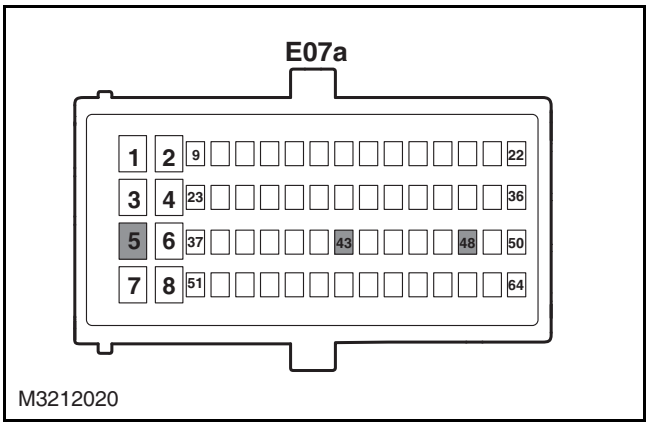
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>C. Select menu: "UAES M788 (EA12)/Read DTC", and read the DTC.<br>Is there any DTC other than DTCs P0506 and P0507?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 2. |
| 2. Inspect air intake system | |
| | A. Inspect the air intake system for the followings.<br>Blockage: Air filter dirty, impurity trapped in the air intake pipe, etc.<br>Leakage: Air intake pipe joint, air cleaner housing, etc.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the fault. |
| 3. Inspect throttle body state | |
| | A. Inspect the throttle body for carbon deposit and foreign matter. If the throttle disc cannot close completely, it may bend and need to be replaced.<br>B. Remove the idling stepper motor, and inspect the valve body for carbon deposit and other objects, and inspect if the stepper motor is stuck. If it is dirty and stuck, clean the idling stepper motor. Replace the throttle body assembly when necessary.<br>C. While the vehicle is running, knock idling stepper motor gently with your hands, and listen to the sound of idle speed rising.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the fault, and replace the idling stepper motor or throttle body assembly when necessary. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect idling stepper motor and throttle body | |
| | A. Replace with a normal idling stepper motor or throttle body assembly.<br>B. Clear the DTC.<br>Are they normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 5. |
| 5. Inspect engine control module circuit | |
|  <br>M3212019<br>  <br>M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0508, P0509, P0511

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0508 | Idle Air Control System Circuit Low | ECM controls engine idle speed by adjusting the position of IAC valve core shaft. IAC valve is a stepper motor that is driven by two internal coils. Movement of idling stepper motor is electrically controlled by four circuits. Driver inside ECM controls the polarity of two windings in the idling stepper motor by these circuits, and ECM commands the motor in the IAC valve to rotate clockwise or counterclockwise. IAC valve motor is connected to idling stepper motor core shaft by drive screws. Electrical pulse delivered from ECM to IAC valve coil allows the core shaft to stretch or contract into the passage of throttle body. The air passes through the throttle valve by contracting of core shaft to increase air flow and improve engine speed. When the core shaft stretches, the air flow is reduced and the engine speed is decreased. DTC will be set if engine control module detects that engine speed is not in the expected range. Terminals 22, 21, 35, 36 of ECM wiring harness connector E07a are connected to terminals 1, 2, 3, 4 of IAC valve wiring harness connector E14a respectively. |
| P0509 | Idle Air Control System Circuit High | |
| P0511 | Idle Air Control Circuit | |

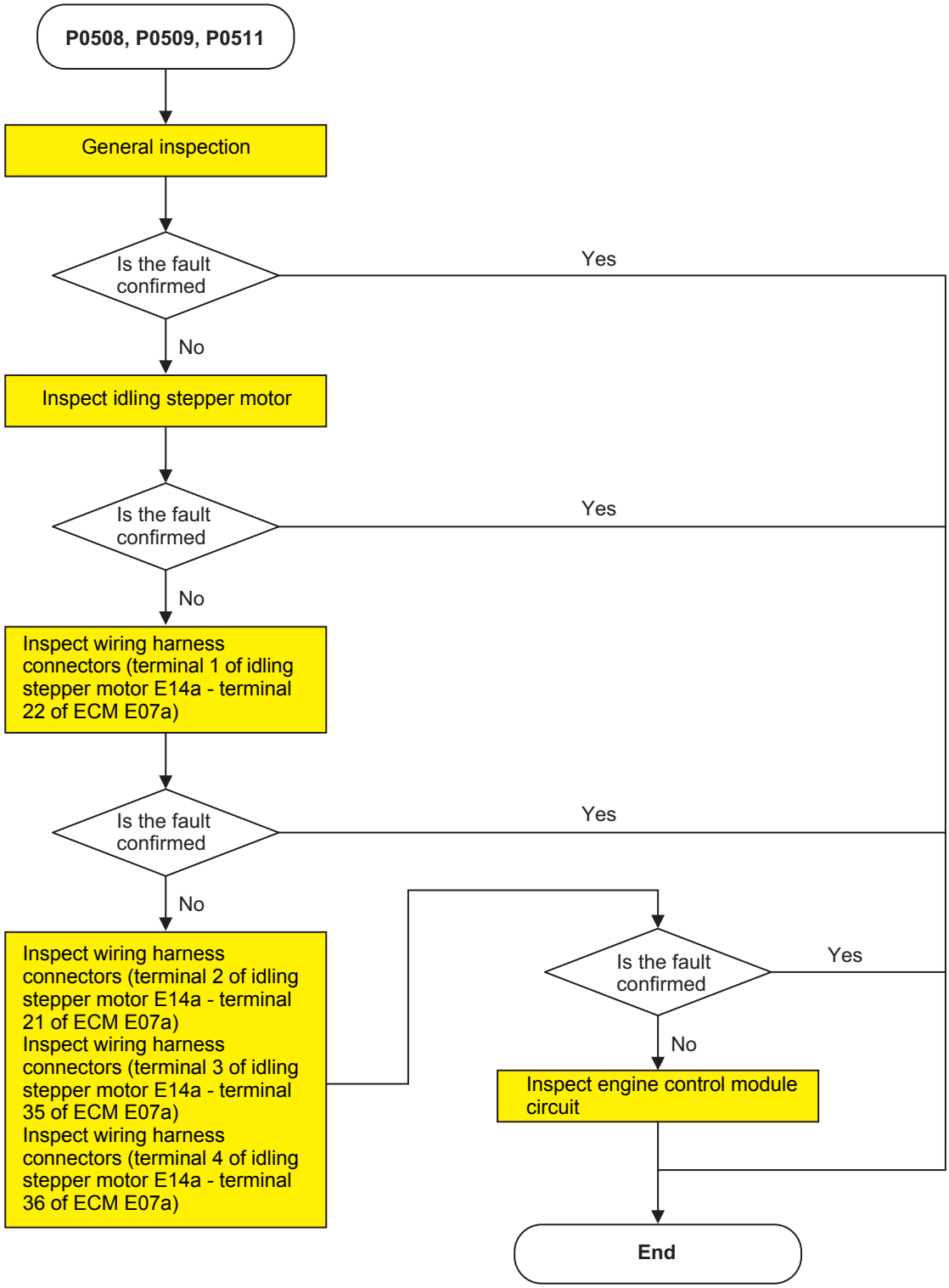
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0508 | Hardware circuit inspection | One terminal of stepper motor is short to ground | • Stepper motor circuit<br>• Stepper motor<br>• ECM |
| P0509 | | One terminal of stepper motor is short to battery positive | |
| P0511 | | One terminal of stepper motor is open | |

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### 3. Diagnosis Procedure



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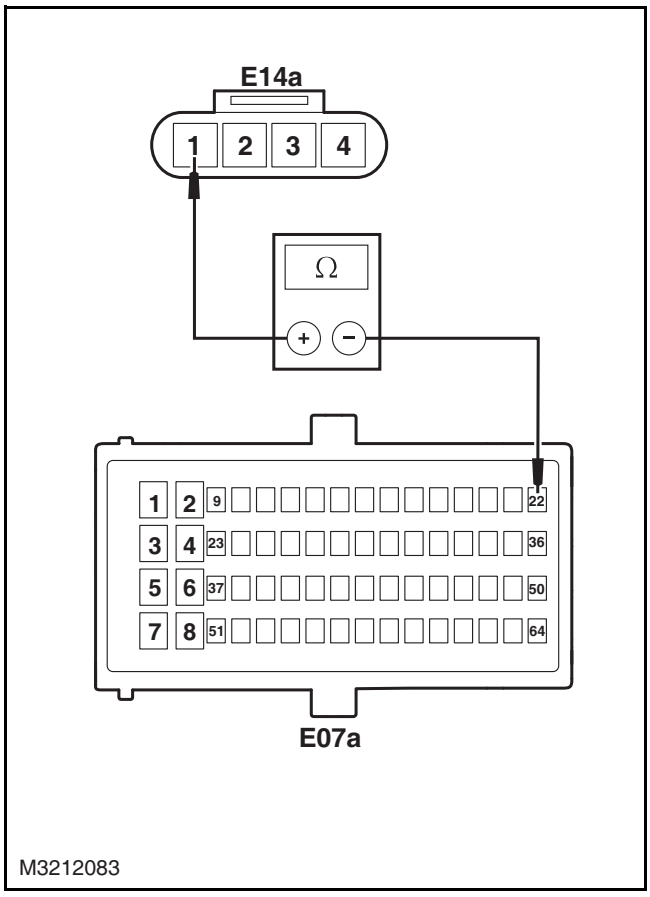


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the stepper motor wiring harness connector E14a for looseness or poor contact.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect idling stepper motor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the idling stepper motor wiring harness connector E14a.<br>C. Measure the resistance of idling stepper motor.<br>**Standard resistance:**<br>53 ± 5.3 Ω between terminals A and D, B and C<br>10 MΩ or more between terminals A and C, B and D<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the idling stepper motor. |

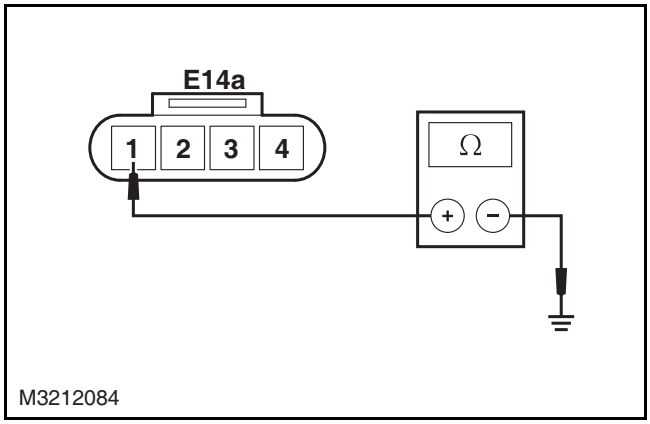
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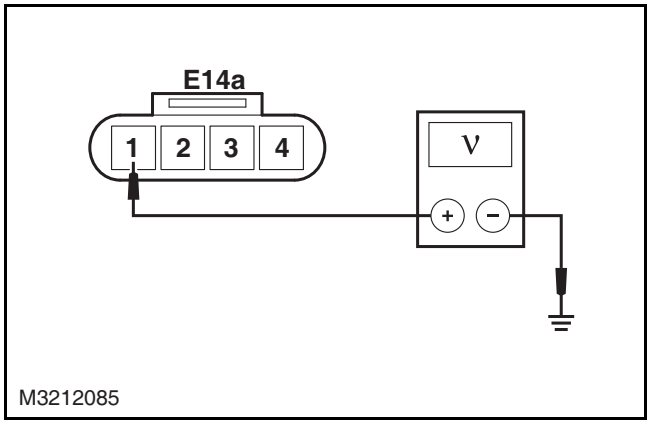
| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect wiring harness connectors (terminal 1 of idling stepper motor E14a - terminal 22 of ECM E07a) | |




M3212083




M3212084




M3212085

A. Turn the ignition switch to "LOCK".

B. Disconnect the idling stepper motor wiring harness connector E14a.

C. Disconnect the engine control module wiring harness connector E07a.

D. Measure the resistance between terminal 1 of idling stepper motor wiring harness connector E14a and terminal 22 of engine control module wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 1 of idling stepper motor wiring harness connector E14a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 1 of idling stepper motor wiring harness connector E14a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

Go to step 4.

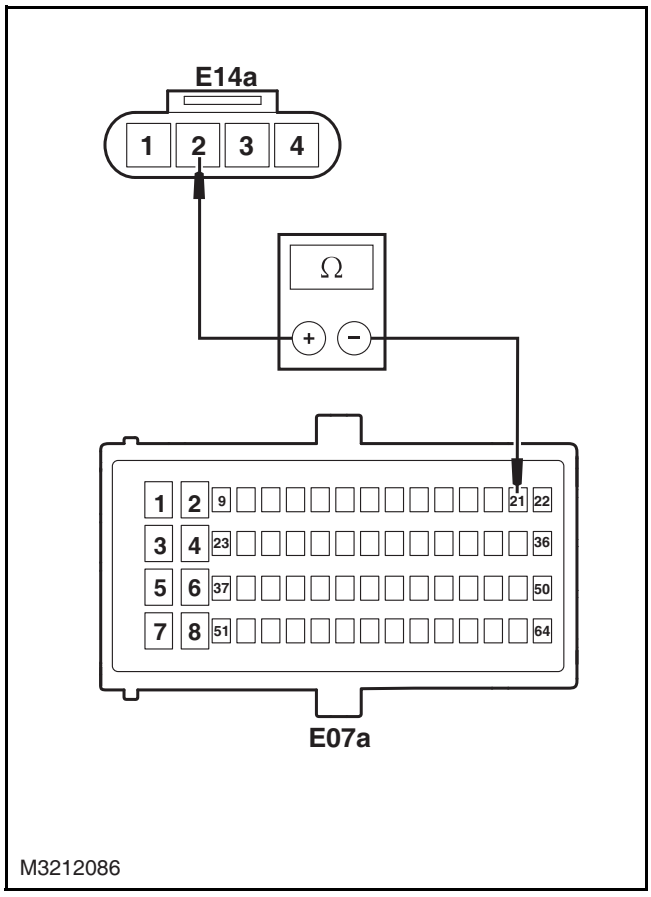
**No**

Repair the fault circuit between terminal 1 of idling stepper motor wiring harness connector E14a and terminal 22 of engine control module wiring harness connector E07a.

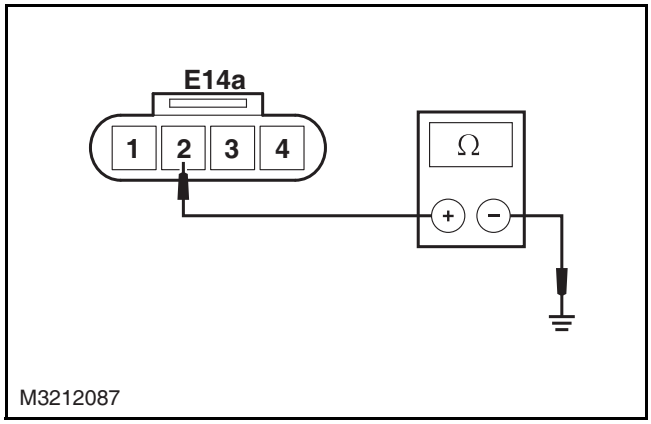
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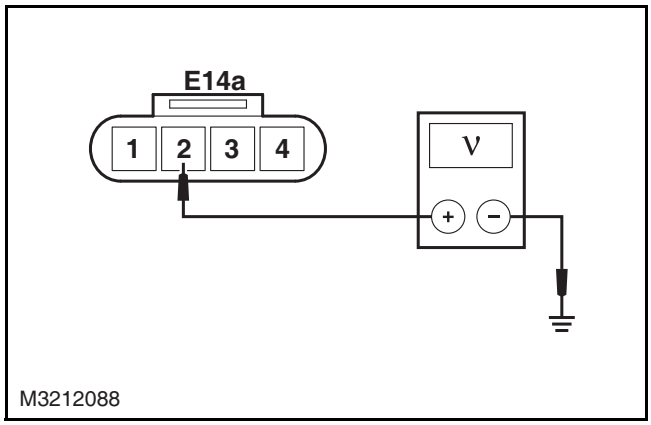
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect wiring harness connectors (terminal 2 of idling stepper motor E14a - terminal 21 of ECM E07a) | |




M3212086




M3212087




M3212088

A. Turn the ignition switch to "LOCK".

B. Disconnect the idling stepper motor wiring harness connector E14a.

C. Disconnect the engine control module wiring harness connector E07a.

D. Measure the resistance between terminal 2 of idling stepper motor wiring harness connector E14a and terminal 21 of engine control module wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 2 of idling stepper motor wiring harness connector E14a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 2 of idling stepper motor wiring harness connector E14a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

Go to step 5.

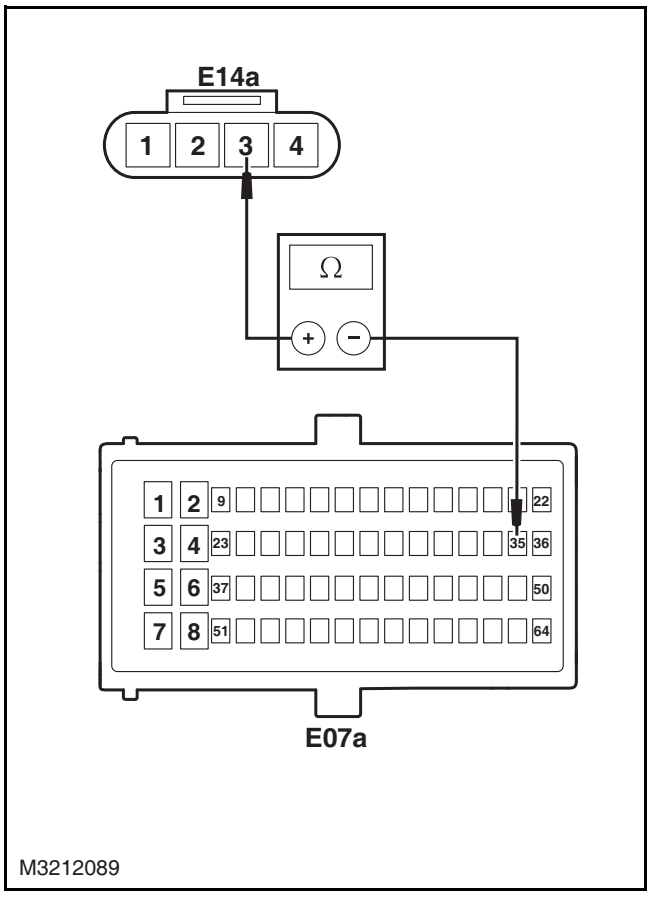
**No**

Repair the fault circuit between terminal 2 of idling stepper motor wiring harness connector E14a and terminal 21 of engine control module wiring harness connector E07a.

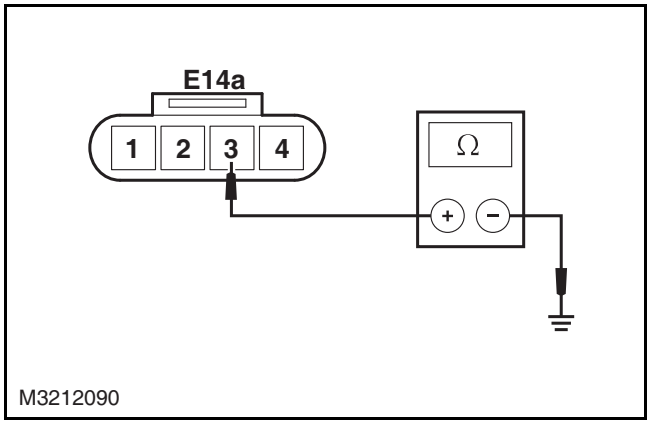
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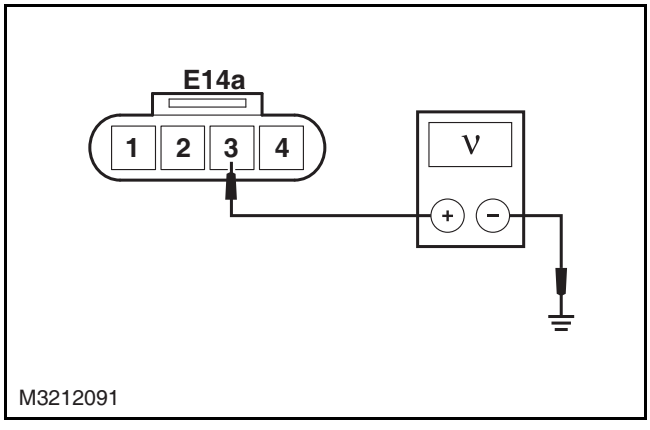
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect wiring harness connectors (terminal 3 of idling stepper motor E14a - terminal 35 of ECM E07a) | |




M3212089




M3212090




M3212091

A. Turn the ignition switch to "LOCK".

B. Disconnect the idling stepper motor wiring harness connector E14a.

C. Disconnect the engine control module wiring harness connector E07a.

D. Measure the resistance between terminal 3 of idling stepper motor wiring harness connector E14a and terminal 35 of engine control module wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 3 of idling stepper motor wiring harness connector E14a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 3 of idling stepper motor wiring harness connector E14a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

Are they normal?

**Yes**

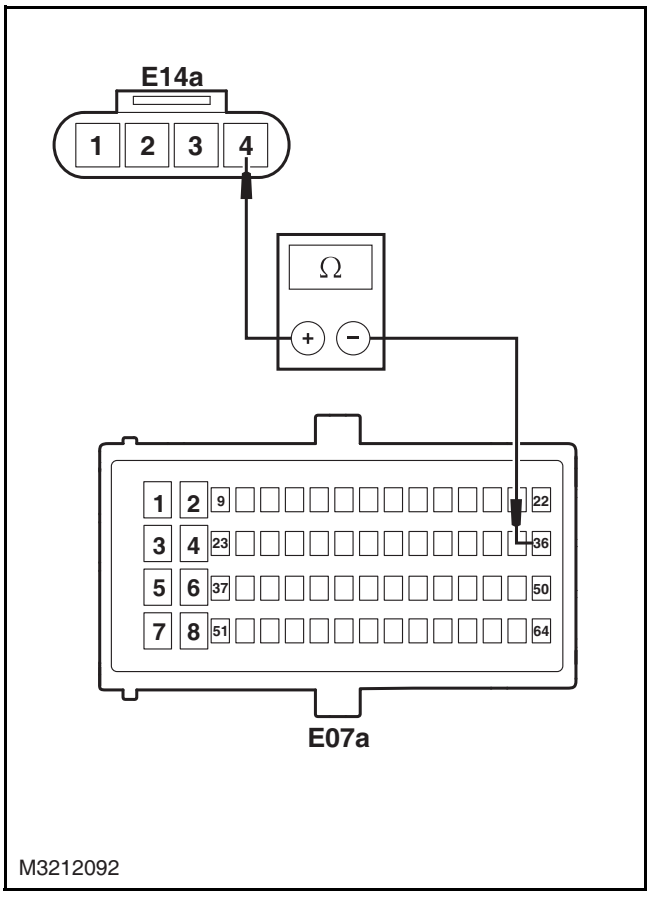
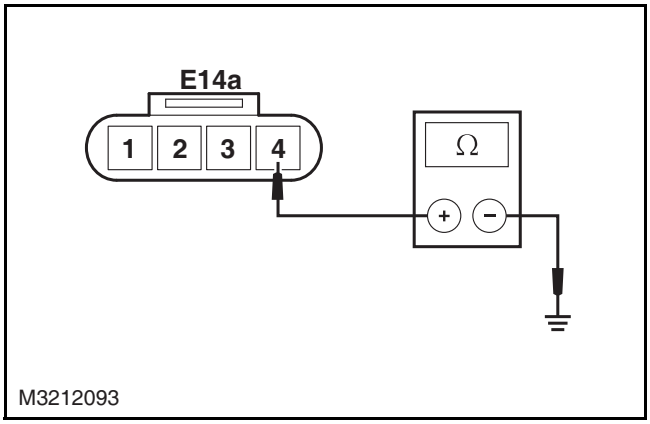
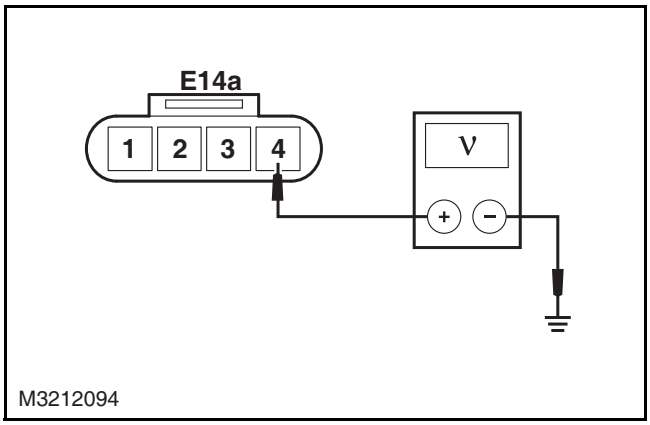
Go to step 6.

**No**

Repair the fault circuit between terminal 3 of idling stepper motor wiring harness connector E14a and terminal 35 of engine control module wiring harness connector E07a.

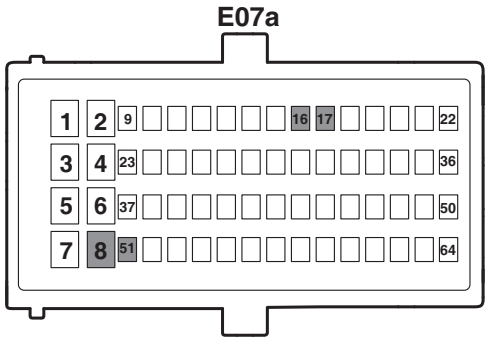
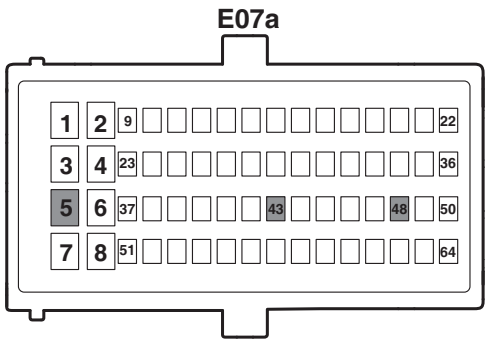
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect wiring harness connectors (terminal 4 of idling stepper motor E14a - terminal 36 of ECM E07a) | |
|  M3212092 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the idling stepper motor wiring harness connector E14a.<br>C. Disconnect the engine control module wiring harness connector E07a.<br>D. Measure the resistance between terminal 4 of idling stepper motor wiring harness connector E14a and terminal 36 of engine control module wiring harness connector E07a. Inspect for open circuit.<br>**Standard resistance: less than 5 Ω**<br>E. Measure the resistance between terminal 4 of idling stepper motor wiring harness connector E14a and reliable grounding. Inspect for short to ground.<br>**Standard resistance: 10 MΩ or more**<br>F. Measure the voltage between terminal 4 of idling stepper motor wiring harness connector E14a and reliable grounding. Inspect for short to power supply.<br>**Standard voltage: 0 V**<br>Are they normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Repair the fault circuit between terminal 4 of idling stepper motor wiring harness connector E14a and terminal 36 of engine control module wiring harness connector E07a. |
|  M3212093 | |
|  M3212094 | |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0560, P0562, P0563

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0560 | System Voltage Malfunction | ECM power supply consists of the following circuits:<br>Through the ECM fuse, constant battery power is supplied to ECM via the terminal 16 of ECM wiring harness connector E07a.<br>When the ignition switch is turned to "ON", the fuse IF37 supplies power to terminal 17 of engine control module wiring harness connector E07a.<br>• When ECM detects battery voltage at terminal 17 of ECM wiring harness connector E07a, it controls the main relay to close by internal grounding of E07a terminal 32.<br>• After the main relay is closed, the power from battery supply main relay IR05 is supplied to ECM via E07a terminals 8, 51. |
| P0562 | System Voltage Low Voltage | |
| P0563 | System Voltage High Voltage | |

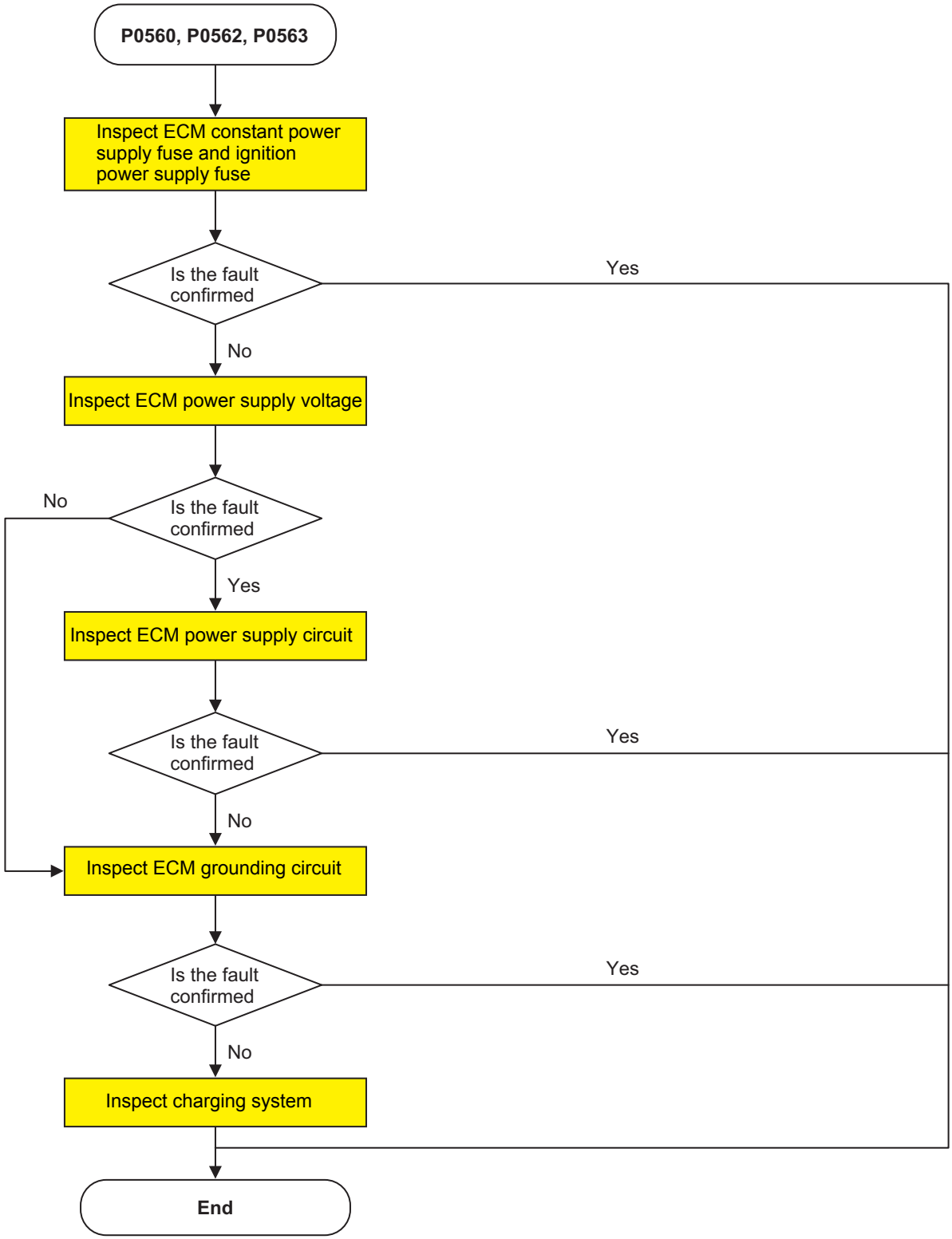
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0560 | Implausibility check | • ADC value of battery voltage is lower than 2.5 V | • Battery<br>• ECM power supply and grounding circuit<br>• Charging system |
| P0562 | Lower limit value exceeded | • Starting time is more than 180 s<br>• ADC value of battery voltage is higher than 2.5 V, lower than 10.02 V | |
| P0563 | Upper limit value exceeded | • ADC value of battery voltage is higher than 17.02 V for 0.2 s<br>• Vehicle speed is greater than 25 km/h<br>• Starting time is more than 180 s | |

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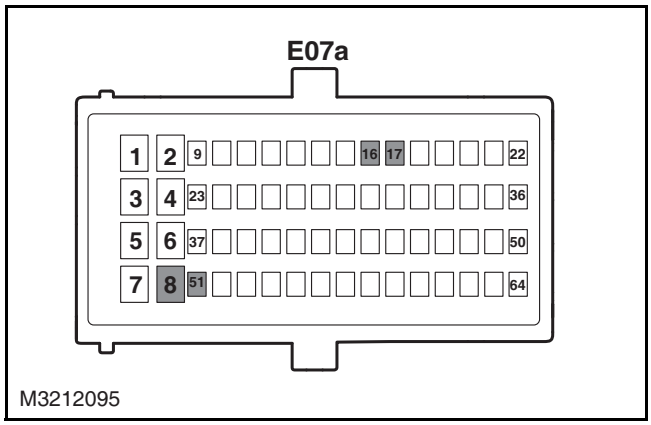


### 3. Diagnosis Procedure



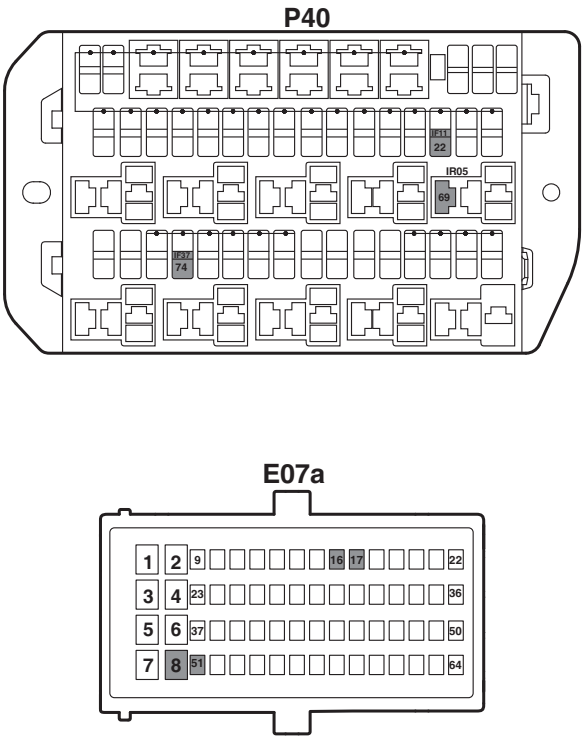
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect ECM constant power supply fuse and ignition power supply fuse | |
| | A. Turn the ignition switch to "LOCK".<br>B. Remove the ECM constant power supply fuse IF11 and ignition power supply fuse IF37 from the instrument panel fuse box P40.<br>C. Inspect the conductivity between two terminals of fuses with the multimeter.<br>Are the fuses normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the fuses. Verify that the system is normal. |
| 2. Inspect ECM power supply voltage | |
|  <br>M3212095 | A. Turn the ignition switch to "ON".<br>Make sure the main relay operates normally, or replace it.<br>B. Measure the voltages between terminals 16, 17, 8, 51 of ECM wiring harness connector E07a and reliable grounding from the backside.<br>**Standard voltage: 11 ~ 14 V**<br>Are the voltage values normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 3. |

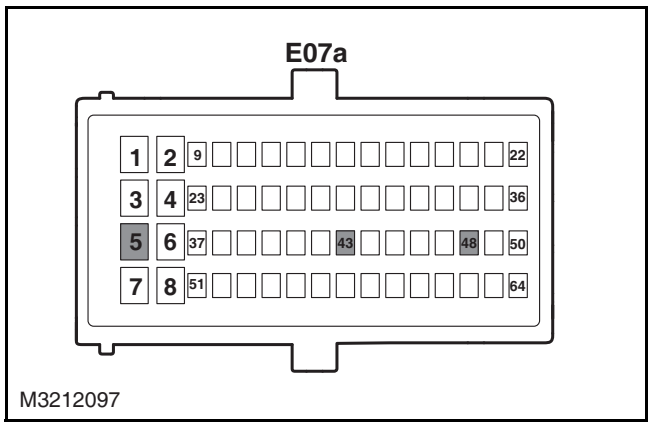
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect ECM power supply circuit | |
|  <br>M3212096 | A. Turn the ignition switch to "LOCK".<br>B. Remove the ECM constant power supply fuse IF11.<br>C. Remove the main relay IR05.<br>D. Measure the resistance between terminal 22 of ECM constant power supply fuse IF11 and terminal 16 of ECM wiring harness connector E07a.<br>**Standard resistance: less than 5 Ω**<br>E. Measure the resistance between terminal 74 of fuse IF37 in the instrument panel fuse box P40 and terminal 17 of ECM wiring harness connector E07a.<br>**Standard resistance: less than 5 Ω**<br>F. Measure the resistances between terminal 69 of main relay IR05 and terminals 8, 51 of ECM wiring harness connector E07a.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair related circuit. Make sure the system is normal. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect ECM grounding circuit | |
|  M3212097 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the ECM wiring harness connector E07a.<br>C. Measure the resistances between terminals 5, 43, 48 of ECM wiring harness E07a and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Are the resistance values normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair the fault circuit between terminal 5 of ECM wiring harness connector E07a and grounding point G301, or between terminals 43, 48 of E07a and grounding point G302. |
| 5. Inspect charging system | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the battery voltage.<br>**Standard voltage: 11 ~ 14 V**<br>C. Start and run the engine to the normal temperature, turn off all equipment, and change the engine speed from idle speed to 4000 rpm.<br>D. Inspect the engine charging voltage.<br>**Standard voltage: 11.5 ~ 14.5 V**<br>Is the voltage value normal?<br>**Yes**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).**<br>**No**<br>Repair battery or charging system fault. |

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# DTC P0602

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0602 | Control Module Programming Error | ECM internal program processing fault, ECM power supply and grounding abnormal. |

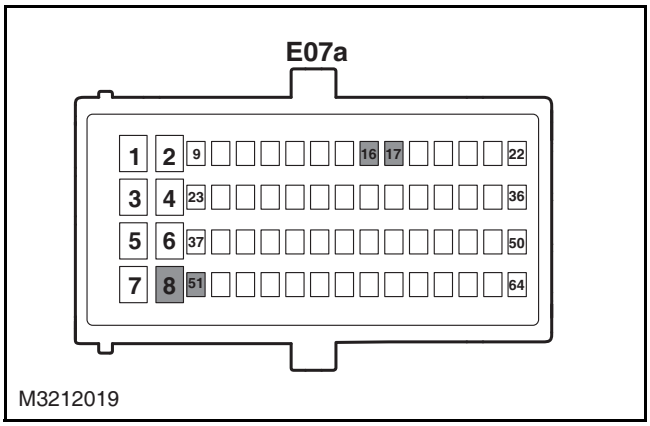
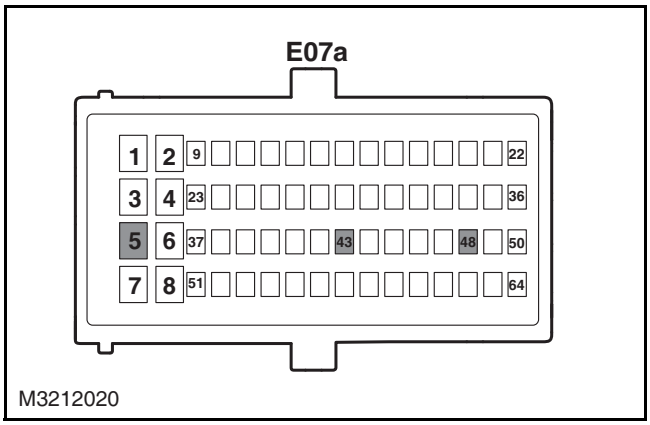
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0602 | Diagnose the Diagnostic Data Identification (DDI) code programming | - | • ECM circuit<br>• ECM |

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### 3. Diagnosis Procedure

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect DTC | |
| | A. Connect the diagnostic tool to data link connector.<br>B. Turn the ignition switch to "ON".<br>C. Diagnose the engine system.<br>Is there any DTC other than P0602?<br>**Yes**<br>Repair the DTC other than P0602.<br>**No**<br>Go to step 2. |
| 2. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P0627, P0628, P0629

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0627 | Fuel Pump "A" Control Circuit/ Open | Working power of oil pump relay coil is supplied by main relay controlled by ECM. ECM controls the grounding of terminal 80 of oil pump relay IR08 via terminal 60 of ECM wiring harness connector E07a to close the oil pump relay. There is a drive circuit in the ECM to control the relay coil grounding. The drive circuit provides a feedback circuit to ECM, and ECM determines if an open circuit, short to ground or power supply occurs in control circuit by monitoring the feedback voltage. |
| P0628 | Fuel Pump "A" Control Circuit Low | |
| P0629 | Fuel Pump "A" Control Circuit High | |

## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0627 | Hardware circuit inspection | Open circuit | • Relay<br>• Relay circuit<br>• ECM |
| P0628 | | Short to ground | |
| P0629 | | Short to power supply | |

## 3. Diagnosis Procedure

**Refer to: Diagnosis Procedure for Fuel Pump Failure (3.2.7 Fuel System, Symptom Diagnosis and Testing).**

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# DTCs P0645, P0646, P0647

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0645 | A/C Clutch Relays Circuit | Working power of A/C compressor relay is supplied by main relay controlled by ECM. ECM controls the internal grounding of A/C compressor relay via terminal 61 of ECM wiring harness connector E07a to close the relay. There is a drive circuit in the ECM to control the relay coil grounding. The drive circuit provides a feedback circuit to ECM, and ECM determines if an open circuit, short to ground or power supply occurs in control circuit by monitoring the feedback voltage. |
| P0646 | A/C Clutch Relay Control Circuit Low | |
| P0647 | A/C Clutch Relay Control Circuit High | |

## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0645 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Relay<br>• Relay circuit<br>• ECM |
| P0646 | | | |
| P0647 | | | |

## 3. Diagnosis Procedure

**Refer to: Diagnosis Procedure for A/C Compressor Clutch Fault (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing).**

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# DTC P0650

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P0650 | Malfunction Indicator Lamp Control Circ. | Engine malfunction indicator lamp is controlled by ECM. When ECM detects engine malfunction, it sets DTC and turns on MIL by setting it at low potential via special line. |

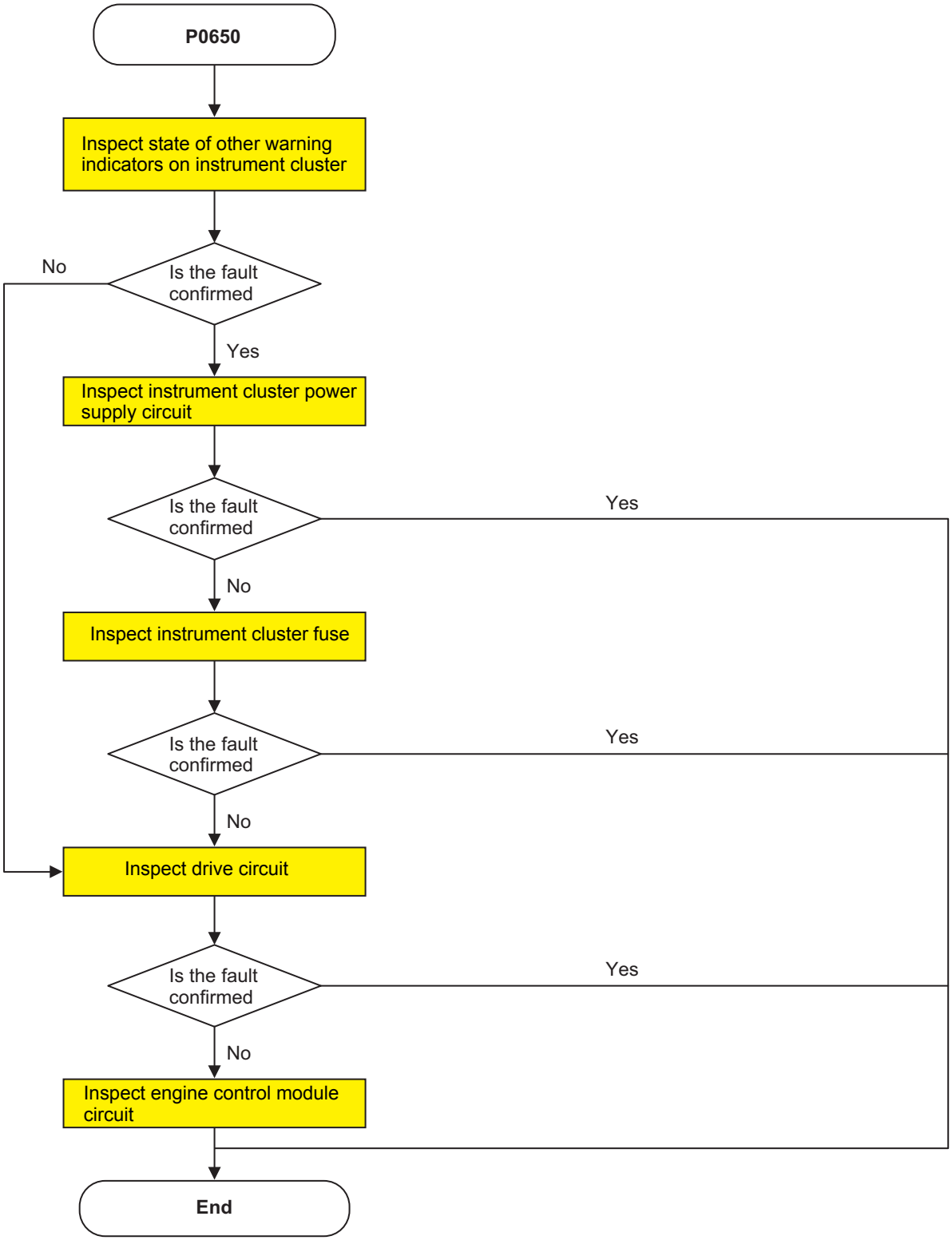
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P0650 | Hardware circuit inspection | • Open circuit<br>• Short to ground<br>• Short to power supply | • Instrument cluster<br>• MIL circuit<br>• ECM |

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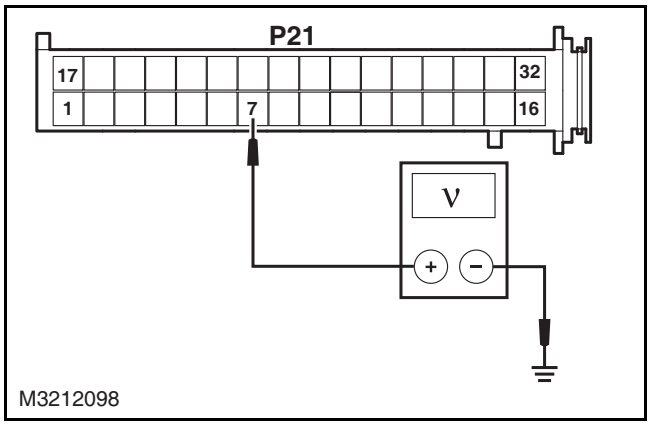


### 3. Diagnosis Procedure



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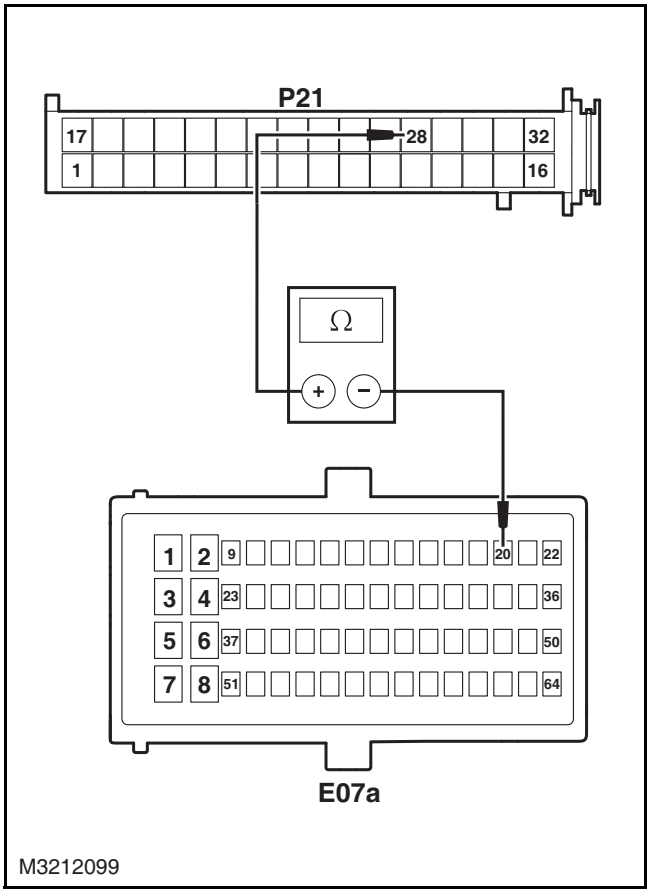


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect state of other warning indicators on instrument cluster | |
| | A. Turn the ignition switch to "ON".<br>B. Inspect the status of all the warning indicators.<br>Is there any other warning indicator abnormal besides MIL indicator?<br>**Yes**<br>Go to step 2.<br>**No**<br>Go to step 4. |
| 2. Inspect instrument cluster power supply circuit | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 7 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the instrument cluster. Make sure the system is normal.<br>**No**<br>Go to step 3. |
| 3. Inspect instrument cluster fuse | |
| | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument cluster fuse IF35 from the instrument panel fuse box P40.<br>C. Inspect the conductivity between two terminals of fuse with the multimeter.<br>Is the fuse normal?<br>**Yes**<br>Inspect and repair the fault circuit between terminal 7 of instrument cluster wiring harness connector P21 and fuse IF35.<br>**No**<br>Replace the fuse. Verify that the system is normal. |

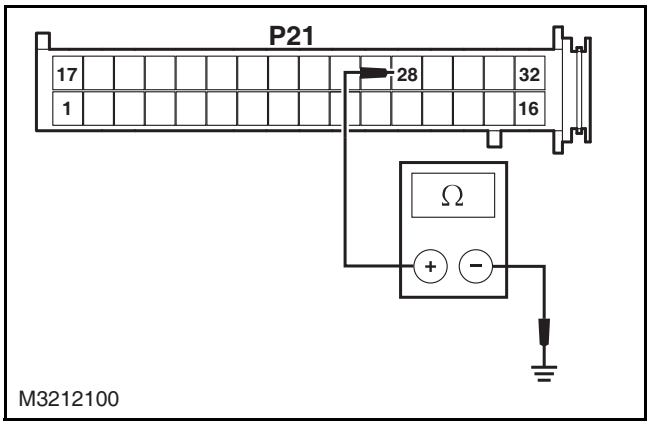
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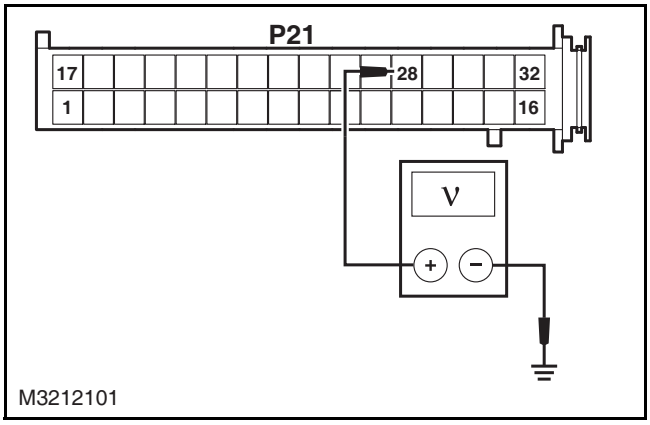
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect drive circuit | |




M3212099




M3212100




M3212101

A. Turn the ignition switch to "LOCK".

B. Disconnect the instrument cluster wiring harness connector P21.

C. Disconnect the engine control module wiring harness connector E07a.

D. Measure the resistance between the terminal 28 of instrument cluster wiring harness connector P21 and terminal 20 of engine control module wiring harness connector E07a.

**Standard resistance: less than 5 Ω**

E. Measure the resistance between terminal 28 of instrument cluster wiring harness connector P21 and reliable grounding.

**Standard resistance: 10 MΩ or more**

F. Measure the voltage between terminal 28 of instrument cluster wiring harness connector P21 and reliable grounding.

**Standard voltage: 0 V**

Are they normal?

**Yes**

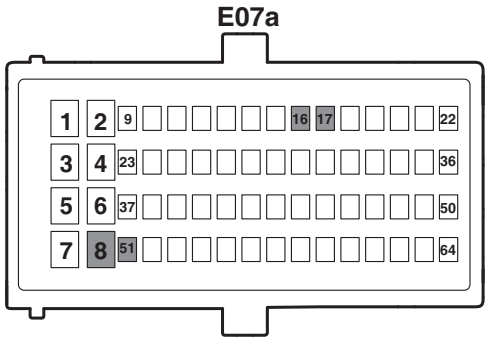
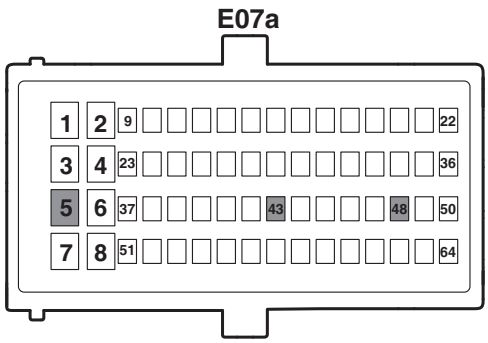
Go to step 5.

**No**

Repair the fault circuit between terminal 28 of instrument panel wiring harness connector P21 and terminal 20 of engine control module wiring harness connector E07a.

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect engine control module circuit | |
|  M3212019<br>  M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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# DTCs P2177, P2178, P2187, P2188

## 1. DTC Description

| DTC Code | Description | Definition |
|---|---|---|
| P2177 | System Too Lean Off Idle | Engine Control Module (ECM) controls closed loop air-fuel ratio measuring system, achieving best cooperation of drivability, fuel economy and emission control. In closed loop mode, ECM monitors the signal voltage of heated oxygen sensor (HO2S) and regulates the fuel supply according to the signal voltage.<br>Changes in fuel supply will change the fuel trim values of long term and short term. The fuel short term trim value will change rapidly, responding to the change of heated oxygen sensor signal voltage. These changes will finely tune the engine fuel supply. The fuel long term trim value changes in response to the fuel short term trim trend. The fuel long term trim adjusts fuel supply roughly, in order to return to the short term center fuel value, and to recover the control to fuel short term trim.<br>Ideal value of the fuel trim is about 0%. If the fuel trim value is positive, it shows the engine control module is increasing fuel to compensate the condition that the fuel mixture is too lean. If the fuel trim value is negative, it shows the engine control module is decreasing fuel to compensate the condition that the fuel mixture is too rich. |
| P2178 | System Too Rich Off Idle | |
| P2187 | System Too Lean at Idle | |
| P2188 | System Too Rich at Idle | |

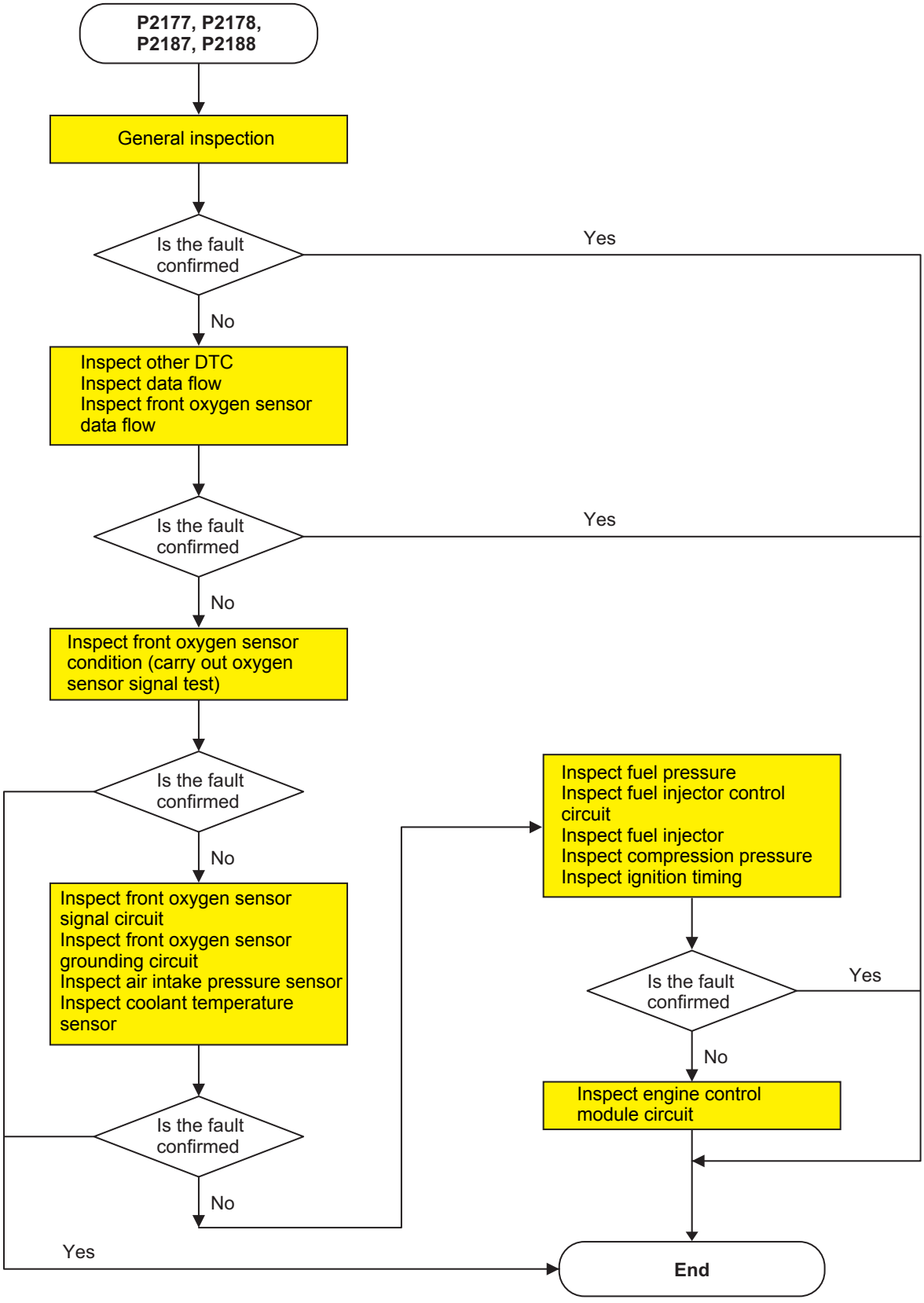
## 2. Possible Causes

| DTC Code | Monitor Strategy | Setting Conditions (Control Strategy) | Faulty Area |
|---|---|---|---|
| P2177 | Fuel trim high limits exceeded | • Multiplicative adaption value is more than 1.23 for 25 s<br>• Air-fuel ratio adaption on<br>• Engine speed is 1400 ~ 4000 rpm<br>• Air mass flow is 18 ~ 70 kg/h<br>• Load is 16% ~ 70% | • Air intake pressure sensor<br>• Oxygen sensor<br>• Sensor circuit<br>• Coolant temperature sensor<br>• Fuel pressure<br>• Fuel injector and control circuit<br>• Engine mechanical<br>• ECM |
| P2178 | Fuel trim low limits exceeded | • Multiplicative adaption value is less than 0.77 for 25 s<br>• Air-fuel ratio adaption on<br>• Engine speed is 1400 ~ 4000 rpm<br>• Air mass flow is 18 ~ 70 kg/h<br>• Load is 16% ~ 70% | |
| P2187 | - | - | |
| P2188 | - | - | |

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### 3. Diagnosis Procedure



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the oxygen sensor, air intake pressure/ temperature sensor, engine coolant temperature sensor wiring harness connector for damage, poor contact, aging, looseness and so on.<br>B. Inspect the vacuum tube for damage, looseness or leakage.<br>C. Inspect the air intake system for leakage.<br>D. Inspect for contamination that may damage the oxygen sensor: dirty fuel, unqualified silicone, oil and coolant.<br>E. Inspect the engine PCV (Positive Crankcase Ventilation) system.<br>F. Inspect the engine exhaust system for blockage or leakage.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault, and verify that the system is normal. |
| 2. Inspect other DTC | |
| | A. Connect the diagnostic tool.<br>B. Start the engine and diagnose the engine system.<br>C. Inspect DTC.<br>Is there any DTC other than P2177, P2178, P2187 and P2188?<br>**Yes**<br>Go to DTC diagnosis procedure.<br>**No**<br>Go to step 3. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect data flow | |
| | A. Connect the diagnostic tool.<br>B. Start engine and access to the engine system data flow on diagnostic tool.<br>C. Inspect the long, short and final long term fuel trim values.<br>Are the values normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>**Refer to: Intermittent Malfunction Diagnosis Procedure (3.2.12 Electronic Control System - M7, Symptom Diagnosis and Testing).** |
| 4. Inspect front oxygen sensor data flow | |
| | A. Start the engine, and run it till the engine coolant temperature reaches above 80°C.<br>B. Use diagnostic tool to enter engine data flow, and observe the "O2 sensor voltage bank 1, sensor 1" parameter.<br>**Standard voltage: fluctuates between 0.1 ~ 0.9 V.**<br>C. Turn the ignition switch to "LOCK" after measurement.<br>Does the voltage of oxygen sensor fluctuate between 0.1 ~ 0.9 V?<br>**Yes**<br>Go to step 8.<br>**No**<br>Go to step 5. |

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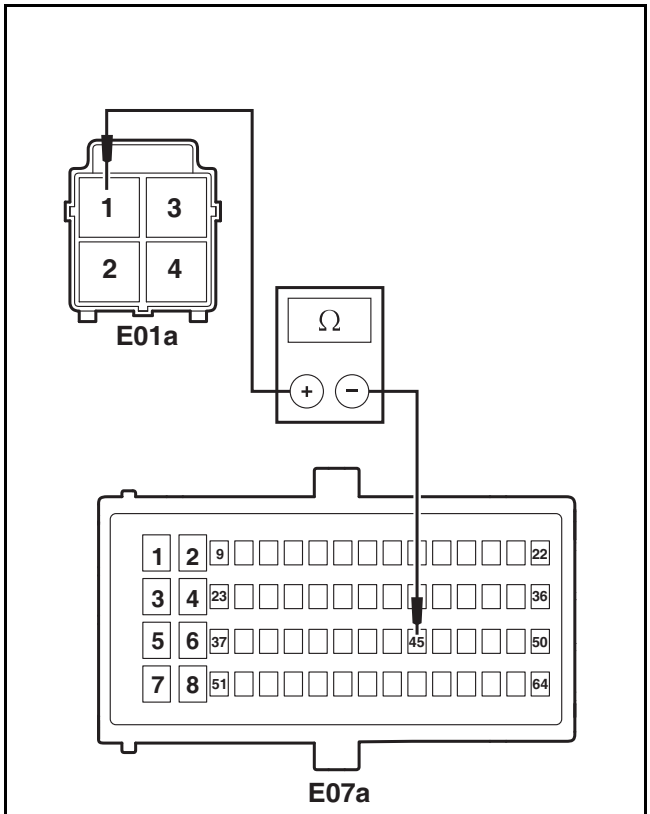


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect front oxygen sensor condition (carry out oxygen sensor signal test) | |
| | A. If the voltage displayed in data flow remains below 0.45 V (mixture too lean), inspect according to the following steps:<br>• Jet a proper amount of propane into the intake port.<br>• Observe if the front oxygen sensor voltage in data flow changes obviously and the signal voltage rises quickly.<br>B. If the voltage displayed in data flow remains above 0.45 V (mixture too rich), inspect according to the following steps:<br>• Position the transmission at neutral gear.<br>• Apply the parking brake.<br>• Depress the accelerator pedal until the engine speed suddenly increases to 4000 rpm and then quickly release the accelerator pedal.<br>• Repeat the previous step more than 3 times.<br>• Observe if the front oxygen sensor voltage in data flow changes obviously and the signal voltage drops quickly.<br>In the implementation of above test, the oxygen sensor signal voltage should change significantly as the test continues.<br>Does it change significantly?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the front oxygen sensor.<br>**Refer to: Front Oxygen Sensor (3.2.12 Electronic Control System - M7, Removal and Installation).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect front oxygen sensor signal circuit | |




M3212102

A. Inspect the front oxygen sensor signal circuit.

B. Turn the ignition switch to "LOCK".

C. Disconnect the front oxygen sensor wiring harness connector E01a.

D. Disconnect the ECM wiring harness connector E07a.

E. Measure the resistance between terminal 1 of front oxygen sensor wiring harness connector E01a and terminal 45 of ECM wiring harness connector E07a. Inspect for open circuit.

**Standard resistance: less than 5 Ω**

F. Measure the resistance between terminal 1 of front oxygen sensor wiring harness connector E01a and reliable grounding. Inspect for short to ground.

**Standard resistance: 10 MΩ or more**

G. Measure the voltage between terminal 1 of front oxygen sensor wiring harness connector E01a and reliable grounding. Inspect for short to power supply.

**Standard voltage: 0 V**

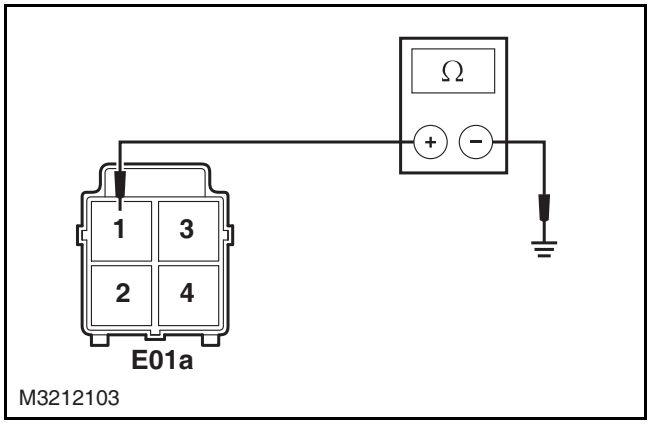
Is it normal?

**Yes**

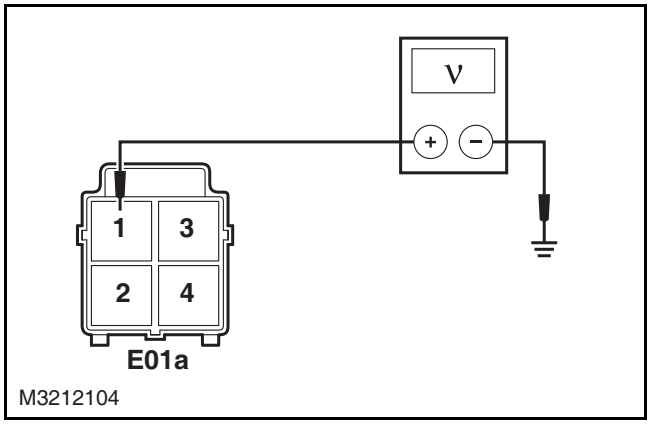
Go to step 7.

**No**

Repair the fault circuit between terminal 1 of front oxygen sensor wiring harness connector E01a and terminal 45 of ECM wiring harness connector E07a.



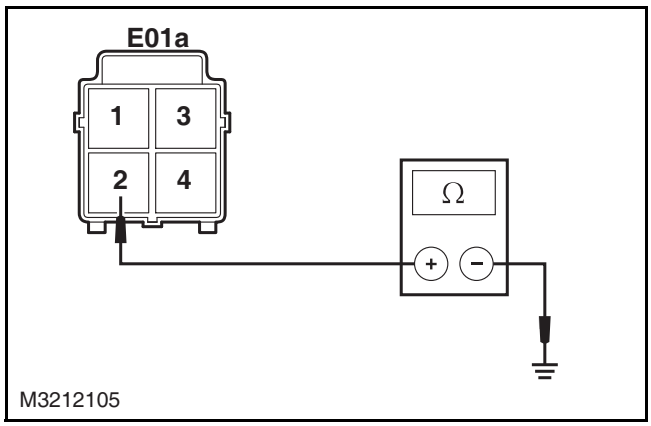

M3212103




M3212104

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect front oxygen sensor grounding circuit | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front oxygen sensor wiring harness connector E01a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the resistance between terminal 2 of E01a and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the fault circuit between terminal 2 of front oxygen sensor wiring harness connector E01a and terminal 39 of ECM wiring harness connector E07a. |
| 8. Inspect air intake pressure sensor | |
| | A. Turn the ignition switch to "LOCK".<br>B. Connect a vacuum gauge to the intake manifold vacuum source.<br>C. Start the engine and idle it.<br>D. Read the "Actual intake manifold pressure" data flow with the diagnostic tool.<br>Is the difference between readings on the diagnostic tool and vacuum gauge within 1 in (25 mm)?<br>**Yes**<br>Go to step 9.<br>**No**<br>Replace the air intake pressure/temperature sensor, and clean the throttle and intake manifold. Verify that the system is normal. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect coolant temperature sensor | |
| | **CAUTION: To make the test effective, the thermostat should work normally.**<br><br>**CAUTION: Carry out this test when the engine is cold (cool it to the ambient temperature).**<br><br>A. Turn the ignition switch to "ON" with engine not running.<br>B. Use the diagnostic tool to read the value of engine coolant temperature (ECT) sensor. The temperature should be close to the ambient temperature.<br>C. Start the engine.<br>When the engine is warmed up, monitor the ECT sensor value. Changes from start to normal operating temperature (82°C (180°F)) should be stable.<br>This value should be at least 82°C (180°F).<br>Is it normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Replace the coolant temperature sensor. |
| 10. Inspect fuel pressure | |
| | A. Turn the ignition switch to "LOCK".<br>B. Measure the fuel pressure.<br>**Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**<br>Is the fuel pressure normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Inspect the fuel system fault.<br>**Refer to: Low Pressure in Fuel System (3.3.7 Fuel System, Symptom Diagnosis and Testing).** |

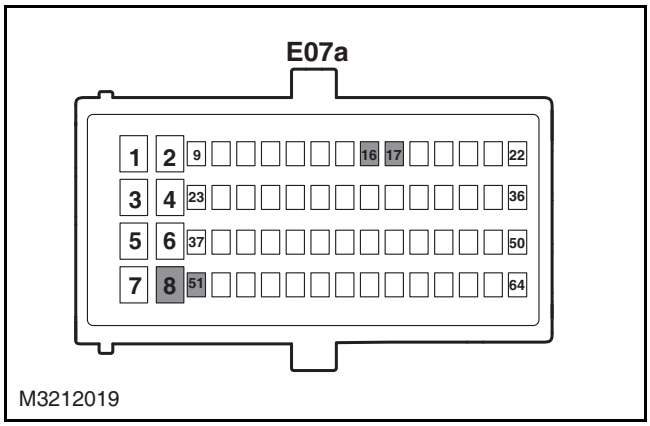
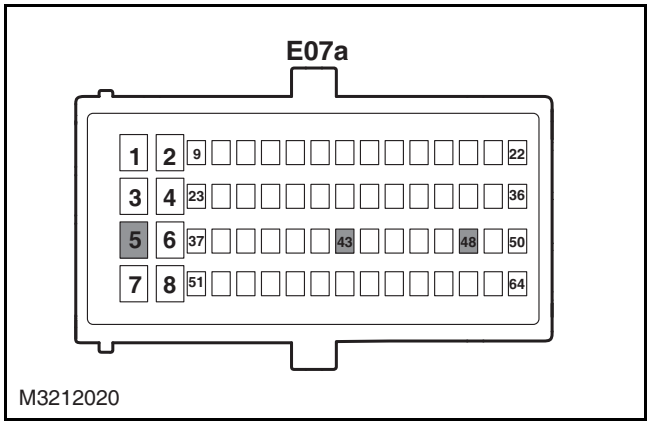
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 11. Inspect fuel injector control circuit | |
| | A. Disconnect the fuel injector wiring harness connector from the possible faulty cylinder.<br>B. Connect the test pen with LED to the fuel injector terminal.<br>**CAUTION: LED must connect with 1 ~ 2 kΩ resistor in series, otherwise the LED or ECM may be damaged.**<br>C. Inspect the LED state during engine start.<br>Does the LED flash?<br>**Yes**<br>Go to step 12.<br>**No**<br>Inspect the fuel injector wiring harness. Repair or replace if necessary. |
| 12. Inspect fuel injector | |
| | A. Remove the fuel injector.<br>B. Replace with a fuel injector in good condition.<br>C. Clear the DTC.<br>D. Start engine and carry out road test when necessary.<br>E. Diagnose the engine system.<br>Are there DTCs P2177, P2178, P2187 and P2188?<br>**No**<br>Replace the fuel injector.<br>**Yes**<br>Go to step 13. |
| 13. Inspect compression pressure | |
| | A. Inspect the engine compression pressure.<br>**Refer to: Cylinder Compression Pressure Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the compression pressure normal?<br>**Yes**<br>Go to step 14.<br>**No**<br>Inspect the cause of low compression pressure, and repair the fault. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 14. Inspect ignition timing | |
| | A. Inspect the ignition timing.<br>**Refer to: Timing Inspection (3.2.2 Mechanical System, General Inspection).**<br>Is the ignition timing normal?<br>**Yes**<br>Go to step 15.<br>**No**<br>Repair the ignition timing fault. Verify that the system is normal. |
| 15. Inspect engine control module circuit | |
|  <br>M3212019<br>  <br>M3212020 | A. Connect the ECM wiring harness connector, and turn the ignition switch to "ON".<br>B. Inspect if the power supply for terminals 8, 16, 17 and 51 is normal with the multimeter.<br>C. Turn the ignition switch to "LOCK". Inspect if the grounding for terminals 5, 43 and 48 is normal.<br>Is the engine control module circuit normal?<br>**Yes**<br>Replace the engine control module.<br>**Refer to: Engine Control Module (3.2.12 Electronic Control System - M7, Removal and Installation).**<br>**No**<br>Repair the circuit. |

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## Removal and Installation

# Engine Control Module

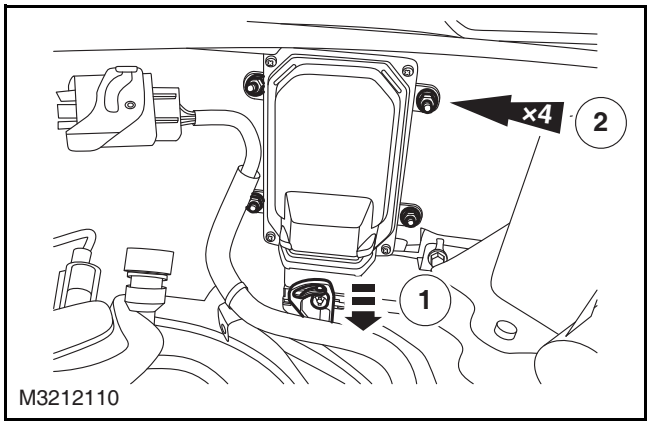
### Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Disconnect the engine control module wiring harness connector (1).
3. Remove the engine control module retaining nuts (2).

   Torque: 8 ± 2 Nm




### Installation

1. Installation is in the reverse order of removal.

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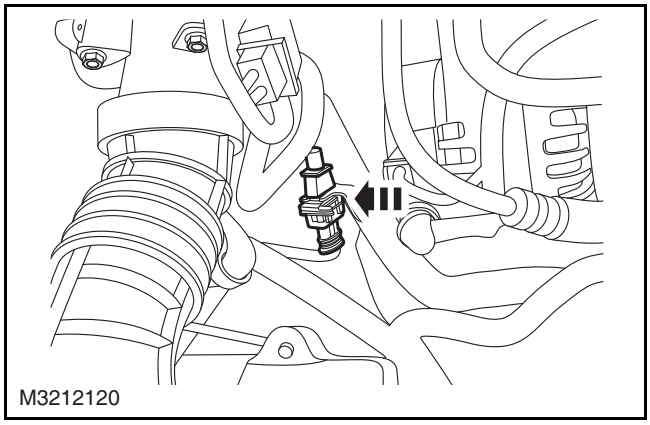
# Crankshaft Position Sensor

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Disconnect the crankshaft position sensor wiring harness connector.

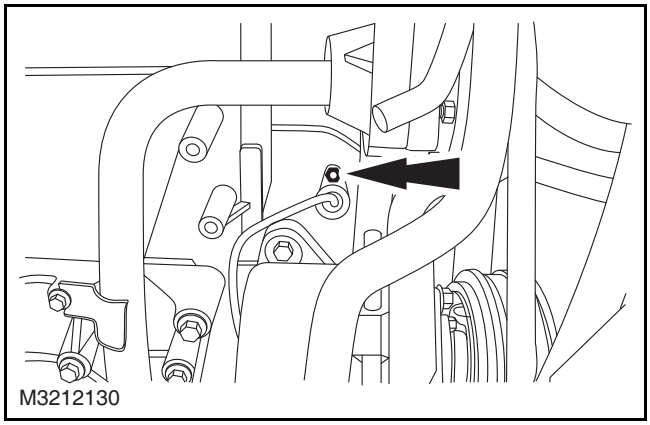

M3212120

3. Remove the air intake manifold.

   **Refer to: Intake Manifold (3.2.5 Air Intake System, Removal and Installation).**

4. Remove the crankshaft position sensor retaining bolt.

   Torque: 10 ± 2 Nm


M3212130

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Before installation, apply lubricant to the O-ring and press in the sensor with hands.**

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# Throttle Position Sensor

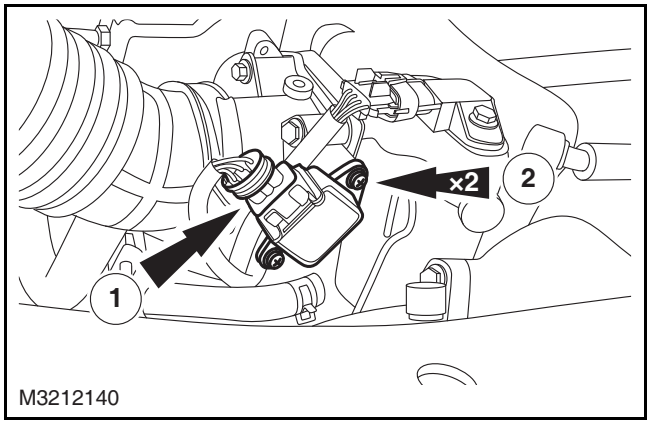
## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Disconnect the throttle position sensor wiring harness connector (1).
3. Remove 2 retaining bolts (2) from the throttle position sensor.

   Torque: 1.5 ~ 2.5 Nm



M3212140

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure the seal ring of sensor is fully inserted to the end and the wiring harness connector is set in place during installation.**

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# Idling Stepper Motor

## Removal

1. Disconnect the negative battery cable.

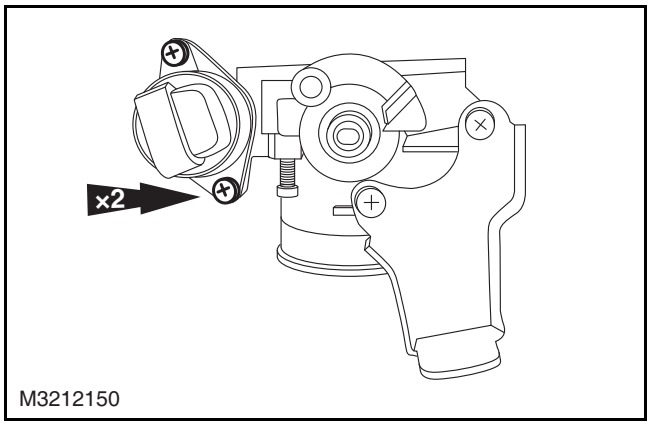
   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Remove the throttle body.

   **Refer to: Throttle Body (3.2.5 Air Intake System, Removal and Installation).**

3. Remove 2 retaining bolts from the idling stepper motor.

   Torque: 4 ± 0.4 Nm



M3212150

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Pulling or pushing the shaft of stepper motor is prohibited, or it will cause permanent damage.**

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# Coolant Temperature Sensor

## Removal

1. Disconnect the negative battery cable.

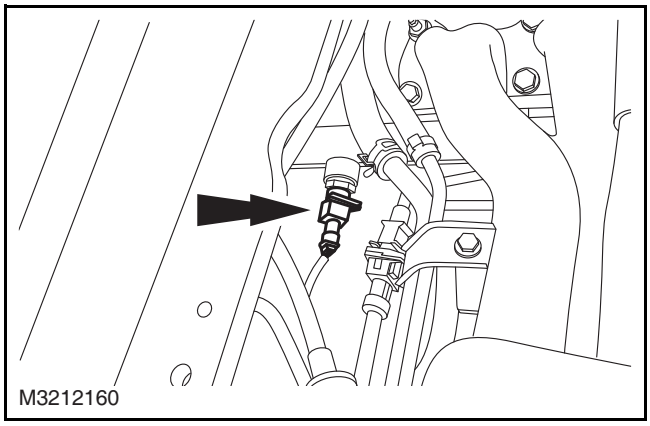
   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Drain the coolant.

   **Refer to: Coolant Draining and Filling (3.2.4 Cooling System, General Inspection).**

3. Disconnect the coolant temperature sensor connector.
4. Remove the coolant temperature sensor.

   Torque: 20 Nm or less




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure the sensor is fully inserted to the end and there is no coolant leakage.**

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# Air Intake Pressure/Temperature Sensor

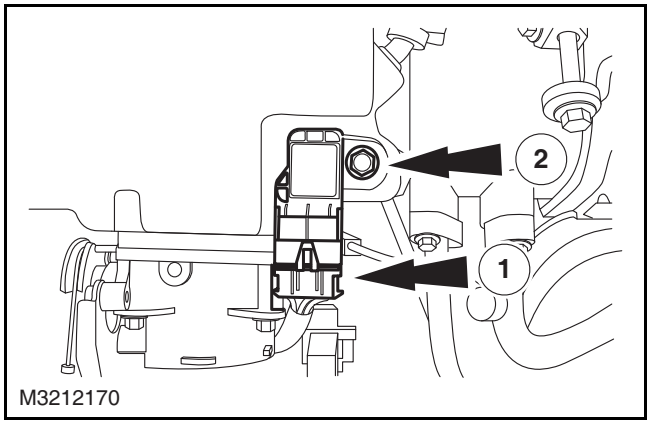
## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Disconnect the air intake pressure/temperature sensor wiring harness connector (1).
3. Remove the retaining bolt (2) from the air intake pressure/temperature sensor.

   Torque: 8 ± 2 Nm



M3212170

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Installing the sensor with any impactive tool (such as hammer) is prohibited. Avoid water, oil etc. entering the sensor.**

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# Fuel Injector

## Removal

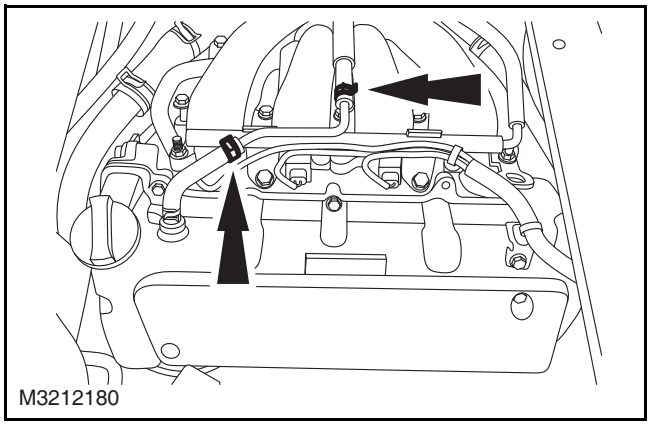
1. Release the fuel pressure.

   **Refer to: Fuel System Pressure Test (3.2.7 Fuel System, General Inspection).**

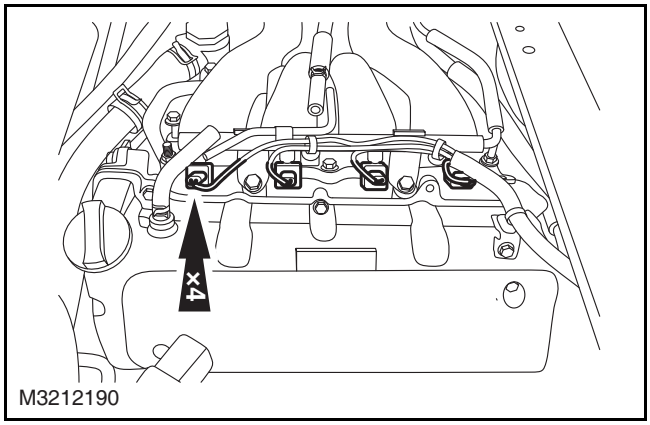
2. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

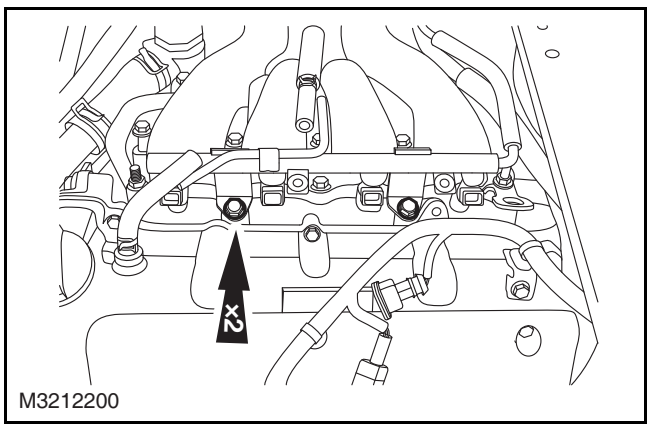
3. Disengage 2 clamps and separate 2 hoses.




4. Disconnect 4 connectors from the fuel injectors.



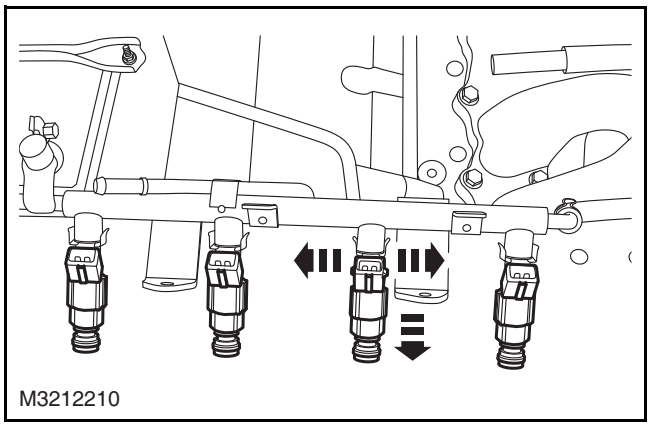

5. Remove 2 retaining bolts from the fuel rail and separate the fuel main pipe assembly from the cylinder block.



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6. Loosen the retaining clips from the fuel injector, and remove the fuel injector.


M3212210

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Replace the fuel injector clips and seal rings during installation.**
**Before assembly, it is necessary to apply clean lubricant to the injector lower seal ring. Prevent the lubricant contaminating the injector plate, and keep the injector mounting hole on the engine clean. Carefully install the fuel rail to the cylinder block with an even force in the axial direction of injector. Avoid applying excessive impact during assembly.**

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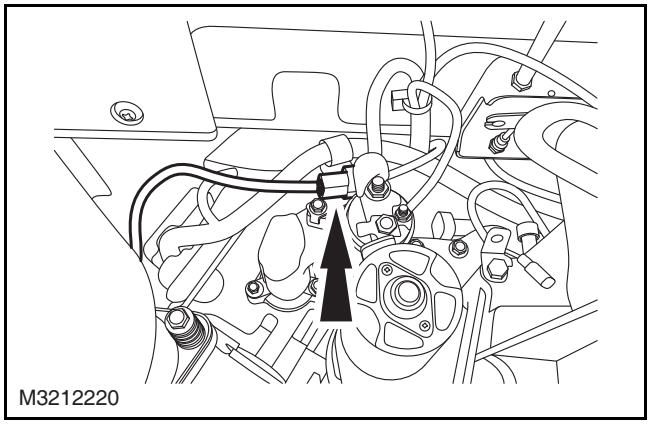
# Front Oxygen Sensor

## Removal

1. Disconnect the negative battery cable.

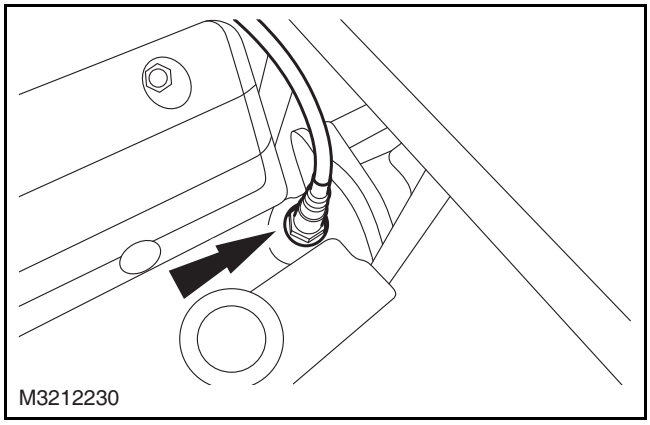
   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Disconnect the front oxygen sensor wiring harness connector.


M3212220

3. Remove the front oxygen sensor with a suitable tool.

   Torque: 50 ± 10 Nm


M3212230

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Applying washer fluid, oily liquid or volatile solid on the oxygen sensor is prohibited.**

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# Rear Oxygen Sensor

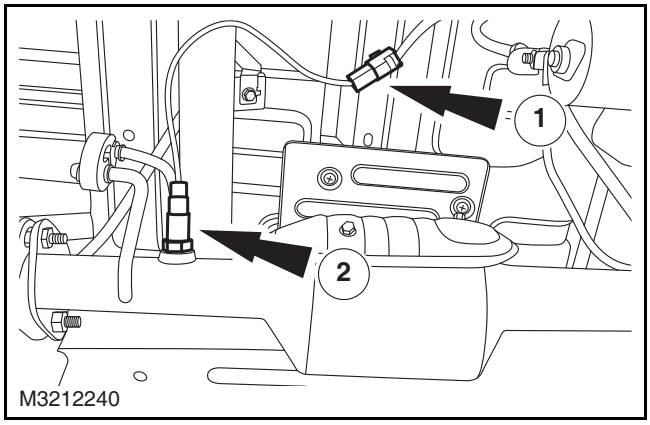
## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Disconnect the rear oxygen sensor wiring harness connector (1).
3. Remove the rear oxygen sensor (2) with a suitable tool.

   Torque: 50 ± 10 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Applying washer fluid, oily liquid or volatile solid on the oxygen sensor is prohibited.**

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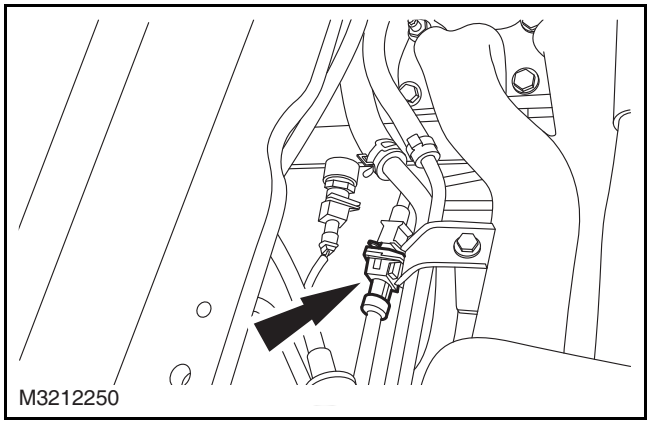
# Knock Sensor

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Disconnect the knock sensor wiring harness connector.

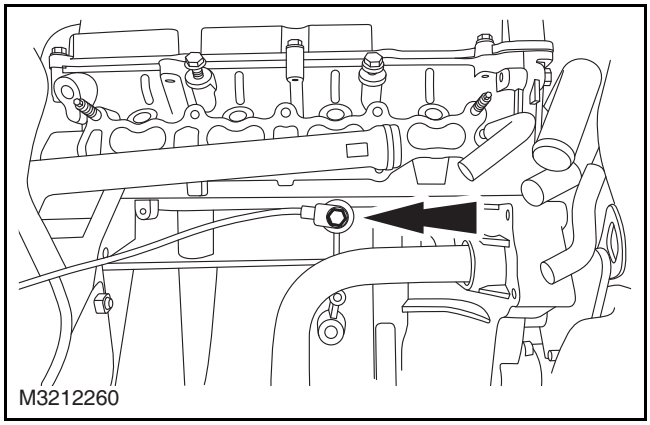



3. Remove the air intake manifold.

   **Refer to: Intake Manifold (3.2.5 Air Intake System, Removal and Installation).**

4. Remove the retaining bolt from the knock sensor.

   Torque: 20 ± 5 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure that the mounting boss surface is clean with no oil stain. Any type of washer shall not be used between sensor and cylinder block when installing the metal face to the cylinder block.**

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# 3.3 Manual Transmission/Clutch

## 2014 MD/MS201

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## Specifications

# Material Specifications

| Item | Model |
|---|---|
| Transmission oil | API GL-4 75W-90 |

# Component Specifications

| Item | Specifications |
|---|---|
| Clutch driven disc assembly diameter (outer/ inner) | 180/125 mm |
| Clutch driven disc assembly wear limit | 1.5 mm |
| Clutch pedal free travel standard value | 5 ~ 11 mm |

# General Specifications

| Item | Specifications |
|---|---|
| Type | Dry clutch with single plate diaphragm spring |
| Operation type | Mechanical |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Clutch pressure plate retaining bolt | 23.5 ± 2 | - | - |

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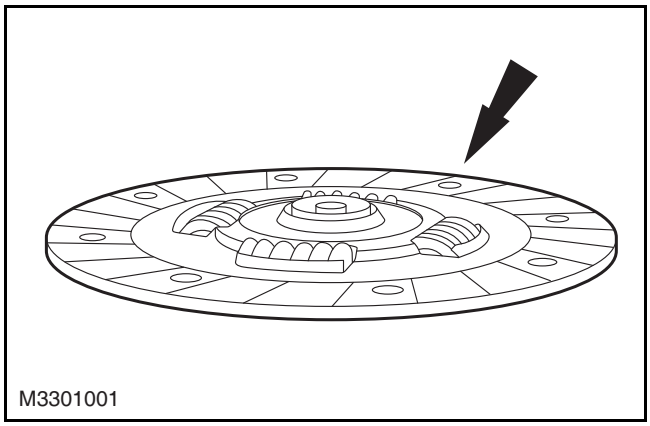


## General Inspection

## Clutch Driven Disc Inspection

**WARNING: Do not clean the clutch driven disc with wax-based cleaning agents or solvents.**

1. Clean the clutch driven disc.
2. Inspect the clutch driven disc for the following:
   - Oil stain
   - Scorch mark
   - Thickness
   - Spring (if it is damaged, replace the clutch driven disc)



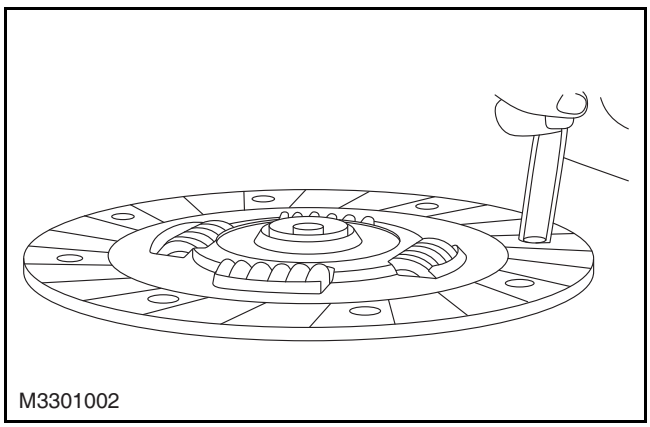
M3301001

3. Measure the rivet head depth (the distance between rivet head and clutch driven disc assembly surface), if any rivet head depth exceeds the limit, replace the clutch driven disc assembly.

   Rivet head depth

   Standard: 1.15 ~ 1.75 mm

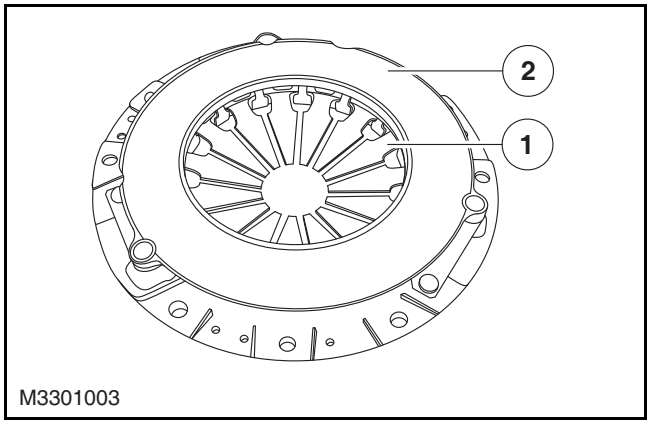
   Limit: 0.5 mm



M3301002

## Clutch Pressure Plate Inspection

1. Clean the clutch pressure plate.
2. Inspect whether the diaphragm spring (1) is abnormally worn or damaged.
3. Inspect whether the clutch pressure plate assembly (2) is worn or has local hot spot.
4. If any abnormality is found, replace the assembly as diaphragm and pressure plate cannot be disassembled.




M3301003

## Clutch Pedal Assembly and Cable Inspection

1. Inspect whether the bushing is worn or damaged.
2. Inspect whether the spacer bush is worn or damaged.
3. Inspect whether the pedal arm is damaged or deformed.
4. Inspect whether the torsion spring is deformed.
5. Inspect whether the pedal pad is worn or damaged.
6. Inspect whether the clutch cable is worn, deformed or damaged.

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# Clutch Pedal Free Travel Inspection

1. Press clutch pedal with hand until resistance begins to be felt (clutch pedal operation force should not be more than 140 N) and measure the distance (clutch pedal free travel).
2. Inspect the pedal travel.

   Standard free travel: 5 ~ 11 mm
3. Adjust the clutch cable and clutch pedal when necessary if free travel is not within the specified range.
4. After inspection of clutch pedal free travel, inspect whether clutch works normally while engine is running. When the clutch pedal is depressed, the clutch disengages completely and returns in time after the pedal is released; Slipping is forbidden after engaging and no unusual noise during operation.

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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical fault.
3. If an obvious cause has been found, solve the fault before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.
5. Inspect clutch operation: Place a piece of wood with thickness of 25 mm under clutch pedal, and then depress the clutch pedal deeply. If the transmission can be shifted into 1st or 2nd gear when the engine is running and the parking brake is applied, the clutch works normally. Otherwise, repair the clutch.

# Symptom Chart

If the fault occurs, but the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Clutch slippage | • Clutch pedal free travel<br>• Clutch pedal bonding<br>• Diaphragm spring<br>• Clutch pressure plate<br>• Clutch driven disc surface<br>• Surface of clutch driven disc too stiff or oily<br>• Flywheel<br>• Improper adjustment of clutch cable | **Refer to: Diagnosis Procedure for Clutch Slippage (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing).** |
| Clutch clickety-clack or shudder | • Engine bracket<br>• Oil stain on clutch driven disc surface<br>• Diaphragm spring<br>• Clutch pressure plate<br>• Clutch driven disc surface<br>• Flywheel<br>• Clutch cable | **Refer to: Diagnosis Procedure for Clutch Clickety-clack or Judder (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing).** |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Clutch drag | • Clutch pedal free travel<br>• Diaphragm spring<br>• Clutch driven disc<br>• Clutch driven disc spline<br>• Oil stain on clutch driven disc surface<br>• Clutch pedal<br>• Improper adjustment of clutch cable | Refer to: Diagnosis Procedure for Clutch Drag (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing). |
| Clutch pedal pulsation | • Poor lubrication of clutch and brake pedal pivot<br>• Flywheel<br>• Fatigue pressure plate spring<br>• Clutch cable | Refer to: Diagnosis Procedure for Clutch Pulsation (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing). |
| Clutch vibration | • Engine components in contact with frame<br>• Drive belt<br>• Flywheel bolt<br>• Flywheel<br>• Clutch pressure plate out of balance<br>• Mounting bush is weak, bolt or nut of the engine is loose | Refer to: Diagnosis Procedure for Clutch Vibration (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing). |
| Difficult gear shifting | • Improper adjustment of clutch cable<br>• Clutch pedal free travel<br>• Manual transmission fault | Refer to: Diagnosis Procedure for Difficult Gear Shifting (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing). |
| Excessive noise | • Clutch pedal free travel<br>• Clutch release bearing<br>• Poor lubrication of clutch release bearing<br>• Release bearing<br>• Excessive crankshaft thrust clearance<br>• Clutch cable | Refer to: Diagnosis Procedure for Excessive Noise (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing). |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Clutch makes quack noise | • Diaphragm spring too flexible | • Replace the clutch pressure plate.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).** |
| | • Release fork loose | • Remove and reinstall the release fork correctly. |
| | • Oil on driven disc | • Exclude the cause of engine oil leak, and replace the driven disc.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).** |
| | • Damping spring of driven disc damaged | • Replace the driven disc.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).** |
| | • Cable rust | • Replace the clutch cable. |
| Clutch stuck (pedal is difficult to push) | • Cable rust | • Replace the clutch cable. |
| | • Clutch disc is worn too thin | • Replace the clutch disc assembly.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).** |

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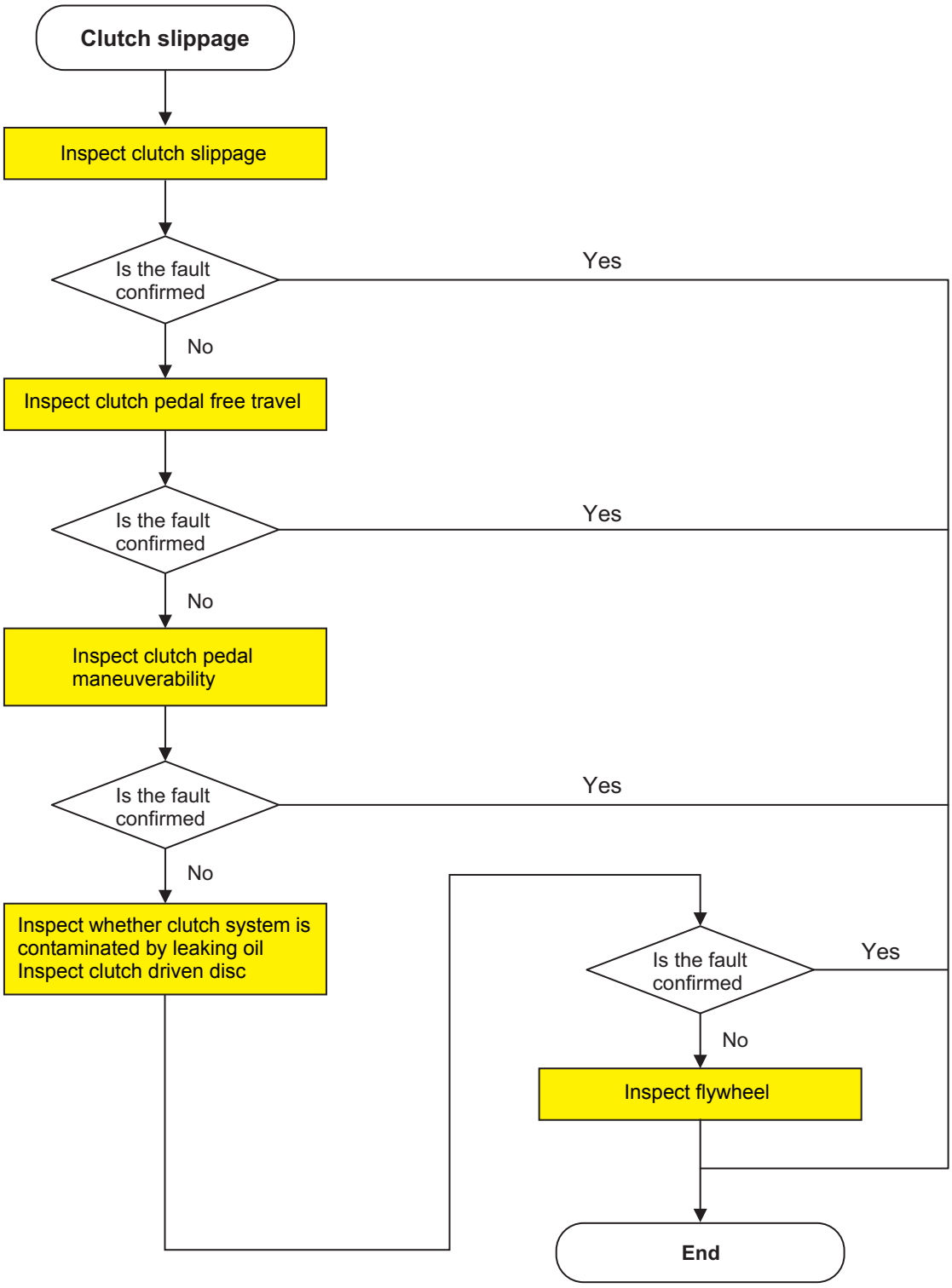


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Out of gear | • Gearshift mechanism | • Adjust the gearshift mechanism, replace when necessary.<br>**Refer to: Gearshift Mechanism (3.3.4 Manual Transmission External Control, Removal and Installation).** |
| | • Self-locking mechanism<br>• Synchronizer assembly<br>• Gearshift mechanism | • Adjust or replace.<br>**Refer to: Disassembly and Assembly of Transmission (3.3.3 Manual Transmission - MR510L02, Disassembly and Assembly).** |
| | • Transmission or engine support | • Repair or replace the transmission or engine support. |
| Abnormal driving noise | • Shift gear<br>• Input shaft bearing<br>• Output shaft bearing<br>• Clutch<br>• Wheel bearing<br>• Tire<br>• Universal joint | **Refer to: Diagnosis Procedure for Abnormal Driving Noise (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing).** |

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# Diagnosis Procedure for Clutch Slippage



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect clutch slippage | |
| | A. Inspect the wheel and apply the parking brake.<br>B. Turn the ignition switch to "START".<br>C. Start engine, shift the transmission to the 4th gear.<br>D. Run the engine at 2000 rpm.<br>E. Release the clutch pedal slowly.<br>Whether the engine stalls when the clutch pedal is released completely?<br>**Yes**<br>Clutch is normal.<br>**No**<br>Go to step 2. |
| 2. Inspect clutch pedal free travel | |
| | A. Press the clutch pedal with hand until resistance begins to be felt.<br>B. Inspect the pedal travel.<br>Is the measured dimension within 5 ~ 11 mm?<br>**Yes**<br>Go to step 3.<br>**No**<br>Adjust the clutch pedal free travel. |
| 3. Inspect clutch pedal maneuverability | |
| | A. Inspect the lubrication.<br>Is the lubrication of clutch pedal pivot good?<br>**Yes**<br>Go to step 4.<br>**No**<br>Lubricate the clutch pedal pivot. |
| 4. Inspect whether clutch system is contaminated by leaking oil | |
| | A. Remove the transmission.<br>**Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**<br>B. Inspect whether the clutch system is contaminated by oil leak.<br>Is the clutch system contaminated by oil leak?<br>**Yes**<br>Repair the oil leak.<br>**No**<br>Go to step 5. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect clutch driven disc | |
| | A. Remove the clutch driven disc.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>B. Inspect whether the driven disc is oily, stiff or damaged. Inspect the thickness of driven disc.<br>**Refer to: Clutch Driven Disc Inspection (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, General Inspection).**<br>Is the clutch driven disc normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the clutch driven disc.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).** |

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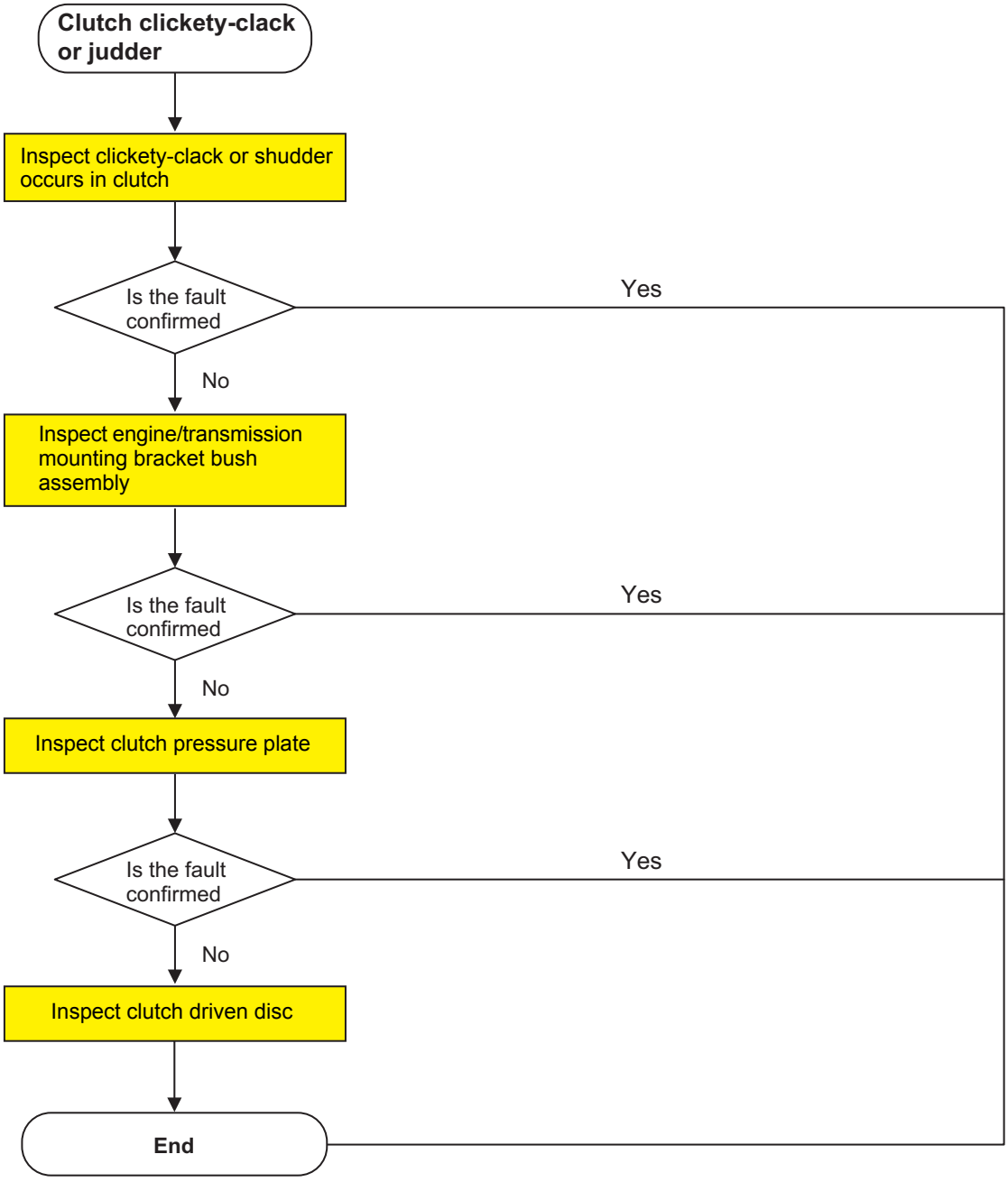


| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect flywheel | |
| | A. Remove the clutch driven disc assembly and pressure plate assembly.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>B. Inspect the junction surface of flywheel for blue, grooved wear or cracks.<br>C. Inspect the end face runout of flywheel.<br>Is the flywheel normal?<br>**Yes**<br>Replace the clutch pressure plate with a new one.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>**No**<br>Repair or replace flywheel.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).** |

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# Diagnosis Procedure for Clutch Clickety-clack or Judder



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect clickety-clack or shudder occurs in clutch | |
| | A. Turn the ignition switch to "START".<br>B. Start engine and shift to the 1st gear.<br>C. Run the engine at 1200 ~ 1500 rpm.<br>D. Release the clutch pedal slowly.<br>Does the vehicle shudder at start?<br>**Yes**<br>Go to step 2.<br>**No**<br>Clutch is normal. |
| 2. Inspect engine/transmission mounting bracket bush assembly | |
| | A. Inspect the engine/manual transmission mounting bush and bolt.<br>Are they loose or damaged?<br>**Yes**<br>Tighten the bolt or replace the damaged mounting bush when necessary.<br>**No**<br>Go to step 3. |
| 3. Inspect clutch pressure plate | |
| | A. Remove the clutch pressure plate.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>Is there any wear on the clutch pressure plate?<br>**Yes**<br>Replace the clutch pressure plate with a new one.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>**No**<br>Go to step 4. |

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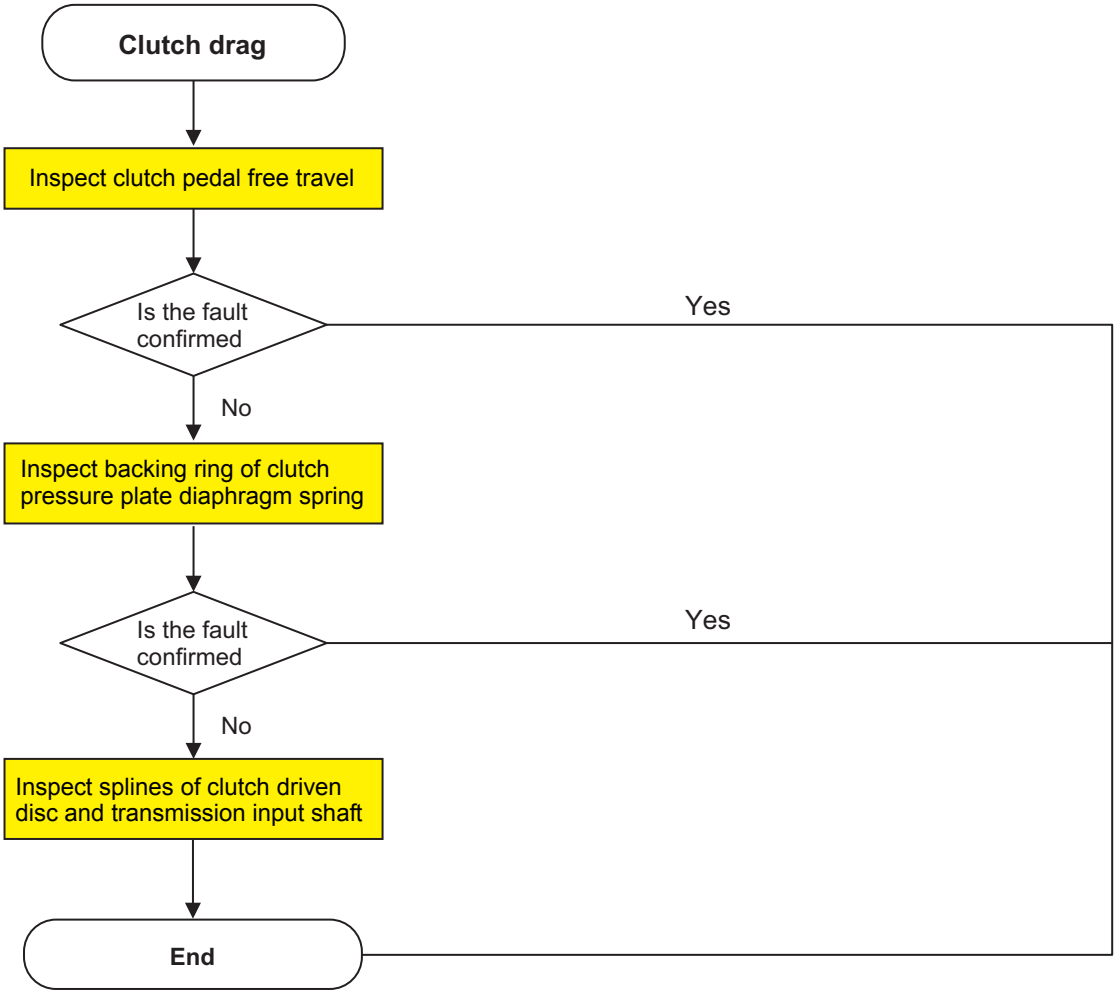


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect clutch driven disc | |
| | A. Inspect the clutch driven plate.<br>**Refer to: Clutch Driven Disc Inspection (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, General Inspection).**<br>Does the clutch driven disc have any oil stain or scorch?<br>**Yes**<br>Replace the clutch driven disc with a new one.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>**No**<br>Inspect the flywheel.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).** |

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# Diagnosis Procedure for Clutch Drag



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect clutch pedal free travel | |
| | A. Inspect whether engine/transmission mounting bush or bolt is damaged or loose.<br>B. Inspect the pedal travel.<br>Is the measured dimension within 5 ~ 11 mm?<br>**Yes**<br>Go to step 2.<br>**No**<br>Adjust the clutch cable or repair pedal fault. |
| 2. Inspect backing ring of clutch pressure plate diaphragm spring | |
| | A. Remove the clutch pressure plate.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>Is there any wear on clutch pressure plate or diaphragm spring backing ring?<br>**Yes**<br>Replace the clutch pressure plate with a new one.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>**No**<br>Go to step 3. |

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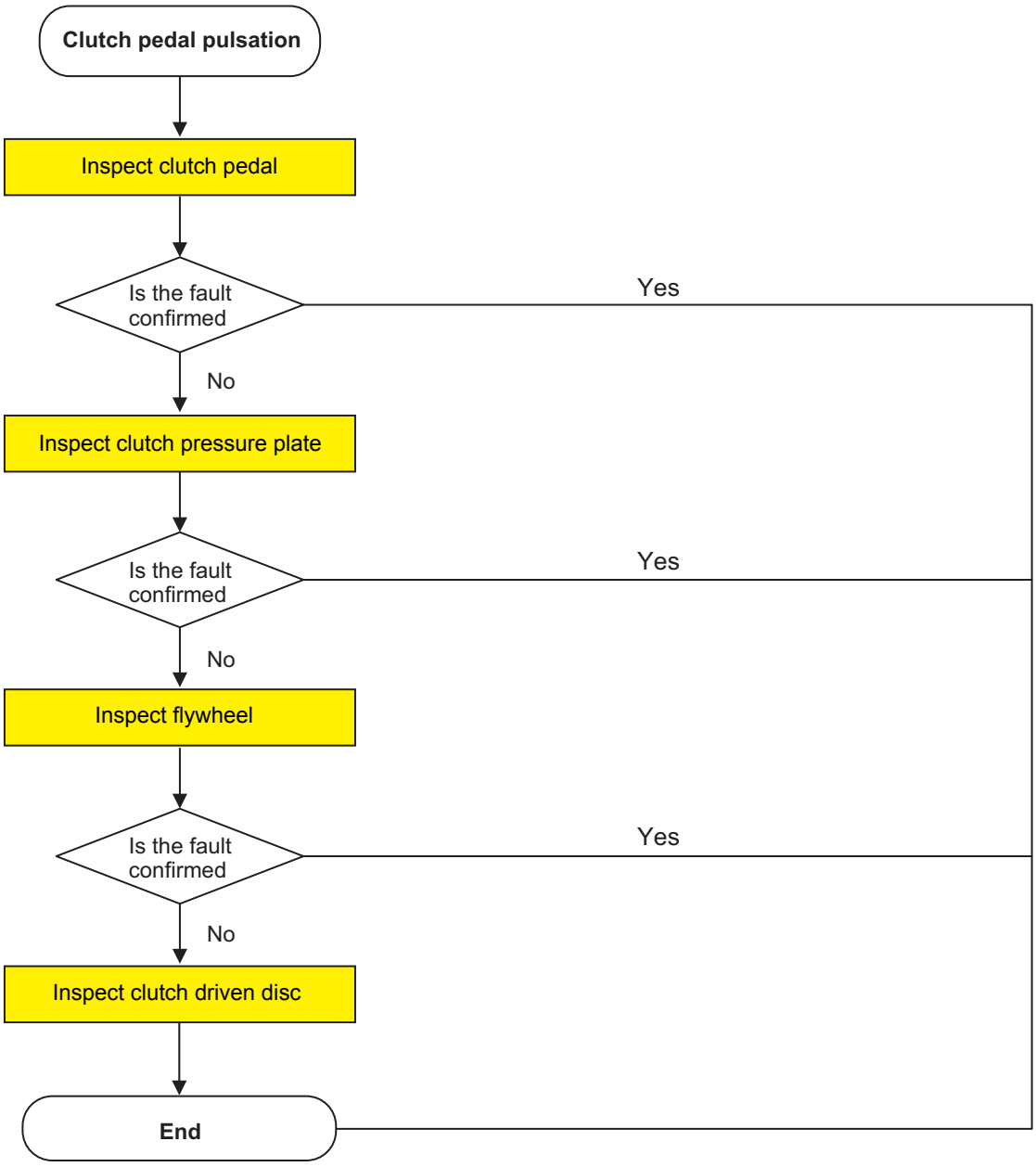


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect splines of clutch driven disc and transmission input shaft | |
| | A. Remove the transmission.<br>**Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**<br>B. Inspect the splines of clutch driven disc and transmission input shaft.<br>Are the splines of clutch driven disc and transmission input shaft normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair or replace the clutch driven disc or transmission input shaft.<br>**Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**<br>**Refer to: Disassembly and Assembly of Transmission (3.3.3 Manual Transmission - MR510L02, Disassembly and Assembly).** |

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# Diagnosis Procedure for Clutch Pedal Pulsation



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect clutch pedal | |
| | A. Inspect the lubrication of clutch pedal mechanism.<br>Is the lubrication of clutch pedal pivot good?<br>**Yes**<br>Go to step 2.<br>**No**<br>Lubricate the clutch pedal pivot. |
| 2. Inspect clutch pressure plate | |
| | A. Remove the clutch pressure plate.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>B. Inspect the end face runout of clutch pressure plate.<br>C. Inspect the wear depth of clutch pressure plate release lever.<br>Is the clutch pressure plate normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the clutch pressure plate.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).** |

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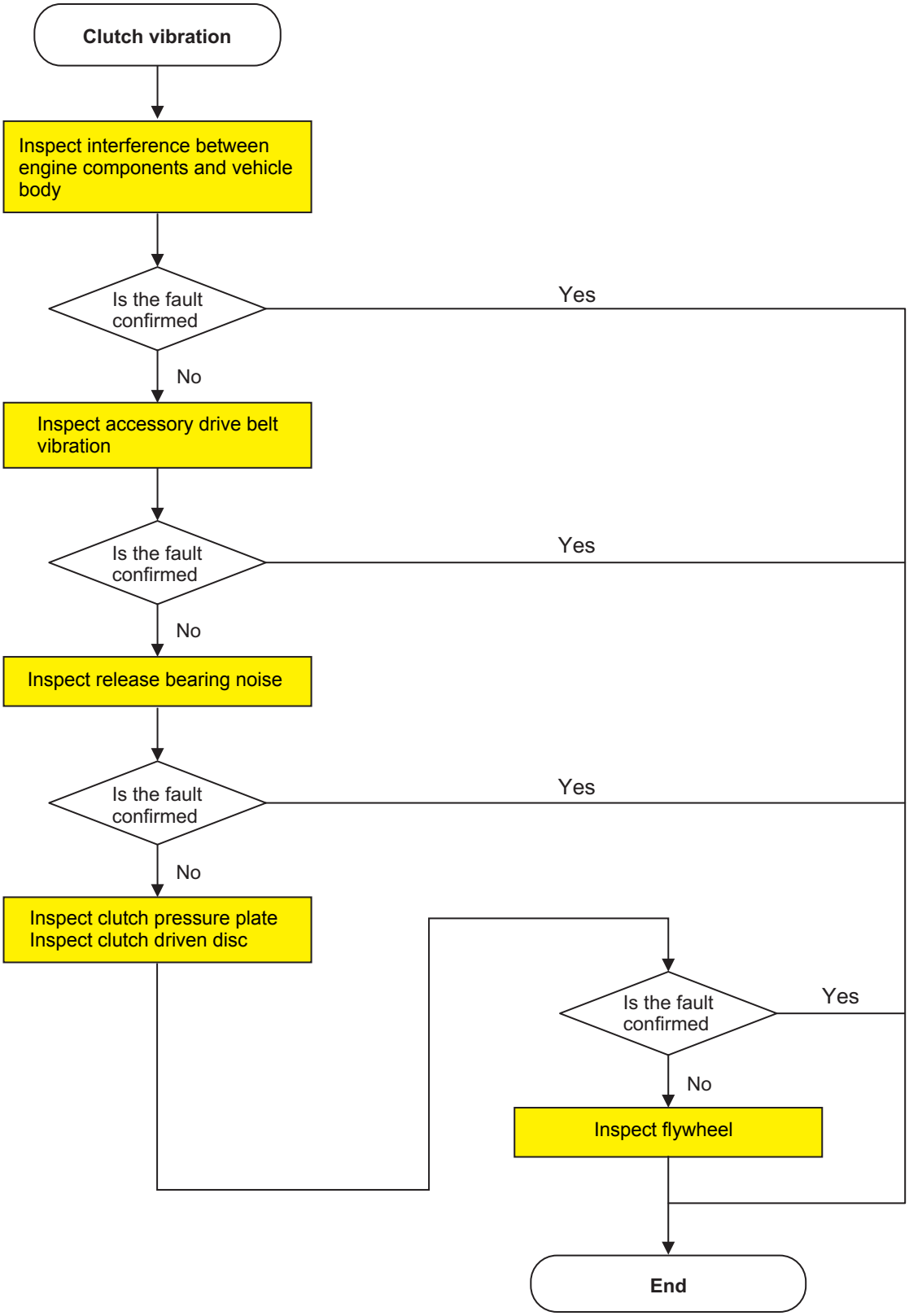


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect flywheel | |
| | A. Remove the clutch driven disc assembly and pressure plate assembly.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>B. Inspect the end face runout of flywheel.<br>C. Inspect the junction surface of flywheel for blue, grooved wear or cracks.<br>Is the flywheel normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the flywheel.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).** |
| 4. Inspect clutch driven disc | |
| | A. Remove the clutch driven disc.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>B. Inspect whether the clutch driven disc is stiff or distorted and its thickness reaches the limit.<br>C. Inspect the end face runout of clutch driven disc.<br>Is the clutch driven disc normal?<br>**Yes**<br>Replace the clutch release bearing.<br>**No**<br>Replace the clutch driven disc.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).** |

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# Diagnosis Procedure for Clutch Vibration



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect interference between engine components and vehicle body | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect whether there is interference between link mechanism installed on the engine and vehicle body or frame.<br>C. Inspect the interference between exhaust manifold or other engine components and vehicle body or frame.<br>D. Inspect if the mounting bush is weak, or the bolt or nut of engine is loose.<br>Is it connected with vehicle body or frame normally?<br>**Yes**<br>Repair and replace when necessary.<br>**No**<br>Go to step 2. |
| 2. Inspect accessory drive belt vibration | |
| | A. If the engine torque is changed, inspect the accessory vibration when the clutch is disengaged or engaged.<br>B. Loosen accessory drive belt to inspect the vibration.<br>Does the vibration stop when the accessory drive belt is removed?<br>**Yes**<br>Repair or replace the accessory drive belt.<br>**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**<br>**No**<br>Go to step 3. |
| 3. Inspect release bearing noise | |
| | A. Turn the ignition switch to "START".<br>B. Depress and hold the clutch pedal.<br>Is there any harsh grating?<br>**Yes**<br>Replace the release bearing.<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect clutch pressure plate | |
| | A. Remove the clutch pressure plate.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>B. Inspect the end face runout of clutch pressure plate.<br>C. Inspect the wear depth of clutch pressure plate release lever.<br>Is the clutch pressure plate normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the clutch pressure plate with a new one.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).** |

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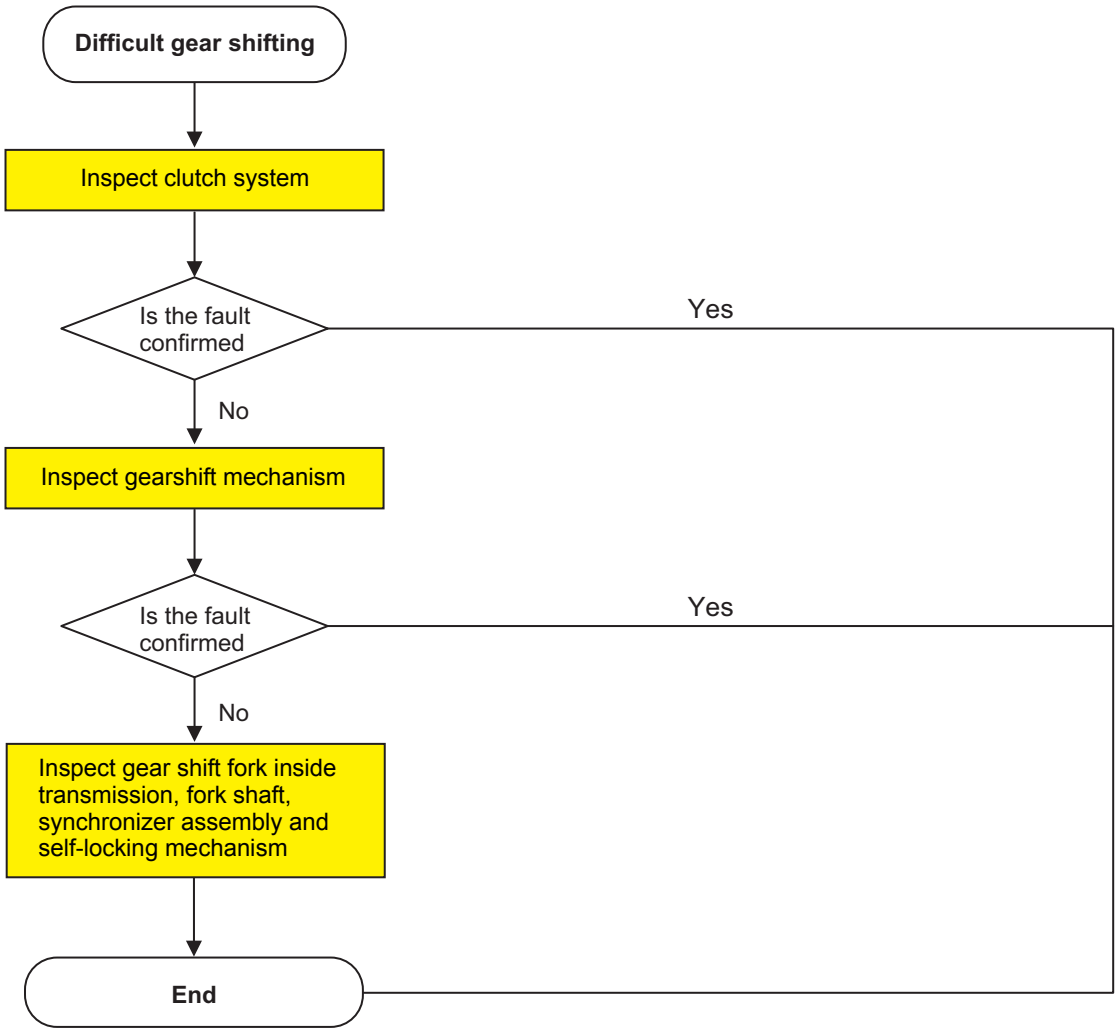


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect clutch driven disc | |
| | A. Remove the clutch driven disc.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>B. Inspect whether the clutch driven disc is stiff or distorted and its thickness reaches the limit.<br>C. Inspect the end face runout of clutch driven disc.<br>Is the clutch driven disc normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the clutch driven disc.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).** |
| 6. Inspect flywheel | |
| | A. Remove the clutch driven disc assembly and pressure plate assembly.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>B. Inspect whether the flywheel bolts are loose.<br>C. Inspect the flywheel roundness.<br>D. Inspect the end face runout of flywheel.<br>Is the flywheel normal?<br>**Yes**<br>Diagnose the fault of engine vibration.<br>**No**<br>Tighten or replace the flywheel.<br>**Refer to: Main Bearing, Crankshaft and Cylinder Block (3.1.2 Mechanical System, Disassembly and Assembly).** |

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# Diagnosis Procedure for Difficult Gear Shifting



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect clutch system | |
| | A. Inspect whether the clutch system is completely disengaged and engaged reliably.<br>**Refer to: Diagnosis Procedure for Clutch Drag (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing).**<br>Is the clutch system normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the clutch system. |
| 2. Inspect gearshift mechanism | |
| | A. Inspect the gearshift mechanism.<br>Is the gearshift mechanism normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Adjust or replace the gearshift mechanism.<br>**Refer to: Gearshift Mechanism (3.3.4 Manual Transmission External Control, Removal and Installation).** |

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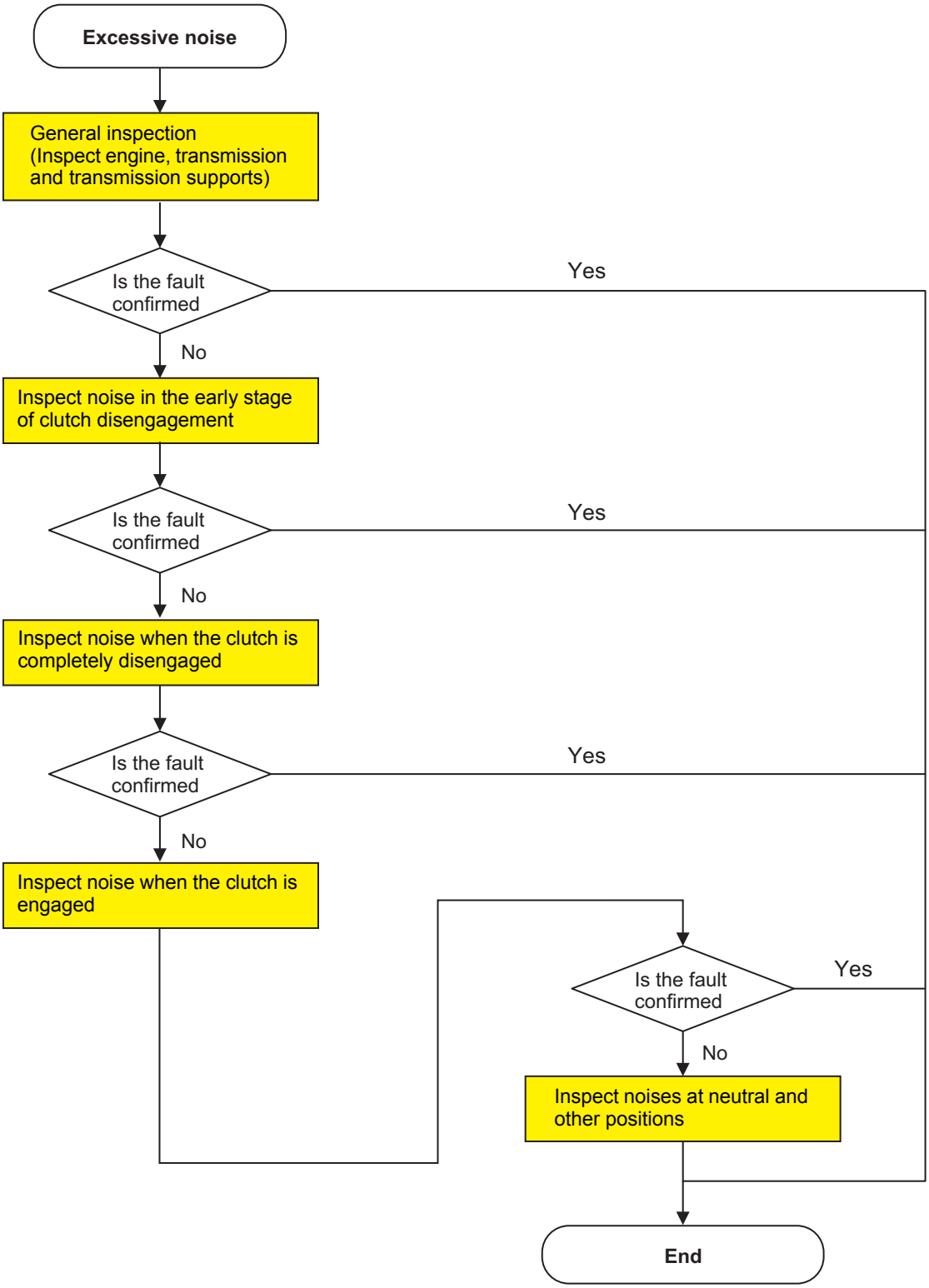


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect gear shift fork inside transmission, fork shaft, synchronizer assembly and self-locking mechanism | |
| | A. Remove the transmission.<br>**Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**<br>B. Disassemble the transmission.<br>**Refer to: Disassembly and Assembly of Transmission (3.3.3 Manual Transmission - MR510L02, Disassembly and Assembly).**<br>C. Inspect whether the gear shift fork and fork shaft are normal.<br>D. Inspect whether the synchronizer assembly is normal.<br>E. Inspect the self-locking mechanism, gear shift fork inside transmission, fork shaft and synchronizer.<br>Are they normal?<br>**Yes**<br>Replace the engine or transmission support.<br>**No**<br>Repair the transmission interior fault. |

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# Diagnosis Procedure for Excessive Noise



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect whether there is any crack, looseness and damage on the engine and transmission supports.<br>B. Inspect whether the transmission interferes with exhaust pipe and vehicle body, and the transmission support has foreign material, such as stones.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault part. |
| 2. Inspect noise in the early stage of clutch disengagement | |
| | A. Start the engine.<br>B. Depress the clutch pedal lightly, but not to the bottom.<br>Is there any noise?<br>**Yes**<br>Replace the clutch release bearing.<br>**No**<br>Go to step 3. |
| 3. Inspect noise when the clutch is completely disengaged | |
| | A. Start the engine.<br>B. Depress the clutch pedal to the bottom.<br>C. Operate the accelerator pedal to change the engine speed.<br>Is there any noise as the engine speed changes?<br>**Yes**<br>Replace the release bearing.<br>**No**<br>Go to step 4. |

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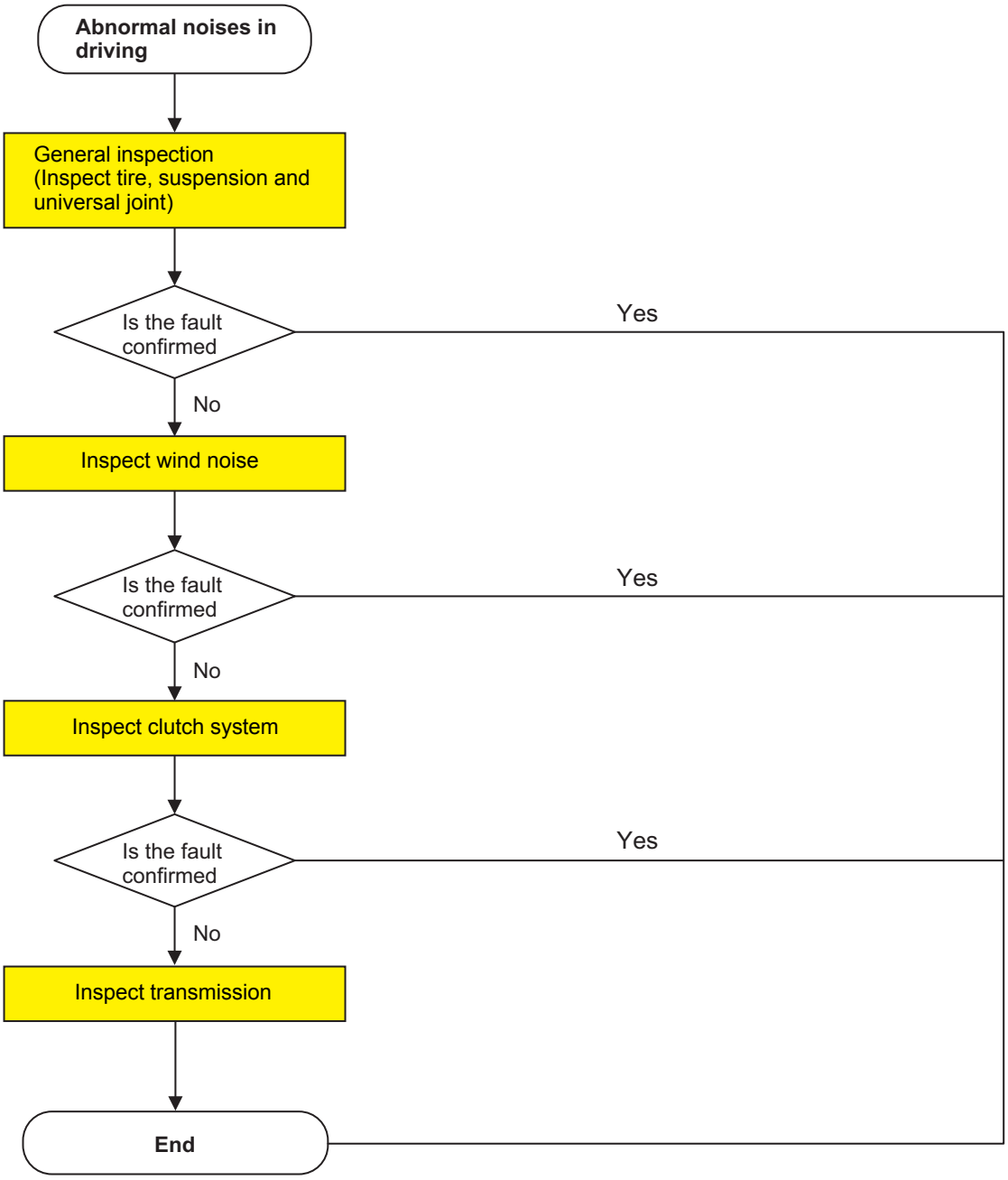


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect noise when the clutch is engaged | |
| | A. Remove the clutch driven disc.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>B. Inspect the torsion spring wear.<br>Is there any wear?<br>**Yes**<br>Install the clutch driven disc with a new one.<br>**Refer to: Clutch Pressure Plate Assembly and Clutch Driven Disc Assembly (3.3.2 Manual Transmission - MR510L02 Clutch, Removal and Installation).**<br>**No**<br>Go to step 5. |
| 5. Inspect noises at neutral and other positions | |
| **WARNING: To avoid personal injury caused by out of control, road test should be conducted by two persons together in order to maintain safe driving. Be sure to control steering wheel properly. Failure to follow these instructions may result in personal injury.** | A. Turn the ignition switch to "START".<br>B. Start the engine at neutral gear.<br>C. Inspect noises at neutral or other positions.<br>Is there any noise from the transmission?<br>**Yes**<br>Inspect and repair the transmission.<br>**Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**<br>**Refer to: Disassembly and Assembly of Transmission (3.3.3 Manual Transmission - MR510L02, Disassembly and Assembly).**<br>**No**<br>Inspect the engine system noises.<br>**Refer to: Abnormal Interior Noises under Engine (3.1.2 Mechanical System, Symptom Diagnosis and Testing).** |

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# Diagnosis Procedure for Abnormal Noises in Driving



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Lift the vehicle.<br>**Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**<br>B. Inspect the wheel tire pressure, tire tread wear and tire type.<br>C. Inspect the suspension retaining bolt, connecting rubber bushing and ball joint.<br>D. Inspect whether the universal joint is loose.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair or replace the fault component. |
| 2. Inspect wind noise | |
| **WARNING: To avoid personal injury caused by out of control, road test should be conducted by two persons together in order to maintain safe driving. Be sure to control steering wheel properly. Failure to follow these instructions may result in personal injury.** | A. Carry out road test.<br>B. Inspect for the wind noise as the speed changes.<br>Is there wind noise as the speed changes?<br>**Yes**<br>Repair the wind noise fault.<br>**No**<br>Go to step 3. |
| 3. Inspect clutch system | |
| | A. Start engine and keep it at the neutral position.<br>B. Operate the clutch. Inspect whether there is abnormal noise during clutch engagement or disengagement.<br>Is the clutch normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Before road test, repair and replace with new components when necessary. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect transmission | |
| **WARNING: To avoid personal injury caused by out of control, road test should be conducted by two persons together in order to maintain safe driving. Be sure to control steering wheel properly. Failure to follow these instructions may result in personal injury.** | A. Carry out road test.<br>B. Inspect whether there is any gear impact noise when shifting.<br>C. Inspect whether there is any abnormal noise at each position.<br>Is the transmission normal?<br>**Yes**<br>**Refer to: Noise Diagnosis Procedure (1.1.5 Noise, Vibration and Harshness, Symptom Diagnosis and Testing).**<br>**No**<br>Repair the transmission.<br>**Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).** |

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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| Clutch type | Dry clutch with single disc diaphragm spring |
| Operation type | Mechanical |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Clutch pressure plate retaining bolt | 23.5 ± 2 | - | - |

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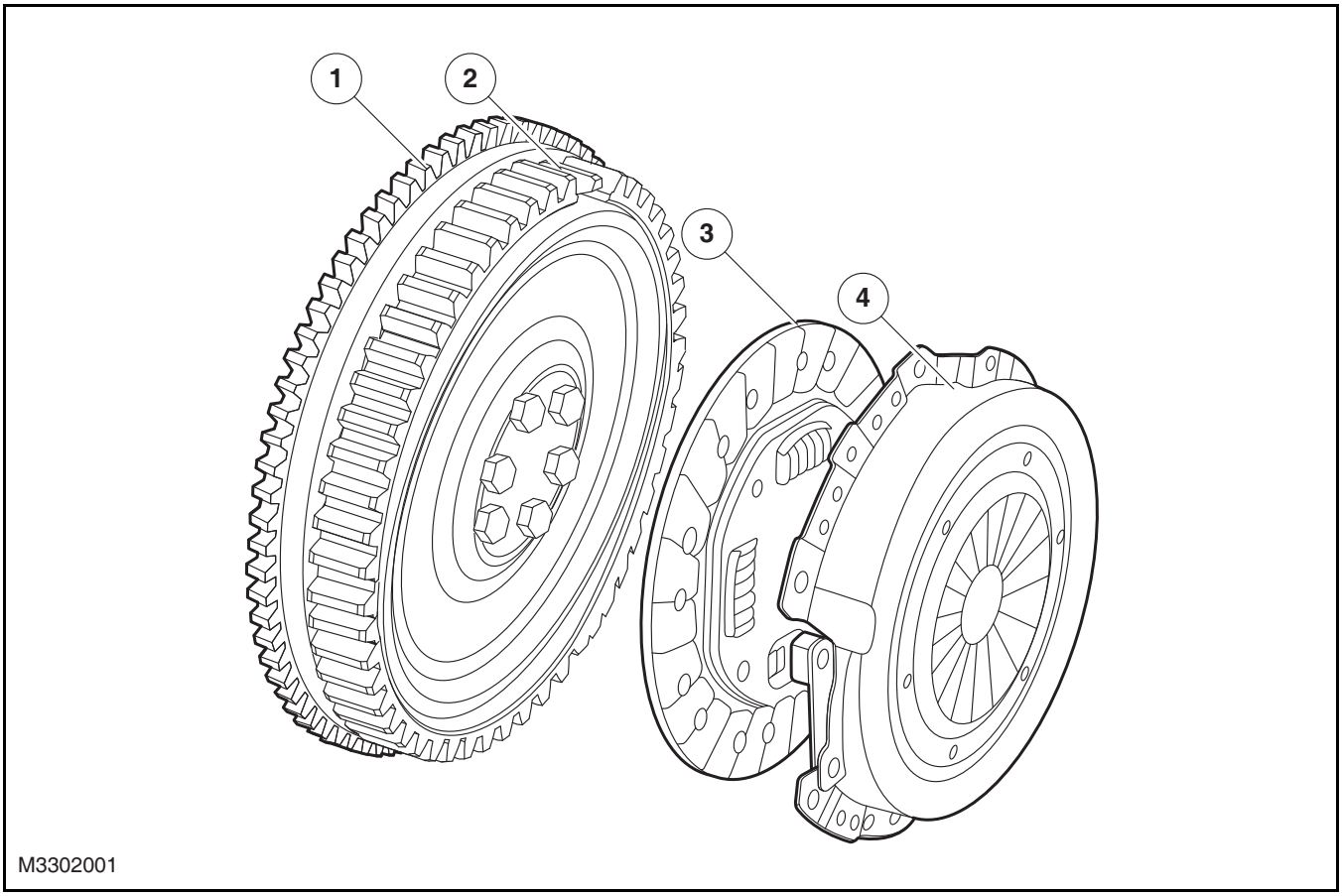


## Description and Operation

# System Overview

Clutch includes one clutch driven disc assembly and one clutch pressure plate assembly fixed on the flywheel. In the normal operating condition, through connecting with the flywheel ring gear assembly the clutch driven disc assembly under the pressure of the clutch pressure disc assembly transfers engine power to the transmission assembly. When the clutch pedal is depressed completely, clutch pressure plate assembly is disengaged from the clutch driven disc assembly. At this time clutch driven disc cannot transfer engine power to the transmission assembly; when the pedal is completely released, clutch pressure plate assembly compresses driven disc assembly, which transfers engine power to the transmission assembly.

Function of clutch mainly involves: connecting engine with drive device gradually to ensure the smooth start; disconnecting engine with drive device temporarily, to reduce shocks to transmission gear with gear shifting and ensure the smooth operation of drive device and vehicle; absorbing energy by slippage of clutch while applying emergency brakes, preventing drive device components from overloading and damaging.

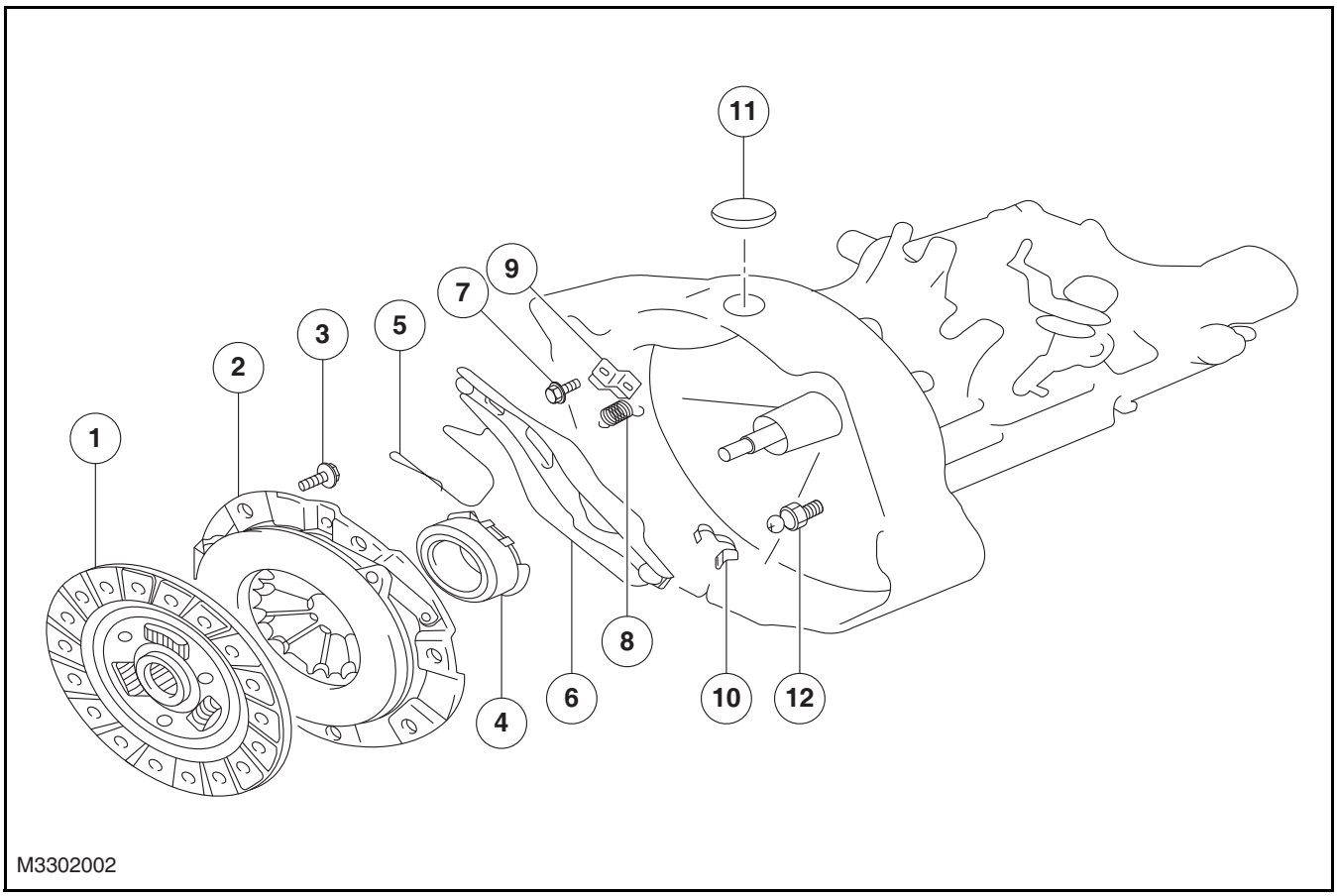



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Flywheel ring gear assembly | 3 | Clutch driven disc |
| 2 | Crankshaft position sensor plate | 4 | Clutch pressure plate |

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# Components Exploded View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Clutch driven disc assembly | 7 | Clutch release fork bracket bolt |
| 2 | Clutch pressure plate assembly | 8 | Clutch release fork return spring |
| 3 | Clutch pressure plate retaining bolt | 9 | Clutch release fork return spring bracket |
| 4 | Clutch release bearing | 10 | Clutch release fork clip |
| 5 | Release bearing clip | 11 | Front case viewport cover |
| 6 | Clutch release fork | 12 | Clutch release support |

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## Symptom Diagnosis and Testing

Refer to: Symptom Chart (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing).

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## Removal and Installation

# Clutch Pressure Plate Assembly, Clutch Driven Disc Assembly

### Special Tool

| | |
|---|---|
| Flywheel holding tool | 09924-17810 |
| Driven disc mounting shaft | 09923-36330 |

### Removal

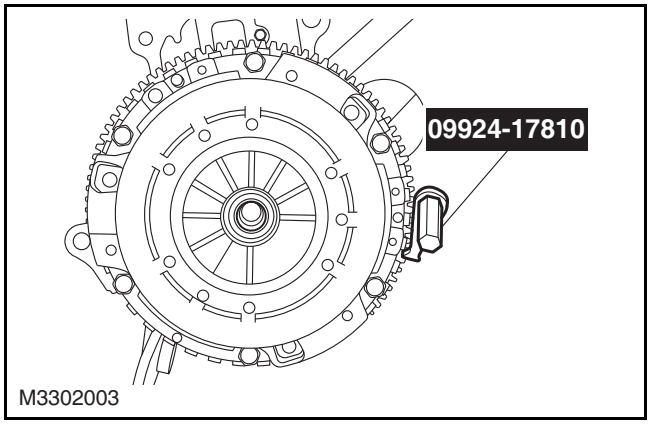
1. Remove the manual transmission.

   **Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**

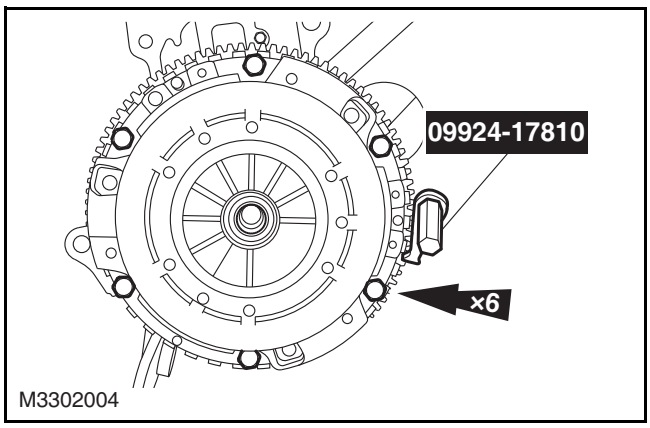
2. Remove the clutch pressure plate and clutch driven disc assembly.

   1 Use the special tool to hold the flywheel assembly.

   Special tool: 09924-17810




   2 Remove the clutch pressure plate retaining bolts, then remove the clutch pressure plate assembly and clutch driven disc assembly in turn.



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## Installation

**CAUTION: When tightening the clutch pressure plate retaining bolts, firmly press the clutch driven disc with the special tool to make sure that clutch driven disc assembly is aligned with the center.**

**CAUTION: Diagonally tighten the clutch pressure plate retaining bolts in order.**

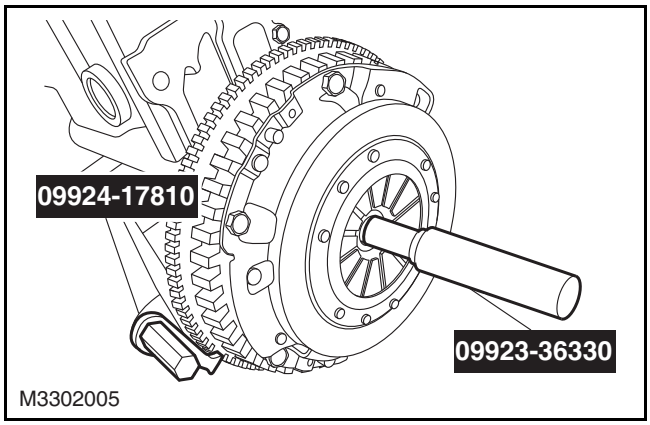
1. Inspect the joint surface of the flywheel and driven disc.
2. Install the clutch pressure plate and driven disc assembly.

   1 Use the special tool to align the clutch driven disc with the center of the flywheel, install the clutch pressure plate assembly and bolts, and then tighten them to the specified torque.

   Torque: 23.5 ± 2 Nm

   Special tool: Driven disc mounting shaft 09923-36330

   Special tool: Flywheel holding tool 09924-17810

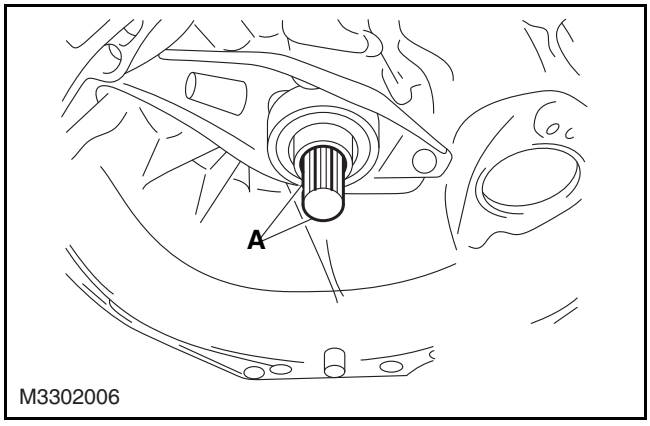



**CAUTION: When tightening the clutch pressure plate retaining bolts, firmly press the clutch driven disc with the special tool 09923-36330 to make sure that clutch driven disc assembly is aligned with the center.**

**CAUTION: Diagonally tighten the clutch pressure plate retaining bolts in order.**

3. Apply a small amount of grease to the input shaft, and then connect the manual transmission and engine.

   "A": 99000-25210




**CAUTION: While inserting the transmission input shaft to the clutch driven disc assembly, rotate the crankshaft with the wrench from the front side until the splines are engaged.**

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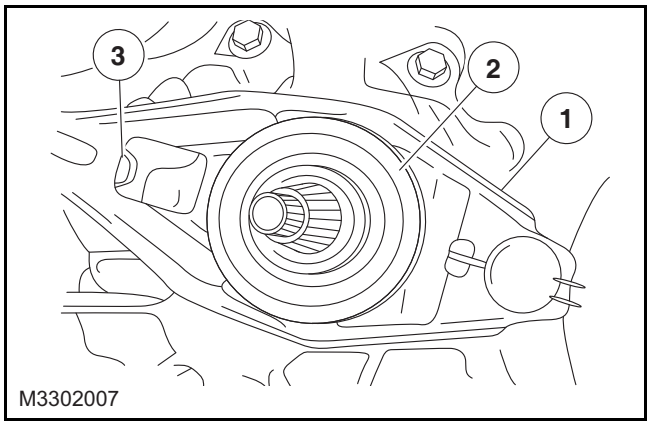
# Clutch fork

## Removal

1. Remove the manual transmission.

   **Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**

2. Remove the clutch fork return spring (3) and fork (1) clip.
3. Remove the fork and release bearing (2) together.



M3302007

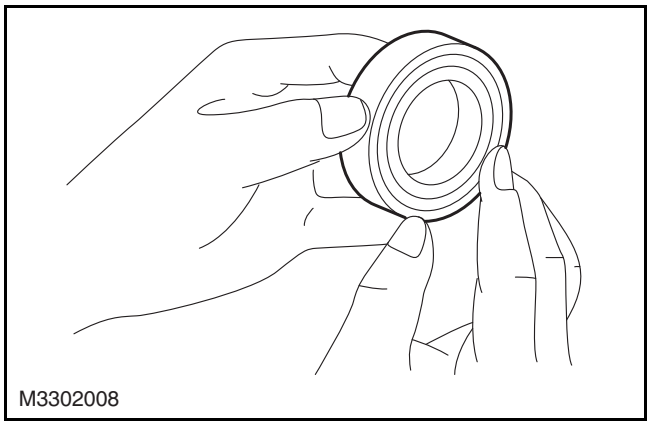
4. Remove the clutch release bearing and clutch fork clip.

## Inspection

1. Inspect if the clutch release bearing rotates smoothly, replace if any fault is found.

**CAUTION: Do not clean release bearing to flush out grease, which will damage the bearing.**

2. Inspect the clutch release fork and clip for damage and deformation, as well as the release fork return spring. Replace if any fault is found.


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## Installation

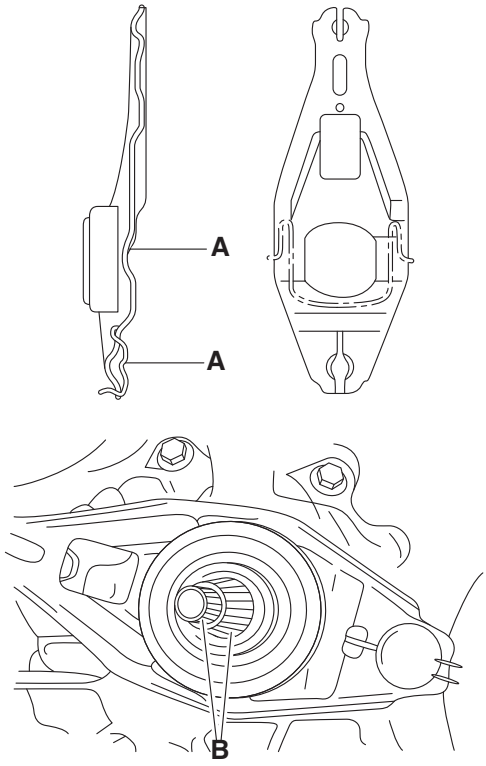
**1.** Installation is in the reverse order of removal.

**CAUTION: Apply the grease as shown in the figure.**

"A": 99000-25010

"B": 99000-25210

**CAUTION: Install the release bearing, return spring and clip to their original position.**




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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| Transmission type | MR510L02 |
| Operation type | Single-disc, dry type |
| Transmission oil type | API GL-4 75W-90 |
| Manual transmission oil capacity | 1.5 L |
| 1st gear speed ratio | 4.425 |
| 2nd gear speed ratio | 2.273 |
| 3rd gear speed ratio | 1.792 |
| 4th gear speed ratio | 1.227 |
| 5th gear speed ratio | 1 |
| Reverse gear speed ratio | 4.722 |
| Maximum input torque | 110 Nm |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Inlet plug | 10 ~ 25 | - | - |
| Drain plug | 10 ~ 25 | - | - |
| Vehicle speed sensor | 10 | - | 89 |
| Backup lamp switch | 15 ~ 20 | - | - |
| Transmission grounding wiring harness retaining bolt | 8 ± 1 | - | - |
| Connecting nut between transmission and engine | 58 | 43 | - |
| Gear shift and select cable bracket retaining bolt | 23 ± 2 | - | - |
| Connecting bolt between transmission and engine | 51 | 38 | - |
| Rear mounting bracket bush assembly retaining bolt | 55 ± 10 | - | - |
| Worm set retaining bolt | 10 ± 1 | - | - |
| Intermediate shaft locking nut | 60 ~ 75 | - | - |
| Oil delivery trough retaining bolt | 23 ± 5 | - | - |
| Gear shift fork shaft locking bolt | 23 ± 5 | - | - |
| Reverse gear shift fork assembly bolt | 23 ± 5 | - | - |
| Rear case cover retaining bolt | 23 ± 5 | - | - |
| 5th gear fork bolt | 10 ± 2 | - | - |
| 5th gear shift lever bolt | 23 ± 5 | - | - |
| Gearshift guide case bolt | 23 ± 5 | - | - |

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| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Reverse gear shaft screw | 23 ± 5 | - | - |
| Gear shift locking bolt | 23 ± 5 | - | - |
| 5th and reverse gear interlocking bolt | 23 ± 5 | - | - |
| Shift rocker bracket bolt | 23 ± 5 | - | - |

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# System Overview

Transmission MR510L02 is a mechanical manual transmission. It is a full-synchronization manual mechanical transmission with five forward gears and one reverse gear. It has the advantages of easy gearshift without impact noise. The maximum input torque is 110 Nm. The transmission housing using front case and rear case, are characterized by good rigidity structure, easy machining, convenient disassembly/assembly, compact and rational construction. It uses inertia synchronizer, ensuring reliable shifting. It is suitable for the Front-engine Rear-wheel drive models, due to the peculiar structure design, achieving excellent power performance and fuel economy.

MR510L02 transmission has the following advantages:

1. It expands the engine drive torque and speed change range to suit the power demand under various conditions;
2. Under the condition that the crankshaft rotation direction remains unchanged, the vehicle realizes reverse driving requirements;
3. Engine power transfer can be cut off to meet the needs of short-run and coast.

MR510L02 transmission housing adopts front and rear cases, and mainly includes the following: front case, rear case, input shaft set, intermediate shaft set, output shaft set, extension case set, gear shift shaft set and shift rocker set. It is a 3-shaft and inertia synchronizer manual transmission with five forward gears and one reverse gear. The select rocker set functions together with the shift rocker set to achieve gear shifting; and at this time, the inertia synchronizer assures the flexible gear shifting; then by 3 synchronizers and 4 shafts (input shaft, output shaft, intermediate shaft and reverse gear shaft), the speed will be changed. Constant mesh gears are used for all the forward gears, and a sliding structure is for reverse gear. Low-speed synchronizer is installed on the intermediate shaft and engaged with 1st gear or 2nd gear of intermediate shaft. High-speed synchronizer is on the input shaft and engaged with 3rd gear or 4th gear of input shaft.

## Appropriate Speed of Each Forward Gear:

| Gear | 1st Gear | 2nd Gear | 3rd Gear | 4th Gear | 5th Gear |
|---|---|---|---|---|---|
| km/h | 10 ~ 30 | 20 ~ 50 | 30 ~ 70 | 40 ~ 90 | 50 ~ 135 |

**CAUTION: Gear shifting should be within speed ranges.**

**CAUTION: The speed at different gears varies with different vehicle with the transmission.**

## Gearshift Principle

As the vehicle is moving forward, you should shift as following: the shift up should be from 1st gear to 5th gear gradually, while shift down from 5th gear to 1st gear. It is forbidden to shift into the reverse gear when moving forward. The transmission is equipped with reverse lock to avoid shifting from 5th gear to reverse gear by misoperation. In principle, the reverse gear should be shifted when the vehicle is stationary; Do not shift into the reverse gear when the vehicle is moving forward and do not shift into the forward gear when the vehicle is reversing.

**CAUTION: The gearshift principle of transmission can be ignored in emergency when driving.**

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## Transmission Power Flow:

1st gear: Input shaft → intermediate shaft 1st gear → low-speed synchronizer → intermediate shaft intermediate shaft driven gear → output shaft

2nd gear: Input shaft → intermediate shaft 2nd gear → low-speed synchronizer → intermediate shaft intermediate shaft driven gear → output shaft

3rd gear: Input shaft → high-speed synchronizer → input shaft 3rd gear → intermediate shaft → intermediate shaft driven gear → output shaft

4th gear: Input shaft → high-speed synchronizer → input shaft 4th gear → intermediate shaft → intermediate shaft driven gear → output shaft

5th gear: Input shaft → 5th gear synchronizer → output shaft

Reverse gear: Input shaft → reverse idler gear → low-speed synchronizer → intermediate shaft → intermediate shaft driven gear → output shaft

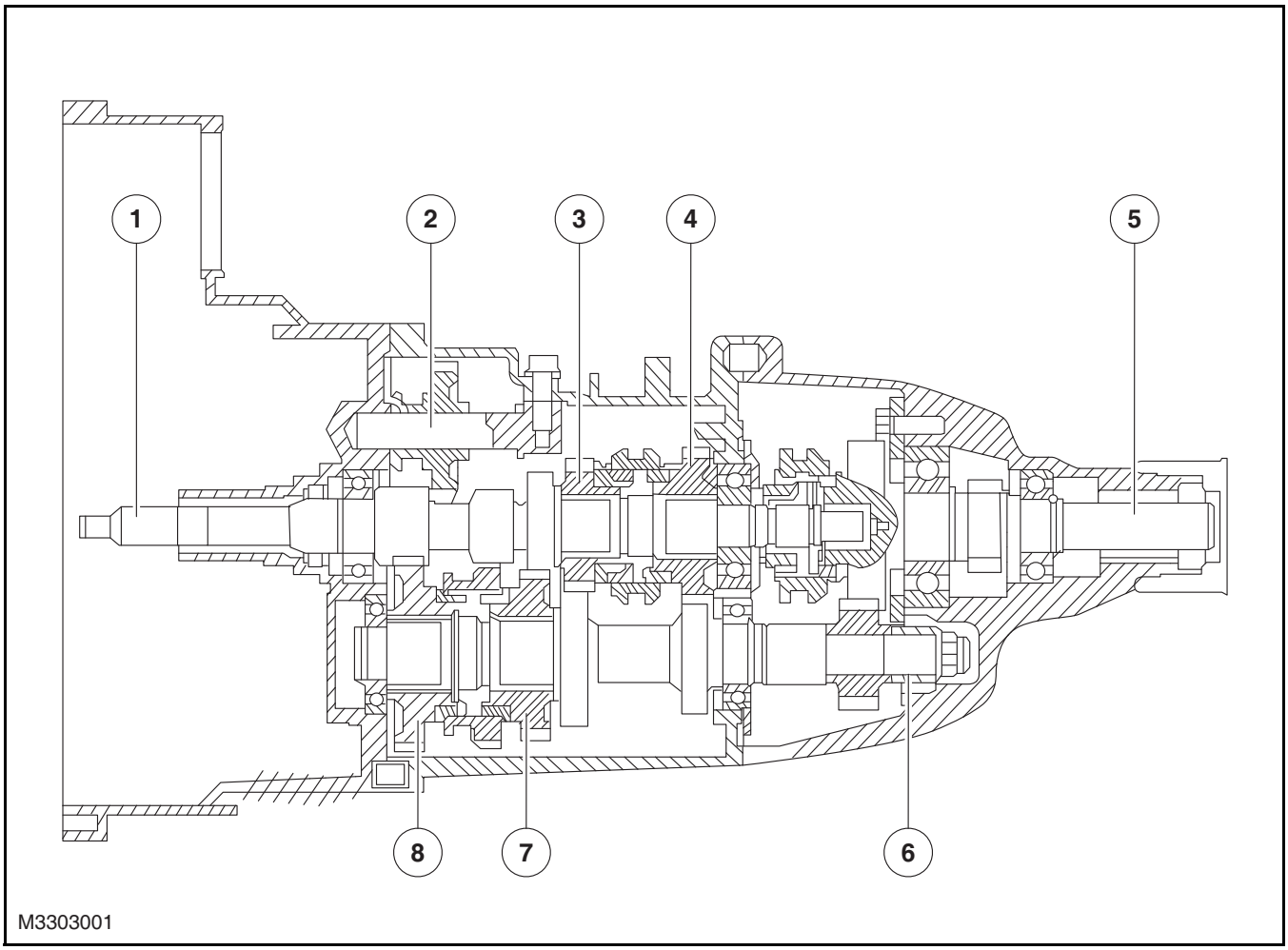
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## Description and Operation

# Components Location View

### MR510L02 Transmission Structure Chart



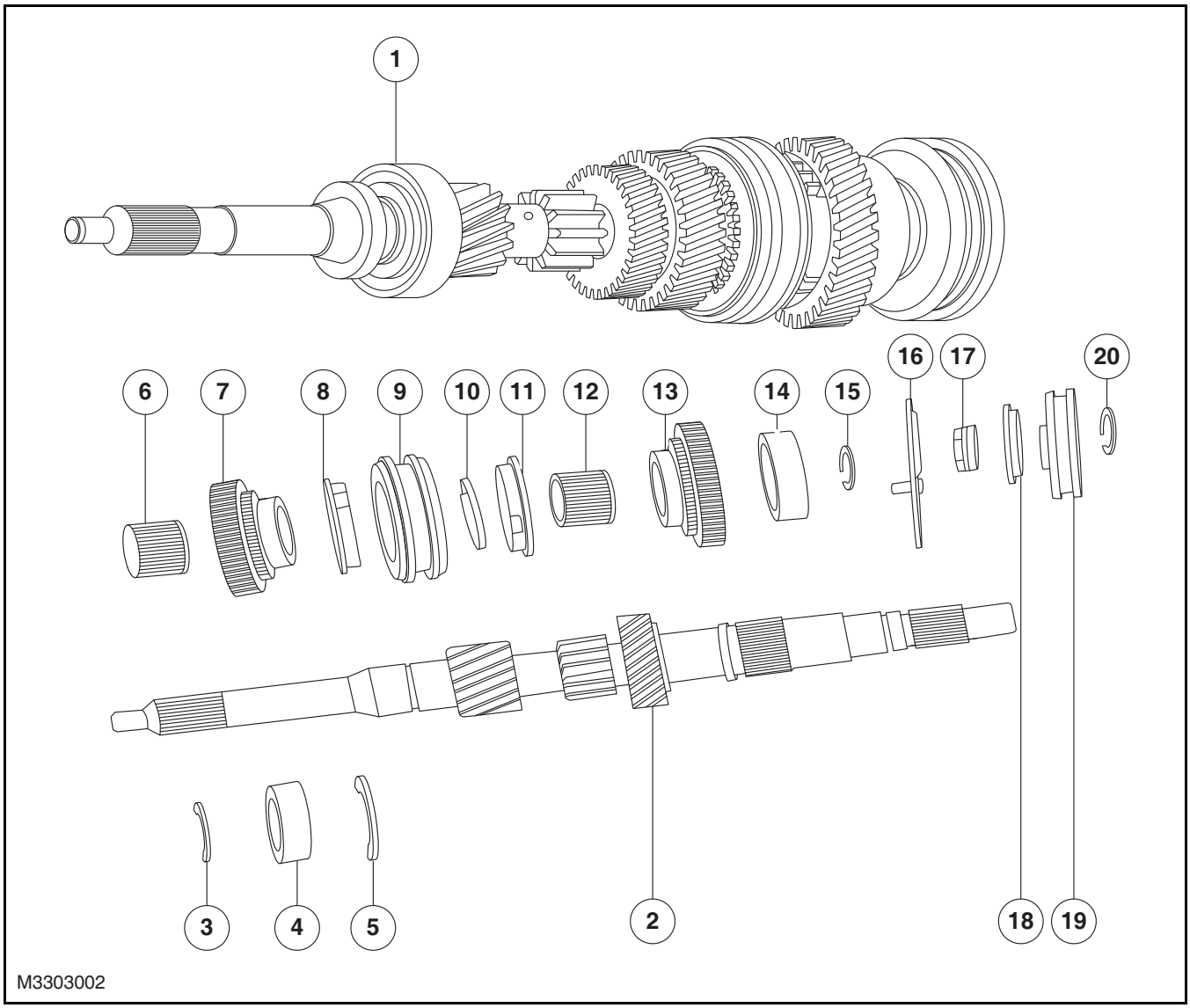

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Input shaft | 5 | Output shaft |
| 2 | Reverse gear shaft | 6 | Intermediate shaft |
| 3 | 3rd gear | 7 | 2nd gear |
| 4 | 4th gear | 8 | 1st gear |

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# Components Exploded View

## 1. Input Shaft Set



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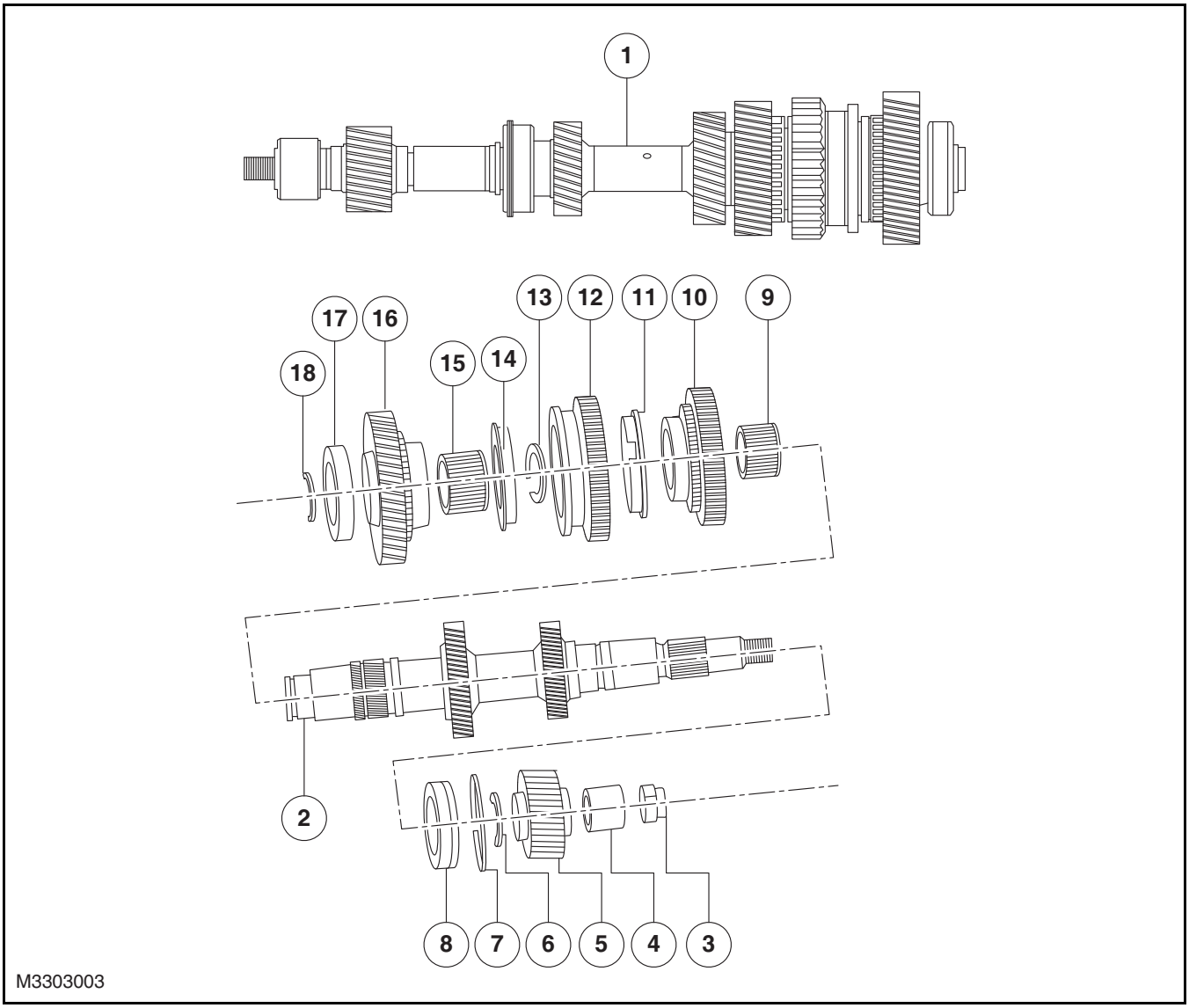


| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Input shaft set | 1 | 11 | High-speed synchronizer gear ring | 1 |
| 2 | Input shaft | 1 | 12 | 4th gear needle roller bearing | 1 |
| 3 | Input shaft front case rear bearing circlip | 1 | 13 | Input shaft 4th gear assembly | 1 |
| 4 | Input shaft front case rear bearing | 1 | 14 | Input shaft rear case rear bearing | 1 |
| 5 | Input shaft front case rear circlip | 1 | 15 | Input shaft rear case rear bearing circlip | 1 |
| 6 | 3rd gear needle roller bearing | 1 | 16 | Rear case cover | 1 |
| 7 | 3rd gear assembly | 1 | 17 | Reverse gear taper ring | 1 |
| 8 | High-speed synchronizer gear ring | 1 | 18 | Reverse gear stop ring | 1 |
| 9 | High-speed synchronizer set | 1 | 19 | 5th gear synchronizer set | 1 |
| 10 | High-speed synchronizer circlip | 1 | 20 | 5th gear synchronizer circlip | 1 |

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## 2. Intermediate Shaft Set



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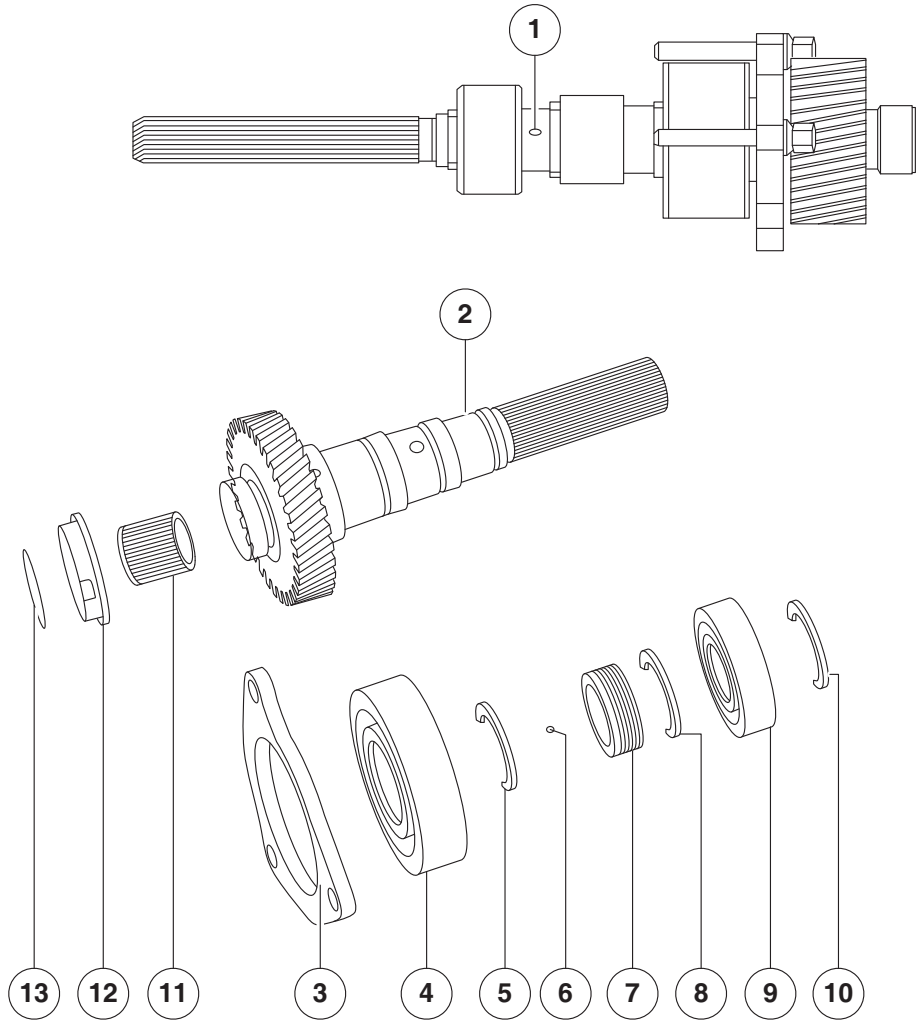


| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Intermediate shaft set | 1 | 10 | Intermediate shaft 2nd gear | 1 |
| 2 | Intermediate shaft | 1 | 11 | 2nd gear synchronizer gear ring | 1 |
| 3 | Intermediate shaft nut | 1 | 12 | Low-speed synchronizer set | 1 |
| 4 | Intermediate shaft rear case rear bearing bushing | 1 | 13 | Low-speed synchronizer circlip | 1 |
| 5 | Intermediate shaft driven gear | 1 | 14 | 1st gear synchronizer gear ring | 1 |
| 6 | Intermediate shaft rear bearing circlip | 1 | 15 | 1st gear needle roller bearing | 1 |
| 7 | Intermediate shaft rear bearing outer circlip | 1 | 16 | Intermediate shaft 1st gear | 1 |
| 8 | Intermediate shaft rear bearing | 1 | 17 | Intermediate shaft front case rear bearing | 1 |
| 9 | 2nd gear needle roller bearing | 1 | 18 | Intermediate shaft front case rear bearing circlip | 1 |

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## 3. Output Shaft Set



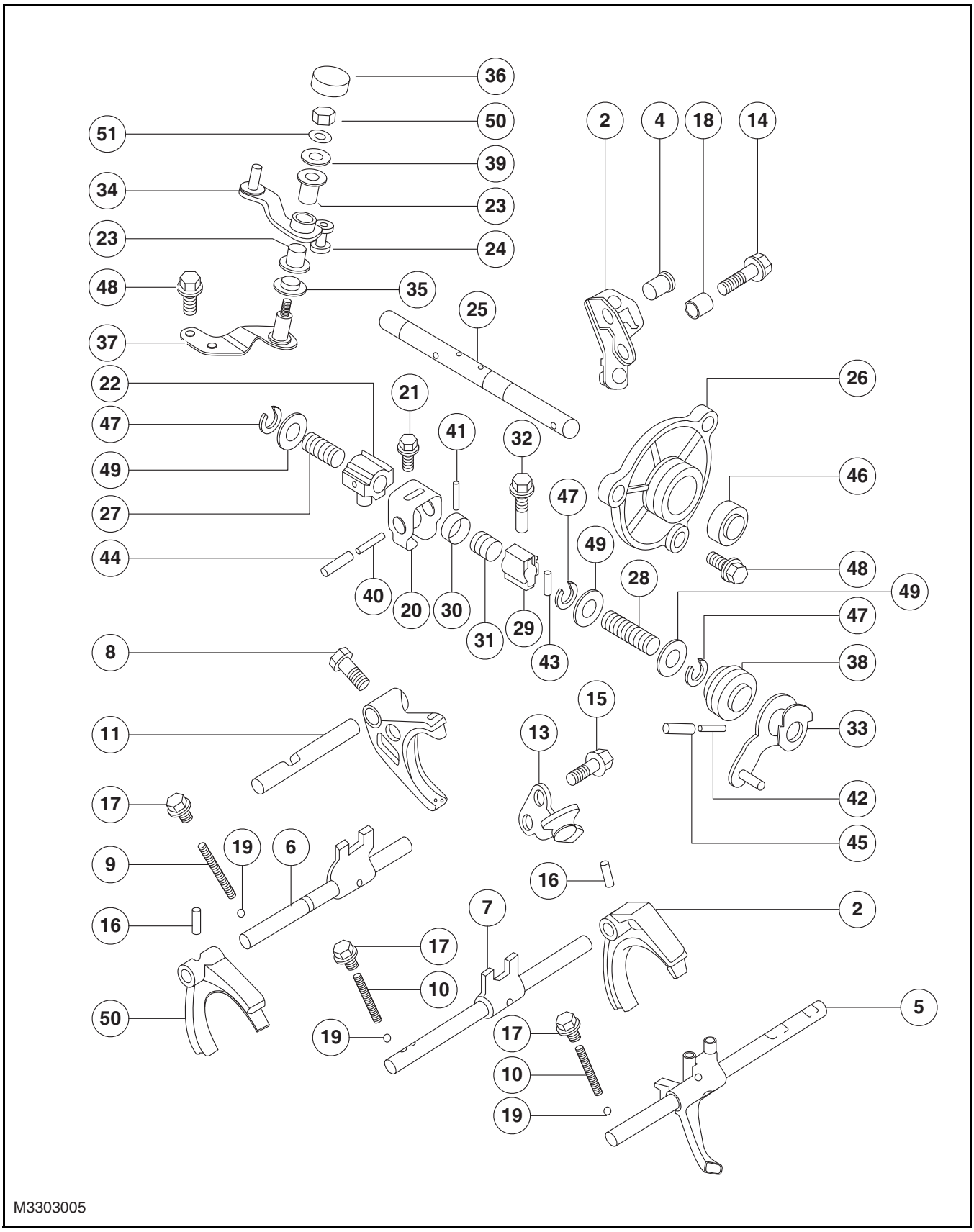

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| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Output shaft set | 1 | 8 | Worm circlip | 1 |
| 2 | Output shaft | 1 | 9 | Output shaft rear case rear bearing | 1 |
| 3 | Output shaft front case rear bearing pressure plate | 1 | 10 | Output shaft rear case rear bearing circlip | 1 |
| 4 | Output shaft front case rear bearing | 1 | 11 | 5th gear synchronizer wave spring | 1 |
| 5 | Output shaft front case rear bearing circlip | 1 | 12 | 5th gear synchronizer gear ring | 1 |
| 6 | Worm steel ball | 1 | 13 | Input shaft needle roller bearing | 1 |
| 7 | Worm | 1 | | | |

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## 4. Gearshift Mechanism



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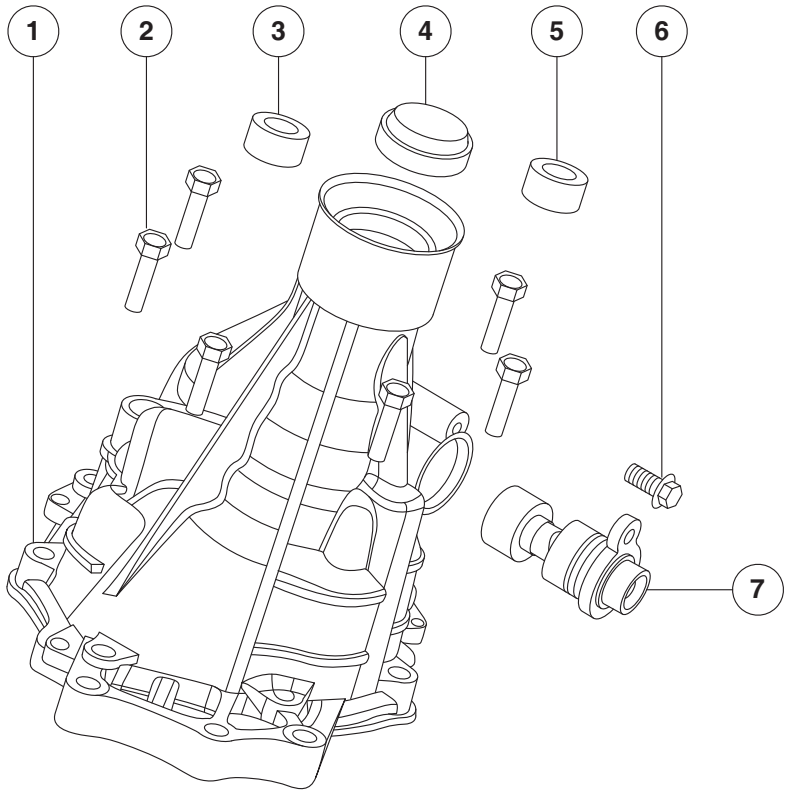


| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | 1st-2nd gear shift fork | 1 | 27 | Low-speed gear select spring | 1 |
| 2 | 3rd-4th gear shift fork | 1 | 28 | Reverse gear select spring | 1 |
| 3 | 5th gear shift fork | 1 | 29 | Reverse lock cam | 1 |
| 4 | Reverse gear shift fork locking assembly | 1 | 30 | Reverse lock cam seat | 1 |
| 5 | Reverse gear fork shaft assembly | 1 | 31 | Cam seat return spring | 1 |
| 6 | 1st-2nd gear fork shaft assembly | 1 | 32 | 5th and reverse gear interlocking bolt | 1 |
| 7 | 3rd-4th gear fork shaft assembly | 1 | 33 | Shift rocker assembly | 1 |
| 8 | 5th gear fork bolt | 1 | 34 | Select rocker assembly | 1 |
| 9 | Self-locking long spring | 1 | 35 | Guide shaft inner dust cover | 1 |
| 10 | Self-locking short spring | 2 | 36 | Guide shaft outer dust cover | 1 |
| 11 | 5th gear fork shaft | 1 | 37 | Select rocker bracket assembly | 1 |
| 12 | Reverse gear shift fork assembly | 1 | 38 | Gear shift shaft dust boot | 1 |
| 13 | 5th gear shift lever assembly | 1 | 39 | Guide shaft washer | 1 |
| 14 | Reverse gear fork assembly bolt | 2 | 40 | Select arm inner pin | 1 |
| 15 | 5th gear shift lever bolt | 2 | 41 | Reverse lock cam seat pin | 1 |
| 16 | Gear shift fork pin | 2 | 42 | Shift rocker arm inner pin | 1 |
| 17 | Gear shift locking bolt | 3 | 43 | Reverse lock cam pin | 1 |
| 18 | Reverse gear shift fork assembly dowel pin | 2 | 44 | Select arm outer pin | 1 |
| 19 | Fork shaft steel ball | 3 | 45 | Shift rocker outer pin | 1 |
| 20 | Interlock cover | 1 | 46 | Gear shift shaft oil seal | 1 |
| 21 | Gear shift locking bolt assembly | 1 | 47 | Gear shift shaft E circlip | 3 |
| 22 | Select arm | 1 | 48 | Gearshift guide case bolt | 5 |
| 23 | Spacer | 2 | 49 | Gear shift shaft washer | 3 |
| 24 | Spacer | 1 | 50 | Guide shaft nut | 1 |
| 25 | Gear shift shaft | 1 | 51 | Guide shaft elastic washer | 1 |
| 26 | Gearshift guide case | 1 | | | |

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## 5. Transmission Extension Case



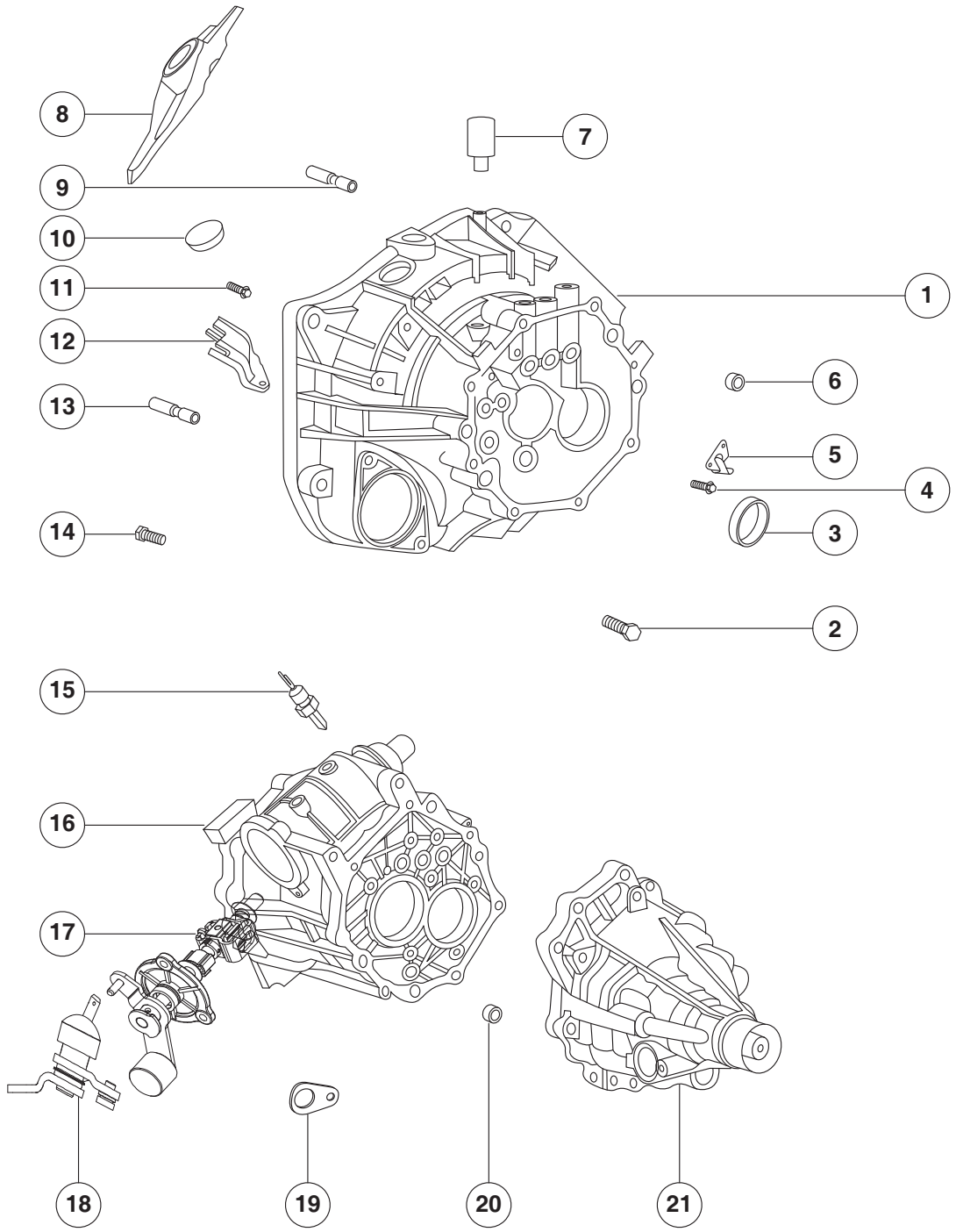

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| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Extension case assembly | 1 | 5 | Drain plug | 1 |
| 2 | Extension case bolt | 7 | 6 | Worm bushing bolt | 1 |
| 3 | Inlet plug | 1 | 7 | Worm set | 1 |
| 4 | Extension case oil seal | 1 | | | |

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## 6. Transmission External Components (Front / Rear Case)




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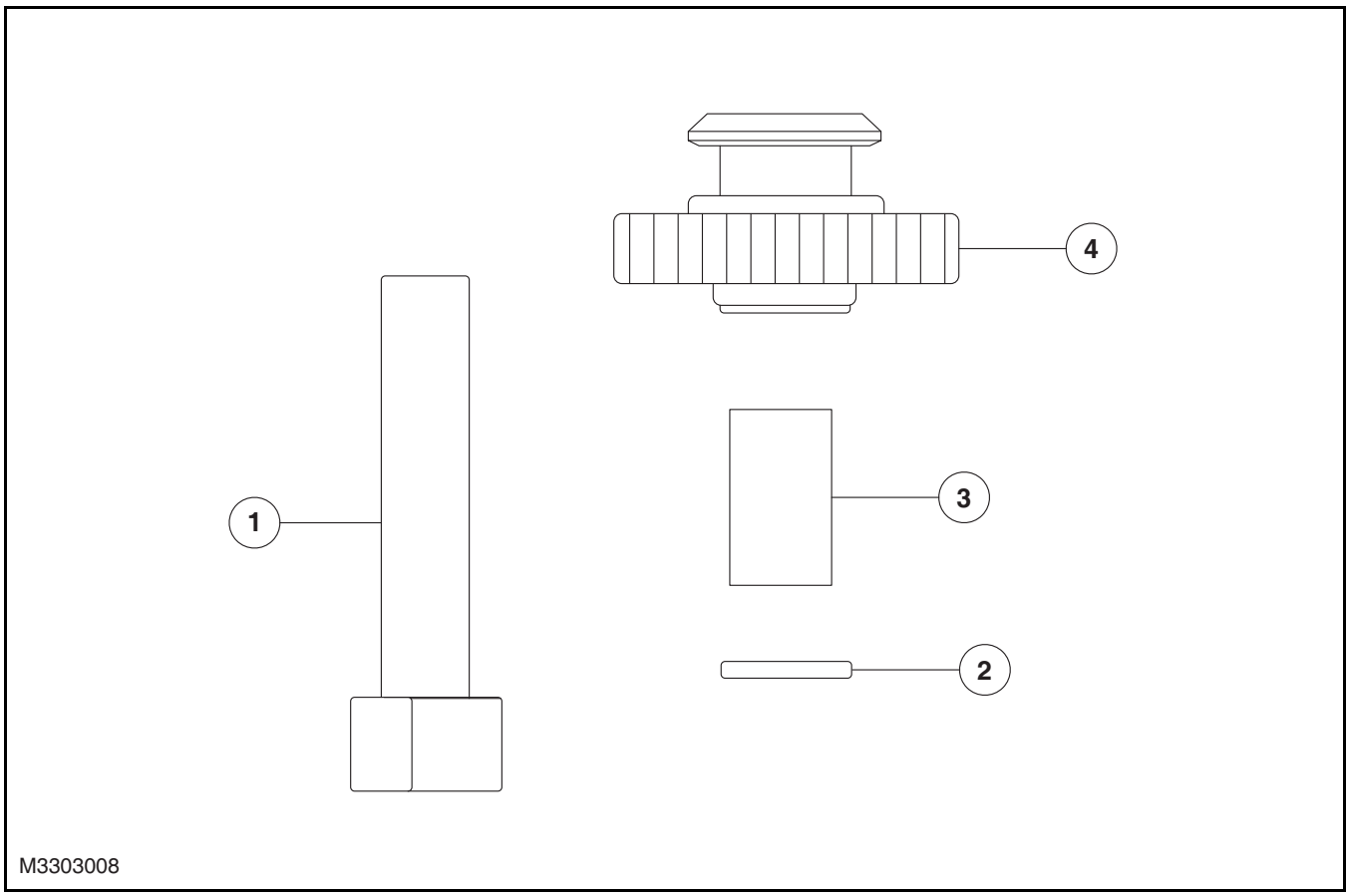


| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Front case | 1 | 12 | Cable bracket | 1 |
| 2 | Front and rear case No.1 bolt | 5 | 13 | Transmission No.2 stud bolt | 1 |
| 3 | Input shaft oil seal | 1 | 14 | Transmission No.2 stud bolt M8 | 3 |
| 4 | Oil guide bolt | 1 | 15 | Backup lamp switch assembly | 1 |
| 5 | Oil delivery trough assembly | 1 | 16 | Rear case | 1 |
| 6 | Front and rear case dowel pin | 2 | 17 | Gear shift shaft set | 1 |
| 7 | Vent plug | 1 | 18 | Select rocker set | 1 |
| 8 | Clutch fork set | 1 | 19 | Hook | 2 |
| 9 | Transmission No.1 stud bolt | 1 | 20 | Extension case dowel pin | 2 |
| 10 | Viewport cover | 1 | 21 | Extension case set | 1 |
| 11 | Cable bracket bolt M8 | 2 | | | |

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## 7. Reverse Gear Shaft Set




| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Reverse gear shaft | 1 | 3 | Reverse idler gear bushing | 1 |
| 2 | Reverse gear shaft washer | 1 | 4 | Reverse idler gear | 1 |

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## General Inspection

# Transmission Maintenance Intervals

**Regular maintenance interval is given in the following table:**

| km | $1\times10^4$ | $2\times10^4$ | $3\times10^4$ | $4\times10^4$ | $5\times10^4$ | $6\times10^4$ | $7\times10^4$ | $8\times10^4$ |
|---|---|---|---|---|---|---|---|---|
| Month | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 |
| Method | B | H | B | H | B | H | B | H |

**CAUTION: B stands for replacing the transmission oil as necessary during maintenance check; H stands for replacing the transmission oil.**

**CAUTION: The maintenance intervals should be determined by the odometer reading or the month, whichever comes first.**

**CAUTION: This table shows the regular maintenance within $8\times10^4$ km, and also follow the same interval shown in table for maintenance in case of exceeding $8\times10^4$ km.**

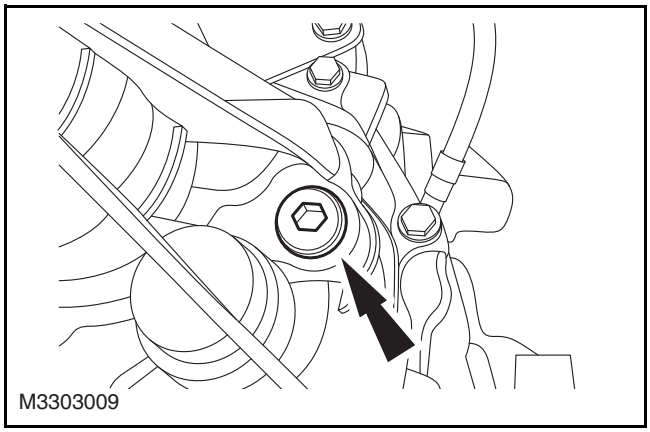
**CAUTION: Transmission oil volume is 1.5 L.**

**CAUTION: If the vehicle is lifting for other repair work except changing the oil, the transmission oil also should be checked at the same time.**

# Inspection of Transmission Oil

1. Confirm that the vehicle is horizontal so as to inspect oil level.
2. To prevent uncertainty, vehicle inspection can be performed when the oil level is maintained and the oil temperature is close to normal temperature rather than done immediately after the vehicle stops, due to thermal expansion of oil.
3. Inspect whether the transmission oil is leaking. Repair if necessary.
4. Remove the inlet plug.

   Torque: 10 ~ 25 Nm




5. Inspect oil level. You can inspect oil level roughly through inlet plug hole. Remove the inlet plug, if the oil flows out from or reaches the inlet plug hole, the oil level is normal. If not, add the specified oil until it slowly flows from the inlet plug hole.

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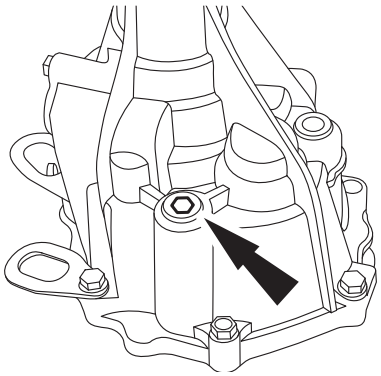
# Replacement of Transmission Oil

1. Stop engine and lift vehicle horizontally before replacing transmission oil.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Inspect oil level and leaking when lifting the vehicle. Repair if necessary.
3. Remove oil drain plug and drain waste oil.
4. Apply the sealant to the oil drain plug and tighten it to the specified torque.

   Torque: 10 ~ 25 Nm



M3303010

5. Remove the inlet plug.
6. Add the specified transmission oil until it comes out from the inlet plug hole.
   Apply the sealant to the inlet plug and tighten it to the specified torque.

   Torque: 10 ~ 25 Nm

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## Removal and Installation

# Vehicle Speed Sensor

### Removal

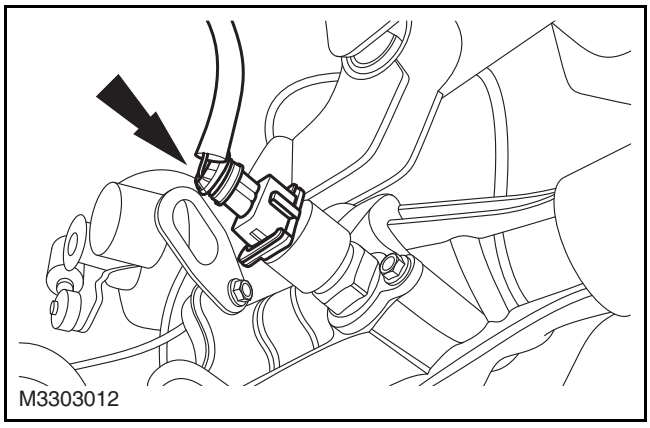
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

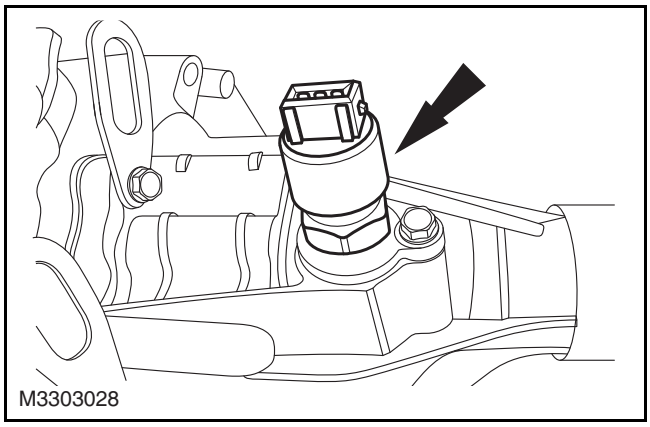
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Disconnect the vehicle speed sensor wiring harness connector.




4. Use a proper tool to remove the vehicle speed sensor.

   Torque: 10 Nm




### Installation

1. Installation is in the reverse order of removal.

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# Backup Lamp Switch

## Removal

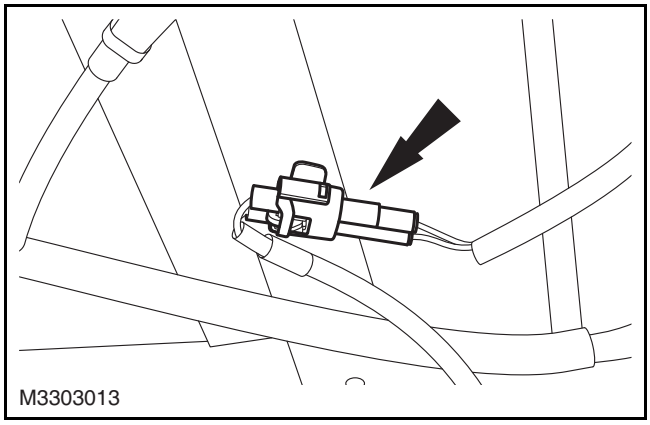
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

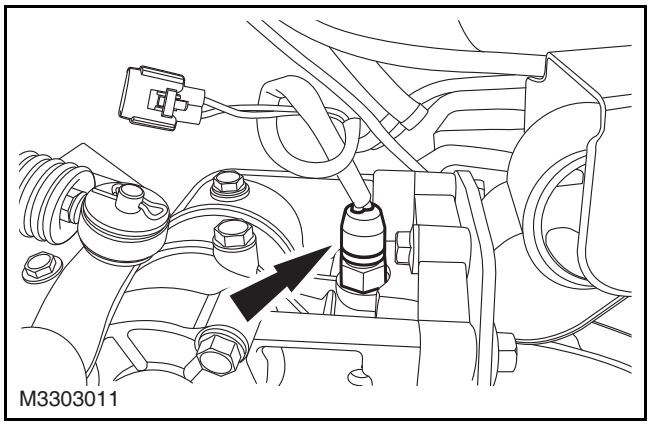
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Disconnect the backup lamp switch wiring harness connector.




4. Use a proper tool to remove the backup lamp switch.

   Torque: 15 ~ 20 Nm




## Installation

1. Installation is in the reverse order of removal.

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# Manual Transmission

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the crankshaft position sensor.

   **Refer to: Crankshaft Position Sensor (3.1.12 Electronic Control System - M7, Removal and Installation).**

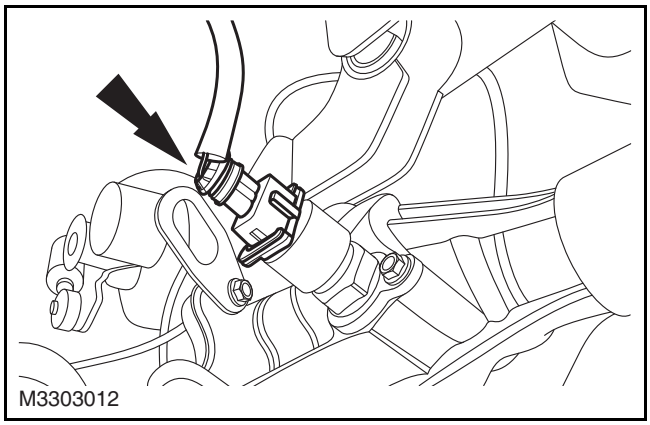
3. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

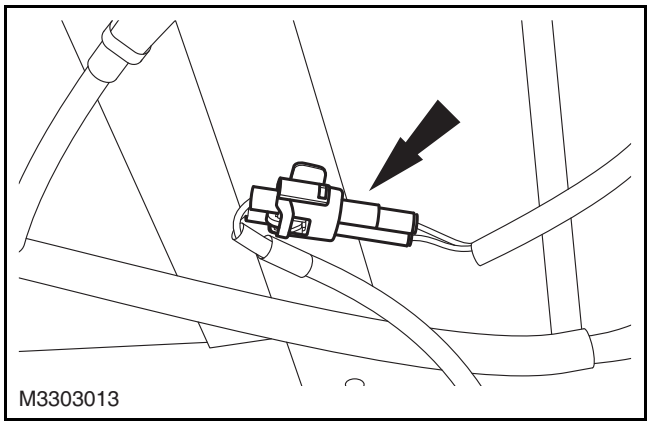
4. Drain the transmission oil.

   **Refer to: Replacement of Transmission Oil (3.3.3 Manual Transmission - MR510L02, General Inspection).**

5. Disconnect the vehicle speed sensor wiring harness connector.


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6. Disconnect the backup lamp switch wiring harness connector.

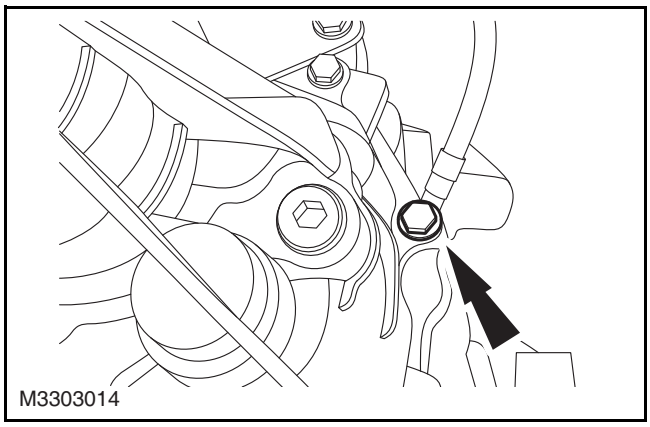

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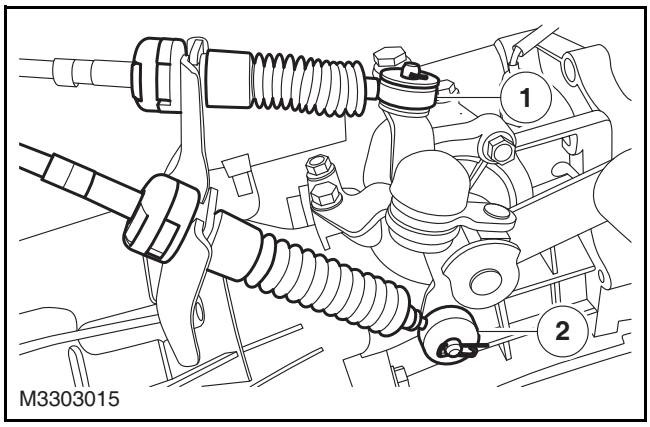
**7.** Remove the transmission grounding wiring harness retaining bolt.

Torque: 8 ± 1 Nm

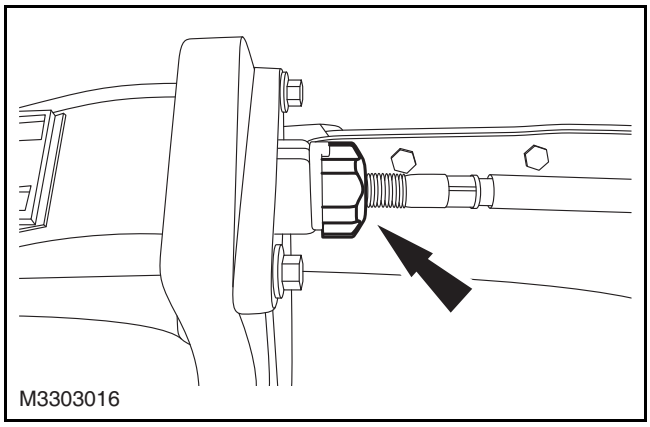



**8.** Disconnect the gear shift cable (1) and gear select cable (2) from the transmission.

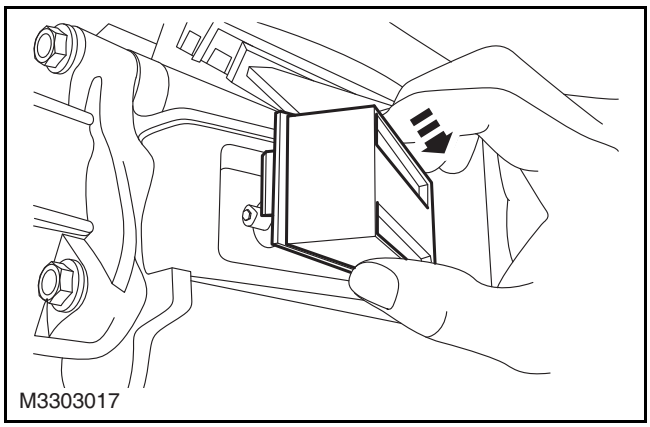
**Refer to: Gearshift Mechanism (3.3.4 Manual Transmission External Control, Removal and Installation).**




**9.** Loosen the clutch cable retaining nut.



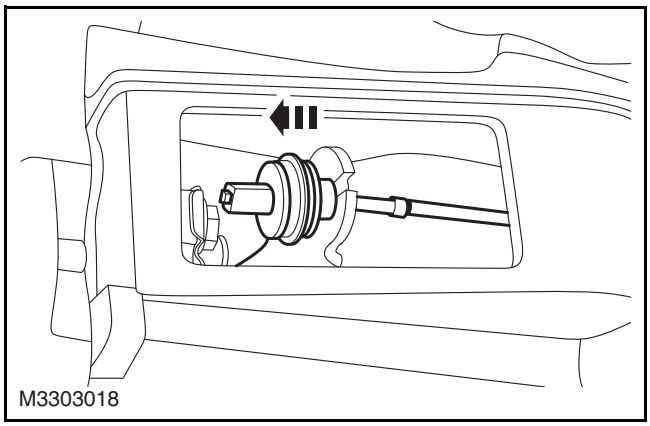

**10.** Remove the clutch cable cover.



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**11.** Disconnect the clutch cable from the clutch fork.


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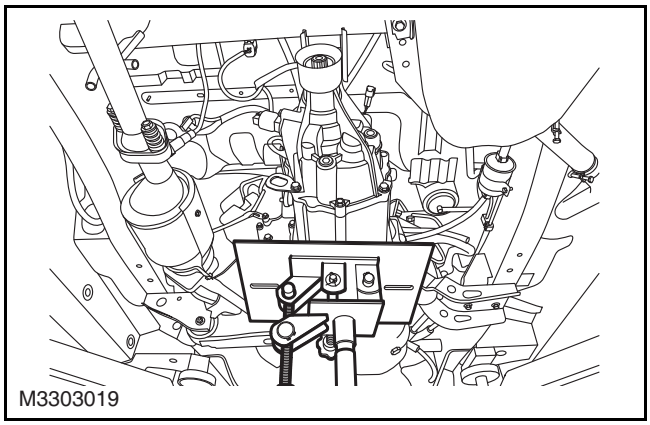
**12.** Remove the starting motor.

**Refer to: Starting Motor (3.1.9 Starting System, Removal and Installation).**

**13.** Remove the propeller shaft.

**Refer to: Propeller Shaft (2.2.2 Propeller Shaft, Removal and Installation).**

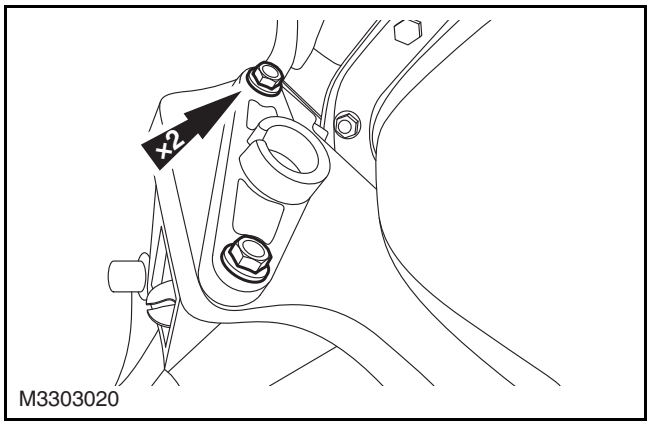
**14.** Use the flat jack to support the transmission.


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**15.** Remove the positioning plate of clutch cable retaining nuts.

1 Remove 2 positioning plate retaining bolts.

Torque: 23 ± 2 Nm



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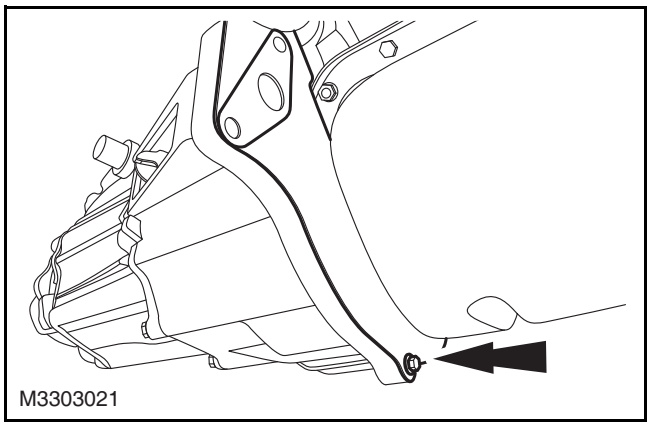
2 Remove the positioning plate of clutch cable retaining nuts.

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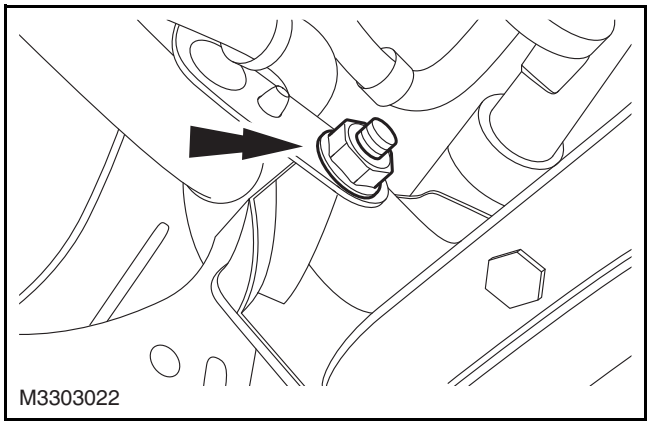
**16.** Remove the clutch partition plate retaining bolt and remove the clutch partition plate.

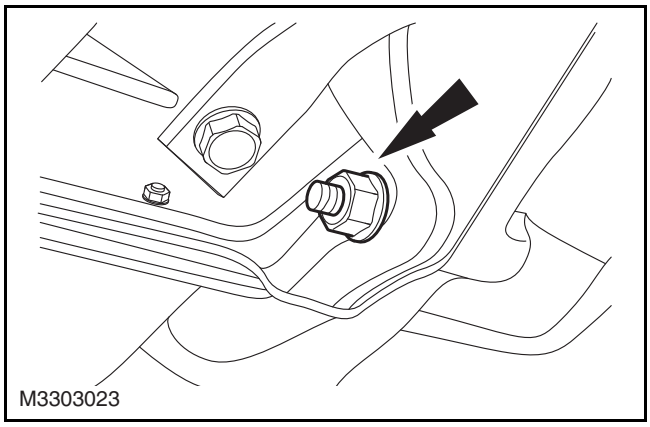
Torque: 10 Nm


M3303021

**17.** Remove 2 connecting nuts between transmission and engine.

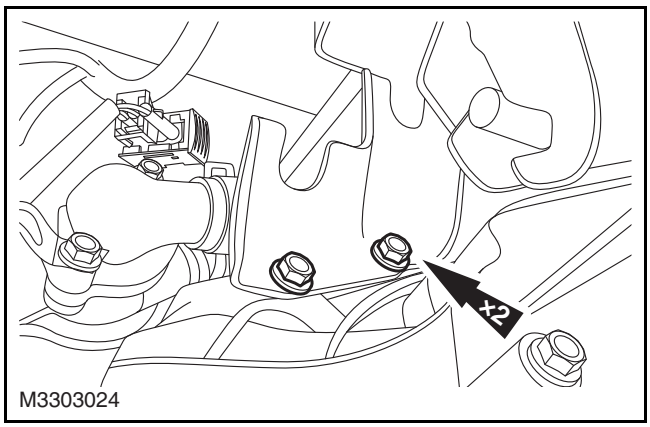
Torque: 58 Nm


M3303022


M3303023

**18.** Remove 2 retaining bolts from the gear shift and select cable bracket, and remove the gear shift and select cable bracket.

Torque: 23 ± 2 Nm



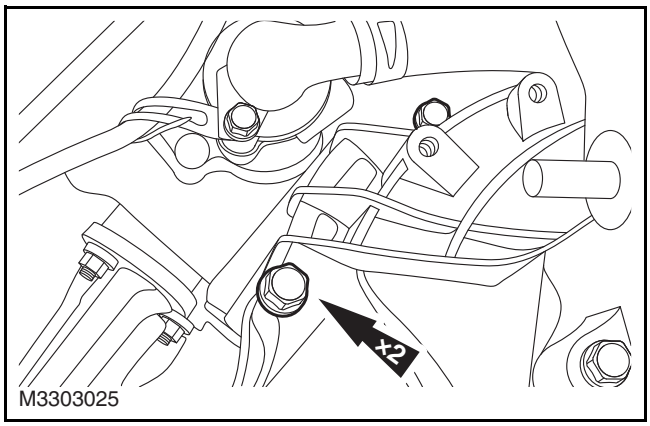
M3303024

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**19.** Remove 2 connecting bolts between transmission and engine.

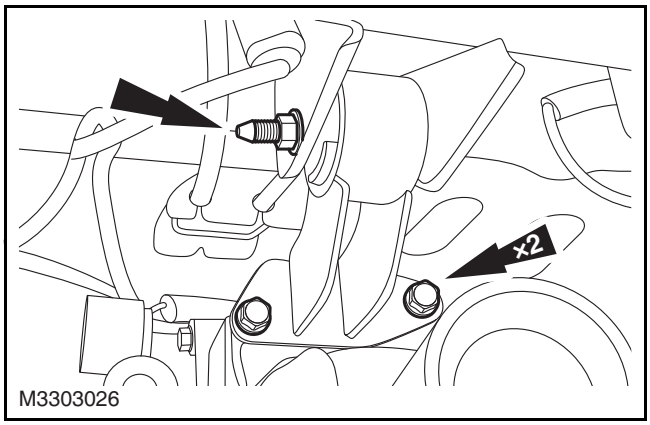
Torque: 51 Nm



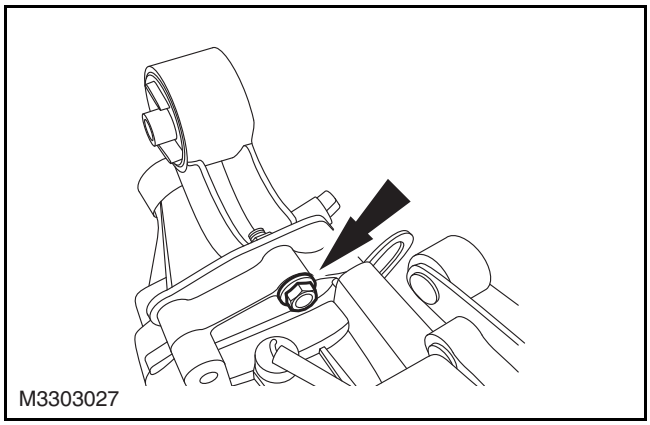
M3303025

**20.** Remove the rear mounting bush assembly retaining nut and 3 retaining bolts.

Torque: 55 ± 10 Nm



M3303026


M3303027

**21.** Separate the transmission from the engine, lower the flat jack slowly and remove the transmission.

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## Installation

1. Installation is in the reverse order of removal.
2. Fill manual transmission oil, and inspect transmission oil level.

**CAUTION: Inspection of Transmission Oil (3.3.3 Manual Transmission - MR510L02, General Inspection).**

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## Disassembly and Assembly

# Disassembly of Transmission

### Precautions

**CAUTION: Keep the disassembly and assembly site clean.**

**CAUTION: Be careful not to scratch the oil seal lip while installing the propeller shaft.**

**CAUTION: It is better to use hexagon sockets while disassembling and assembling bolts.**

**CAUTION: The fitting surface of components should be clean and scatheless while disassembling and assembling.**

**CAUTION: Components should be classified and placed unifiedly while disassembling and assembling.**

**CAUTION: Only use rubber hammer to strike when disassembling the case.**

### General Equipment

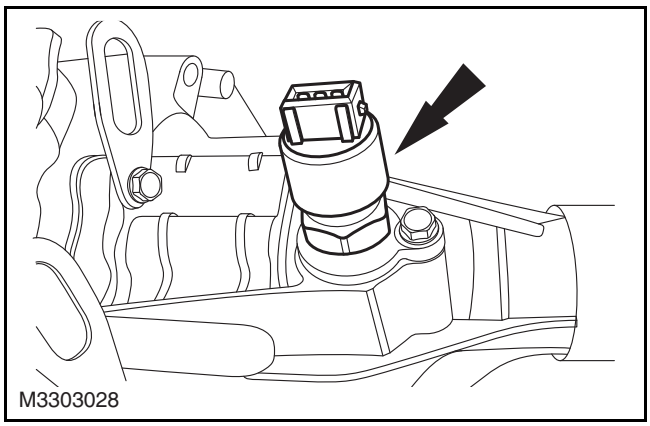
| |
|---|
| Rubber hammer |
| Copper rod |

### Disassembly

1. Remove the manual transmission.

   **Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**

2. Remove the vehicle speed sensor.



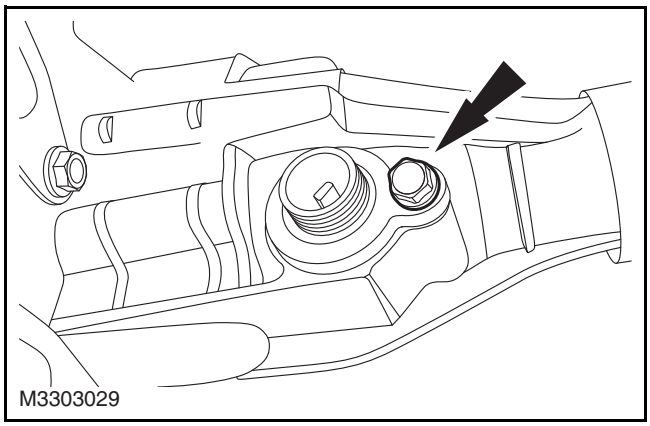
https://truckmanualshub.com/



**3.** Remove the worm set.

1 Remove the worm set retaining bolt.

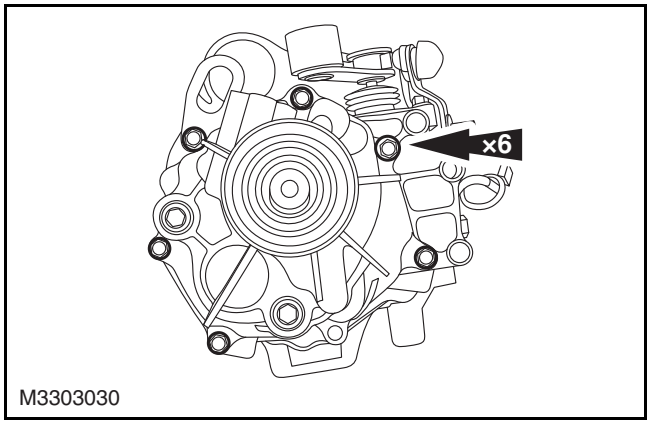
Torque: 10 ± 1 Nm


M3303029

2 Remove the worm set.

**4.** Remove 6 retaining bolts from extension case.

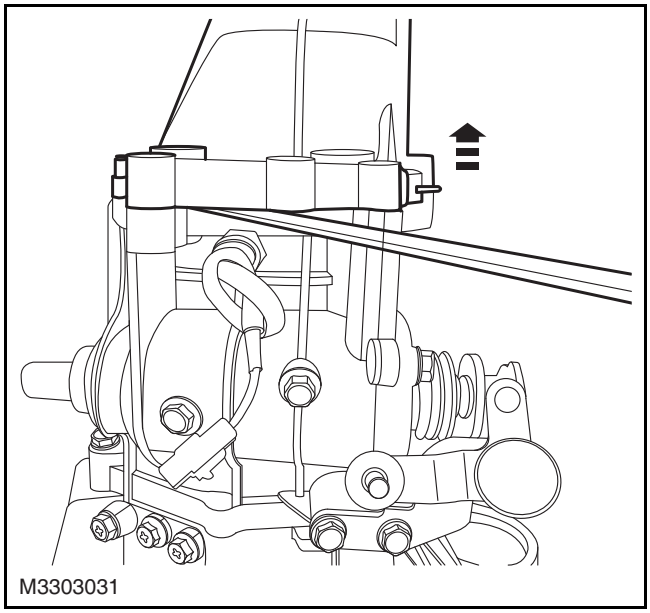
⚠ **CAUTION: Case bolts should be removed diagonally.**



M3303030

**5.** Separate the extension case from rear case with proper tool.

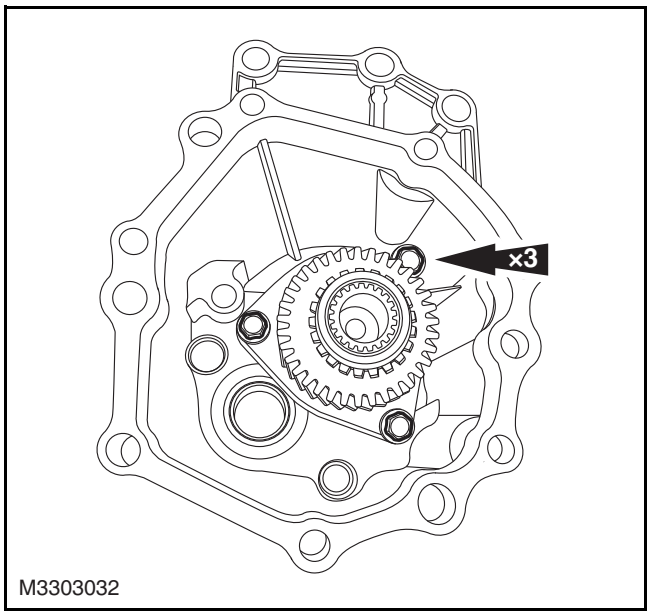
⚠ **CAUTION: Avoid any damage to the contact surface while separating the extension case from rear case.**


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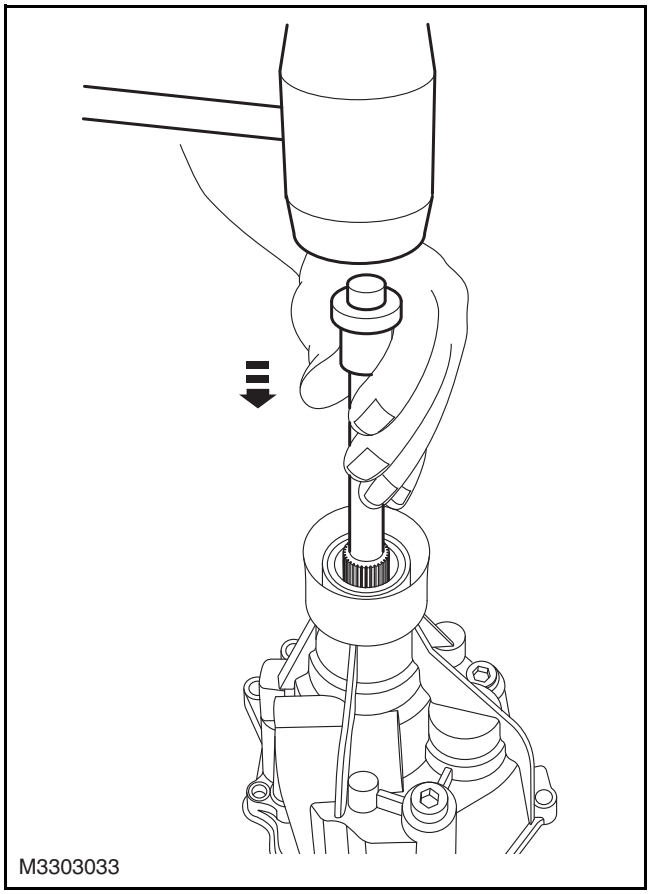


6. Remove 3 retaining bolts from the output shaft front case rear bearing pressure plate.




7. Tap the rear end of output shaft with proper tool lightly to separate the output shaft and extension case.

**CAUTION: Do not damage the output shaft key groove.**



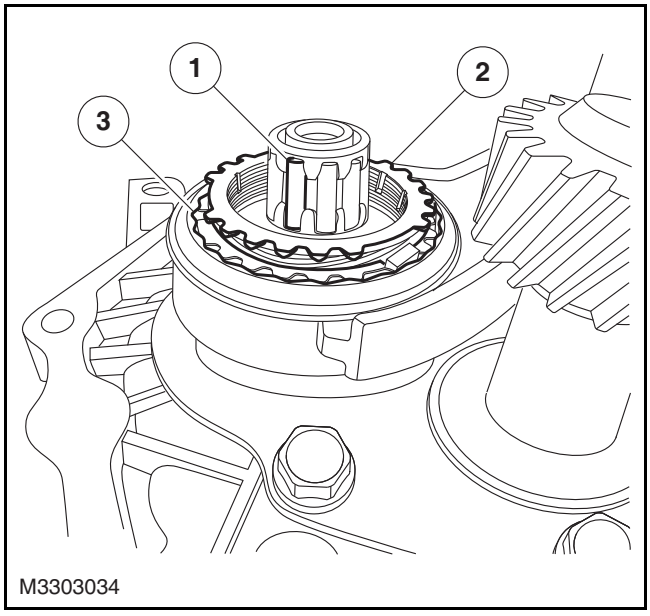

8. Remove the input shaft needle roller bearing (1).

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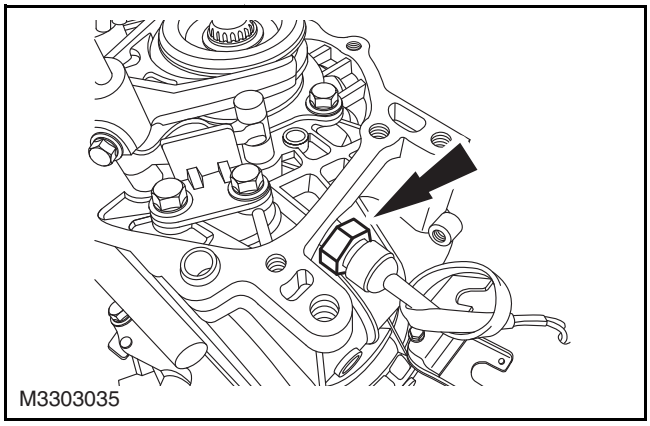
**9.** Remove the 5th gear synchronizer gear ring (2) and 5th gear synchronizer wave spring (3).

**CAUTION: There is 5th gear synchronizer wave ring (3) between 5th gear synchronizer gear ring and 5th gear synchronizer.**



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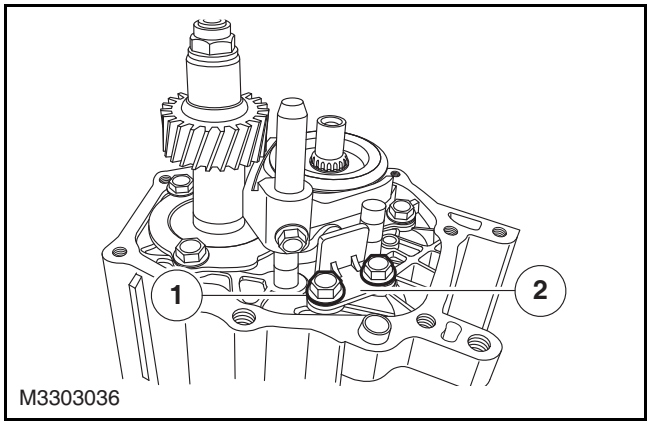
**10.** Remove the backup lamp switch assembly with wrench.


M3303035

**11.** Remove the 5th gear shift lever assembly.

1 Remove 2 retaining bolts (1) from 5th gear shift lever assembly.

2 Remove the 5th gear shift lever assembly (2).

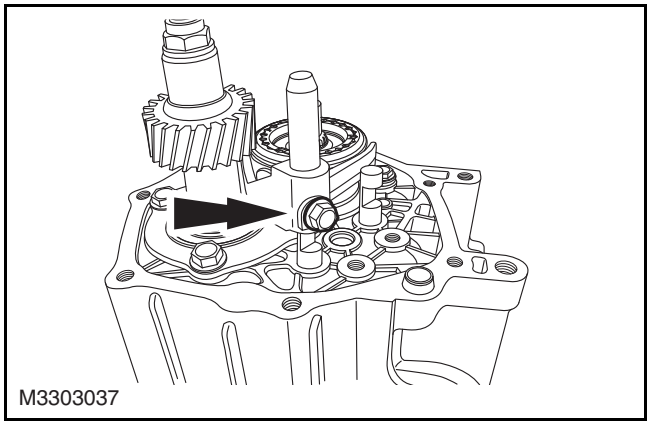


M3303036

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**12.** Remove the 5th gear fork retaining bolt.

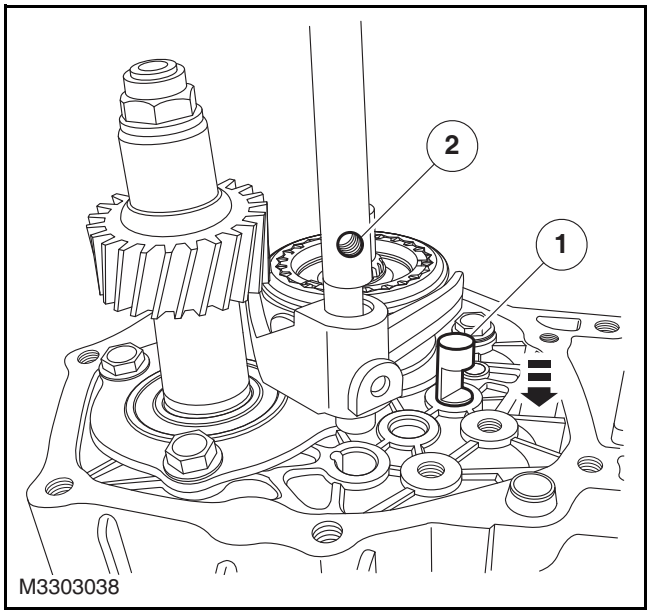



**13.** Remove the 5th gear fork and 5th gear fork shaft.

1 Move the reverse gear fork shaft (1) downward, and engage with the 5th gear.

2 Remove the 5th gear fork and 5th gear fork shaft (2).

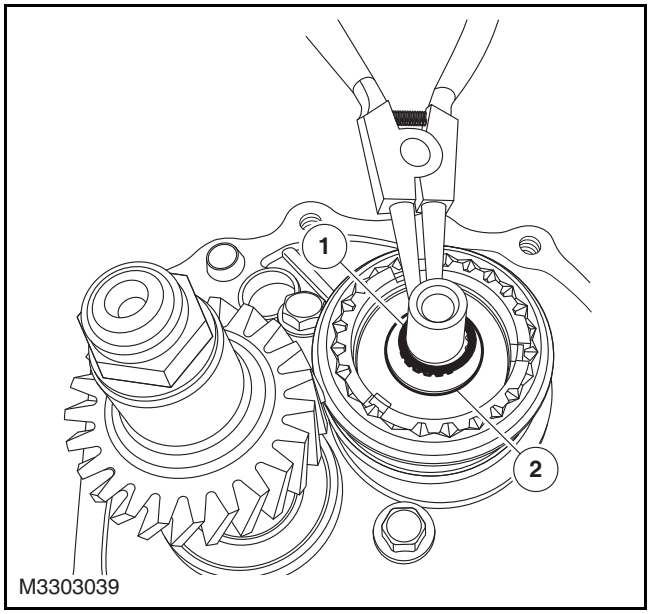
**CAUTION: If reverse gear fork shaft is not moved down, it will interfere with 5th gear shift fork while removal. Move reverse gear fork shaft up until it returns to neutral after removal.**




**14.** Remove the 5th gear synchronizer.

1 Use the circlip pliers to remove the 5th gear synchronizer circlip (1).

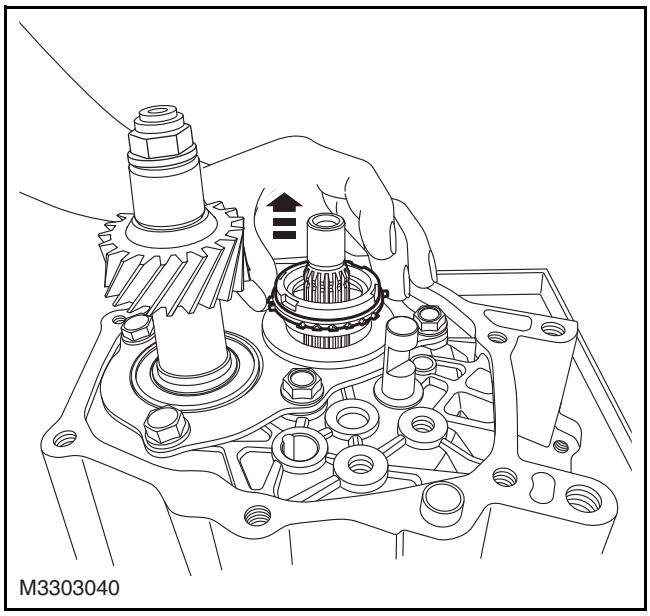
2 Remove the 5th gear synchronizer (2).



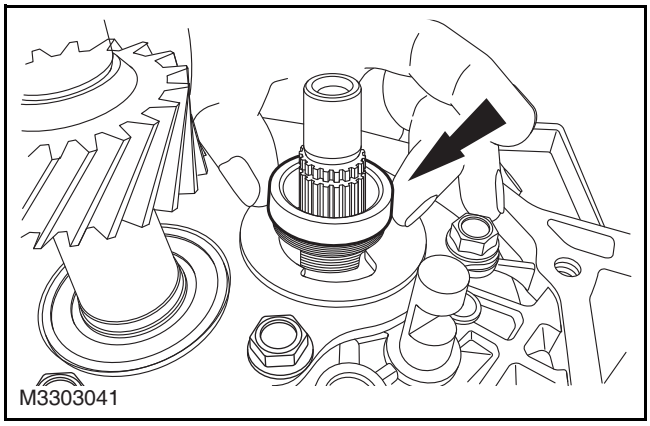
https://truckmanualshub.com/



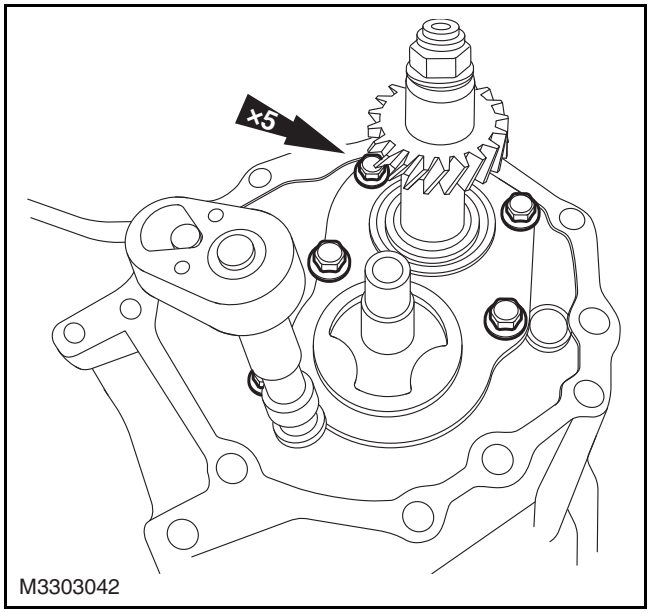
**15.** Remove the reverse gear stop ring.


M3303040

**16.** Remove the reverse gear taper ring.


M3303041

**17.** Remove 5 retaining bolts from the rear case cover.



M3303042

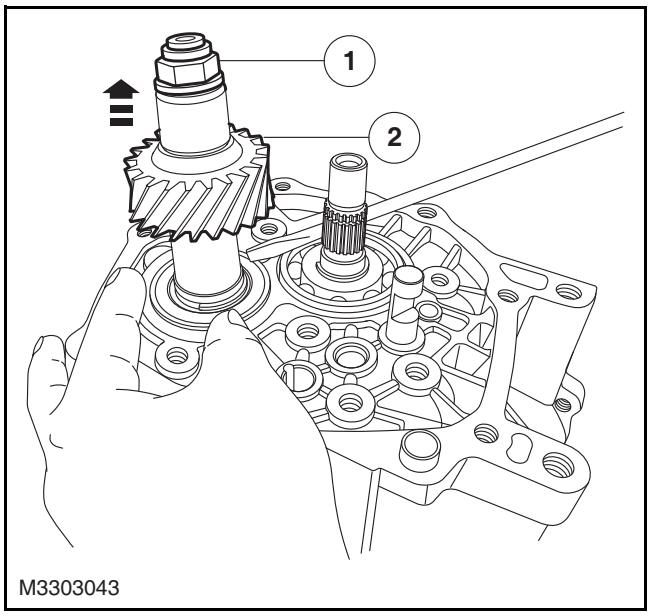
https://truckmanualshub.com/



**18.** Remove the intermediate shaft rear bearing outer circlip.

1 Extract intermediate shaft up with proper tool.

2 Use a proper tool to remove the intermediate shaft rear bearing outer circlip.

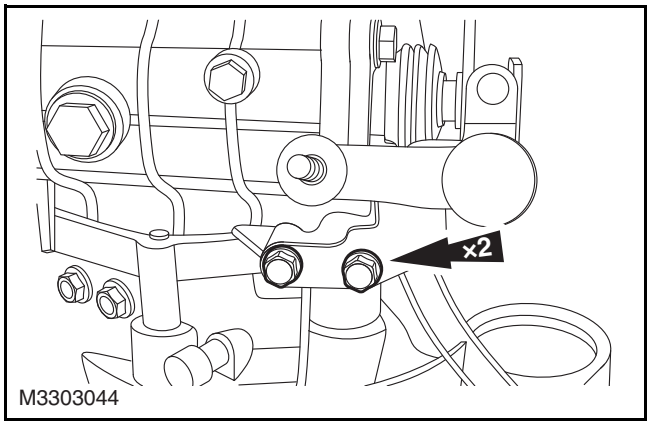


M3303043

**19.** Remove the shift rocker assembly.

1 Remove 2 retaining bolts from the shift rocker bracket.

2 Remove the shift rocker assembly.

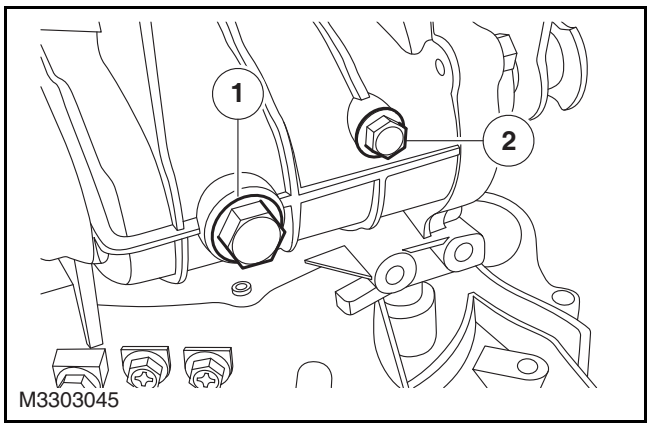


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**20.** Remove the gear shift locking bolt and interlocking bolt of 5th and reverse gear.

1 Remove the gear shift locking bolt (1).

2 Remove the interlocking bolt (2) from 5th and reverse gear.

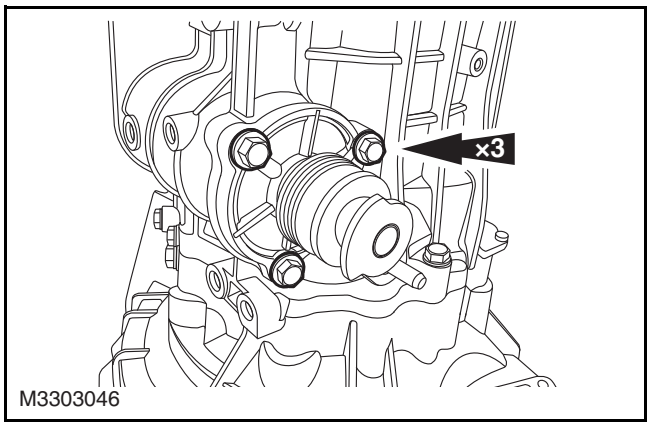


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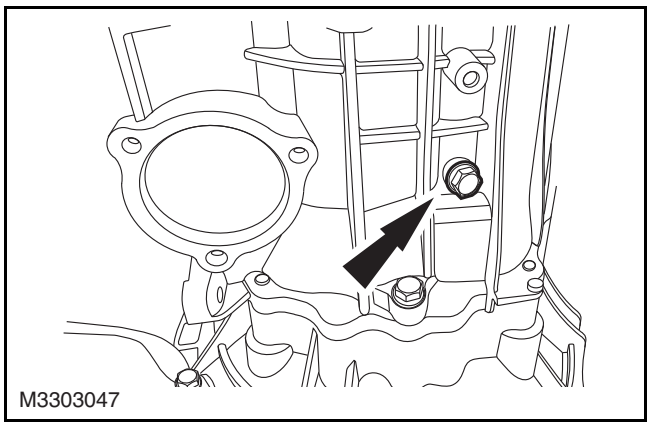


**21.** Remove 3 retaining bolts from the gearshift guide case.



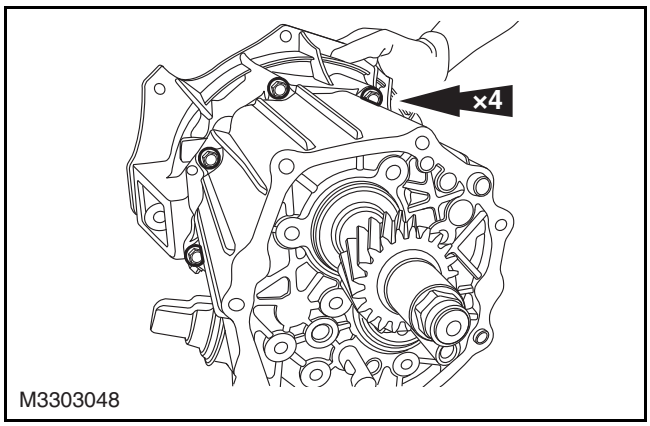

**22.** Tap the gearshift guide case lightly with proper tool to separate it from the case. Remove the shift shaft set of gearshift guide case.

**23.** Remove the reverse gear shaft bolt.



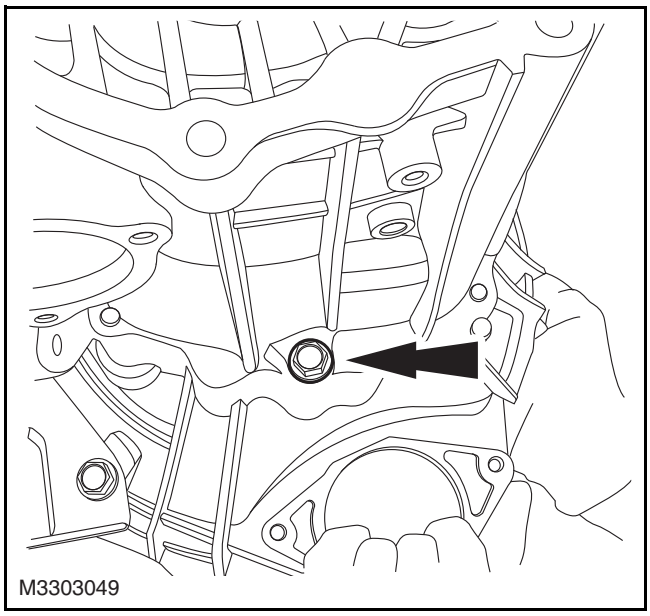

**24.** Remove 5 No.1 connecting bolts from the transmission front and rear cases.

⚠ **CAUTION: Case bolts should be removed diagonally.**

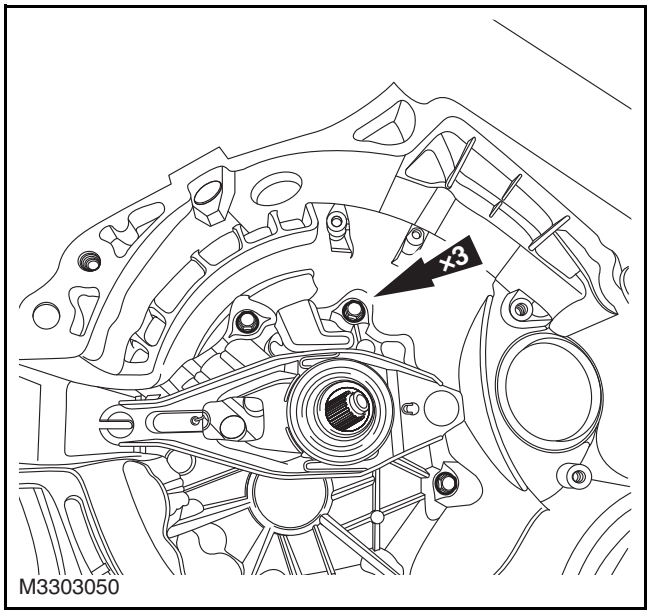


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**25.** Remove 3 No.2 connecting bolts from the transmission front and rear cases.



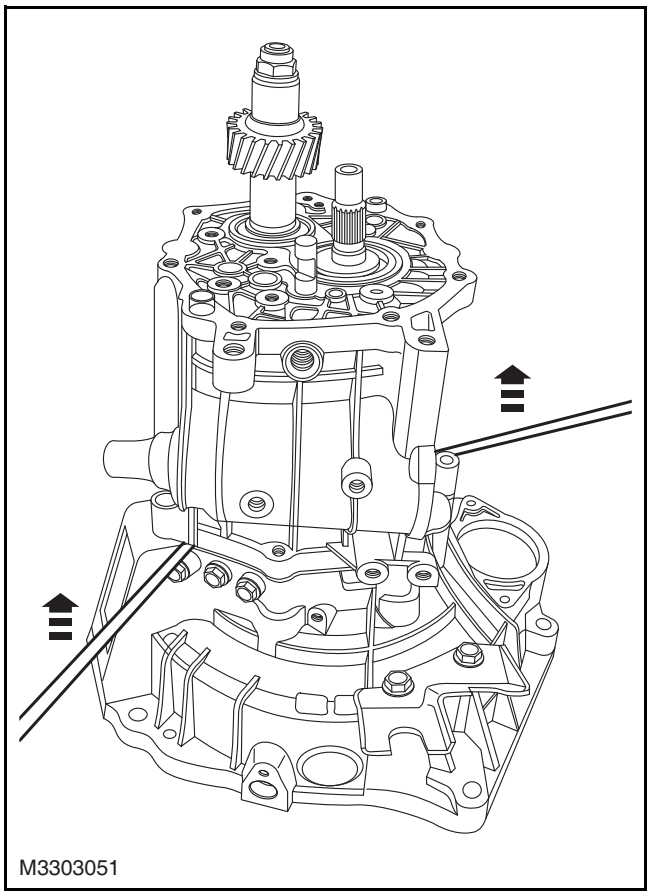
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**26.** Separate the rear case from front case with proper tool.

**CAUTION: Avoid any damage to the contact surface while separating the rear case from front case.**

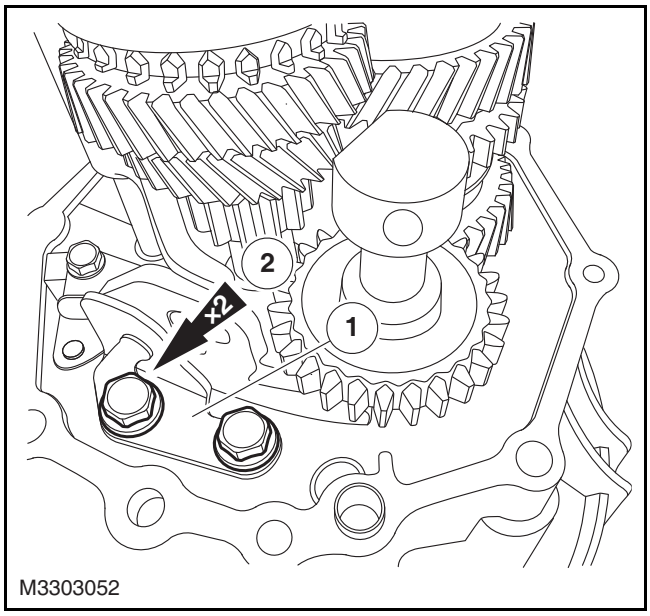


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**27.** Remove the reverse gear shift fork.

1 Remove 2 retaining bolts (2) from the reverse gear shift fork.

2 Remove the reverse gear shift fork (1).

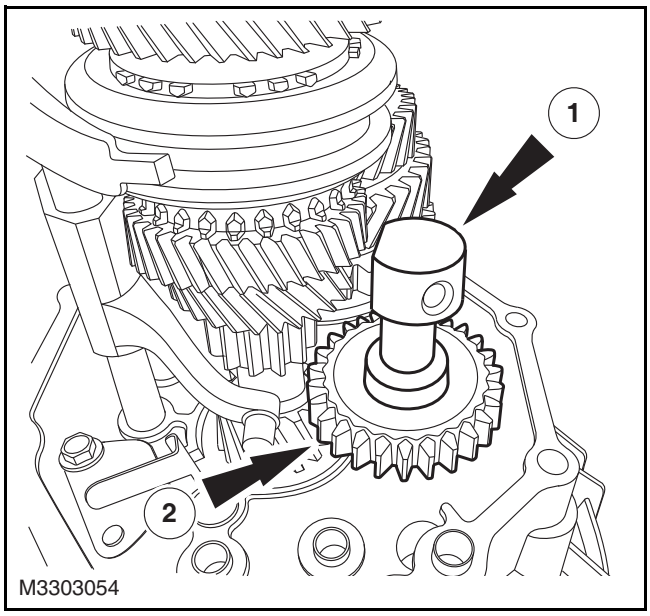



M3303052

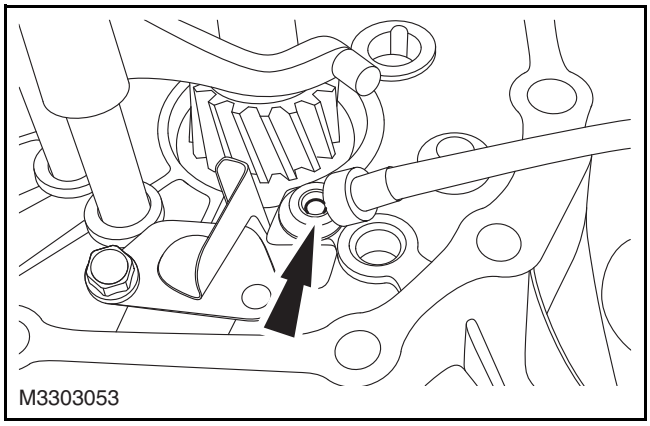
https://truckmanualshub.com/



**28.** Remove the reverse gear shaft (1), and remove the reverse idler gear (2).

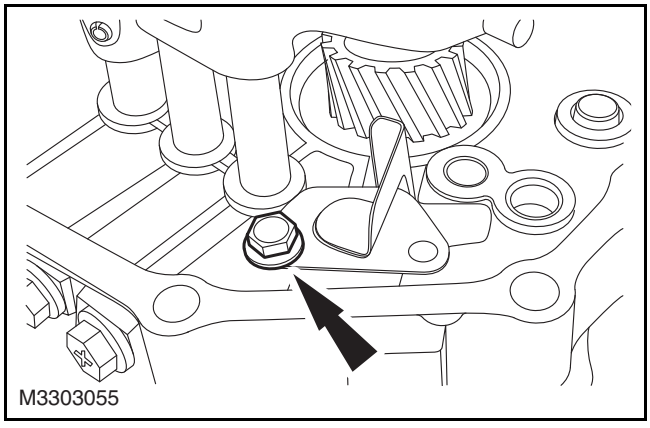



**29.** Suck out the gear shift fork locking assembly with magnetic bar.




**30.** Remove the oil delivery trough.

1 Remove the oil delivery trough retaining bolt.



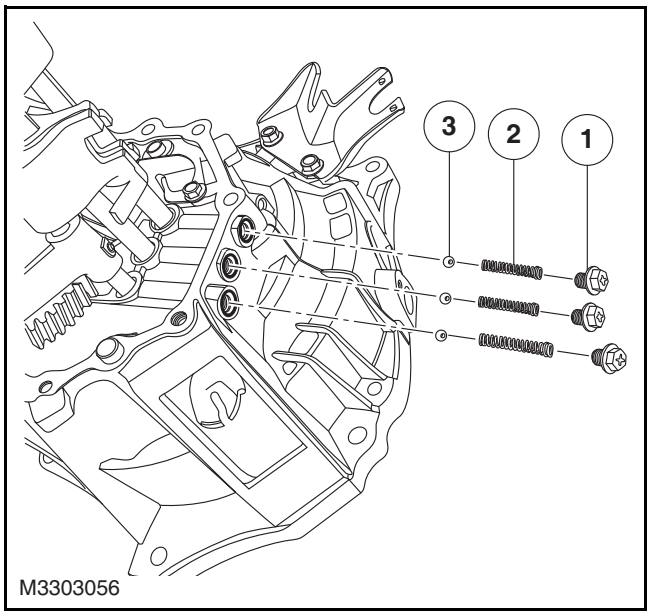

2 Remove the oil delivery trough.

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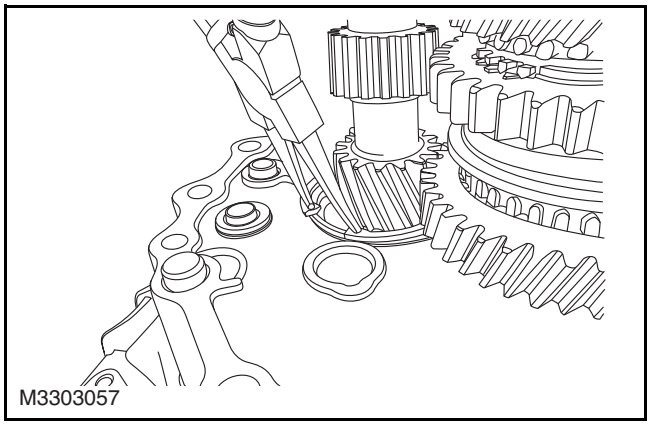
**31.** Remove 3 gear shift locking bolts (1), self-locking springs (2) and fork shaft steel balls (3).

**CAUTION: The 3 self-locking springs (2) have different lengths, which of 1st-2nd gear fork shaft is longer than those of 3rd-4th gear and reverse gear fork shafts.**



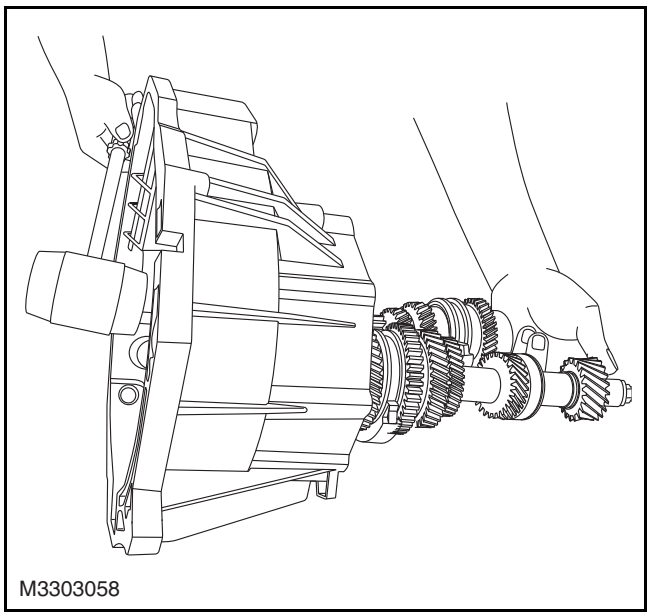
M3303056

**32.** Use the circlip pliers to remove the input shaft front case rear circlip.


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**33.** Tap the front end of input shaft with rubber hammer to remove the input shaft, intermediate shaft together with fork assembly set from the transmission front end housing.

**CAUTION: Be careful not to drop the shift fork and shift fork shaft when removing.**


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# Replacement of Input Shaft Oil Seal

1. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

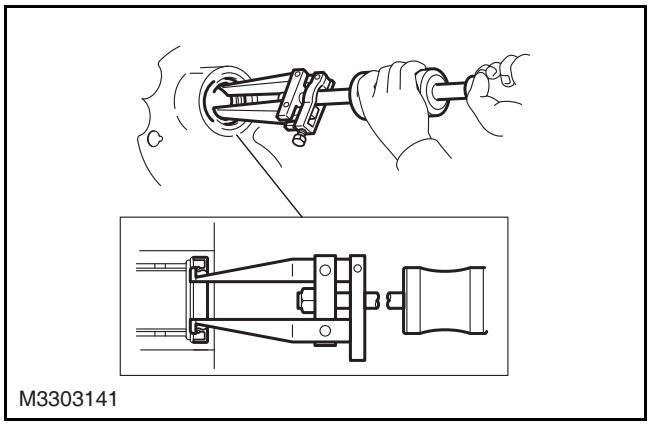
2. Remove the manual transmission.

   **Refer to: Manual Transmission (3.3.3 Manual Transmission - MR510L02, Removal and Installation).**

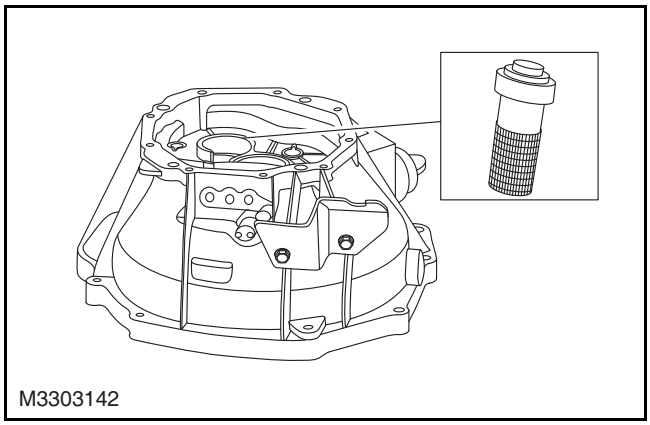
3. Disassemble the transmission.

   **Refer to: Disassembly of Transmission (3.3.3 Manual Transmission - MR510L02, Disassembly and Assembly).**

4. Use a proper tool to remove the oil seal.


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5. Use the input shaft oil seal assistant tool to install the new input shaft oil seal.


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6. Apply the grease to the edge of oil seal, and check the contact portion between input shaft and oil seal to make sure it is even.
7. Assemble the transmission.

   **Refer to: Assembly of Transmission (3.3.3 Manual Transmission - MR510L02, Disassembly and Assembly).**

8. Add transmission oil as specified, and check that the oil is sealed tightly by the oil seal.

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# Replacement of Extension Case Oil Seal

1. Drain the transmission oil.

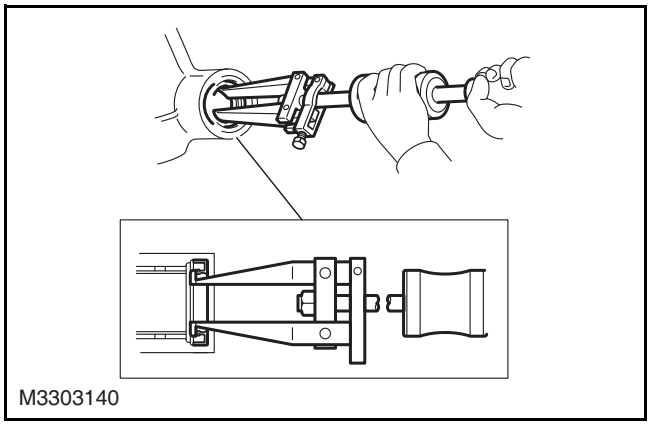
   **Refer to: Replacement of Transmission Oil (3.3.3 Manual Transmission - MR510L02, General Inspection).**

2. Remove the propeller shaft.

   **Refer to: Propeller Shaft (2.2.2 Propeller Shaft, Removal and Installation).**

3. Remove the transmission extension case oil seal.

   1 Use a proper tool to remove the oil seal.


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4. Install the transmission extension case oil seal.

   1 Apply gear oil to the lip of oil seal.

   2 Install the new oil seal to the extension case.

5. Install the propeller shaft.
6. Add transmission oil.

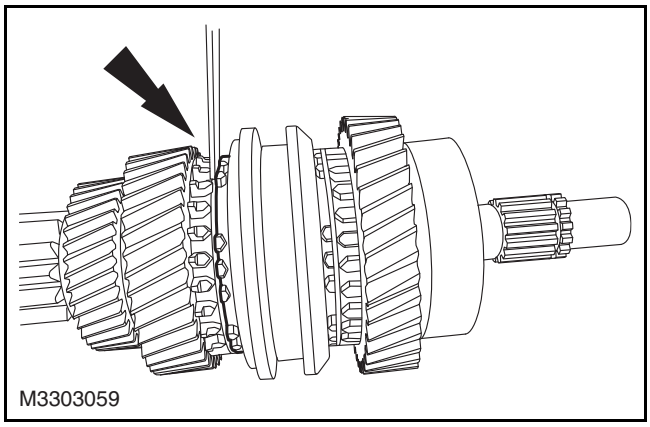
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## Inspection

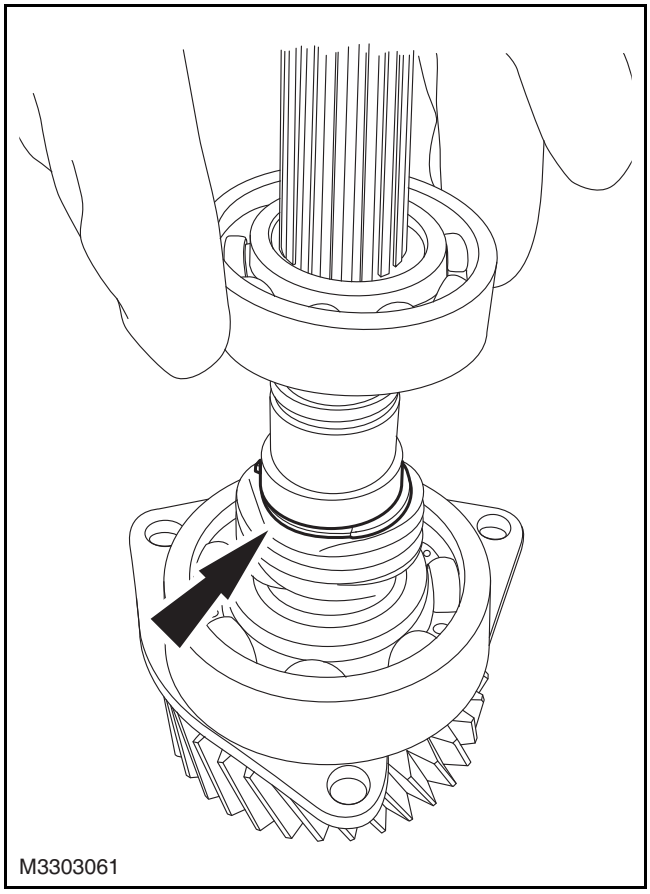
**1.** Inspect the input shaft set.

- Inspect the input shaft gear teeth for breakage and the tooth surface for pitting, serious wear and gluing. Input shaft must be replaced if any case above occurs.
- Inspect whether input shaft splines are badly worn or damaged. Input shaft must be replaced if it is badly worn or damaged.
- Feel with finger to check whether bearing rotation is inflexible and seized. Bearing must be replaced if the troubles occur.


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**2.** Inspect the output shaft set.

- Inspect the output shaft gear teeth for breakage and the tooth surface for pitting, serious wear and gluing. Output shaft must be replaced if any case above occurs.
- Inspect whether output shaft splines are badly worn or damaged. Output shaft must be replaced if it is badly worn or damaged.
- Feel with finger to check whether bearing rotation is inflexible and seized. Bearing must be replaced if the troubles occur.

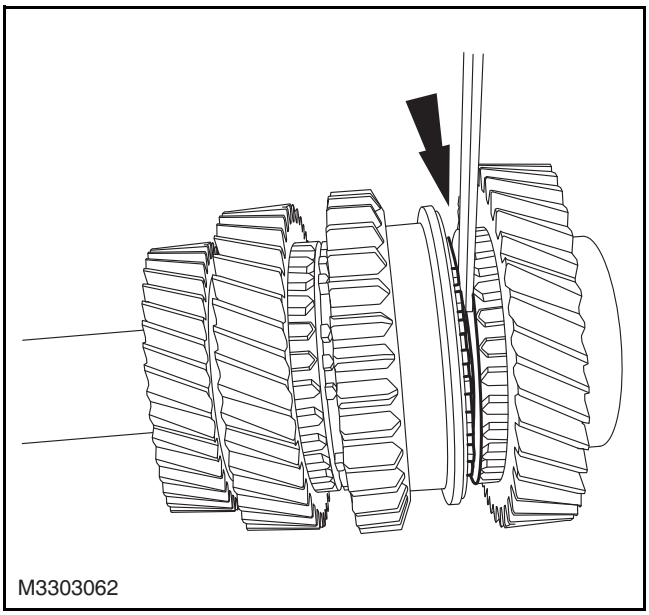

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**3.** Inspect the intermediate shaft set.

- Inspect the intermediate shaft gear teeth for breakage and the tooth surface for pitting, serious wear and gluing. Intermediate shaft must be replaced if any case above occurs.
- Feel with finger to check whether bearing rotation is inflexible and seized. Bearing must be replaced if the troubles occur.

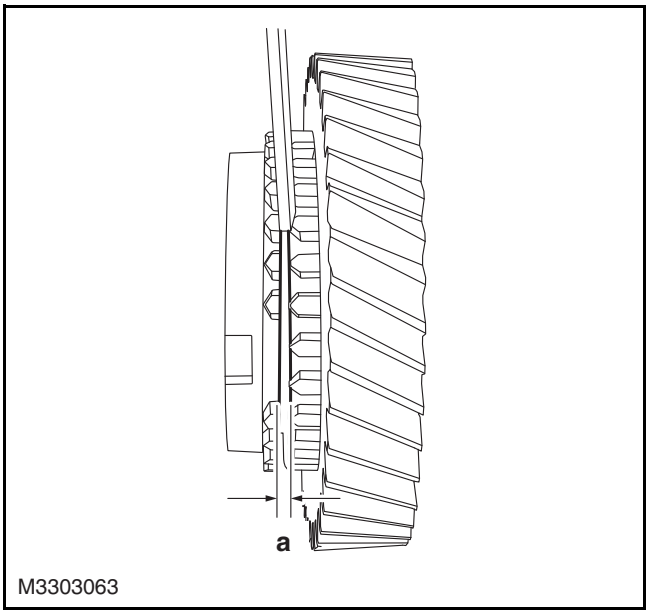


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**4.** Inspect the gear and synchronizer gear ring.

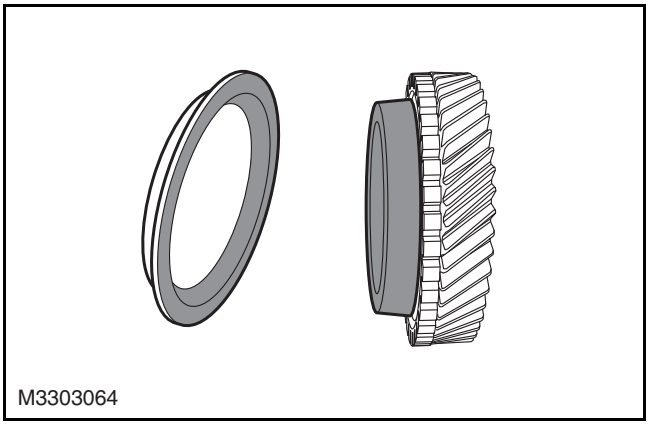
- Fit the synchronizer gear ring onto the mating gear cone and inspect the meshing backlash between gear and gear ring. As for requirement details see chart below. Components must be replaced if backlash reaches or exceeds limit value.

| Backlash "a" between gear and gear ring | Theoretical Value (mm) | Limit Value (mm) |
|---|---|---|
| | 0.8 ~ 1.2 | 0.5 |




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- Inspect whether the gear outer conical surface and gear ring inner conical surface are worn, the component must be replaced if there is abnormal wear.



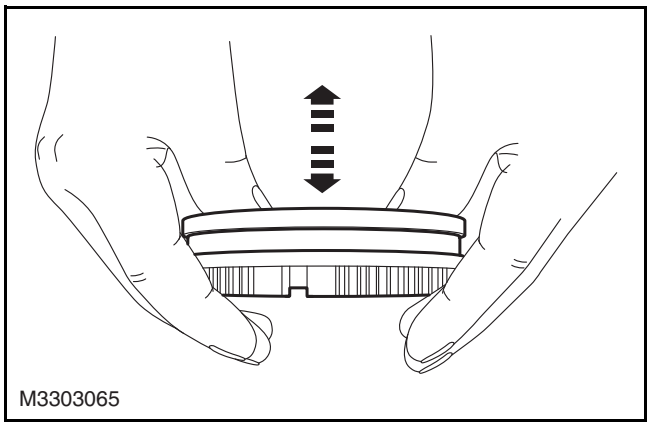
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**5.** Inspect the synchronizer set.

- Inspect the sliding flexibility of synchronizer set, repair or replace if it is seized.


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**6.** Inspect other components.

- Inspect whether the shift fork shaft is deformed, and whether the self-locking or interlocking steel balls are damaged and spring is deformed.
- Inspect whether the tip of synchronizer sleeve synchronizer is worn or gear ring key groove gets worn and wider.
- Inspect whether the bearing is loose, damaged or gear thrust clearance is excessive.
- Inspect whether the gear is badly worn or engagement clearance is excessive.
- Inspect the clearance between fork and hub sleeve.
- Inspect whether there is crack and scratch on the oil seal lip.

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# Disassembly of Input Shaft

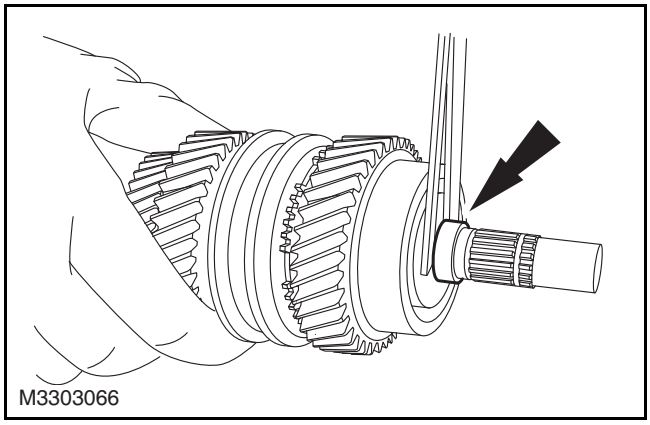
## General Equipment

| |
|---|
| Puller |

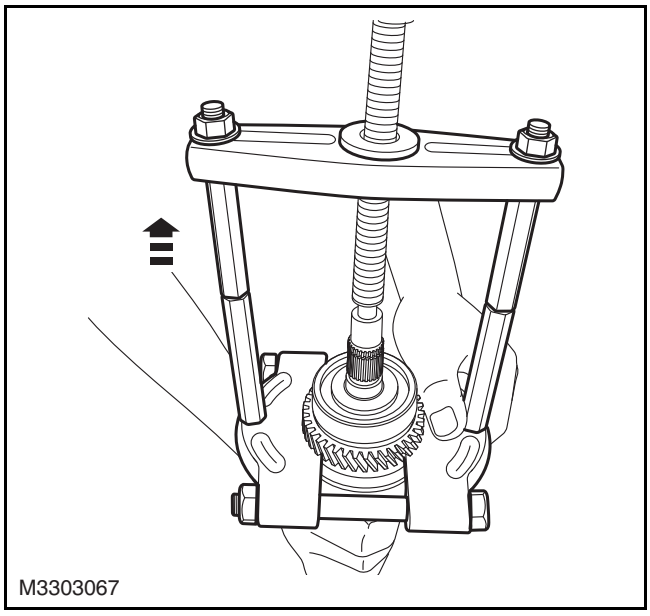
## Disassembly

1. Use a proper tool to remove the input shaft rear case rear bearing circlip.

**CAUTION: Place a cloth under the input shaft set to prevent circlip from flying out.**


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2. Using the puller, pull out the input shaft 4th gear together with input shaft rear case rear bearing.

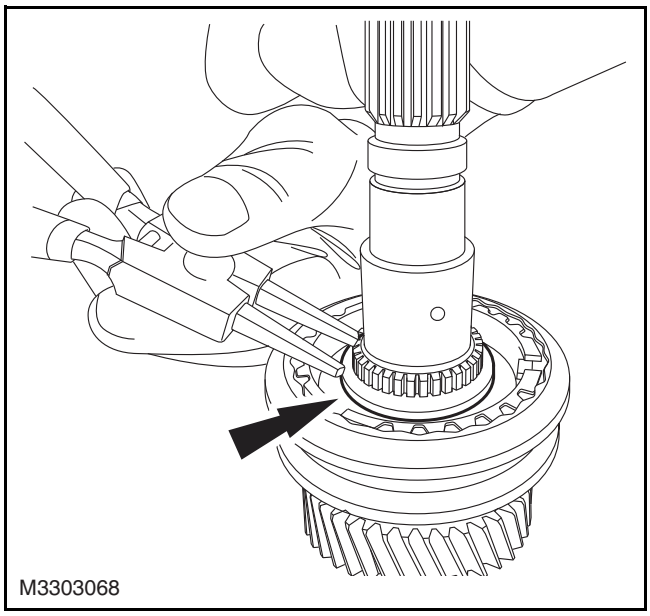

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3. Remove the high-speed synchronizer gear ring and 4th gear needle roller bearing.

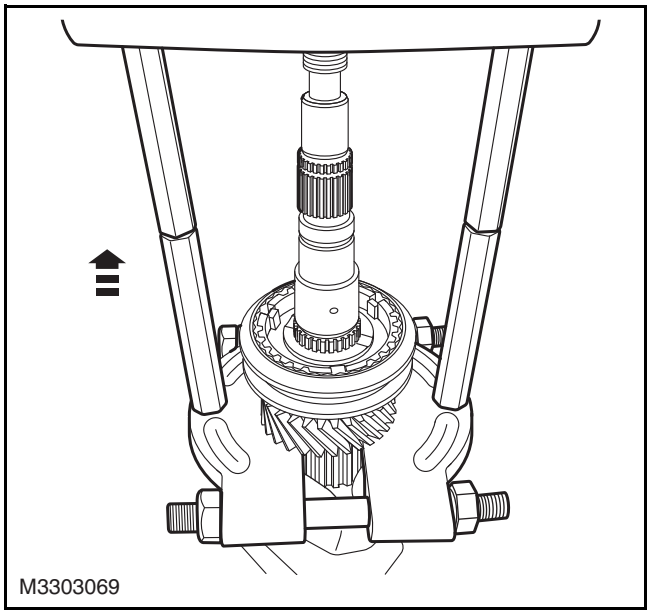
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**4.** Use the circlip pliers to remove the high-speed synchronizer circlip.



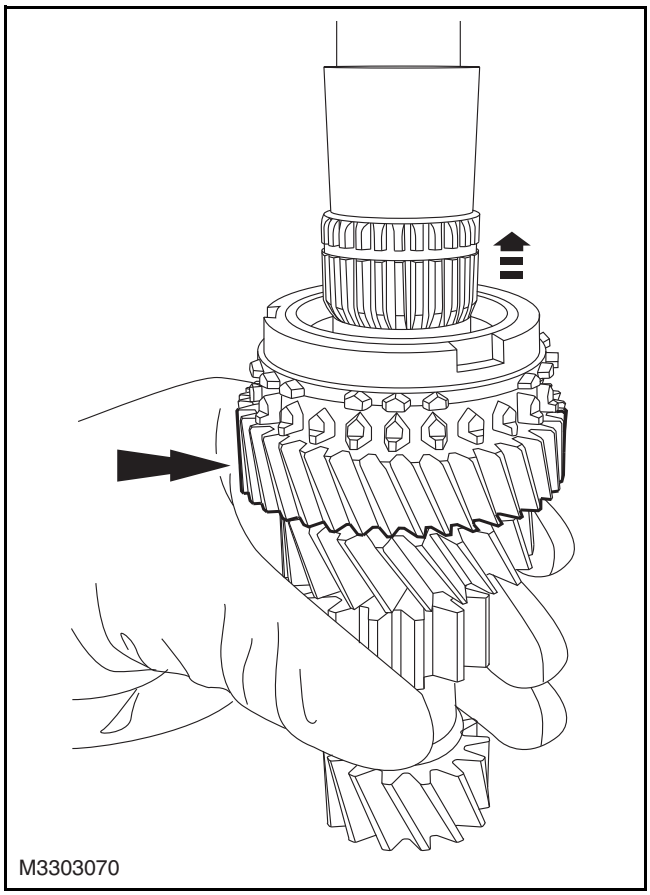

**5.** Using the puller, pull out the high-speed synchronizer, high-speed synchronizer gear ring together with input shaft 3rd gear.



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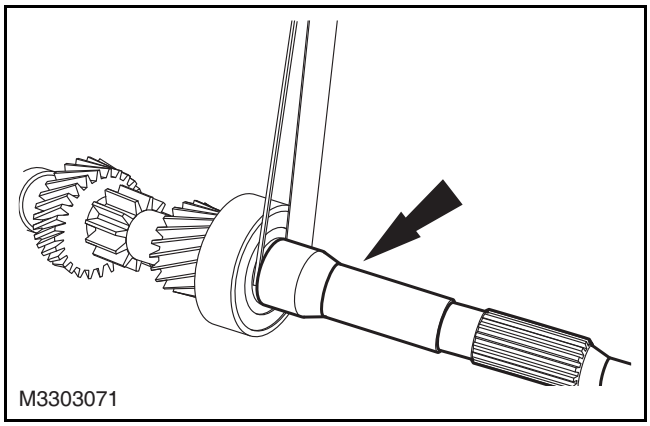


6. Remove the input shaft 3rd gear synchronizer gear ring, 3rd gear and 3rd gear needle roller bearing.


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7. Use a proper tool to remove the input shaft front case rear bearing circlip.

**CAUTION: Place a cloth under the input shaft set to prevent circlip from flying out.**

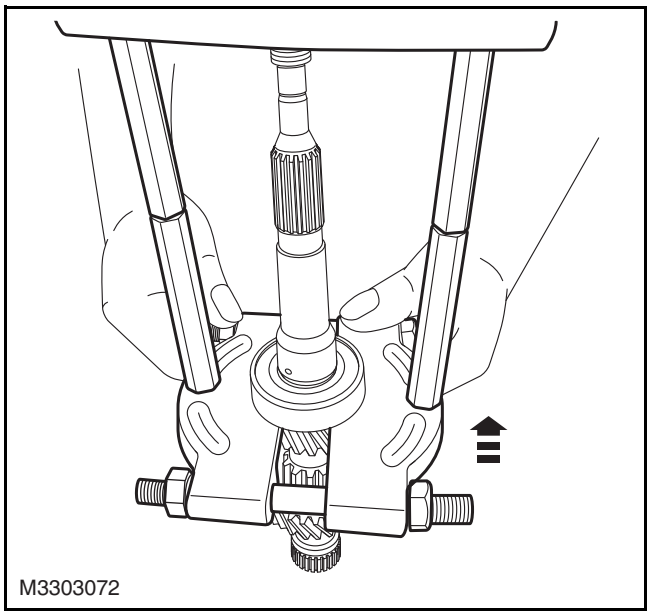

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8. Use the puller to remove the input shaft front case rear bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while removing bearing with the puller.**



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# Disassembly of Output Shaft

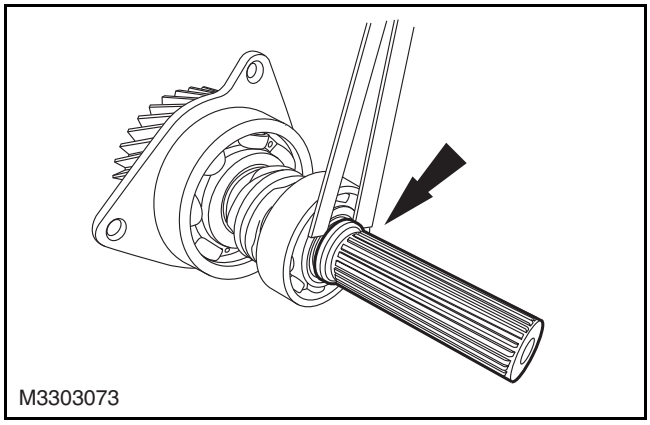
## General Equipment

| |
|---|
| Puller |

## Disassembly

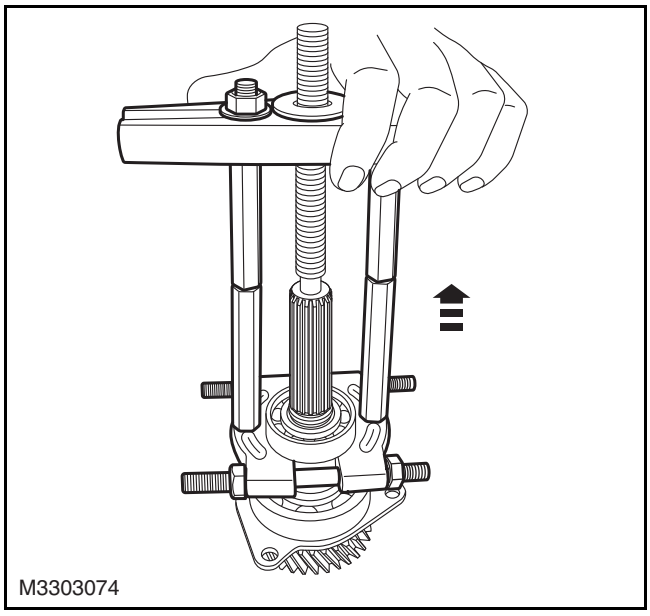
1. Use a proper tool to remove the output shaft rear case rear bearing circlip.

**CAUTION: Place a cloth under the output shaft set to prevent circlip from flying out.**


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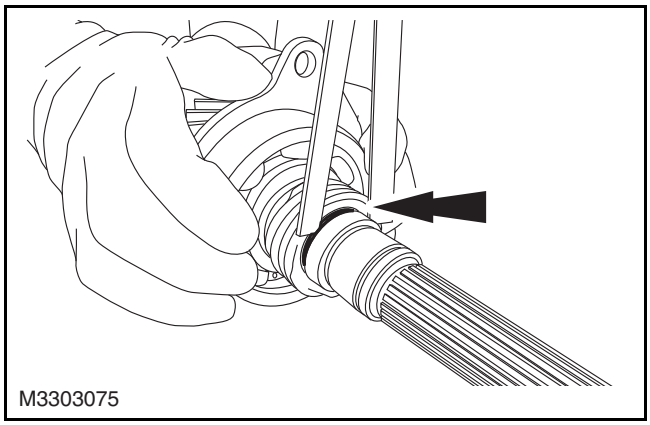
2. Use the puller to remove the output shaft rear case rear bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while removing bearing with the puller.**


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3. Use a proper tool to remove the worm circlip.

**CAUTION: Place a cloth under the output shaft set to prevent circlip from flying out.**


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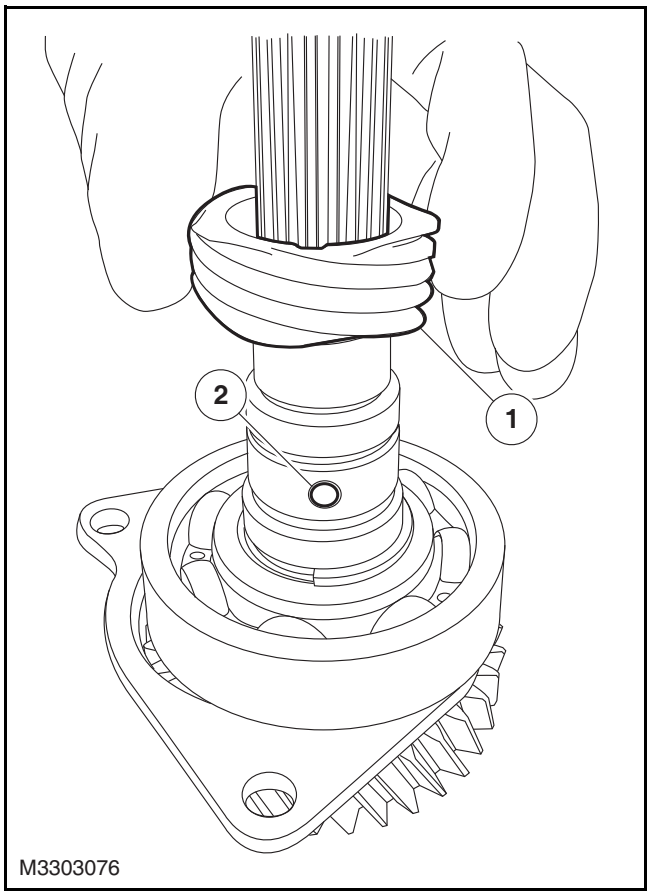
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**4.** Remove the worm set.

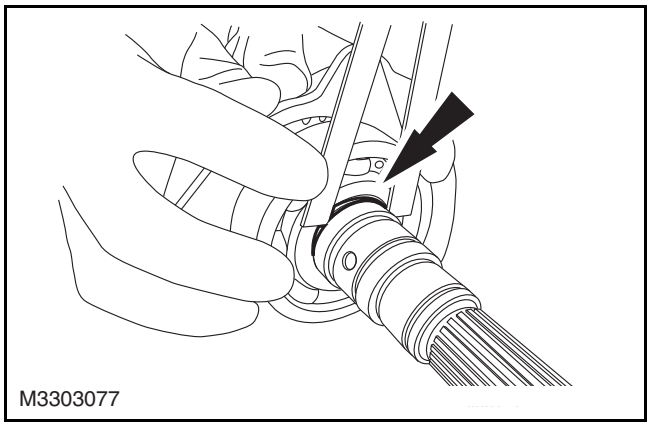
1 Remove the worm (1).

2 Use a magnetic tool to suck out the output shaft worm steel ball (2).




**5.** Use a proper tool to remove the output shaft front case rear bearing circlip.

⚠ **CAUTION: Place a cloth under the output shaft set to prevent circlip from flying out.**

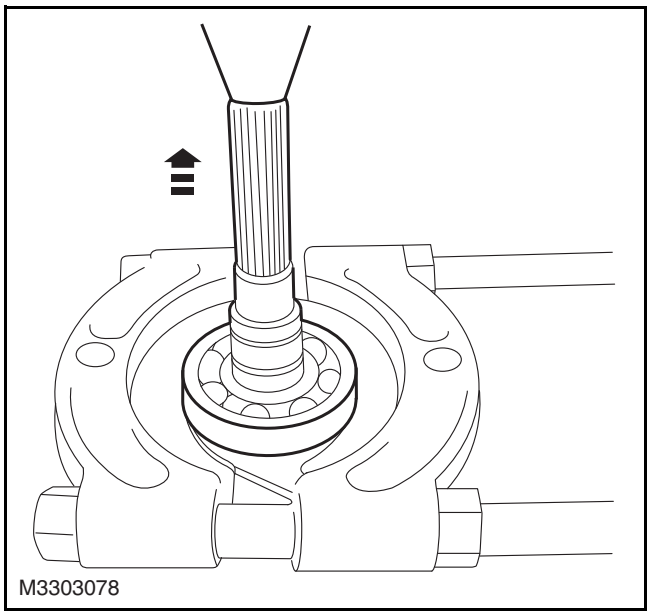


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6. Use the puller to remove the output shaft front case rear bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while removing bearing with the puller.**


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# Disassembly of Intermediate Shaft

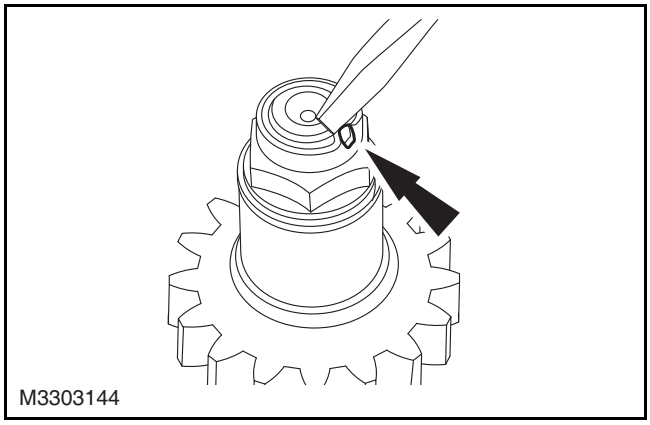
## General Equipment

| |
|---|
| Puller |

## Disassembly

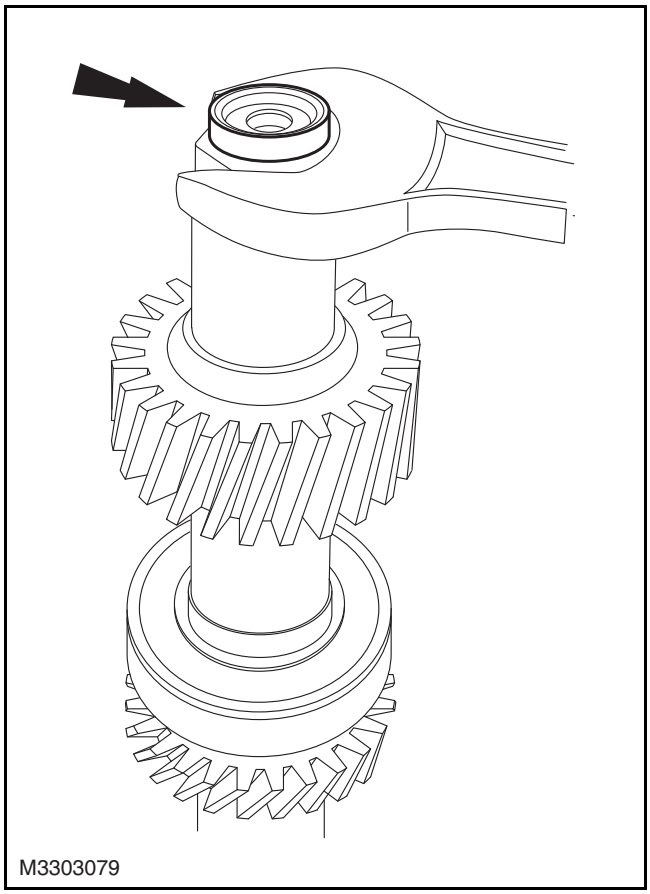
**1.** Remove the intermediate shaft nut.

1 Use a proper tool to pry up the locking groove of intermediate shaft nut.



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2 Use a proper tool to remove the intermediate shaft nut.

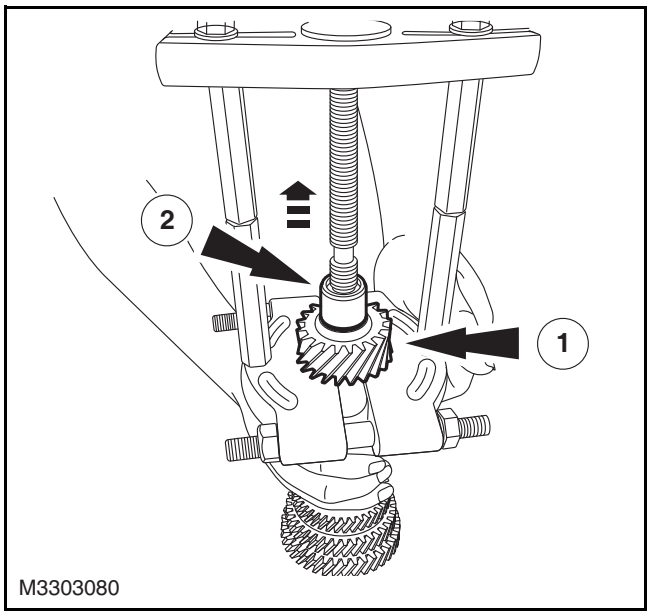


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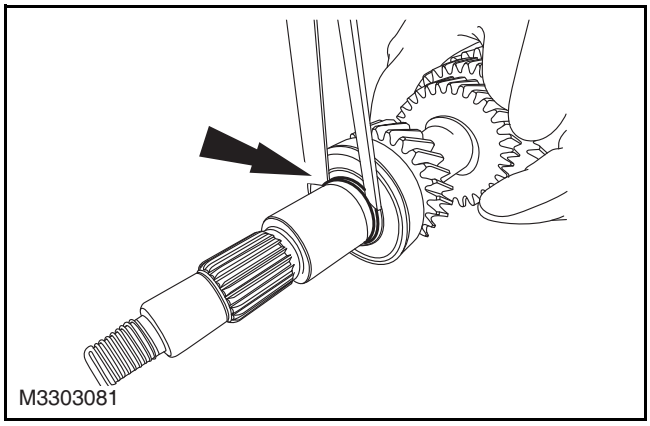


2. Using the puller, pull out the intermediate shaft driven gear (1) together with intermediate shaft rear case rear bearing bushing (2).



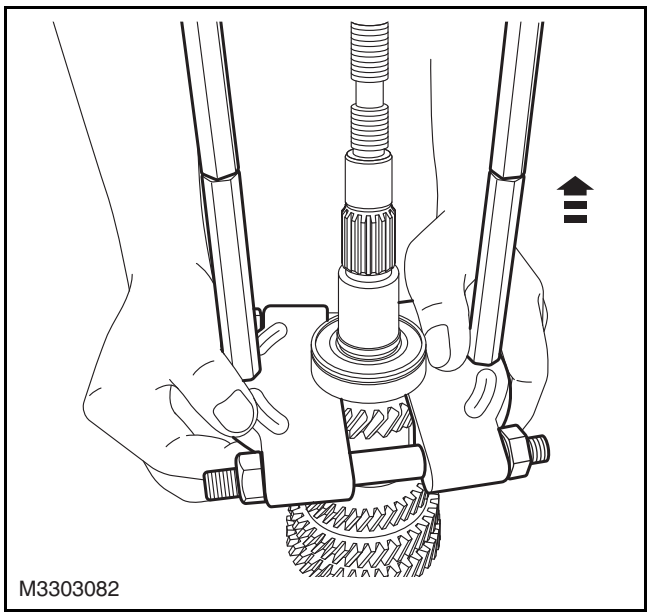

3. Use a proper tool to remove the intermediate shaft rear bearing circlip.

**CAUTION: Place a cloth under the intermediate shaft set to prevent circlip from flying out.**




4. Use the puller to remove the intermediate shaft rear bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while removing bearing with the puller.**

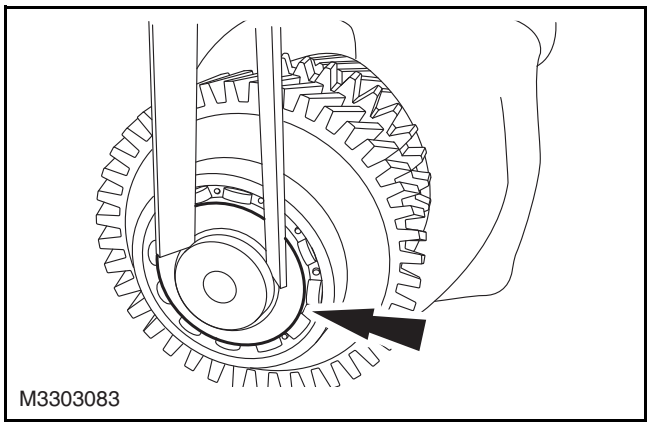


https://truckmanualshub.com/

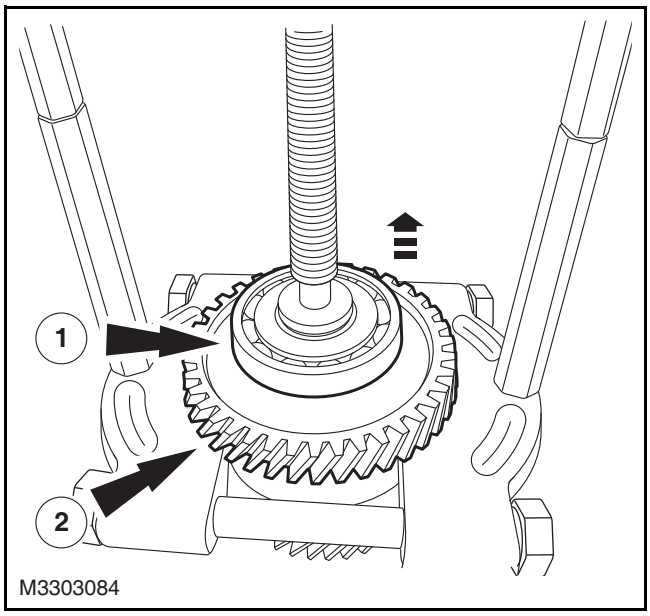


5. Use a proper tool to remove the intermediate shaft front case rear bearing circlip.

**CAUTION: Place a cloth under the intermediate shaft set to prevent circlip from flying out.**


M3303083

6. Using the puller, pull out the intermediate shaft front case rear bearing (1) together with 1st gear (2).

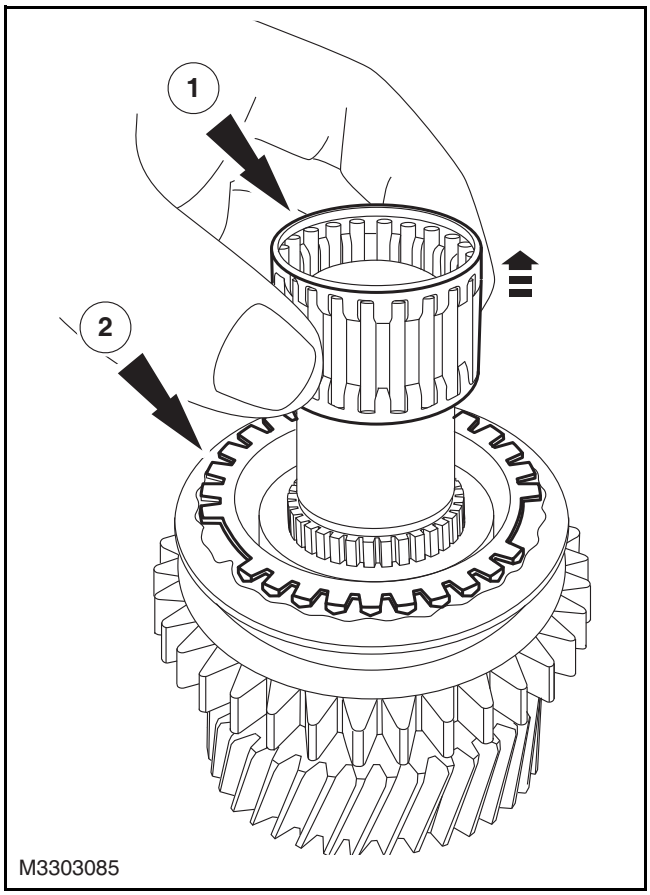


M3303084

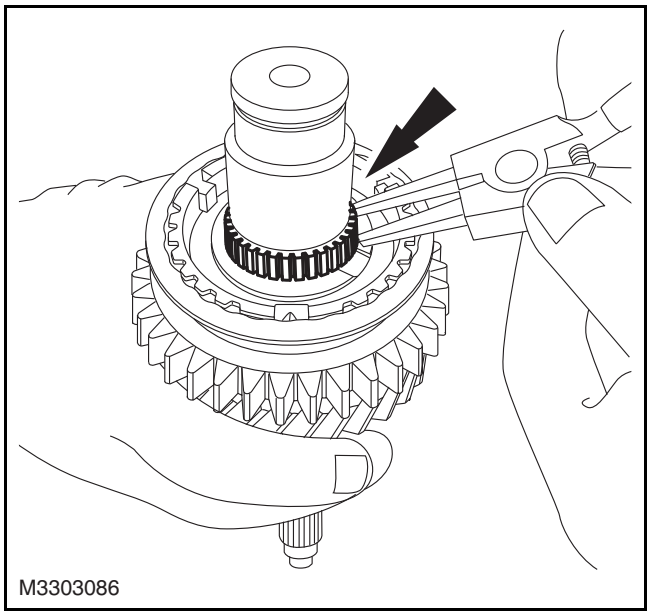
https://truckmanualshub.com/



**7.** Remove the 1st gear needle roller bearing (1) and 1st gear synchronizer gear ring (2).



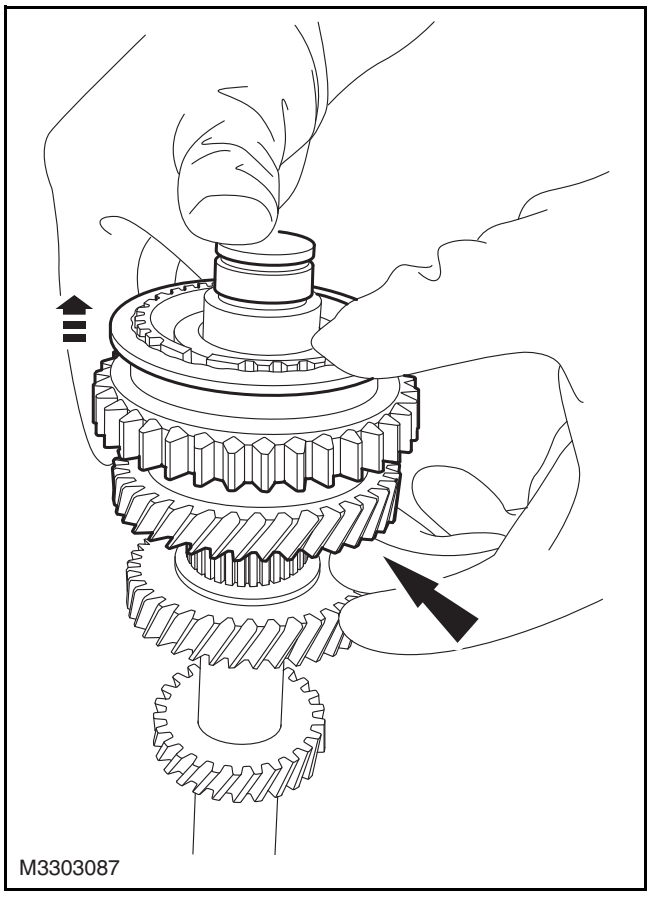

**8.** Use the circlip pliers to remove the low-speed synchronizer circlip.



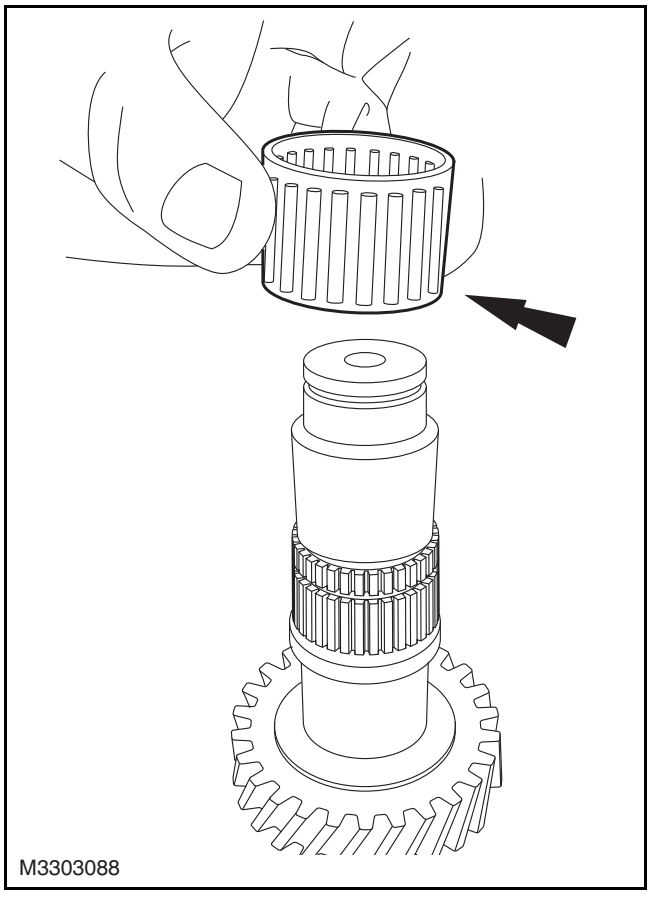
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**9.** Remove the low-speed synchronizer, 2nd gear synchronizer gear ring together with 2nd gear.




**10.** Remove the intermediate shaft 2nd gear needle roller bearing.



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# Assembly of Intermediate Shaft

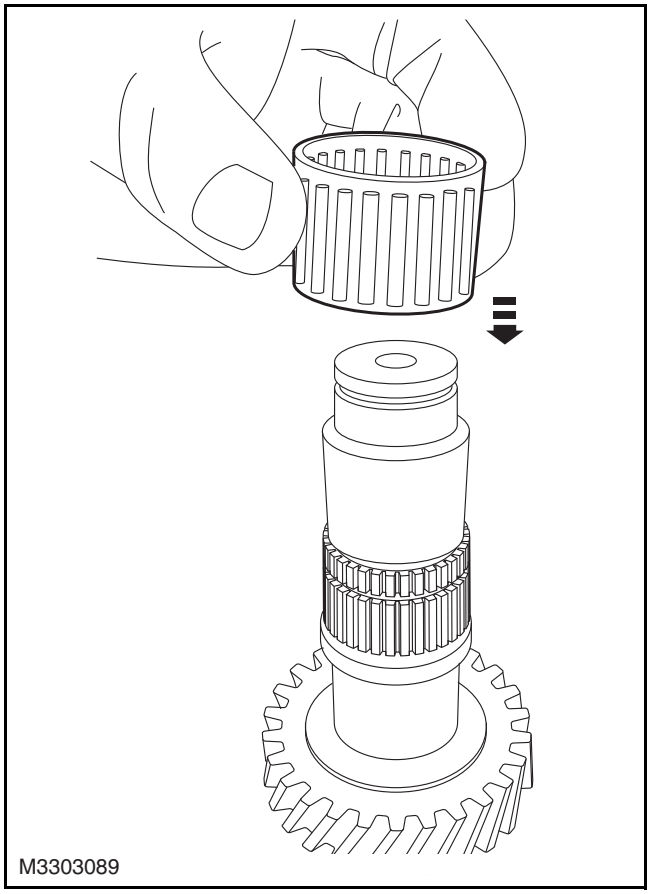
## Material

| Item | Model |
|---|---|
| Manual Transmission Oil | API GL-4 75W-90 |

## Assembly

1. Install the intermediate shaft 2nd gear needle roller bearing.

**CAUTION: Uniformly apply lubricant to the part of needle roller end face that contacts shaft journal.**



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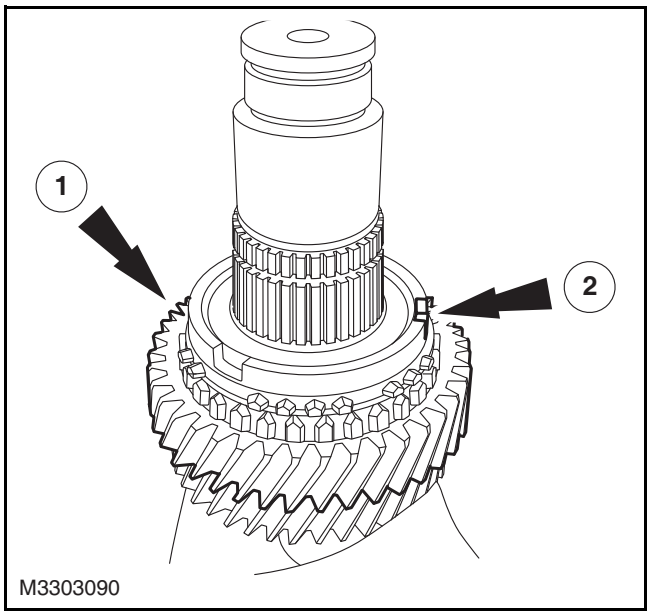


**2.** Install the intermediate shaft 2nd gear and 2nd gear synchronizer gear ring.

1 Install the intermediate shaft 2nd gear (1).

2 Install the 2nd gear synchronizer gear ring (2).

**CAUTION: The method to distinguish the 1st from 2nd gear synchronizer gear ring is that 1st gear synchronizer gear ring has eight teeth and 2nd gear synchronizer gear ring has seven teeth.**




**3.** Install the low-speed synchronizer circlip.

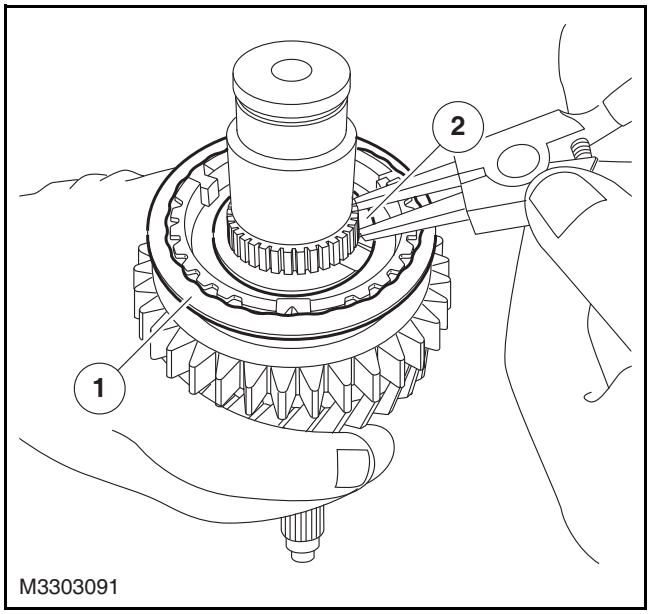
1 Install the low-speed synchronizer (1).

2 Use the circlip pliers to install the low-speed gear synchronizer circlip (2).

**CAUTION: Synchronizer slider is aligned with gear ring slider slot while installation. Gear rotation should be flexible and free after installation. 1st gear synchronizer gear ring has eight teeth and 2nd gear synchronizer gear ring has seven teeth.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**



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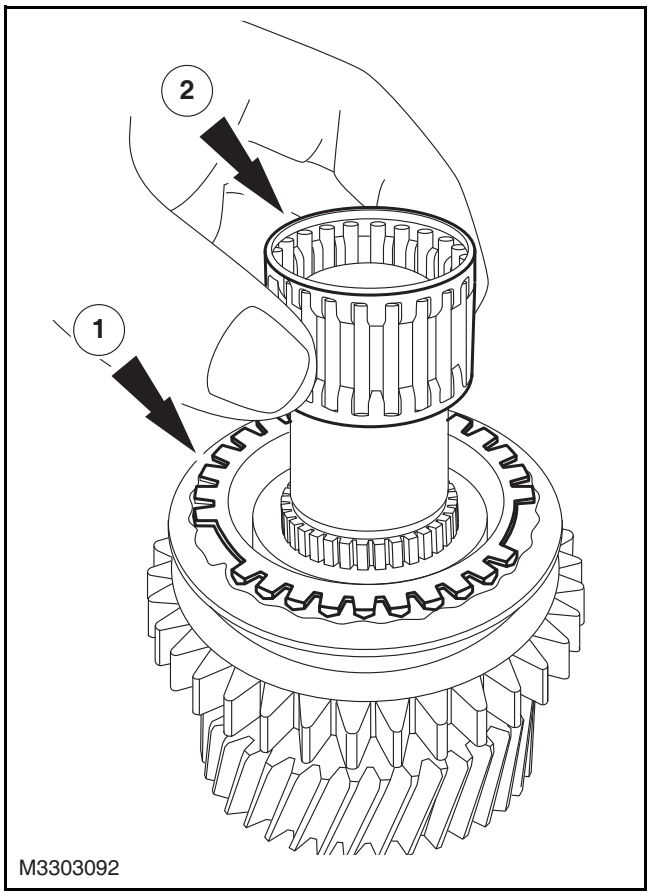
**4.** Install the 1st gear synchronizer gear ring and 1st gear needle roller bearing.

1 Install the 1st gear synchronizer gear ring (1).

2 Install the intermediate shaft 1st gear needle roller bearing (2).

**CAUTION: Synchronizer gear ring slider slot is aligned with synchronizer slider while installation.**

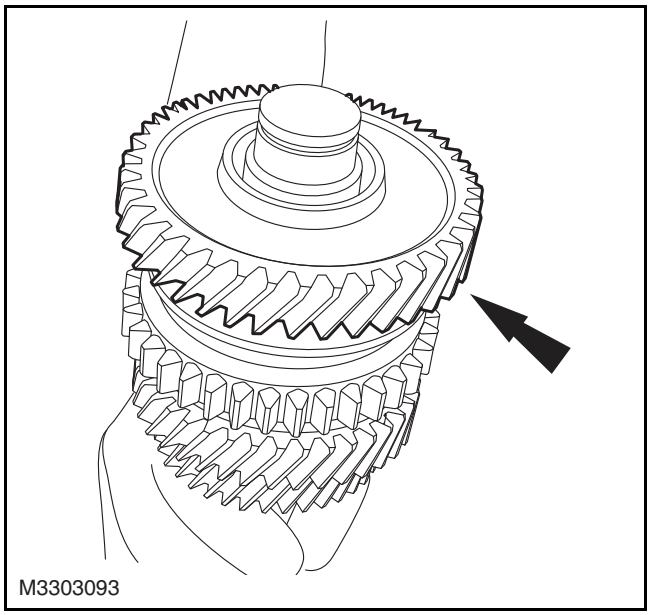
**CAUTION: Uniformly apply lubricant to the part of needle roller end face that contacts shaft journal.**




**5.** Install the intermediate shaft 1st gear.

**CAUTION: Use the vise holder protector all the time when using the vise.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**



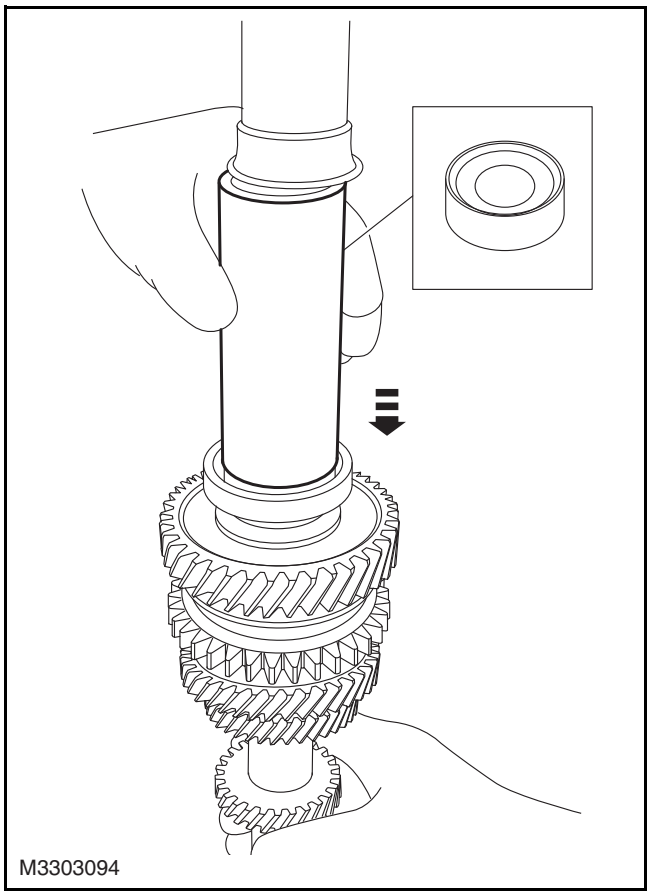
https://truckmanualshub.com/



6. Use the intermediate shaft front case rear bearing pressing assistant tool to install the intermediate shaft front case rear bearing.

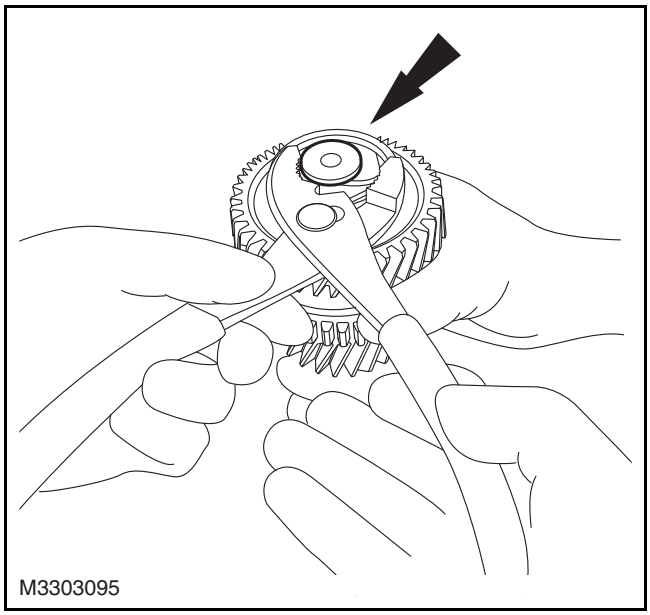
**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

**CAUTION: Use the vise holder protector all the time when using the vise.**




7. Use a proper tool to install the intermediate shaft front case rear bearing circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**



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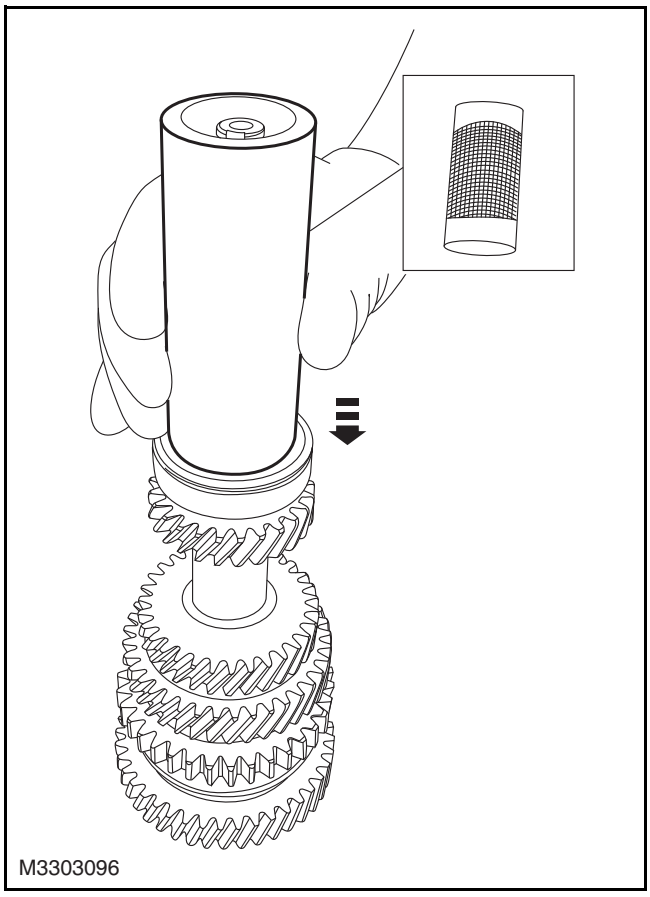


8. Use the intermediate shaft rear bearing pressing assistant tool to install the intermediate shaft rear bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

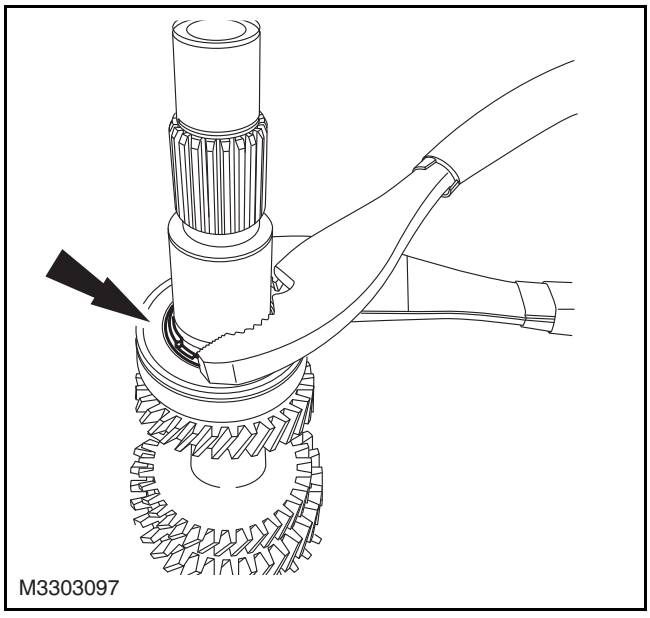
**CAUTION: Use the vise holder protector all the time when using the vise.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**


M3303096

9. Use a proper tool to install the intermediate shaft rear bearing circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**

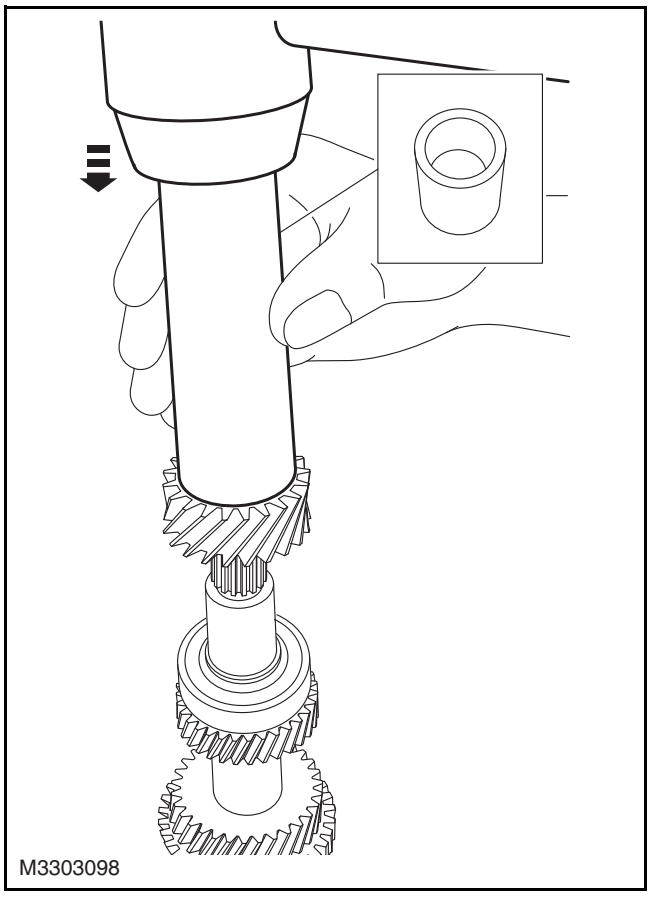

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https://truckmanualshub.com/



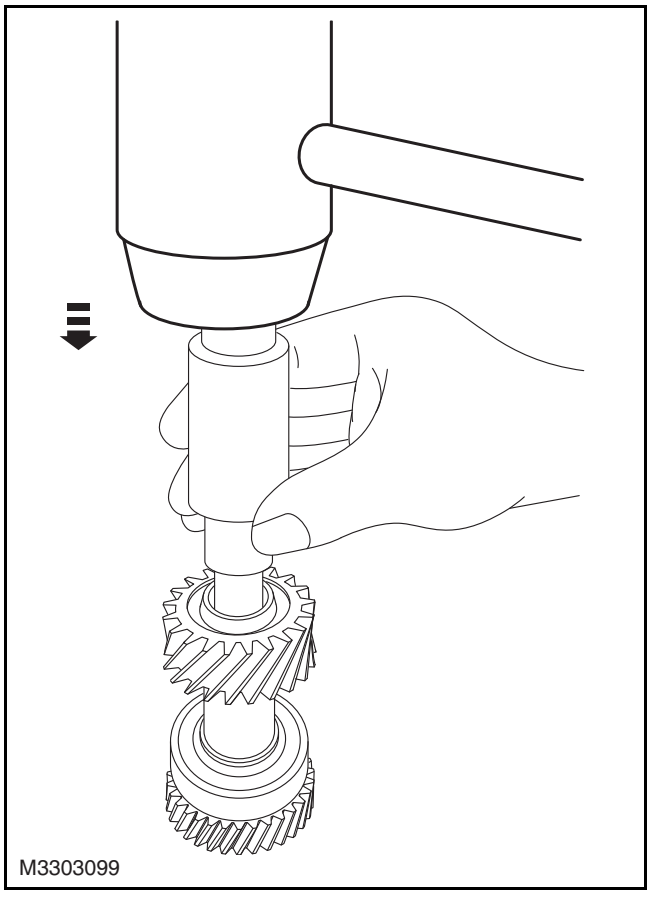
**10.** Use the intermediate shaft driven gear pressing assistant tool to install the intermediate shaft driven gear.

**CAUTION: Intermediate shaft driven gear taper side faces towards intermediate shaft rear end (nut side).**




**11.** Use a proper tool to install the intermediate shaft rear case rear bearing bushing.

**CAUTION: Chamfer side in the bushing faces towards intermediate shaft front end (reverse direction of nut).**



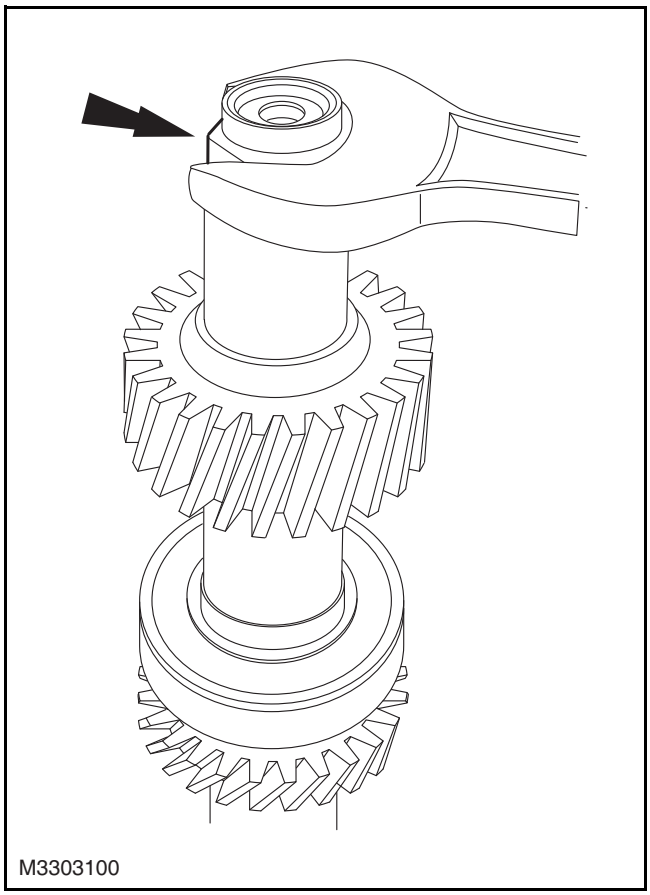
https://truckmanualshub.com/



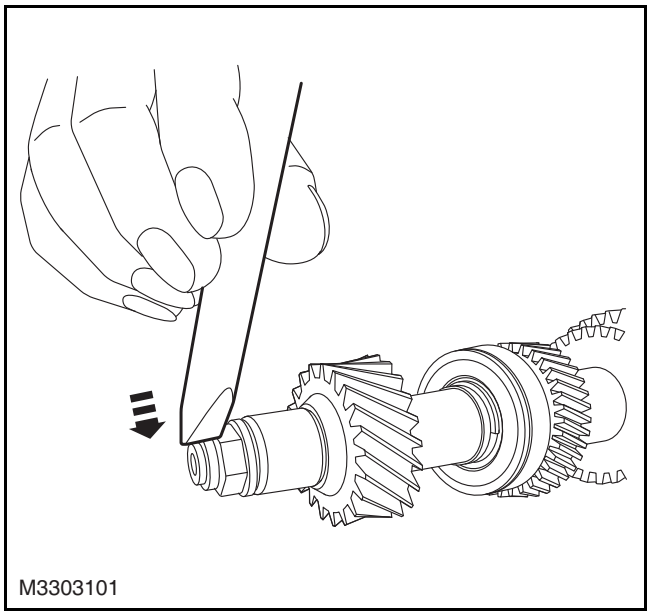
**12.** Tighten the intermediate shaft locking nut to the specified torque.

Torque: 60 ~ 75 Nm

**CAUTION: Be sure to use new nut.**


M3303100

**13.** Caulk the intermediate shaft locking nut with punch.


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# Assembly of Output Shaft

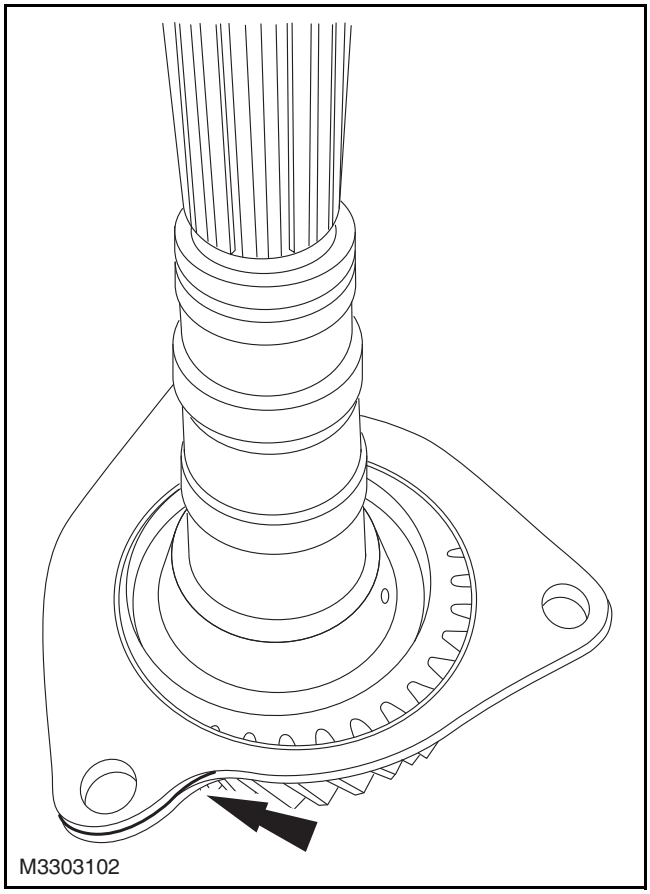
## Material

| Item | Model |
|---|---|
| Manual Transmission Oil | API GL-4 75W-90 |

## Assembly

1. Install the output shaft front case rear bearing pressure plate.

**CAUTION: Pay attention to the installation direction while assembling. If rear end of output shaft faces upward while assembling, pressure plate bulging plane shall face counterclockwise direction.**


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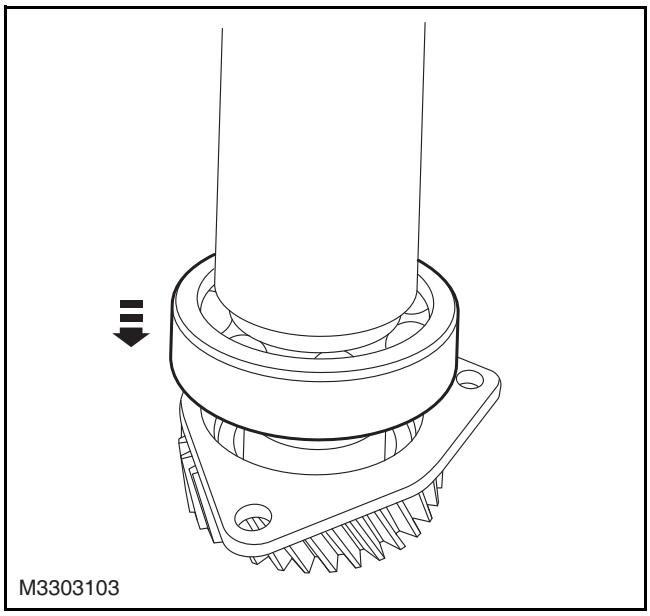
https://truckmanualshub.com/



2. Use the output shaft front case rear bearing pressing assistant tool to install the output shaft front case rear bearing.

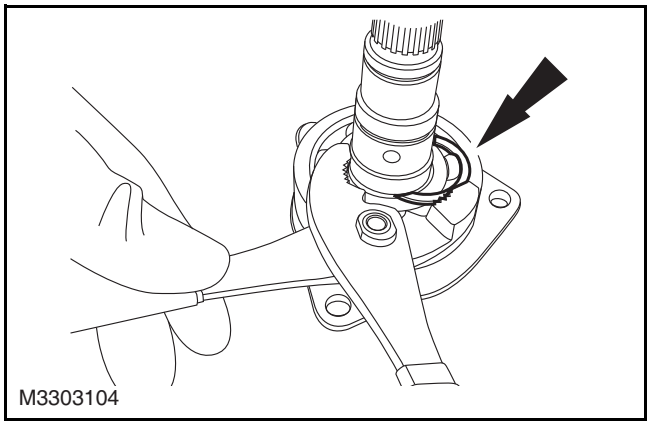
**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**


M3303103

3. Use a proper tool to install the output shaft front case rear bearing circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**

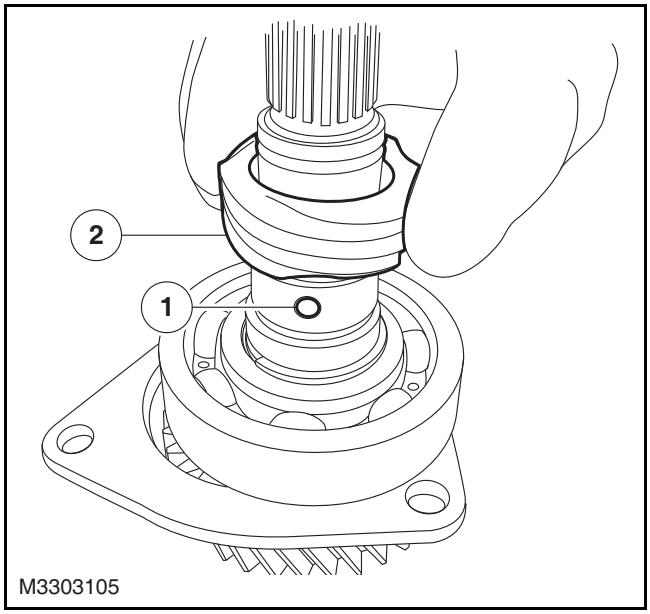

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4. Install the worm set.

   1 Install the output shaft steel ball (1).

   2 Install the worm (2).

**CAUTION: Apply a small amount of grease to the surface of steel ball when installing.**



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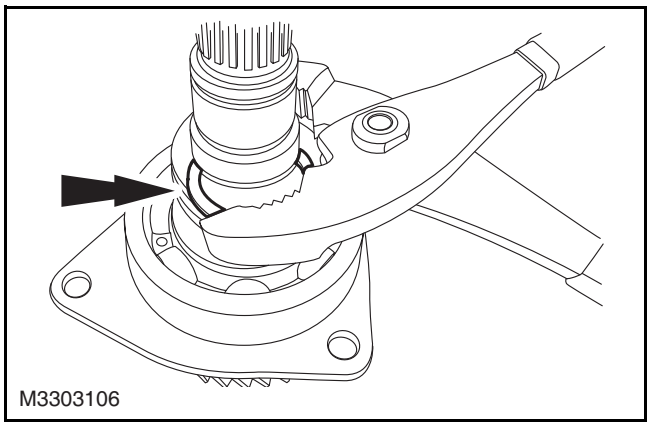
https://truckmanualshub.com/



5. Use a proper tool to install the worm circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**

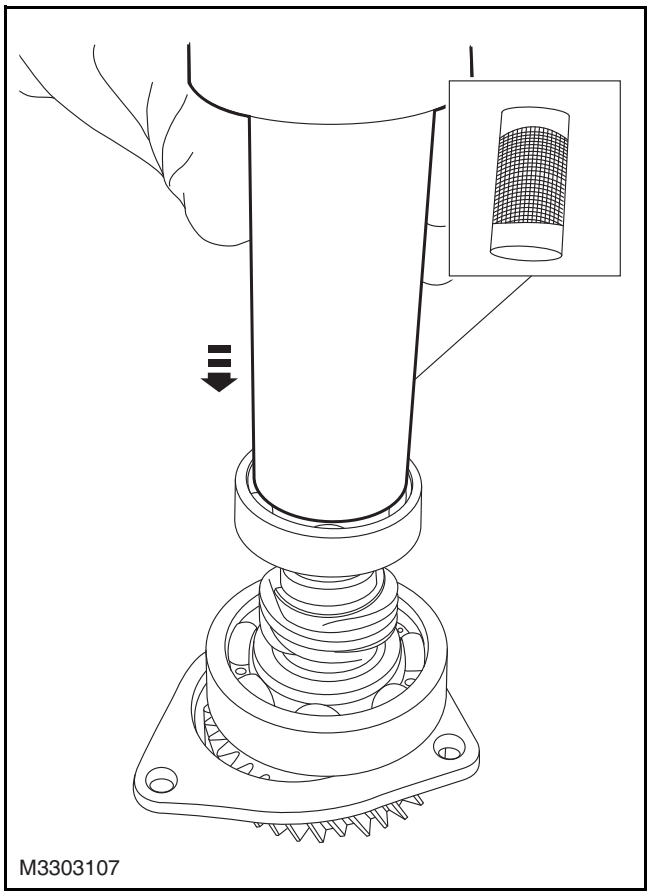
**CAUTION: The circlip opening does not face towards steel ball when installing.**


M3303106

6. Use the output shaft front case rear bearing pressing assistant tool to install the output shaft front case rear bearing.

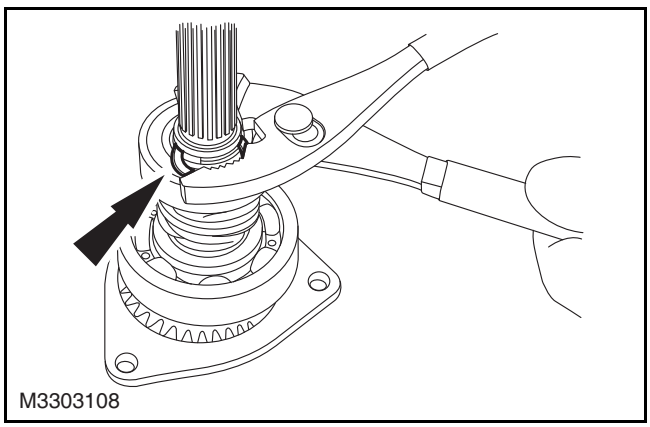
**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**


M3303107

7. Use a proper tool to install the output shaft rear case rear bearing circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**


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# Assembly of Input Shaft

## Material

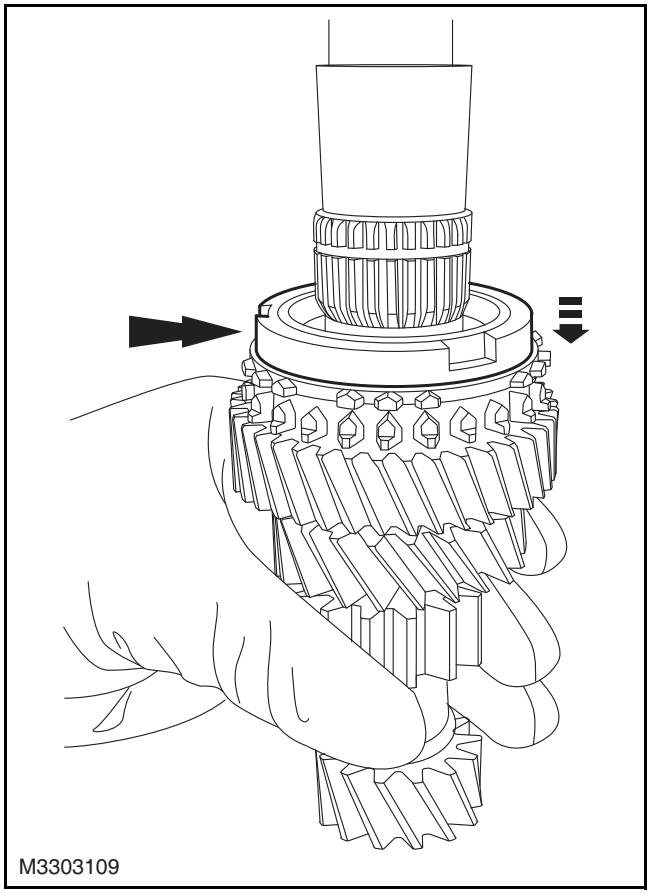
| Item | Model |
|---|---|
| Manual Transmission Oil | API GL-4 75W-90 |

## Assembly

1. Install the 3rd gear needle roller bearing, 3rd gear and 3rd gear synchronizer gear ring.

**CAUTION: Uniformly apply lubricant to the part of needle roller end face that contacts shaft journal.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**


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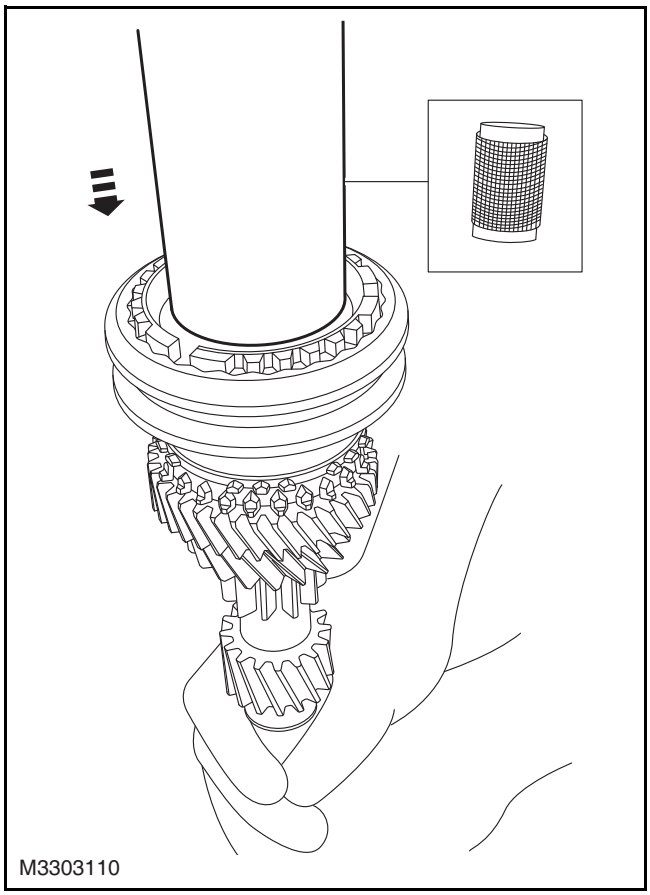


2. Use the high-speed synchronizer pressing assistant tool to install the high-speed synchronizer.

**CAUTION: High-speed synchronizer boss should face towards input shaft front end.**

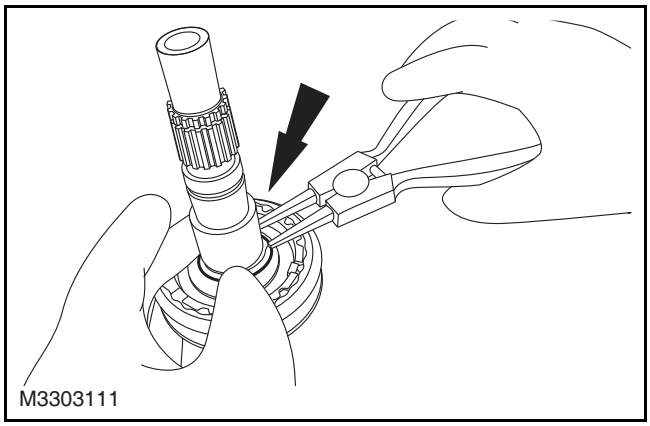
**CAUTION: Synchronizer slider is aligned with gear ring slider slot while installation. Gear rotation should be flexible and free after installation.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**




3. Use a proper tool to install the high-speed gear synchronizer circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**



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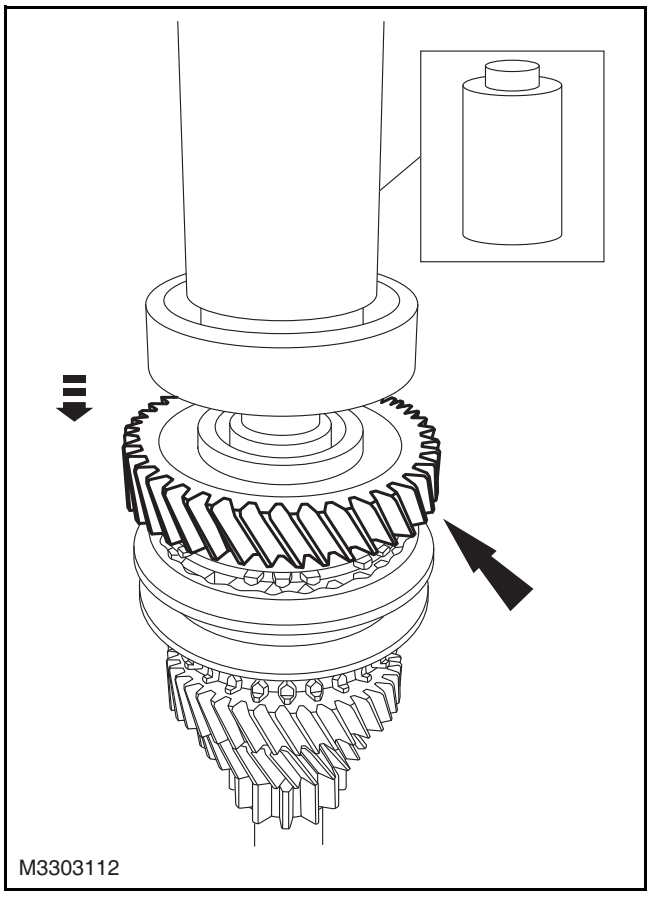
**4.** Install the input shaft 4th gear needle roller bearing, high-speed synchronizer gear ring, 4th gear and input shaft rear case rear bearing.

1 Install the input shaft 4th gear needle roller bearing.

2 Install the high-speed synchronizer gear ring.

3 Install the input shaft 4th gear.

4 Use the input shaft rear case rear bearing pressing assistant tool to install the input shaft rear case rear bearing.




**⚠ CAUTION: Uniformly apply lubricant to the part of needle roller end face that contacts shaft journal.**

**⚠ CAUTION: Synchronizer slider is aligned with gear ring slider slot while installation. Gear rotation should be flexible and free after installation.**

**⚠ CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

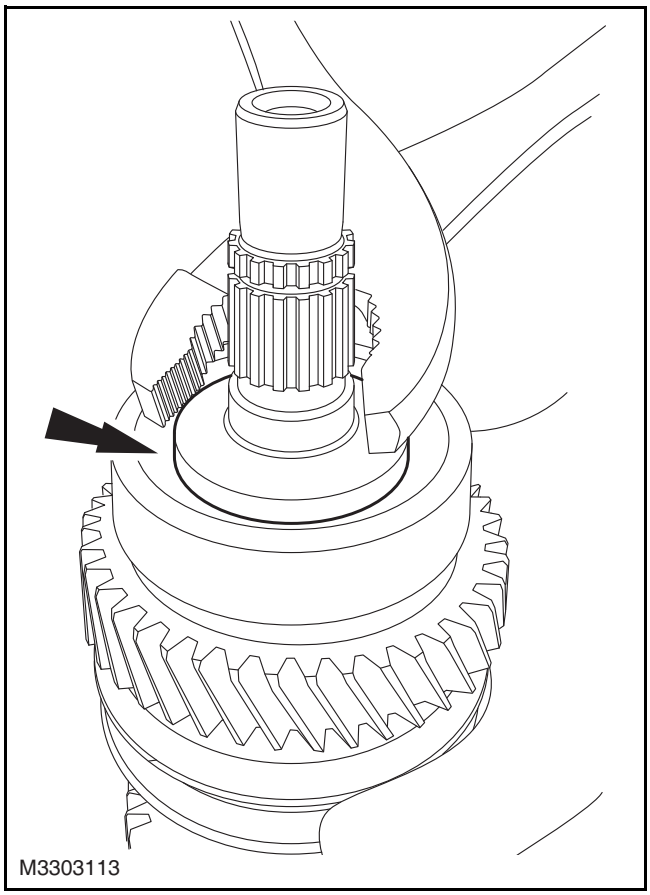
**⚠ CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**

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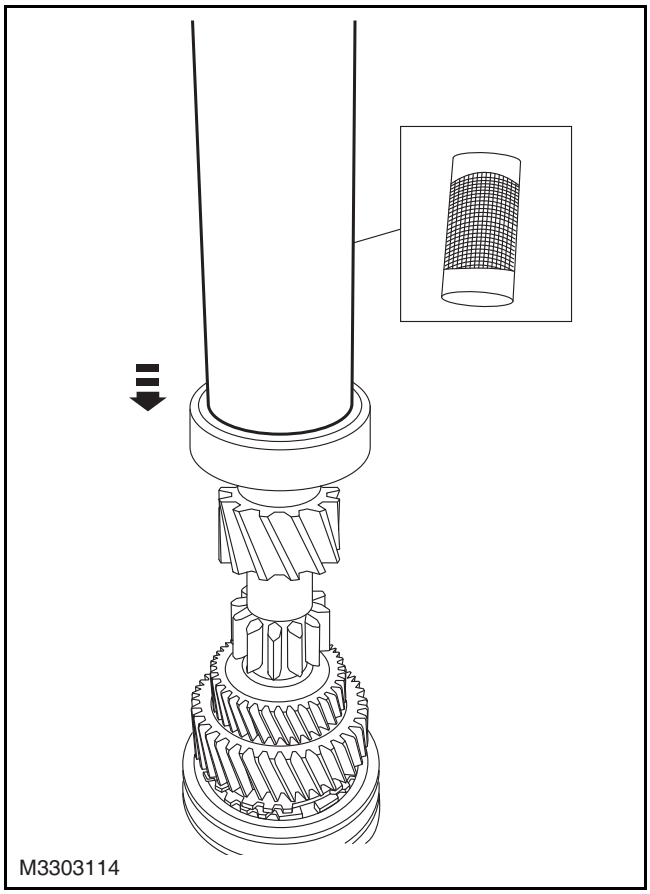
5. Use a proper tool to install the input shaft rear case rear bearing circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**




6. Use the input shaft front case rear bearing pressing assistant tool to install the input shaft front case rear bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

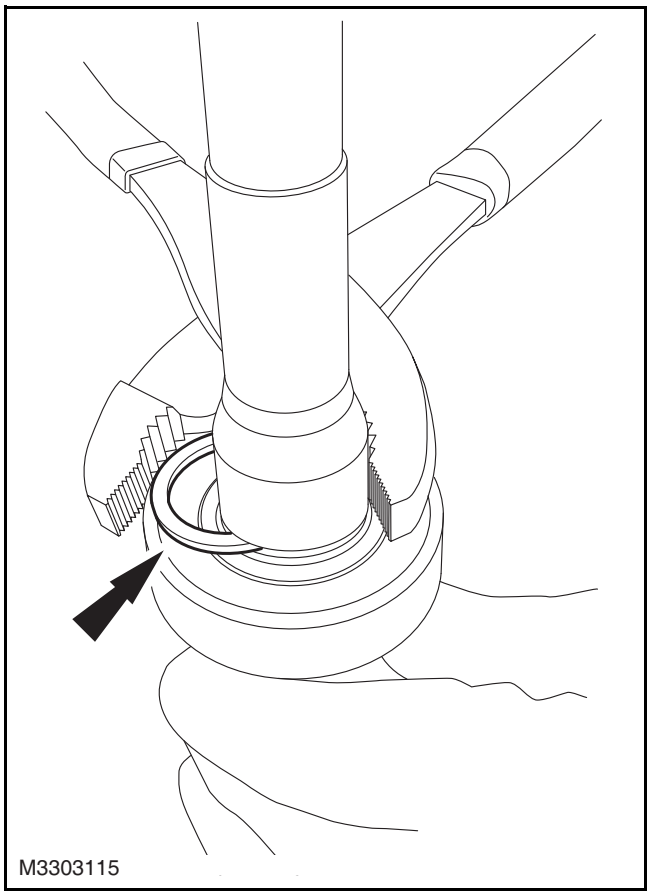


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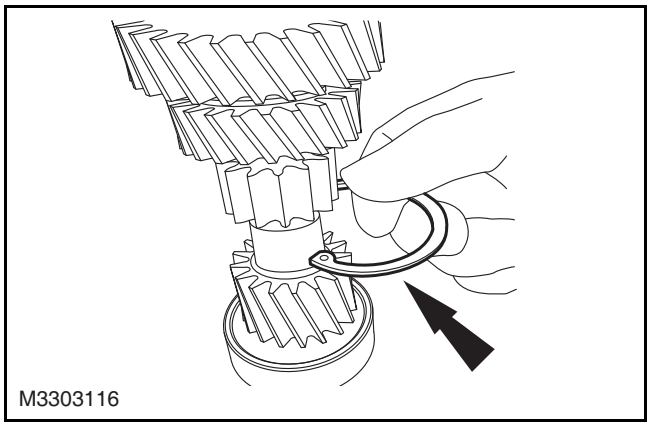
7. Use a proper tool to install the input shaft front case rear bearing circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**




8. Install the input shaft front case rear circlip.

**CAUTION: Chamfer side in the rear circlip faces towards input shaft rear end.**



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# Assembly of Transmission

## Material

| Item | Model |
|---|---|
| Sealant | YT5699 silicone sealant |
| Manual Transmission Oil | API GL-4 75W-90 |

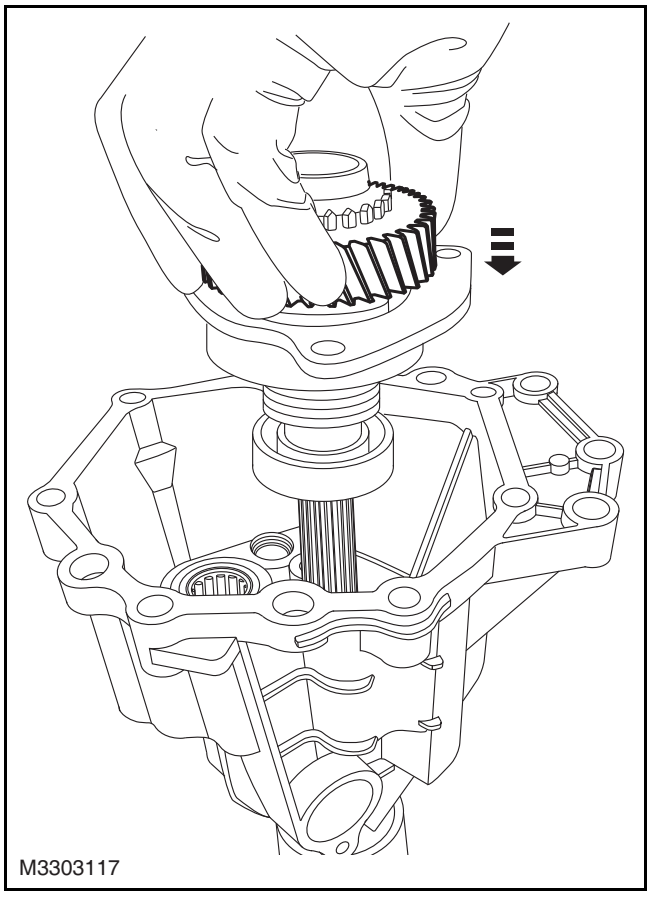
Precautions for transmission before assembling:

- Clean all the parts.
- Apply gear oil to part surface with relative movement.
- Apply grease to circular surface of needle roller bearing before assembling needle roller bearing.
- Apply grease to outer ring and inner ring of bearing before assembling deep groove ball bearing.
- Apply grease to lip while assembling oil seal.

## Assembly

**1.** Install the output shaft to extension case and tighten it to the specified torque.

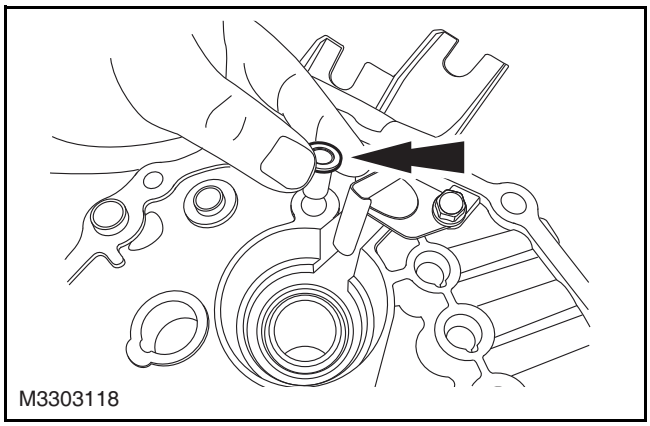
Torque: 23 ± 5 Nm


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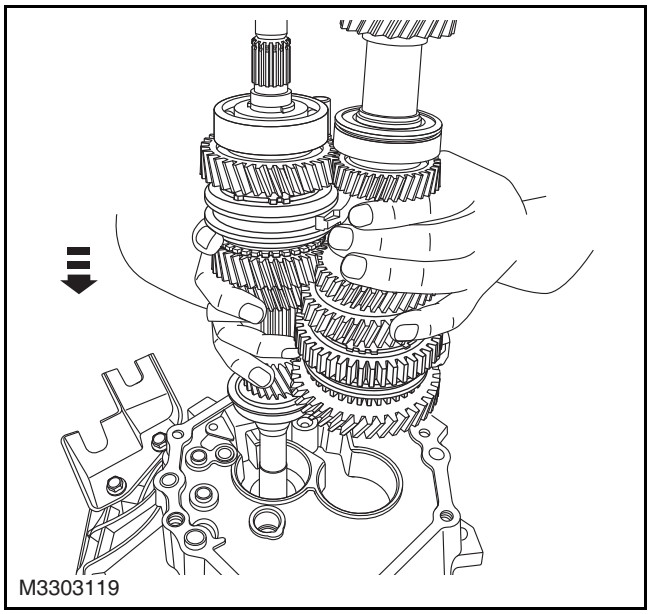


2. Before installing the input shaft set, ensure that reverse gear shift fork locking assembly has been installed in place.

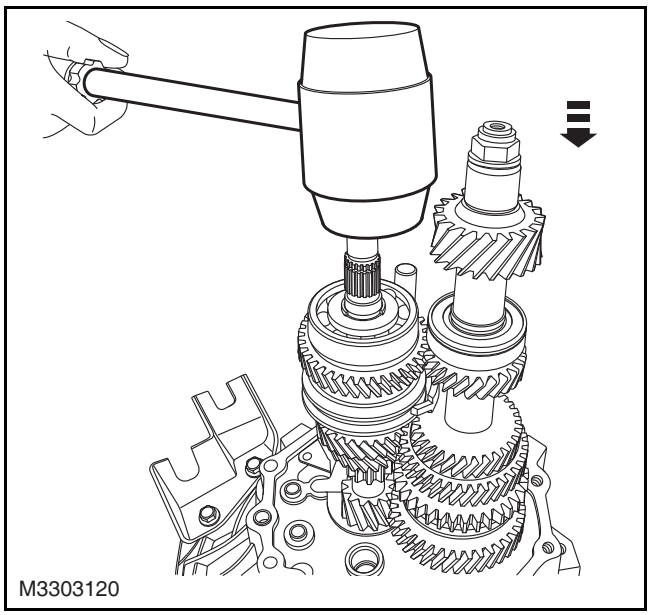

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3. Use oil seal protection tool to cover the input shaft front end and install input shaft and intermediate shaft set.

**CAUTION: Fork must be stuck in the slot of synchronizer sleeve and each of three gear fork shafts must be placed into the hole correspondingly.**


M3303119

4. Tap the rear end of input shaft with rubber hammer lightly to ensure that each set has been installed in place.

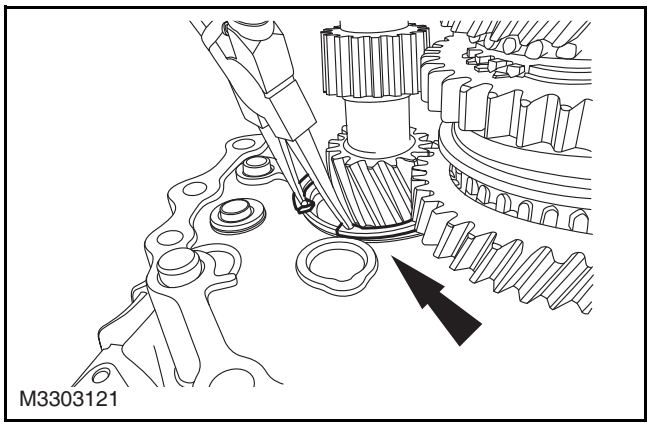

M3303120

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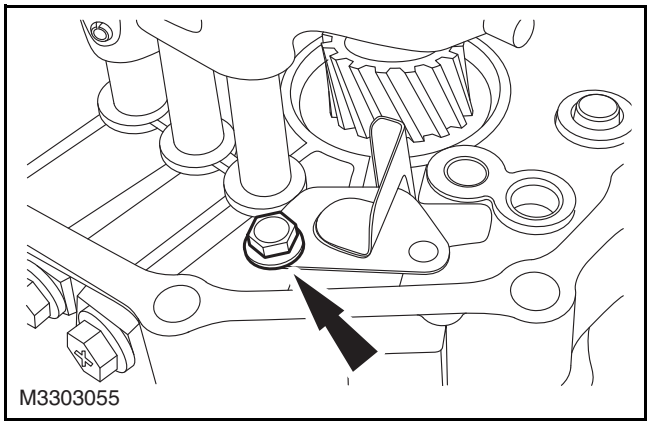
5. Use a proper tool to install the input shaft front case rear circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**


M3303121

6. Install the oil delivery trough and tighten the retaining bolt to the specified torque.

   Torque: 23 ± 5 Nm

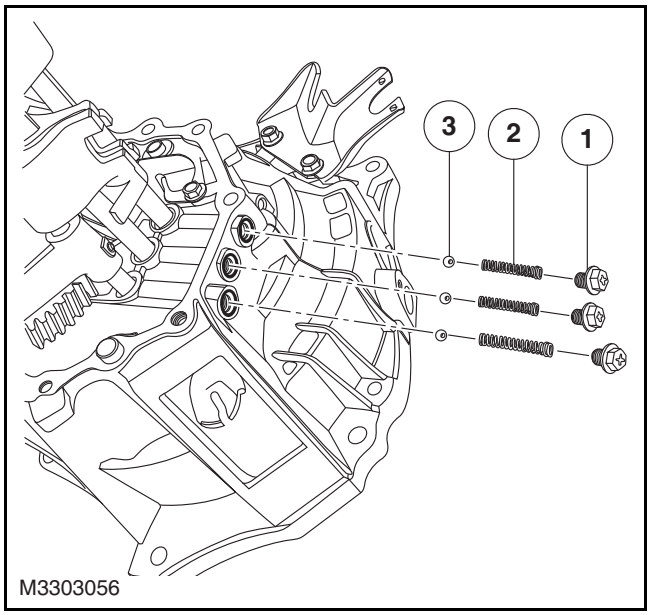

M3303055

7. Install the gear fork shaft steel balls (1), self-locking springs (2) and gear fork shaft locking bolts (3) and tighten them to the specified torque.

   Torque: 23 ± 5 Nm

**CAUTION: The 3 self-locking springs (2) have different lengths, which of 1st-2nd gear fork shaft is longer than those of 3rd-4th gear and reverse gear fork shafts.**

**CAUTION: Be sure to use new gear fork shaft locking bolts.**



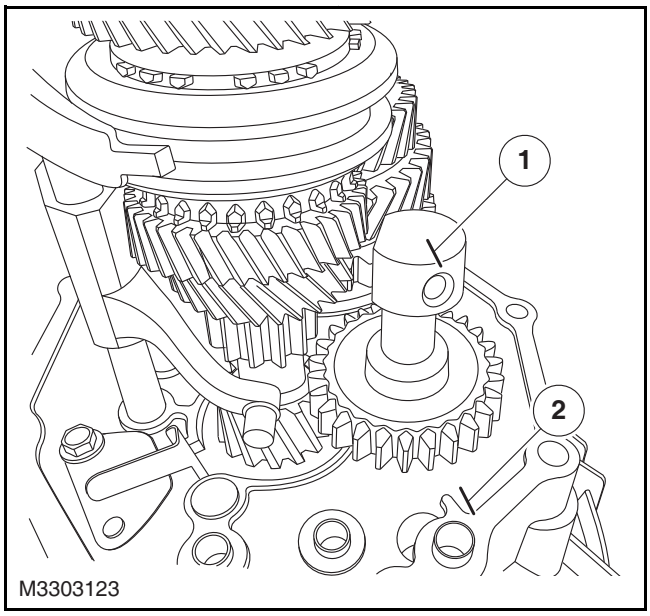
M3303056

https://truckmanualshub.com/



8. Install the reverse gear shaft set.

**CAUTION: While installing the reverse gear shaft set, mark (1) on the reverse gear shaft is in line with mark (2) on the front case for easy installation of reverse gear shaft bolts.**



M3303123

9. Tighten the reverse gear shift fork to the specified torque after installation.

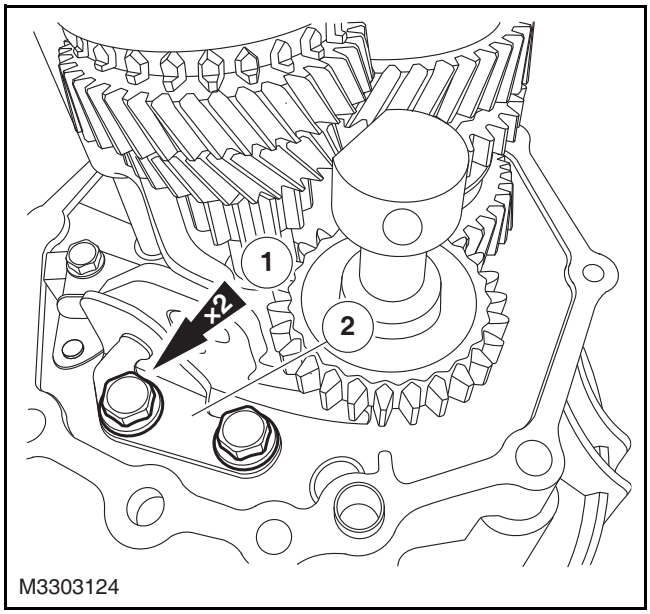
   1 Install the reverse gear shift fork (2).

   2 Install the reverse gear shift fork assembly bolts (1).

   Torque: 23 ± 5 Nm

**CAUTION: While installing the reverse gear shift fork, reverse gear shift fork must be stuck to the slot of reverse idler gear sleeve.**

**CAUTION: Be sure to use new reverse gear shift fork assembly retaining bolts.**



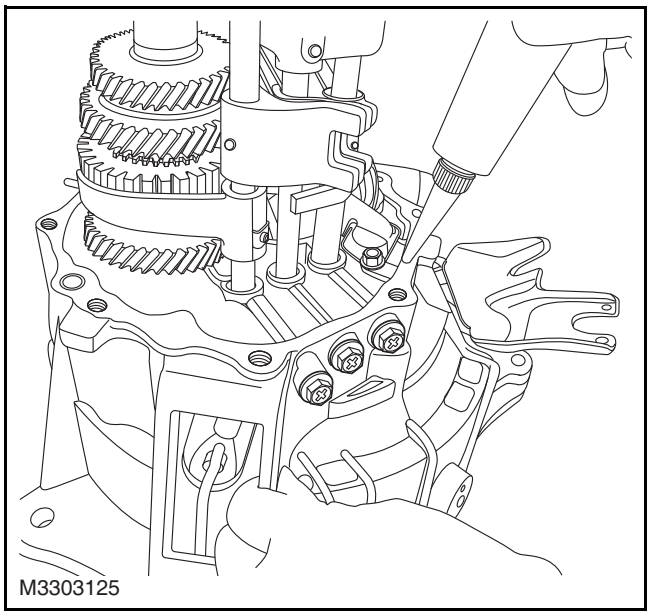
M3303124

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**10.** Apply sealant to the case contact surface.

**CAUTION: Remove the remaining sealant on the case contact surface with scraper before applying. Be sure to apply evenly in a continuous bead with 2 ~ 3 mm in diameter. After applying, fit the cases within specified time. Remove and reapply if exceeding the specified time.**

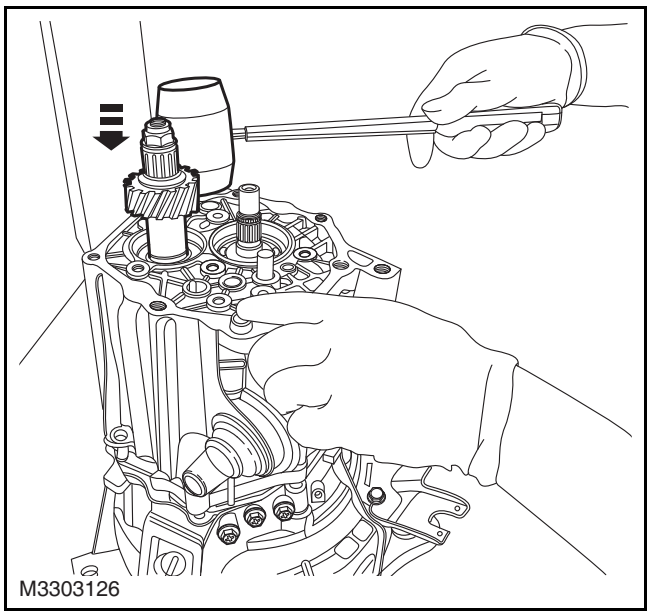

M3303125

**11.** Tighten the rear box to the specified torque after installation.

Torque: 23 ± 5 Nm

**CAUTION: To ensure installing in place, knock extension case knock pin lightly with rubber hammer and do not tap the case contact surface while installing rear case.**

**CAUTION: Case bolts should be tightened diagonally.**


M3303126

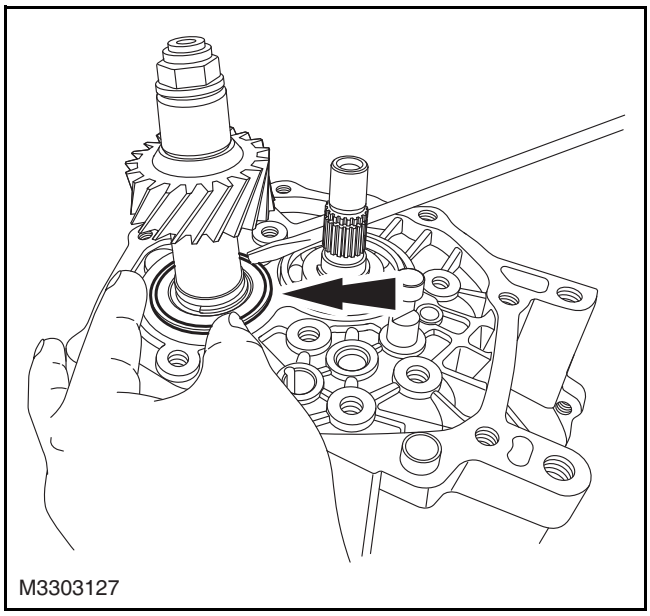
https://truckmanualshub.com/



**12.** Use a proper tool to install the intermediate shaft rear bearing outer circlip.

**CAUTION: In order to install circlip easily, slightly extract intermediate shaft upward and then install the outer circlip.**

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**

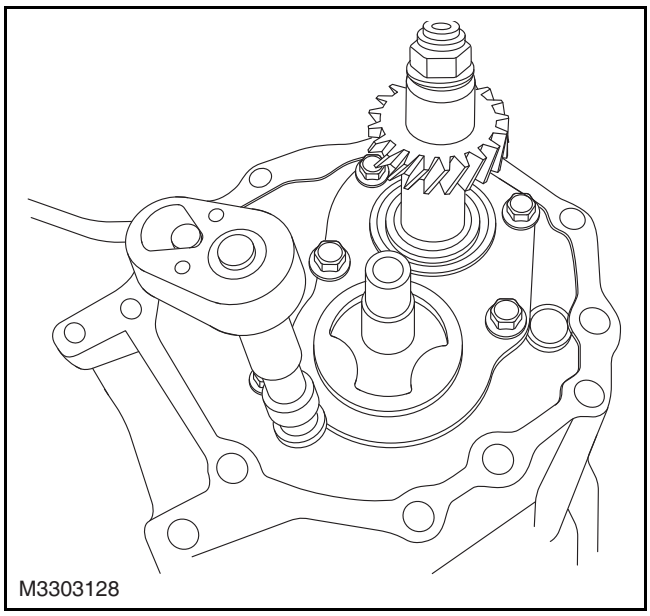


M3303127

**13.** Install the rear case cover, and tighten the bolts to the specified torque.

Torque: 23 ± 5 Nm

**CAUTION: Be sure to use new rear case cover bolts.**



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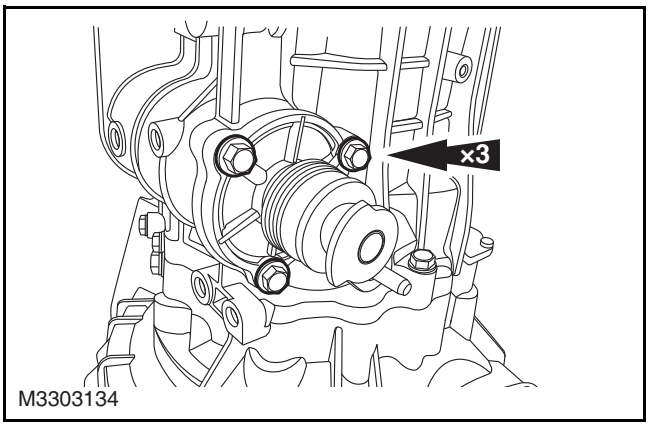
**14.** Tighten the gearshift guide case to the specified torque after installation.

1 Apply sealant to the case contact surface.

2 Install the gearshift guide case.

3 Tighten the gearshift guide case bolts to the specified torque.

Torque: 23 ± 5 Nm

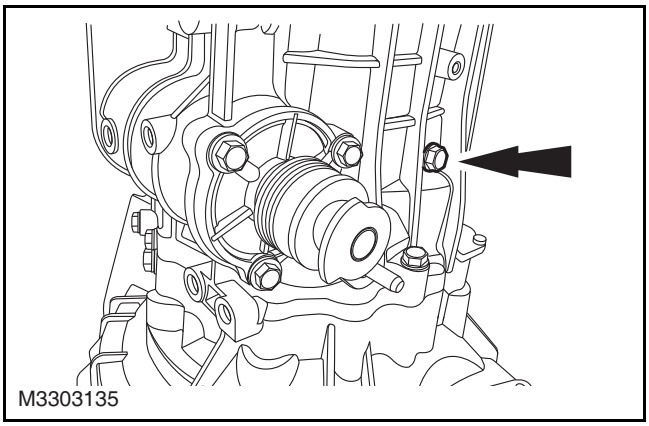



⚠ **CAUTION: Remove the remaining sealant on the case contact surface with scraper before applying. Be sure to apply evenly to the inner circle in a continuous bead with 2 ~ 3 mm in diameter. After applying, fit the cases within specified time. Remove and reapply if exceeding the specified time.**

**15.** Install the reverse gear shaft bolt.

Torque: 23 ± 5 Nm

⚠ **CAUTION: Be sure to use new reverse gear shaft bolt.**



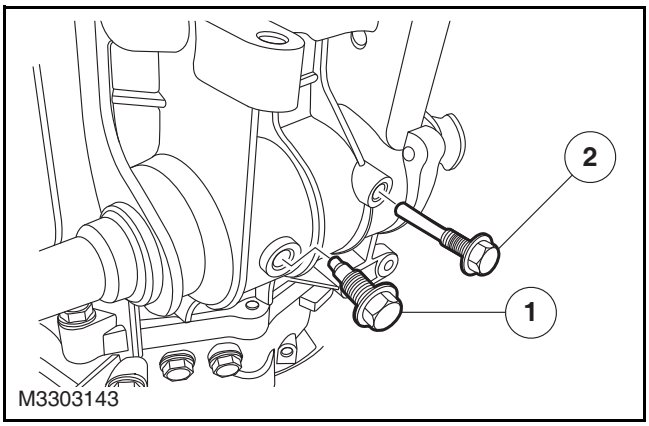

**16.** Install the gear shift locking bolt and interlocking bolt of 5th and reverse gear.

1 Install the gear shift locking bolt (1).

Torque: 23 ± 5 Nm

2 Install the interlocking bolt (2) to 5th and reverse gear.

Torque: 23 ± 5 Nm



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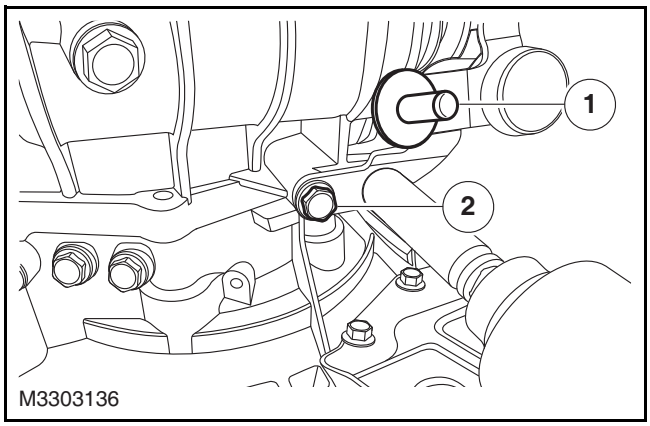


**17.** Install the shift rocker.

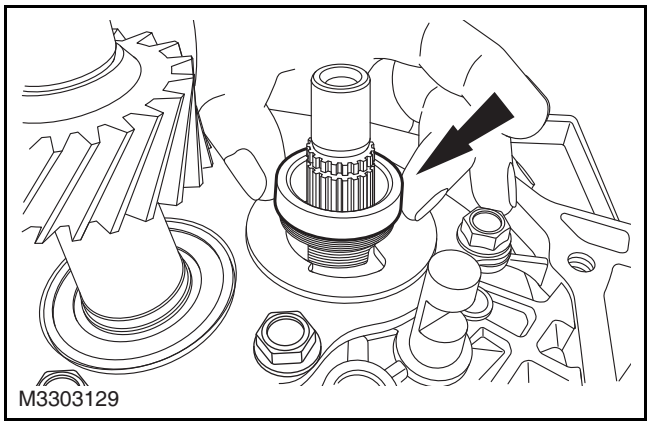
1 Install the shift rocker (1).

2 Tighten the shift rocker bracket bolt (2) to the specified torque.

Torque: 23 ± 5 Nm

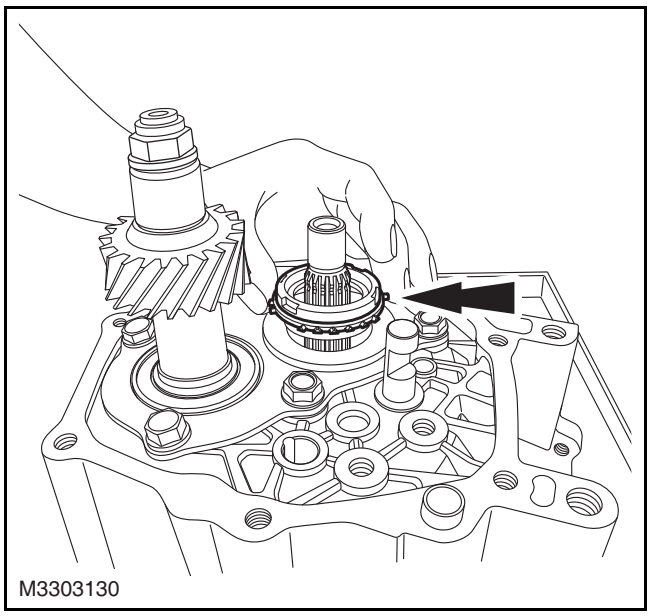



**18.** Install the reverse gear taper ring.




**19.** Install the reverse gear stop ring.

**CAUTION: The method to distinguish reverse gear stop ring from 5th gear synchronizer gear ring is that there is a "J" on the surface of reverse gear stop ring which is thinner than 5th gear synchronizer gear ring.**



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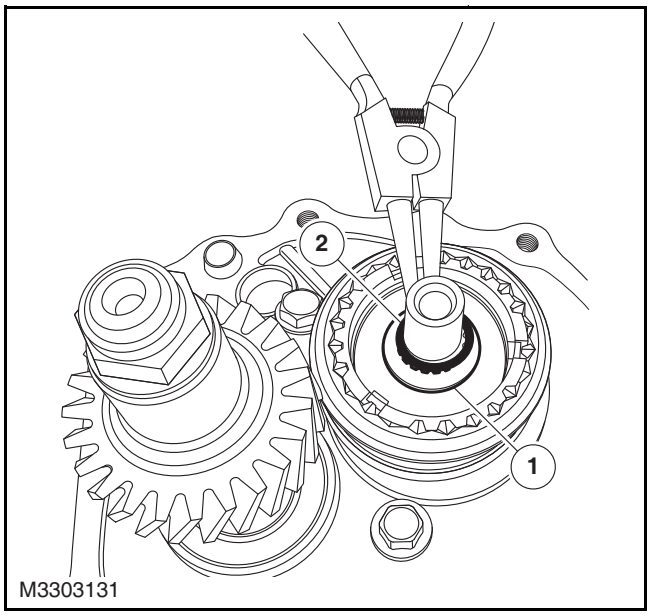
**20.** Install the 5th gear synchronizer and circlip.

1 Install the 5th gear synchronizer (1).

2 Install the 5th gear synchronizer circlip (2).

**CAUTION: Synchronizer slider is aligned with gear ring slider slot while installation.**

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**




**21.** Install the 5th gear shift set.

1 Install the 5th gear shift fork (1).

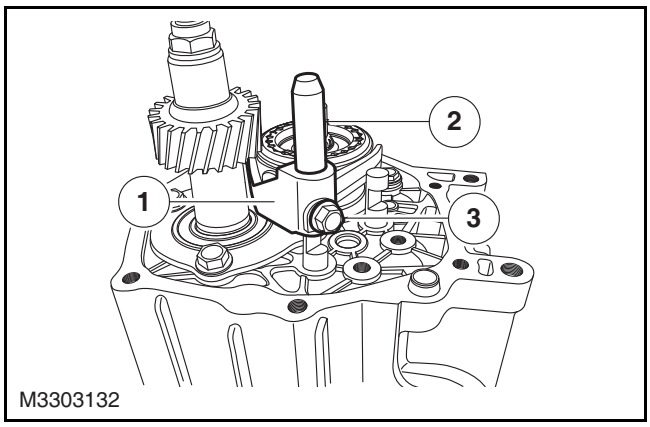
2 Install the 5th gear fork shaft (2).

3 Tighten the 5th gear fork bolt (3) to the specified torque.

Torque: 10 ± 2 Nm

**CAUTION: Move the reverse gear fork shaft downward with proper tool and engage with the 5th gear to avoid interference of 5th gear shift fork with reverse gear fork shaft before installing 5th gear shift fork. Move the reverse gear fork shaft up to neutral position after installation.**

**CAUTION: Be sure to use new 5th gear fork bolt.**



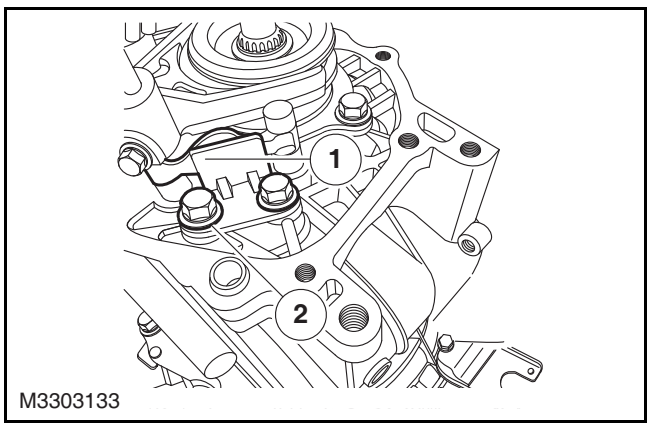

**22.** Install the 5th gear shift lever assembly.

1 Install the 5th gear shift lever (1).

2 Tighten 2 5th gear shift lever bolts (2) to the specified torque.

Torque: 23 ± 5 Nm

**CAUTION: Be sure to use new 5th gear shift lever bolts.**

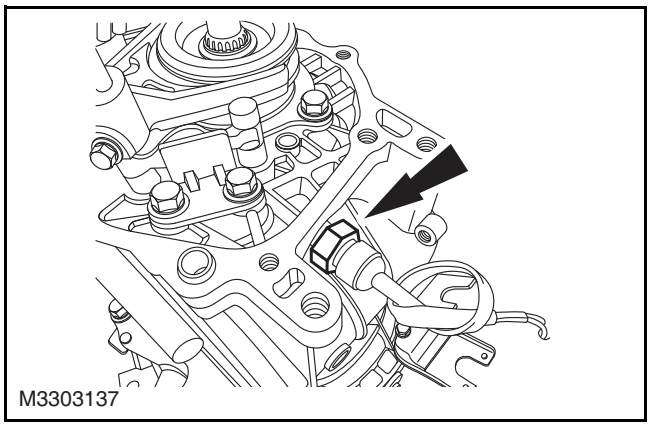


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**23.** Install the backup lamp switch assembly with wrench.

Torque: 15 ~ 20 Nm


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**24.** Install the input shaft needle roller bearing (1), 5th gear synchronizer gear ring (2) and wave ring (3).

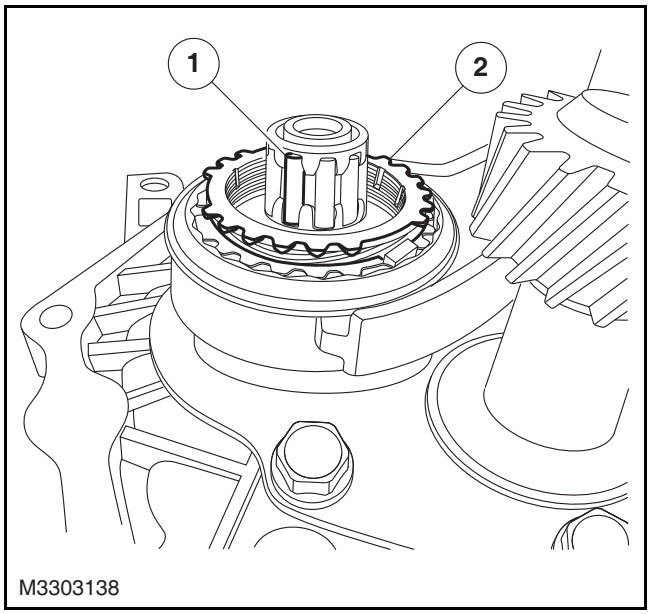
1 Install the input shaft needle roller bearing.

2 Install the 5th gear synchronizer gear ring and wave ring to ensure that gear ring, wave ring and 5th gear synchronizer have been installed in place.

**CAUTION: Uniformly apply lubricant to the part of needle roller end face that contacts shaft journal.**

**CAUTION: Synchronizer gear ring slider slot is aligned with synchronizer slider while installation.**

**CAUTION: As for installation position of wave ring, its wave trough (the lowest point) should be aligned with gear ring slider slot.**



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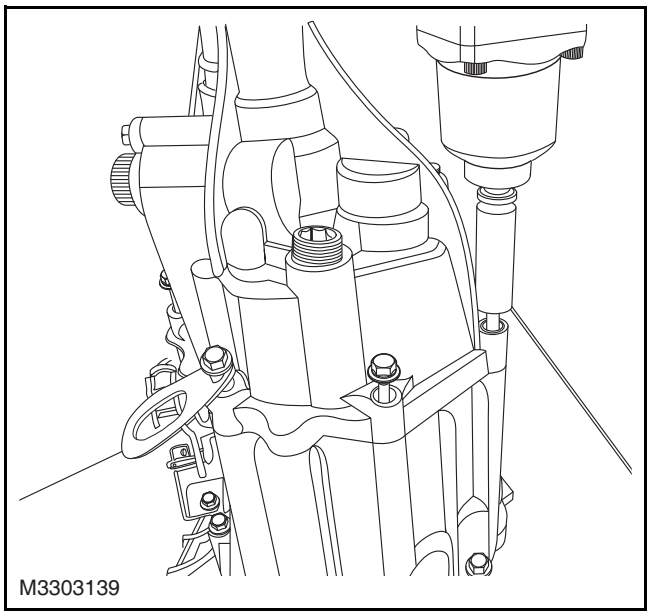
**25.** Install the extension case.

1 Apply sealant to the case contact surface.

2 Install the extension case.

3 Tighten the extension case bolts to the specified torque.

Torque: 23 ± 5 Nm

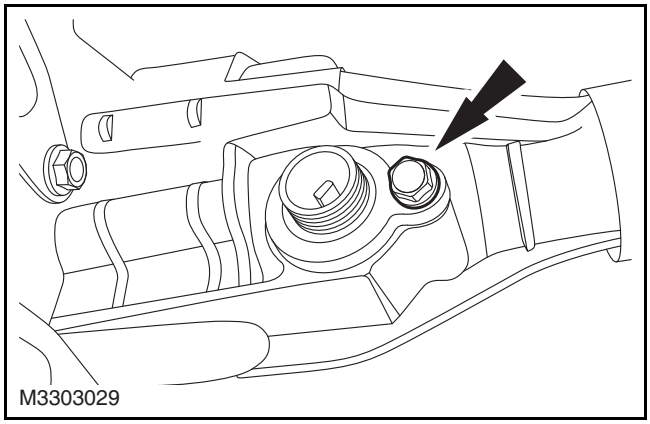



**CAUTION: Remove the remaining sealant on the case contact surface with scraper before applying. Be sure to apply evenly to the inner circle in a continuous bead with 2 ~ 3 mm in diameter. After applying, fit the cases within specified time. Remove and reapply if exceeding the specified time.**

**CAUTION: Case bolts should comply with diagonal tightening methods. If there is no trace around the surface of extension case bolt hole, hanger bolt can be installed here.**

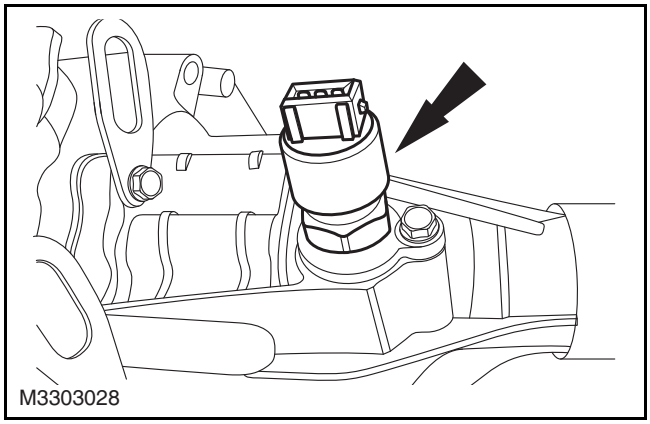
**26.** Install the speedometer worm set and tighten it to the specified torque.

Torque: 10 ± 1 Nm




**27.** Install the vehicle speed sensor.

Torque: 10 Nm



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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Connecting bolt between gearshift control assembly and middle-compartment | 20 ± 2 | - | - |
| Gear control cable grommet plate retaining bolt | 9 | - | 80 |

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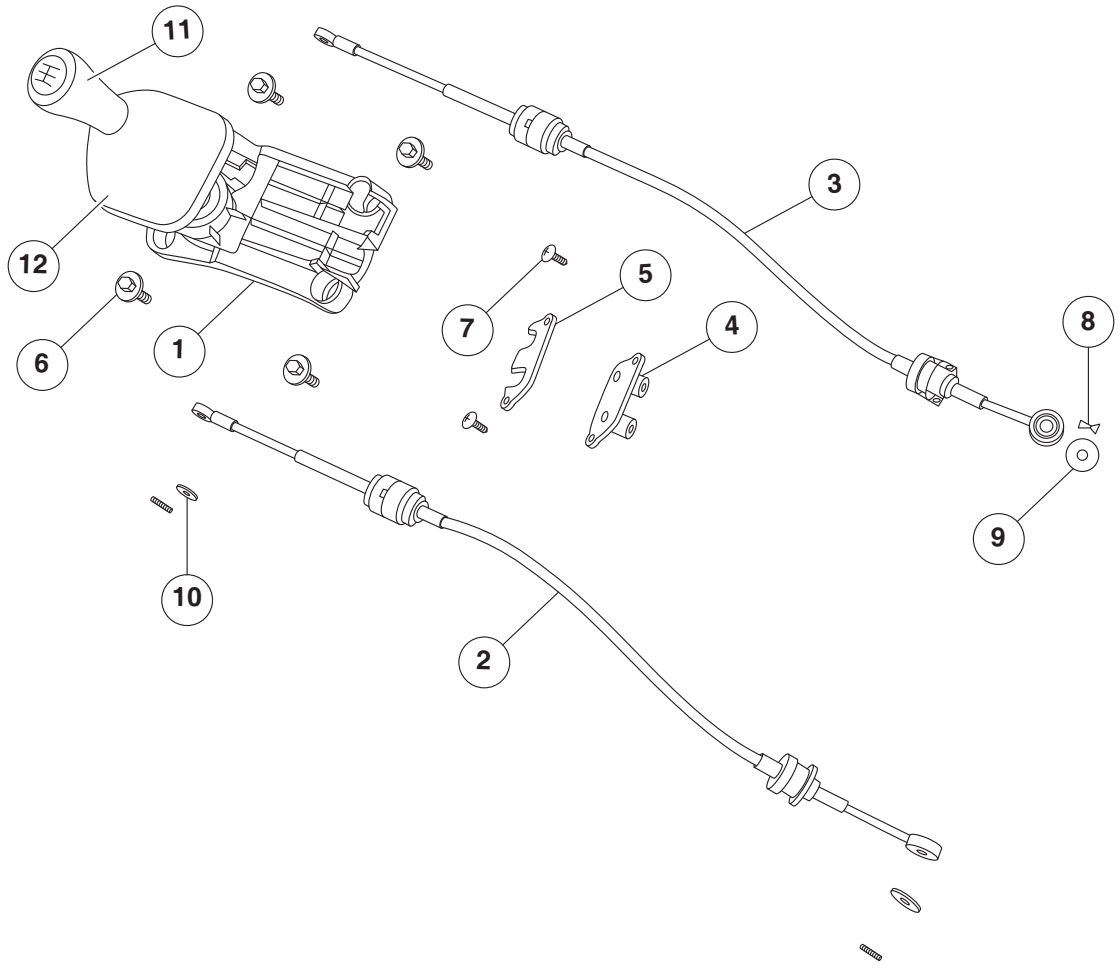


## Description and Operation

# System Overview

Manual Transmission gearshift mechanism includes gearshift retainer assembly and gear control cables. The gearshift retainer is connected with transmission via gear shift and select cables to isolate the external gearshift mechanism from vehicle body, thus reducing the vibration..

# Components Exploded View




M3304001

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Gearshift control assembly | 7 | Cross recessed pan head screw |
| 2 | Gear shift cable assembly | 8 | Flexible clip |
| 3 | Gear select cable assembly | 9 | Plate washer |
| 4 | Gear control cable grommet | 10 | Plate washer |
| 5 | Gear control cable grommet plate | 11 | Hand knob assembly |
| 6 | Bolt | 12 | Dust boot set |

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## Symptom Diagnosis and Testing

# Inspection and Verification

1. Verify the customer concern and reproduce the fault as necessary.
2. If the customer concern cannot be identified, carry out road test or visual inspection according to the table below.
3. If the fault can be identified obviously, proceed to the repair process.
4. If the fault cannot be identified obviously, carry out a precise inspection according to the Symptom Chart.

**Visual Inspection Chart**

| Mechanical |
|---|
| • Obviously damaged or worn components |
| • Loose or lost nuts or bolts |

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## Symptom Chart

If the fault occurs, but there is no DTC stored in the control module for this fault and the causes cannot be verified in basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Difficult operation of gearshift mechanism | • Distorted connection of external gearshift mechanism | • Adjust the external gearshift mechanism |
| | • Damaged shift lever | • Diagnosis Procedure for Difficult Operation of Gearshift Mechanism |
| | • Damaged gear shift and select cables | |

## Diagnosis Procedure for Difficult Operation of Gearshift Mechanism

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect tire | |
| | A. Separate shift lever from transmission.<br>Does external gearshift mechanism operate difficultly?<br>**Yes**<br>Remove the shift lever and find out fault components.<br>**Refer to: Gearshift Mechanism (3.3.4 Manual Transmission External Control, Removal and Installation).**<br>**No**<br>Go to step 2. |
| 2. Inspect gear shift and select cables | |
| | A. Remove the gear shift and select cables from transmission.<br>Are the cables damaged?<br>**Yes**<br>Find out the fault, and replace the cables.<br>**Refer to: Gearshift Mechanism (3.3.4 Manual Transmission External Control, Removal and Installation).**<br>**No**<br>Transmission fault. |

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## Removal and Installation

# Gearshift Mechanism

### Removal

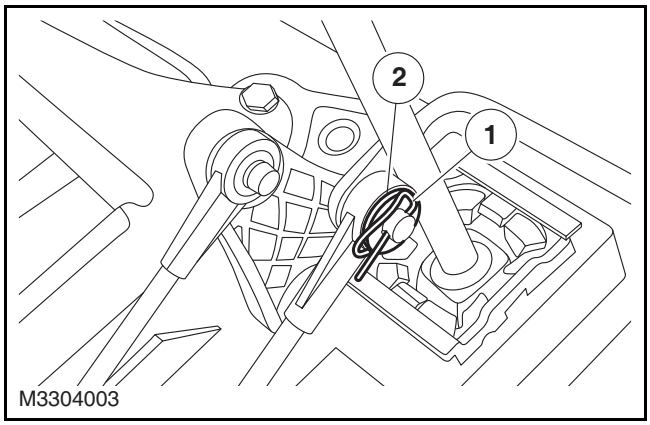
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

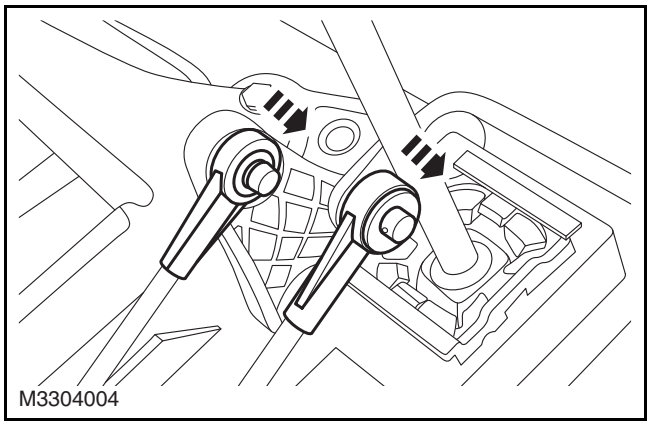
2. Remove the center console assembly.

   **Refer to: Console (5.1.6 Instrument Panel and Console, Removal and Installation).**

3. Remove the gear control cable flexible clip (1) and plate washer (2).




4. Disconnect the gear shift and select cables from the shift lever.

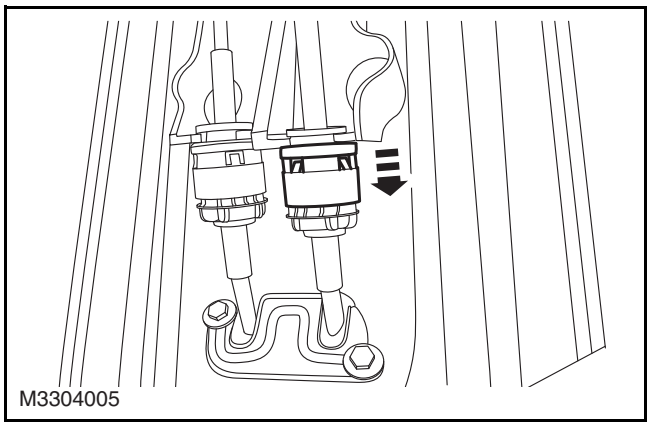


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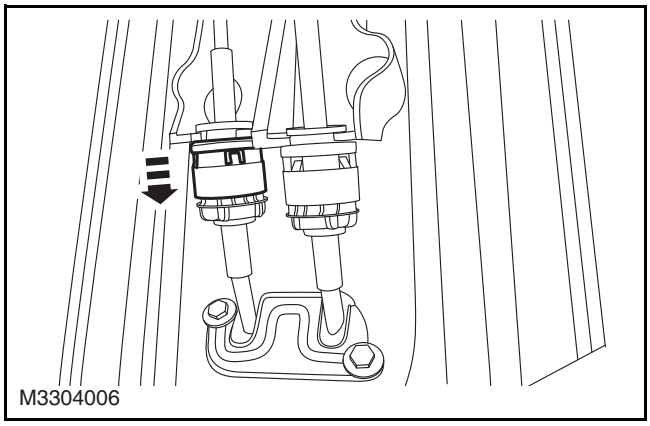


**5.** Separate the gear shift and select cables from bottom of gearshift mechanism.

1 Push down the gear shift cable clamp to separate the cable from the bottom of gearshift mechanism as shown in the figure.

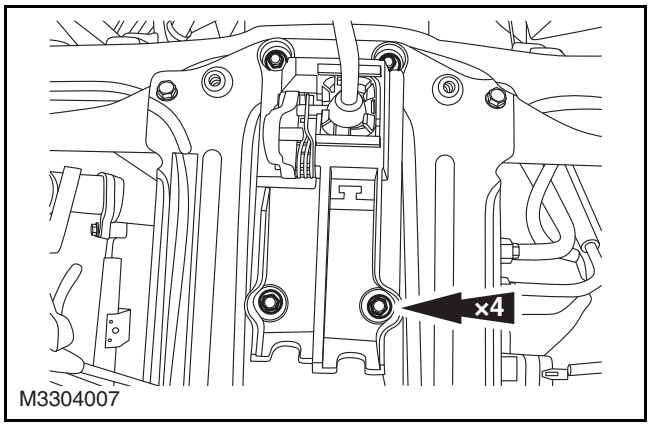

M3304005

2 Push down the gear select cable clamp to separate the cable from the bottom of gearshift mechanism as shown in the figure.


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**6.** Remove 4 retaining bolts from the gearshift control assembly.

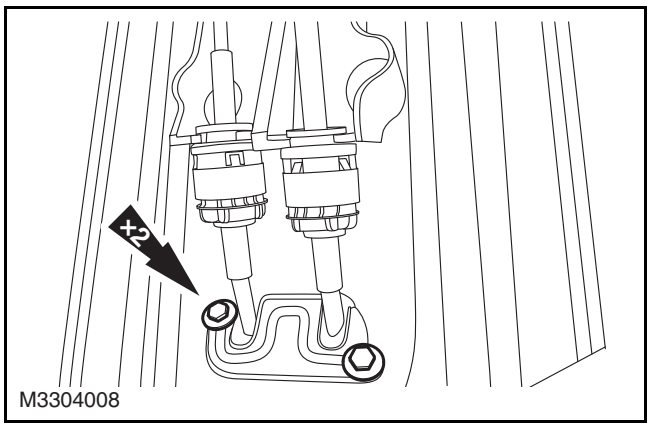
Torque: 20 ± 2 Nm



M3304007

**7.** Remove 2 retaining bolts from the gear control cable grommet plate.

Torque: 9 Nm



M3304008

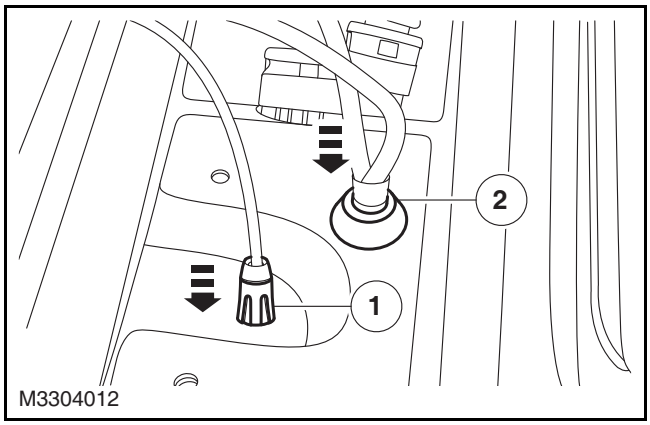
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8. Remove the gear control cable grommet plate and grommet in order.
9. Remove the parking brake lever.

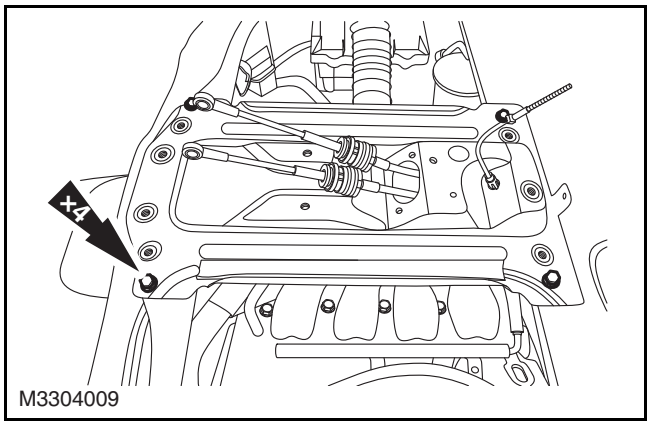
   **Refer to: Parking Brake Lever (2.3.4. Parking Brake and Operation, Removal and Installation).**

10. Separate the No.1 parking brake cable (1) from the gearshift middle-compartment.
11. Press down the wiring harness fixing rubber ring (2) to separate it from the middle-compartment.




12. Remove 4 retaining bolts from the gearshift middle-compartment.

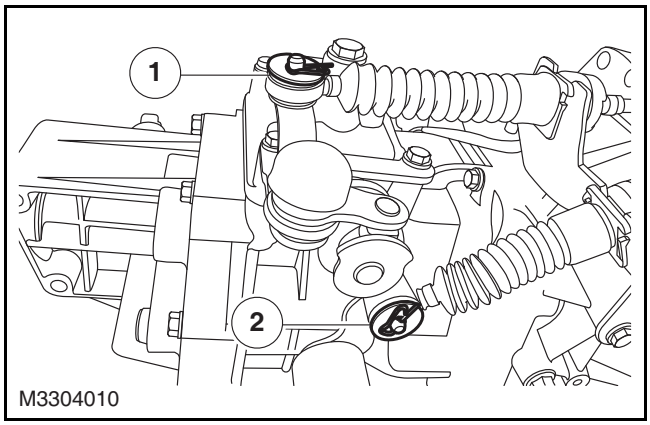
    Torque: 20 ± 2 Nm




13. Remove the attachments from transmission gearcase and gear control cables.

    1 Remove the gear select cable (1) flexible clip and plate washer.

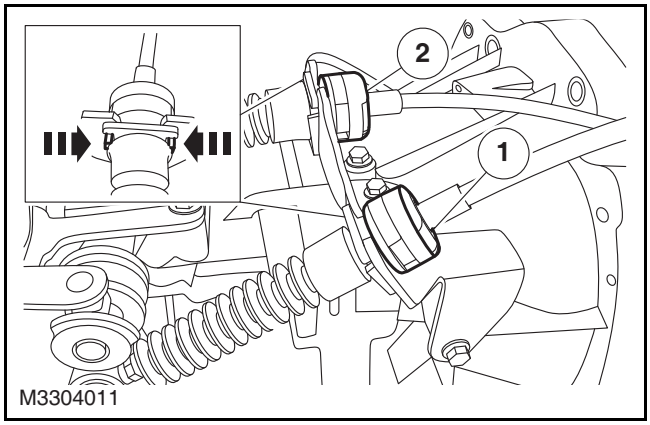
    2 Remove the gear shift cable (2) flexible clip and plate washer.



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**14.** Separate the gear shift cable (1) and gear select cable (2) from the control cable bracket.




**15.** Remove the gear shift and select cables.

## Installation

**1.** Installation is in the reverse order of removal.

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## Specifications

# Material Specifications

| Item | Model |
|---|---|
| Transmission oil | API (GL-4) SAE 75W-90, Shell Spirax S4 GS |

# Component Specifications

| Item | Specifications |
|---|---|
| Clutch driven disc assembly diameter (outer/ inner) | 200/130 mm |
| Clutch driven disc assembly wear limit | 1.7 mm |
| Clutch pedal free travel standard value | 5 ~ 11 mm |

# General Specifications

| Item | Specifications |
|---|---|
| Type | Dry clutch with single disc diaphragm spring |
| Operation type | Mechanical |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Clutch pressure plate retaining bolt | 32 ± 2 | - | - |

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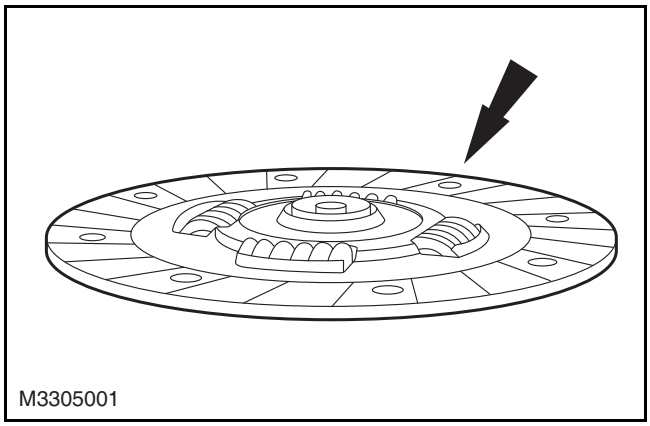


## General Inspection

## Clutch Driven Disc Inspection

**WARNING: Do not clean the clutch driven disc with wax-based cleaning agents or solvents.**

1. Clean the clutch driven disc.
2. Inspect the clutch driven disc for the following:
   - Oil stain
   - Scorch mark
   - Thickness
   - Spring (if it is damaged, replace the clutch driven disc)



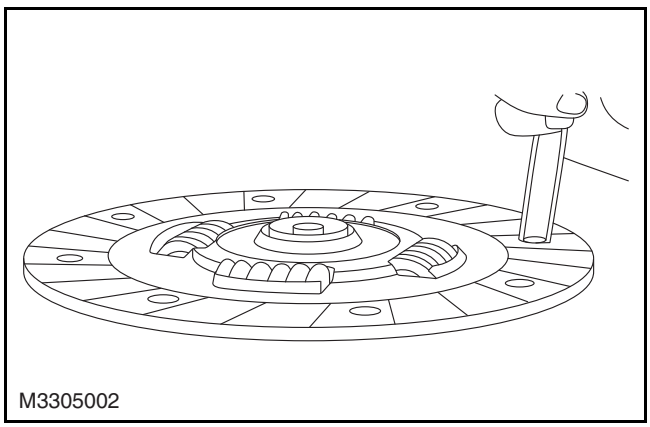
M3305001

3. Measure the rivet head depth (the distance between rivet head and clutch driven disc assembly surface), if any rivet head depth exceeds the limit, replace the clutch driven disc assembly.

   Rivet head depth

   Standard: 1.15 ~ 1.65 mm

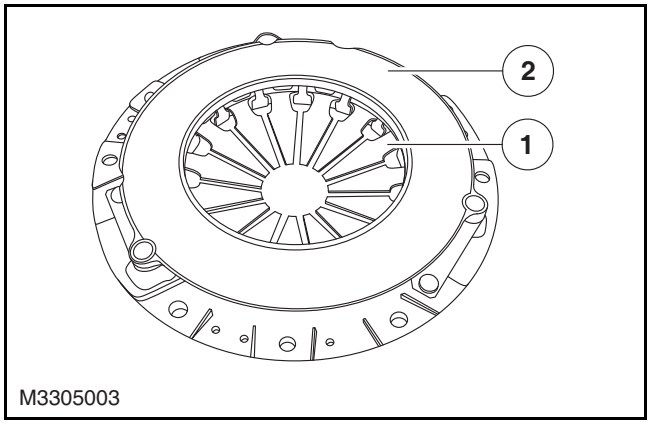
   Limit: 0.5 mm



M3305002

## Clutch Pressure Plate Inspection

1. Clean the clutch pressure plate.
2. Inspect whether the diaphragm spring (1) is abnormally worn or damaged.
3. Inspect whether the clutch pressure plate assembly (2) is worn or has local hot spot.
4. If any abnormality is found, replace the assembly as diaphragm and pressure plate cannot be disassembled.




M3305003

## Clutch Pedal Assembly and Cable Inspection

1. Inspect whether the bushing is worn or damaged.
2. Inspect whether the spacer bush is worn or damaged.
3. Inspect whether the pedal arm is damaged or deformed.
4. Inspect whether the torsion spring is deformed.
5. Inspect whether the pedal pad is worn or damaged.
6. Inspect whether the clutch cable is worn, deformed or damaged.

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# Clutch Pedal Free Travel Inspection

1. Press clutch pedal with hand until resistance begins to be felt (clutch pedal operation force should not be more than 140 N) and measure the distance (clutch pedal free travel).
2. Inspect the pedal travel.

   Standard free travel: 5 ~ 11 mm
3. Adjust the clutch cable and clutch pedal when necessary if free travel is not within the specified range.
4. After inspection of clutch pedal free travel, inspect whether clutch works normally while engine is running. When the clutch pedal is depressed, the clutch disengages completely and returns in time after the pedal is released; Slipping is forbidden after engaging and no unusual noise during operation.

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## Symptom Diagnosis and Testing

**Refer to: Symptom Chart (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing).**

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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| Clutch type | Dry clutch with single disc diaphragm spring |
| Operation type | Mechanical |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Clutch pressure plate retaining bolt | 32 ± 2 | - | - |

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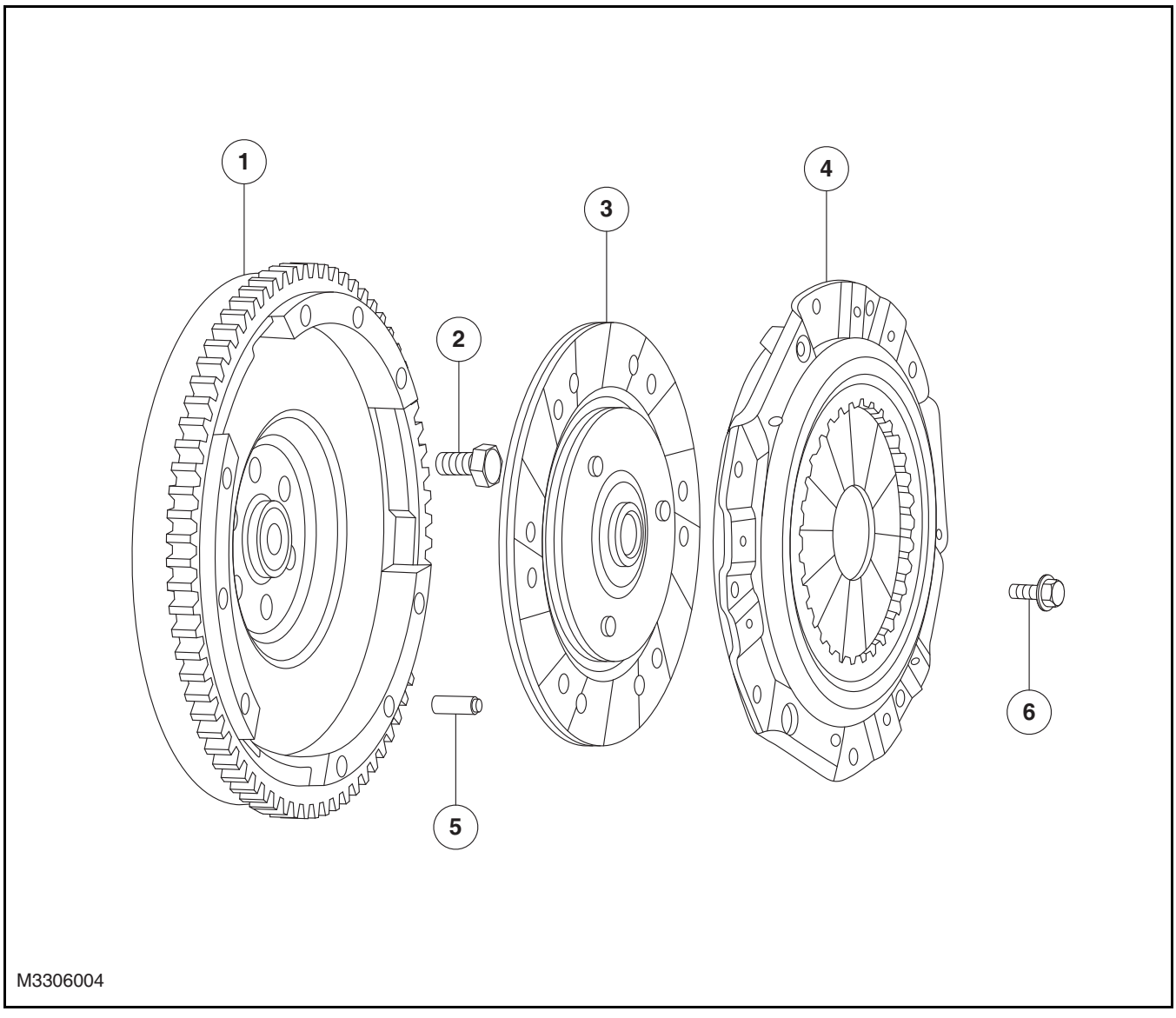


## Description and Operation

# System Overview

Clutch includes one clutch driven disc assembly and one clutch pressure plate assembly fixed on the flywheel. In the normal operating condition, through connecting with the flywheel ring gear assembly the clutch driven disc assembly under the pressure of clutch pressure disc assembly transfers engine power to the transmission assembly. When the clutch pedal is depressed completely, clutch pressure plate assembly is disengaged from the clutch driven disc assembly. At this time clutch driven disc cannot transfer engine power to the transmission assembly; when the pedal is completely released, clutch pressure plate assembly compresses driven disc assembly, which transfers engine power to the transmission assembly.

Function of clutch mainly involves: connecting engine with drive device gradually to ensure the smooth start; disconnecting engine with drive device temporarily, to reduce shocks to transmission gear with gear shifting and ensure the smooth operation of drive device and vehicle; absorbing energy by slippage of clutch while applying emergency brakes, preventing drive device components from overloading and damaging.




M3306004

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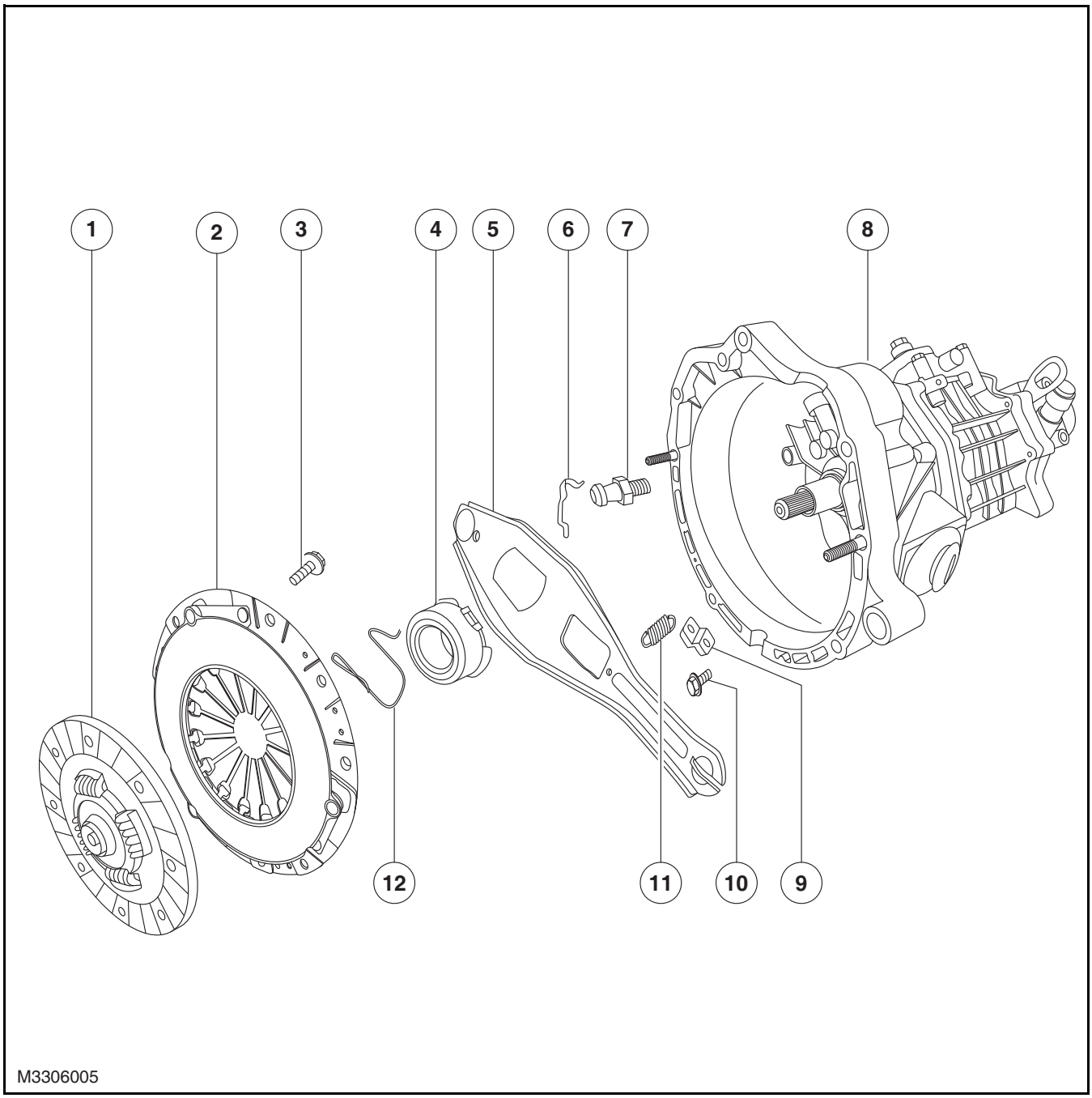


| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Flywheel ring gear assembly | 4 | Clutch pressure plate assembly |
| 2 | Flywheel bolt | 5 | Pressure plate dowel pin |
| 3 | Clutch driven disc assembly | 6 | Clutch pressure plate retaining bolt |

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# Components Exploded View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Clutch driven disc assembly | 7 | Clutch release bearing |
| 2 | Clutch pressure plate assembly | 8 | Transmission assembly |
| 3 | Clutch pressure plate retaining bolt | 9 | Clutch release fork return spring bracket |
| 4 | Clutch release bearing | 10 | Clutch release fork bracket bolt |
| 5 | Clutch release fork | 11 | Clutch release fork return spring |
| 6 | Clutch release fork clip | 12 | Release bearing clip |

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## Symptom Diagnosis and Testing

Refer to: Symptom Chart (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing).

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## Removal and Installation

# Clutch Pressure Plate Assembly, Clutch Driven Disc Assembly

### Special Tool

| | |
|---|---|
| Flywheel holding tool | 09924-17810 |
| Driven disc mounting shaft | 09923-36330 |

### Removal

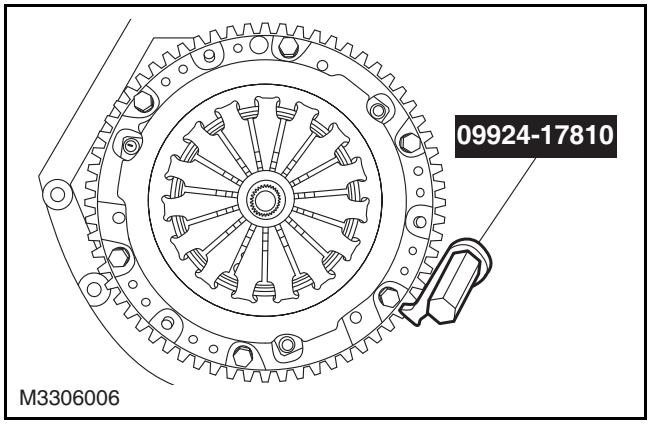
**1.** Remove the manual transmission.

**Refer to: Manual Transmission (3.3.7 Manual Transmission - MR513C01, Removal and Installation).**

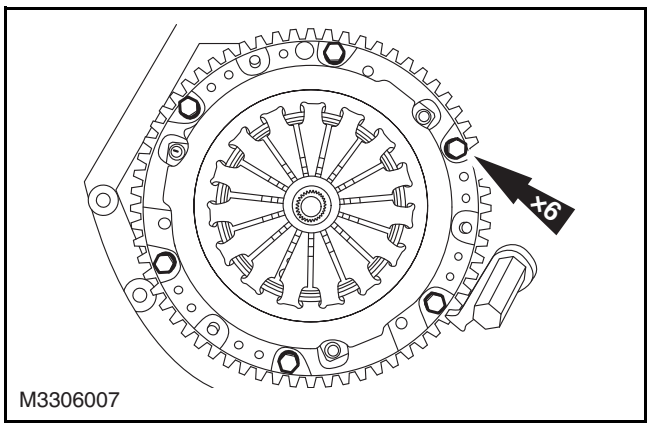
**2.** Remove the clutch pressure plate and clutch driven disc assembly.

1 Use the special tool to hold the flywheel assembly.

Special tool: 09924-17810




2 Remove the clutch pressure plate retaining bolts, then remove the clutch pressure plate assembly and clutch driven disc assembly in turn.



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## Installation

**CAUTION: When tightening the clutch pressure plate retaining bolts, firmly press the clutch driven disc with the special tool to make sure that clutch driven disc assembly is aligned with the center.**

**CAUTION: Diagonally tighten the clutch pressure plate retaining bolts in order.**

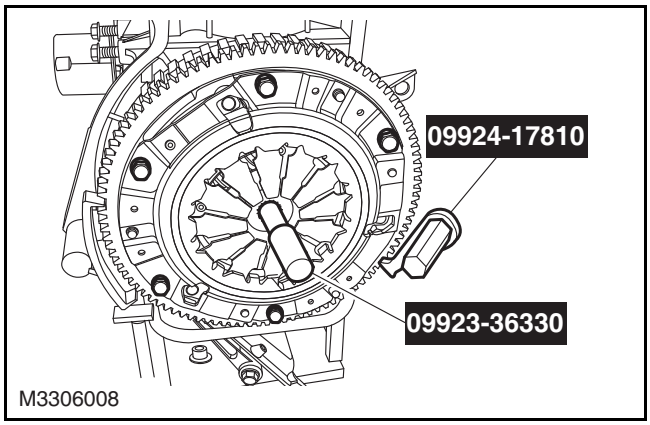
1. Inspect the joint surface of the flywheel and driven disc.
2. Install the clutch pressure plate and driven disc assembly.

   1 Use the special tool to align the clutch driven disc with the center of flywheel, install the clutch pressure plate assembly and bolts, and then tighten them to the specified torque.

   Torque: 32 ± 2 Nm

   Special tool: Driven disc mounting shaft 09923-36330

   Special tool: Flywheel holding tool 09924-17810

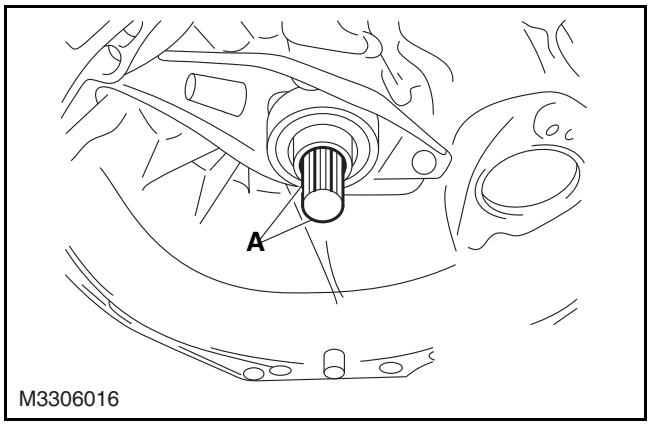



**CAUTION: When tightening the clutch pressure plate retaining bolts, firmly press the clutch driven disc with the special tool 09923-36330 to make sure that clutch driven disc assembly is aligned with the center.**

**CAUTION: Diagonally tighten the clutch pressure plate retaining bolts in order.**

3. Apply a small amount of grease to the input shaft, and then connect the manual transmission and engine.

   "A": 99000-25210




**CAUTION: While inserting the transmission input shaft to the clutch driven disc, rotate the crankshaft with the wrench from the front side until the splines are engaged.**

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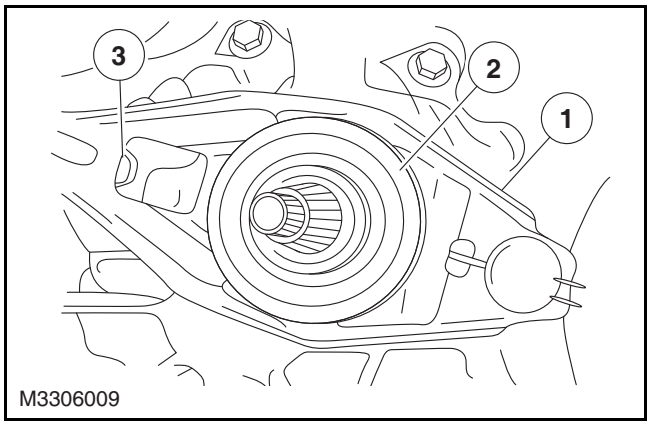
# Clutch Fork

## Removal

1. Remove the manual transmission.

   **Refer to: Manual Transmission (3.3.7 Manual Transmission - MR513C01, Removal and Installation).**

2. Remove the clutch fork return spring (3) and fork (1) clip.
3. Remove the fork and release bearing (2) together.



M3306009

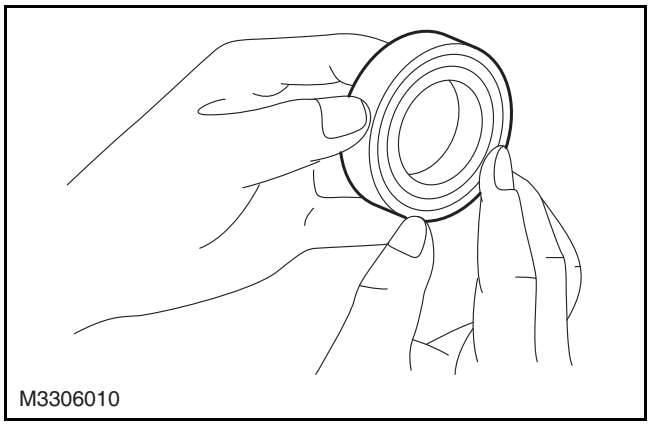
4. Remove the clutch release bearing and clutch fork clip.

## Inspection

1. Inspect if the clutch release bearing rotates smoothly, replace if any fault is found.

**CAUTION: Do not clean release bearing to flush out grease, which will damage the bearing.**

2. Inspect the clutch release fork and clip for damage and deformation, as well as the release fork return spring. Replace if any fault is found.


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## Installation

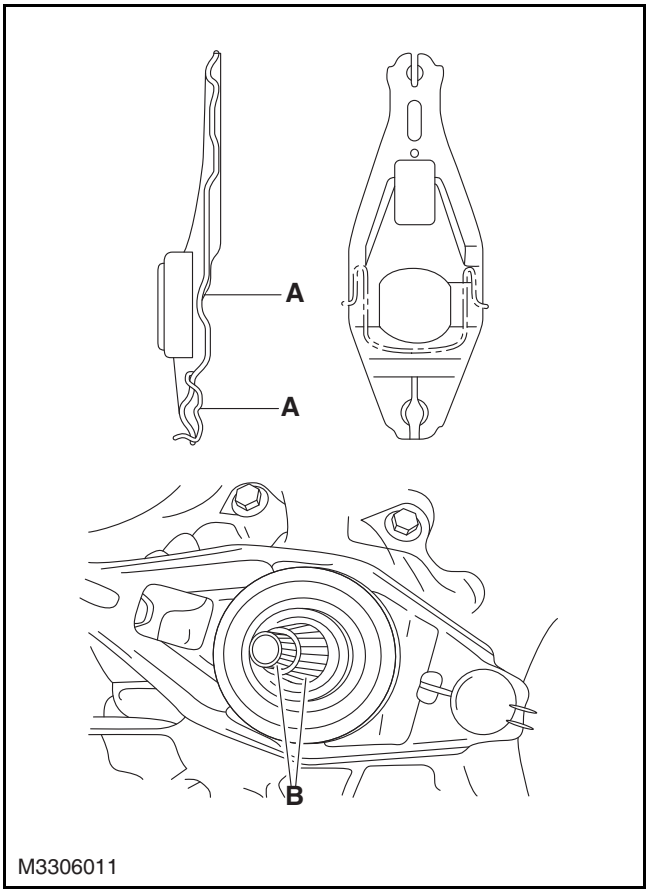
**1.** Installation is in the reverse order of removal.

**CAUTION: Apply the grease as shown in the figure.**

"A": 99000-25010

"B": 99000-25210

**CAUTION: Install the release bearing, return spring and clip to their original position.**



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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| Transmission type | MR513C01 |
| Operation type | Single-disc, dry type |
| Transmission oil type | API (GL-4) SAE 75W-90, Shell Spirax S4 GS |
| Transmission oil capacity | 1.5 ~ 1.6 L |
| 1st gear speed ratio | 3.358 |
| 2nd gear speed ratio | 1.858 |
| 3rd gear speed ratio | 1.315 |
| 4th gear speed ratio | 1 |
| 5th gear speed ratio | 0.801 |
| Reverse gear speed ratio | 4.452 |
| Maximum input torque | 125 Nm |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Gearcase retaining bolt | 23 ± 5 | - | - |
| Transmission gearshift mechanism retaining bolt | 23 ± 5 | - | - |
| Lock steel ball assembly | 23 ± 5 | - | - |
| Gear shift and select cable bracket | 23 ± 5 | - | - |
| Speedometer retaining bolt | 23 ± 5 | - | - |
| Drain plug | 5 ~ 10 | - | - |
| Inlet plug | 5 ~ 10 | - | - |
| Self-locking bolt | 13 ± 3 | - | - |
| Reverse gear shift fork assembly bolt | 23 ± 5 | - | - |
| Interlock gasket retaining bolt | 23 ± 5 | - | - |
| Reverse gear shaft bolt | 23 ± 5 | - | - |
| Retaining bolt between front and rear cases | 23 ± 5 | - | - |
| Backup lamp switch assembly | 15 ~ 22 | 11 ~ 16 | - |
| Reverse gear bolt | 23 ± 5 | - | - |
| Worm set retaining bolt | 10 ± 2 | - | - |
| Vehicle speed sensor | 10 | - | 89 |
| No.1 wiring harness clamp bracket retaining bolt | 10 ± 1 | - | - |
| Transmission grounding wiring harness retaining bolt | 10 ± 1 | - | - |

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| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Transmission dustproof board retaining bolt | 10 ± 1 | - | - |
| Connecting bolt and nut between transmission and engine | 50 ± 5 | - | - |
| Transmission rear mounting bolt | 70 ± 5 | - | - |

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## Description and Operation

# System Overview

Transmission MR513C01 is a minicar mechanical transmission. It is a full-synchronization manual mechanical transmission with five forward gears and one reverse gear. All the forward gears are constant mesh type and reverse gear is sliding idler gear unit. It has the advantages of easy gearshift without impact noise. The maximum input torque is 125 Nm. The important features, such as transmission efficiency, synchronizer life, fatigue life, noise and cleanliness, are technically advanced as anything in china's market. The transmission housing using front case, rear case and extension case, are characterized by good rigidity structure, easy machining, convenient disassembly/assembly, compact and rational construction. It uses inertia synchronizer, ensuring reliable shifting.

MR513C01 transmission has the following advantages:

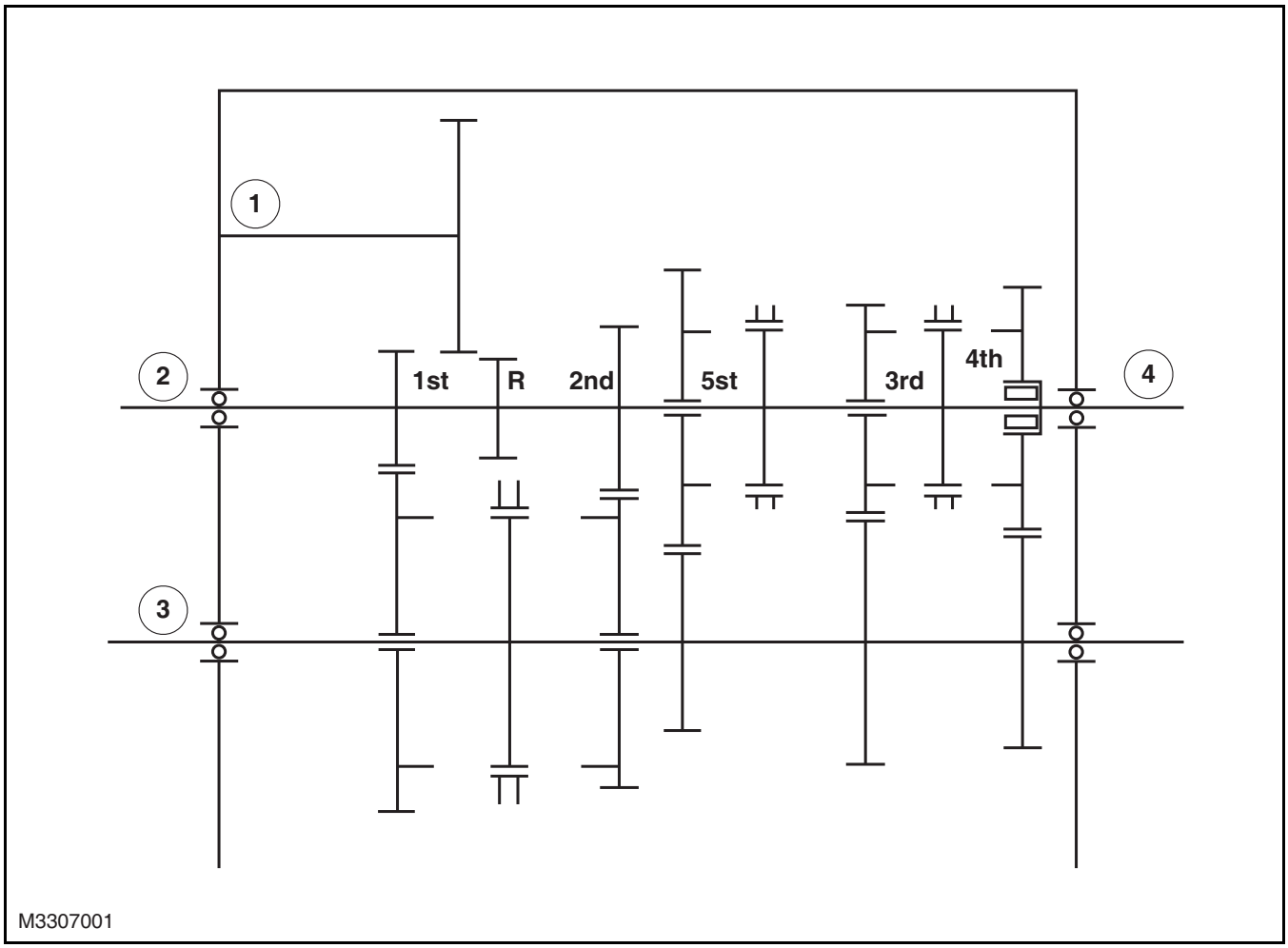
1. As changing the gear ratio, it expands the engine drive torque and speed change range to suit the power demand under various conditions and driving requirement, and to run the engine in good working state;
2. Under the condition that the crankshaft rotation direction remains unchanged, the vehicle realizes reverse driving requirements;
3. Engine power transfer can be cut off to meet the needs of short-run and coast, and to facilitate the transmission shifting or power output.

Transmission MR513C01 is divided into 7 sets according to the function and position: front case, rear case, extension case, input shaft set, intermediate shaft set, output shaft set and gear shift and select set. It has three shafts inside. The input shaft and intermediate shaft are parallel to each other. Output shaft and input shaft are in a straight line. Power inputs from the input shaft, then goes through the intermediate shaft and outputs from the output shaft. Transmission MR513C01 moves the gear shaft through the gear shift and select set, to realize the position-shift and the axial movement of shift lever realizes the gear shift. The inertia synchronizer assures the flexible gear shifting.

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Transmission MR513C01 uses different pairs of gears to realize variable speed, torque, and rotation direction change. The specific transferring route is shown in the figure below:




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Reverse gear shaft | 3 | Intermediate shaft |
| 2 | 5th gear synchronizer | 4 | Output shaft |

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### Appropriate Speed of Each Forward Gear:

| Gear | 1st Gear | 2nd Gear | 3rd Gear | 4th Gear | 5th Gear |
|---|---|---|---|---|---|
| km/h | 0 ~ 15 | 20 ~ 30 | 35 ~ 45 | 50 ~ 60 | 65 ~ 75 |

**CAUTION: Gear shifting should be within speed ranges.**

**CAUTION: The speed at different gears varies with different vehicle with the transmission.**

### Gearshift Principle

As the vehicle is moving forward, you should shift as following: the shift up should be from 1st gear to 5th gear gradually, while shift down from 5th gear to 1st gear. It is forbidden to shift into the reverse gear when moving forward. The transmission is equipped with reverse lock to avoid shifting from 5th gear to reverse gear by misoperation. In principle, the reverse gear should be shifted when the vehicle is stationary and depressing the clutch pedal more than 3 seconds; Do not shift into the reverse gear when the vehicle is moving forward and do not shift into the forward gear when the vehicle is reversing.

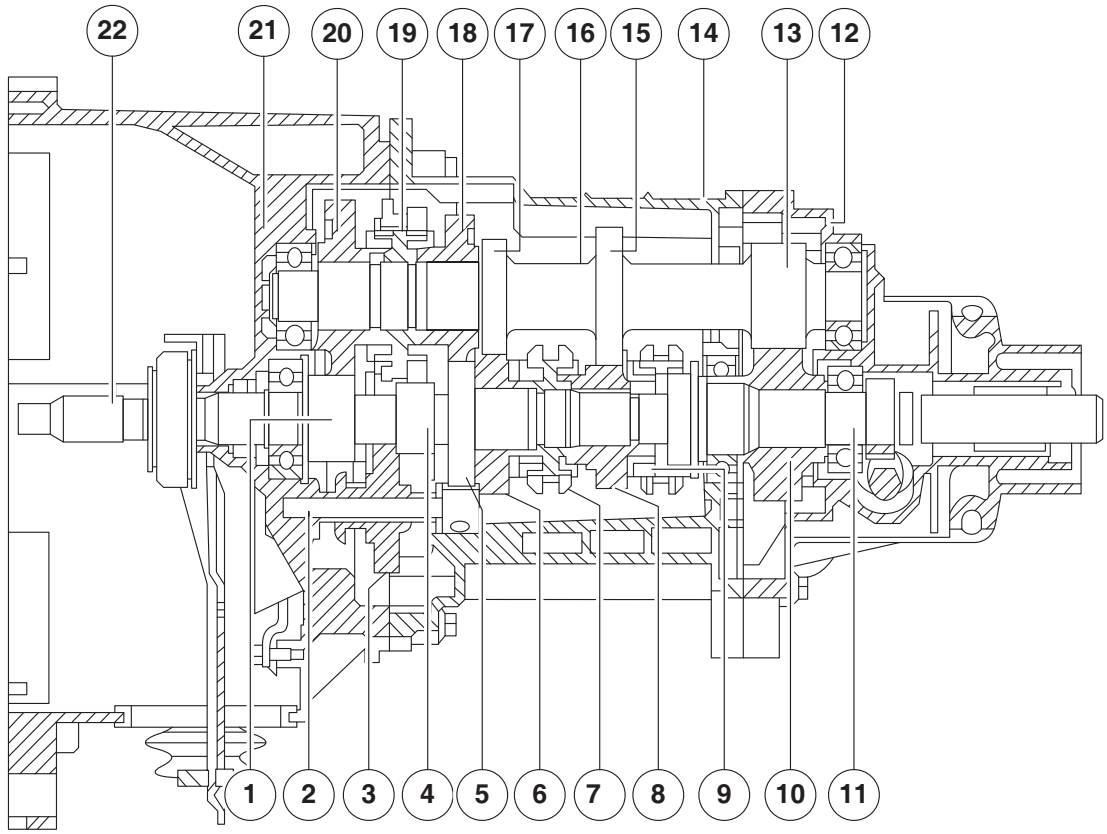
**CAUTION: The gearshift principle of transmission can be ignored in emergency when driving.**

## Components Location View

### Transmission Structure Chart

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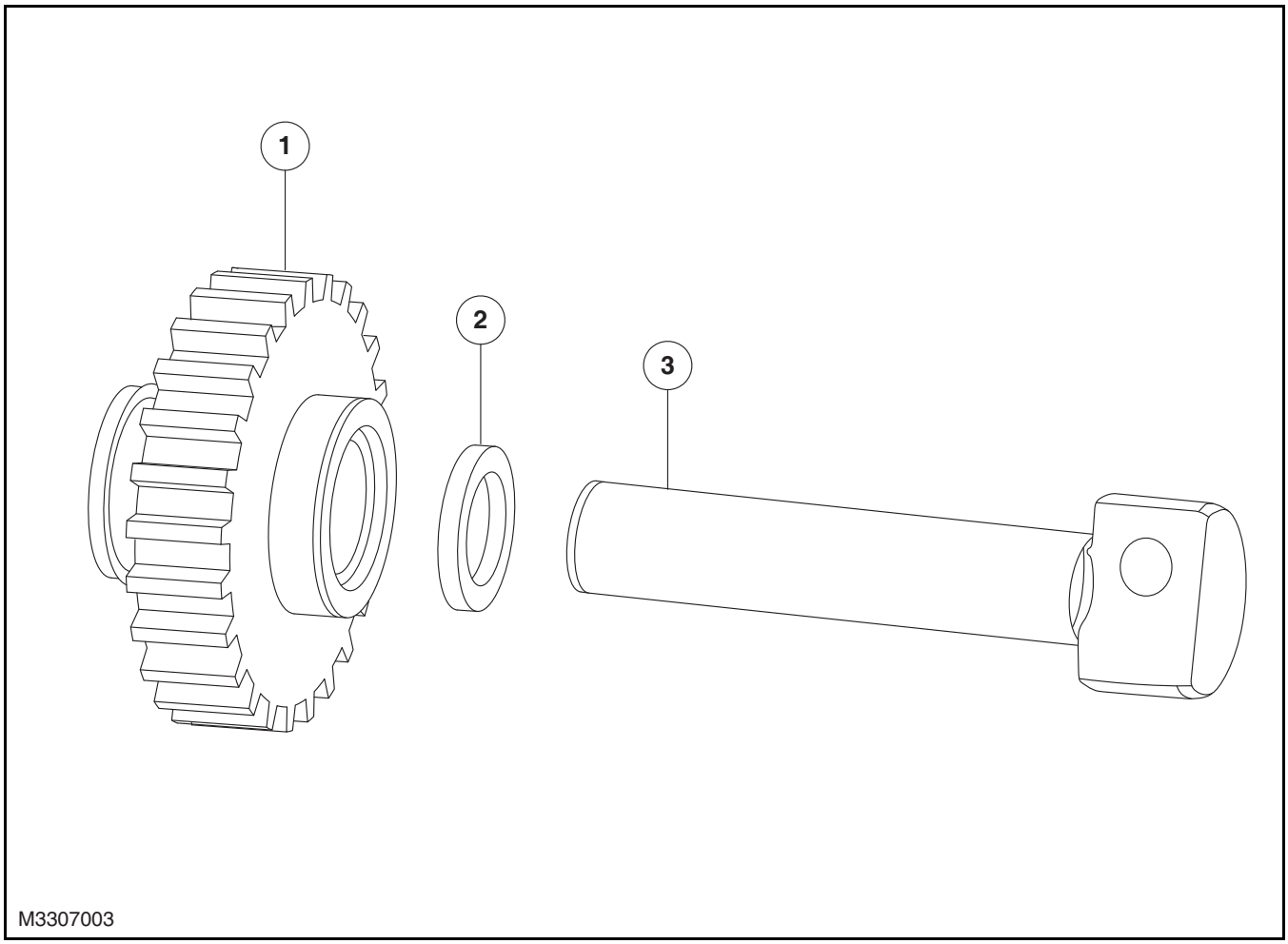
| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Input shaft 1st gear | 12 | Extension case |
| 2 | Reverse idler gear shaft | 13 | Intermediate shaft 4th gear |
| 3 | Reverse idler gear | 14 | 2nd gear |
| 4 | Input shaft reverse gear | 15 | 1st gear |
| 5 | Input shaft 2nd gear | 16 | Intermediate shaft |
| 6 | Input shaft 5th gear | 17 | Intermediate shaft 5th gear |
| 7 | 5th gear synchronizer | 18 | Intermediate shaft 2nd gear |
| 8 | Input shaft 3rd gear | 19 | Low-speed synchronizer |
| 9 | High-speed synchronizer | 20 | Intermediate shaft 1st gear |
| 10 | Output shaft driven gear | 21 | Front case |
| 11 | Output shaft | 22 | Input shaft |

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# Components Exploded View

## 1. Transmission Reverse Gear Shaft Set

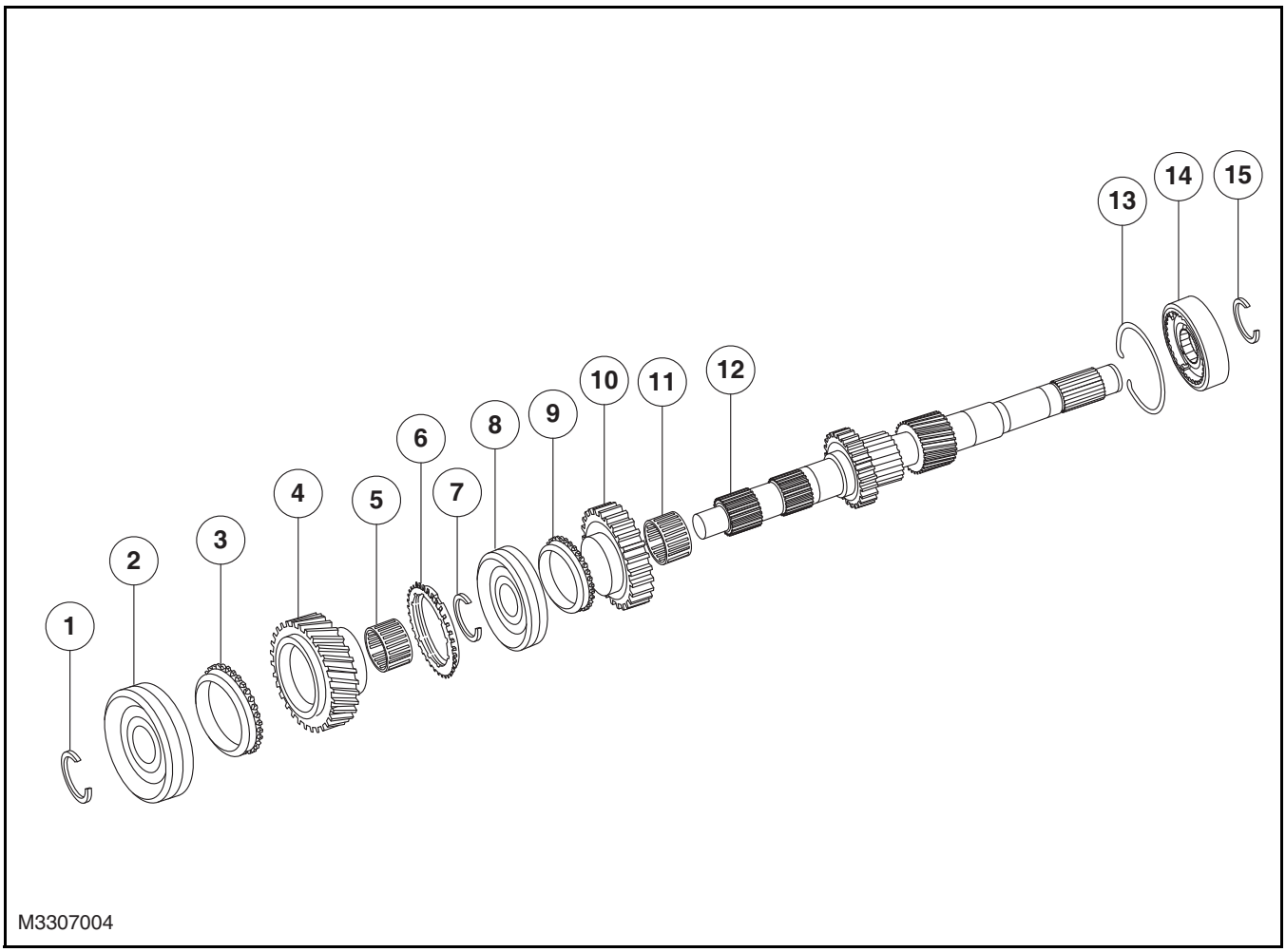



| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Reverse idler gear assembly | 1 | 3 | Reverse gear shaft | 1 |
| 2 | Reverse gear shaft washer | 1 | | | |

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## 2. Input Shaft Set

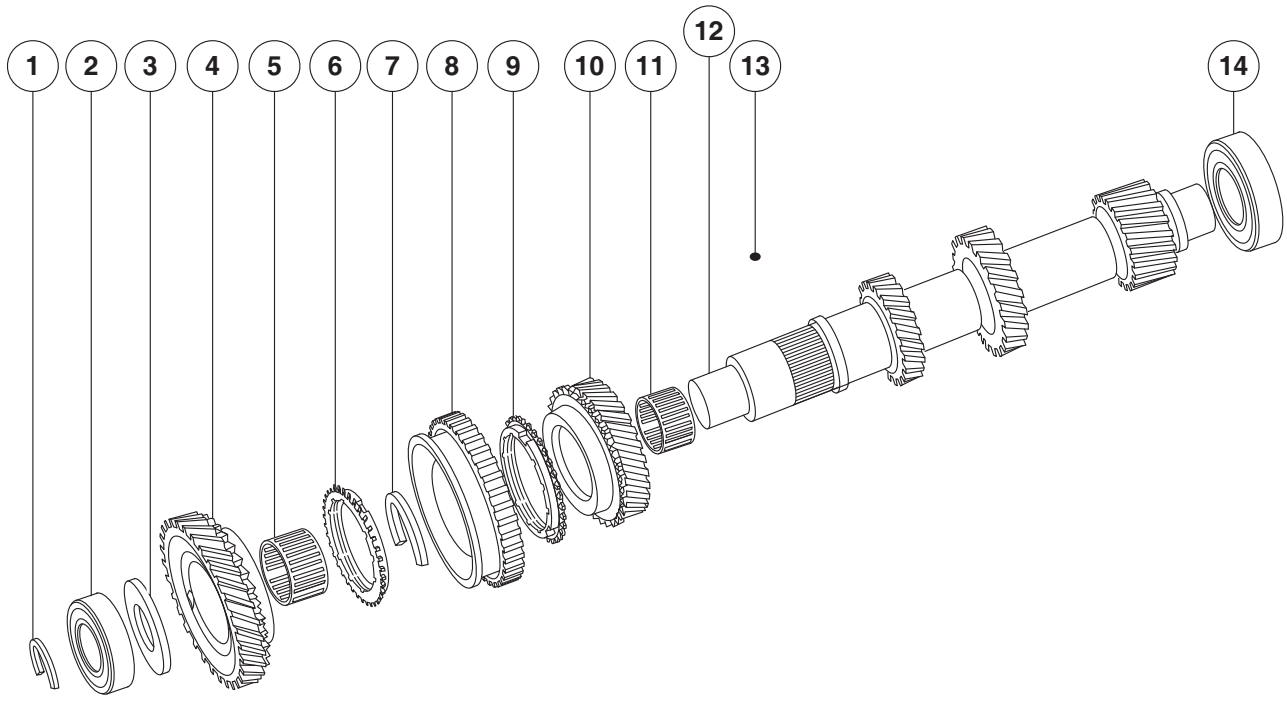



| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | High-speed synchronizer circlip | 1 | 9 | 5th gear synchronizer gear ring | 1 |
| 2 | High-speed synchronizer set | 1 | 10 | Input shaft 5th gear assembly | 1 |
| 3 | High-speed synchronizer gear ring | 1 | 11 | Input shaft 5th gear needle roller bearing | 1 |
| 4 | Input shaft 3rd gear assembly | 1 | 12 | Input shaft | 1 |
| 5 | 3rd gear needle roller bearing | 1 | 13 | Input shaft front case circlip | 1 |
| 6 | Reverse gear ring | 1 | 14 | Input shaft bearing | 1 |
| 7 | 5th gear synchronizer circlip | 1 | 15 | Input shaft bearing circlip | 1 |
| 8 | 5th gear synchronizer set | 1 | | | |

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## 3. Intermediate Shaft Set

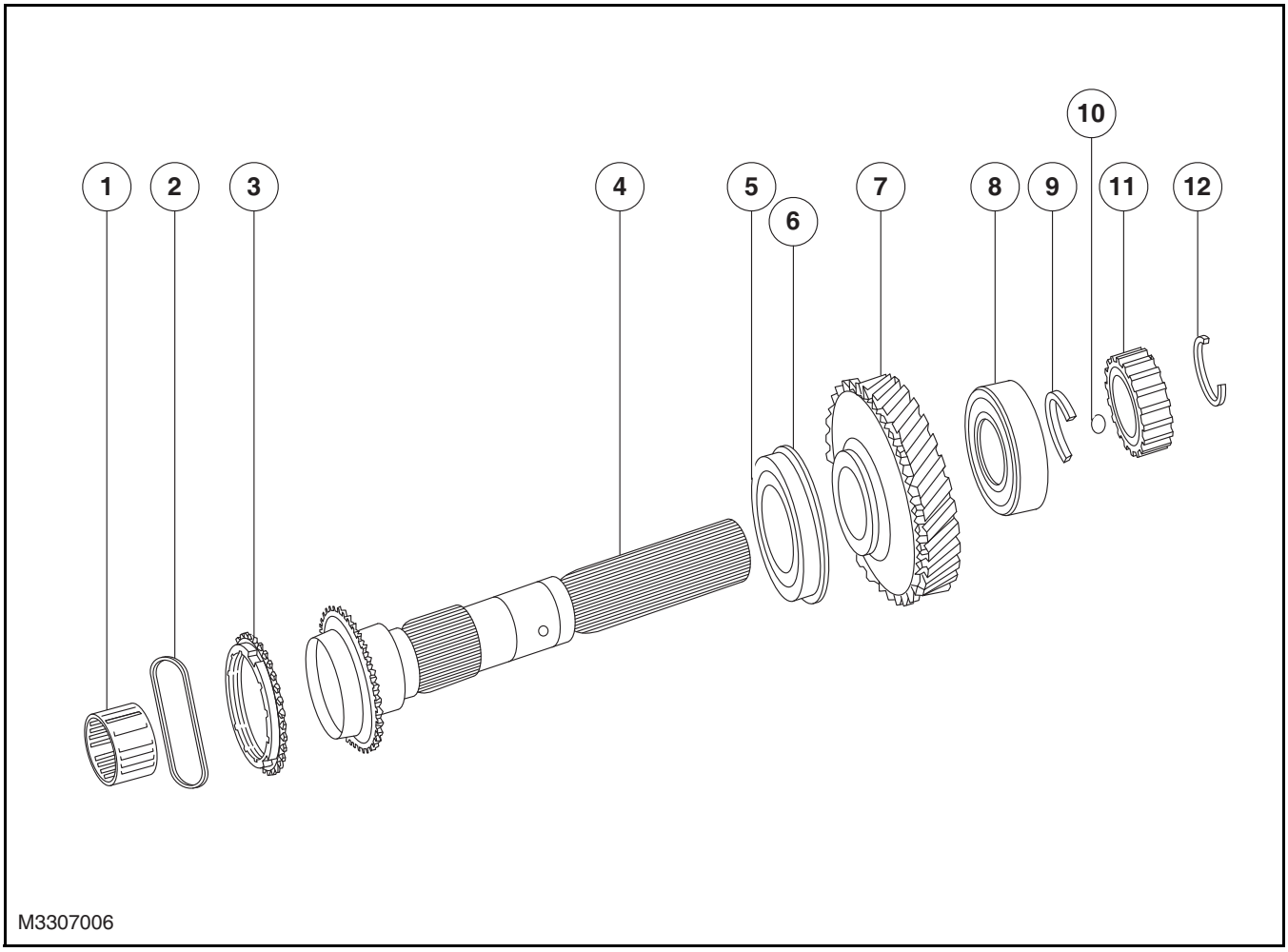



| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Intermediate shaft front bearing circlip | 1 | 8 | Low-speed synchronizer set | 1 |
| 2 | Intermediate shaft front bearing | 1 | 9 | 2nd gear synchronizer gear ring | 1 |
| 3 | Intermediate shaft front bearing washer | 1 | 10 | Intermediate shaft 2nd gear assembly | 1 |
| 4 | Intermediate shaft 1st gear | 1 | 11 | 2nd gear needle roller bearing | 1 |
| 5 | 1st gear needle roller bearing | 1 | 12 | Intermediate shaft | 1 |
| 6 | 1st gear synchronizer gear ring | 1 | 13 | Steel ball ($\phi$3) | 1 |
| 7 | Low-speed synchronizer circlip | 1 | 14 | Intermediate shaft rear bearing | 1 |

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## 4. Transmission Output Shaft Set

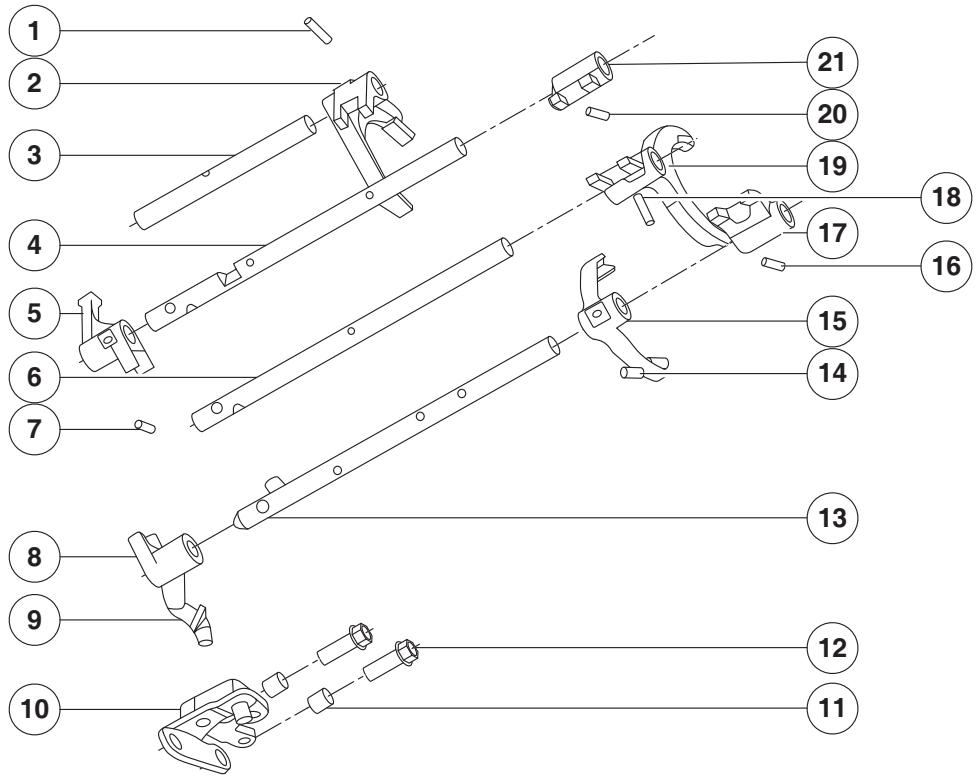



| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Input shaft needle roller bearing K182516 | 1 | 7 | Output shaft driven gear | 1 |
| 2 | High-speed synchronizer wave spring | 1 | 8 | Output shaft rear bearing | 1 |
| 3 | High-speed synchronizer gear ring | 1 | 9 | Output shaft rear bearing circlip | 1 |
| 4 | Output shaft | 1 | 10 | Worm steel ball | 1 |
| 5 | Output shaft front bearing assembly | 1 | 11 | Worm | 1 |
| 6 | Output shaft front bearing circlip | 1 | 12 | Worm circlip | 1 |

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## 5. Transmission Gearshift Mechanism



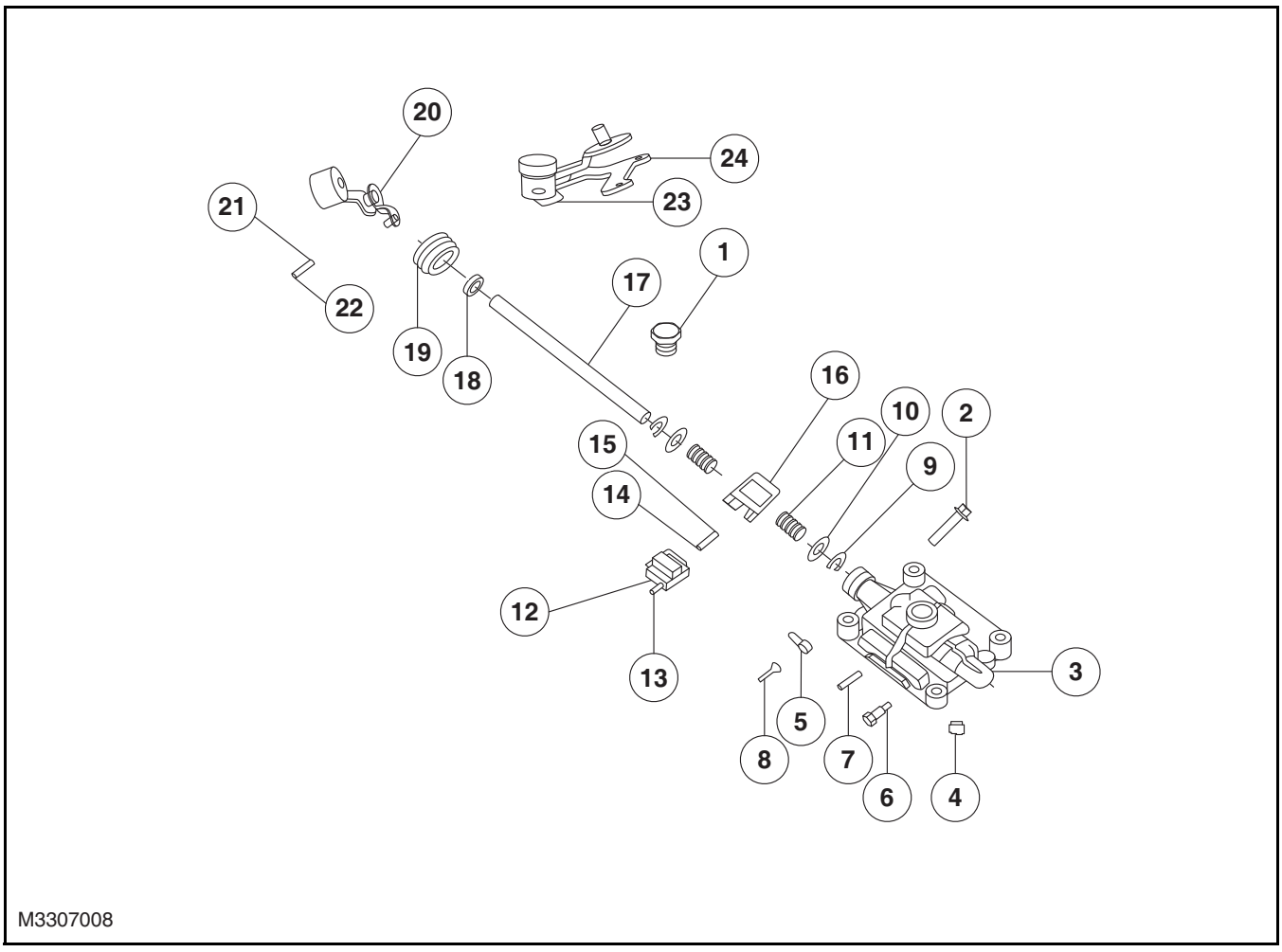

M3307007

| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | 1st-2nd gear shift fork pin | 1 | 12 | Reverse gear shift fork assembly bolt M8x30-6g | 2 |
| 2 | 1st-2nd gear shift fork | 1 | 13 | 5th and reverse gear shift fork shaft | 1 |
| 3 | 1st-2nd gear fork shaft | 1 | 14 | 5th gear shift fork pin | 1 |
| 4 | 1st-2nd gear fork shaft | 1 | 15 | 5th gear shift fork | 1 |
| 5 | 1st-2nd gear shift lever | 1 | 16 | 5th and reverse gear shift fork pin | 1 |
| 6 | 3rd-4th gear fork shaft | 1 | 17 | 5th and reverse gear shift fork | 1 |
| 7 | 1st-2nd gear shift lever pin | 1 | 18 | 3rd-4th gear shift fork pin | 1 |
| 8 | Reverse gear select arm | 1 | 19 | 3rd-4th gear shift fork | 1 |
| 9 | Reverse gear select arm pin | 1 | 20 | 1st-2nd gear shift fork pin | 1 |
| 10 | Reverse gear select arm assembly | 1 | 21 | 1st-2nd gear shift fork | 1 |
| 11 | Reverse gear shift fork assembly dowel pin 11x12 | 2 | | | |

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## 6. Transmission Gearcase Set

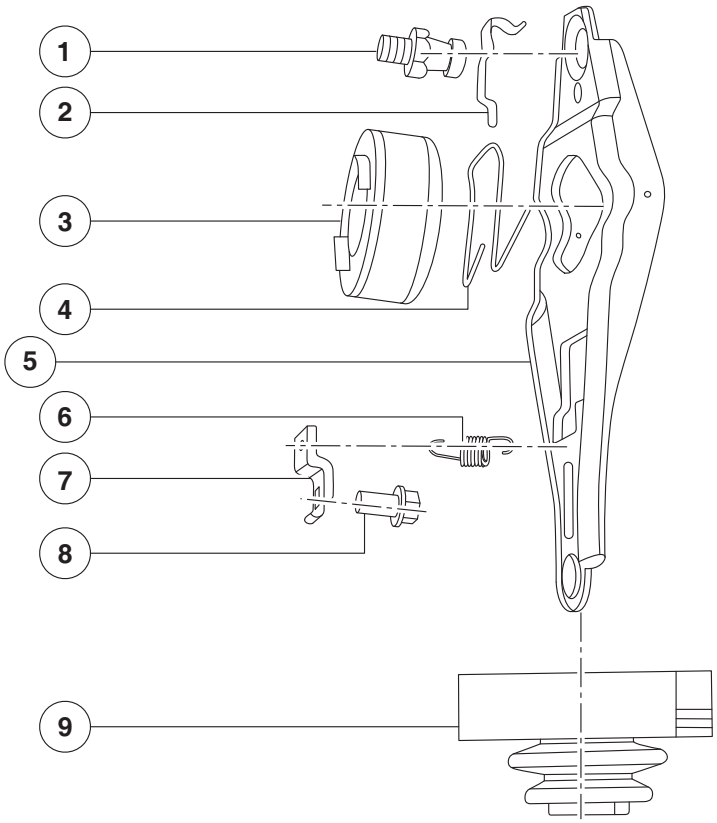



| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Lock steel ball assembly | 1 | 13 | Reverse gear lock pin | 1 |
| 2 | Gearcase retaining bolt | 4 | 14 | Select arm inner pin | 1 |
| 3 | Gearcase assembly | 1 | 15 | Select arm outer pin | 1 |
| 4 | Gearcase dowel pin | 2 | 16 | Interlock gasket | 1 |
| 5 | Reverse lock spring | 1 | 17 | Gear shift shaft | 1 |
| 6 | Reverse lock bolt | 1 | 18 | Gearcase oil seal | 1 |
| 7 | Reverse lock spring pin GB/T119.2 5x20 | 1 | 19 | Gear shift shaft boot | 1 |
| 8 | 5th and reverse gear interlock torsion spring | 1 | 20 | Shift rocker assembly | 1 |
| 9 | Gear shift shaft E circlip | 2 | 21 | Shift rocker inner pin | 1 |
| 10 | Gear shift shaft washer | 2 | 22 | Shift rocker outer pin | 1 |
| 11 | Return spring | 2 | 23 | Spacer | 1 |
| 12 | Gear select arm | 1 | 24 | Gear select set | 1 |

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## 7. Transmission Clutch Fork Set



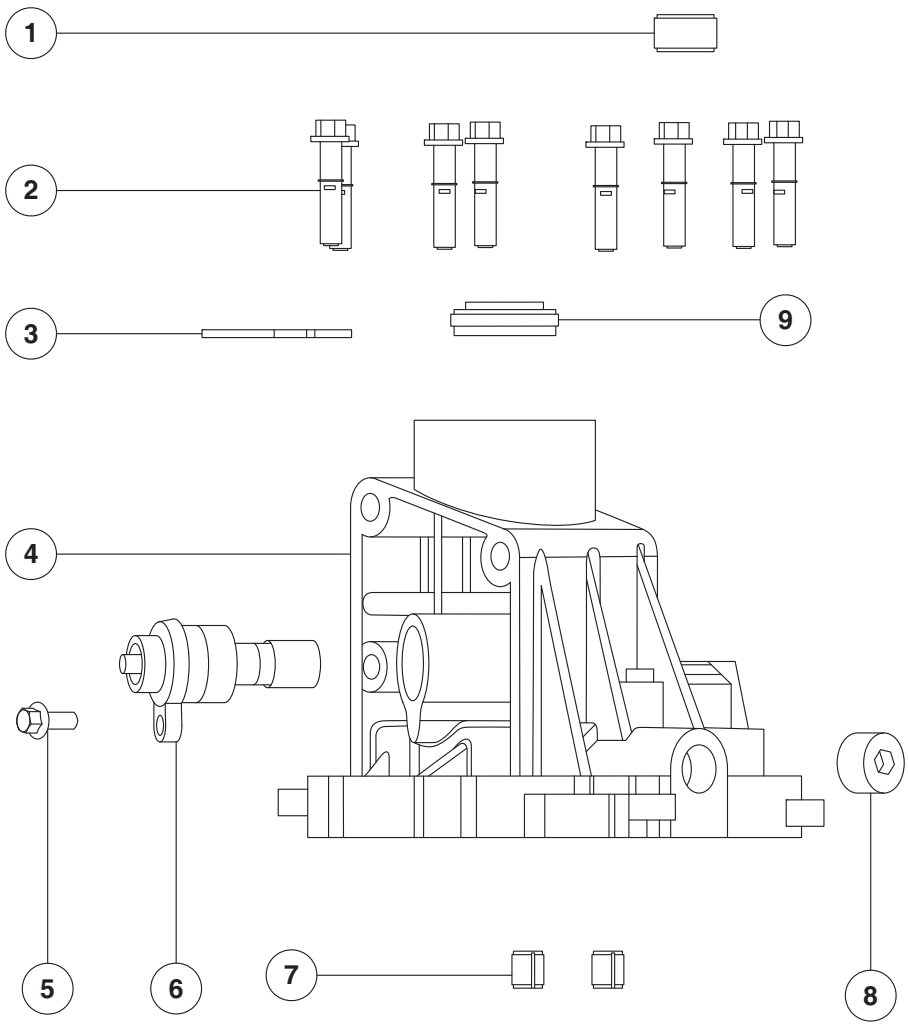

M3307009

| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Clutch release support | 1 | 6 | Clutch fork return spring | 1 |
| 2 | Clutch fork clip | 1 | 7 | Clutch fork return spring bracket | 1 |
| 3 | Clutch release bearing | 1 | 8 | Clutch fork bracket bolt M6X12 | 1 |
| 4 | Release bearing clip | 1 | 9 | Clutch fork dust boot | 1 |
| 5 | Clutch fork | 1 | | | |

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## 8. Transmission Extension Case and External Components



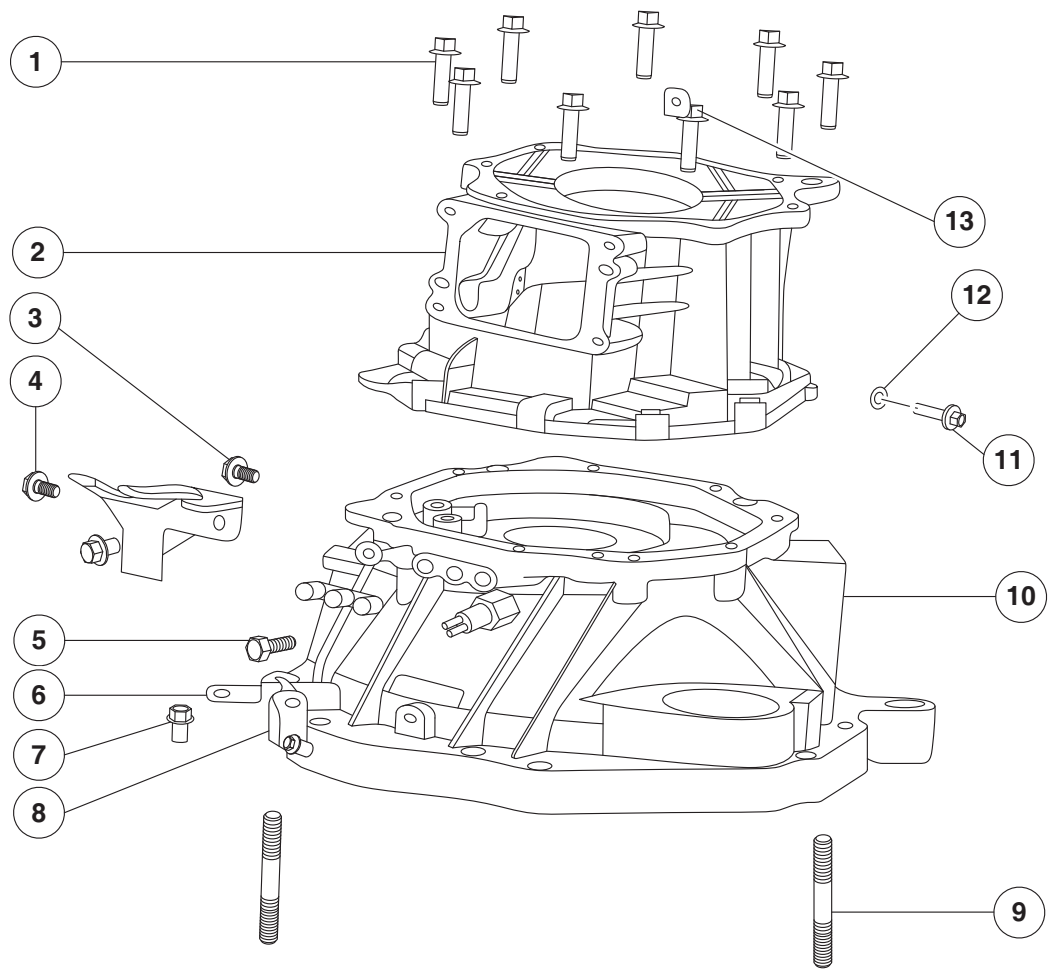

M3307010

| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Inlet plug | 1 | 6 | Worm set | 1 |
| 2 | Extension case retaining bolt | 8 | 7 | External case dowel pin | 2 |
| 3 | Hook | 1 | 8 | Drain plug | 1 |
| 4 | Extension case assembly | 1 | 9 | Extension case oil seal | 1 |
| 5 | Worm bushing bolt | 1 | | | |

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## 9. Transmission Front, Rear Case and External Components




M3307011

| Item | Description | Qty. | Item | Description | Qty. |
|---|---|---|---|---|---|
| 1 | Rear case retaining bolt | 9 | 8 | No.2 wiring harness clamp bracket | 1 |
| 2 | Rear case | 1 | 9 | Stud bolt | 2 |
| 3 | Gear select self-locking bolt | 4 | 10 | Front case | 1 |
| 4 | Gear shift and select cable bracket bolt | 2 | 11 | Reverse gear shaft bolt | 1 |
| 5 | Vent plug | 1 | 12 | Reverse gear shaft bolt washer | 1 |
| 6 | No.1 wiring harness clamp bracket | 1 | 13 | No.4 wiring harness clamp bracket | 1 |
| 7 | Wiring harness clamp bracket bolt | 2 | | | |

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## General Inspection

# Transmission Maintenance Intervals

**Regular maintenance interval is given in the following table:**

| First Service (km) | Later Service (km) | Oil Brand No. | Oil Grade |
|---|---|---|---|
| 7500 | Every 15000 (inspect and replace as necessary) | Shell Brand SPIRAX | 75W/90 GL-4 |

**CAUTION: Transmission oil volume is 1.5 ~ 1.6 L.**

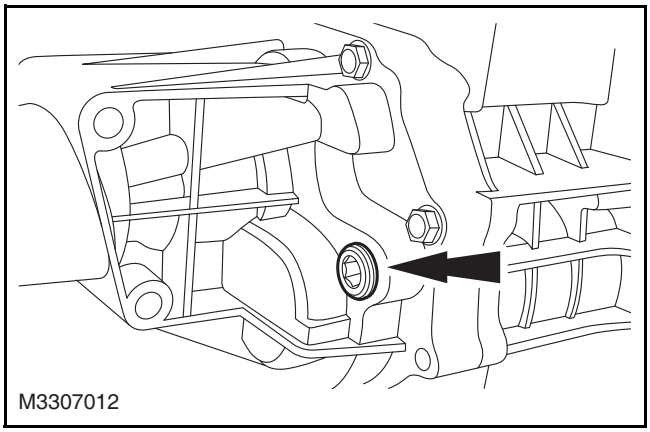
**CAUTION: For the first maintenance, change the transmission oil for the first time at 7500 km; and perform regular maintenance in the future. The maintenance should be performed in a special maintenance station.**

**CAUTION: If the vehicle is lifting for other repair work except changing the oil, the transmission oil also should be checked at the same time.**

# Inspection of Transmission Oil

1. Confirm that the vehicle is horizontal so as to inspect oil level.
2. Inspect whether the transmission oil is leaking. Repair if necessary. For the repair method, refer to the Removal and Installation of Transmission to repair the leakage area.
3. Remove the inlet plug.

   Torque: 5 ~ 10 Nm



M3307012

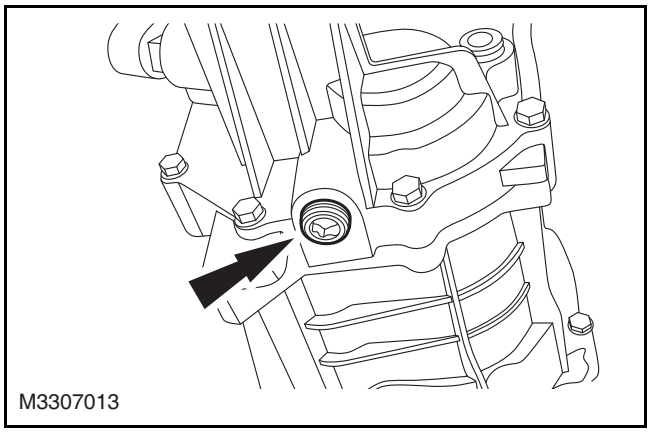
4. Inspect oil level. You can inspect oil level roughly through inlet plug hole. If the oil is flush with or below the bottom of the inlet plug hole, the oil level is normal. If not, add the specified oil.

# Replacement of Transmission Oil

1. Stop engine and lift vehicle horizontally before replacing transmission oil.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Inspect oil level and leaking when lifting the vehicle. Repair if necessary.
3. Remove oil drain plug and drain waste oil.



M3307013

4. Apply the sealant to the oil drain plug and tighten it to the specified torque.

   Sealant: YT5699 (Yutai)

   Torque: 5 ~ 10 Nm

5. Remove the inlet plug.
6. Add the specified transmission oil until it comes out or reaches the visible level.
7. Apply the sealant to the inlet plug and tighten it to the specified torque.

**CAUTION: If leakage of input shaft oil seal is found when maintaining, replace the oil seal.**

**CAUTION: If leakage of extension case oil seal is found when maintaining, replace the oil seal.**

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## Symptom Diagnosis and Testing

Refer to: Symptom Chart (3.3.1 Manual Transmission - MR510L02 Clutch - Overview, Symptom Diagnosis and Testing).

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## Removal and Installation

# Vehicle Speed Sensor

### Removal

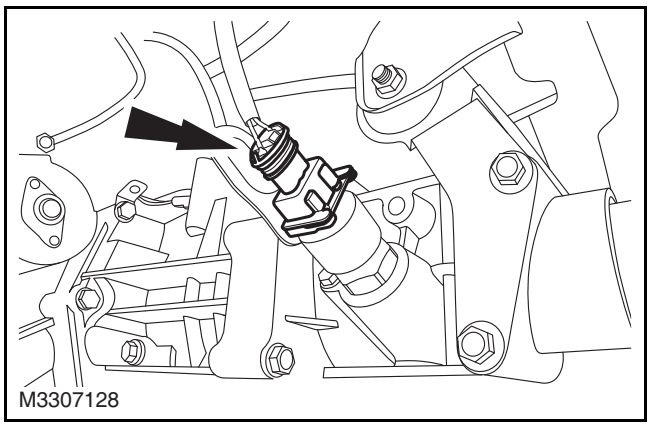
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

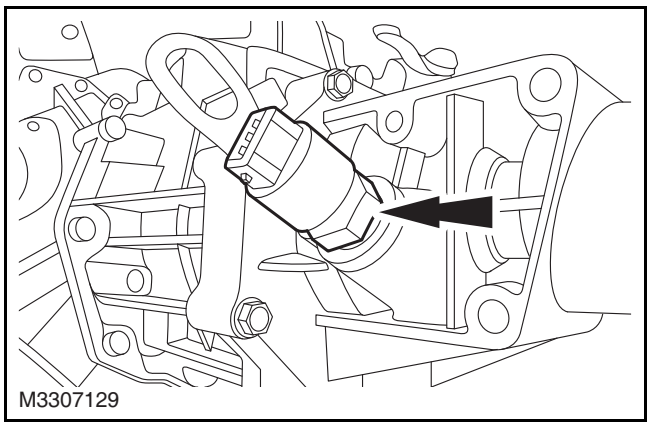
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Disconnect the vehicle speed sensor wiring harness connector.




4. Use a proper tool to remove the vehicle speed sensor.

   Torque: 10 Nm




### Installation

1. Installation is in the reverse order of removal.

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# Backup Lamp Switch

## Removal

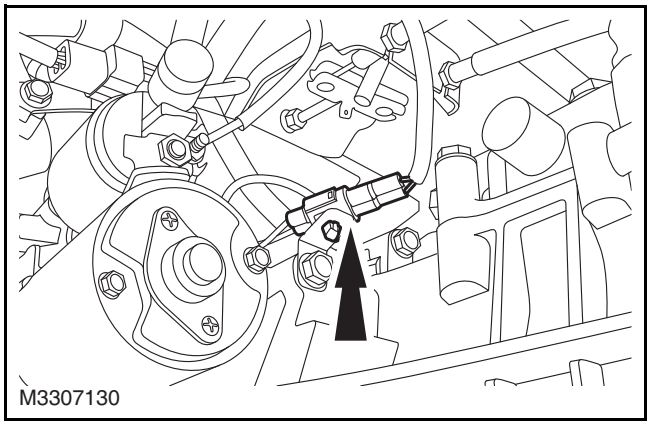
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

2. Lift the vehicle.

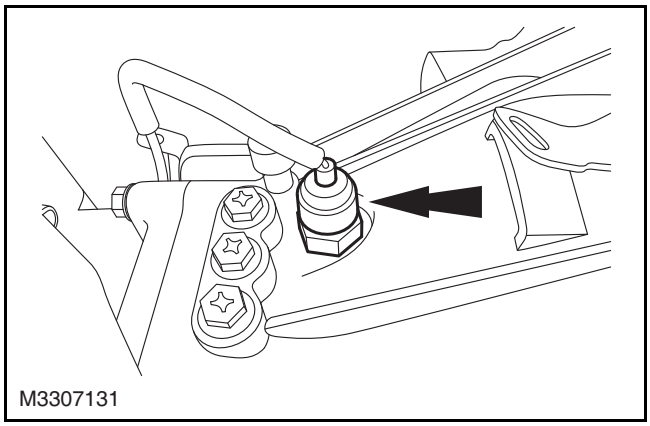
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

3. Disconnect the backup lamp switch wiring harness connector.


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4. Use a proper tool to remove the backup lamp switch.

   Torque: 15 ~ 22 Nm


M3307131

## Installation

1. Installation is in the reverse order of removal.

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# Manual Transmission

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.2.10 Charging System, Removal and Installation).**

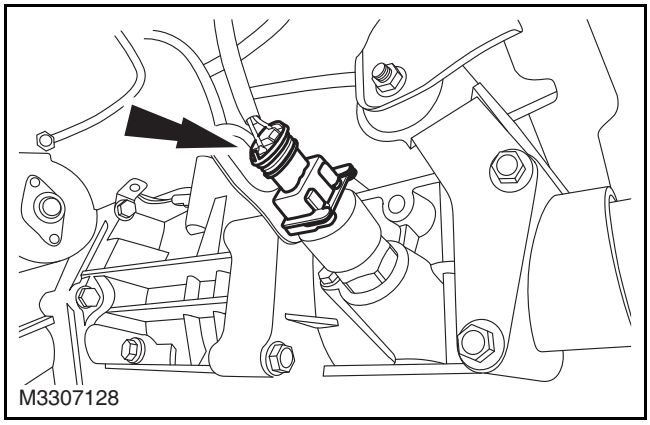
2. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

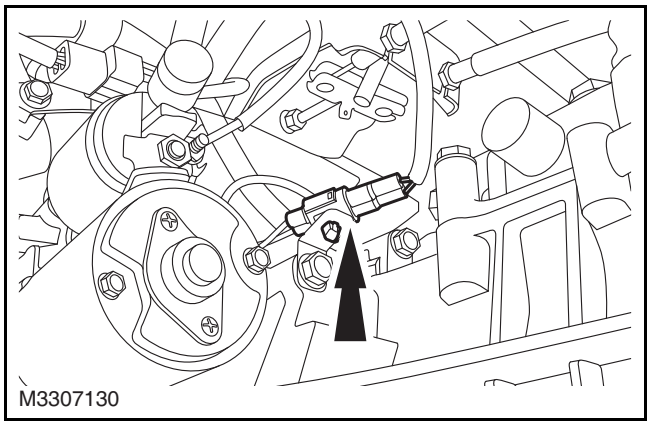
3. Drain the transmission oil.

   **Refer to: Replacement of Transmission Oil (3.3.7 Manual Transmission - MR513C01, General Inspection).**

4. Disconnect the vehicle speed sensor wiring harness connector.


M3307128

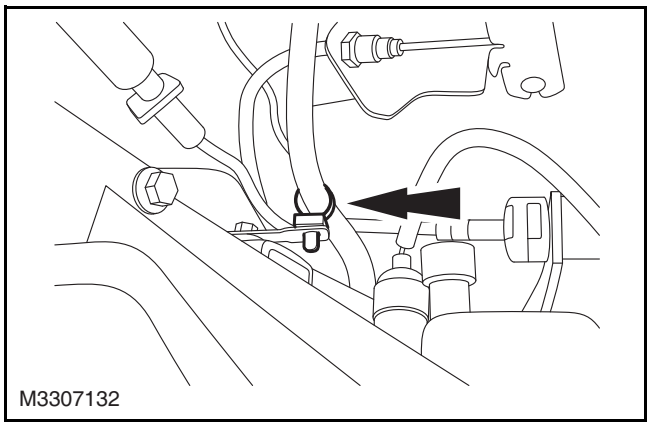
5. Disconnect the backup lamp switch wiring harness connector.


M3307130

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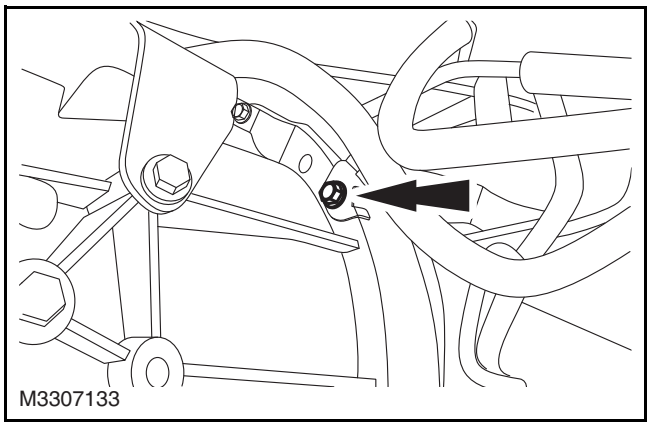


**6.** Detach the engine wiring harness from No.2 wiring harness clamp bracket.


M3307132

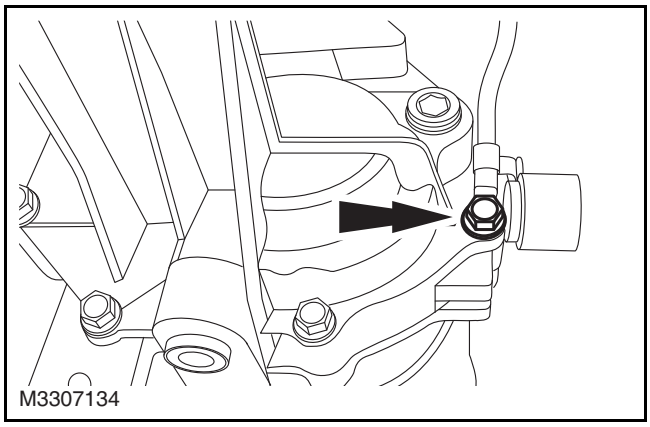
**7.** Remove the No.1 wiring harness clamp bracket retaining bolt from the transmission.

Torque: 10 ± 1 Nm

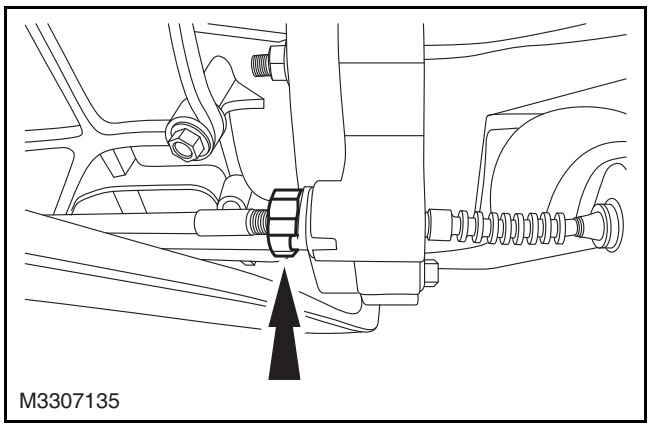

M3307133

**8.** Remove the transmission grounding wiring harness retaining bolt.

Torque: 8 ± 1 Nm


M3307134

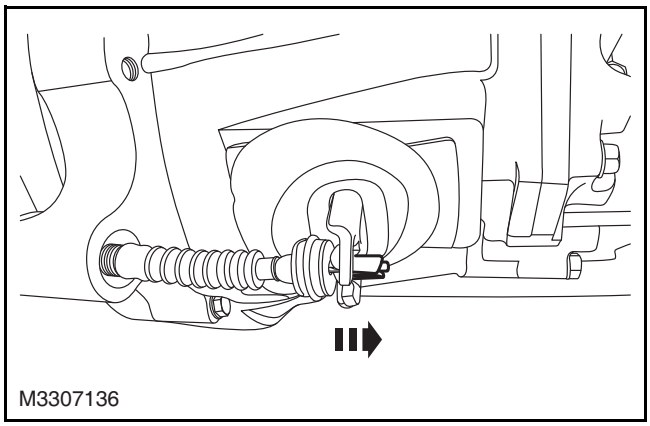
**9.** Loosen the clutch cable retaining nut.


M3307135

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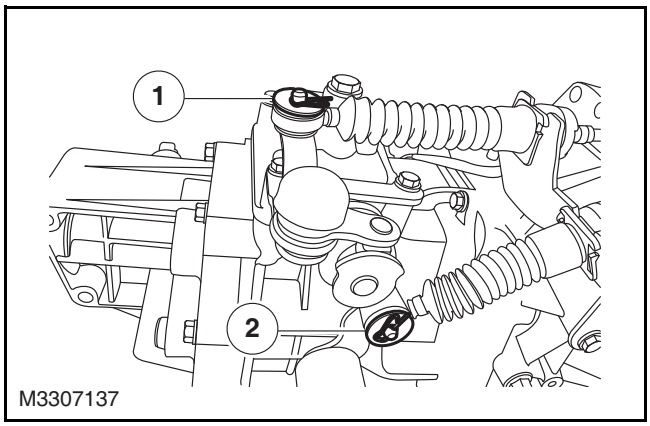


**10.** Disconnect the clutch cable from the clutch fork.


M3307136

**11.** Disconnect the transmission gear shift cable (2) and gear select cable (1) from the transmission.

**Refer to: Gearshift Mechanism (3.3.4 Manual Transmission External Control, Removal and Installation).**



M3307137

**12.** Remove the starting motor.

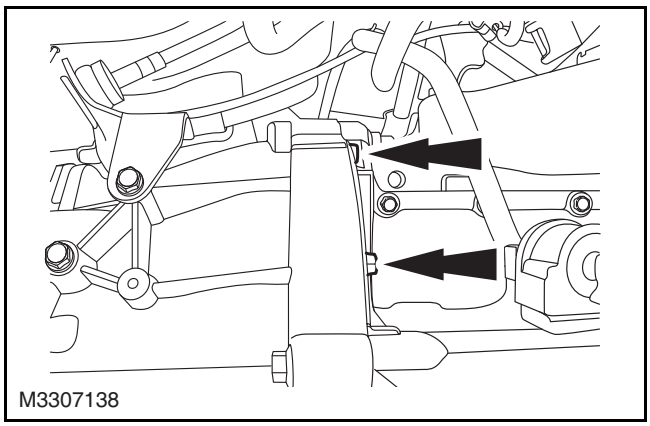
**Refer to: Starting Motor (3.2.9 Starting System, Removal and Installation).**

**13.** Remove the propeller shaft.

**Refer to: Propeller Shaft (2.2.2 Propeller Shaft, Removal and Installation).**

**14.** Remove 2 transmission dustproof board retaining bolts.

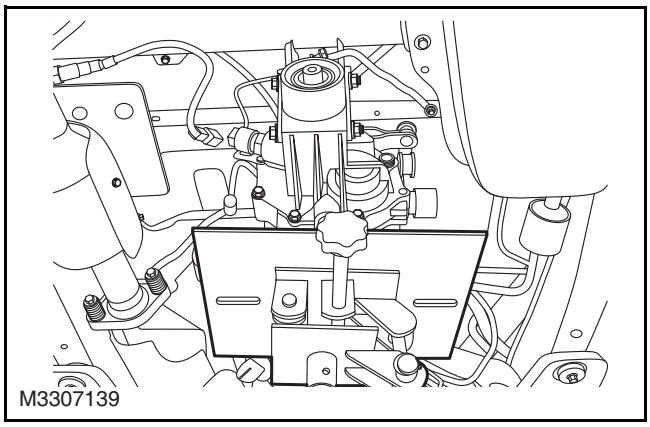
Torque: 10 ± 1 Nm


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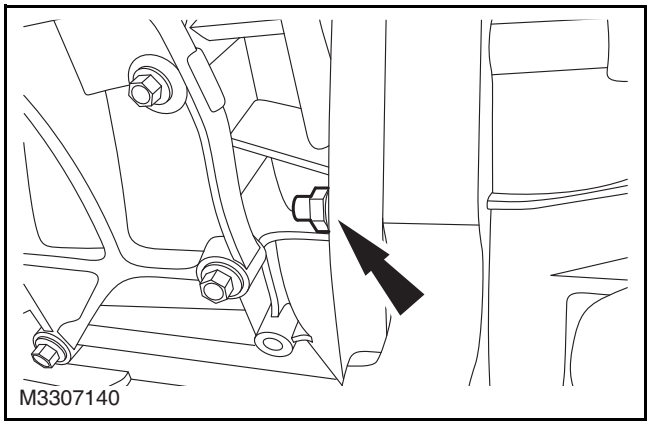


**15.** Use the flat jack to support the transmission.



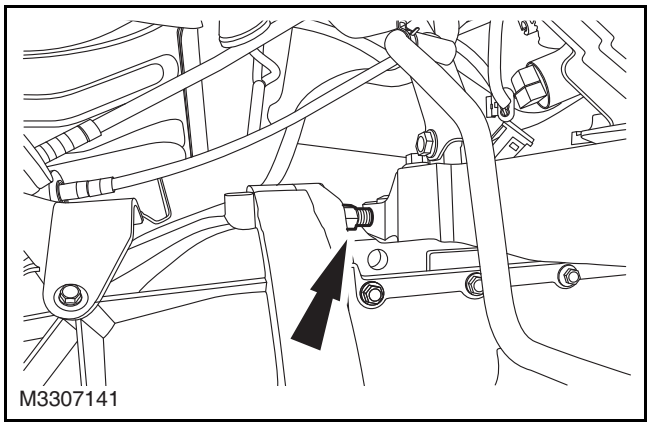

**16.** Remove the connecting nut between engine and transmission.

Torque: 50 ± 5 Nm



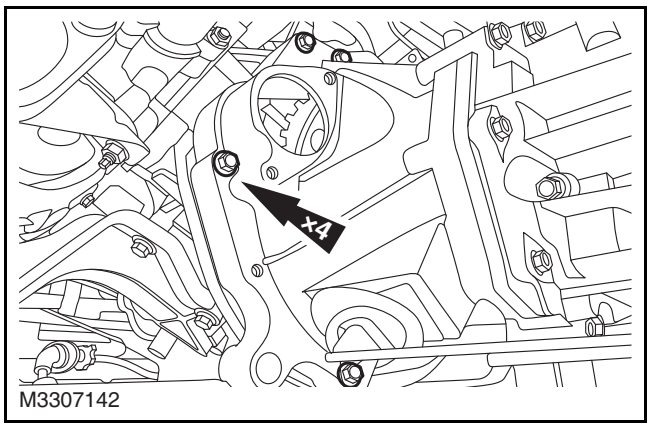

**17.** Remove the connecting nut between engine and transmission.

Torque: 50 ± 5 Nm




**18.** Remove 4 connecting bolts between transmission and engine from the side where the starting motor is installed.

Torque: 50 ± 5 Nm

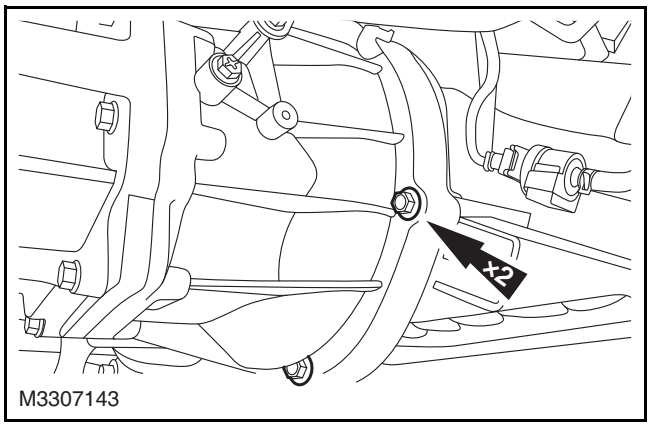


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**19.** Remove 2 connecting bolts between transmission and engine.

Torque: 50 ± 5 Nm

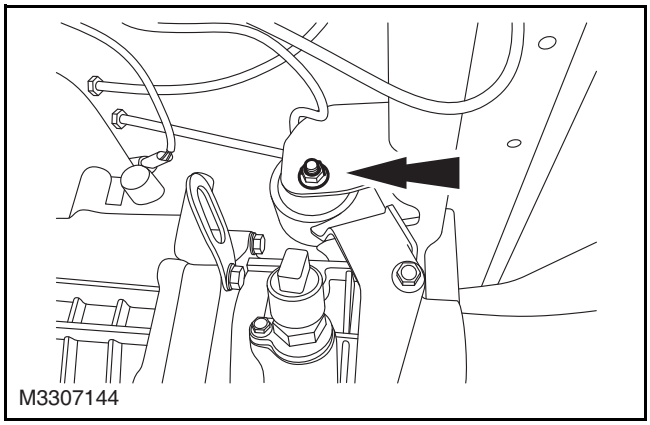


M3307143

**20.** Remove the rear mounting.

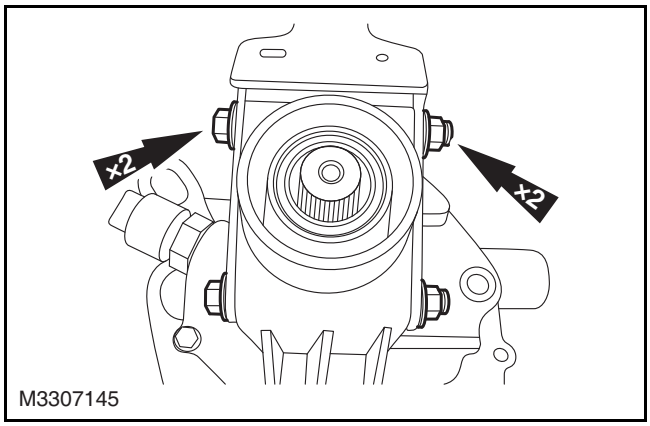
1 Remove the connecting bolt and nut between rear mounting bush and body.

Torque: 70 ± 5 Nm


M3307144

2 Remove 2 connecting bolts and 2 connecting nuts between rear mounting bush and transmission.

Torque: 70 ± 5 Nm



M3307145

**21.** Separate the transmission from the engine, lower the flat jack slowly and remove the transmission.

## Installation

**1.** Installation is in the reverse order of removal.

**2.** Fill manual transmission oil, and inspect transmission oil level.

⚠ **CAUTION: Inspection of Transmission Oil (3.3.7 Manual Transmission - MR513C01, General Inspection).**

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## Disassembly and Assembly

# Disassembly of Transmission

### Precautions

**CAUTION: Keep the disassembly and assembly site clean.**

**CAUTION: Be careful not to scratch the oil seal lip while installing the propeller shaft.**

**CAUTION: It is better to use hexagon sockets while disassembling and assembling bolts.**

**CAUTION: The fitting surface of components should be clean and scatheless while disassembling and assembling.**

**CAUTION: Components should be classified and placed unifiedly while disassembling and assembling.**

**CAUTION: Only use rubber hammer to strike when disassembling the case.**

### General Equipment

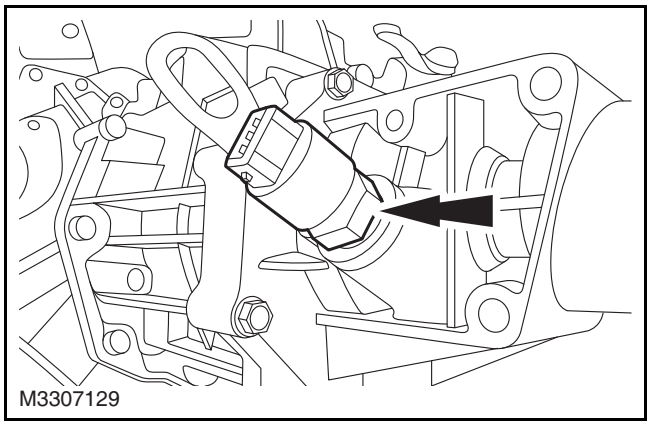
| |
|---|
| Rubber hammer |

### Disassembly

1. Remove the manual transmission.

   **Refer to: Manual Transmission (3.3.7 Manual Transmission - MR513C01, Removal and Installation).**

2. Remove the vehicle speed sensor.


M3307129

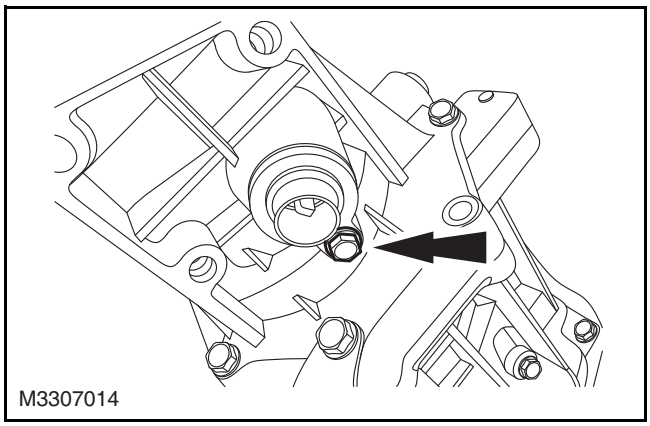
https://truckmanualshub.com/



**3.** Remove the worm set.

1 Remove the worm set retaining bolt.

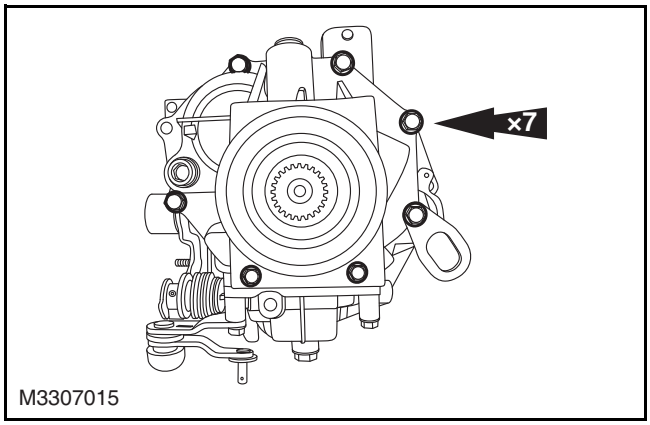
2 Remove the worm set.


M3307014

**4.** Remove the extension case.

1 Remove 7 retaining bolts from extension case.

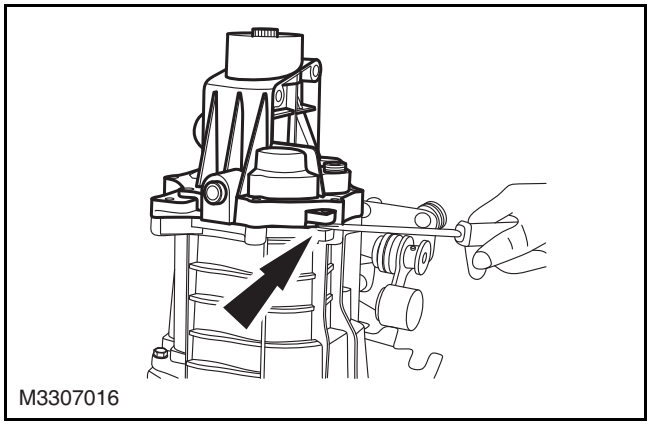
**CAUTION: Extension case bolts should be removed diagonally.**



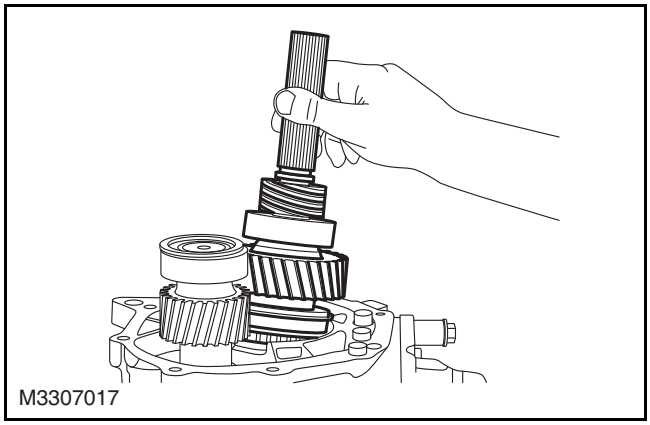
M3307015

2 Separate the extension case from rear case with proper tool.

**CAUTION: Avoid any damage to the contact surface while separating the extension case from rear case.**


M3307016

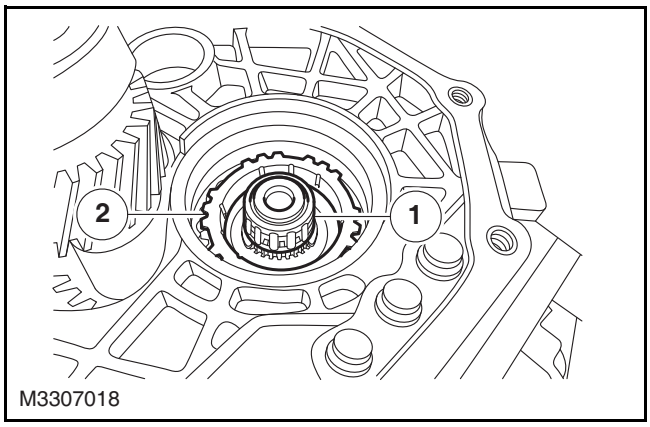
**5.** Remove the output shaft set from the input shaft.


M3307017

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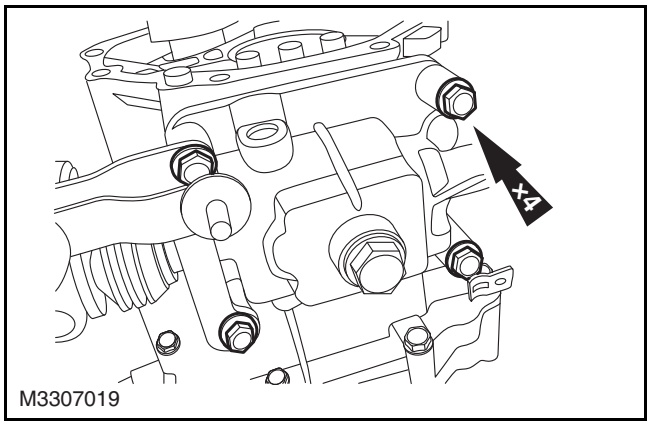
**6.** Remove input shaft needle roller bearing (1), high-speed synchronizer gear ring (2) and high-speed synchronizer wave spring in sequence.



M3307018

**7.** Remove the transmission gearshift mechanism.

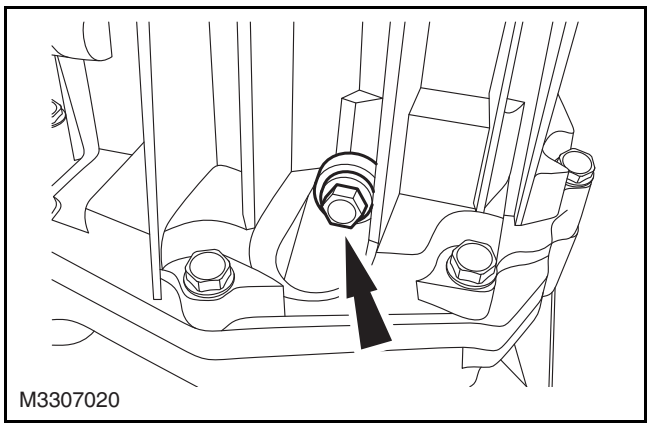
1 Remove 4 retaining bolts from the transmission gearshift mechanism.



M3307019

2 Remove the transmission gearshift mechanism.

**8.** Remove the reverse gear shaft bolt.


M3307020

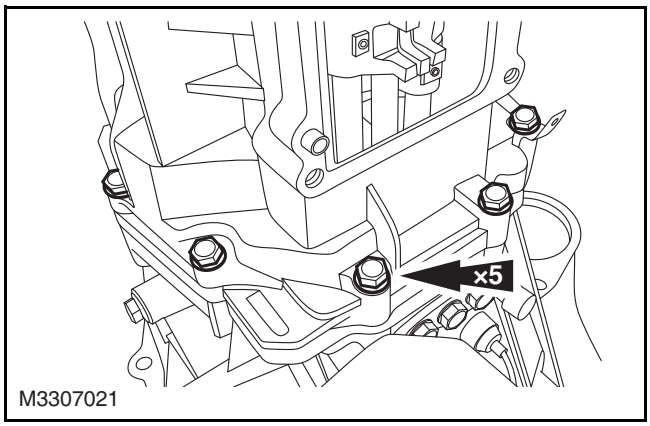
https://truckmanualshub.com/



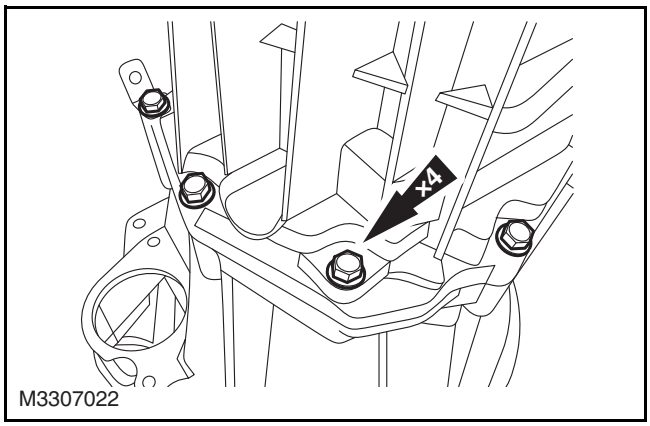
**9.** Remove the transmission rear case.

1 Remove 9 retaining bolts from the transmission rear case.

**CAUTION: Rear case retaining bolts should be removed diagonally.**



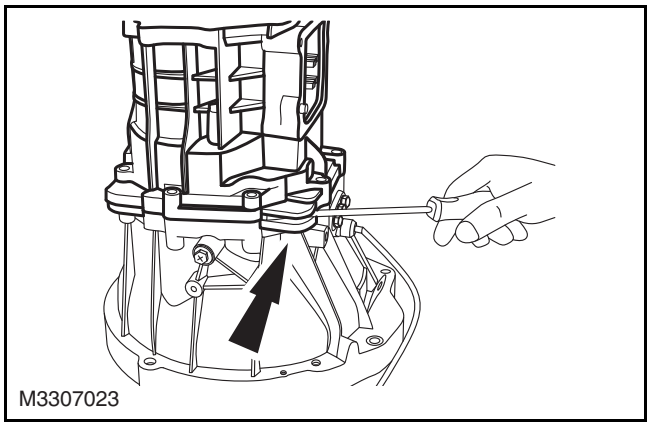
M3307021



M3307022

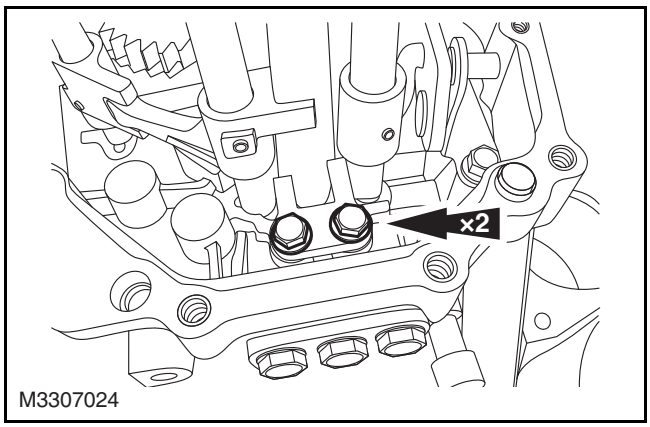
2 Separate the front case from rear case with proper tool.

**CAUTION: Avoid any damage to the contact surface while separating the front case from rear case.**


M3307023

**10.** Remove the interlock gasket and interlock steel ball.

1 Remove 2 interlock gasket retaining bolts.

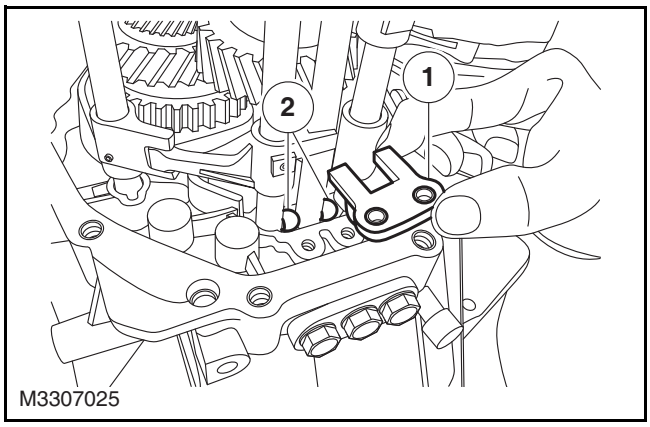


M3307024

https://truckmanualshub.com/

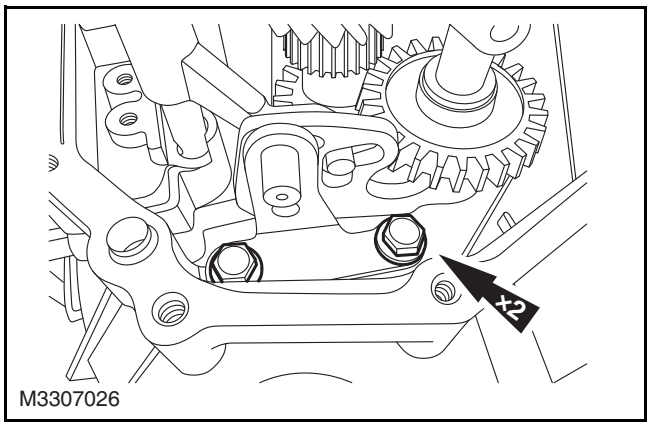


2 Remove the interlock gasket (1) and interlock steel balls (2) in sequence.




**11.** Remove the reverse gear shift fork.

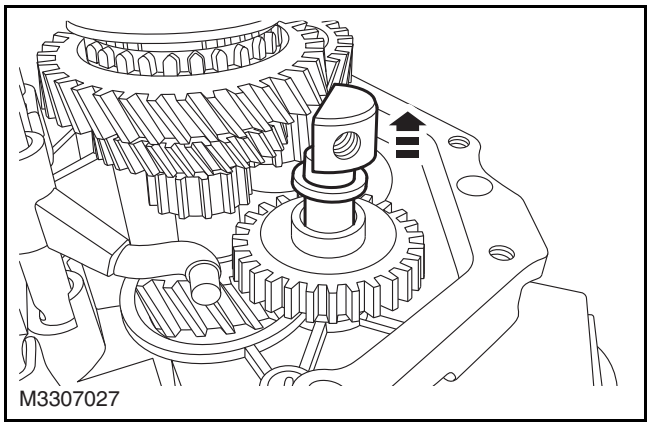
1 Remove 2 retaining bolts from the reverse gear shift fork.



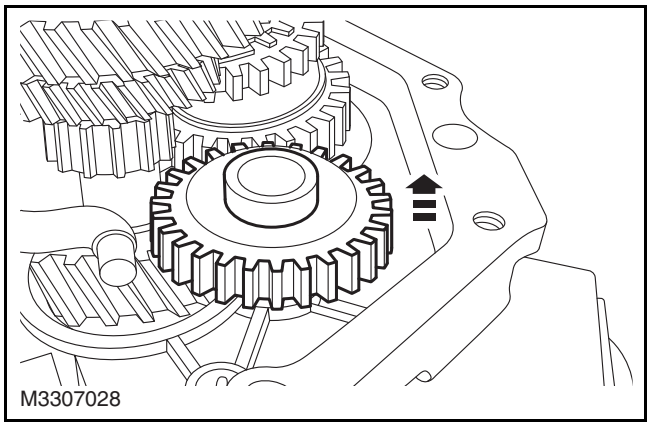

2 Remove the reverse gear shift fork.

**12.** Remove the reverse gear shaft set.

1 Remove the reverse gear shaft.




2 Remove the reverse idler gear.

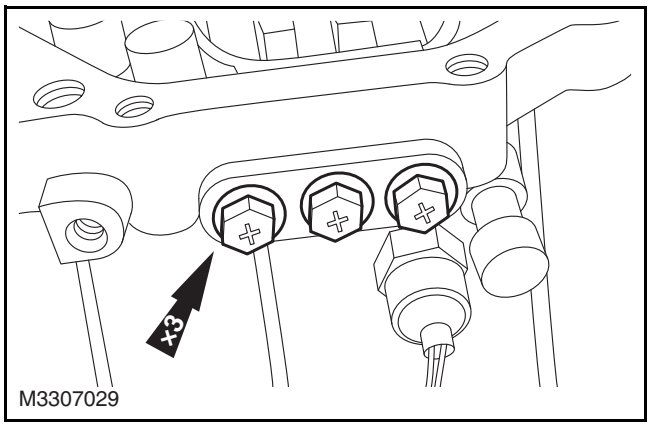


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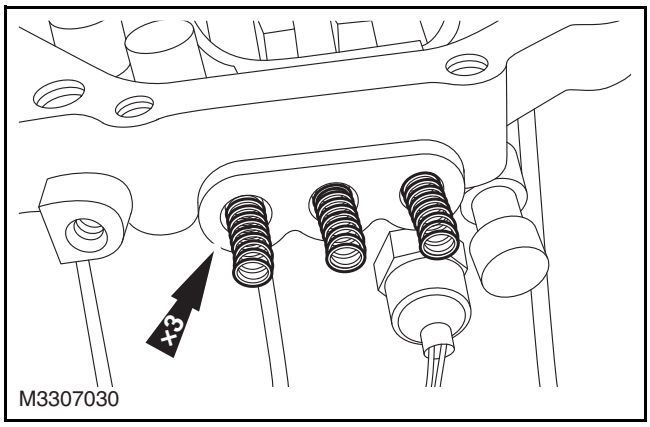


**13.** Remove the self-locking bolt, self-locking spring and self-locking steel ball.

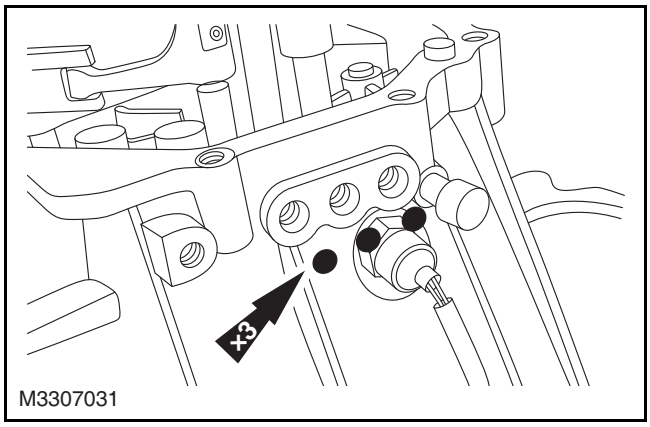
1 Remove 3 self-locking bolts.



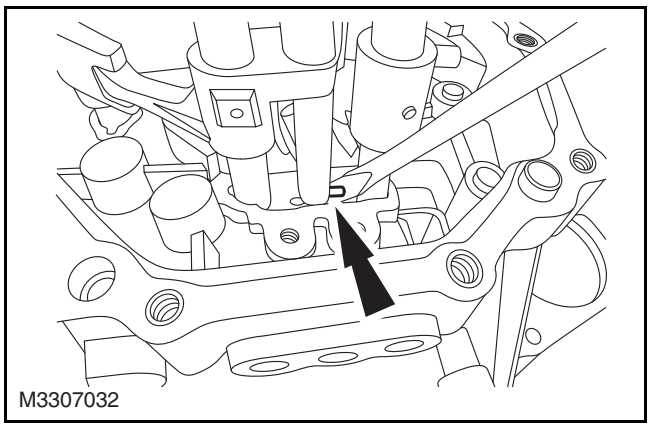

2 Suck out 3 self-locking springs with magnetic bar.




3 Suck out 3 self-locking steel balls with magnetic bar.



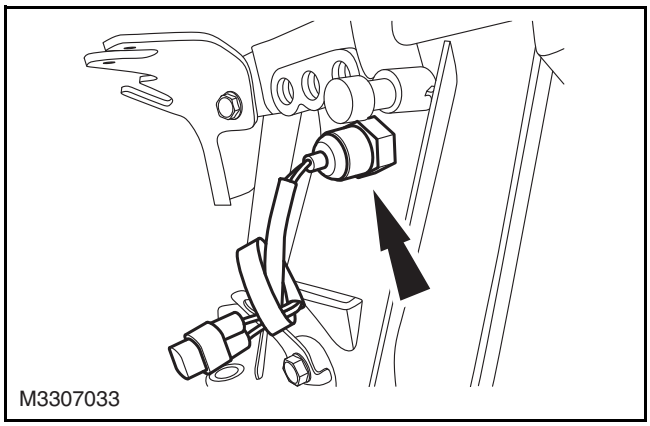

**14.** Use magnetic screwdriver to suck out the lever pin from the lower part of 3rd-4th gear fork shaft.



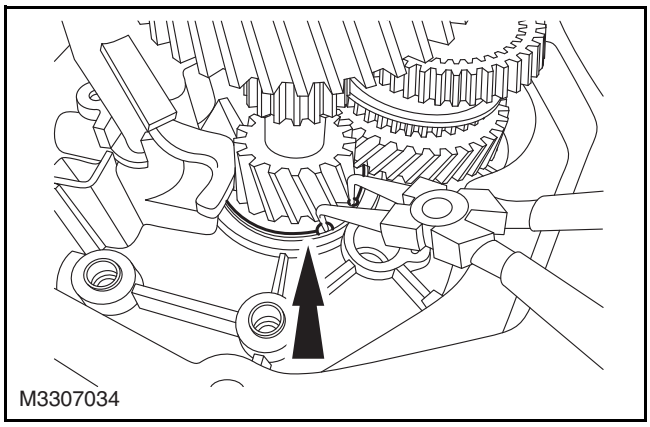
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**15.** Remove the backup lamp switch.

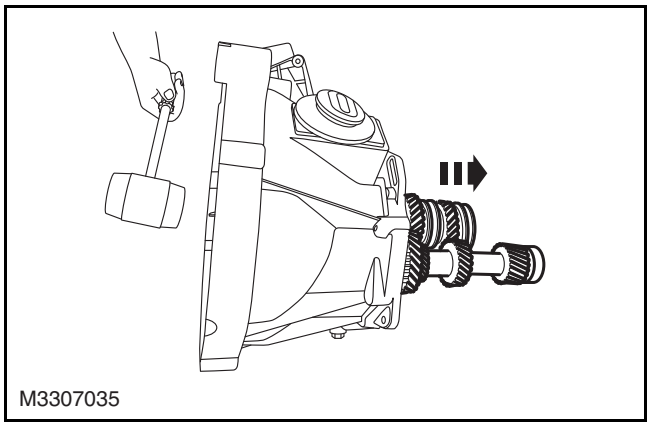



**16.** Remove the input shaft front case circlip.



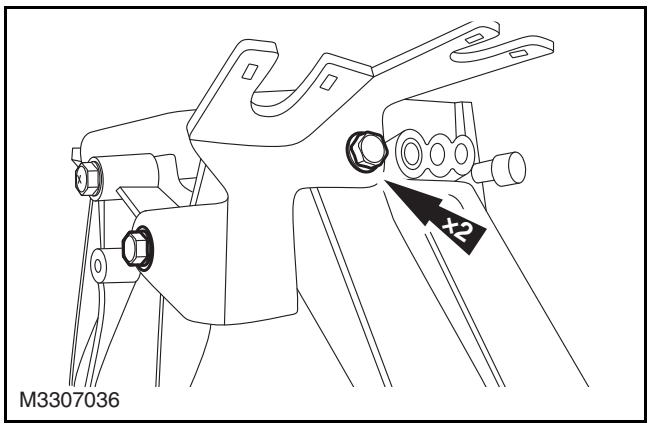

**17.** Remove the input shaft set, intermediate shaft set, 1st-2nd gear fork shaft assembly, 1st-2nd gear shift fork assembly, 3rd-4th gear fork shaft assembly, 5th and reverse gear shift fork shaft assembly.

**CAUTION: When tapping the front case input shaft spline end slightly, tap out all sets from it.**




**18.** Remove the gear shift and select cable bracket.

1 Remove 2 retaining bolts from the gear shift and select cable bracket.



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2 Remove the gear shift and select cable bracket.

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# Replacement of Input Shaft Oil Seal

1. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

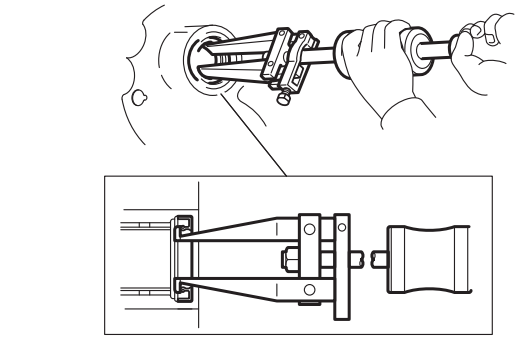
2. Remove the manual transmission.

   **Refer to: Manual Transmission (3.3.7 Manual Transmission - MR513C01, Removal and Installation).**

3. Disassemble the transmission.

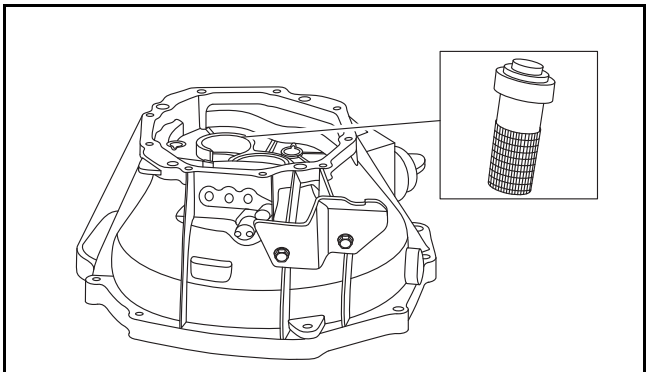
   **Refer to: Disassembly of Transmission (3.3.7 Manual Transmission- MR513C01, Disassembly and Assembly).**

4. Use a proper tool to remove the oil seal.



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5. Use the input shaft oil seal assistant tool to install the new input shaft oil seal.



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6. Apply the grease to the edge of oil seal, and check the contact portion between input shaft and oil seal to make sure it is even.
7. Assemble the transmission.

   **Refer to: Assembly of Transmission (3.3.7 Manual Transmission - MR513C01, Disassembly and Assembly).**

8. Add transmission oil as specified, and check that the oil is sealed tightly by the oil seal.

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# Replacement of Extension Case Oil Seal

1. Drain the transmission oil.

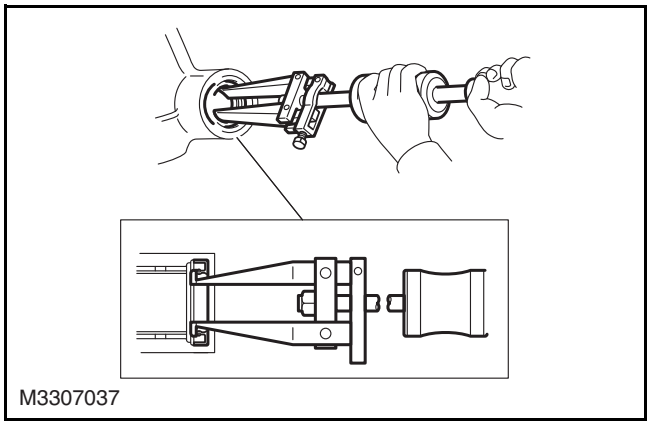
   **Refer to: Replacement of Transmission Oil (3.3.7 Manual Transmission - MR513C01, General Inspection).**

2. Remove the propeller shaft.

   **Refer to: Propeller Shaft (2.2.2 Propeller Shaft, Removal and Installation).**

3. Remove the transmission extension case oil seal.

   1 Use a proper tool to remove the oil seal.


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4. Install the transmission extension case oil seal.

   1 Apply gear oil to the lip of oil seal.

   2 Install the new oil seal to the extension case.

5. Install the propeller shaft.
6. Add transmission oil.

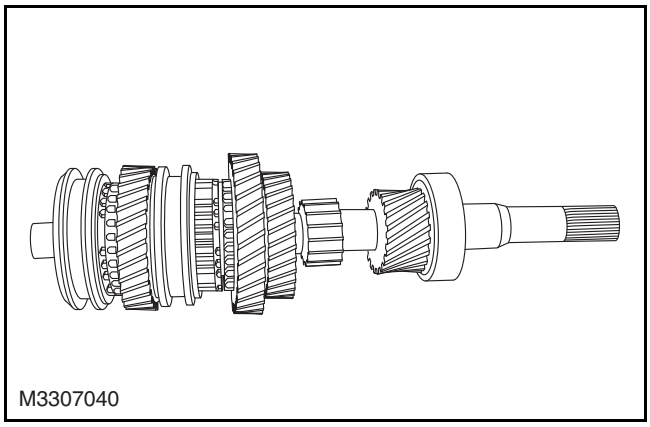
https://truckmanualshub.com/



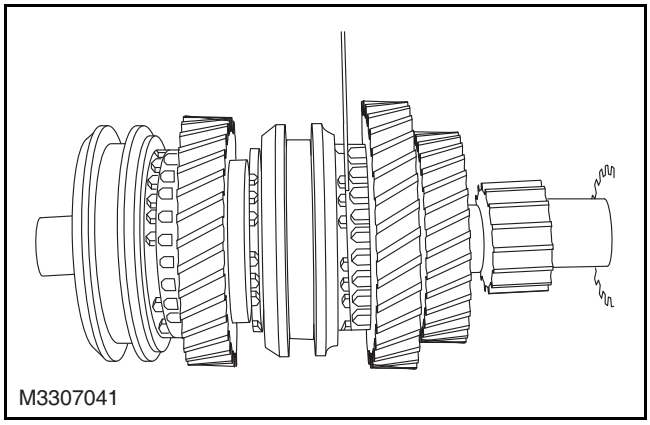
## Inspection

**1.** Inspect the input shaft set.

- Inspect the input shaft gear teeth for breakage and the tooth surface for pitting, serious wear and gluing. Input shaft must be replaced if any case above occurs.


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- Inspect whether input shaft splines are badly worn or damaged. Input shaft must be replaced if it is badly worn or damaged.
- Feel with finger to check whether bearing rotation is inflexible and seized. Bearing must be replaced if the troubles occur.
- Check for abnormality of high-speed synchronizer, 5th gear synchronizer, and replace if necessary.
- Check for abnormality of input shaft 3rd gear assembly, 4th gear assembly, and if they rotate flexibly, check the meshing backlash between gear ring and gear. Check the crowned tooth, ring and sleeve of each gear, and replace if necessary. (Theoretical backlash value: 0.8 ~ 1.2 mm)


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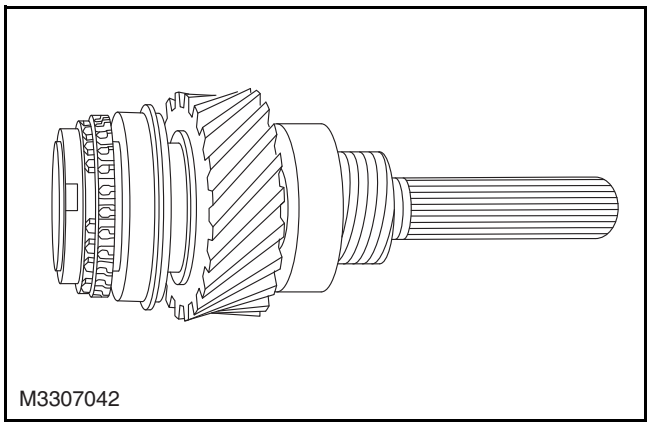
- Check for abnormality of each gear ring, and replace if necessary.

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**2.** Inspect the output shaft set.

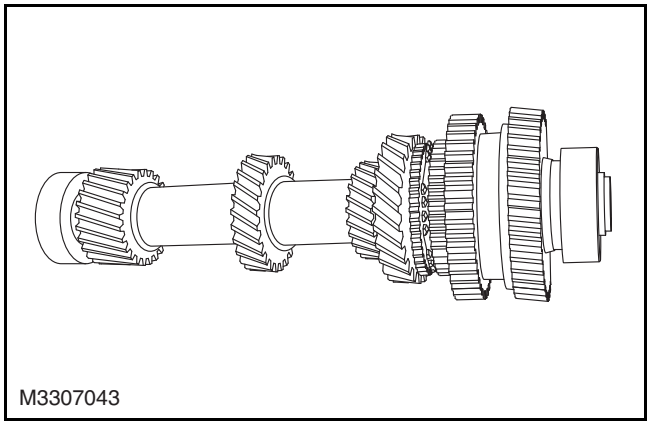
- Inspect the output shaft gear teeth for breakage and the tooth surface for pitting, serious wear and gluing. Output shaft must be replaced if any case above occurs.
- Inspect whether output shaft splines are badly worn or damaged. Output shaft must be replaced if it is badly worn or damaged.
- Feel with finger to check whether bearing rotation is inflexible and seized. Bearing must be replaced if the troubles occur.



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**3.** Inspect the intermediate shaft set.

- Inspect the intermediate shaft gear teeth for breakage and the tooth surface for pitting, serious wear and gluing. Intermediate shaft must be replaced if any case above occurs.
- Feel with finger to check whether bearing rotation is inflexible and seized. Bearing must be replaced if the troubles occur.

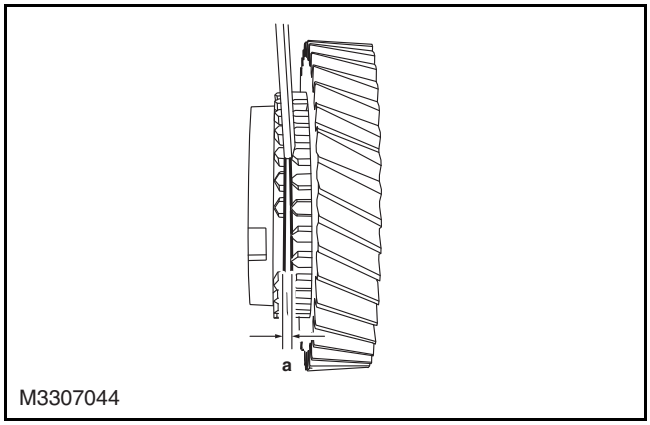


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**4.** Inspect the gear and synchronizer gear ring.

- Fit the synchronizer gear ring onto the mating gear cone and inspect the meshing backlash between gear and gear ring. As for requirement details see chart below. Components must be replaced if backlash reaches or exceeds limit value.

| | Theoretical Value (mm) | Limit Value (mm) |
|---|---|---|
| Backlash "a" between gear and gear ring | 0.8 ~ 1.2 | 0.5 |

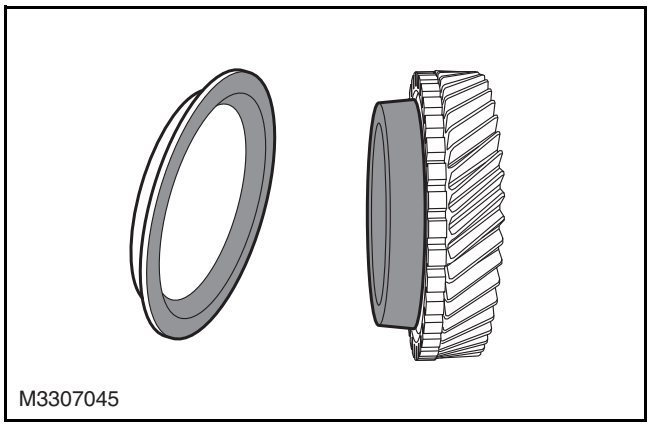



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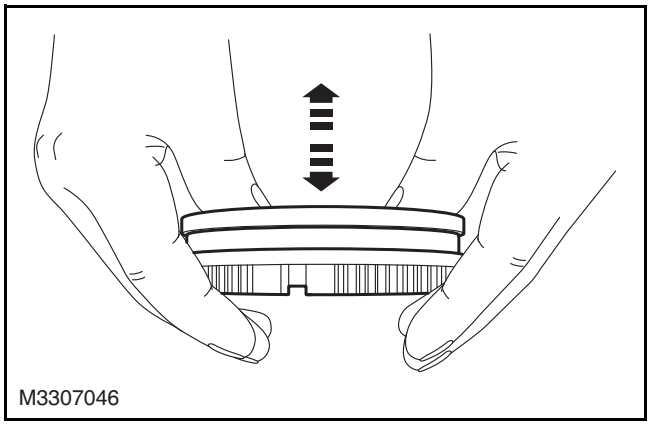


- Inspect whether the gear outer conical surface and gear ring inner conical surface are worn, the component must be replaced if there is abnormal wear.


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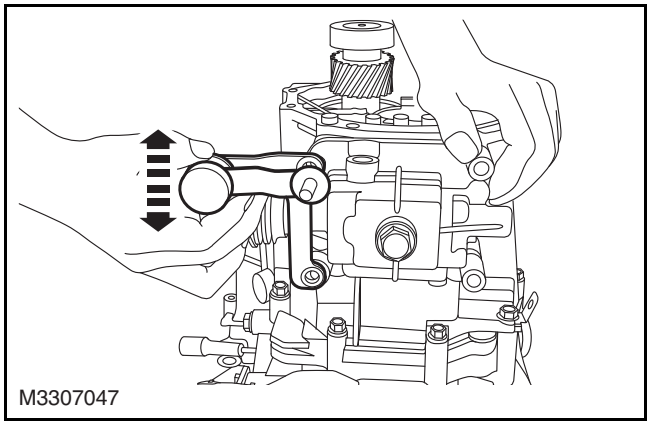
**5.** Inspect the synchronizer set.

- Inspect the sliding flexibility of synchronizer set, repair or replace if it is seized.


M3307046

**6.** Inspect the gearcase set, shift lever set and gearshift mechanism.

- Check for abnormality of gearcase set, and replace if necessary.
- Check for abnormality of each shift lever set and each dowel pin, and replace if necessary.
- Check if the 1st-2nd gear shift lever rotates freely, and replace if necessary.
- Check if the reverse gear shift fork assembly rotates freely, and replace if necessary.


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**7.** Inspect the front case, rear case and extension case set.

- Check for abnormality of each case, and check if there are any cracks on the case wall, and replace if necessary.

**8.** Inspect other components.

- Inspect whether the shift fork shaft is deformed, and whether the self-locking or interlock steel balls are damaged and spring is deformed.
- Inspect whether the tip of synchronizer sleeve synchronizer is worn or gear ring key groove gets worn and wider.
- Inspect whether the bearing is loose, damaged or gear thrust clearance is excessive.
- Inspect whether the gear is badly worn or engagement clearance is excessive.
- Inspect the clearance between fork and hub sleeve.
- Inspect whether there is crack and scratch on the oil seal lip.

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# Disassembly of Input Shaft

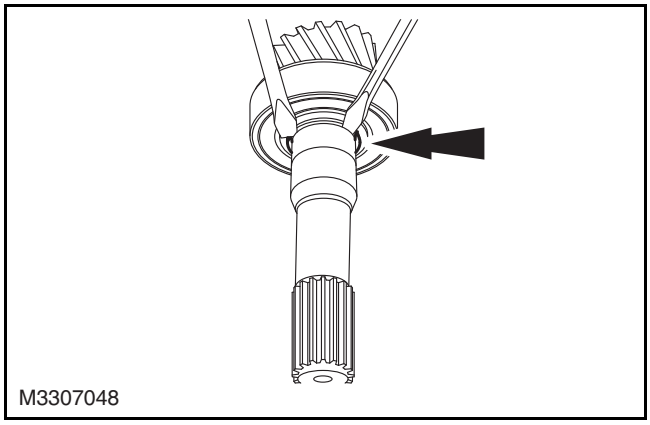
## General Equipment

| |
|---|
| Puller |

## Disassembly

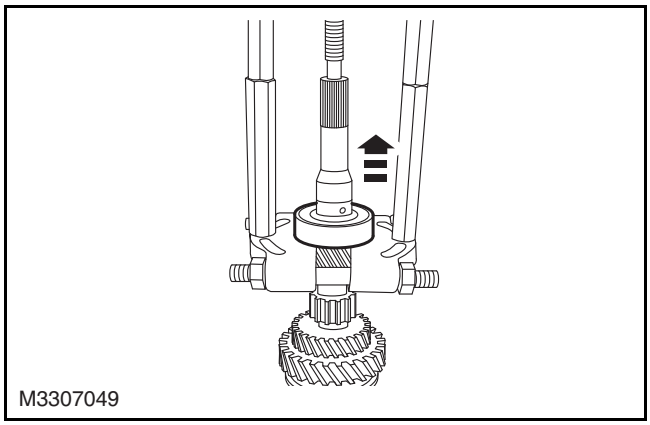
1. Use a proper tool to remove the input shaft bearing circlip.

**CAUTION: Place a cloth under the input shaft set to prevent circlip from flying out.**


M3307048

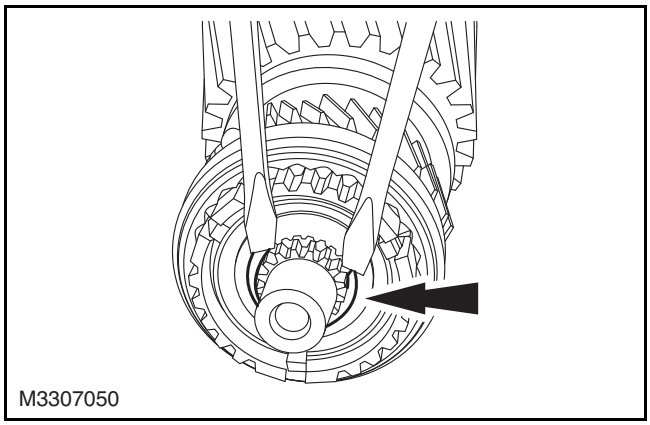
2. Use the puller to remove the input shaft bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while removing bearing with the puller.**


M3307049

3. Use a proper tool to remove the high-speed synchronizer circlip.

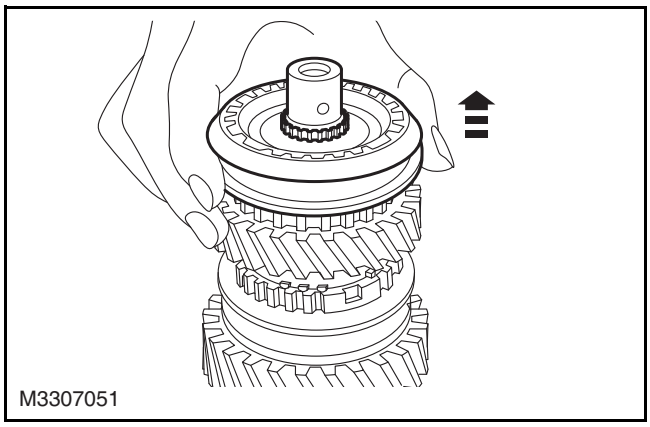
**CAUTION: Place a cloth under the input shaft set to prevent circlip from flying out.**


M3307050

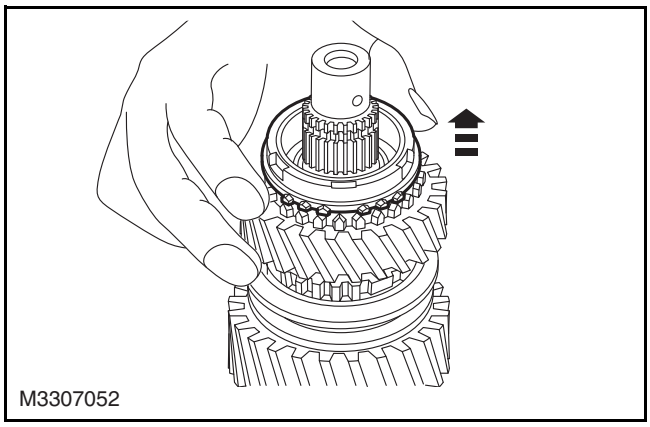
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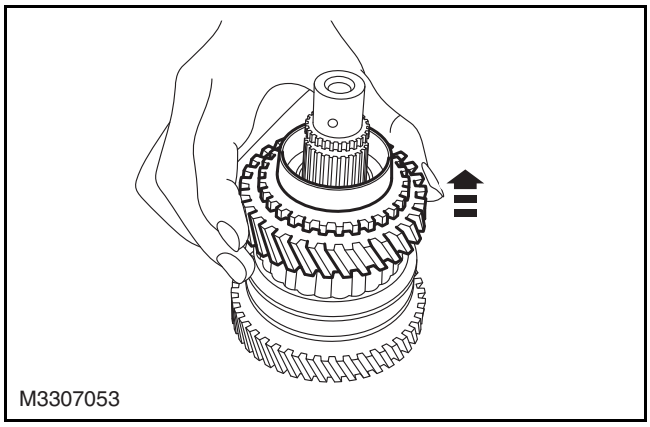
**4.** Remove the high-speed synchronizer.


M3307051

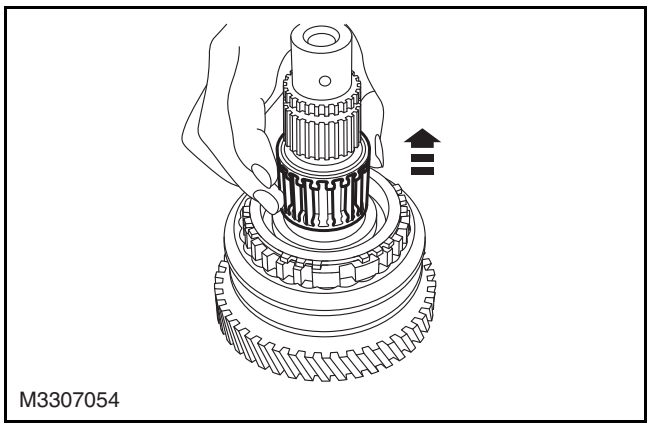
**5.** Remove the high-speed synchronizer gear ring.


M3307052

**6.** Remove the input shaft 3rd gear.


M3307053

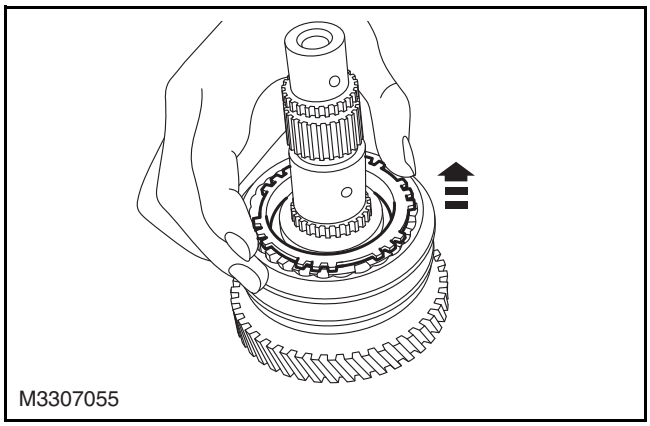
**7.** Remove the 3rd gear needle roller bearing.


M3307054

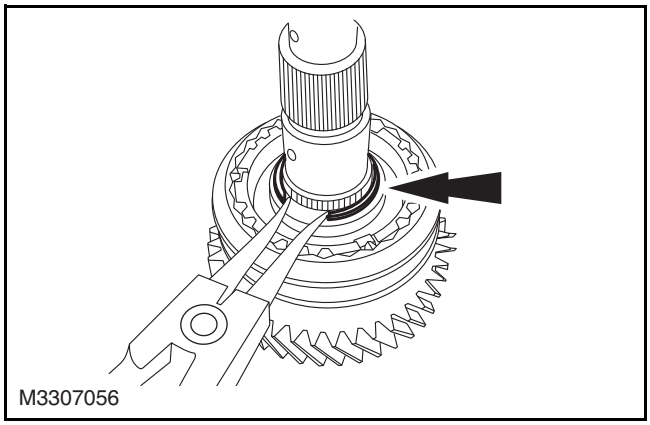
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**8.** Remove the reverse gear ring.

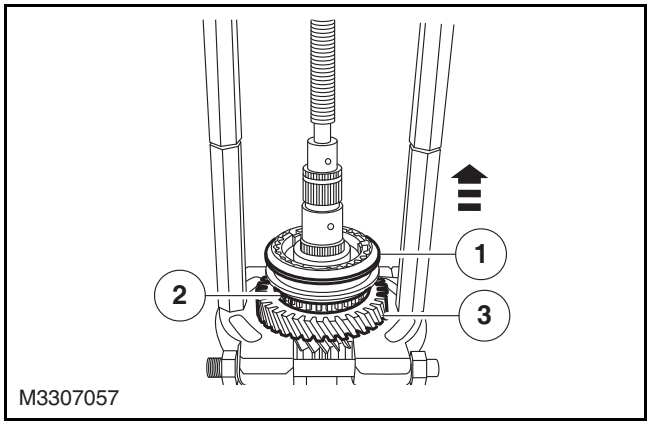

M3307055

**9.** Use the circlip pliers to remove the 5th gear synchronizer circlip.


M3307056

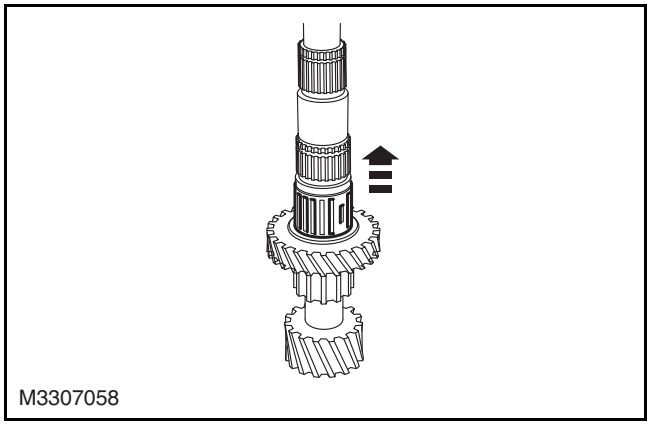
**10.** Using the puller, pull out the 5th gear synchronizer (1), 5th gear synchronizer gear ring (2) together with input shaft 5th gear (3).

**CAUTION: Ensure that force bearing point of gear is at its inner ring while removing the gear with puller.**



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**11.** Remove the input shaft 5th gear needle roller bearing.


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# Disassembly of Output Shaft

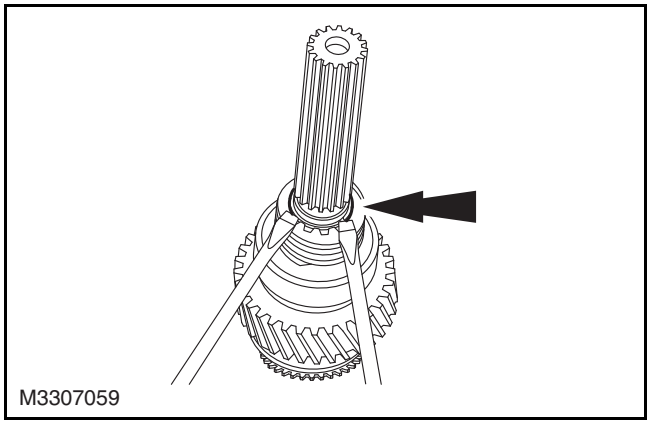
## General Equipment

| |
|---|
| Puller |

## Disassembly

1. Use a proper tool to remove the output shaft worm circlip.

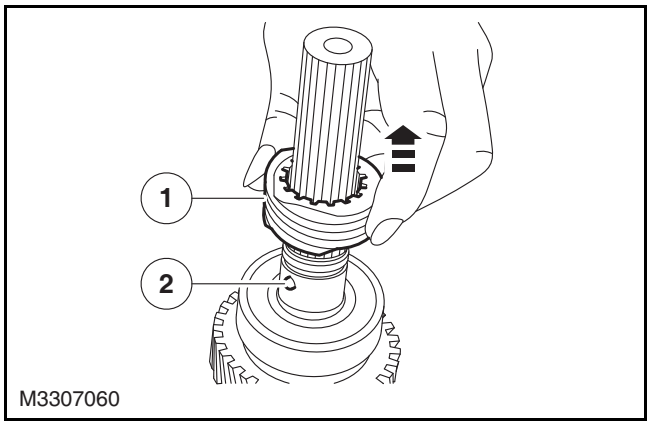
**CAUTION: Place a cloth under the output shaft set to prevent circlip from flying out.**


M3307059

2. Remove the worm set.

   1 Remove the worm (1).

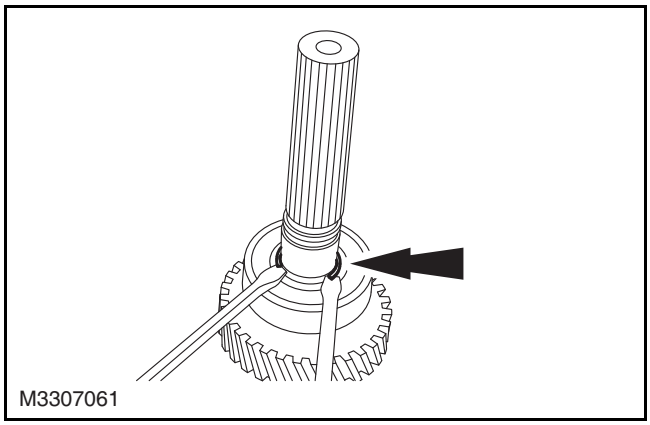
   2 Use magnetic screwdriver to suck out the worm steel ball (2).



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3. Use a proper tool to remove the output shaft rear bearing circlip.

**CAUTION: Place a cloth under the output shaft set to prevent circlip from flying out**

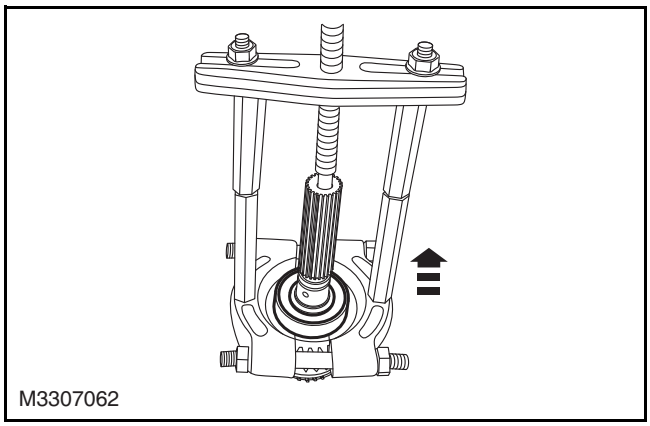

M3307061

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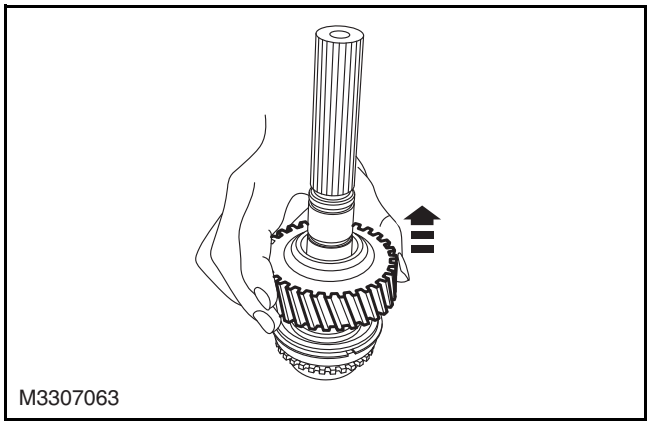


4. Use the puller to remove the output shaft rear bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while removing bearing with the puller.**

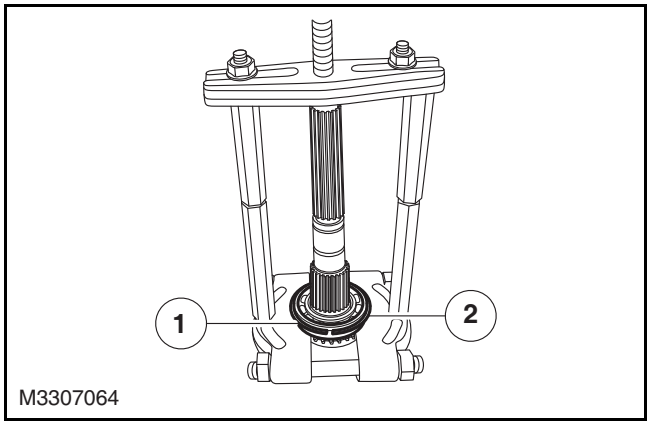

M3307062

5. Remove the output shaft driven gear.


M3307063

6. Using the puller, pull out the output shaft front bearing (1) together with output shaft front bearing circlip (2).

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while removing bearing with the puller.**



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# Disassembly of Intermediate Shaft

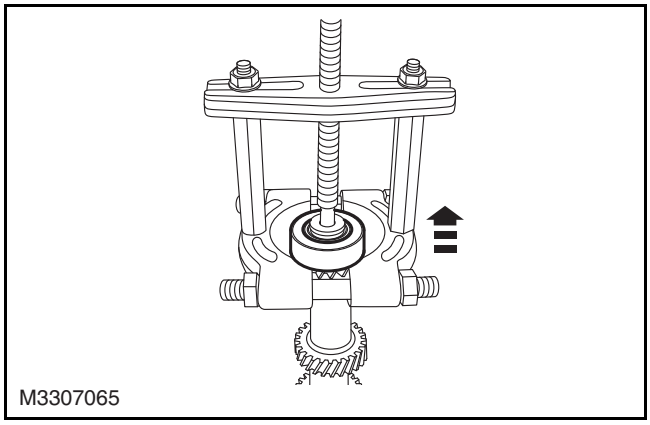
## General Equipment

| |
|---|
| Puller |

## Disassembly

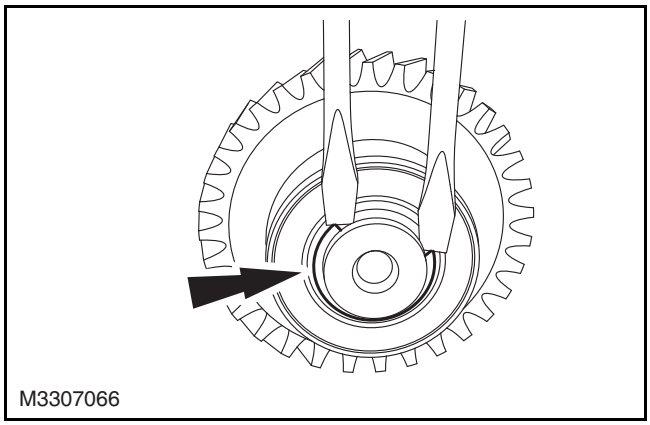
1. Use the puller to remove the intermediate shaft rear bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while removing bearing with the puller.**


M3307065

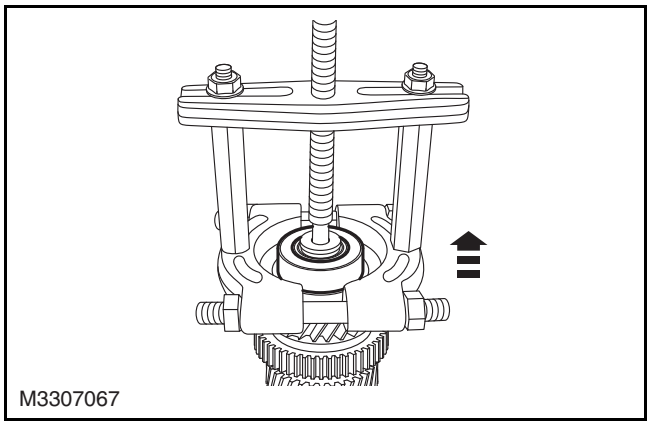
2. Use a proper tool to remove the intermediate shaft front bearing circlip.

**CAUTION: Place a cloth under the intermediate shaft set to prevent circlip from flying out.**


M3307066

3. Use the puller to remove the intermediate shaft front bearing.

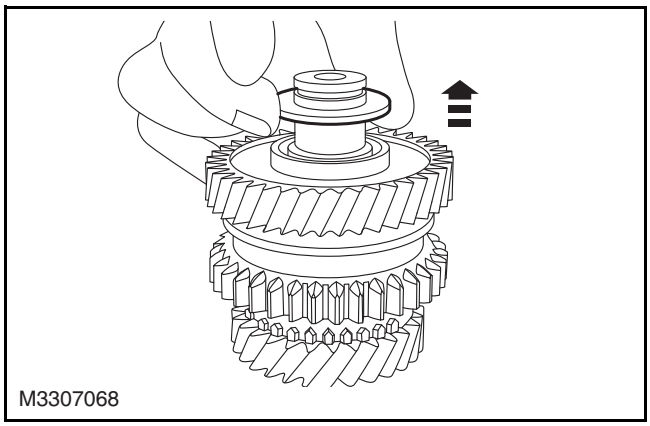
**CAUTION: Ensure that force bearing point of bearing is at its inner ring while removing bearing with the puller.**


M3307067

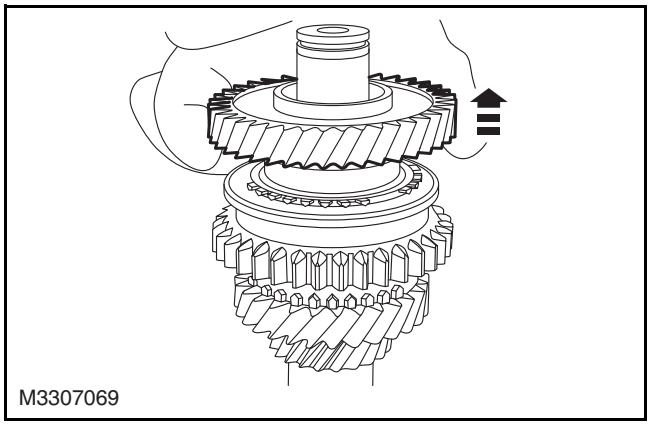
https://truckmanualshub.com/



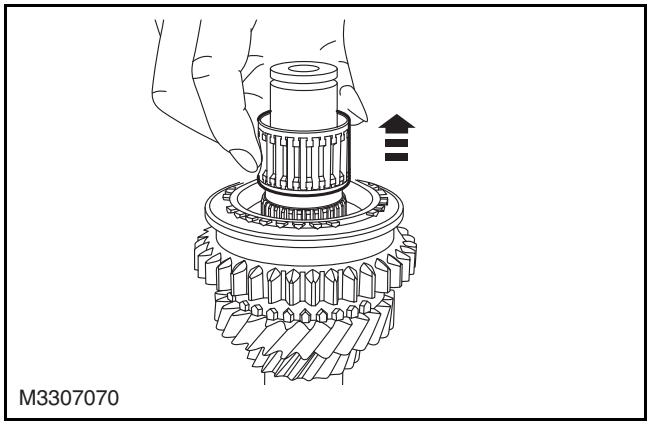
**4.** Remove the intermediate shaft front bearing washer.


M3307068

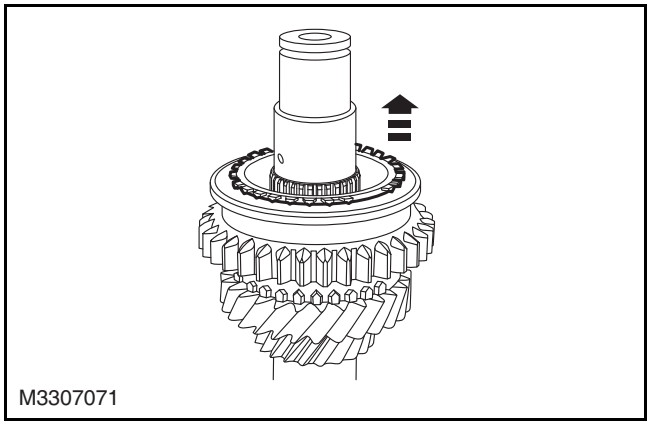
**5.** Remove the intermediate shaft 1st gear.


M3307069

**6.** Remove the intermediate shaft 1st gear needle roller bearing.


M3307070

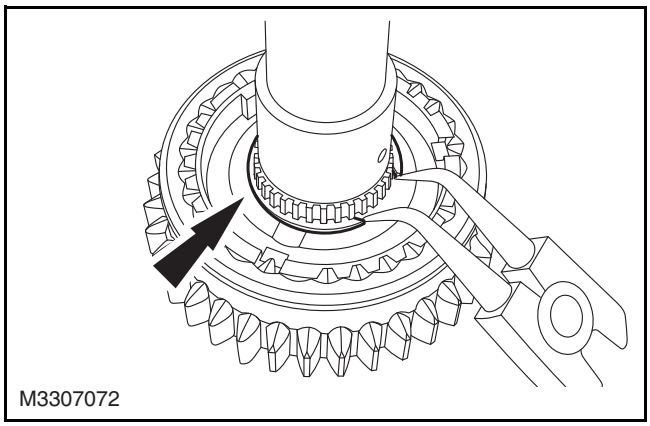
**7.** Remove the 1st gear synchronizer gear ring.


M3307071

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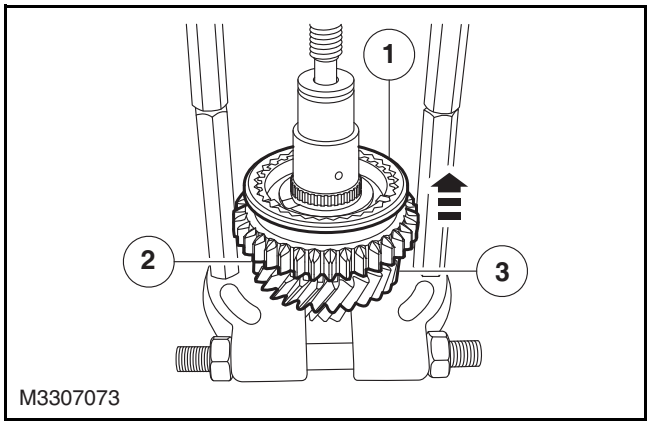


**8.** Use a proper tool to remove the low-speed synchronizer circlip.


M3307072

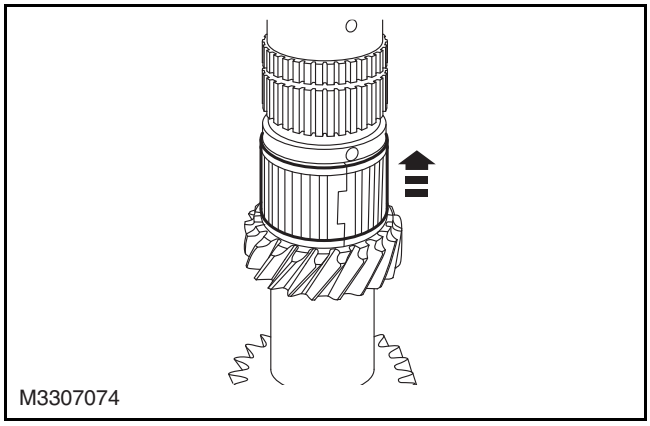
**9.** Using the puller, pull out the low-speed synchronizer (1), 2nd gear synchronizer gear ring (2) together with intermediate shaft 2nd gear (3).

**CAUTION: Ensure that force bearing point of gear is at its inner ring while removing the gear with puller.**



M3307073

**10.** Remove the intermediate shaft 2nd gear needle roller bearing.


M3307074

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# Assembly of Intermediate Shaft

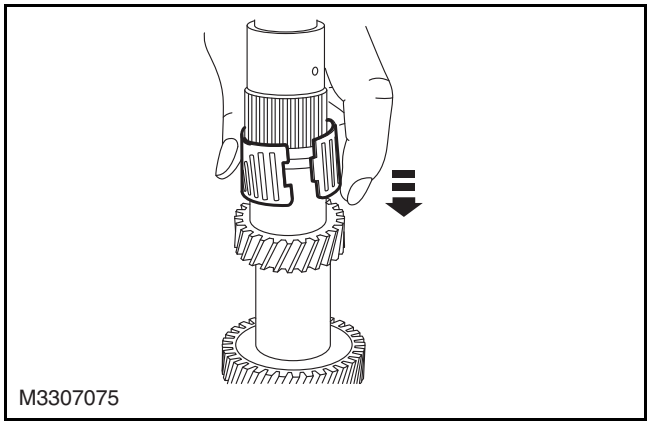
## Material

| Item | Model |
|---|---|
| Manual Transmission Oil | API (GL-4) SAE 75W-90, Shell Spirax S4 GS |

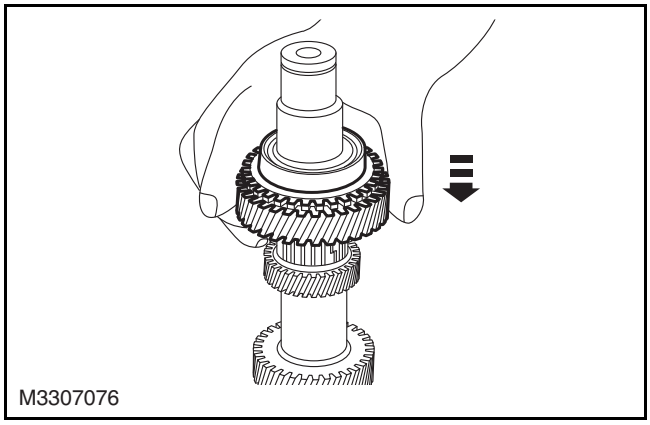
## Assembly

1. Install the intermediate shaft 2nd gear needle roller bearing.

**CAUTION: Uniformly apply lubricant to the part of needle roller end face that contacts shaft journal.**

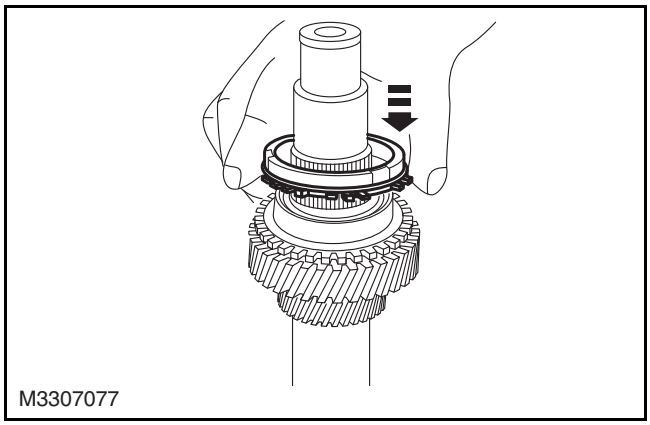

M3307075

2. Install the intermediate shaft 2nd gear.


M3307076

3. Install the 2nd gear synchronizer gear ring.

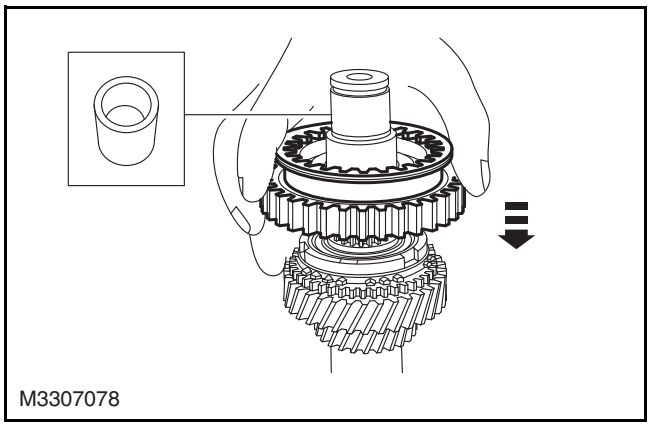
**CAUTION: The method to distinguish the 1st from 2nd gear synchronizer gear ring is that 1st gear synchronizer gear ring has eight teeth and 2nd gear synchronizer gear ring has seven teeth.**


M3307077

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4. Use the low-speed synchronizer set pressing assistant tool to install the low-speed synchronizer.

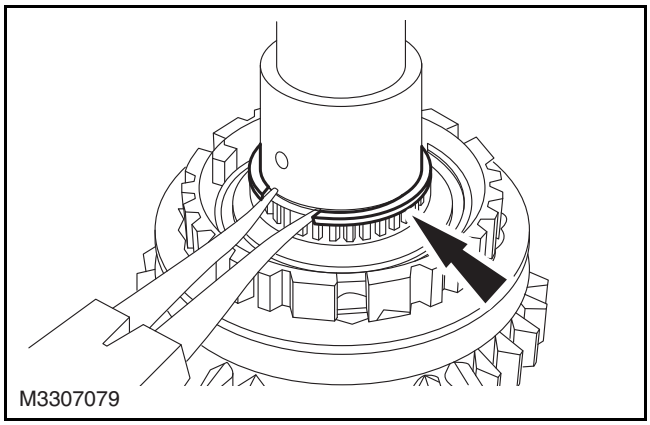

M3307078

**CAUTION: Synchronizer slider is aligned with gear ring slider slot while installation. Gear rotation should be flexible and free after installation.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**

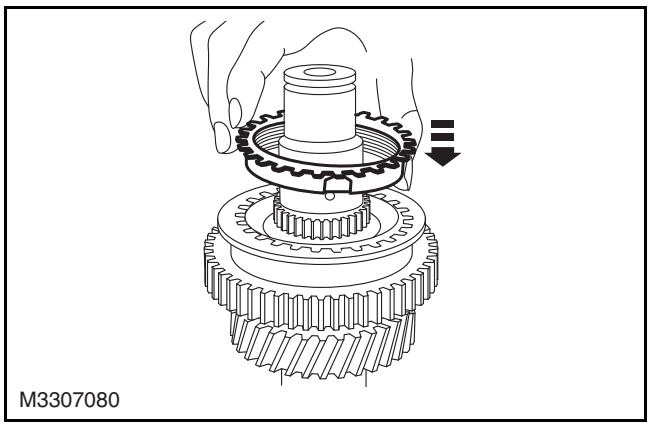
**CAUTION: Use the vise holder protector all the time when using the vise.**

5. Use the circlip pliers to install the low-speed synchronizer circlip.


M3307079

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**

6. Install the 1st gear synchronizer gear ring.


M3307080

**CAUTION: Synchronizer gear ring slider slot is aligned with synchronizer slider while installation.**

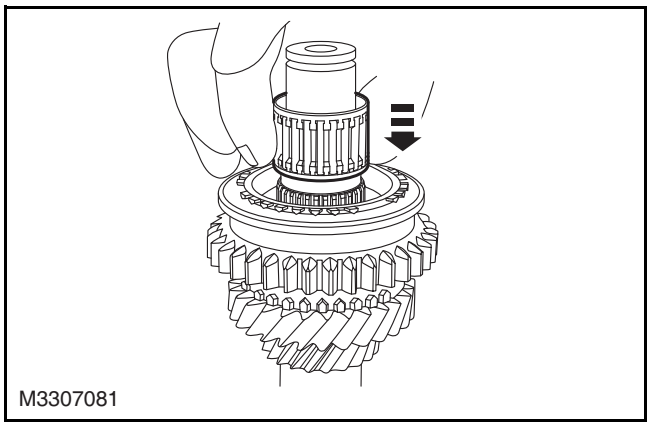
**CAUTION: The method to distinguish the 1st from 2nd gear synchronizer gear ring is that 1st gear synchronizer gear ring has eight teeth and 2nd gear synchronizer gear ring has seven teeth.**

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7. Install the intermediate shaft 1st gear needle roller bearing.

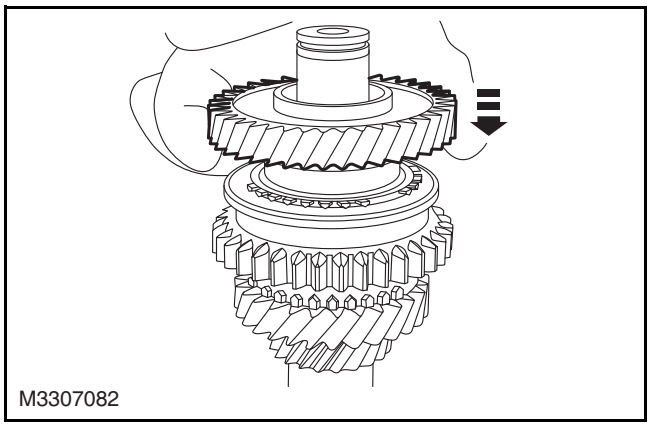
**CAUTION: Uniformly apply lubricant to the part of needle roller end face that contacts shaft journal.**


M3307081

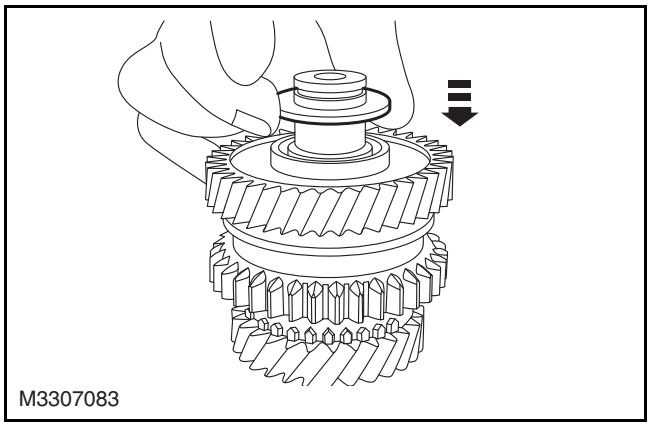
8. Install the intermediate shaft 1st gear.

**CAUTION: Use the vise holder protector all the time when using the vise.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**


M3307082

9. Install the intermediate shaft front bearing washer.


M3307083

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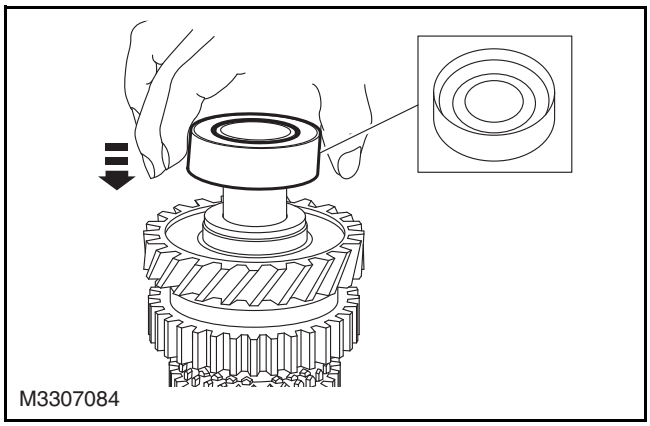


**10.** Use the intermediate shaft front bearing pressing assistant tool to install the intermediate shaft front bearing.

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**

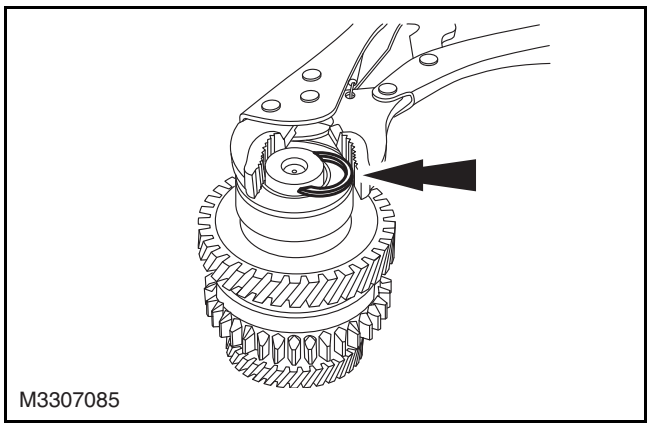
**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

**CAUTION: Use the vise holder protector all the time when using the vise.**


M3307084

**11.** Use a proper tool to install the intermediate shaft front bearing circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**

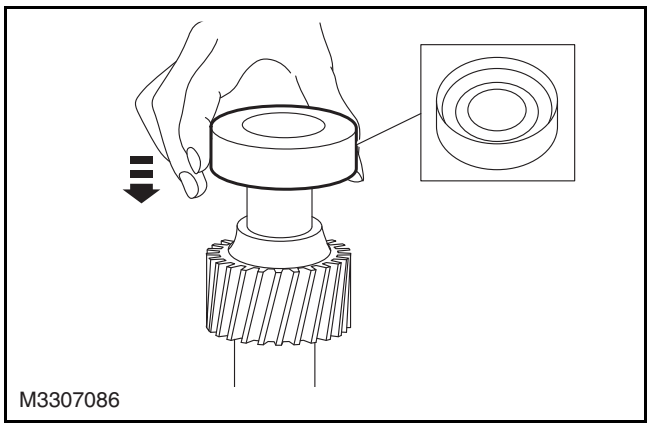

M3307085

**12.** Use the intermediate shaft rear bearing pressing assistant tool to install the intermediate shaft rear bearing.

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

**CAUTION: Use the vise holder protector all the time when using the vise.**


M3307086

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# Assembly of Output Shaft

## Material

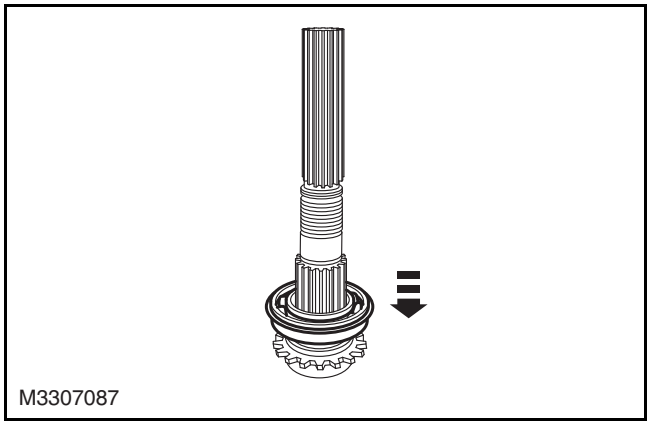
| Item | Model |
|---|---|
| Manual Transmission Oil | API (GL-4) SAE 75W-90, Shell Spirax S4 GS |

## Assembly

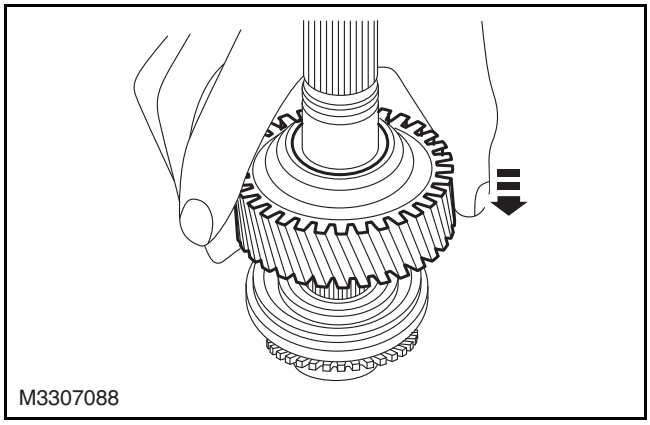
1. Use a proper tool to install the output shaft front bearing and output shaft front bearing circlip.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**


M3307087

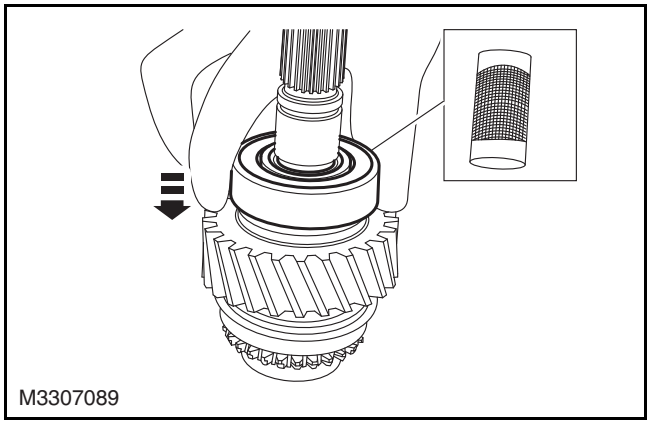
2. Install the output shaft driven gear.


M3307088

3. Use the output shaft rear bearing pressing assistant tool to install the output shaft rear bearing.

**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**

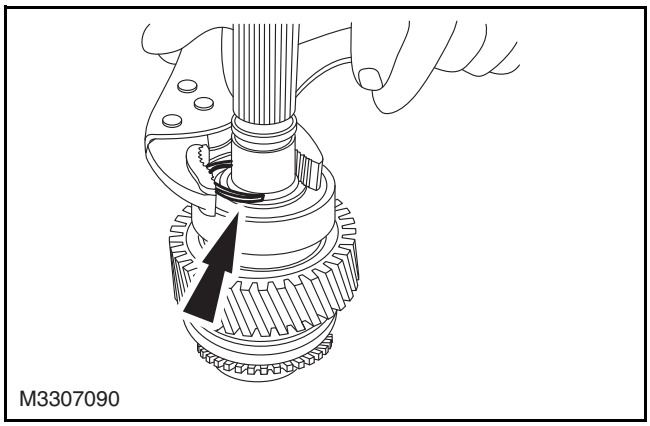

M3307089

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4. Use a proper tool to install the output shaft rear bearing circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**

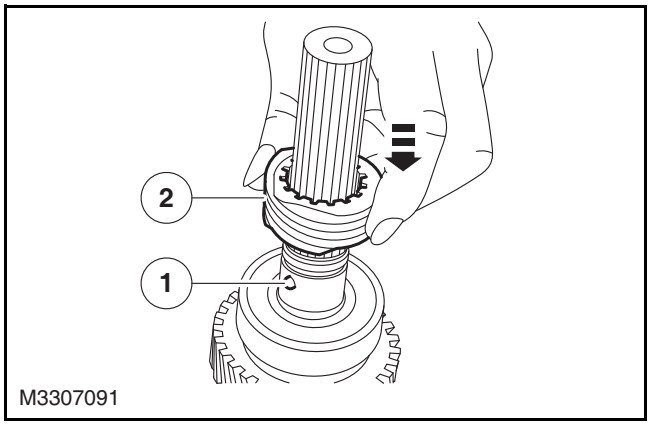

M3307090

5. Install the worm set.

   1 Install the worm steel ball (1).

   2 Install the worm (2).

**CAUTION: Apply a small amount of grease to the surface of steel ball when installing.**



M3307091

6. Use a proper tool to install the worm circlip.

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# Assembly of Input Shaft

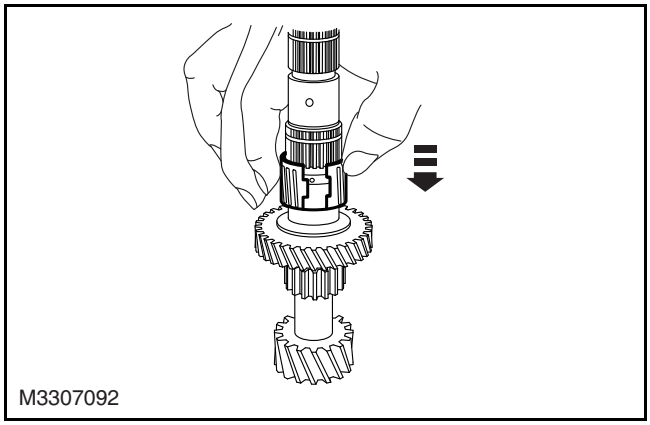
## Material

| Item | Model |
|---|---|
| Manual Transmission Oil | API (GL-4) SAE 75W-90, Shell Spirax S4 GS |

## Assembly

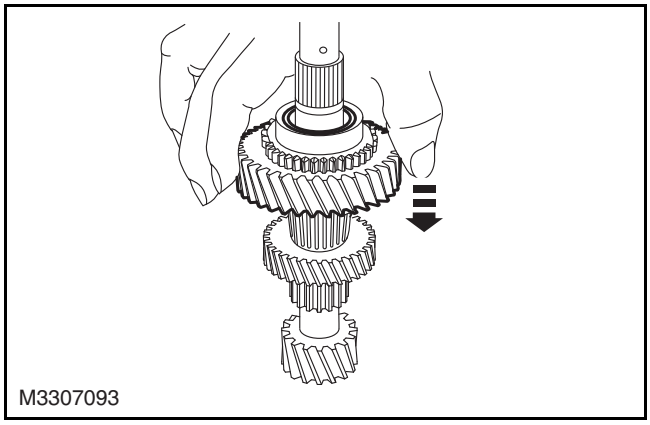
1. Install the input shaft 5th gear needle roller bearing.

**CAUTION: Uniformly apply lubricant to the part of needle roller end face that contacts shaft journal.**

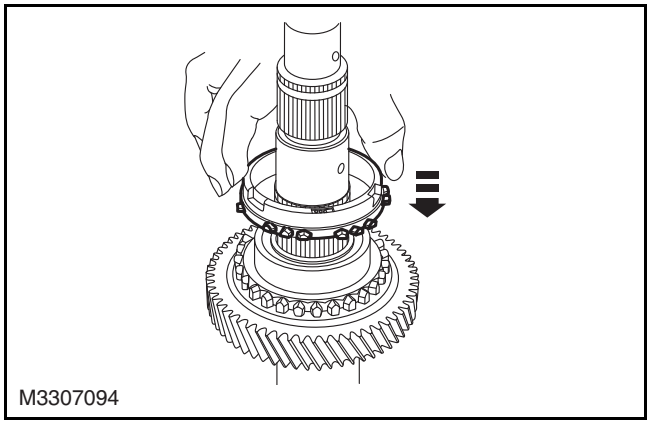

M3307092

2. Install the input shaft 5th gear.

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**


M3307093

3. Install the 5th gear synchronizer gear ring.


M3307094

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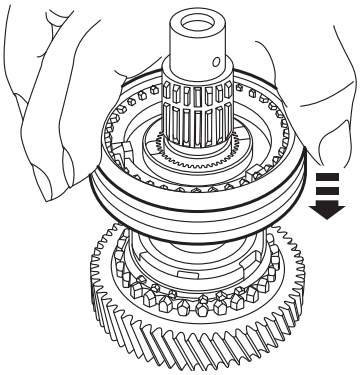


4. Use a proper tool to install the 5th gear synchronizer.

**CAUTION: 5th gear synchronizer boss should face towards input shaft front end.**

**CAUTION: Synchronizer slider is aligned with gear ring slider slot while installation. Gear rotation should be flexible and free after installation.**

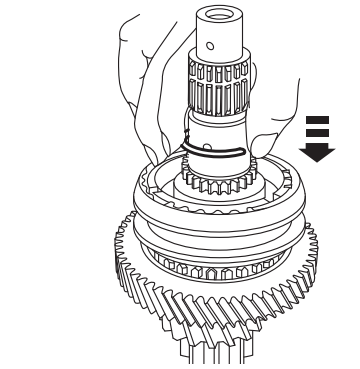
**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**



M3307095

5. Use a proper tool to install the 5th gear synchronizer circlip.

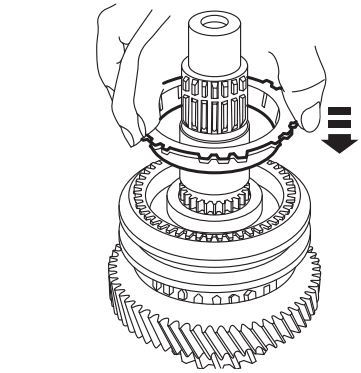
**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**



M3307096

6. Install the reverse gear ring.

**CAUTION: Reverse gear ring slider slot is aligned with synchronizer slider while installation.**



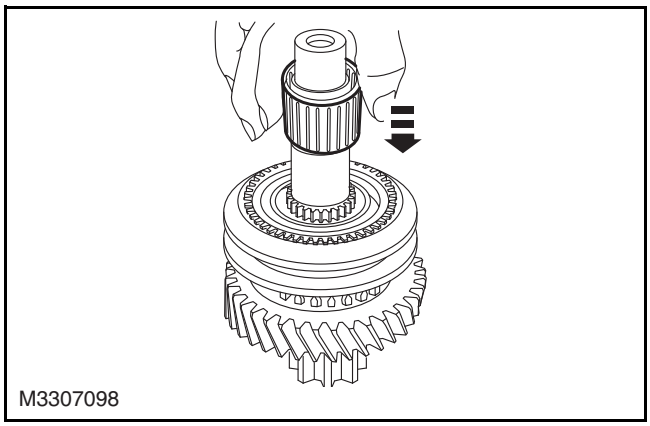
M3307097

https://truckmanualshub.com/

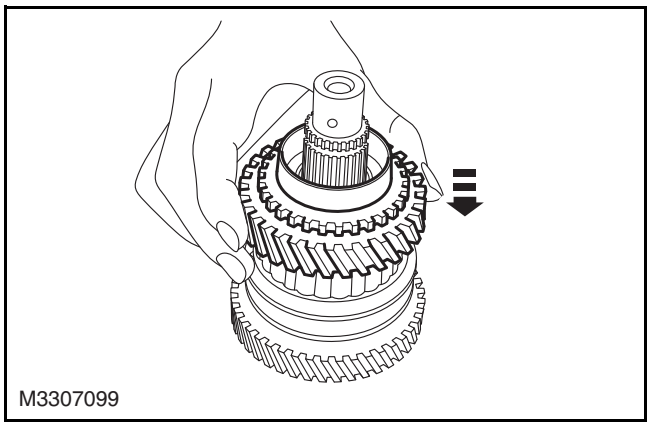


7. Install the 3rd gear needle roller bearing.

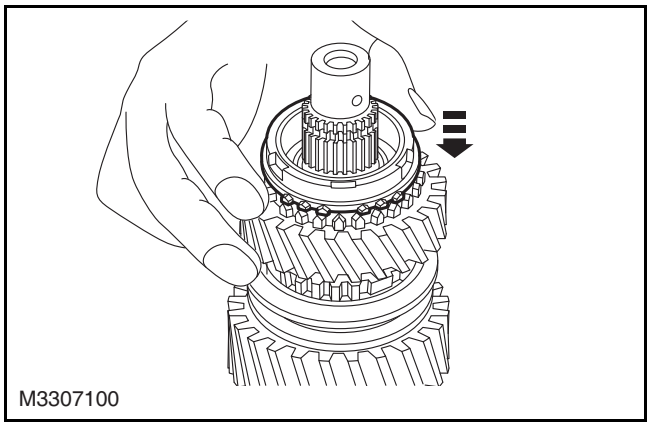
**CAUTION: Uniformly apply lubricant to the part of needle roller end face that contacts shaft journal.**


M3307098

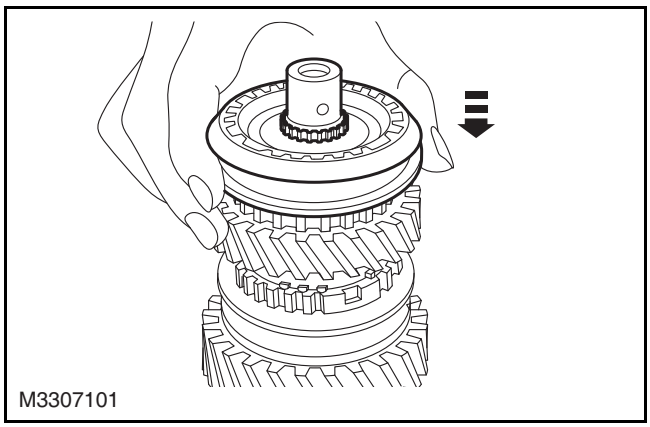
8. Install the input shaft 3rd gear.


M3307099

9. Install the high-speed synchronizer gear ring.


M3307100

10. Install the high-speed synchronizer.

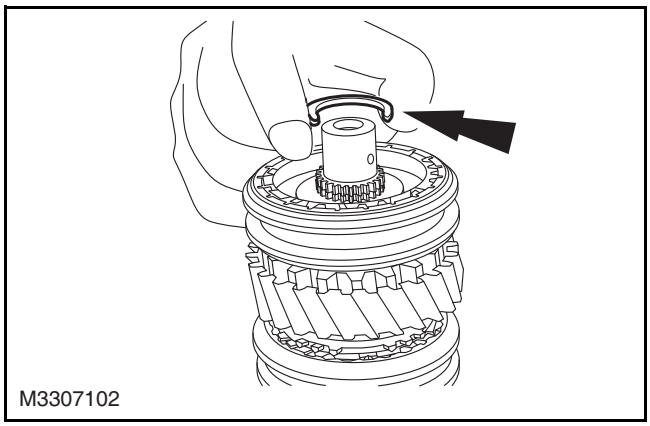

M3307101

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**11.** Use a proper tool to install the high-speed synchronizer circlip.

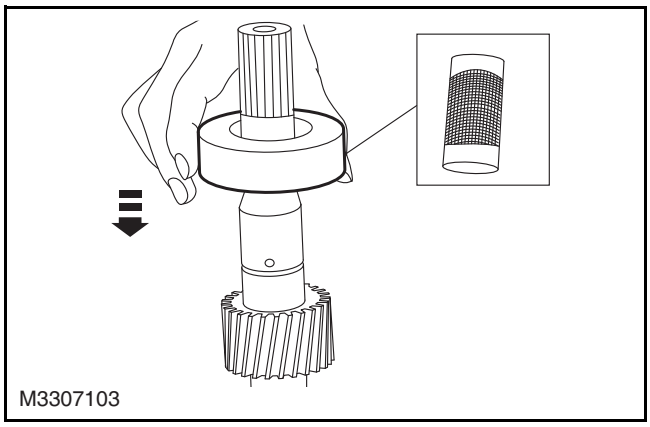
**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**


M3307102

**12.** Use the input shaft bearing pressing assistant tool to install the input shaft bearing.

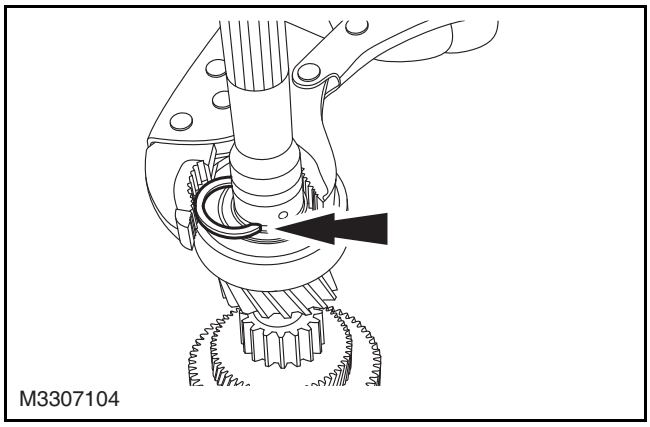
**CAUTION: Ensure that force bearing point of bearing is at its inner ring while installing the bearing with the tool.**

**CAUTION: All the gears and bearings have positive and negative directions. Do not mix them up.**


M3307103

**13.** Use a proper tool to install the input shaft bearing circlip.

**CAUTION: All the circlips must be replaced with new ones after removal. When inserting the circlip into the circlip slot, both sides of circlip must hold the circlip slot tightly.**


M3307104

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# Assembly of Transmission

## Material

| Item | Model |
|---|---|
| Sealant | YT5699 silicone sealant |
| Manual Transmission Oil | API (GL-4) SAE 75W-90, Shell Spirax S4 GS |

Precautions for transmission before assembling:

- Clean all the parts.
- Apply gear oil to part surface with relative movement.
- Apply grease to circular surface of needle roller bearing before assembling needle roller bearing.
- Apply grease to outer ring and inner ring of bearing before assembling deep groove ball bearing.
- Apply grease to lip while assembling oil seal.

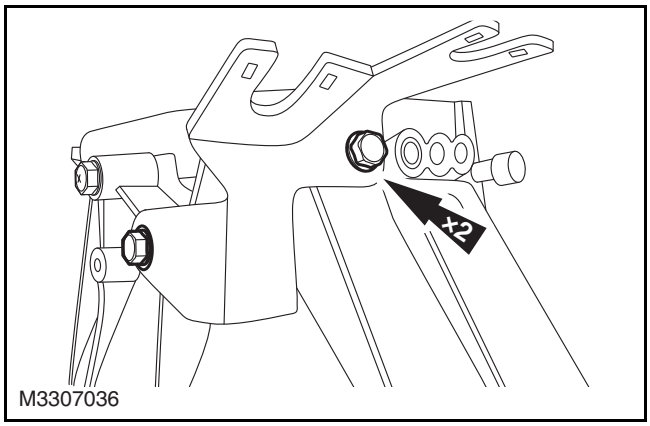
## Assembly

**1.** Install the gear shift and select cable bracket and tighten it to the specified torque.

1 Install the gear shift and select cable bracket.

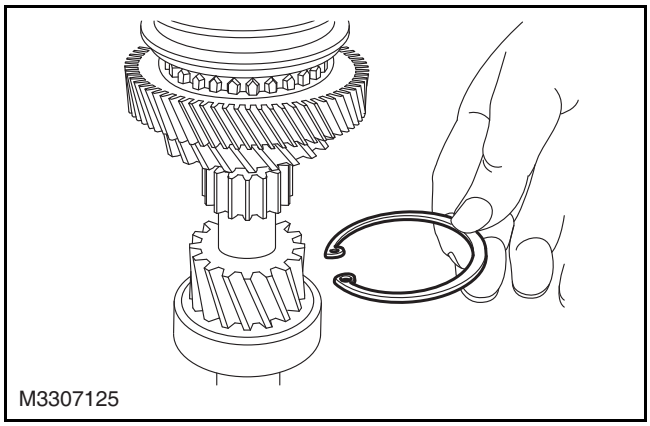
2 Install 2 retaining bolts to the cable bracket.

Torque: 18 ~ 28 Nm



M3307036

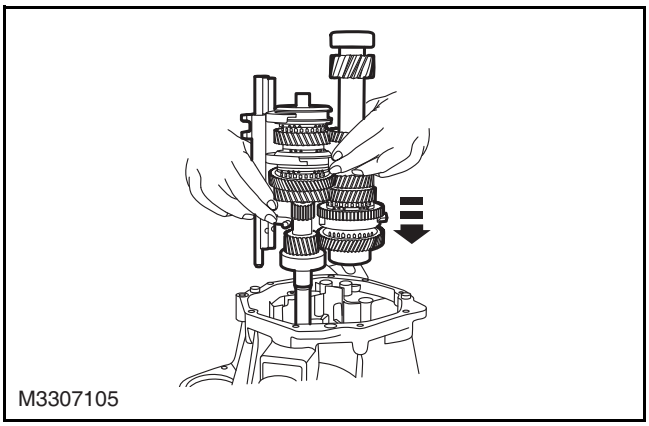
**2.** Install the input shaft front case circlip to the input shaft.


M3307125

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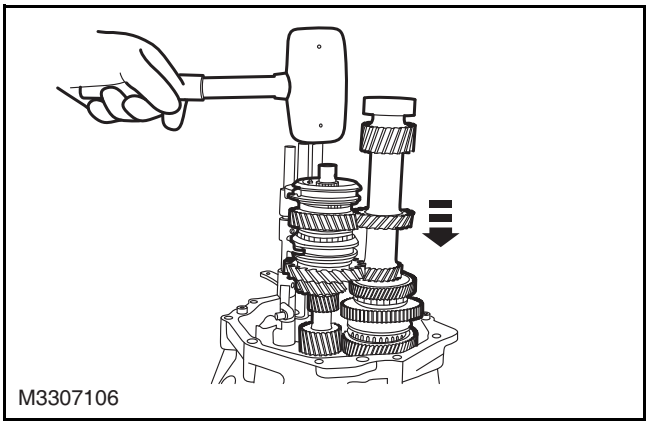


3. Install the input shaft set, intermediate shaft set, 1st-2nd gear fork shaft assembly, 1st-2nd gear shift fork assembly, 3rd-4th gear fork shaft assembly together with 5th and reverse gear shift fork shaft assembly to the front case.

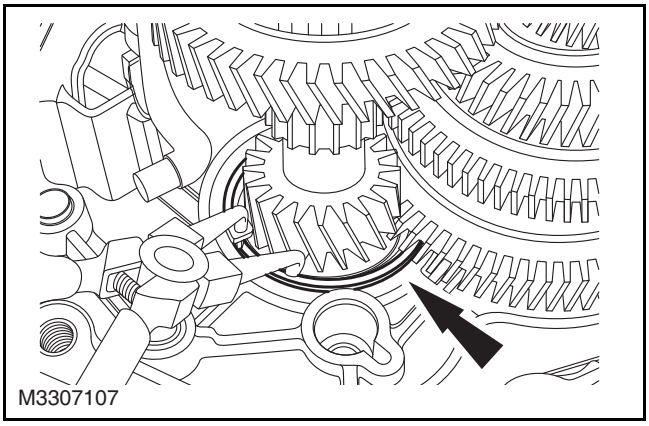

M3307105

**CAUTION: Fork must be stuck in the slot of synchronizer sleeve and each of three gear fork shafts must be placed into the hole correspondingly.**

4. Tap the rear ends of input shaft and intermediate shaft with rubber hammer lightly to ensure that each set has been installed in place.

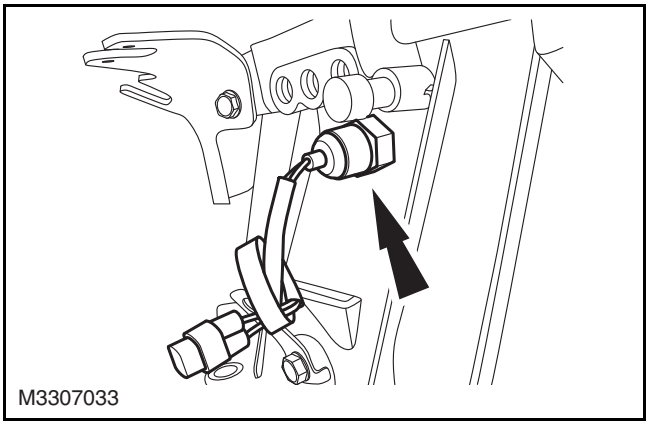

M3307106

5. Use the circlip pliers to install the input shaft front circlip.


M3307107

6. Install the backup lamp switch.

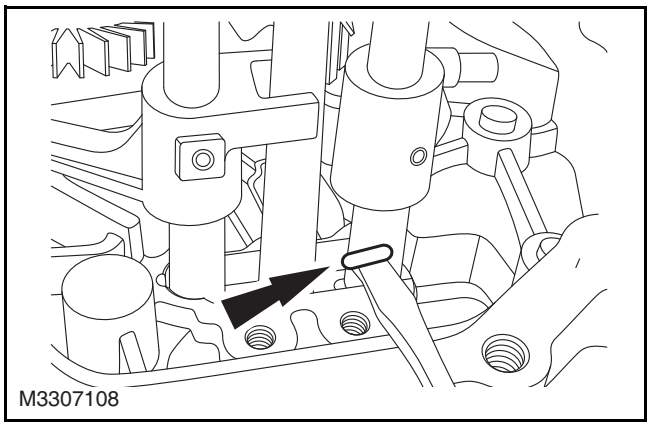
   Torque: 15 ~ 22 Nm


M3307033

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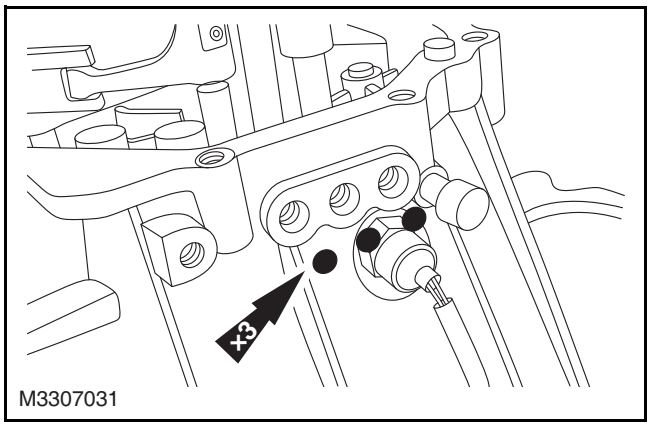


**7.** Use magnetic screwdriver to put the lever pin into the transverse slot on the lower part of 3rd-4th gear fork shaft.

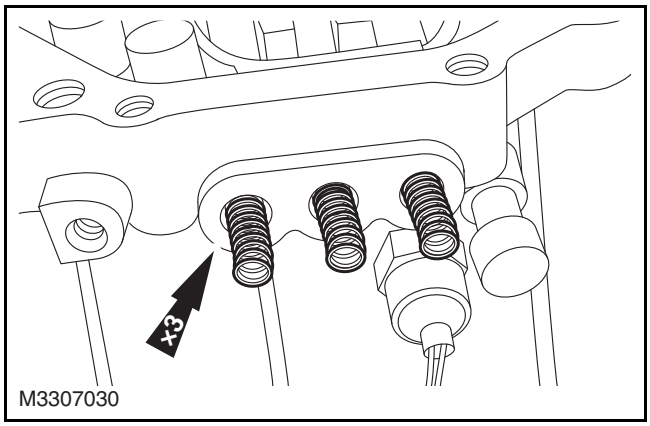



**8.** Install the self-locking steel ball, self-locking spring and self-locking bolt.

1 Install 3 self-locking steel balls.

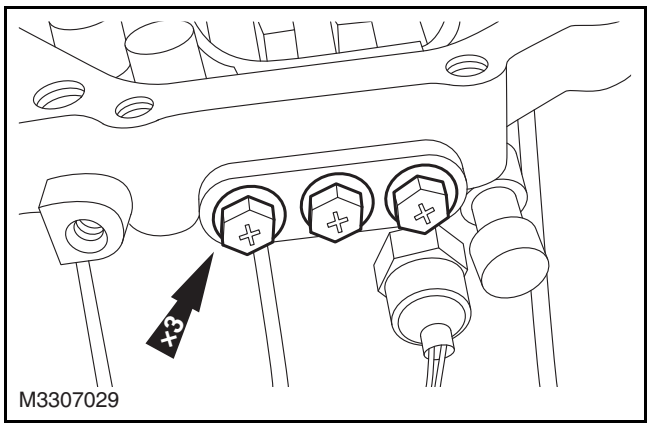



2 Install 3 self-locking springs.




3 Apply adhesive to 3 self-locking bolts, and then tighten them.

Torque: 10 ~ 16 Nm



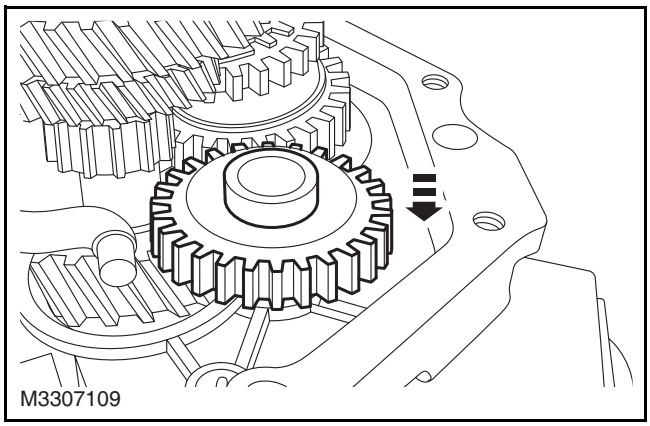
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**9.** Install the reverse gear shaft set.

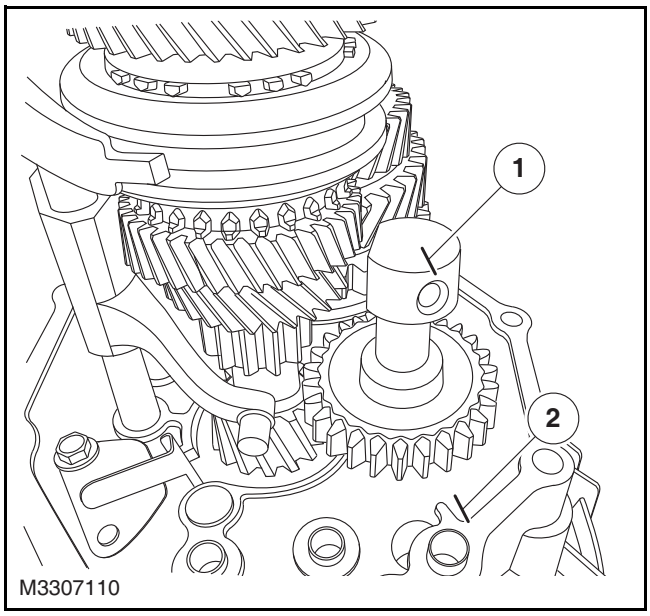
1 Install the reverse idler gear.

**CAUTION: While installing the reverse gear shift fork, the reverse gear shift fork must be stuck to the slot of reverse idler gear sleeve.**


M3307109

2 Install the reverse gear shaft.

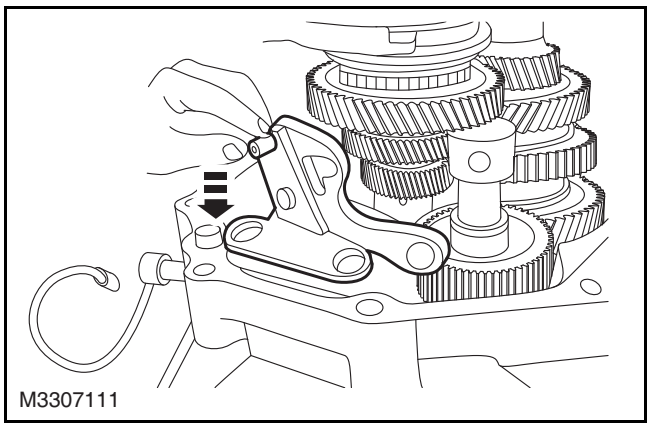
**CAUTION: While installing the reverse gear shaft set, mark (1) on the reverse gear shaft is in line with mark (2) on the front case for easy installation of reverse gear shaft bolts.**



M3307110

**10.** Install the reverse gear shift fork, and tighten it to the specified torque.

1 Install the reverse gear shift fork.

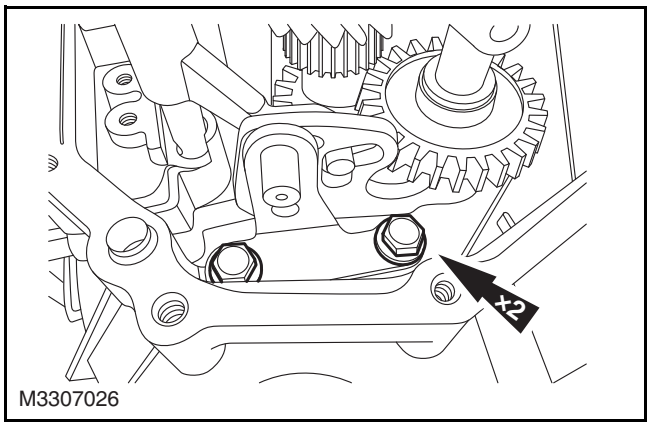

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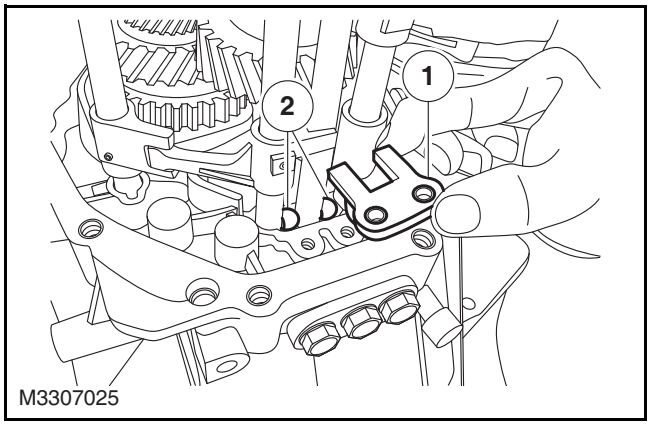
2 Apply adhesive to 2 reverse gear shift fork retaining bolts, and then tighten them.

Torque: 18 ~ 28 Nm



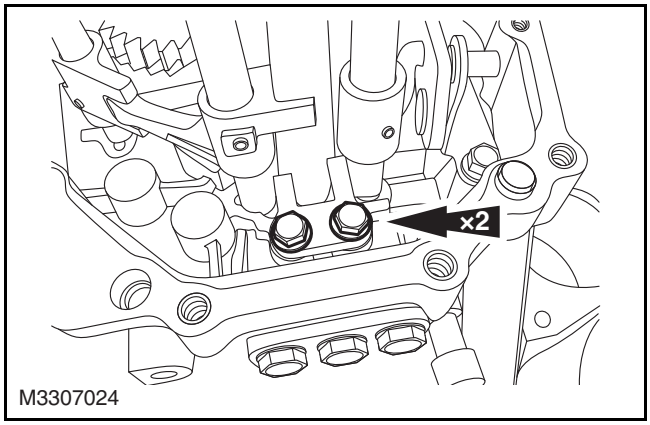

**11.** Install the interlock steel ball and interlock gasket.

1 Install the interlock steel balls (2) and interlock gasket (1).

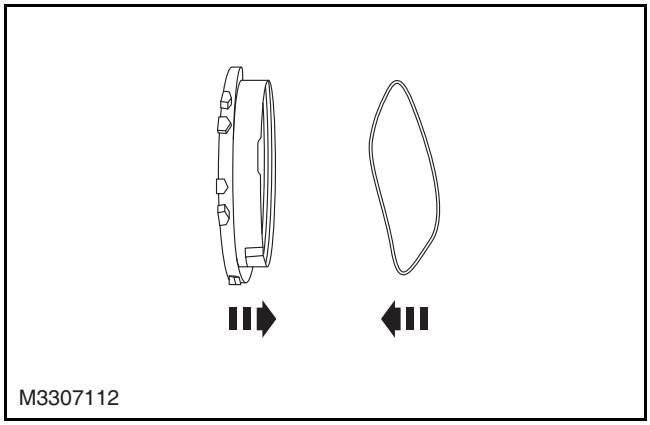



2 Install 2 interlock gasket retaining bolts.

Torque: 18 ~ 28 Nm




**12.** Engage the high-speed synchronizer wave spring and high-speed synchronizer gear ring.

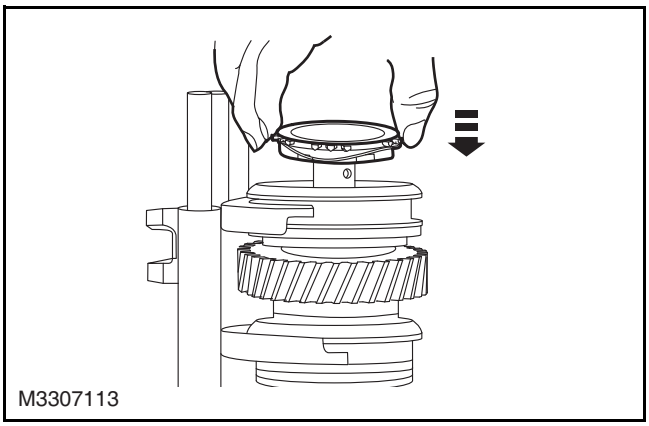


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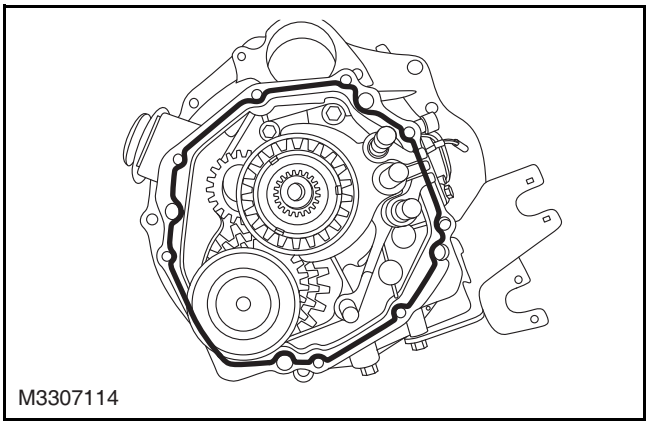
**13.** Put the high-speed synchronizer gear ring onto the input shaft high-speed synchronizer.

**CAUTION: Synchronizer gear ring slider slot is aligned with synchronizer slider while installation.**


M3307113

**14.** Apply sealant to case contact surface.

**CAUTION: Remove the remaining sealant on the case contact surface with scraper before applying. Be sure to apply evenly in a continuous bead with 2 ~ 3 mm in diameter. After applying, fit the cases within specified time. Remove and reapply if exceeding the specified time.**

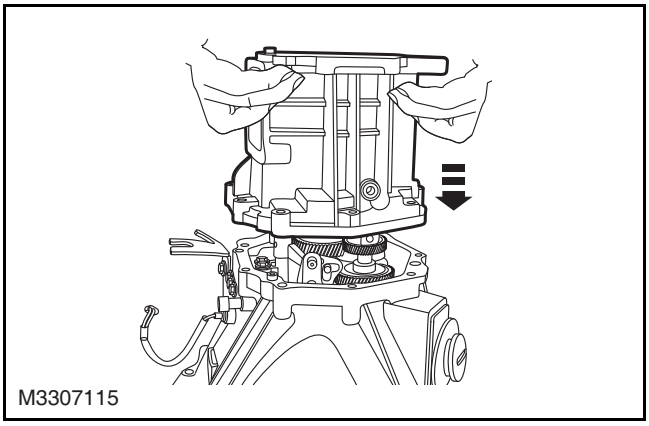

M3307114

**15.** Tighten the rear case to the specified torque after installation.

Torque: 18 ~ 28 Nm

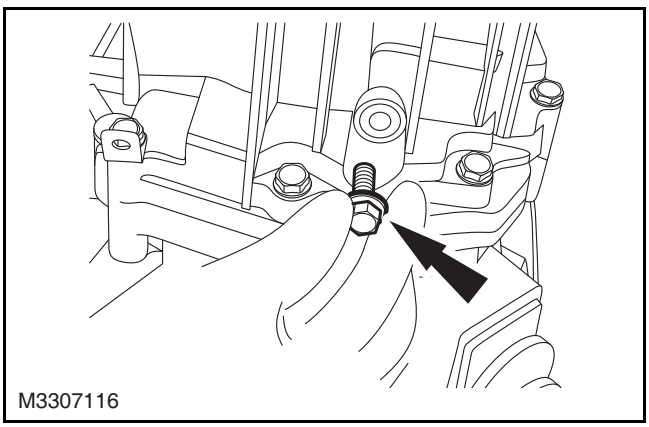
**CAUTION: To ensure installing in place, knock extension case knock pin lightly with rubber hammer and do not tap the case contact surface while installing rear case.**

**CAUTION: Case bolts should be tightened diagonally.**


M3307115

**16.** Apply adhesive to the reverse gear shaft bolt, and then tighten it.

Torque: 18 ~ 28 Nm

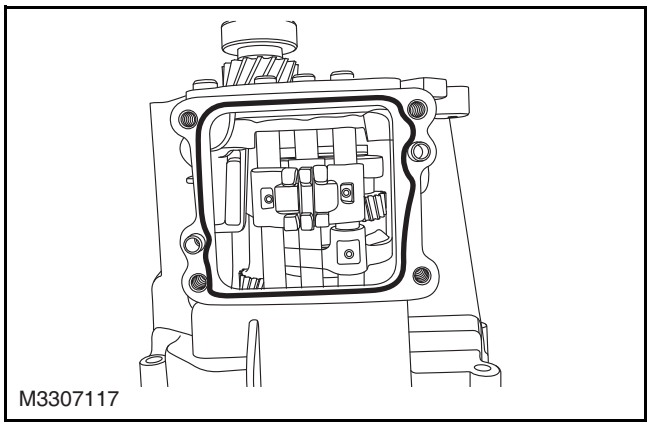

M3307116

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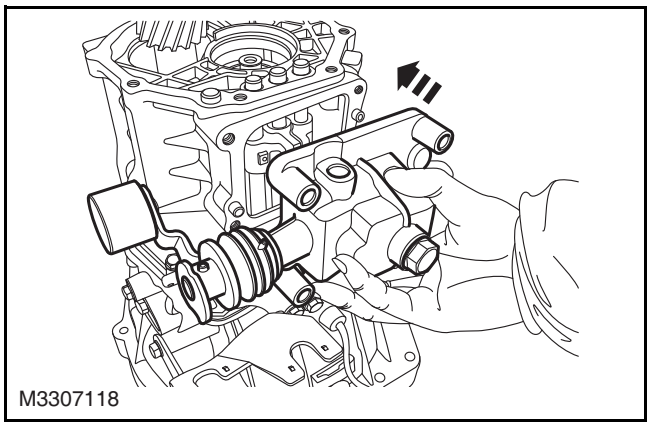
**17.** Apply sealant to the junction surface between transmission gearshift mechanism and rear case.

**CAUTION: Remove the remaining sealant on the junction surface with scraper before applying. Be sure to apply evenly in a continuous bead with 2 ~ 3 mm in diameter. After applying, fit the cases within specified time. Remove and reapply if exceeding the specified time.**

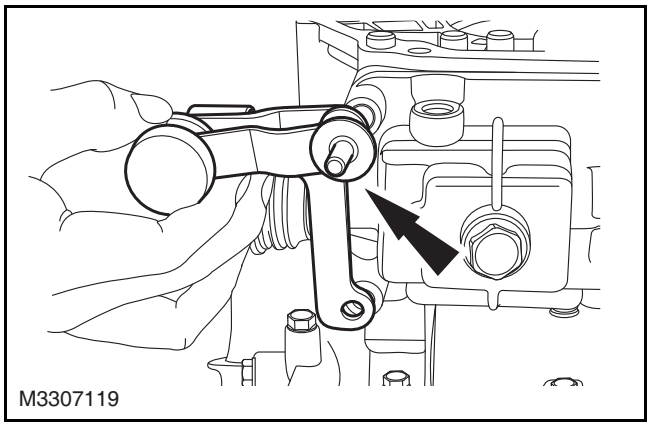

M3307117

**18.** Install the transmission gearshift mechanism.

1 Install the gearshift case.

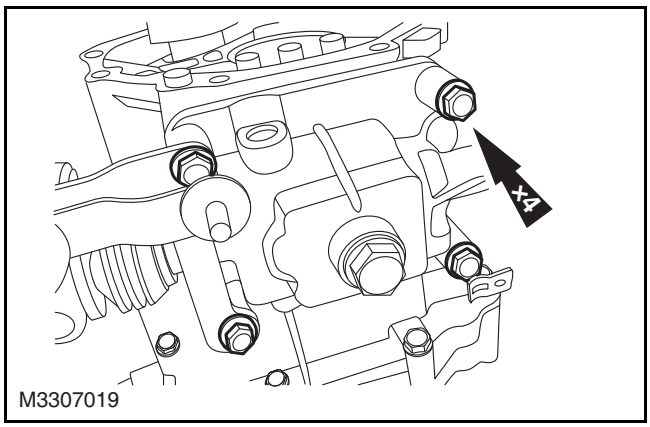

M3307118

2 Install the gear select set.


M3307119

3 Install 4 retaining bolts to the transmission gearshift mechanism.

Torque: 18 ~ 28 Nm



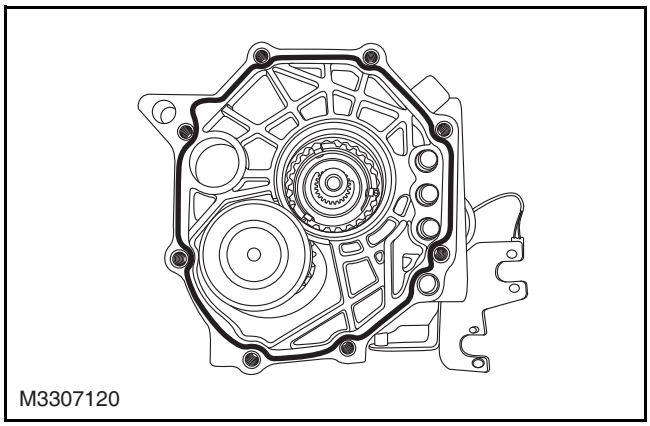
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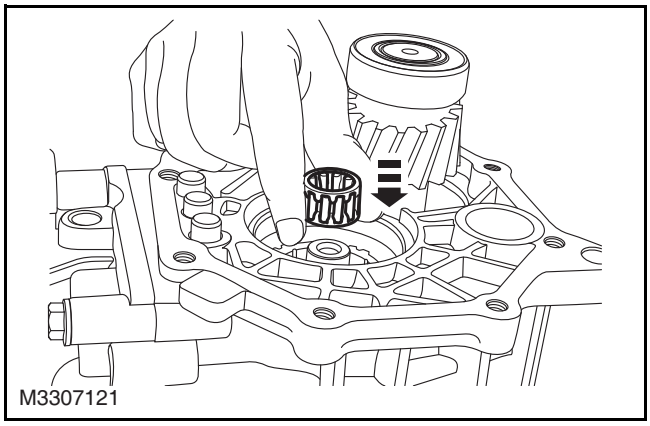
**19.** Apply sealant to case contact surface.

**CAUTION: Remove the remaining sealant on the case contact surface with scraper before applying. Be sure to apply evenly in a continuous bead with 2 ~ 3 mm in diameter. After applying, fit the cases within specified time. Remove and reapply if exceeding the specified time.**



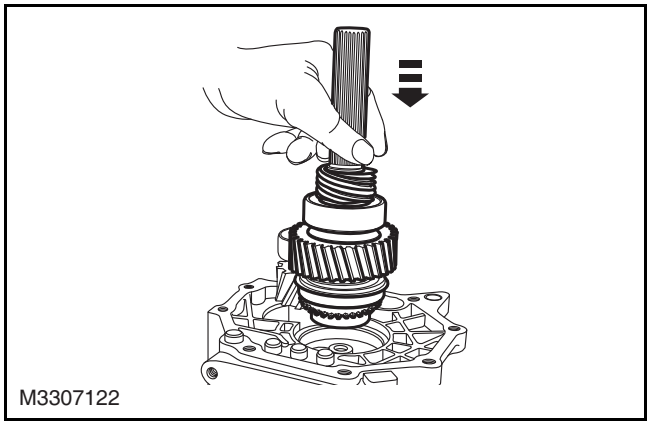
M3307120

**20.** Put the input shaft needle roller bearing onto the input shaft.



M3307121

**21.** Put the output shaft onto the high-speed synchronizer gear ring.



M3307122

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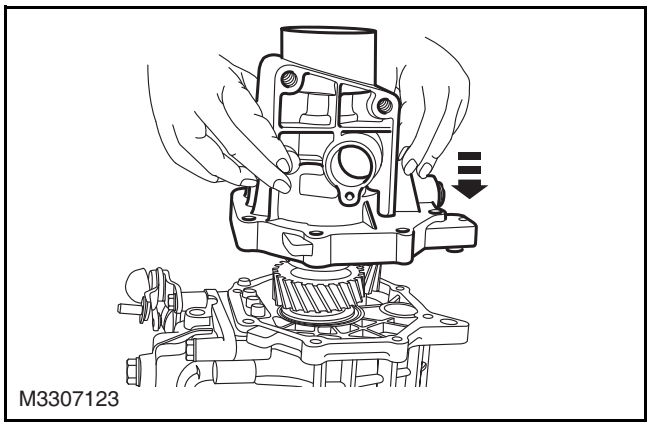
**22.** Install the extension case and tighten to the specified torque.

1 Install the extension case.

2 Tighten the extension case bolts to the specified torque.

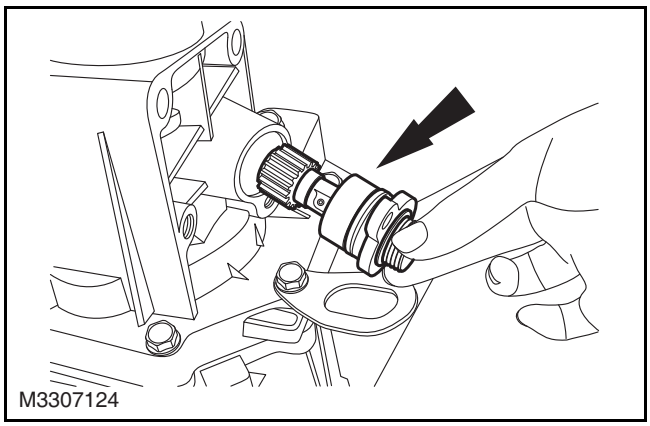
Torque: 18 ~ 28 Nm

**CAUTION: Case bolts should comply with diagonal tightening methods. If there is no trace around the surface of extension case bolt hole, hanger bolt can be installed here.**


M3307123

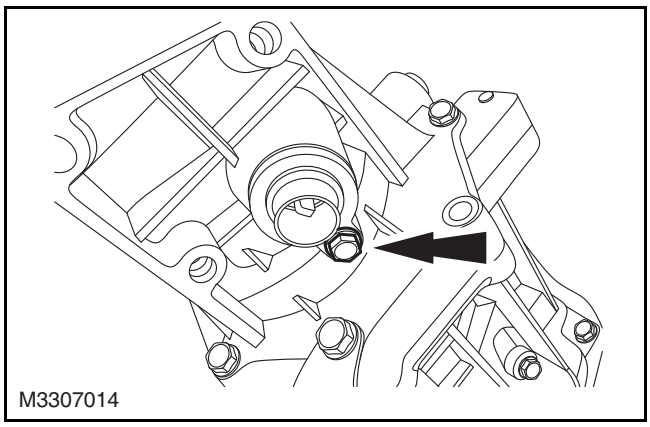
**23.** Install the worm set and tighten to the specified torque.

1 Install the worm set.


M3307124

2 Install the worm set retaining bolt.

Torque: 8 ~ 12 Nm

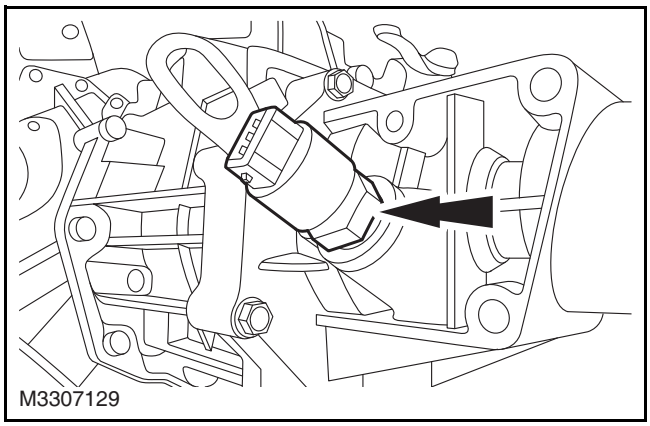

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**24.** Install the vehicle speed sensor.

Torque: 10 Nm



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# GROUP 4

# Electrical

SECTION PAGE

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# 4.1 Heating, Ventilation and Air Conditioning

## 2014 MD/MS201

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## Specifications

| Item | Specifications | Capacity |
|---|---|---|
| Refrigerant oil | PAG56 | 110 ml |
| Refrigerant | HFC-134a | 500 ± 20 g (Single evaporator) |

# General Specifications

| Compressor | Specifications |
|---|---|
| Model | WXH-066 |
| Type | Scroll |
| Displacement | 66 cc/r |
| Electromagnetic clutch power | Less than 48 W (20°C) |
| Voltage | 12 V |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Retaining bolt between No.1 drain pipe and compressor | 14 ~ 17 | 10 ~ 13 | - |
| Retaining bolt between No.1 suction pipe and compressor | 14 ~ 17 | 10 ~ 13 | - |
| Compressor adjusting bolt | 24 ~ 26 | 18 ~ 19 | - |
| Compressor retaining bolt | 25 ~ 30 | 18 ~ 22 | - |
| Condenser retaining bolt | 8 ~ 10 | - | 71 ~ 89 |
| Condenser inlet pipe retaining bolt | 8 ~ 10 | - | 71 ~ 89 |
| Condenser outlet pipe retaining bolt | 8 ~ 10 | - | 71 ~ 89 |
| Retaining bolt between front evaporator inlet/outlet pipe and expansion valve | 8 ~ 10 | - | 71 ~ 89 |

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## Description and Operation

# System Overview

The A/C system is designed to provide passengers with excellent ride comfort regardless of weather. The system can control the ventilation of passenger compartment by actuating the following functions:

- Cooling
- Dehumidification
- Heating
- Circulation

The fresh air goes from the air inlet housing system, then pass through the HVAC assembly, air channels to each vent and finally into the interior space. The A/C system consists of the following main components:

- Refrigeration system
- Heating system
- Air distribution system
- Air conditioning control system

The A/C system has the following characteristics:

- Fresh and dry air to make people feel comfortable
- Power ventilation

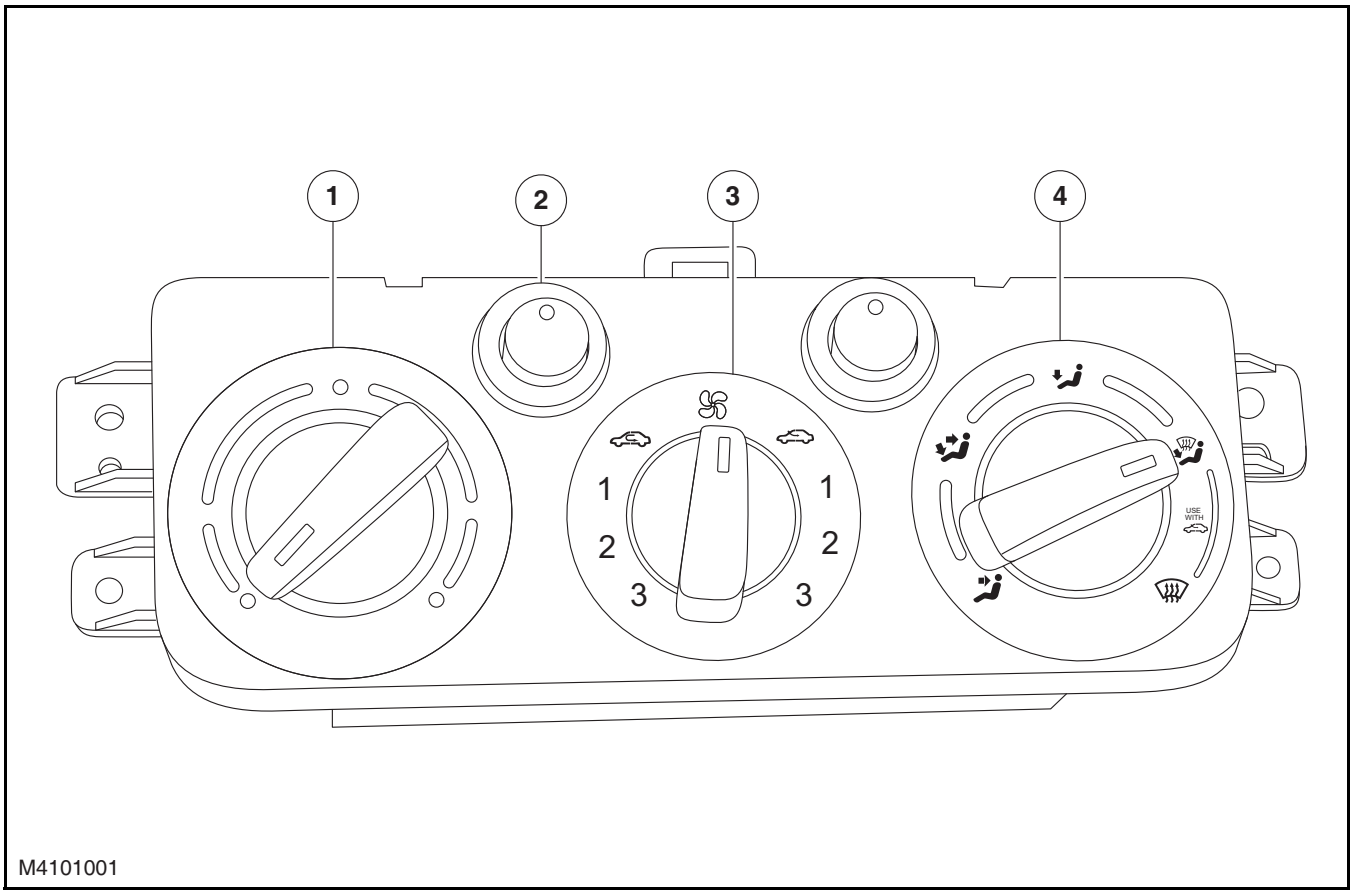
The driver can select any of the following functions on the control panel:

- Room temperature
- Fan speed
- Air inlet and outlet position

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## A/C Control Panel Function Description




M4101001

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Temperature control knob | 3 | Air volume and inside/outside circulation control knob |
| 2 | A/C switch | 4 | Mode selection knob |

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### Temperature Setting

The temperature control knob is used to set the room temperature and control the temperature of air at the vent. Turn to the blue area for cold air or to the red for warm air.

### Air Volume and Inside/Outside Circulation Mode Setting

The air volume and inside/outside circulation mode setting are controlled by the same knob that can be turned left and right to select the inside or outside air circulation and blower speed level.

### Vent Mode

The expected air flow can be reached with ventilation mode selection switch, and the temperature distribution range will be affected by the interior space.

5 vent modes can be selected by the user:

1. Face
2. Face and footwell
3. Footwell
4. Footwell and defroster
5. Defroster

### ON-OFF Mode

The system ON/OFF control is realized by A/C switch. Press the switch to send request signal of A/C system ON or OFF.

When the air volume control knob is not at “OFF”, press the A/C switch and its operation indicator will come on (system ON) or off (system OFF).

**A/C switch signal logic inspection:**

| A/C Switch | Blower Switch | Evaporator Temperature | A/C Signal |
|---|---|---|---|
| OFF | - | - | OFF |
| ON | ON | Above 4°C | ON |
| ON | OFF | - | OFF |
| ON | ON | Below 2°C | OFF |

## Components Description

### Compressor

The A/C compressor is driven by compressor clutch pulley, which is driven through belt by engine crankshaft. Before electromagnetic clutch coil power on, the compressor pulley rotates freely and does not drive compressor shaft; after the coil power on, clutch plate and clutch hub will be pushed to the pulley, then clutch plate and pulley are locked as one by magnetic force to drive the compressor shaft.

The compressor will be turned off under the following conditions:

1. Throttle fully open
2. Low idle speed
3. Low ambient temperature
4. Coolant temperature too high
5. Refrigerant pressure higher than 3.2 ± 0.2 MPa or lower than 0.2 ± 0.02 MPa

### Condenser, Refrigerant Drier

The high-pressure and high-temperature refrigerant vapor from the A/C compressor goes into the condenser. The condenser is made of aluminum pipes and cooling fins which allow the high-pressure and high-temperature refrigerant vapor to carry on quick heat transmission. The high-pressure and high-temperature refrigerant vapor is condensed into the high-pressure and middle-temperature fluid by the cooling fins radiating. The refrigerant drier is located at the right side of condenser. The design of its internal construction will ensure that the high-pressure and high-temperature gas-liquid mixture refrigerant enters the drier and only the high-pressure and middle-temperature liquid refrigerant comes out from the drier. There is desiccant in the drier to absorb the water content in refrigeration system, and the desiccant cannot be used repeatedly.

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## HVAC Assembly

The HVAC assembly is located inside the instrument panel and consists of blower motor, heater core, evaporator, expansion valve as well as all kinds of air deflection dampers and vent ducts.

## Refrigerant HFC-134a and Lubricant

The refrigerant in A/C has the following functions:

- Absorbing heat
- Carrying heat
- Releasing heat

The refrigerant HFC-134a is used in the vehicle. Make sure to follow the steps in instructions when carrying out the following repairs:

- Refrigerant recovery and regeneration
- Add the refrigerant oil
- Vacuumize the refrigeration system
- Refill the refrigeration system

## A/C Pressure Switch

The A/C pressure switch is a tristate pressure switch to transmit the A/C pressure signal.

**Pressure switch value:**

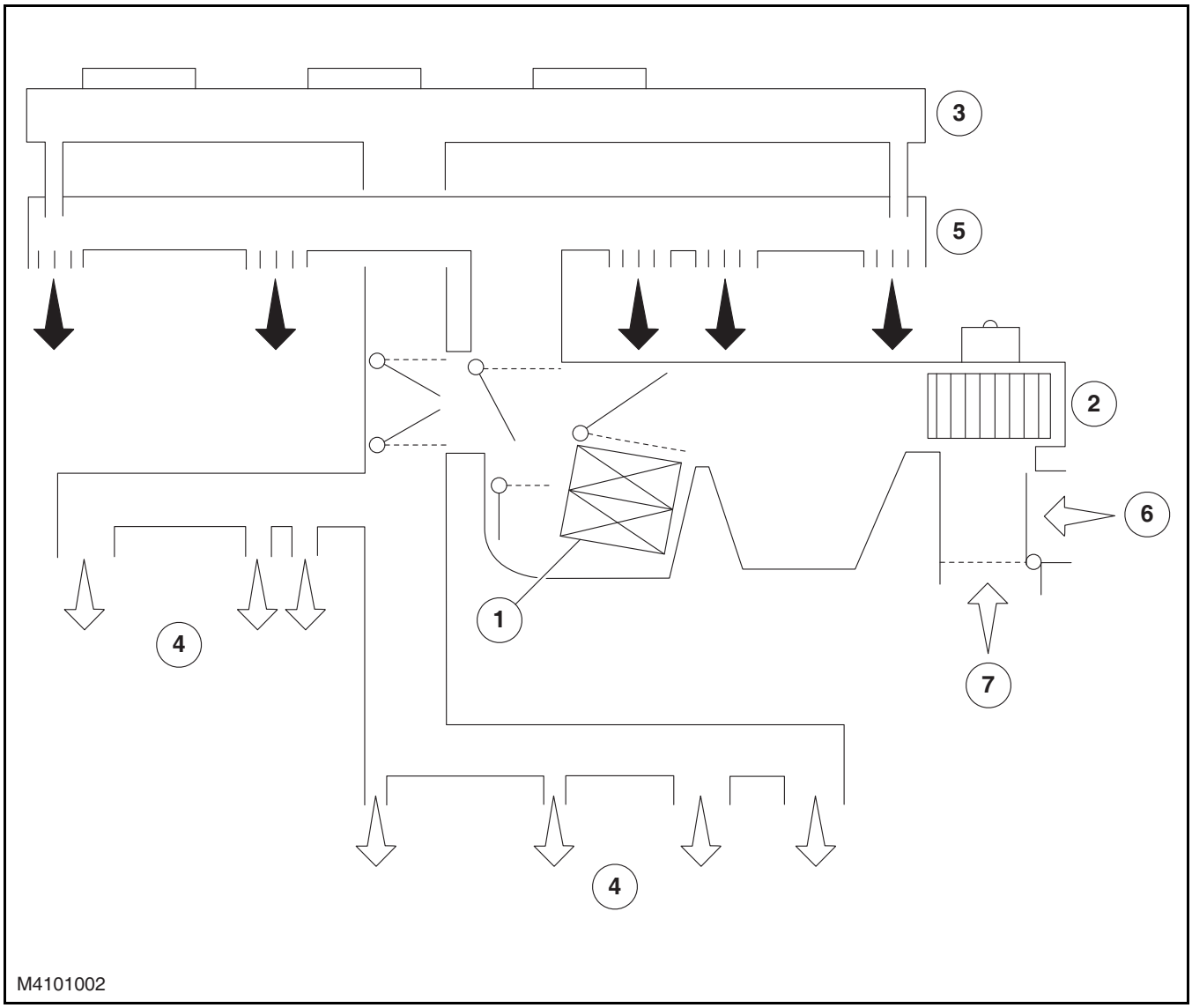
| Item | Pressure Value (MPa) | Signal Value |
|---|---|---|
| High pressure switch | 3.0 ~ 3.4 | OFF |
| Medium pressure switch | 1.48 ~ 1.68 | ON |
| Low pressure switch | 0.21 ~ 0.0.25 | OFF |

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# System Operation

## Ventilation

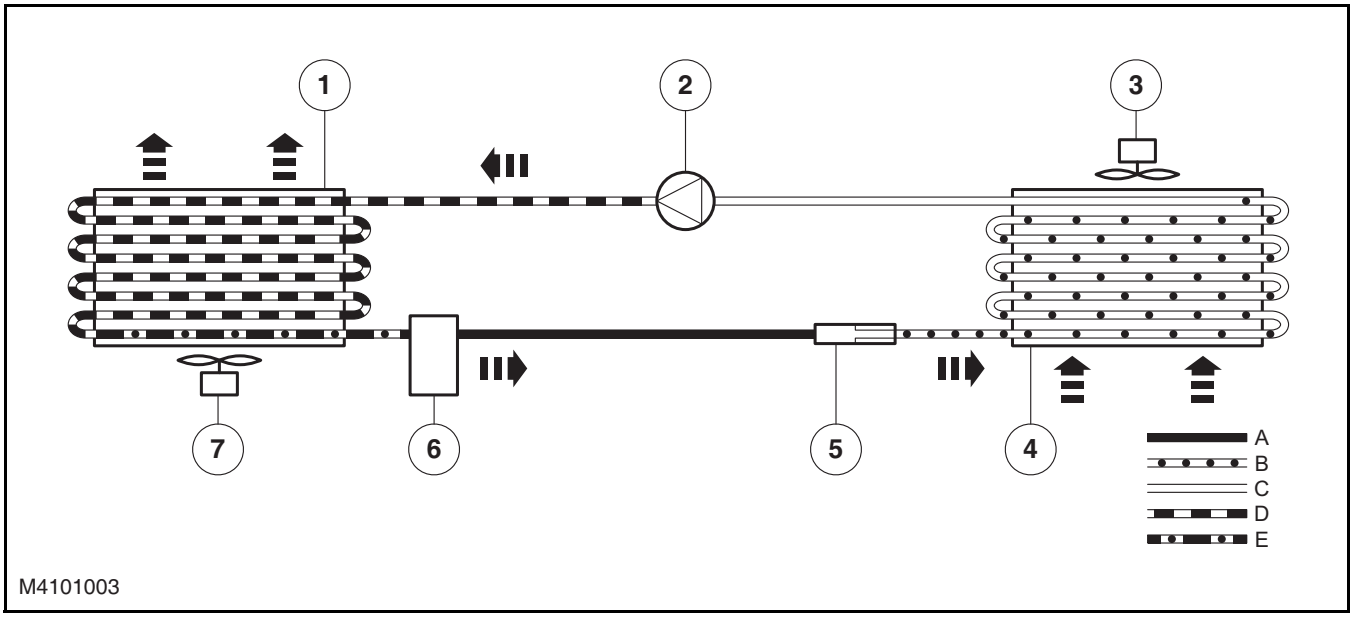



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Heater core | 5 | Instrument panel outlet |
| 2 | Blower | 6 | Inside air |
| 3 | Defroster | 7 | Outside air |
| 4 | Floor outlet | | |

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## Refrigeration System Operation




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Overhead evaporator | 8 | Compressor |
| 2 | F type expansion valve | 9 | Overhead blower motor |
| 3 | H type expansion valve | A | Liquid with high pressure, middle temperature |
| 4 | Front evaporator | B | Liquid with low pressure, low temperature |
| 5 | Front blower motor | C | Gas with low pressure, low temperature |
| 6 | Condenser | D | Gas with high pressure, high temperature |
| 7 | Condenser fan | E | Gas-liquid mixture with high pressure, high temperature |

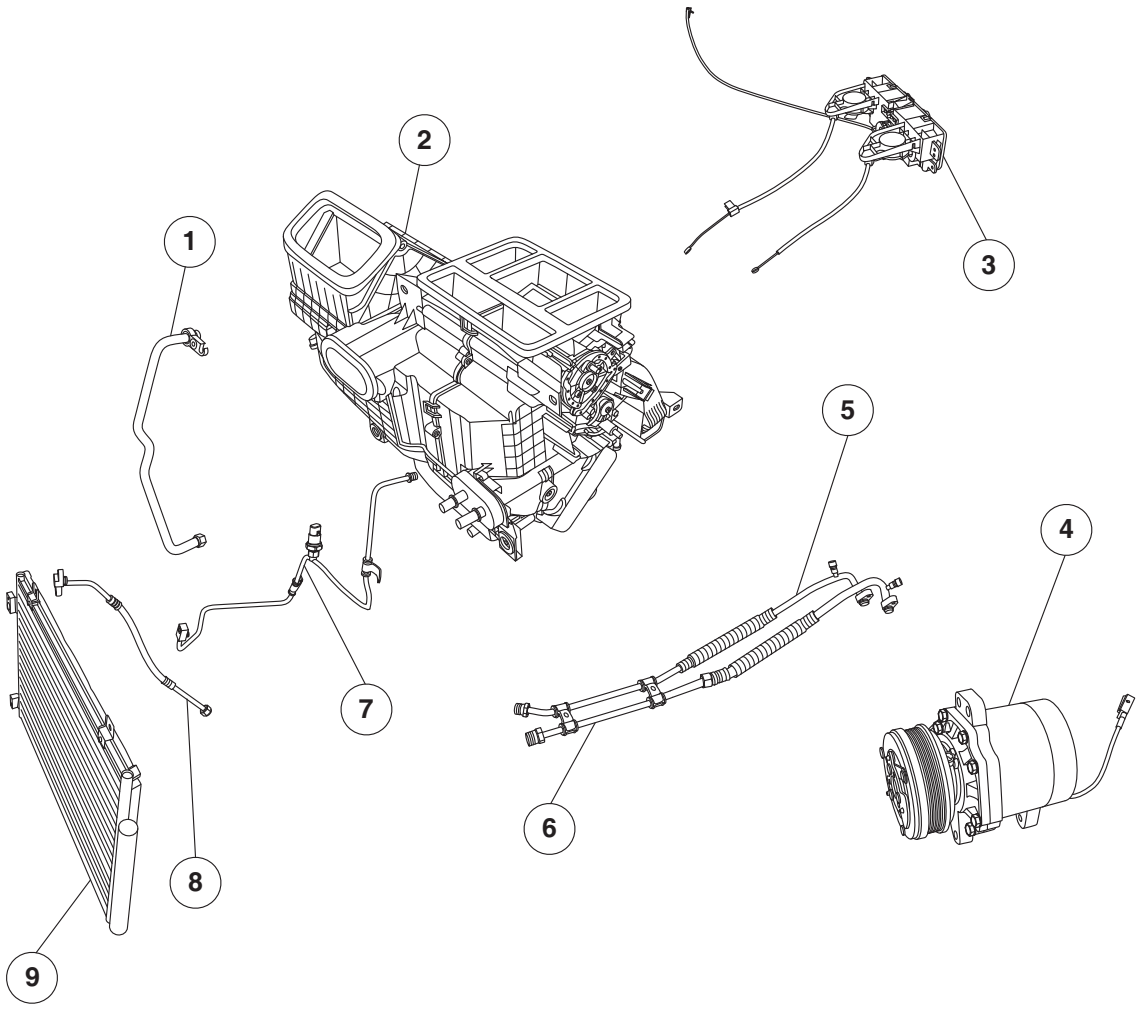
High pressure side: The refrigerant is compressed into high-temperature and high-pressure gas from low-pressure gas, and then flowed into the condenser with lubricant. As the high-temperature and high-pressure gas flows through the condenser, its heat is released to the relatively cool ambient air that goes though condenser pipes, and the vapor is condensed into liquid. The high-temperature and high-pressure liquid continue to be condensed when it goes through the drier and then flows into the expansion valve in which a small adjustable throttle valve restricts the gas from the compressor.

Low pressure side: The pressure and temperature of liquid refrigerant with high temperature and high pressure decreases quickly after it goes through the expansion valve, and the refrigerant turns into the low-temperature and low-pressure gas-liquid mixture. The blower makes the hot air inside the vehicle through the evaporator for heat exchange and the refrigerant completely turns into gas. Therefore the air from vents is cold. Finally, the low-temperature and low-pressure gas is absorbed by the compressor, and A/C circulation starts again.

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# Components Location View




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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Front evaporator outlet pipe | 6 | No.1 suction pipe |
| 2 | HVAC assembly | 7 | Front evaporator inlet pipe |
| 3 | A/C controller assembly | 8 | Condenser inlet pipe |
| 4 | Compressor | 9 | Condenser assembly |
| 5 | No.1 drain pipe | | |

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## General Inspection

### General Equipment

| |
|---|
| Digital multimeter |
| Refrigerant recovery filling machine |

**WARNING: Disconnect the negative battery cable before repairing the electrical system. Do not weld or vapour clean on or near a vehicle with A/C pipes or components.**

**CAUTION: Do not clean the air conditioning system with water, caustic solvent or inflammable or explosive solvent. It is recommended to use R - 141b, heptane and the like.**

The operational efficiency and service life of air conditioning (A/C) system depend on the chemical stability of refrigeration system. When the refrigeration system is contaminated by foreign matters (such as dust, air or moisture), the stability of refrigerant and compressor oil will be changed. Besides, the relationship between pressure and temperature is also affected, resulting in work efficiency reduction. It can cause interior corrosion and abnormal wear of the components as well. Inspect as follows:

1. Clean the oil on and around the joint before opening it in order to reduce the possibility of oil entering the system.
2. Seal the both ends of joint with caps, plugs or adhesive tapes immediately after disconnecting the joint to prevent the oil, foreign matters and moisture from entering the system.
3. Keep all the tools including manifold pressure gauge components and all the replacement components clean and dry.
4. Add refrigerant oil with clean and dry conveyer device and container to protect the refrigerant oil from moisture.
5. Shorten the exposure time of A/C system in the air as far as possible in operation.
6. Drain and refill the A/C system again after its interior is exposed to the air. All the service components are dried and sealed before leaving factory. The sealed components should not be unsealed until installation soon starts. All the components should be at the room temperature before unsealed to prevent water in the air from condensing on the components and entering the system. Seal the components again as fast as possible.

**CAUTION: A/C refrigerant - forbidden operation:**
**a. Do not store the refrigerant in sunniness or at places with heat source; b. Do not let out the refrigerant into the air in any case; c. Do not use different refrigerants at the same time, such as R12 (Freon).**

**CAUTION: Refrigerant oil - precautions: Use the refrigerant oil with the designated type and grade of the compressor factory. Never use refrigerant oil of different types and grades together, or the compressor will be damaged. The refrigerant oil is extremely absorbent of water, so shorten the exposure time of the oil in the air as much as possible.**

## Refrigeration System Test

Inspect the following items when the A/C system may have problems:

1. Inspect the outside surface of radiator and condenser cores to ensure that the air flow is not blocked by the dust, leaves and other foreign matters. Inspect the joint surface between condenser and radiator, and all the outside surfaces.
2. Inspect the condenser core, hose and connecting pipes for blockage or twist.
3. Inspect the operation of blower fan.
4. Inspect all the air pipes for leakage or blockage. A small air flow may mean that the evaporator core is blocked.
5. Inspect the compressor clutch for slippage.
6. Inspect the tension of accessory drive belt.

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## Insufficient A/C Cooling Quick Inspection

Perform the following "hand feel" procedure to see if the adding quantity of A/C system refrigerant is appropriate. The air temperature must be higher than 21°C in all the modes.

1. Warm up the engine. Keep the engine idling.
2. Open the engine hood and all the doors.
3. Switch on the A/C.
4. Set the temperature control knob at coldest.
5. Set the blower speed at highest.
6. "Hand feel" the temperature at the outlet pipe of evaporator. It should be cool.
7. Inspect other faults.
8. Inspect if there is a leakage in the system. If so, drain the system and do necessary repair. Drain the system and refill it with refrigerant again after repair.
9. If there is no leakage.

**Refer to: Symptoms Chart (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and testing).**

## Refrigeration System Pressure Inspection

1. Under normal conditions at room temperature.
2. Turn off the ignition switch.
3. Install the A/C detecting and repairing device, and connect the high/low pressure pipes of device to the high/low pressure pipes of A/C system of the tested vehicle.
4. Measure the balance pressure reading of high-pressure and low-pressure pipes of A/C system in the vehicle.

   **Standard Balance Pressure: 0.7 MPa**
5. Start the engine and keep it running for 5 minutes.
6. Press the A/C switch and keep A/C system working for 2 minutes.
7. Keep the engine speed at 2000 rpm, and measure the pressure reading of high-pressure and low-pressure pipes of A/C system.

**The pressure standard values are as follows:**

| Item | Standard 1 | Standard 2 | Standard 3 |
|---|---|---|---|
| Ambient temp | Higher than 16°C | Higher than 24°C | Higher than 33°C |
| Pressure | 345 kPa | 483 kPa | 690 kPa |

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# A/C System Performance Test

Test Instructions

This test is to measure the work efficiency of A/C system under the following conditions:

- Current ambient temperature
- Current relative humidity
- A/C system high pressure
- A/C system low pressure
- Air temperature at instrument panel vent

Test conditions: doors and engine hood open, A/C ON, inside circulation mode, the coldest state and highest blower speed, no sunlight, wind speed lower than 8 km/h.

**CAUTION: The ambient temperature should be at least 16°C. Do not let extra air flow through the front of vehicle during the test.**

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## HFC-134a Pressure and Temperature Relationship List

| Temperature °C (°F) | Pressure Psi | Temperature °C (°F) | Pressure Psi |
|---|---|---|---|
| -8 (17.6) | 113.1 (16.4) | 9 (48.2) | 296.2 (43.0) |
| -7 (19.4) | 121.5 (17.6) | 10 (50.0) | 309.6 (44.9) |
| -6 (21.2) | 130.2 (18.9) | 15 (59.0) | 383.7 (55.7) |
| -5 (23.0) | 139.1 (20.2) | 20 (68.0) | 467.7 (67.8) |
| -4 (24.8) | 148.4 (21.5) | 25 (77.0) | 567.5 (82.3) |
| -3 (26.6) | 157.9 (22.9) | 30 (86.0) | 667.8 (96.9) |
| -2 (28.4) | 167.6 (24.3) | 35 (95.0) | 785.6 (113.9) |
| -1 (30.2) | 177.8 (25.8) | 40 (104.0) | 916.4 (133.0) |
| 0 (32.0) | 188.2 (27.3) | 45 (113.0) | 1062.2 (154.0) |
| 1 (33.8) | 198.8 (28.8) | 50 (122.0) | 1222.1 (177.2) |
| 2 (35.6) | 209.9 (30.4) | 55 (131.0) | 1398.2 (202.8) |
| 3 (37.4) | 221.2 (32.1) | 60 (140.0) | 1589.6 (230.5) |
| 4 (39.2) | 232.9 (33.8) | 65 (149.0) | 1799.0 (260.9) |
| 5 (41.0) | 245.0 (35.5) | 70 (158.0) | 2026.6 (293.9) |
| 6 (42.8) | 257.4 (37.3) | 75 (167.0) | 2272.2 (329.5) |
| 7 (44.8) | 269.8 (39.1) | 80 (176.0) | 2544.0 (369.0) |
| 8 (46.4) | 282.9 (41.0) | - | - |

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## Refrigeration System Leakage Test

If you doubt that the system has a refrigerant leakage, test it. You also should perform a leakage test when your repair involves the pipelines or joints. The leakage usually appears at the refrigerant joints or interfaces. The faults leading to a leakage are usually as follows:

- Torque is not appropriate.
- Seal ring is damaged.
- Seal ring has dust or fiber on it.

## General Test Method

1. Inspect along the entire pipelines of refrigeration system using the electronic leak detector.

**CAUTION: The electronic leak detector is sensitive to front windshield washing liquid, solvent, cleaning agent and some vehicle adhesives. The surface must be cleaned to ensure correct reading. Make sure that all surfaces are dry to avoid damage to the leak detector.**

2. Move at a speed of 25 ~ 50 mm/s and detect each joint in a full circle.
3. The detector tip is less than 6 mm away from the surface.
4. Do not block the gas inlet.
5. If a leakage is detected, the alarm changes to continuous alarm instead of 1 ~ 2 times per second. Adjust the balance control to keep the alarm at 1 ~ 2 times per second.
6. Inspect all the following items even if one leakage is detected:
   - Inlet and outlet of evaporator
   - Inlet and outlet of condenser
   - Brazing and electric welding parts
   - Damaged components
   - Hose joint
   - Front and rear covers of compressor
   - All joints and interfaces
   - Access ports/valves test

The access ports are protected by seal caps. Make sure that all caps are not lost or loose. Correct cap must be used for every port.

## Evaporator Core Test

A leakage of evaporator core is hard to detect. Test the evaporator core according to the following procedure:

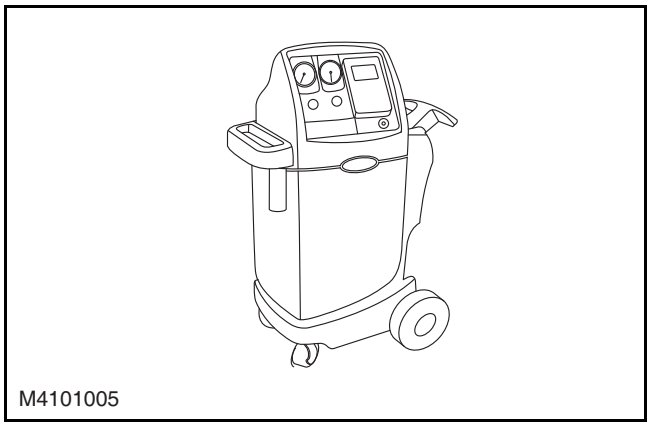
1. Set the blower speed at the highest and keep it working for 15 minutes.
2. Turn off the blower.
3. Wait for 10 minutes.
4. Remove the blower motor speed control module.
5. Insert the leak detector probe as near the evaporator core as possible. The leak detector will give continuous alarm when it detects a leakage.

## Compressor Shaft Seal Test

1. Use compressed air from workshop to blow the rear part of compressor and the front part of compressor clutch/ pulley for at least 15 s.
2. Wait for 1 ~ 2 minutes.
3. Detect the front part of pulley. The leak detector will give continuous alarm when it detects a leakage.

## A/C Refrigerant Recycling and Filling

The refrigerant recovery filling machine can complete the discharging, draining and refilling of A/C system at one connection. Filter the refrigerant during the recycling and draining to ensure the refrigerant filled in the A/C system clean and dry.



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**WARNING: Do refrigerant-relative work in drafty environment. Avoid inhaling and sucking in the A/C refrigerant 134a (Tetrafluoroethane) and refrigerant oil vapor or smog. The eyes, nose and pharyngeal will be irritated if getting in touch with them. Operate in the area with good ventilation. Use repair device (HFC-134a regeneration device) authenticated to meet the requirement of the SAE (Society of Automotive Engineers) to remove the HFC-134a in A/C system. The work area must be ventilated before going on with the repair if the system has an accidental drain. Further information about health and safety can be acquired from the refrigerant and refrigerant oil manufactures.**

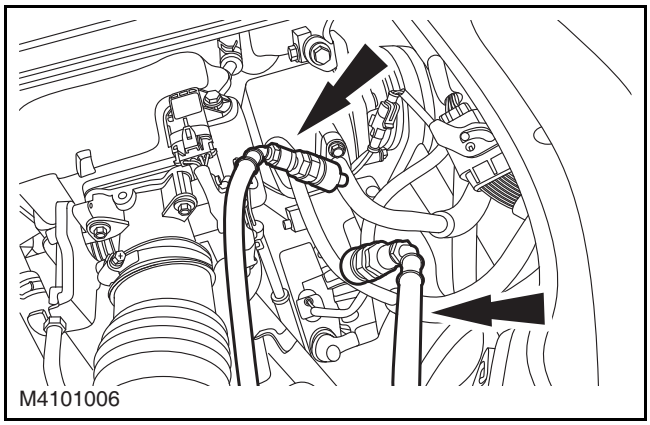
## Refrigerant Recycling

1. Connect high pressure side hose with quick joint to the high-pressure side joint of vehicle A/C system.
2. Open high-pressure side joint valve.
3. Connect low-pressure side hose with quick joint to the low-pressure side joint of vehicle A/C system.
4. Open low-pressure side joint valve.
5. Inspect manometer on the high-pressure side and low-pressure side in the control panel of refrigerant recovery filling machine to ensure there is pressure in the system. If there is no pressure, it indicates there is no recyclable refrigerant in the system.
6. Open the valves on the high-pressure and low-pressure sides.
7. Connect the refrigerant recovery filling machine to a suitable power outlet.
8. Switch on the main power switch.
9. Start the recovery process. Please refer to the operation manual from manufacturer, try to have a detailed knowledge of how to use the refrigerant recovery filling machine.
10. Inspect the manometer in the low-pressure side of control panel. If the pressure in the A/C system is 0, it means the recovery process is finished.
11. If the pressure indicated by manometer in the low-pressure side is not 0, it means that some refrigerant remains in system. Recover the refrigerant residual. Repeat this process until the system pressure maintains 0 for 2 minutes.

## Filling

**CAUTION: Verify that there is no leakage in the A/C system before filling. Drain a little refrigerant oil in the A/C system when recycling the refrigerant. Make sure to compensate for the lost refrigerant oil when filling the A/C system. Do not overfill it with refrigerant. Otherwise the compressor pressure will be excessively high, causing the noise of compressor and the fault of A/C system. Vacuumize the system before refilling it with refrigerant.**

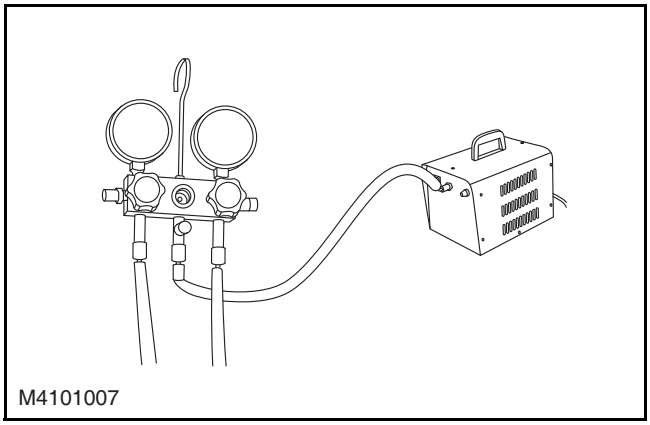
1. Connect the valve on the low-pressure side of compressor.
2. Connect the valve on the high-pressure side of compressor.


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3. Connect the manometer filling pipe to the vacuum pump and vacuumize with the vacuum pump.

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**4.** Close the high-pressure and low-pressure manual valves of manometer after the vacuum pump works for 10 minutes.

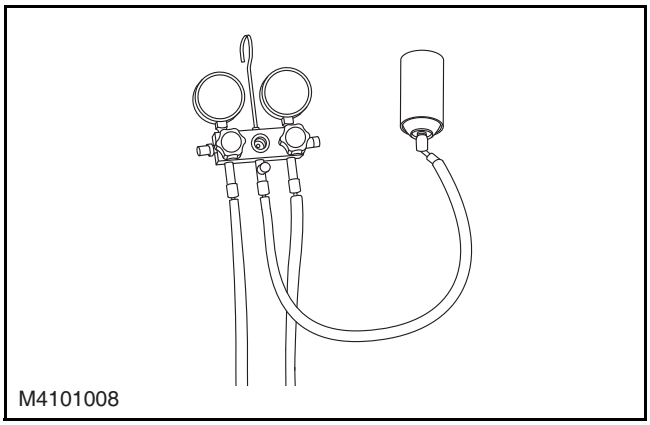
**5.** Wait for 10 minutes to inspect whether there is a change in the vacuum degree of A/C system. If there is a change, the A/C system may has leakage faults, and should be inspected and repaired. If there is no change, the refrigerant oil should be filled.

**6.** Perform the vacuum pumping again for 20 minutes after filling an appropriate amount of refrigerant oil, and close the high-pressure and low-pressure manual valves of manometer.

**7.** Fill the refrigerant.

1 Close the high-pressure and low-pressure valves on the control panel of refrigerant recovery filling machine.

2 Connect the manometer filling pipe to the inverted refrigerant reservoir.


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3 Open the refrigerant reservoir valve and loosen the manometer filling hose until refrigerant gas discharging for 1 ~ 2 seconds, and then tighten the filling pipe.

4 Open the low-pressure manual valve of manometer and fill the refrigerant to A/C system until there is no refrigerant flowing into the system, and then close the manual valve.

5 Start the engine and make the compressor operate.

6 Open the low-pressure manual valve of manometer and continue to fill the refrigerant to the A/C system until the manometer reading reaches the specified condition, and close the low-pressure manual valve.

7 Disconnect the valve on the low-pressure side of compressor.

8 Disconnect the valve on the high-pressure side of compressor.

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## Symptom Diagnosis and Testing

**General Equipment**

| |
|---|
| Digital multimeter |
| Refrigerant recovery filling machine |

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical or electrical damage.

**Visual Inspection Chart**

| Mechanical | Electrical |
|---|---|
| • Compressor drive belt<br>• Compressor<br>• A/C high and low pressure pipe<br>• Condenser<br>• Evaporator<br>• Air channel<br>• HVAC | • Circuit<br>• Refrigerant pressure switch<br>• Blower speed control module<br>• Electric fan<br>• Evaporator temperature sensor<br>• ECM circuit<br>• ECM |

3. Inspect the A/C system pipes which is accessible or visible, to see if there is a leak in the A/C system.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Insufficient refrigerant of A/C | • A/C system pressure does not meet the standard<br>• Poor condenser heat dissipation<br>• Accessory drive belt slippage<br>• Clutch slippage<br>• Pipes leakage<br>• Blower fault<br>• Temperature vent fault<br>• Vent blockage or leakage<br>• Compressor worn | Refer to: Diagnosis Procedure for Insufficient A/C Cooling (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing). |
| Insufficient heating of A/C | • Heater pipe<br>• Heater water tank<br>• Blower<br>• Temperature vent<br>• Vent channel blockage or leakage<br>• Heater valve<br>• Engine | Refer to: Diagnosis Procedure for Insufficient Heating of A/C (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing). |
| Blower fault | • Circuit<br>• Blower speed control module<br>• Air volume control switch<br>• Blower | Refer to: Diagnosis Procedure for Blower Fault (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing). |
| A/C compressor clutch fault | • Circuit<br>• A/C system pressure low<br>• Pipe<br>• Refrigerant pressure switch<br>• A/C switch<br>• A/C relay<br>• Compressor temperature sensor<br>• ECM fault | Refer to: Diagnosis Procedure for A/C Compressor Clutch Fault (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing ). |

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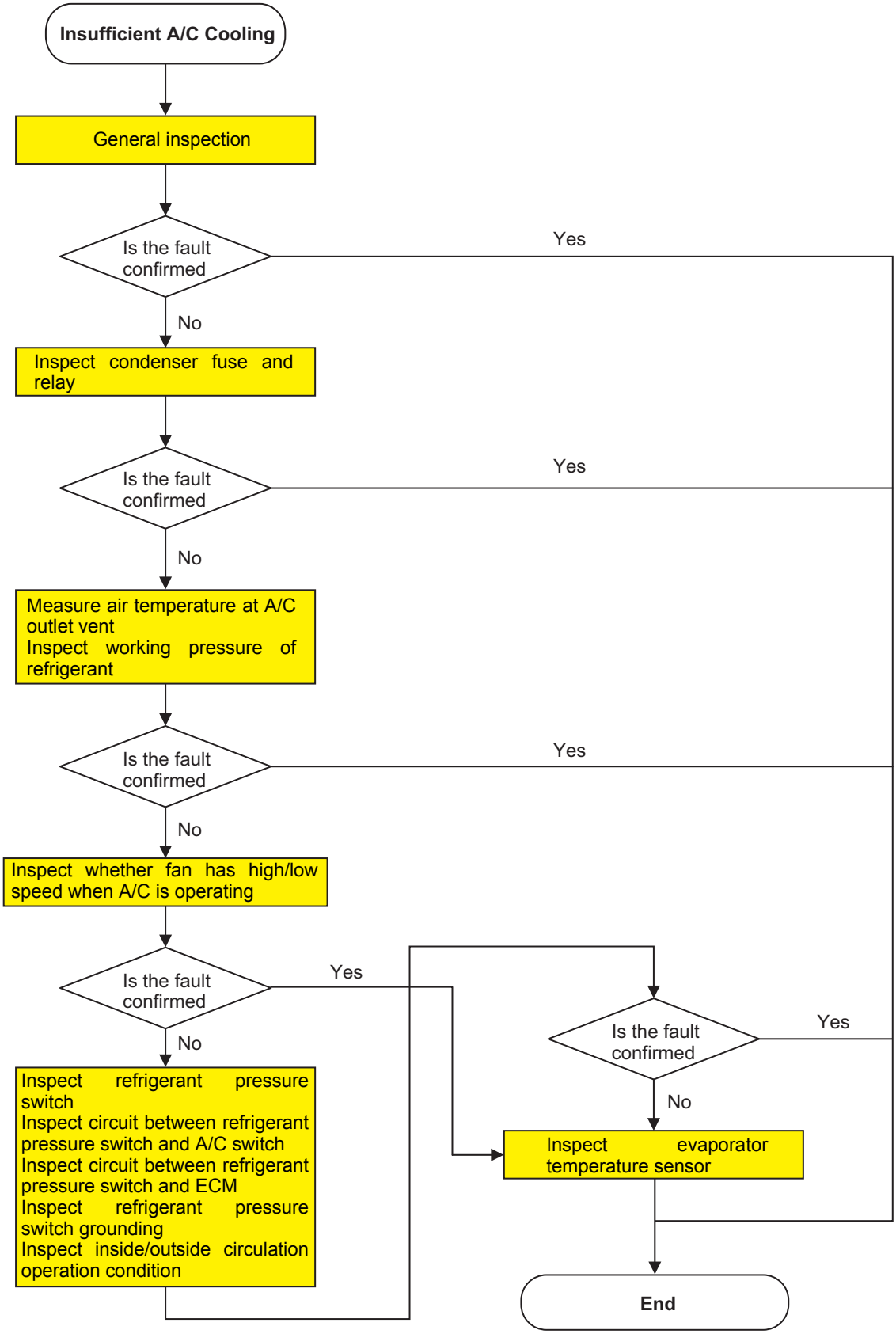


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Signal abnormal of refrigerant pressure switch | • Refrigerant pressure switch indicates a signal which means the pressure in A/C does not meet standard value<br>• Refrigerant pressure switch wiring harness fault<br>• ECM fault | • Repair the refrigerant pressure switch wiring harness.<br>• Replace the refrigerant pressure switch.<br>• Inspect and repair ECM, replace when necessary. |
| Abnormal refrigerant pressure | • High pressure of A/C is over 3.2 MPa | • Drain the excessive refrigerant.<br>• Repair the fault of poor vehicle radiating.<br>• Repair the fault of improper engine working.<br>• Inspect and repair the fault of pipes blockage inside the A/C system. |
| | • Low pressure of A/C is below 0.2 MPa | • Refill the refrigerant.<br>• Inspect and repair the fault of A/C system leakage.<br>• Inspect and repair the fault of pipes blockage inside the A/C system. |
| Water leak from the A/C | • Connection fault between drain pipe and HVAC assembly<br>• Connection fault between drain pipe and vehicle body<br>• Drain pipe blockage | • Inspect and repair the drain pipe.<br>• Replace the drain pipe. |
| Blower cannot send the air out under a high temperature, and can recover after lowering the temperature and restarting | • Thermal protection of speed control module | • Replace the blower speed control module. |
| Condenser fan constantly runs | • A/C switch<br>• Circuit<br>• Relay<br>• ECM fault | **Refer to: Diagnosis Procedure for Condenser Fan Constantly Running (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing).** |
| Condenser fan does not run | • Fuse<br>• Circuit<br>• Relay<br>• Electric fan<br>• ECM fault | **Refer to: Diagnosis Procedure for Condenser Fan Not Running (4.1.1 Heating, Ventilation and Air Conditioning, Symptom Diagnosis and Testing ).** |

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# Diagnosis Procedure for Insufficient A/C Cooling (1.0 L)



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the condenser cleaness.<br>B. Inspect whether the fan blade is damaged.<br>C. Inspect the tension of A/C compressor belt.<br>D. Inspect the cleaness of A/C inlet vent.<br>E. Inspect whether the engine coolant temperature is normal.<br>Is the result normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Clean the condenser, adjust the tension of compressor belt, replace the fan blade, clean the A/C inlet vent, and inspect the engine cooling system when necessary. |
| 2. Inspect condenser fuse and relay | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the condenser fan fuse IF04.<br>**Fuse rated capacity: 20 A**<br>C. Inspect the condenser fan relay IR04.<br>Are the fuse and relay normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse or relay circuit, and replace the fuse or relay. |
| 3. Measure air temperature at A/C outlet vent | |
| | A. Start the engine, and run it at 2000 rpm.<br>B. Turn air volume control switch and move the inside/outside circulation control knob to the inside circulation.<br>C. Turn the air volume to the medium speed and measure the air temperature at A/C outlet vent.<br>Is the air temperature at A/C outlet vent normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect working pressure of refrigerant | |
| | A. Connect the A/C refrigerant pressure gauge set to the high/low pressure pipes of A/C system, and start the engine to run it at 2000 rpm and turn on the A/C system, then measure the pressure on the high-pressure and low-pressure sides.<br>**Standard value: High pressure 1.4 ~ 1.75 MPa**<br>**Low pressure 0.25 ~ 0.35 MPa**<br>Does the refrigerant pressure meet the standard?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair and adjust as below and make sure the system is normal.<br>If the high pressure and low pressure are all too high, drain the excessive refrigerant and refrigerant oil. Replace with the refrigerant that conforms to manufacturer's standard when necessary.<br>If the high pressure is higher but the low pressure is lower than normal value, then clean A/C pipes, and replace the expansion valve.<br>If the high pressure is lower but the low pressure is higher than normal value, inspect and repair or replace the A/C compressor.<br>If the high pressure and low pressure are all too low, inspect and repair, replace the leaking component of A/C system, and fill the refrigerant and refrigerant oil as manufacturer's specified standards. |

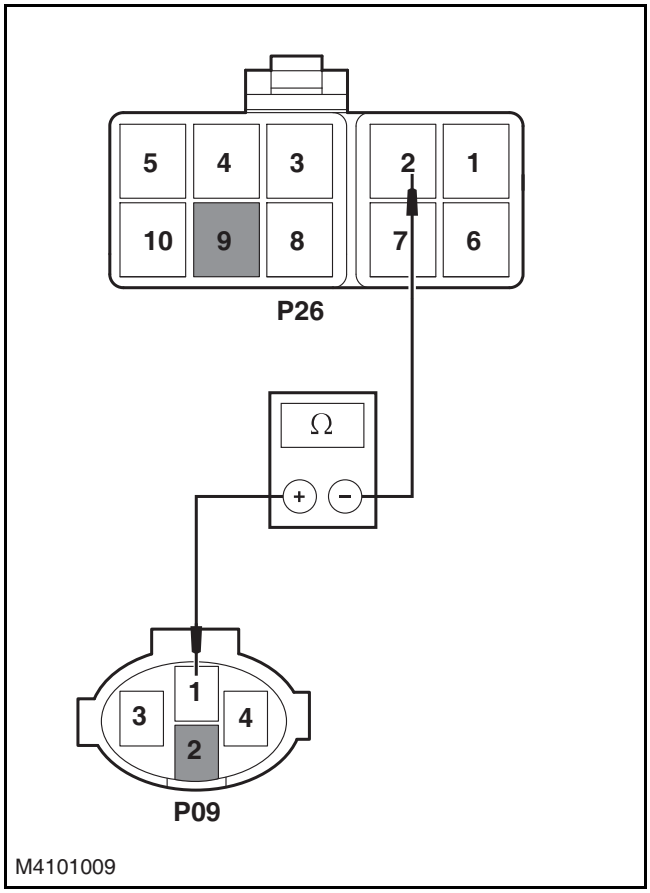
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect whether fan has high/low speed when A/C is operating | |
| | A. Connect the A/C refrigerant pressure manometer set to the high/low pressure pipes of A/C system, and measure the pressure when the A/C is operating.<br>B. Start the engine.<br>C. Turn the air volume control switch, press the A/C switch, set the temperature control knob to cold air and run the engine.<br>D. Inspect whether the A/C fan is operating at a low speed when the A/C system pressure (high pressure) is 1.25 ± 0.1 MPa.<br>E. Inspect whether the A/C fan is operating at a high speed when the A/C system pressure (high pressure) is 1.52 ± 0.1 MPa.<br>Is the result normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Go to step 6. |
| 6. Inspect refrigerant pressure switch | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the refrigerant pressure switch wiring harness connector P09.<br>C. Replace the refrigerant pressure switch with a new one and connect its wiring harness connector P09 properly.<br>**Refer to: Tristate Pressure Switch (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>D. Inspect the A/C fan is operating at a high speed.<br>Is the result normal?<br>**Yes**<br>Replace the refrigerant pressure switch.<br>**No**<br>Go to step 7. |

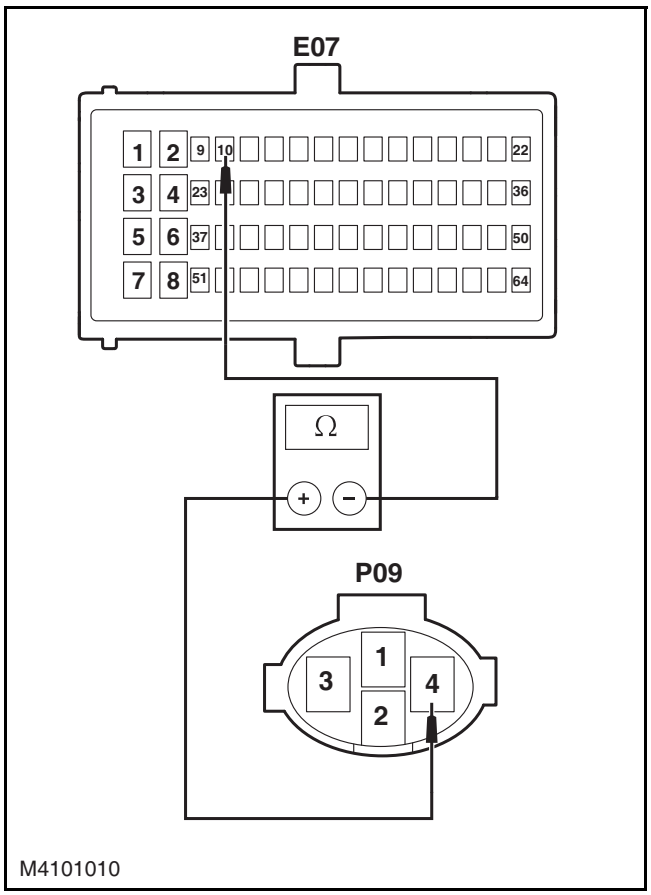
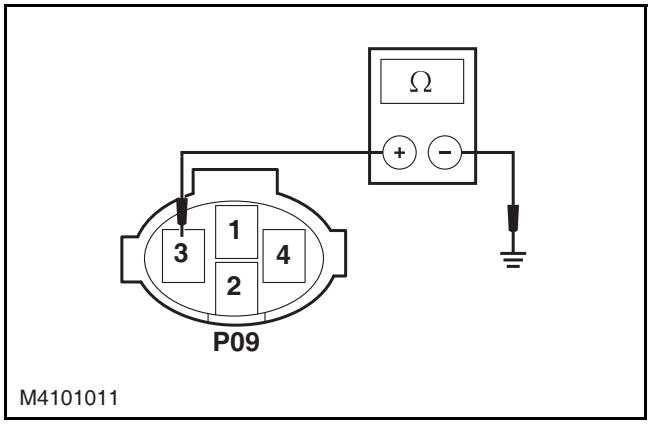
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect circuit between refrigerant pressure switch and A/C switch | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the refrigerant pressure switch wiring harness connector P09.<br>C. Disconnect the A/C controller wiring harness connector P26.<br>D. Measure the resistance between terminal 1 of refrigerant pressure switch wiring harness connector P09 and terminal 2 of A/C controller wiring harness connector P26.<br>E. Measure the resistance between terminal 2 of refrigerant pressure switch wiring harness connector P09 and terminal 9 of A/C controller wiring harness connector P26.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of refrigerant pressure switch wiring harness connector P09 and terminal 2 of A/C controller wiring harness connector P26.<br>Inspect and repair the open circuit fault between terminal 2 of refrigerant pressure switch wiring harness connector P09 and terminal 9 of A/C controller wiring harness connector P26. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect circuit between refrigerant pressure switch and ECM | |
|  <br>M4101010 | A. Turn the ignition switch to "LOCK" and disconnect the negative battery cable.<br>B. Disconnect the refrigerant pressure switch wiring harness connector P09 and ECM wiring harness connector E07.<br>C. Measure the resistance between terminal 4 of refrigerant pressure switch wiring harness connector P09 and terminal 10 of ECM wiring harness connector E07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of refrigerant pressure switch wiring harness connector P09 and terminal 10 of ECM wiring harness connector E07. |
| 9. Inspect refrigerant pressure switch grounding | |
|  <br>M4101011 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the refrigerant pressure switch wiring harness connector P09.<br>C. Measure the resistance between terminal 3 of refrigerant pressure switch wiring harness connector P09 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>**Refer to: Diagnosis Procedure for Electric Fan Not Running (3.1.4 Cooling system, Symptom Diagnosis and Testing).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of refrigerant pressure switch wiring harness connector P09 and G105. |

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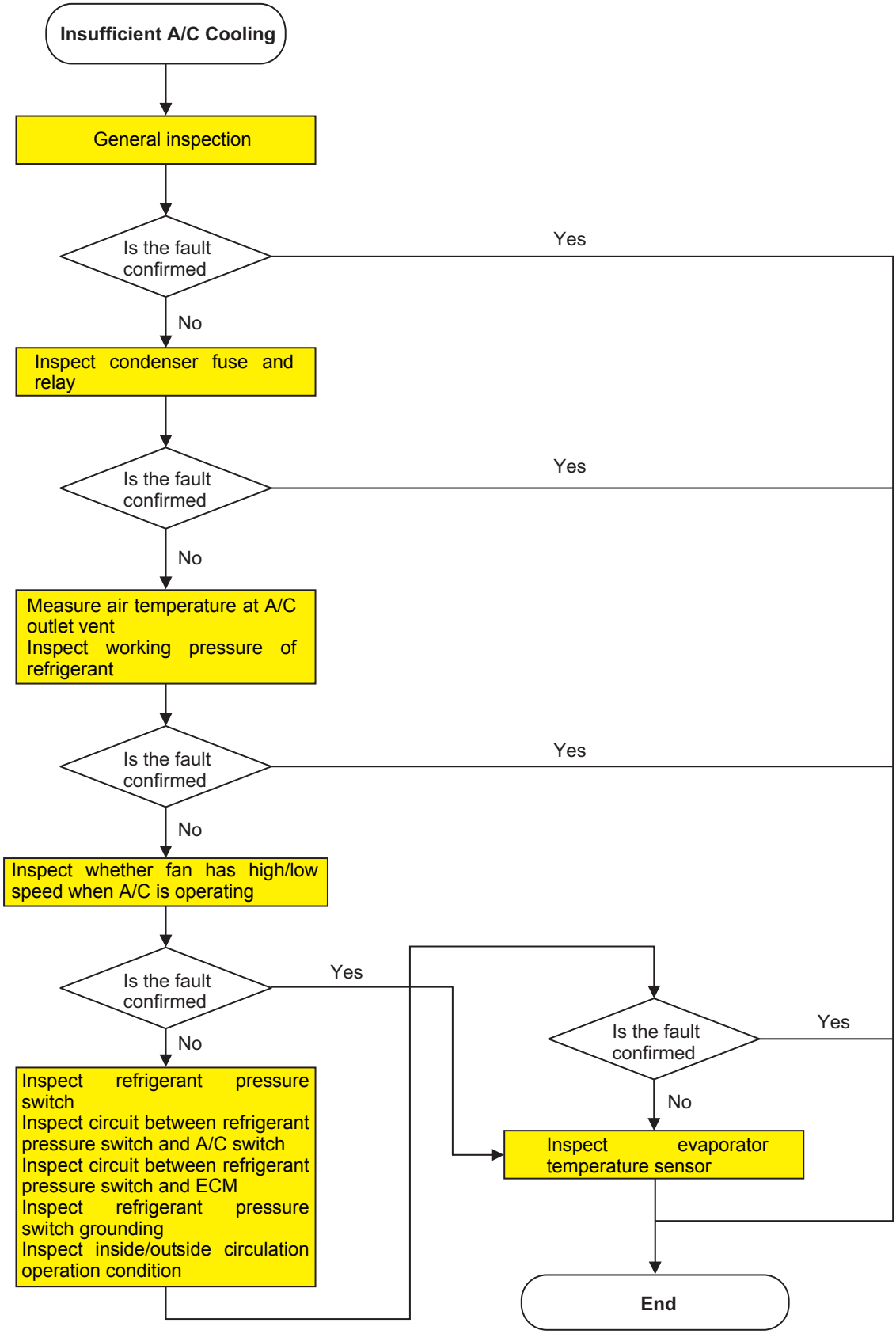


| Test Conditions | Details/Results/Actions |
|---|---|
| 10.Inspect inside/outside circulation operation condition | |
| | A. Turn the air volume control switch and change the inside/outside circulation mode setting.<br>Is the inside/outside circulation vent working condition normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Repair and adjust as below and make sure the system is normal.<br>Inspect the inside/outside circulation vent mechanism, adjust or replace the inside/outside circulation cables and mechanical device when necessary.<br>Inspect the air channel, repair and replace the air leaking channel.<br>Inspect the inside/outside circulation control knob and replace when necessary. |
| 11.Inspect evaporator temperature sensor | |
| | A. Inspect whether the evaporator temperature sensor is installed as the manufacturer's specified standards.<br>B. Inspect whether the evaporator is frosted when the A/C is operating.<br>Is the result normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the evaporator temperature sensor<br>Install a new evaporator temperature sensor as the manufacturer's specified standard position.<br>The system is normal. |

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# Diagnosis Procedure for Insufficient A/C Cooling (1.2 L)



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the condenser cleaness.<br>B. Inspect whether the fan blade is damaged.<br>C. Inspect the tension of A/C compressor belt.<br>D. Inspect the cleaness of A/C inlet vent.<br>E. Inspect whether the engine coolant temperature is normal.<br>Is the result normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Clean the condenser, adjust the tension of compressor belt, replace the fan blade, clean the A/C inlet vent, and inspect the engine cooling system when necessary. |
| 2. Inspect condenser fuse and relay | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect the condenser fan fuse IF04.<br>**Fuse rated capacity: 20 A**<br>C. Inspect the condenser fan relay IR04.<br>Are the fuse and relay normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse or relay circuit, and replace the fuse or relay. |
| 3. Measure air temperature at A/C outlet vent | |
| | A. Start the engine, and run it at 2000 rpm.<br>B. Turn air volume control switch and move the inside/outside circulation control knob to the inside circulation.<br>C. Turn the air volume to the medium speed and measure the air temperature at A/C outlet vent.<br>Is the air temperature at A/C outlet vent normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect working pressure of refrigerant | |
| | A. Connect the A/C refrigerant pressure manometer set to the high/low pressure pipes of A/C system, and start the engine to run it at 2000 rpm and turn on the A/C system, then measure the pressure on the high-pressure and low-pressure sides.<br>**Standard value: High pressure 1.4 ~ 1.75 MPa**<br>**Low pressure 0.25 ~ 0.35 MPa**<br>Does the refrigerant pressure meet the standard?<br>**Yes**<br>Go to step 5.<br>**No**<br>Repair and adjust as below and make sure the system is normal.<br>If the high pressure and low pressure are all too high, drain the excessive refrigerant and refrigerant oil. Replace with the refrigerant that conforms to manufacturer's standard when necessary.<br>If the high pressure is higher but the low pressure is lower than normal value, then clean A/C pipes, and replace the expansion valve.<br>If the high pressure is lower but the low pressure is higher than normal value, inspect and repair or replace the A/C compressor.<br>If the high pressure and low pressure are all too low, inspect and repair, replace the leaking component of A/C system, and fill the refrigerant and refrigerant oil as manufacturer's specified standards. |

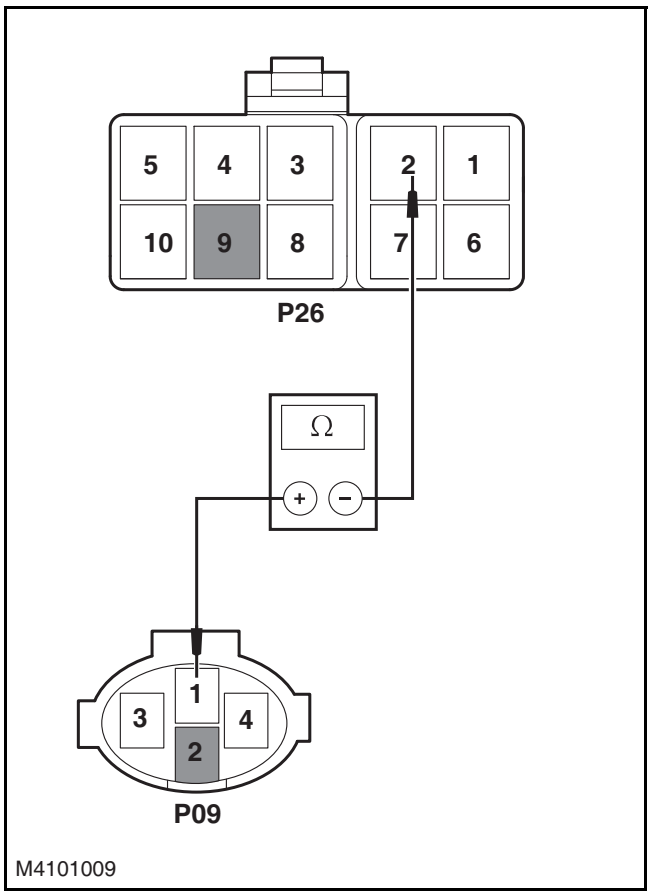
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect whether fan has high/low speed when A/C is operating | |
| | A. Connect the A/C refrigerant pressure manometer set to the high/low pressure pipes of A/C system, and measure the pressure when the A/C is operating.<br>B. Start the engine.<br>C. Turn the air volume control switch, press the A/C switch, set the temperature control knob to cold air and run the engine.<br>D. Inspect whether the A/C fan is operating at a low speed when the A/C system pressure (high pressure) is 1.25 ± 0.1 MPa.<br>E. Inspect whether the A/C fan is operating at a high speed when the A/C system pressure (high pressure) is 1.52 ± 0.1 MPa.<br>Is the result normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Go to step 6. |
| 6. Inspect refrigerant pressure switch | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the refrigerant pressure switch wiring harness connector P09.<br>C. Replace the refrigerant pressure switch with a new one and connect its wiring harness connector P09 properly.<br>**Refer to: Tristate Pressure Switch (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>D. Inspect the A/C fan is operating at a high speed.<br>Is the result normal?<br>**Yes**<br>Replace the refrigerant pressure switch.<br>**No**<br>Go to step 7. |

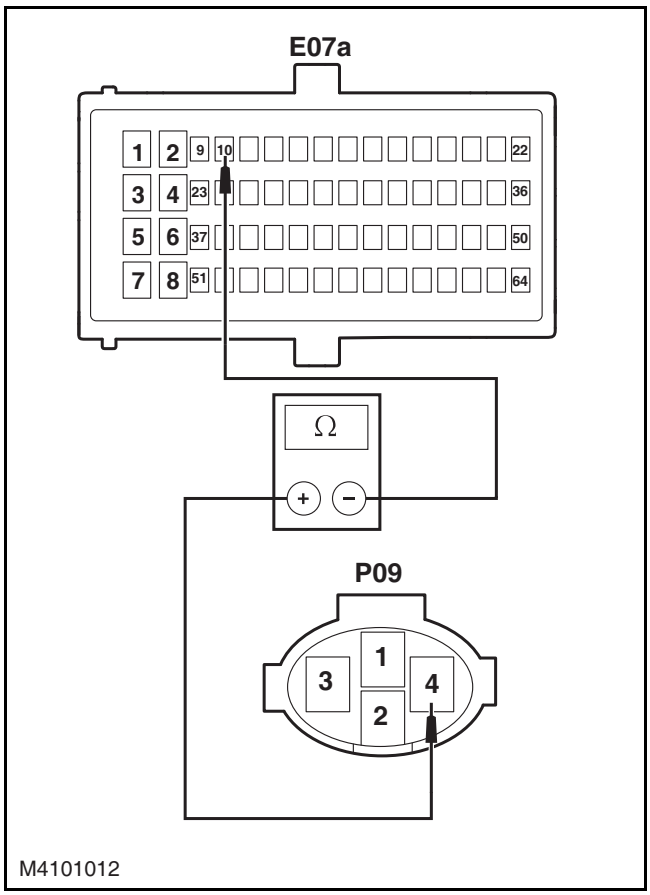
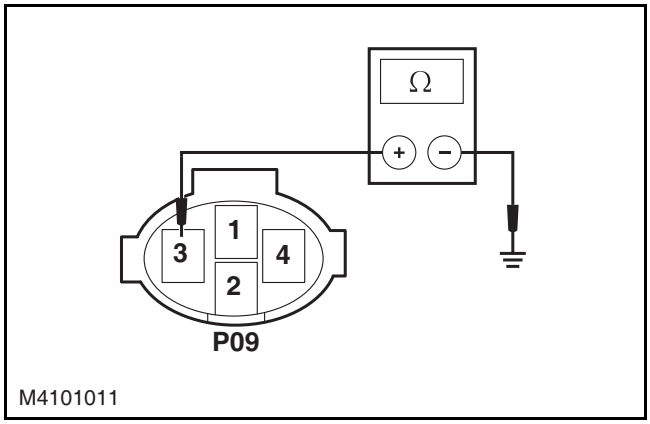
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect circuit between refrigerant pressure switch and A/C switch | |
|  <br>M4101009 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the refrigerant pressure switch wiring harness connector P09.<br>C. Disconnect the A/C controller wiring harness connector P26.<br>D. Measure the resistance between terminal 1 of refrigerant pressure switch wiring harness connector P09 and terminal 2 of A/C controller wiring harness connector P26.<br>E. Measure the resistance between terminal 2 of refrigerant pressure switch wiring harness connector P09 and terminal 9 of A/C controller wiring harness connector P26.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of refrigerant pressure switch wiring harness connector P09 and terminal 2 of A/C controller wiring harness connector P26.<br>Inspect and repair the open circuit fault between terminal 2 of refrigerant pressure switch wiring harness connector P09 and terminal 9 of A/C controller wiring harness connector P26. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect circuit between refrigerant pressure switch and ECM | |
|  <br>M4101012 | A. Turn the ignition switch to "LOCK" and disconnect the negative battery cable.<br>B. Disconnect the refrigerant pressure switch wiring harness connector P09 and ECM wiring harness connector E07a.<br>C. Measure the resistance between terminal 4 of refrigerant pressure switch wiring harness connector P09 and terminal 10 of ECM wiring harness connector E07a.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of refrigerant pressure switch wiring harness connector P09 and terminal 10 of ECM wiring harness connector E07a. |
| 9. Inspect refrigerant pressure switch grounding | |
|  <br>M4101011 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the refrigerant pressure switch wiring harness connector P09.<br>C. Measure the resistance between terminal 3 of refrigerant pressure switch wiring harness connector P09 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>**Refer to: Diagnosis Procedure for Electric Fan Not Running (3.1.4 Cooling system, Symptom Diagnosis and Testing).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of refrigerant pressure switch wiring harness connector P09 and G105. |

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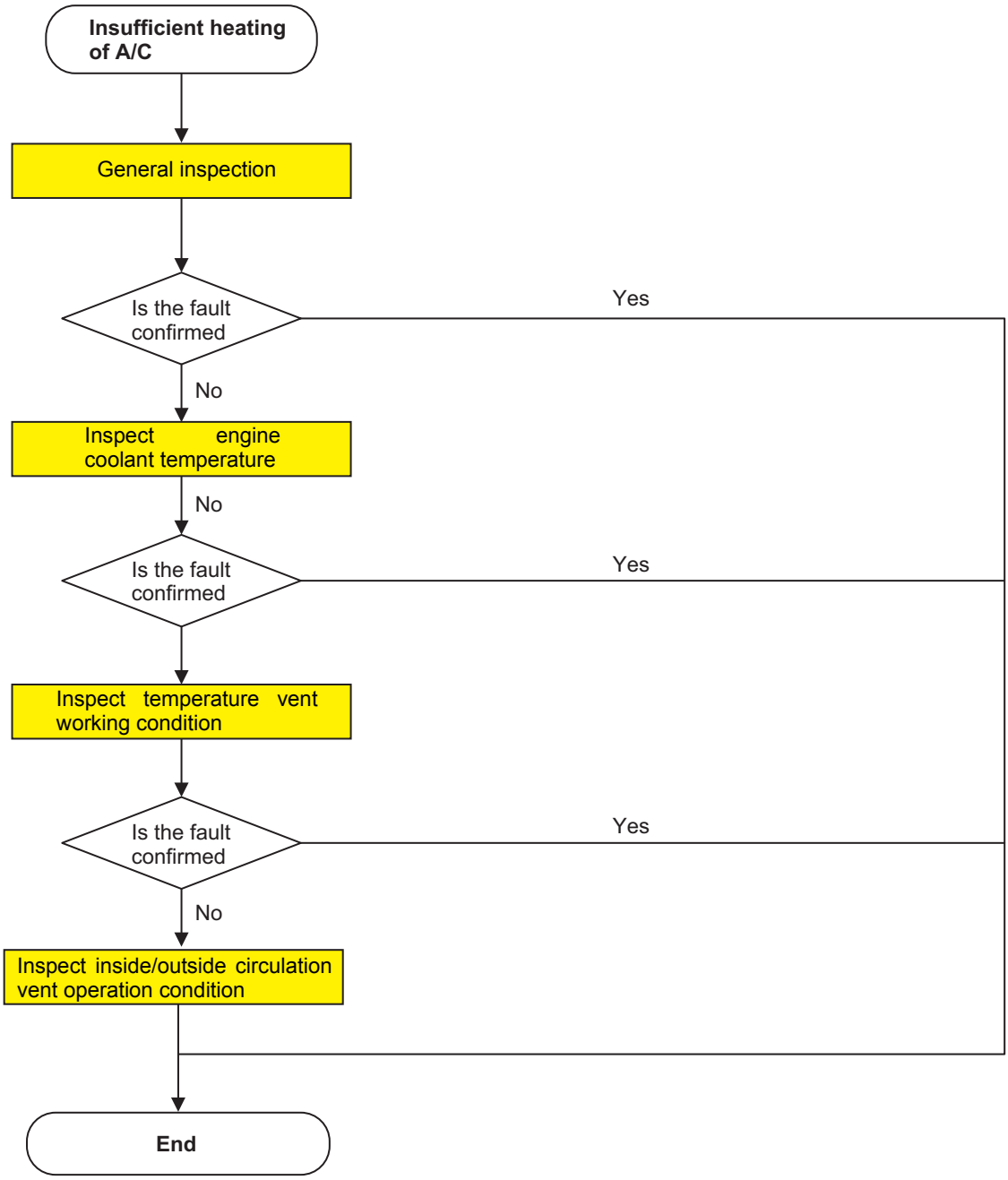


| Test Conditions | Details/Results/Actions |
|---|---|
| 10.Inspect inside/outside circulation operation condition | |
| | A. Turn the air volume control switch and change the inside/outside circulation mode setting.<br>Is the inside/outside circulation vent working condition normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Repair and adjust as below and make sure the system is normal.<br>Inspect the inside/outside circulation vent mechanism, adjust or replace the inside/outside circulation cables and mechanical device when necessary.<br>Inspect the air channel, repair and replace the air leaking channel.<br>Inspect the inside/outside circulation control knob and replace when necessary. |
| 11.Inspect evaporator temperature sensor | |
| | A. Inspect whether the evaporator temperature sensor is installed as the manufacturer's specified standards.<br>B. Inspect whether the evaporator is frosted when the A/C is operating.<br>Is the result normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the evaporator temperature sensor<br>Install a new evaporator temperature sensor as the manufacturer's specified standard position.<br>The system is normal. |

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# Diagnosis Procedure for Insufficient Heating of A/C



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the engine coolant level.<br>B. Inspect the cleaness of A/C inlet vent.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Fill the coolant.<br>**Refer to: Coolant Level Inspection (3.1.4 Cooling System, General Inspection).** |
| 2. Inspect engine coolant temperature | |
| | A. Inspect the engine coolant temperature.<br>Does the engine coolant temperature reach 83°C?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair and adjust as below and make sure the system is normal.<br>Prolong the engine running time.<br>Inspect, repair and replace the thermostat.<br>Discharge the air in the cooling system.<br>Inspect, repair and adjust the engine operation condition. |
| 3. Inspect temperature vent working condition | |
| | A. Inspect the A/C temperature vent working condition.<br>Is the working condition of temperature vent normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair and adjust as below and make sure the system is normal.<br>Inspect the temperature vent mechanism, adjust or replace when necessary.<br>Inspect the air channel, repair and replace the air leaking channel. |

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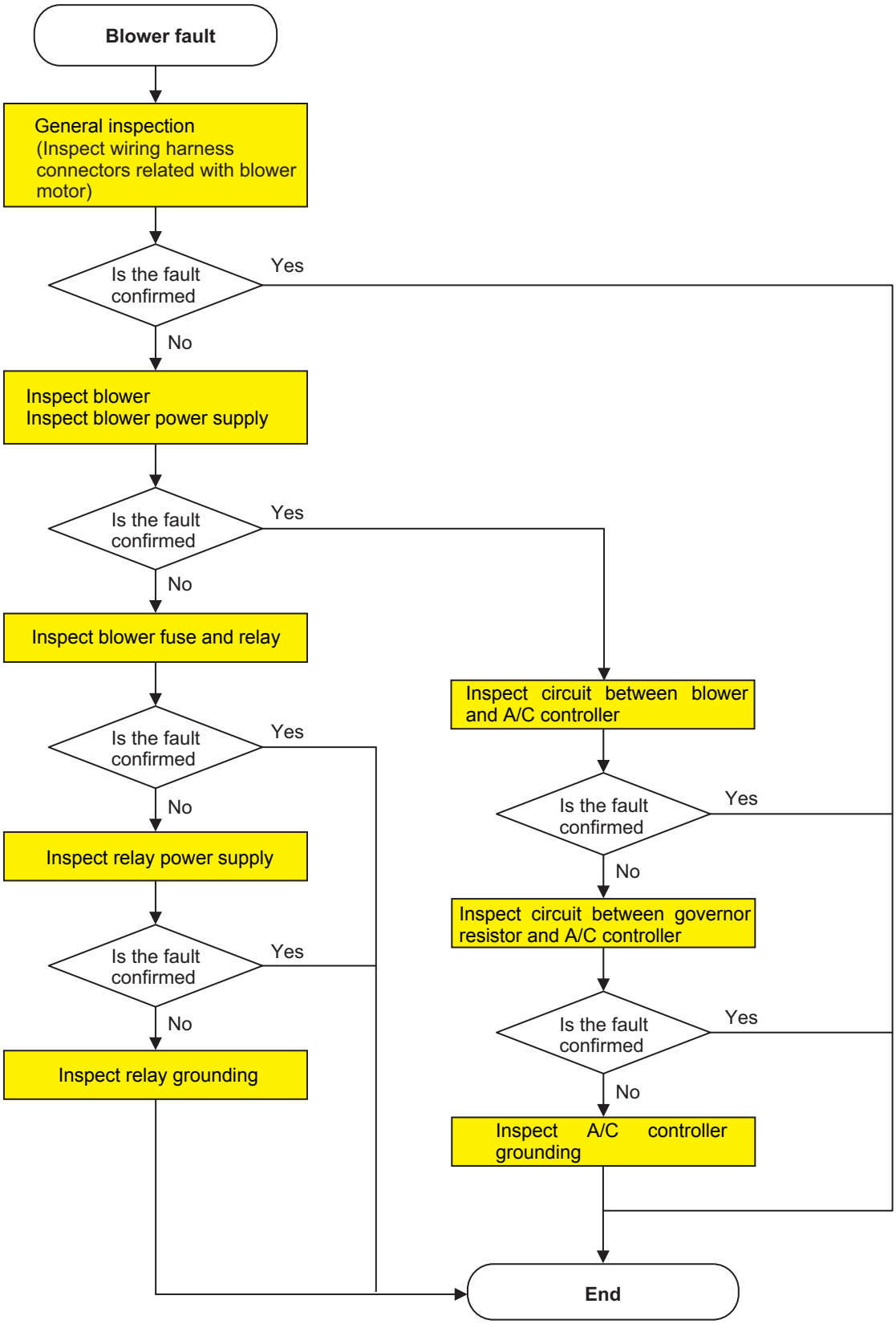


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect inside/outside circulation vent operation condition | |
| | A. Inspect the operation condition of A/C inside/outside circulation vent.<br>Is the operation condition of inside/outside circulation vent normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Carry out the following repair and adjustment. Make sure the system is normal.<br>Inspect inside/outside circulation vent mechanism, adjust or replace when necessary.<br>Inspect the air channel, repair and replace the air leaking channel. |

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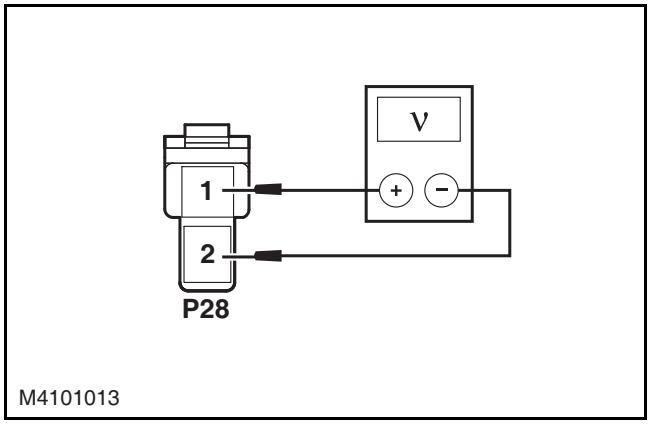
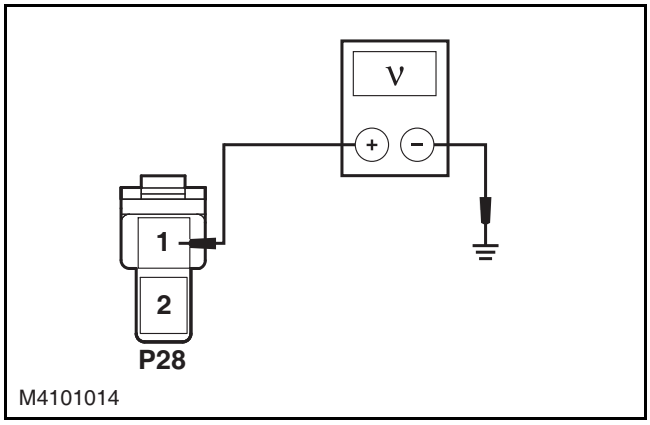


# Diagnosis Procedure for Blower Fault



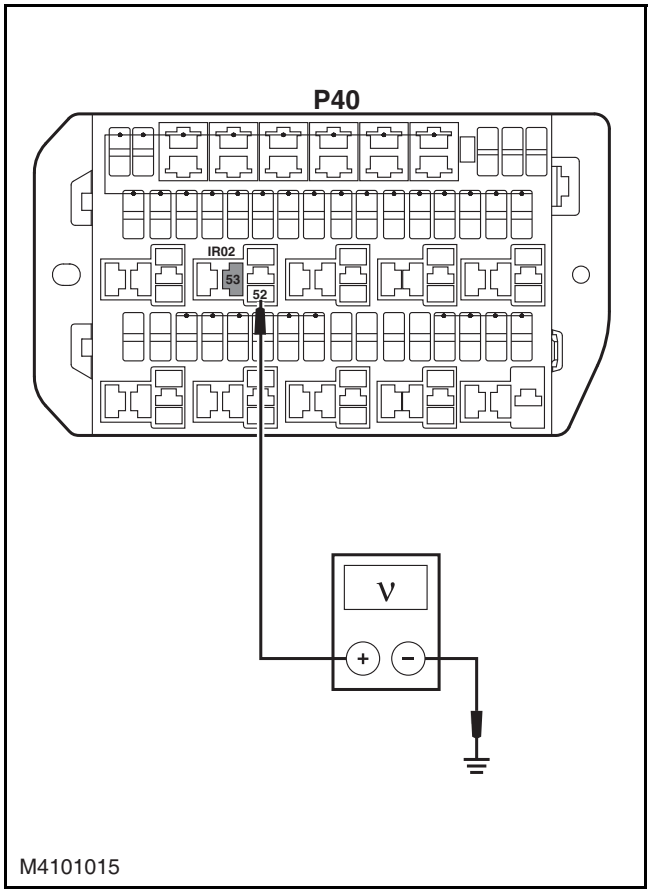
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related with the blower motor for damage, poor contact, aging or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect blower | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the blower motor wiring harness connector P28.<br>C. Measure the voltage between terminals 1, 2 of blower motor wiring connector P28.<br>**Standard voltage: 12 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the blower motor.<br>**No**<br>Go to step 3. |
| 3. Inspect blower power supply | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the blower motor wiring harness connector P28.<br>C. Measure the voltage between terminal 1 of blower motor wiring harness connector P28 and reliable grounding.<br>**Standard voltage: 12 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Go to step 4. |

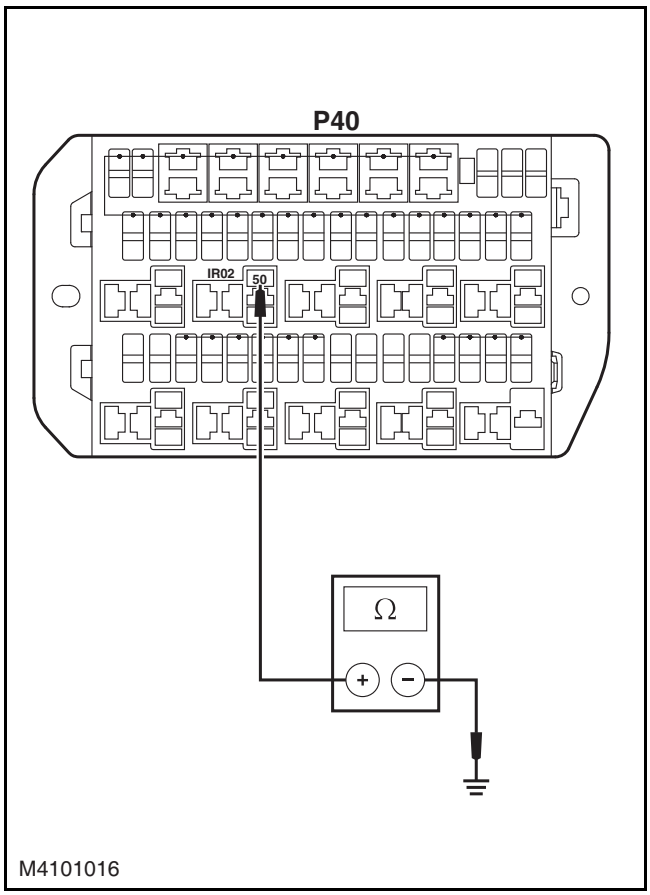
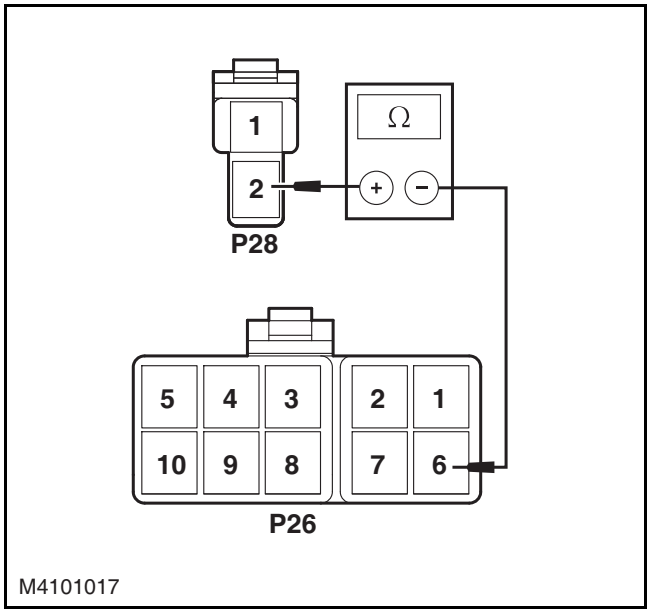
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect blower fuse and relay | |
| | A. Inspect the instrument panel fuse box fuse IF07 and relay IR02.<br>**Fuse rated capacity: 10 A**<br>Is the result normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the fuse or relay circuit, replace the fuse with rated capacity or relay. |
| 5. Inspect relay power supply | |
|  | A. Remove the instrument panel fuse box relay IR02.<br>B. Measure the voltage between terminal 53 of relay IR02 and reliable grounding.<br>C. Measure the voltage between terminal 52 of relay IR02 and reliable grounding.<br>**Standard voltage: 12 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the short circuit fault between terminal 53 of relay IR02 and terminal 34 of fuse IF17.<br>Inspect and repair the short circuit fault between terminal 52 of relay IR02 and terminal 52 of fuse IF26. |

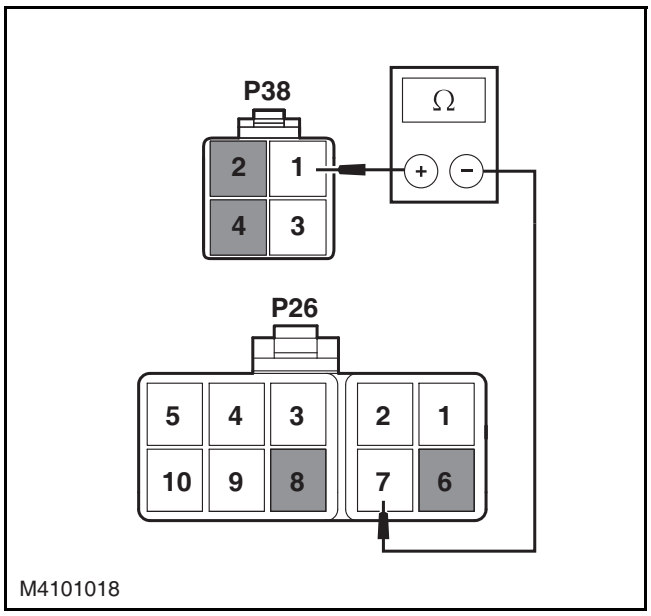
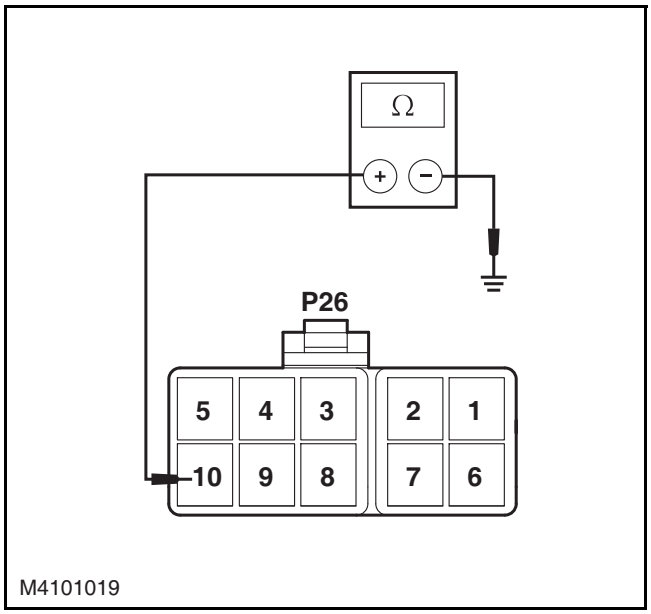
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect relay grounding | |
|  | A. Remove the instrument panel fuse box relay IR02.<br>B. Measure the resistance between terminal 50 of relay IR02 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Inspect and repair the short circuit fault between terminal 54 of relay IR02 and terminal 1 of blower wiring harness connector P28.<br>**No**<br>Inspect and repair the short circuit fault between terminal 50 of relay IR02 and grounding G103. |
| 7. Inspect circuit between blower and A/C controller | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the blower motor wiring harness connetor P28 and A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminal 2 of blower motor wiring harness connector P28 and terminal 6 of A/C controller wiring harness connector P26.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the short circuit fault between terminal 2 of blower motor wiring harness connector P28 and terminal 6 of A/C controller wiring harness connector P26. |

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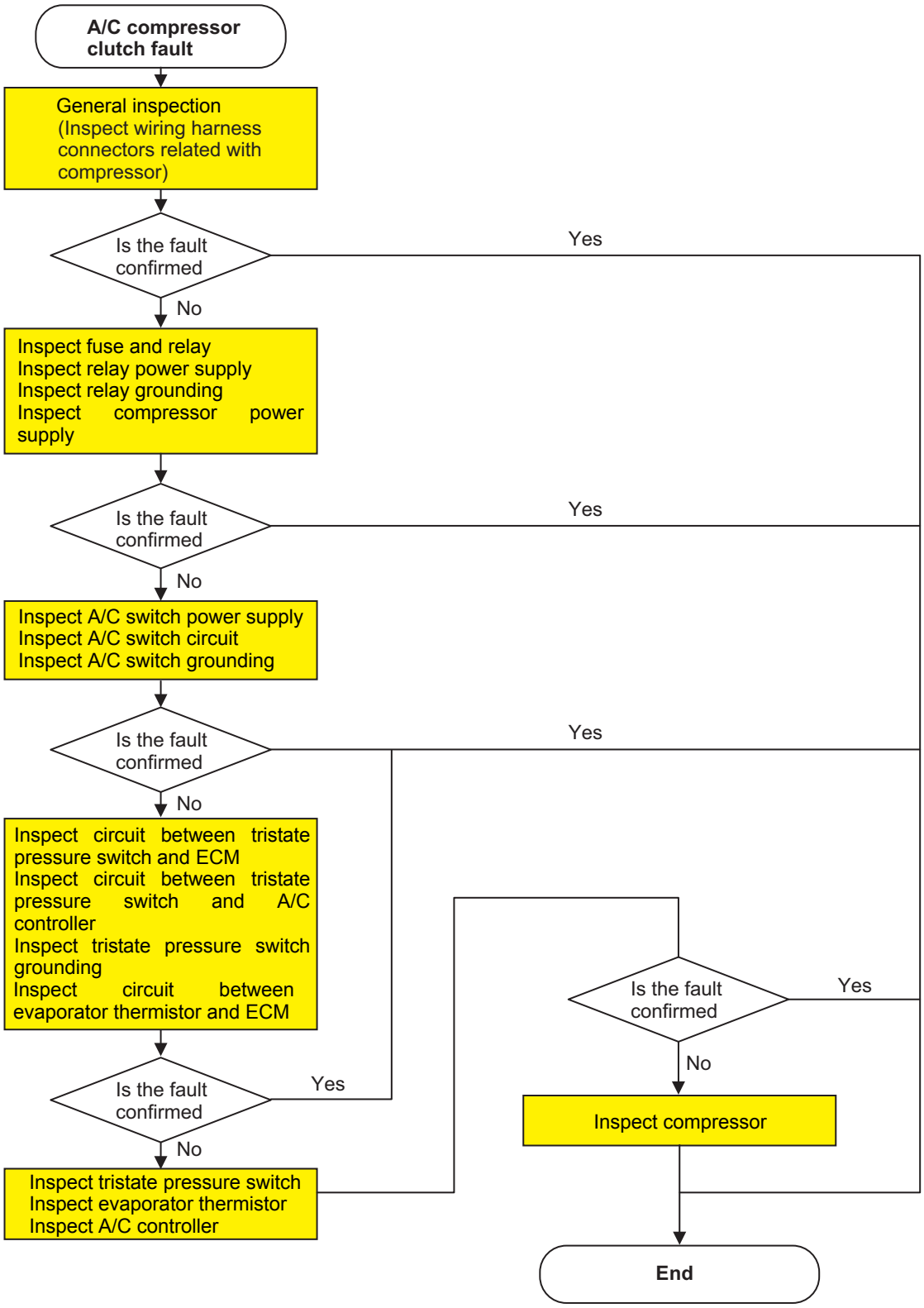


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect circuit between governor resistor and A/C controller | |
|  M4101018 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the governor resistor wiring harness connetor P38 and A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminals 1, 2, 4 of governor resistor wiring harness connector P38 and terminals 7, 8, 6 of A/C controller wiring harness connector P26.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the short circuit fault between terminals 1, 2, 4 of governor resistor wiring harness connector P38 and terminals 7, 8, 6 of A/C controller wiring harness connector P26. |
| 9. Inspect A/C controller grounding | |
|  M4101019 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminal 10 of A/C controller wiring harness connector P26 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the A/C controller.<br>**Refer to: A/C Controller (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>**No**<br>Inspect and repair the short circuit fault between terminal 10 of A/C controller wiring harness connector P26 and grounding G106. |

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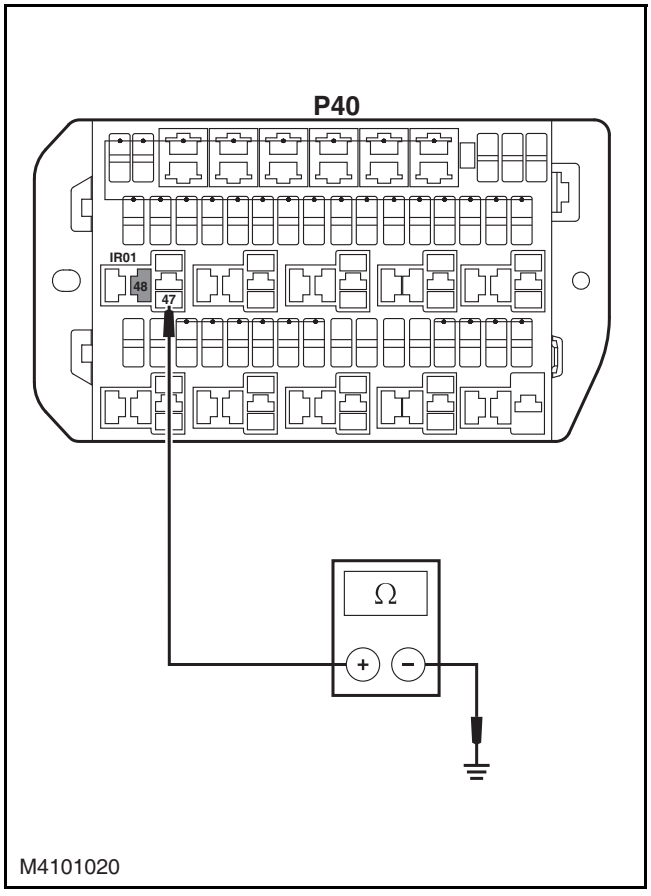


# Diagnosis Procedure for A/C Compressor Clutch Fault (1.0 L)



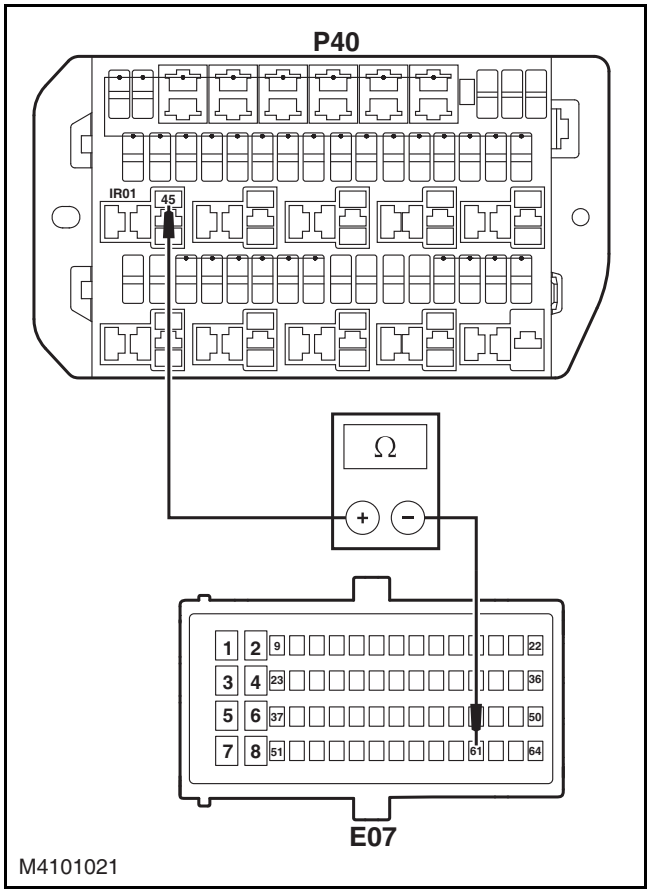
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related with the compressor for damage, poor contact, aging or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect fuse and relay | |
| | A. Inspect the instrument panel fuse box fuse IF18 and relay IR01.<br>**Fuse rated capacity: 10 A**<br>Is the result normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse or relay circuit, replace the fuse with rated capacity or relay. |
| 3. Inspect relay power supply | |
|  | A. Remove instrument panel fuse box relay IR01.<br>B. Measure the resistance between terminals 47, 48 of relay IR01 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the relay power supply circuit. |

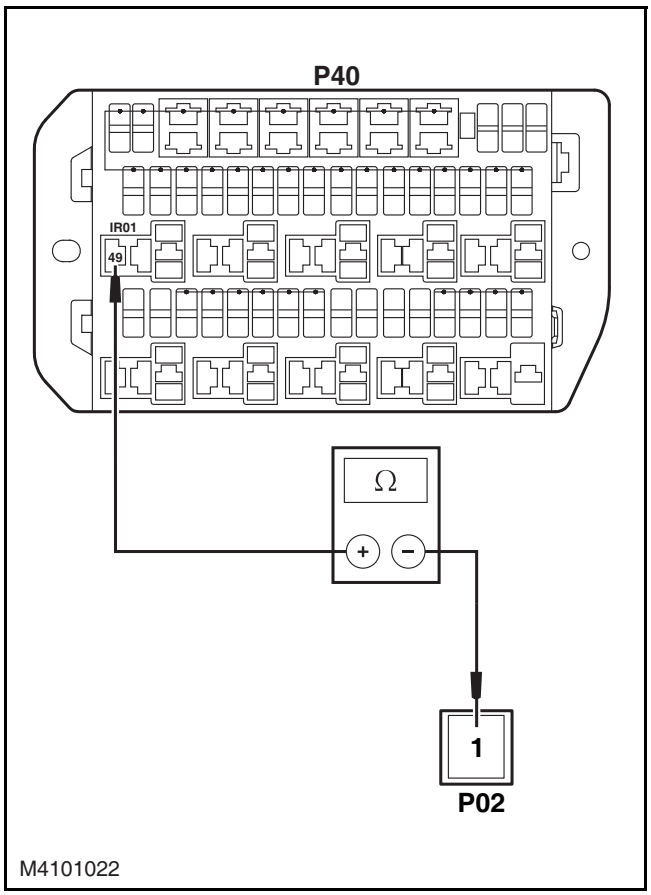
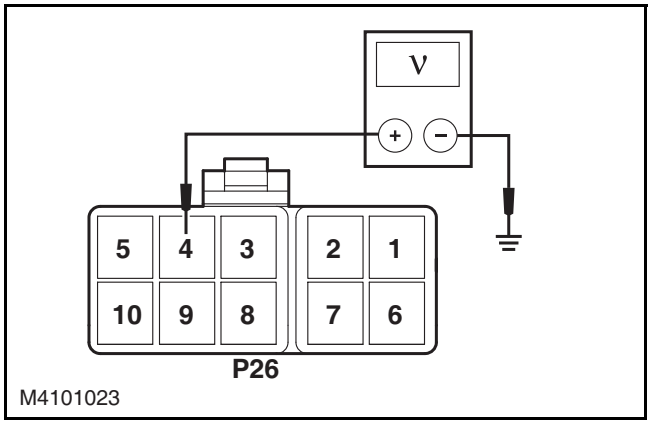
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect relay grounding | |
|  <br>M4101021 | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument panel fuse box relay IR01 and disconnect the ECM wiring harness connector E07.<br>C. Measure the resistance between terminal 45 of instrument panel fuse box relay IR01 and terminal 61 of ECM wiring harness connector E07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the short circuit fault between terminal 45 of instrument panel fuse box relay IR01 and terminal 61 of ECM wiring harness connector E07. |

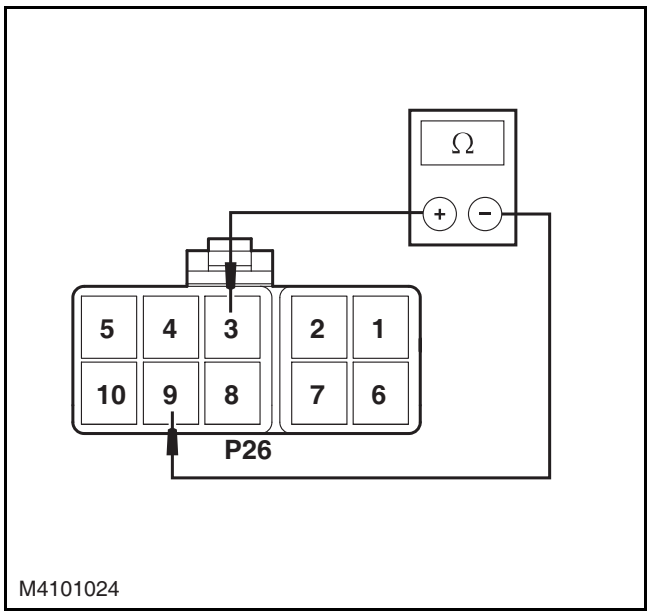
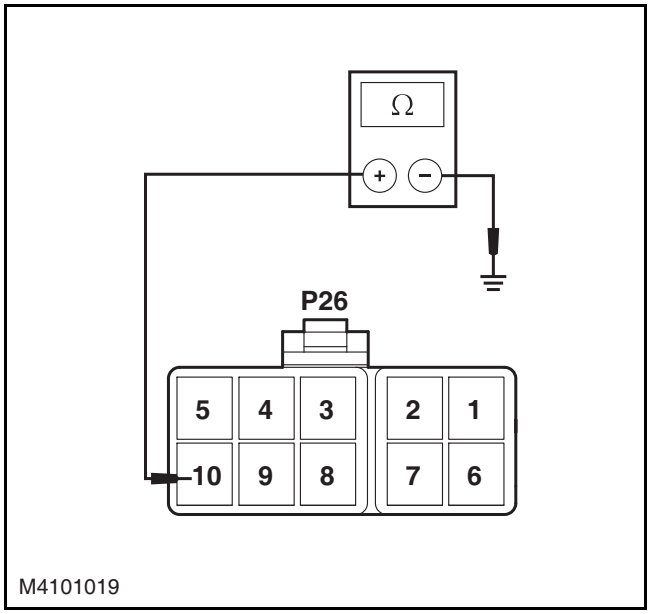
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect compressor power supply | |
|  M4101022 | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument panel fuse box relay IR01 and disconnect the compressor wiring harness connector P02.<br>C. Measure the resistance between terminal 49 of instrument panel fuse box relay IR01 and terminal 1 of compressor wiring harness connector P02.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the short circuit fault between terminal 49 of instrument panel fuse box relay IR01 and terminal 1 of compressor wiring harness connector P02. |
| 6. Inspect A/C switch power supply | |
|  M4101023 | A. Disconnect the A/C controller wiring harness connector P26.<br>B. Turn the ignition switch to "ON".<br>C. Measure the voltage between terminal 4 of A/C controller wiring harness connector P26 and reliable grounding.<br>**Standard voltage: 12 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the short circuit fault between terminal 4 of A/C controller wiring harness connector P26 and terminal 52 of instrument panel fuse box fuse IF26. |

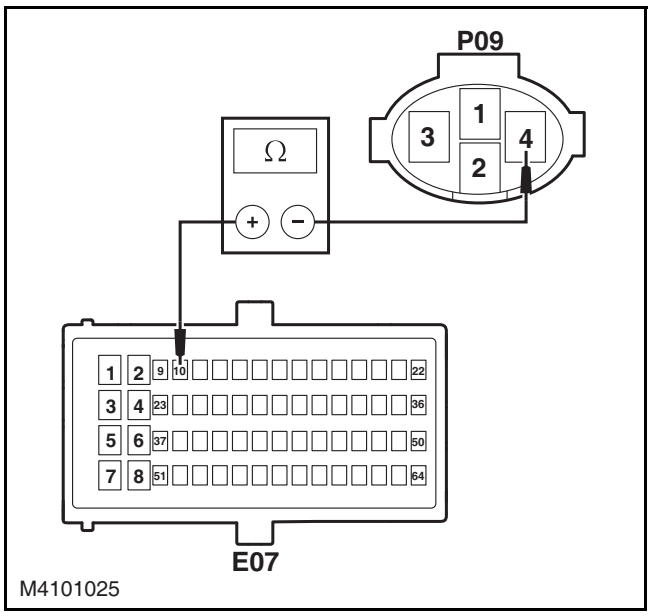
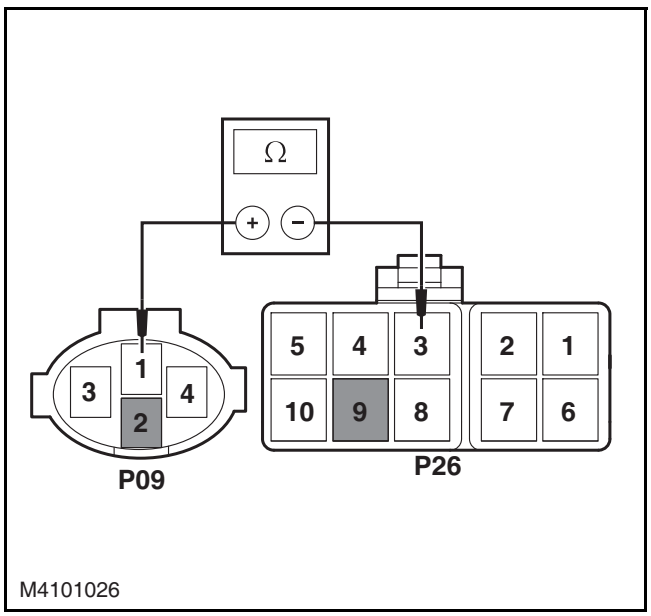
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect A/C switch circuit | |
|  M4101024 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminals 3 and 9 of A/C controller wiring harness connector P26.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminals 3 and 9 of A/C controller wiring harness connector P26. |
| 8. Inspect A/C switch grounding | |
|  M4101019 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminal 10 of A/C controller wiring harness connector P26 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 10 of A/C controller wiring harness connector P26 and grounding G106. |

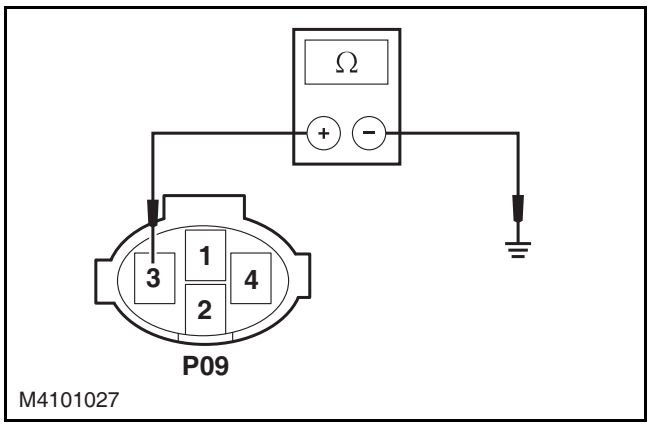
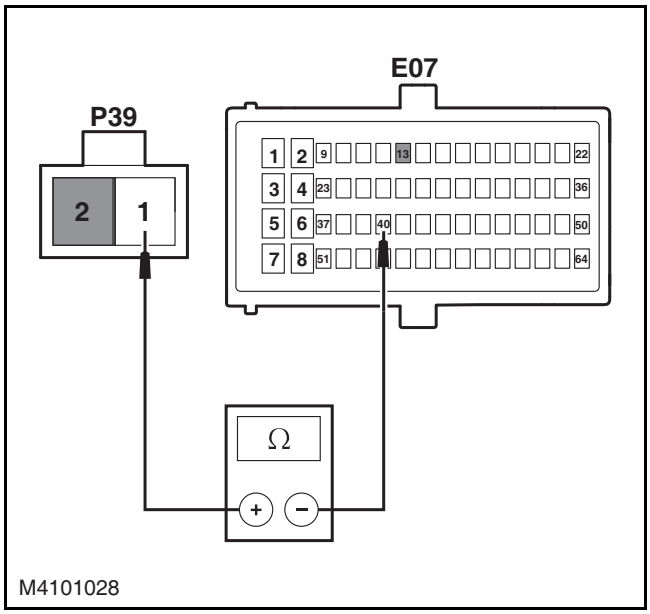
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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect circuit between tristate pressure switch and ECM | |
|  <br>M4101025 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the tristate pressure switch wiring harness connector P09 and ECM wiring harness connector E07.<br>C. Measure the resistance between terminal 4 of tristate pressure switch wiring harness connector P09 and terminal 10 of ECM wiring harness connector E07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Measure the open circuit fault between terminal 4 of tristate pressure switch wiring harness connector P09 and the terminal 10 of ECM wiring harness connector E07. |
| 10.Inspect circuit between tristate pressure switch and A/C controller | |
|  <br>M4101026 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the tristate pressure switch wiring harness connector P09 and A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminals 1, 2 of tristate pressure switch wiring harness connector P09 and terminals 3, 9 of A/C controller wiring harness connector P26.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Inspect and repair the open circuit fault between terminals 1, 2 of tristate pressure switch wiring harness connector P09 and the terminals 3, 9 of A/C controller wiring harness connector P26. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 11.Inspect tristate pressure switch grounding | |
|  M4101027 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the tristate pressure switch wiring harness connector P09.<br>C. Measure the resistance between terminal 3 of tristate pressure switch wiring harness connector P09 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 12.<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of tristate pressure switch wiring harness connector P09 and grounding G105. |
| 12.Inspect circuit between evaporator thermistor and ECM | |
|  M4101028 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the evaporator thermistor wiring harness connector P39 and ECM wiring harness connector E07.<br>C. Measure the resistance between terminals 1, 2 of evaporator thermistor wiring harness connector P39 and terminals 40, 13 of ECM wiring harness connector E07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 13.<br>**No**<br>Inspect and repair the open circuit fault between terminals 1, 2 of evaporator thermistor wiring harness connector P39 and terminals 40, 13 of ECM wiring harness connector E07. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 13.Inspect tristate pressure switch | |
| | A. Replace the tristate pressure switch with a good one.<br>Is the system normal?<br>**Yes**<br>Replace the tristate pressure switch.<br>**Refer to: Tristate Pressure Switch (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>**No**<br>Go to step 14. |
| 14.Inspect evaporator thermistor | |
| | A. Replace the evaporator thermistor with a good one.<br>Is the system normal?<br>**Yes**<br>Replace the evaporator thermistor.<br>**No**<br>Go to step 15. |
| 15.Inspect A/C controller | |
| | A. Replace the A/C controller with a good one.<br>Is the system normal?<br>**Yes**<br>Replace the A/C controller.<br>**Refer to: A/C Controller (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>**No**<br>Go to step 16. |

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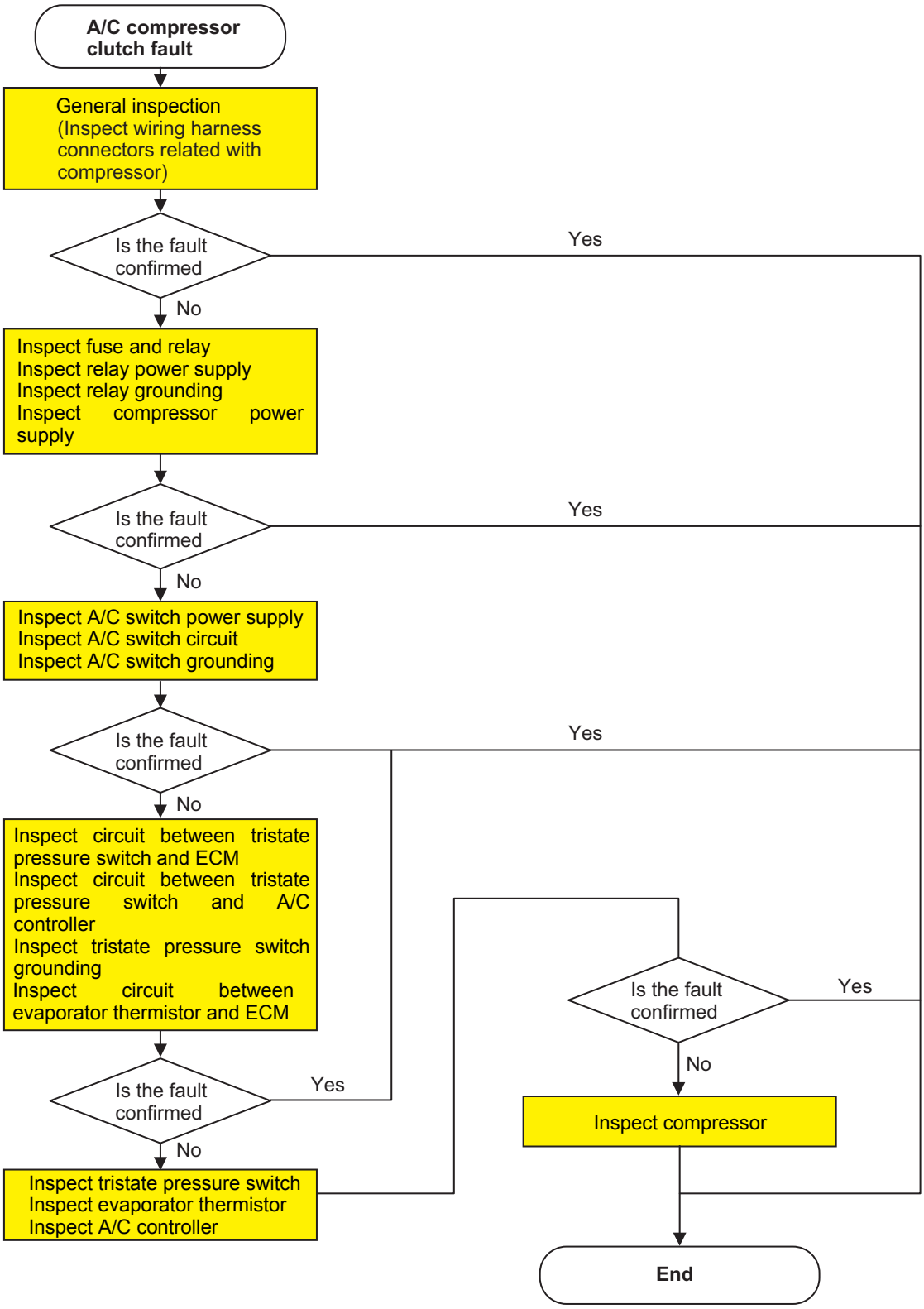


| Test Conditions | Details/Results/Actions |
|---|---|
| 16.Inspect compressor | |
| | A. Replace the compressor with a good one.<br>Is the system normal?<br>**Yes**<br>Replace the compressor.<br>**Refer to: Compressor (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>**No**<br>Replace the ECM.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).** |

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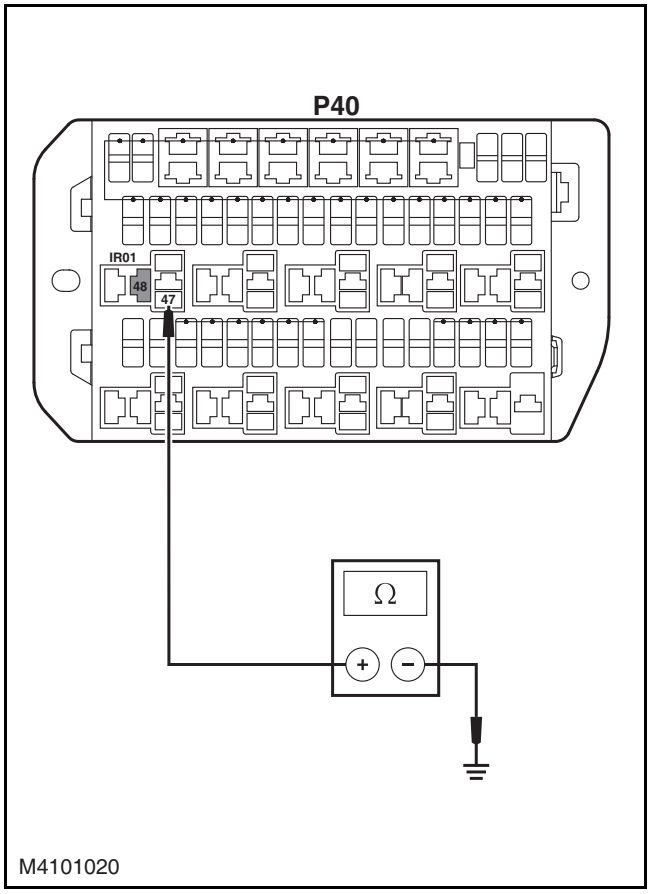


# Diagnosis Procedure for A/C Compressor Clutch Fault (1.2 L)



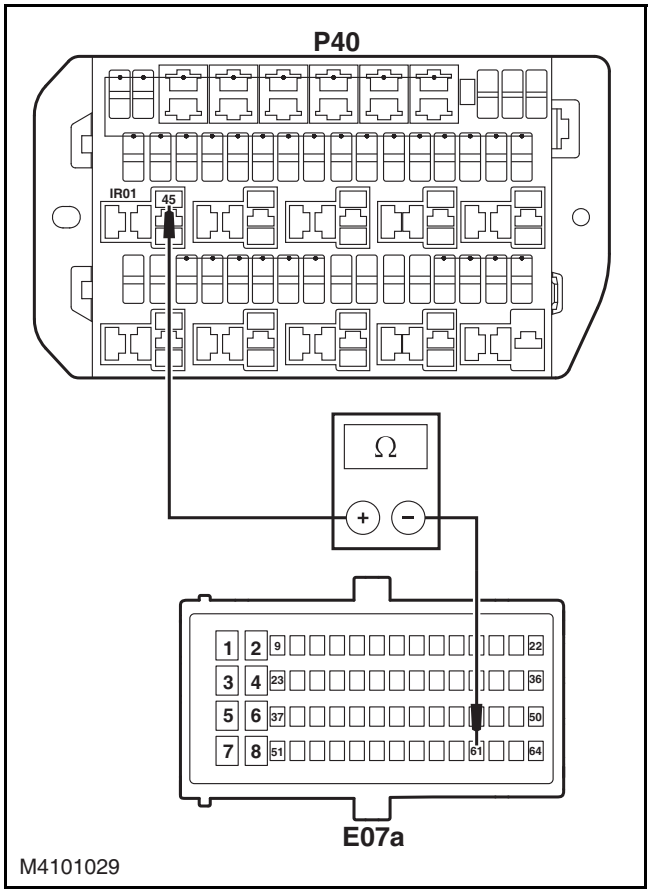
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related with the compressor for damage, poor contact, aging or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect fuse and relay | |
| | A. Inspect the instrument panel fuse box fuse IF18 and relay IR01.<br>**Fuse rated capacity: 10 A**<br>Is the result normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse or relay circuit, replace the fuse with rated capacity or relay. |
| 3. Inspect relay power supply | |
|  | A. Remove instrument panel fuse box relay IR01.<br>B. Measure the resistance between terminals 47, 48 of relay IR01 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Repair the relay power supply circuit. |

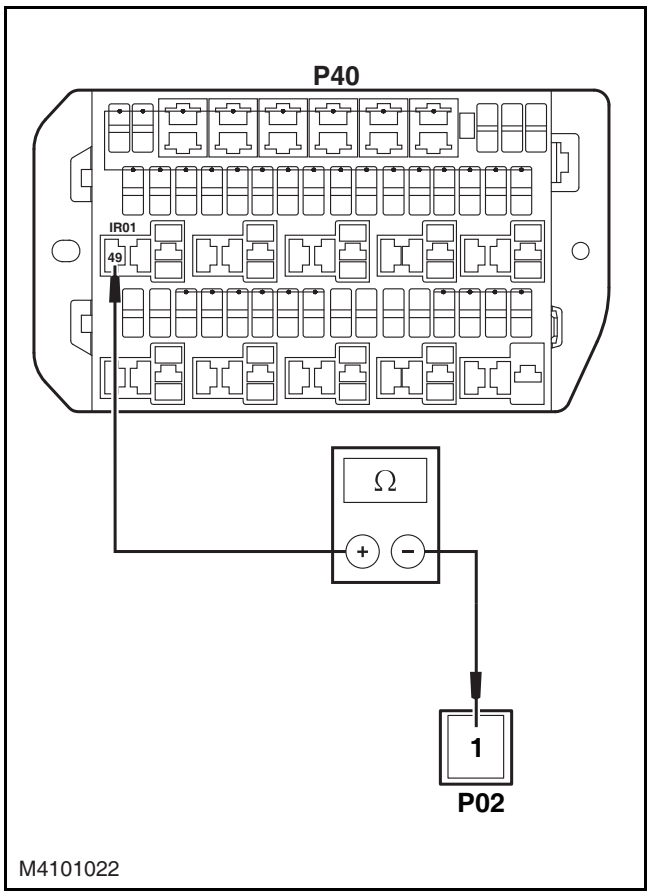
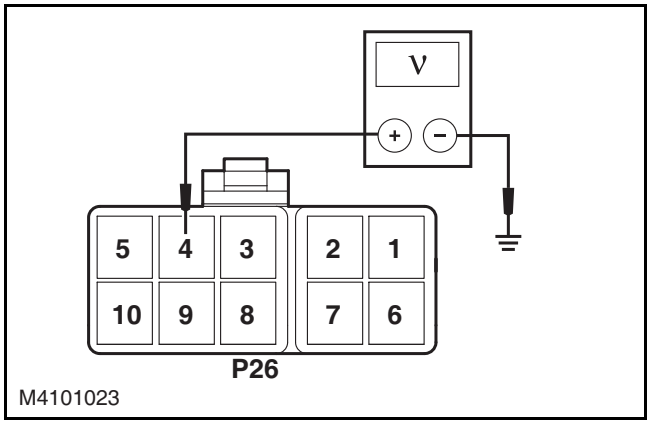
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect relay grounding | |
|  <br>M4101029 | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument panel fuse box relay IR01 and disconnect the ECM wiring harness connector E07a.<br>C. Measure the resistance between terminal 45 of instrument panel fuse box relay IR01 and terminal 61 of ECM wiring harness connector E07a.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the short circuit fault between terminal 45 of instrument panel fuse box relay IR01 and terminal 61 of ECM wiring harness connector E07a. |

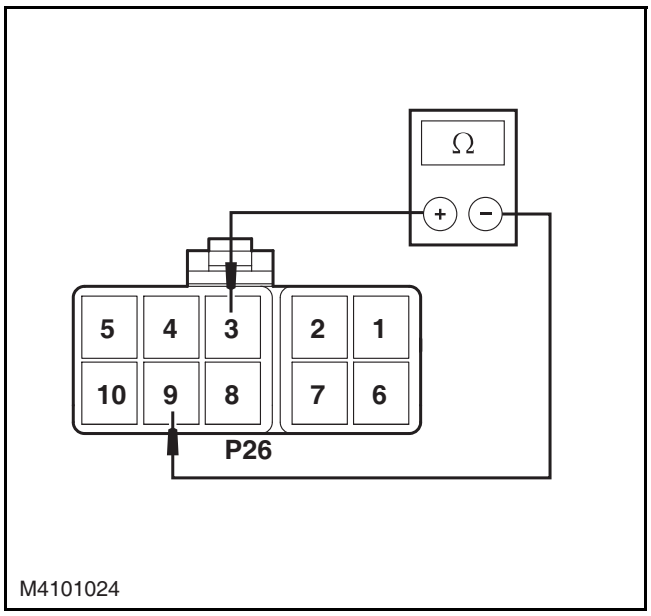
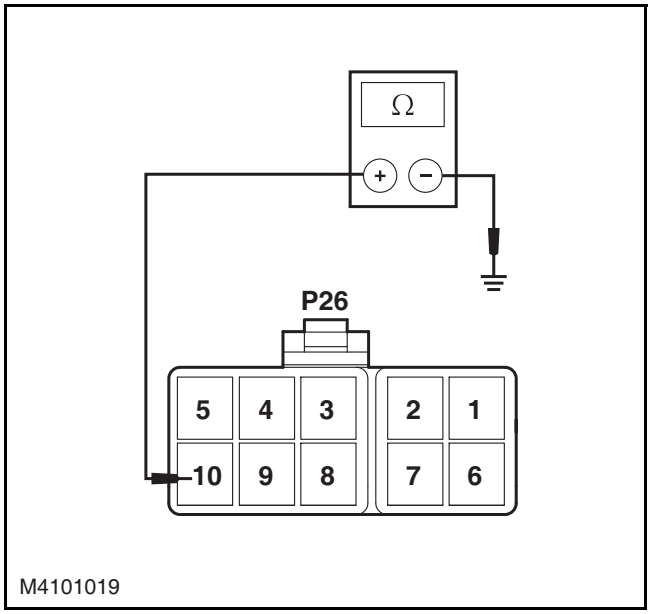
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect compressor power supply | |
|  M4101022 | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument panel fuse box relay IR01 and disconnect the compressor wiring harness connector P02.<br>C. Measure the resistance between terminal 49 of instrument panel fuse box relay IR01 and terminal 1 of compressor wiring harness connector P02.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the short circuit fault between terminal 49 of instrument panel fuse box relay IR01 and terminal 1 of compressor wiring harness connector P02. |
| 6. Inspect A/C switch power supply | |
|  M4101023 | A. Disconnect the A/C controller wiring harness connector P26.<br>B. Turn the ignition switch to "ON".<br>C. Measure the voltage between terminal 4 of A/C controller wiring harness connector P26 and reliable grounding.<br>**Standard voltage: 12 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the short circuit fault between terminal 4 of A/C controller wiring harness connector P26 and terminal 52 of instrument panel fuse box fuse IF26. |

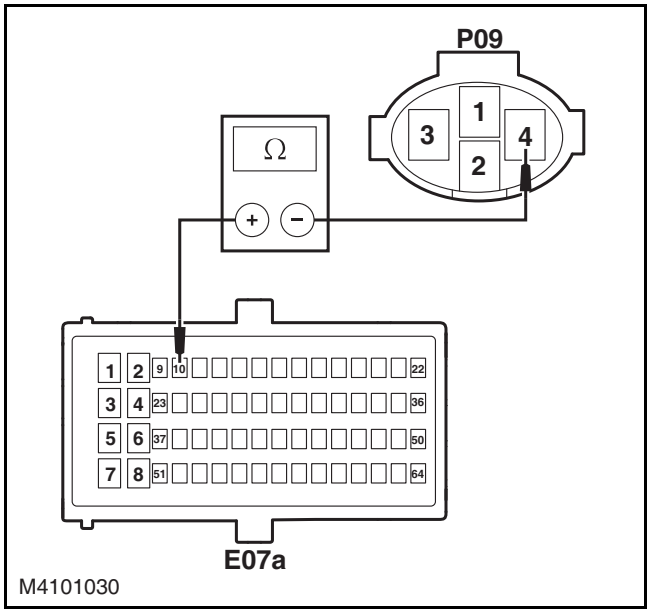
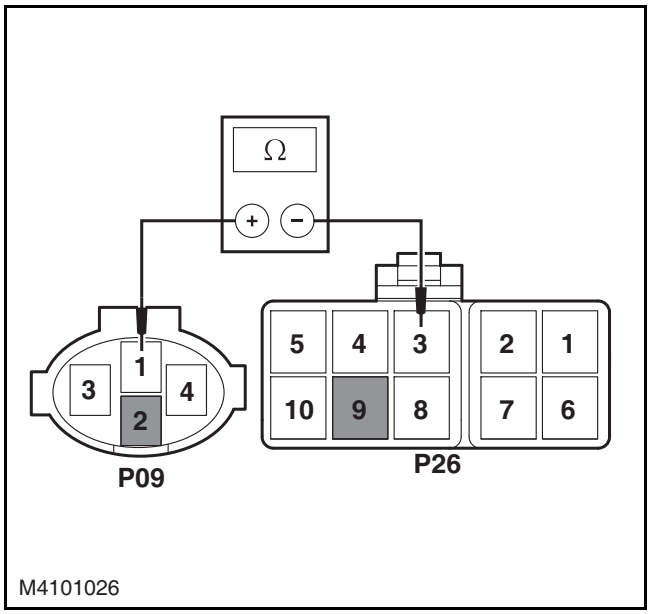
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect A/C switch circuit | |
|  M4101024 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminals 3 and 9 of A/C controller wiring harness connector P26.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminals 3 and 9 of A/C controller wiring harness connector P26. |
| 8. Inspect A/C switch grounding | |
|  M4101019 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminal 10 of A/C controller wiring harness connector P26 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 10 of A/C controller wiring harness connector P26 and grounding G106. |

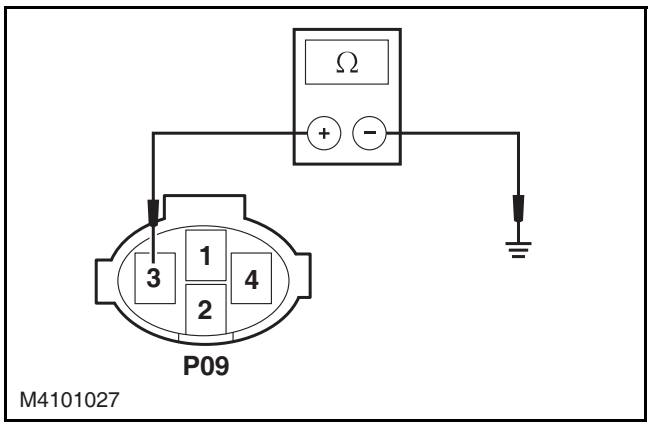
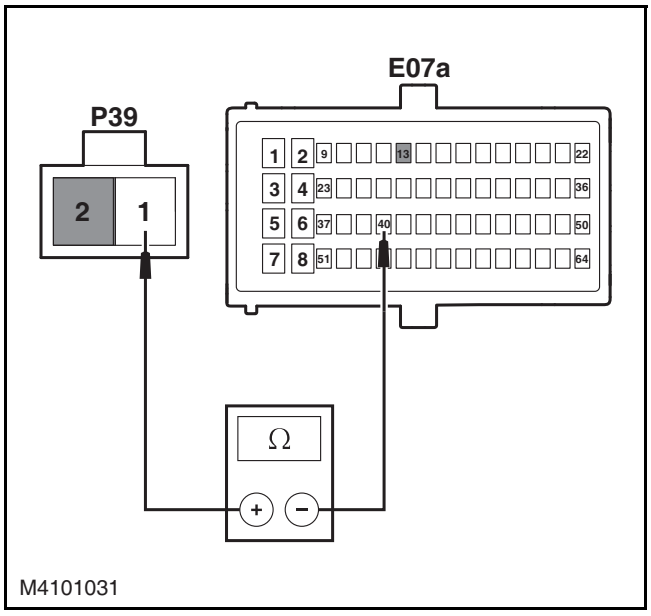
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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect circuit between tristate pressure switch and ECM | |
|  <br>M4101030 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the tristate pressure switch wiring harness connector P09 and ECM wiring harness connector E07a.<br>C. Measure the resistance between terminal 4 of tristate pressure switch wiring harness connector P09 and terminal 10 of ECM wiring harness connector E07a.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Measure the open circuit fault between terminal 4 of tristate pressure switch wiring harness connector P09 and the terminal 10 of ECM wiring harness connector E07a. |
| 10.Inspect circuit between tristate pressure switch and A/C controller | |
|  <br>M4101026 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the tristate pressure switch wiring harness connector P09 and A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminals 1, 2 of tristate pressure switch wiring harness connector P09 and terminals 3, 9 of A/C controller wiring harness connector P26.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Inspect and repair the open circuit fault between terminals 1, 2 of tristate pressure switch wiring harness connector P09 and the terminals 3, 9 of A/C controller wiring harness connector P26. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 11.Inspect tristate pressure switch grounding | |
|  M4101027 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the tristate pressure switch wiring harness connector P09.<br>C. Measure the resistance between terminal 3 of tristate pressure switch wiring harness connector P09 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 12.<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of tristate pressure switch wiring harness connector P09 and grounding G105. |
| 12.Inspect circuit between evaporator thermistor and ECM | |
|  M4101031 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the evaporator thermistor wiring harness connector P39 and ECM wiring harness connector E07a.<br>C. Measure the resistance between terminals 1, 2 of evaporator thermistor wiring harness connector P39 and terminals 40, 13 of ECM wiring harness connector E07a.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 13.<br>**No**<br>Inspect and repair the open circuit fault between terminals 1, 2 of evaporator thermistor wiring harness connector P39 and terminals 40, 13 of ECM wiring harness connector E07a. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 13.Inspect tristate pressure switch | |
| | A. Replace the tristate pressure switch with a good one.<br>Is the system normal?<br>**Yes**<br>Replace the tristate pressure switch.<br>**Refer to: Tristate Pressure Switch (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>**No**<br>Go to step 14. |
| 14.Inspect evaporator thermistor | |
| | A. Replace the evaporator thermistor with a good one.<br>Is the system normal?<br>**Yes**<br>Replace the evaporator thermistor.<br>**No**<br>Go to step 15. |
| 15.Inspect A/C controller | |
| | A. Replace the A/C controller with a good one.<br>Is the system normal?<br>**Yes**<br>Replace the A/C controller.<br>**Refer to: A/C Controller (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>**No**<br>Go to step 16. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 16.Inspect compressor | |
| | A. Replace the compressor with a good one.<br>Is the system normal?<br>**Yes**<br>Replace the compressor.<br>**Refer to: Compressor (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>**No**<br>Replace the ECM.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).** |

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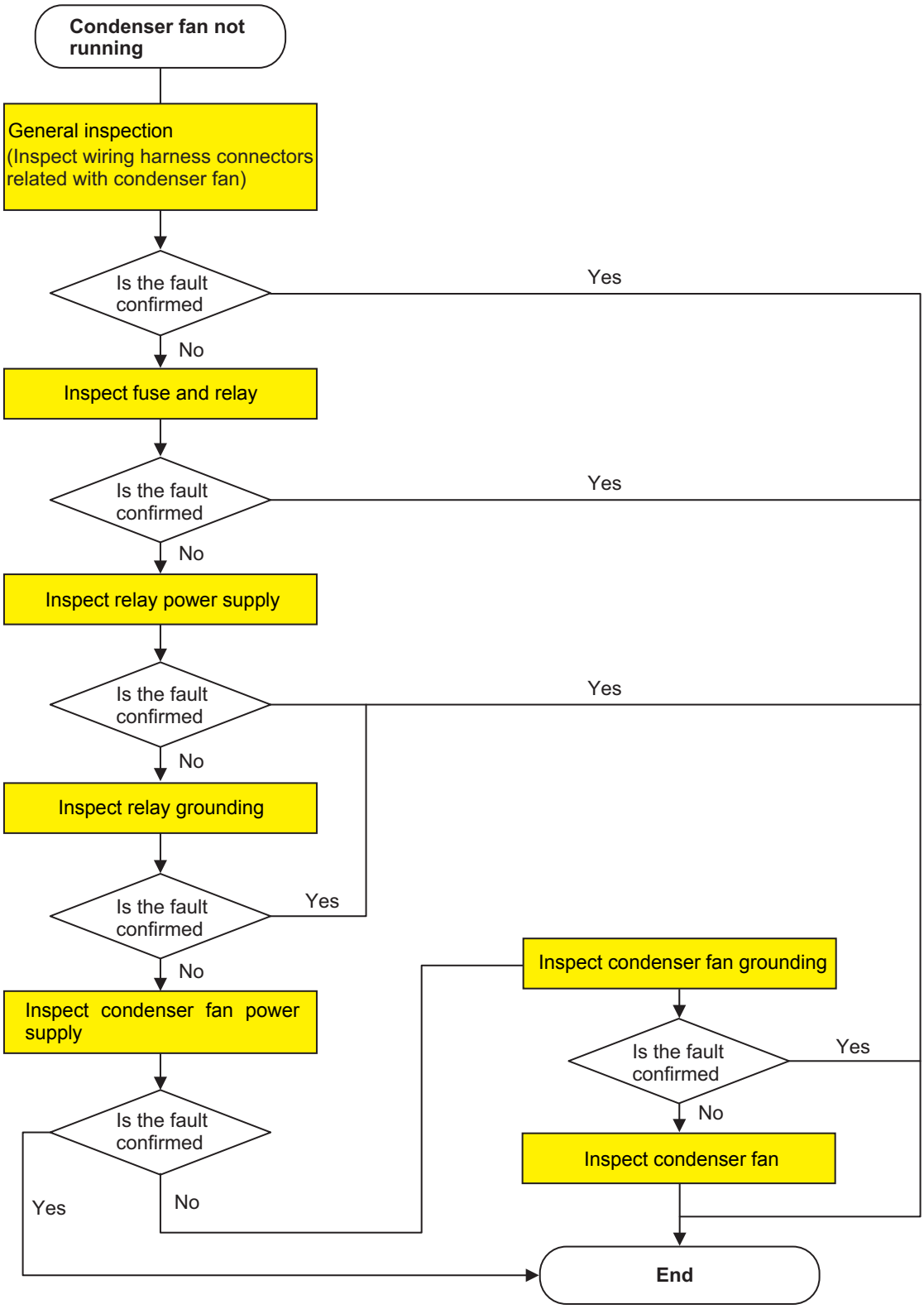
# Diagnosis Procedure for Condenser Fan Constantly Running

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related with the condenser fan for damage, poor contact, aging or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect relay | |
| | A. Remove the instrument panel fuse box relay IR04.<br>Is the system normal?<br>**Yes**<br>Replace the instrument panel fuse box relay IR04.<br>**No**<br>Inspect and repair the short circuit fault between terminal 1 of condenser fan wiring harness connector P13 and the battery power supply. |

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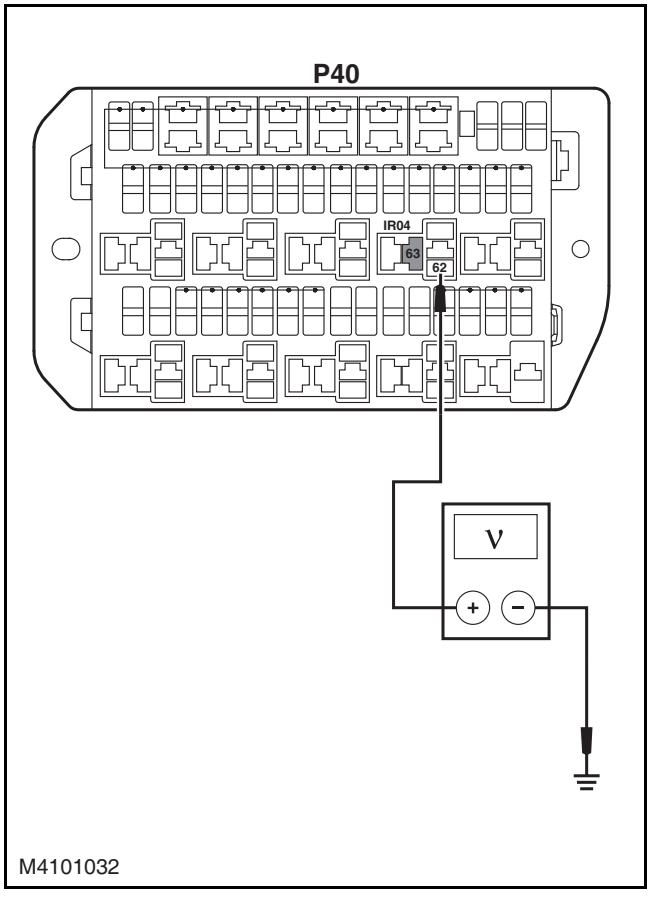


# Diagnosis Procedure for Condenser Fan not Running (1.0 L)



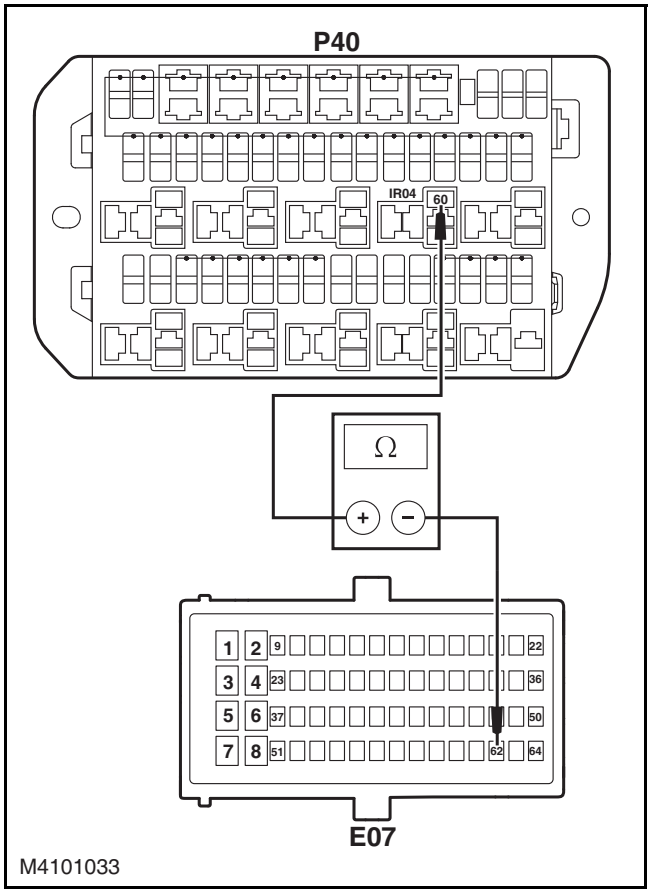
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related with the condenser fan for damage, poor contact, aging or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect fuse and relay | |
| | A. Inspect the instrument panel fuse box fuse IF04 and relay IR04.<br>**Fuse rated capacity: 20 A**<br>Is the result normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse or relay circuit, replace the fuse with rated capacity or relay. |
| 3. Inspect relay power supply | |
|  | A. Remove the instrument panel fuse box relay IR04.<br>B. Measure the voltage between terminal 63 of relay IR04 and reliable grounding.<br>C. Measure the voltage between terminal 62 of relay IR04 and reliable grounding.<br>Standard voltage: 12 ~ 14 V<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the short circuit fault between terminal 63 of relay IR04 and terminal 8 of fuse IF04.<br>Inspect and repair the short circuit fault between terminal 62 of relay IR04 and terminal 69 of relay IR05. |

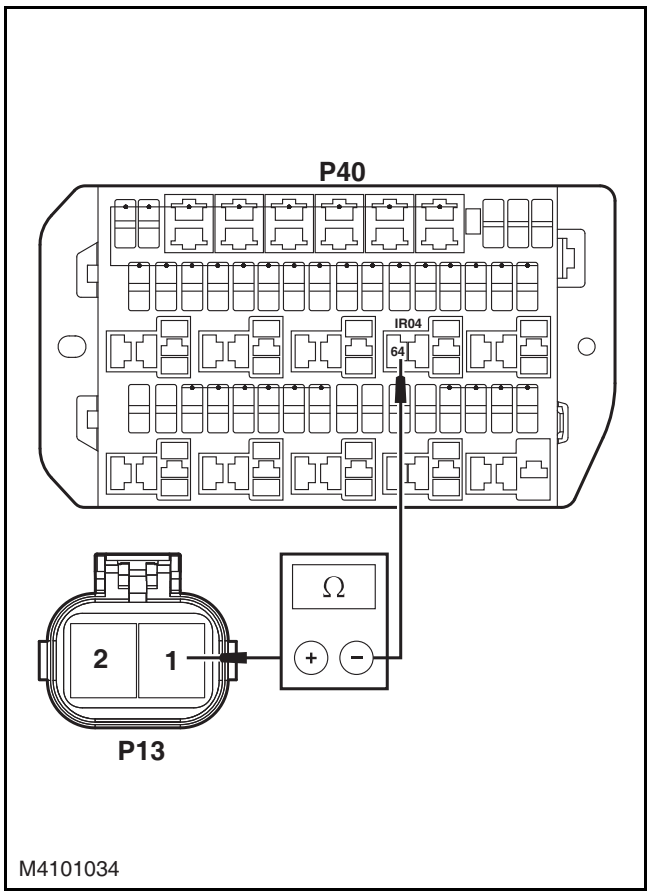
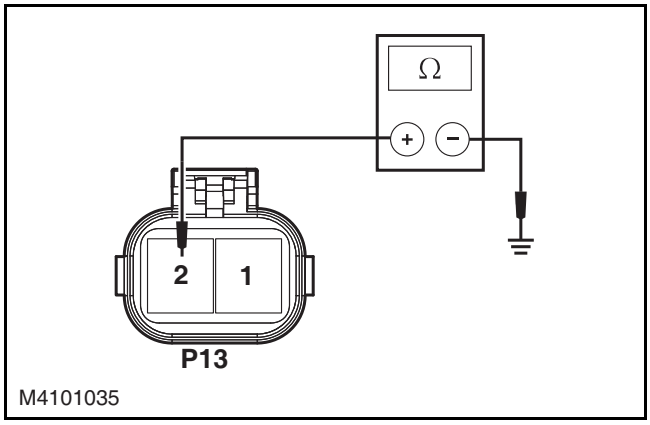
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect relay grounding | |
|  <br>M4101033 | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument panel fuse box relay IR04 and disconnect the ECM wiring harness connector E07.<br>C. Measure the resistance between terminal 60 of instrument panel fuse box relay IR04 and terminal 62 of ECM wiring harness connector E07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the short circuit fault between terminal 60 of instrument panel fuse box relay IR04 and terminal 62 of ECM wiring harness connector E07. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect condenser fan power supply | |
|  M4101034 | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument panel fuse box relay IR04 and disconnect the condenser fan wiring harness connector P13.<br>C. Measure the resistance between terminal 64 of instrument panel fuse box relay IR04 and terminal 1 of condenser fan wiring harness connector P13.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the short circuit fault between terminal 64 of instrument panel fuse box relay IR04 and terminal 1 of condenser fan wiring harness connector P13. |
| 6. Inspect condenser fan grounding | |
|  M4101035 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the condenser fan wiring harness connector P13.<br>C. Measure the resistance between terminal 2 of condenser fan wiring harness connector P13 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the short circuit fault between terminal 2 of condenser fan wiring harness connector P13 and grounding G103. |

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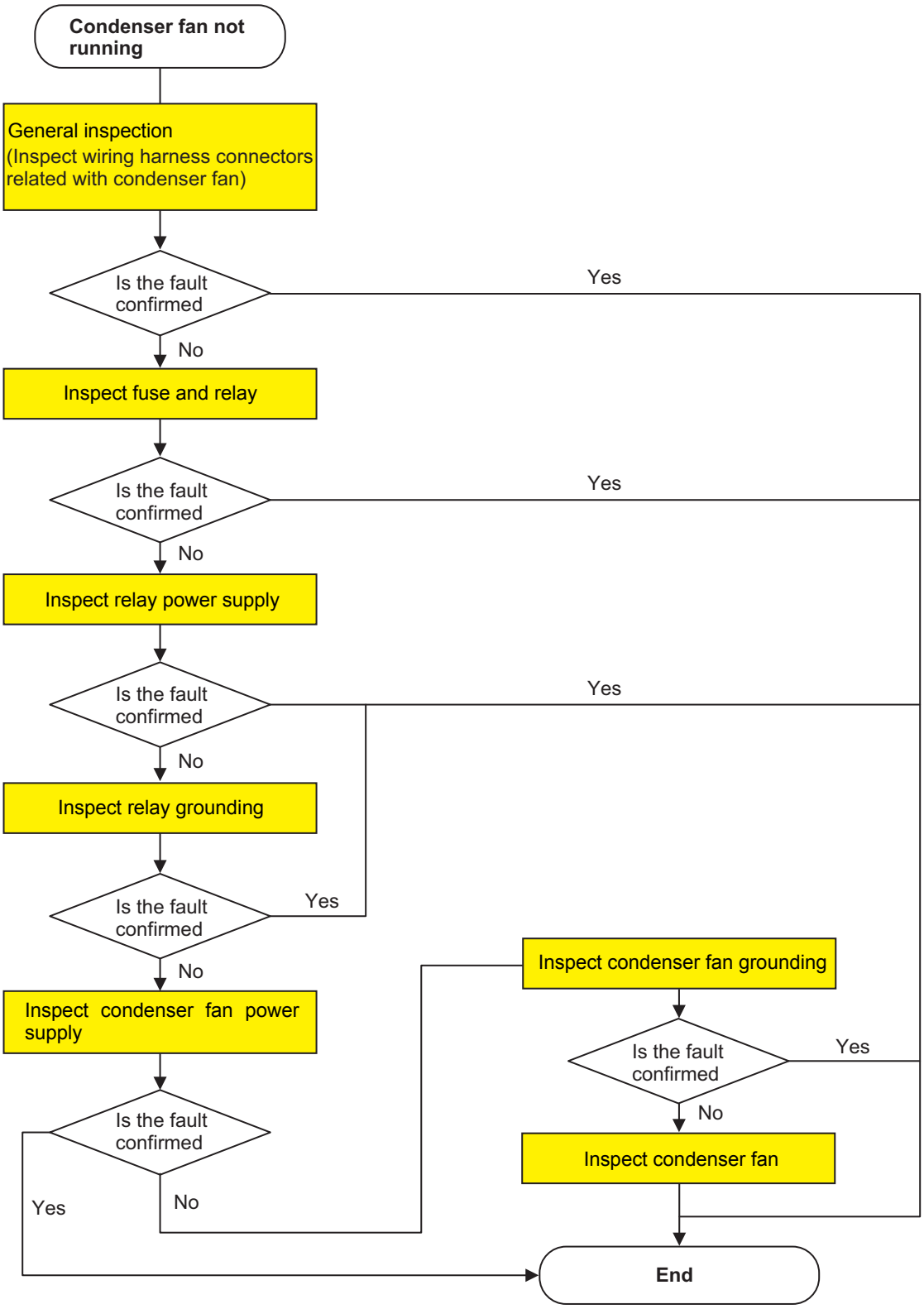


| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect condenser fan | |
| | A. Replace the condenser fan with a good one.<br>B. Disconnect the condenser fan wiring harness connector P13.<br>Is the system normal?<br>**Yes**<br>Replace the condenser fan.<br>**Refer to: Condenser Fan (3.1.4 Cooling System, Removal and Installation).**<br>**No**<br>Replace the ECM.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).** |

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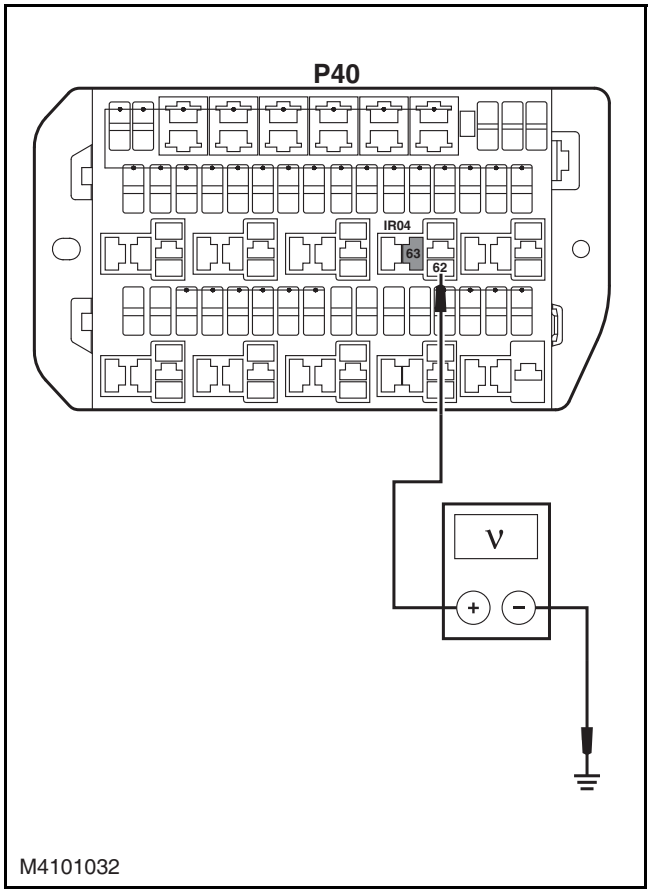


# Diagnosis Procedure for Condenser Fan not Running (1.2 L)



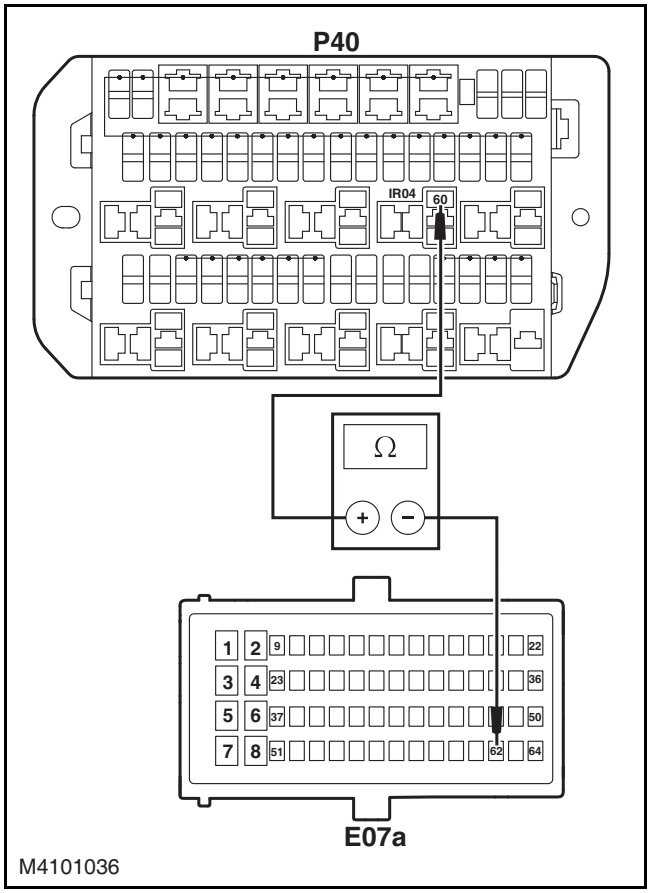
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related with the condenser fan for damage, poor contact, aging or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect fuse and relay | |
| | A. Inspect the instrument panel fuse box fuse IF04 and relay IR04.<br>**Fuse rated capacity: 20 A**<br>Is the result normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse or relay circuit, replace the fuse with rated capacity or relay. |
| 3. Inspect relay power supply | |
|  | A. Remove the instrument panel fuse box relay IR04.<br>B. Measure the voltage between terminal 63 of relay IR04 and reliable grounding.<br>C. Measure the voltage between terminal 62 of relay IR04 and reliable grounding.<br>Standard voltage: 12 ~ 14 V<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the short circuit fault between terminal 63 of relay IR04 and terminal 8 of fuse IF04.<br>Inspect and repair the short circuit fault between terminal 62 of relay IR04 and terminal 69 of relay IR05. |

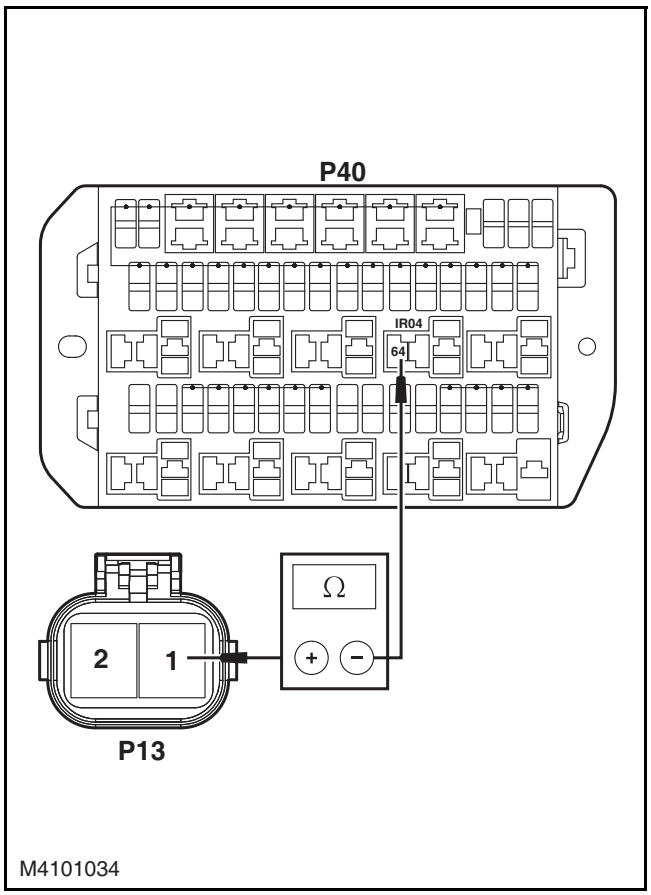
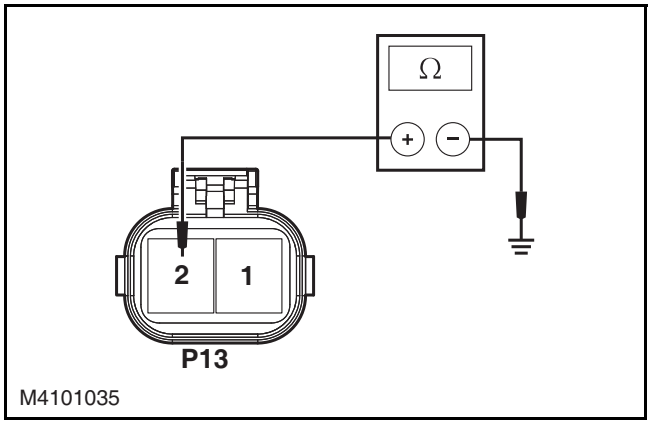
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect relay grounding | |
|  <br>M4101036 | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument panel fuse box relay IR04 and disconnect the ECM wiring harness connector E07a.<br>C. Measure the resistance between terminal 60 of instrument panel fuse box relay IR04 and terminal 62 of ECM wiring harness connector E07a.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the short circuit fault between terminal 60 of instrument panel fuse box relay IR04 and terminal 62 of ECM wiring harness connector E07a. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect condenser fan power supply | |
|  M4101034 | A. Turn the ignition switch to "LOCK".<br>B. Remove the instrument panel fuse box relay IR04 and disconnect the condenser fan wiring harness connector P13.<br>C. Measure the resistance between terminal 64 of instrument panel fuse box relay IR04 and terminal 1 of condenser fan wiring harness connector P13.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the short circuit fault between terminal 64 of instrument panel fuse box relay IR04 and terminal 1 of condenser fan wiring harness connector P13. |
| 6. Inspect condenser fan grounding | |
|  M4101035 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the condenser fan wiring harness connector P13.<br>C. Measure the resistance between terminal 2 of condenser fan wiring harness connector P13 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the short circuit fault between terminal 2 of condenser fan wiring harness connector P13 and grounding G103. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect condenser fan | |
| | A. Replace the condenser fan with a good one.<br>B. Disconnect the condenser fan wiring harness connector P13.<br>Is the system normal?<br>**Yes**<br>Replace the condenser fan.<br>**Refer to: Condenser Fan (3.1.4 Cooling System, Removal and Installation).**<br>**No**<br>Replace the ECM.<br>**Refer to: Engine Control Module (3.1.12 Electronic Control System - M7, Removal and Installation).** |

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## Removal and Installation

# Compressor Belt

**Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

# Compressor - 1.0 L

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

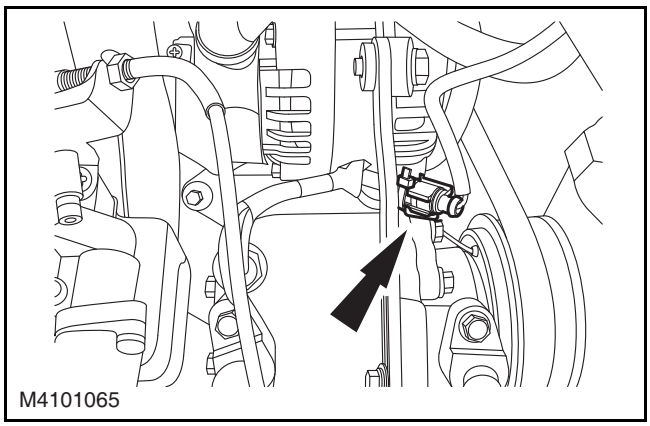
2. Recycle the refrigerant.

   **Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

3. Remove the compressor drive belt.

   **Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

4. Disconnect the compressor wiring harness connector.


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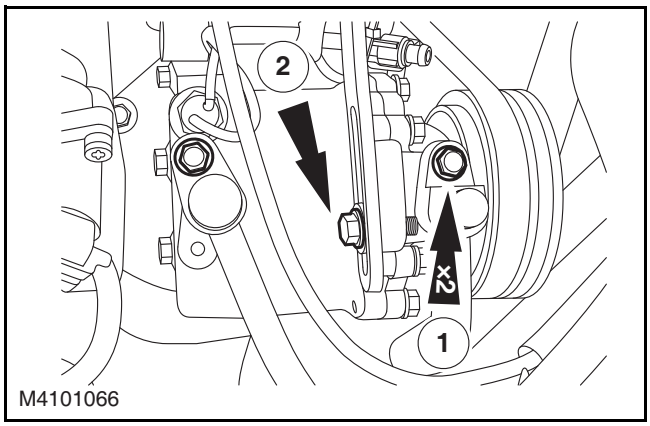
5. Remove the retaining bolts (1) from No. 1 drain pipe and No. 1 suction pipe, and disconnect the pipeline.

   Torque: 14 ~ 17 Nm

**CAUTION: Make sure to use new seal rings.**

6. Remove the compressor adjusting bolts (2).

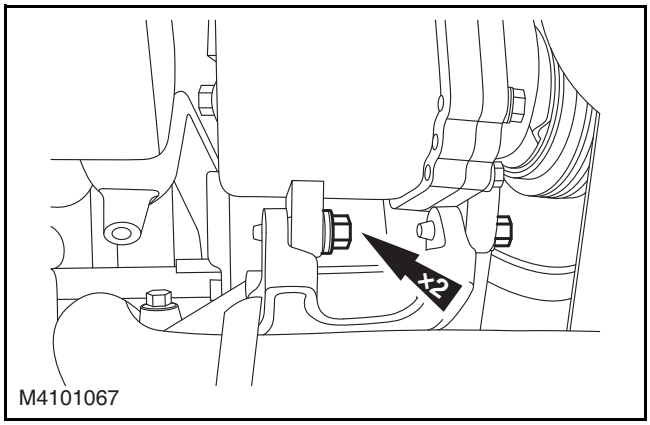
   Torque: 24 ~ 26 Nm



M4101066

7. Remove 2 retaining bolts from the compressor and remove the compressor.

   Torque: 25 ~ 30 Nm



M4101067

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure to use new seal rings.**

2. Fill the refrigerant.

   **Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

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# Compressor - 1.2 L

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Recycle the refrigerant.

   **Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

3. Remove the compressor drive belt.

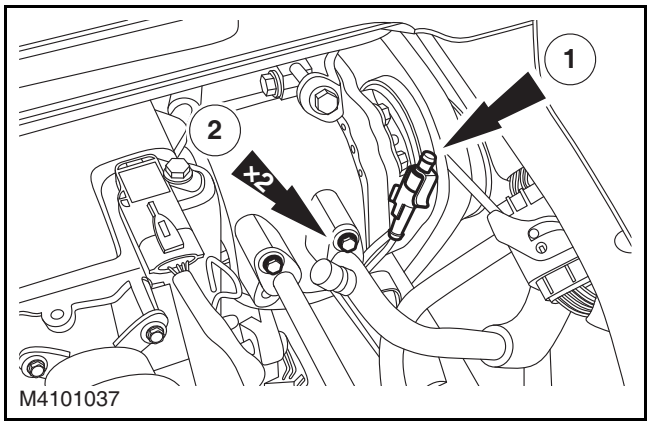
   **Refer to: Accessory Drive Belt (3.1.2 Mechanical System, Removal and Installation).**

4. Disconnect the compressor wiring harness connector (1).

5. Remove the retaining bolts (2) from No. 1 drain pipe and No. 1 suction pipe, and disconnect the pipeline.

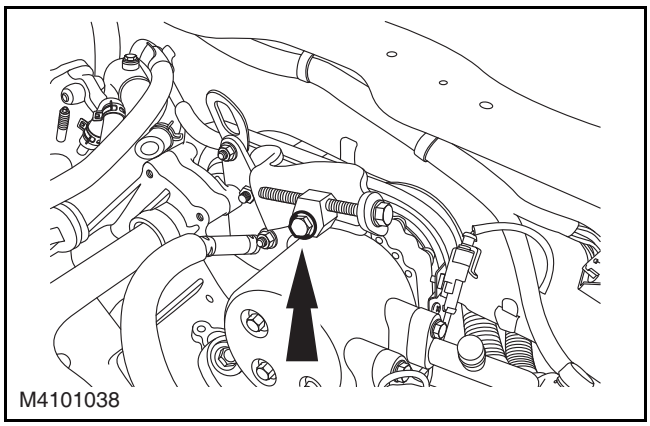
   Torque: 14 ~ 17 Nm

**CAUTION: Make sure to use new seal rings.**




6. Remove the compressor adjusting bolt.

   Torque: 24 ~ 26 Nm

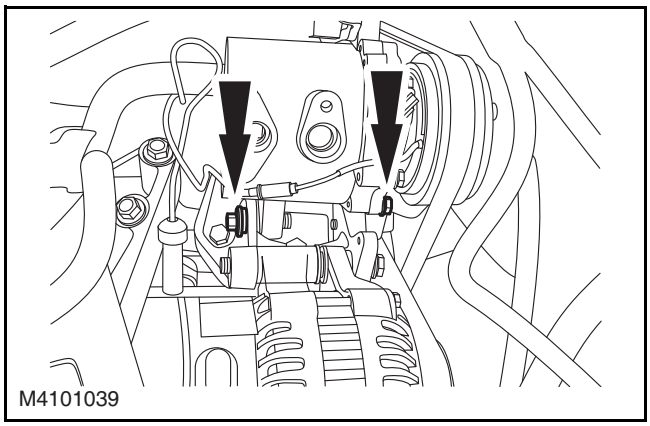


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7. Remove 2 retaining bolts from the compressor.

   Torque: 25 ~ 30 Nm




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure to use new seal rings.**

2. Fill the refrigerant.

   **Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

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# Condenser

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

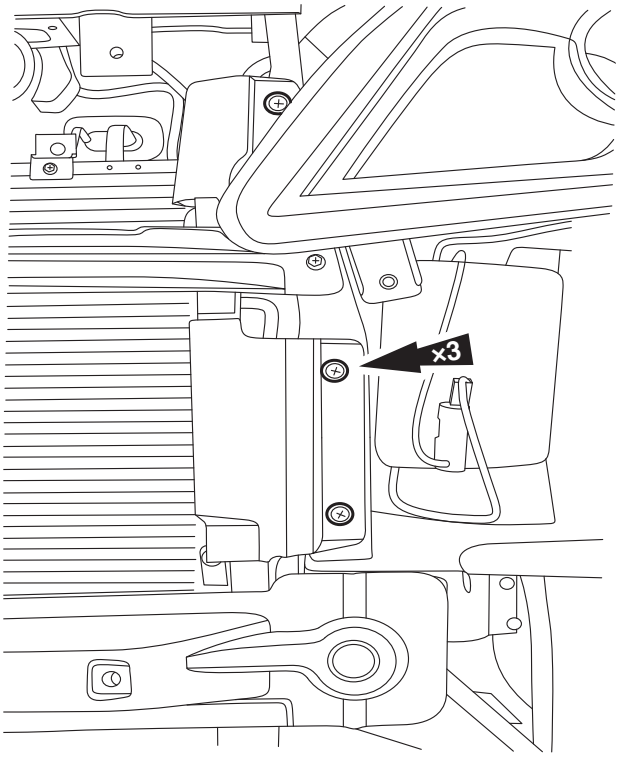
2. Recycle the refrigerant.

   **Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

3. Remove the front bumper.

   **Refer to: Front Bumper (5.1.7 Bumper, Removal and Installation).**

4. Remove 3 retaining screws from the radiator left air dam, and remove the left air dam.

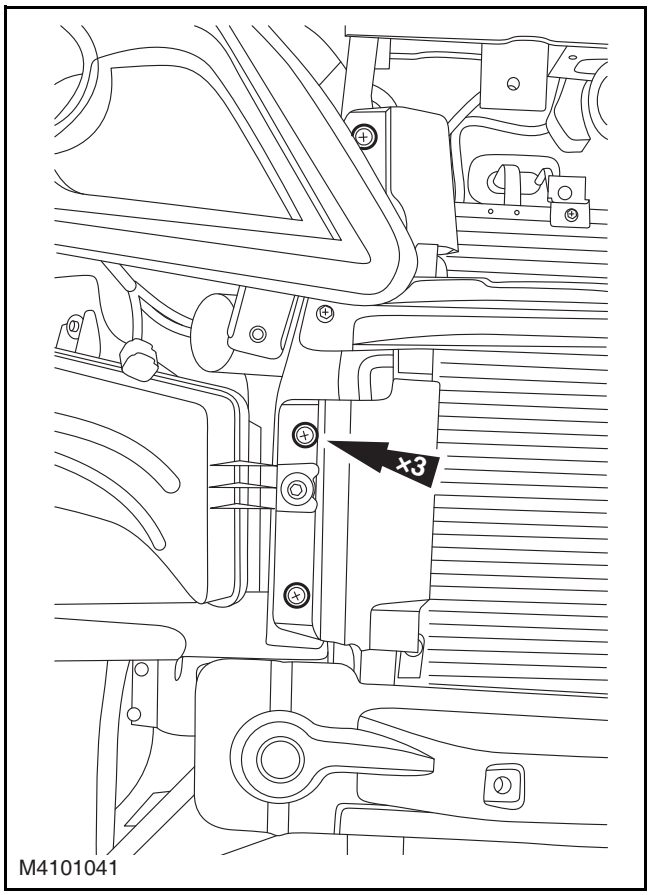


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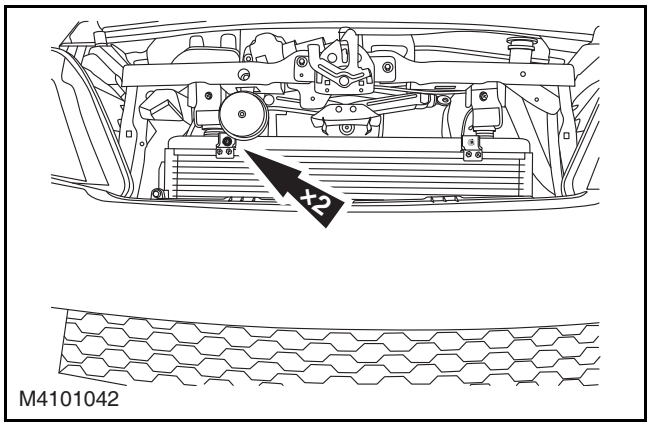


5. Remove 3 retaining screws from the radiator right air dam, and remove the right air dam.




6. Remove 2 condenser retaining bolts.

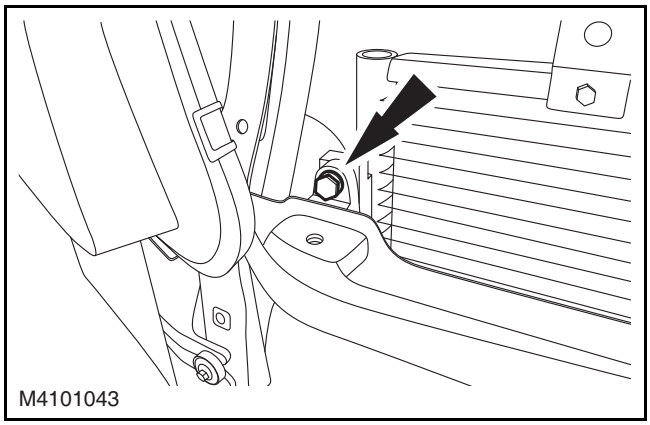
   Torque: 8 ~ 10 Nm




7. Remove the retaining bolt from the condenser inlet pipe and disconnect the pipe.

   Torque: 8 ~ 10 Nm

**CAUTION: Make sure to use new seal rings.**

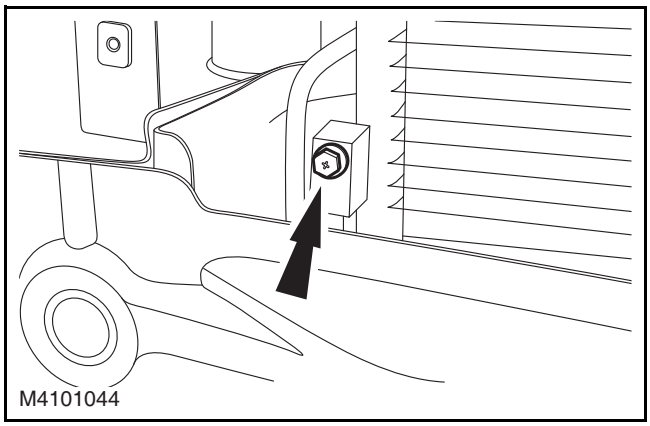


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8. Remove the retaining bolt from the condenser outlet pipe and disconnect the pipe.

   Torque: 8 ~ 10 Nm




9. Remove the condenser.

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure to use new seal rings.**

2. Fill the refrigerant.

   **Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

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# Tristate Pressure Switch

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

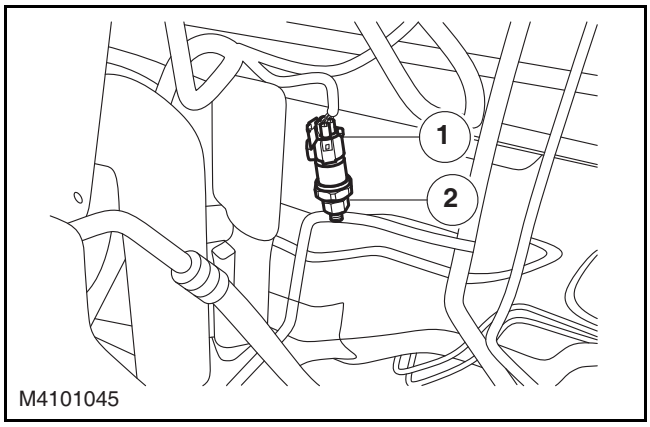
2. Recycle the refrigerant.

   **Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

3. Remove the reservoir.

   **Refer to: Reservoir (3.1.4 Cooling System, Removal and Installation).**

4. Disconnect the tristate pressure switch wiring harness connector (1).
5. Remove the tristate pressure switch (2).




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure to use new seal rings.**

2. Fill the refrigerant.

   **Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

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# A/C Pipeline

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Recycle the refrigerant.

   **Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

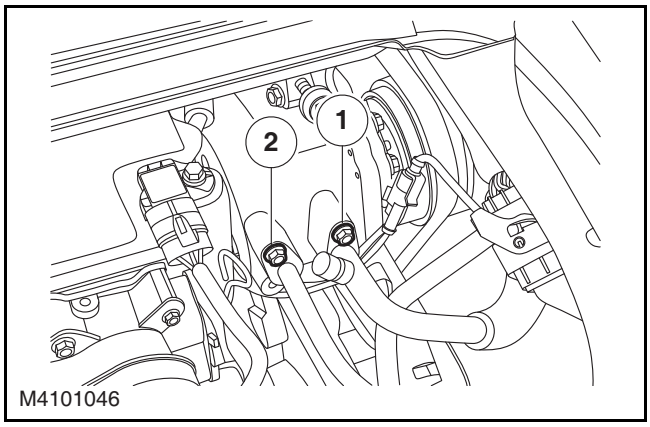
3. Disconnect the A/C pipeline from the compressor.

   - Loosen the connecting nut (1) between No.1 suction pipe and compressor.

   Torque: 14 ~ 17 Nm

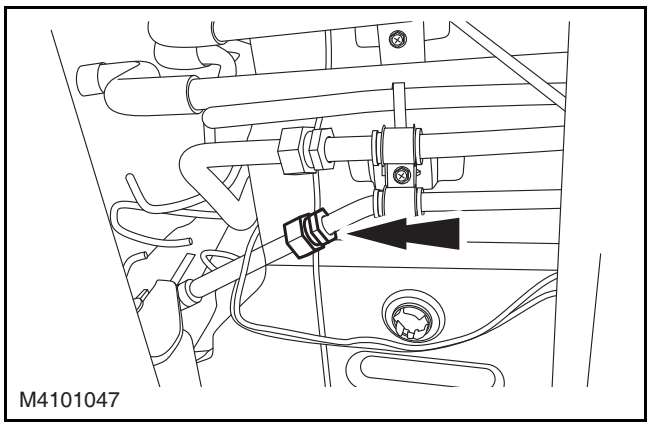
   - Loosen the connecting nut (2) between No.1 drain pipe and compressor.

   Torque: 14 ~ 17 Nm

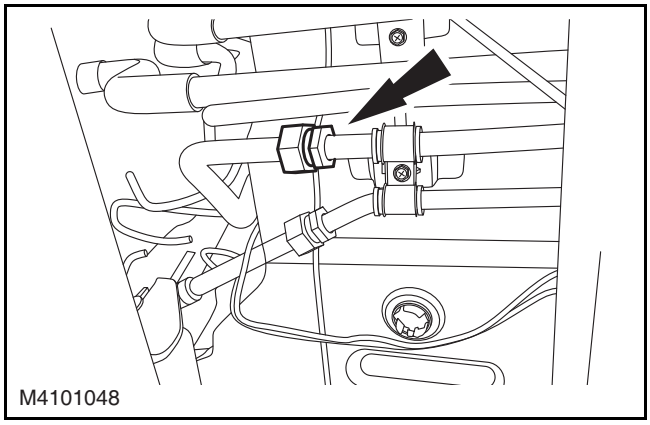


M4101046

4. Loosen the connecting nut between No.1 drain pipe and condenser inlet pipe.


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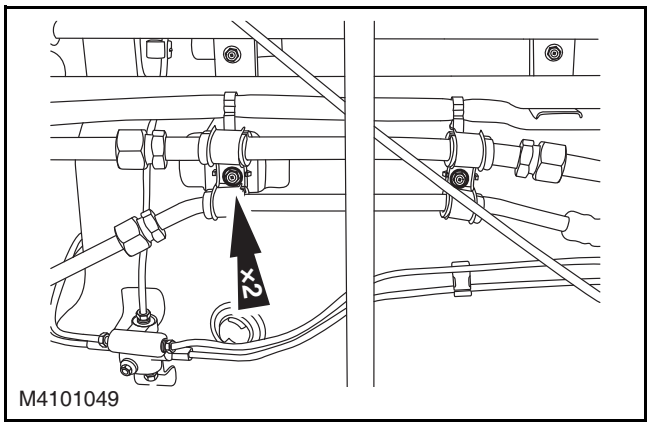
5. Disconnect the connecting nut between No.1 suction pipe and condenser inlet pipe.


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6. Remove 2 retaining bolts between A/C pipeline and vehicle body.

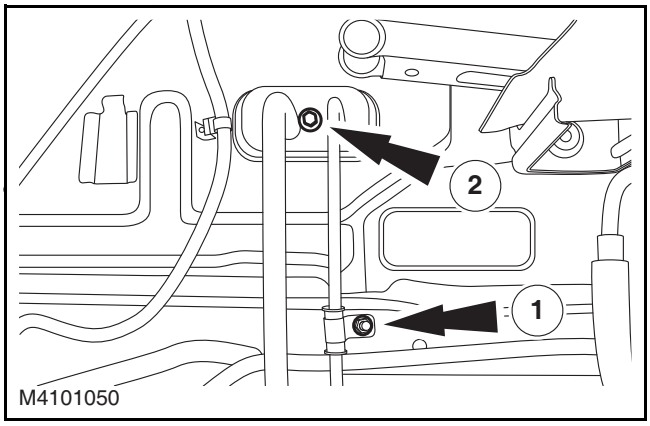



7. Disconnect A/C pipeline from the expansion valve.

   1 Remove the retaining nut (1) from the front evaporator inlet pipe.

   2 Remove the retaining bolt (2) from the front evaporator inlet and outlet pipes and expansion valve and disconnect the pipes.

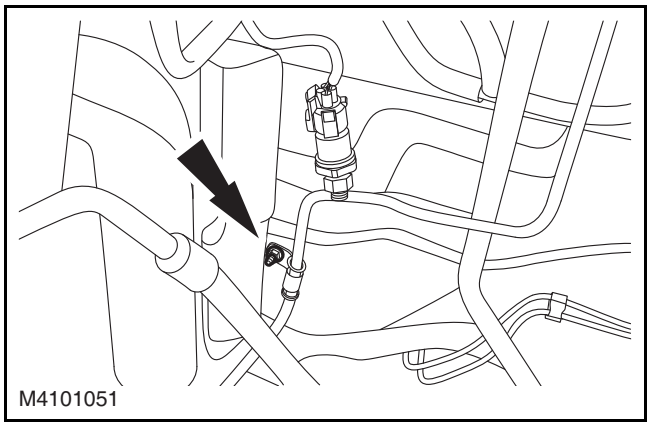
   Torque: 8 ~ 10 Nm




8. Remove the tristate pressure switch.

   **Refer to: Tristate Pressure Switch (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**

9. Remove the retaining nut from the condenser outlet pipe.




10. Remove the condenser.

    **Refer to: Condenser (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**

11. Remove the A/C pipeline.

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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure to use new seal rings.**

**Refer to: Condenser (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**

2. Fill the refrigerant.

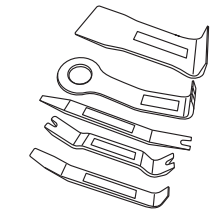
**Refer to: Refrigerant Recycling and Filling (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

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# A/C Controller

### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

## Removal

1. Disconnect the negative battery cable.

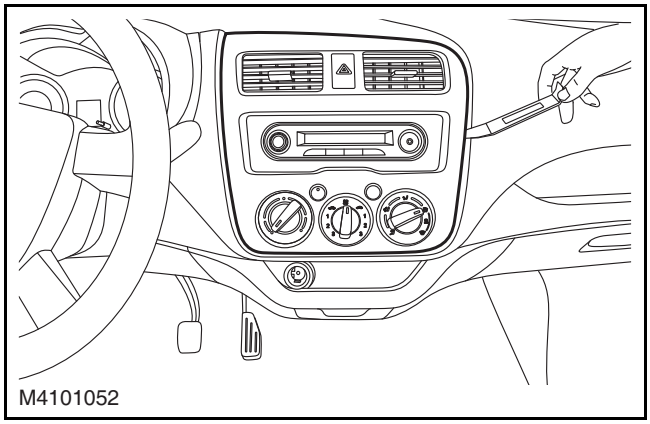
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the glove box.

   **Refer to: Instrument Panel (5.1.6 Instrument Panel and Console, Removal and Installation).**

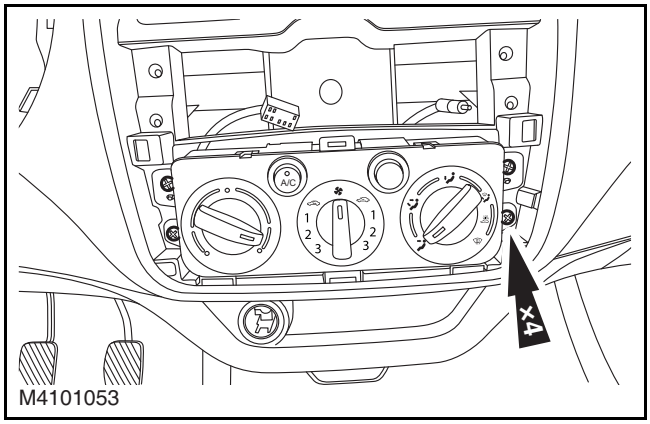
3. Use the special tool to pry the center control panel.

   Special tool: CA501-002


M4101052

4. Remove the A/C controller.

   1 Remove 4 retaining screws from the A/C controller.

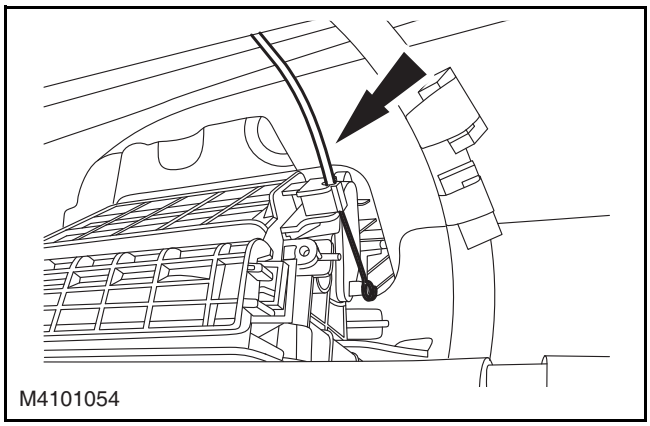


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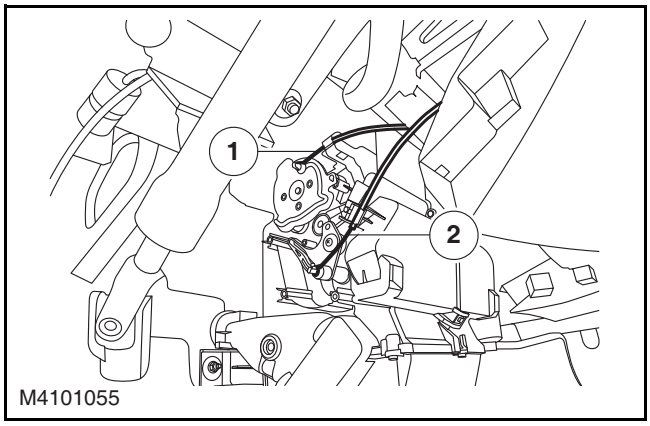
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2 Disconnect the A/C inside/outside circulation control cable.

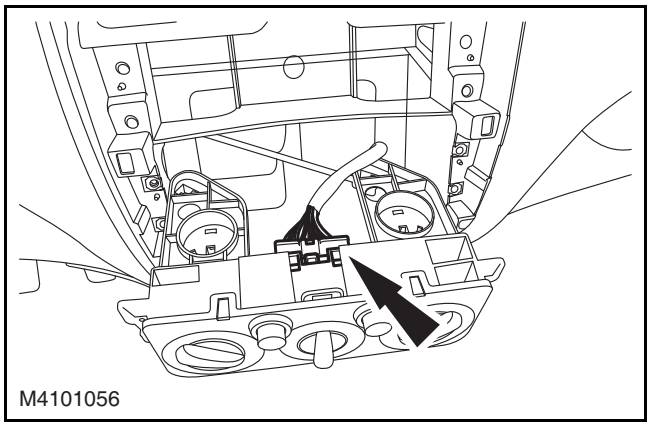

M4101054

3 Disconnect the A/C mode vent control cable (1) and A/C temperature vent control cable (2).



M4101055

4 Disconnect the wiring harness connector and remove the A/C controller.


M4101056

## Installation

**1.** Installation is in the reverse order of removal.

**CAUTION: Make sure that the cables are installed in their original positions and the vent is turned easily and flexibly when installing the cables.**

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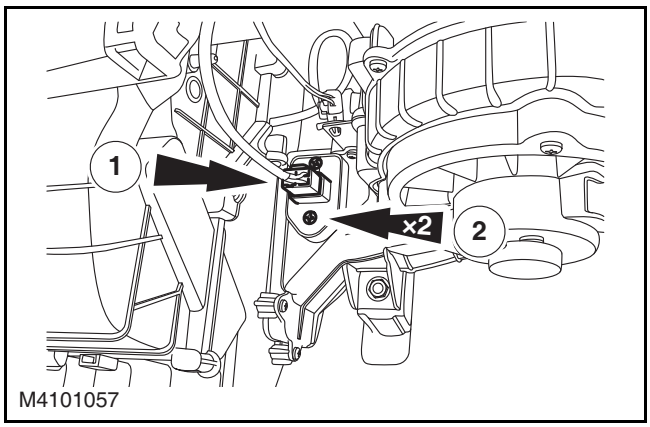
# Governor Resistor

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect the governor resistor wiring harness connector (1).
3. Remove 2 retaining bolts (2) from the governor resistor.




## Installation

1. Installation is in the reverse order of removal.

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# HVAC Assembly

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Recycle the refrigerant.

   **Refer to: Refrigeration System Pressure Inspection (4.1.1 Heating, Ventilation and Air Conditioning, General Inspection).**

3. Drain the engine coolant.

   **Refer to: Coolant Draining and Filling (3.1.4 Cooling System, General Inspection).**

4. Remove the instrument panel.

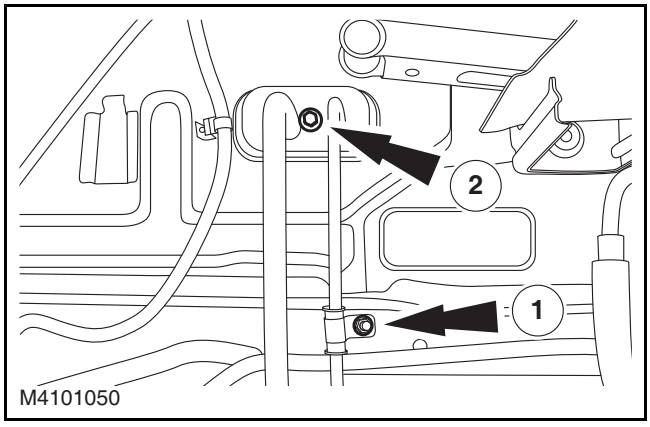
   **Refer to: Instrument Panel (5.1.6 Instrument Panel and Console, Removal and Installation).**

5. Disconnect the A/C pipeline from the expansion valve.

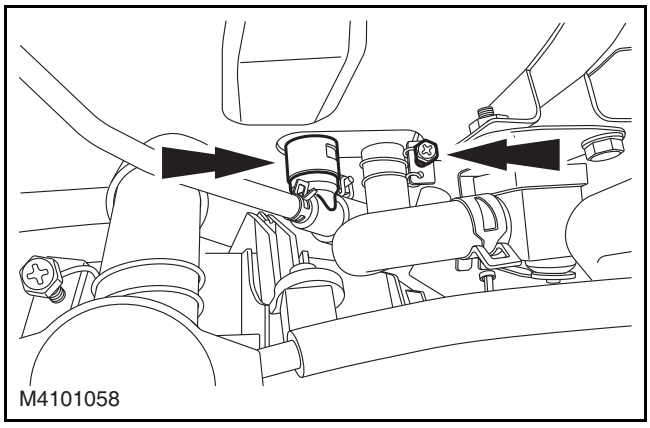
   1 Remove the retaining nut (1) from the front evaporator inlet pipe.

   2 Remove the retaining bolt (2) between front evaporator inlet and outlet pipes and expansion valve and disconnect the pipes.

   Torque: 8 ~ 10 Nm



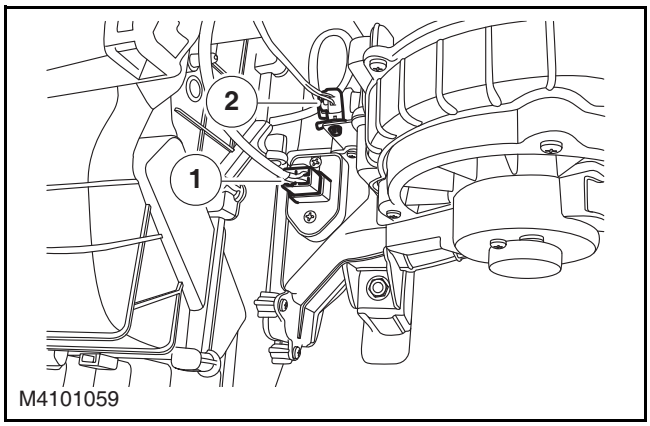

6. Remove the hose of heater water pipeline.



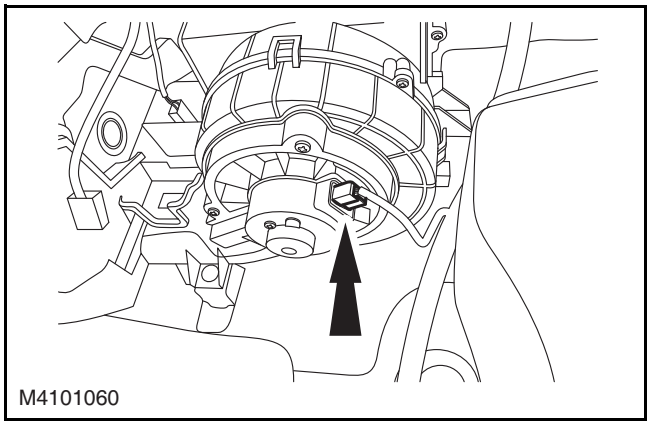
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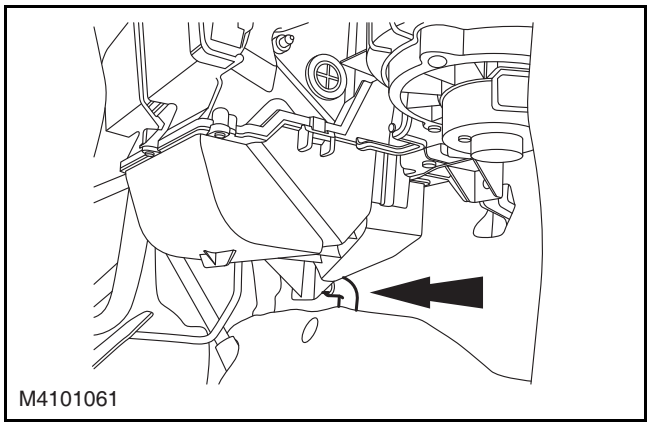
7. Disconnect the governor resistor wiring harness connector (1).
8. Disconnect the evaporator temperature sensor wiring harness connector (2).



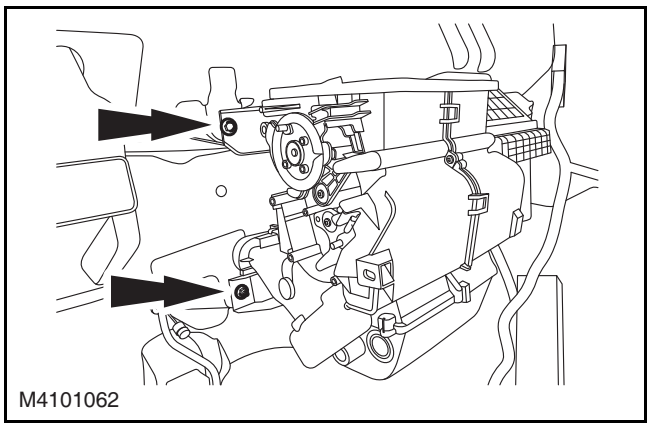

9. Disconnect the blower motor wiring harness connector.




10. Disconnect the A/C drain hose.



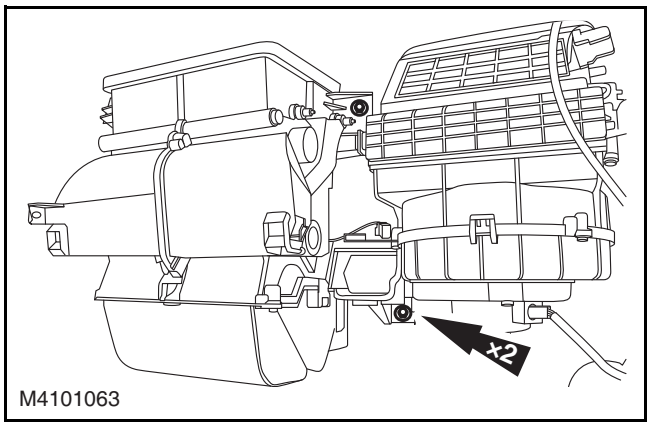

11. Remove the retaining bolt and nut on the left side of HVAC.



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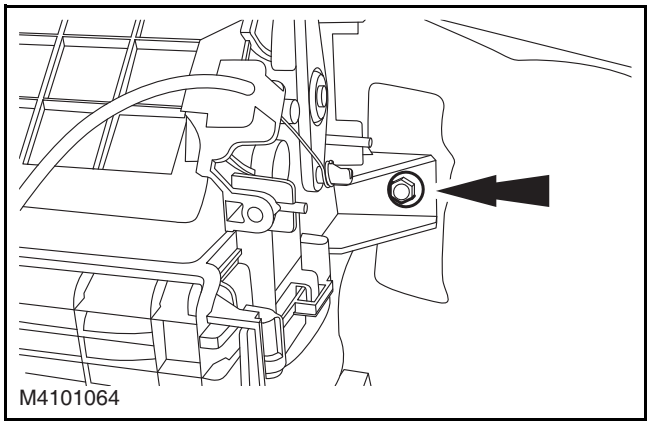


**12.** Remove 2 retaining bolts on the center of HVAC.



M4101063

**13.** Remove the retaining nut on the right side of HVAC.


M4101064

**14.** Remove the HVAC assembly.

## Installation

**1.** Installation is in the reverse order of removal.

**CAUTION: Make sure to use new seal rings.**

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# 4.2 Body Electrical

## 2014 MD/MS201

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## Specifications

# General Specifications

| Item | Rated Voltage | Rated Power |
|---|---|---|
| Instrument cluster panel illumination | 12 V (DV) | - |
| Radio illumination | 12 V (DV) | - |
| A/C control panel illumination | 12 V (DV) | - |
| Hazard warning illumination | 12 V (DV) | - |

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## Description and Operation

# System Overview

When the lighting combination switch is turned to the position lamp or headlamp position, the following components have the panel illumination function:

- Instrument cluster panel
- Radio
- A/C control panel
- Hazard warning lamp

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical or electrical damage or deformation.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Instrument panel<br>• Instrument cluster<br>• Lighting combination switch<br>• Accessory equipment installation | • Fuse<br>• Circuit<br>• Switch |

3. Inspect the system circuit which is accessible or visible.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

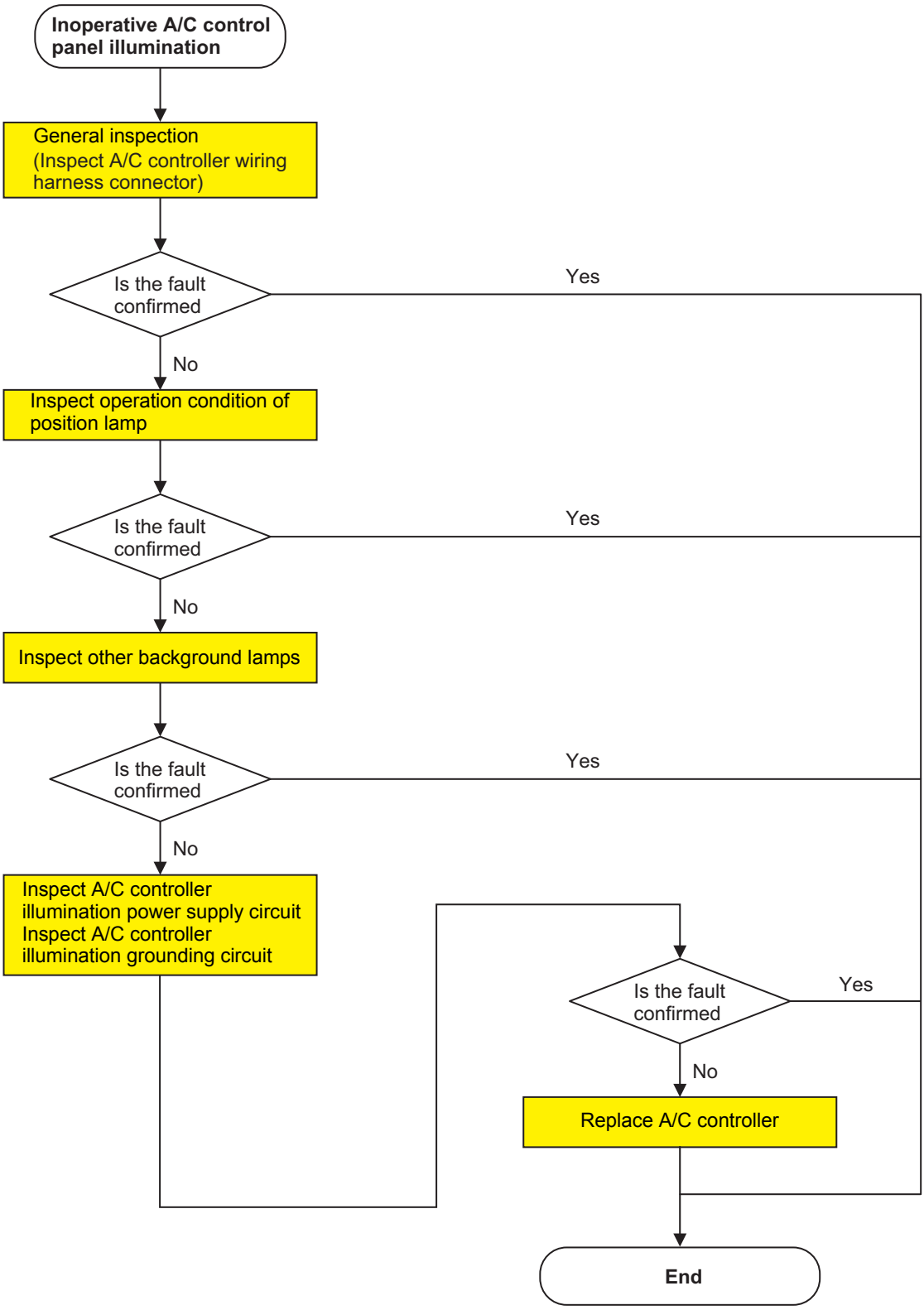
If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Instrument cluster illumination fault | • Fuse and circuit<br>• Lighting combination switch<br>• Instrument cluster | **Refer to: Diagnosis Procedure for Inoperative Instrument Cluster Illumination Lamp with Position Lamp ON (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing).** |
| A/C control panel illumination fault | • Fuse and circuit<br>• Lighting combination switch<br>• A/C control module | **Refer to: Diagnosis Procedure for Inoperative A/C Control Panel Illumination (4.2.1 Instrument Panel and Panel Illumination, Symptom Diagnosis and Testing).** |
| Radio illumination fault | • Fuse and circuit<br>• Lighting combination switch<br>• Radio host | **Refer to: Diagnosis Procedure for Inoperative Radio Illumination (4.2.1 Instrument Panel and Panel Illumination, Symptom Diagnosis and Testing).** |
| Hazard warning lamp switch illumination fault | • Fuse and circuit<br>• Lighting combination switch<br>• Hazard warning lamp switch | **Refer to: Diagnosis Procedure for Inoperative Hazard Warning Lamp Switch Illumination (4.2.1 Instrument Panel and Panel Illumination, Symptom Diagnosis and Testing).** |

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# Diagnosis Procedure for Inoperative A/C Control Panel Illumination



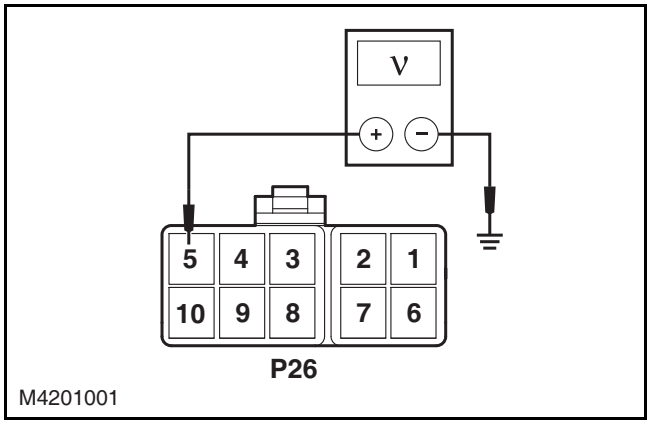
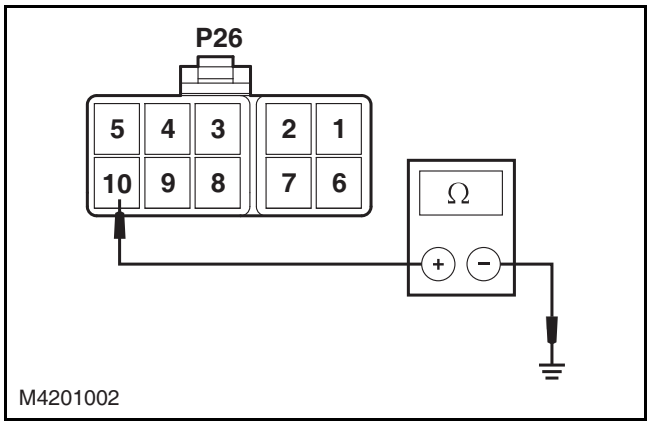
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the A/C controller wiring harness connector for damage, poor contact, aging or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect operation condition of position lamp | |
| | A. Turn the ignition switch to "ON", and turn the combination switch to position lamp.<br>Is the position lamp operating normally?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the position lamp that does not operate.<br>**Refer to: Diagnosis Procedure for Position Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing).** |
| 3. Inspect other background lamps | |
| | A. Inspect the radio background lamp illumination.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>**Refer to: Symptom Chart (4.2.1 Instrument Panel and Panel Illumination, Symptom Diagnosis and Testing).** |

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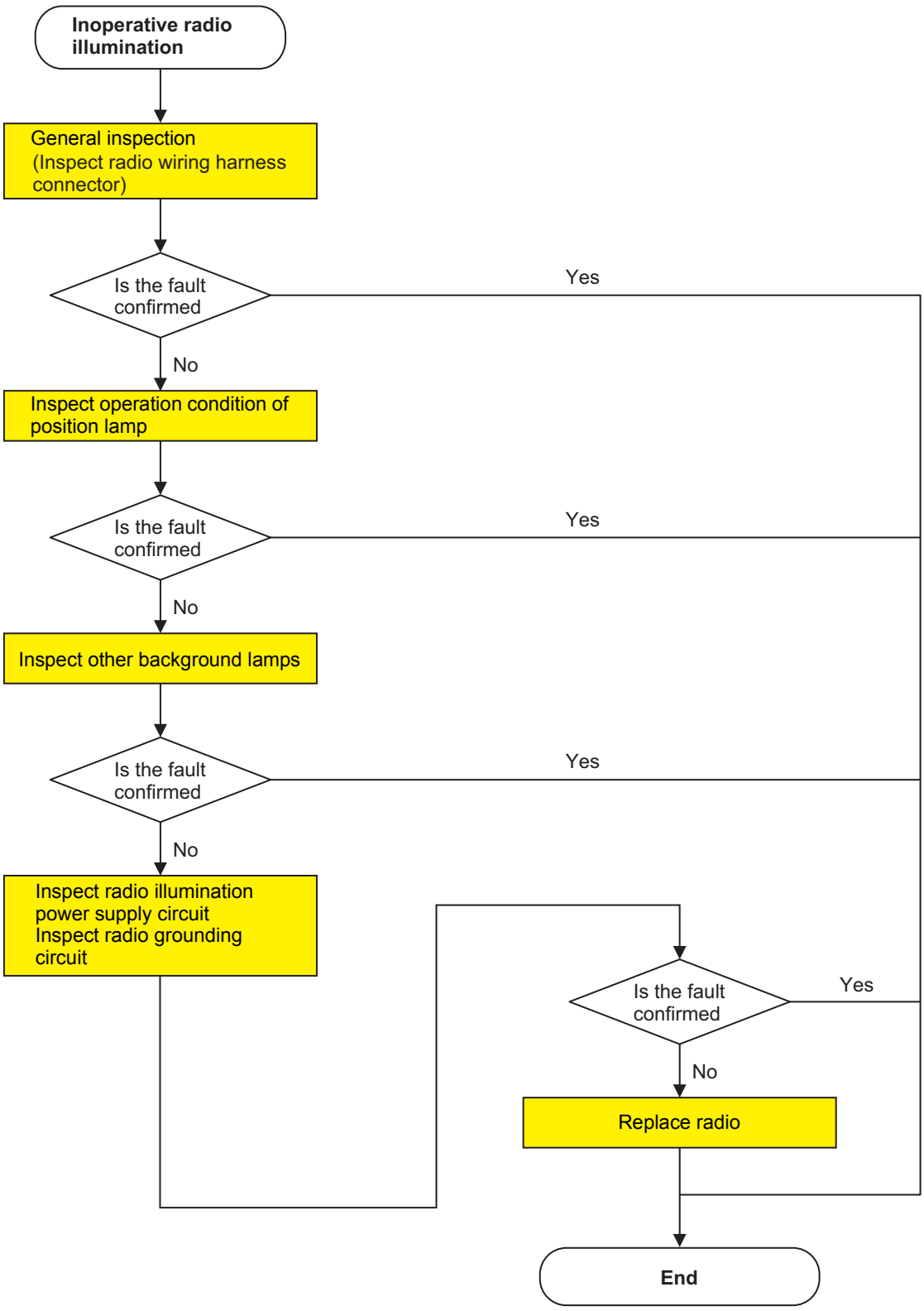


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect A/C controller illumination power supply circuit | |
|  M4201001 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the A/C controller wiring harness connector P26.<br>C. Turn the ignition switch to "ON", and turn the combination switch to position lamp.<br>D. Measure the voltage between terminal 5 of A/C controller wiring harness connector P26 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of A/C controller wiring harness connector P26 and terminal 8 of lighting combination switch wiring harness connector P30. |
| 5. Inspect A/C controller illumination grounding circuit | |
|  M4201002 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the A/C controller wiring harness connector P26.<br>C. Measure the resistance between terminal 10 of A/C controller wiring harness connector P26 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the circuit normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the short circuit fault between terminal 10 of A/C controller wiring harness connector P26 and grounding G106. |
| 6. Replace A/C controller | |
| | A. Turn the ignition switch to "LOCK".<br>B. Replace the A/C controller.<br>**Refer to: A/C Controller (4.1.1 Heating, Ventilation and Air Conditioning, Removal and Installation).**<br>The system is normal. |

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# Diagnosis Procedure for Inoperative Radio Illumination



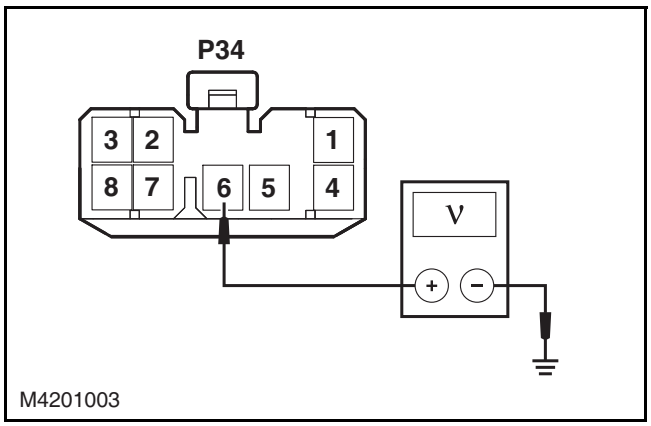
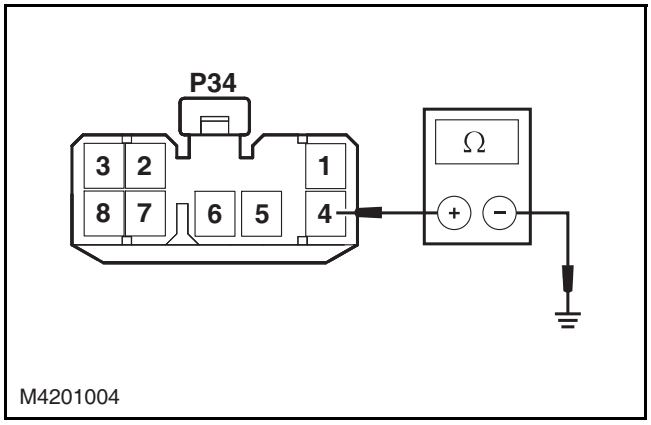
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the radio wiring harness connector for damage, poor contact, aging or loose.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect operation condition of position lamp | |
| | A. Turn the ignition switch to "ON", and turn the combination switch to position lamp.<br>Is the position lamp operating normally?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the position lamp that does not operate.<br>**Refer to: Position Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing).** |
| 3. Inspect other background lamps | |
| | A. Inspect the A/C control panel background lamp illumination.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>**Refer to: Symptom Chart (4.2.1 Instrument Panel and Panel Illumination, Symptom Diagnosis and Testing).** |

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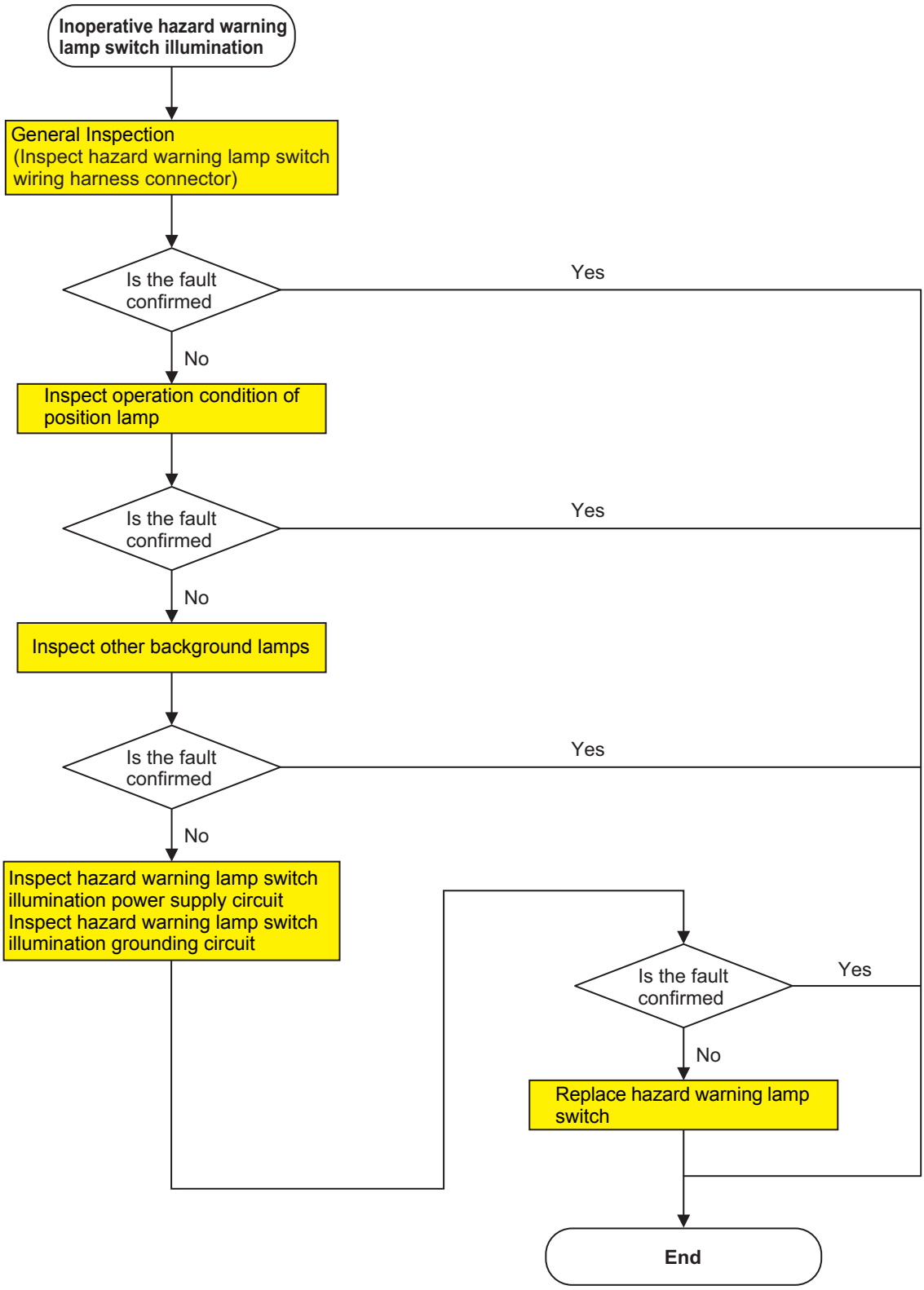


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect radio illumination power supply circuit | |
|  M4201003 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radio wiring harness connector P34.<br>C. Turn the ignition switch to "ON", and turn the combination switch to position lamp.<br>D. Measure the voltage between terminal 6 of radio wiring harness connector P34 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of radio wiring harness connector P34 and terminal 8 of lighting combination switch wiring harness connector P30. |
| 5. Inspect radio grounding circuit | |
|  M4201004 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the radio wiring harness connector P34.<br>C. Measure the resistance between terminal 4 of radio wiring harness connector P34 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of radio wiring harness connector P34 and grounding G106. |
| 6. Replace radio | |
| | A. Turn the ignition switch to "LOCK".<br>B. Replace the radio.<br>**Refer to: Radio (4.2.5 Information and Entertainment System, Removal and Installation).**<br>The system is normal. |

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# Diagnosis Procedure for Inoperative Hazard Warning Lamp Switch Illumination



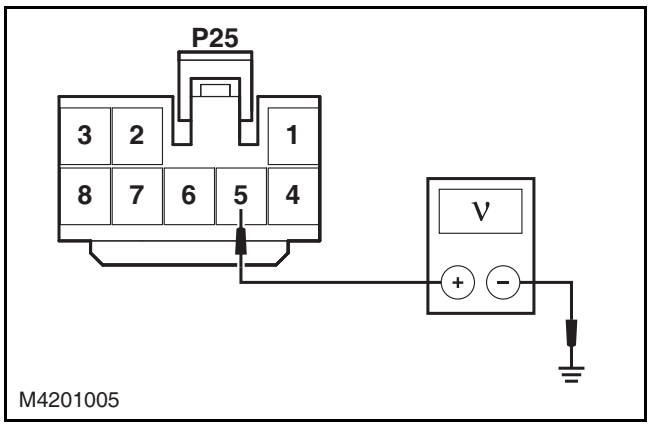
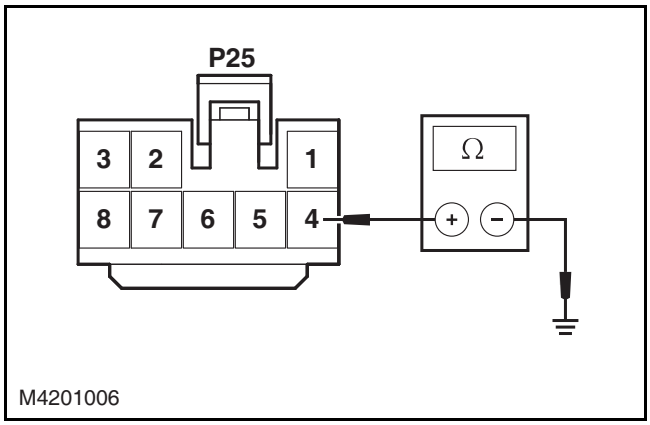
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General Inspection | |
| | A. Inspect the hazard warning lamp switch wiring harness connector for damage, poor contact, aging or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect operation condition of position lamp | |
| | A. Turn the ignition switch to "ON", and turn the combination switch to position lamp.<br>Is the position lamp operating normally?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the position lamp that does not operate.<br>**Refer to: Diagnosis Procedure for Position Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing).** |
| 3. Inspect other background lamps | |
| | A. Inspect the radio background lamp illumination.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>**Refer to: Symptom Chart (4.2.1 Instrument Panel and Panel Illumination, Symptom Diagnosis and Testing).** |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect hazard warning lamp switch illumination power supply circuit | |
|  M4201005 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiring harness connector P25 from the hazard warning lamp switch.<br>C. Turn the ignition switch to "ON", and turn the combination switch to position lamp.<br>D. Measure the voltage between terminal 5 of hazard warning lamp switch wiring harness connector P25 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of hazard warning lamp switch wiring harness connector P25 and terminal 8 of lighting combination switch wiring harness connector P30. |
| 5. Inspect hazard warning lamp switch illumination grounding circuit | |
|  M4201006 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the hazard warning lamp switch wiring harness connector P25.<br>C. Measure the resistance between terminal 4 of hazard warning lamp switch wiring harness connector P25 and grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of hazard warning lamp switch wiring harness connector P25 and grounding G106. |
| 6. Replace hazard warning lamp switch | |
| | A. Turn the ignition switch to "LOCK".<br>B. Replace the hazard warning lamp switch.<br>**Refer to: Hazard Warning Lamp Switch (4.2.6 Lighting System, Removal and Installation).**<br>The system is normal. |

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## Specifications

# General Specifications

| Item | Rated Voltage | Rated Power |
|---|---|---|
| Instrument cluster power supply | 12 V (DC) | - |

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## Description and Operation

# System Overview

The instrument cluster is located on the left side of instrument panel and over the steering column. The meters in the instrument cluster provide the driver with information related to the vehicle performance. When the ignition switch is at "ACC" or "ON", some functions of instrument cluster (IPC) will be tested to inspect if they are normal. Following situations will occur during the test:

- Charging system indicator is illuminated.
- Oil pressure indicator is illuminated.
- Engine malfunction indicator is illuminated briefly.
- Seat belt unfasten indicator is illuminated.

The instrument cluster includes temperature gauge, fuel gauge, speedometer and various indicators.

### Speedometer/Odometer

The speedometer is used to indicate the vehicle speed in "km/h". The vehicle speed signal received by the instrument cluster comes from the vehicle speed sensor VSS at the rear of transmission. The odometer is used to indicate the accumulated vehicle mileage in "km". The trip meter is used to indicate the vehicle mileage after resetting to zero last time.

### Fuel Gauge

The indicator dial of fuel gauge in the instrument cluster is connected with the sensor in the fuel tank. The fuel gauge will indicate the volume of fuel in the fuel tank only when the ignition switch is at "ON" or "ACC".

### Temperature Gauge

The coolant temperature gauge consists of coolant temperature indicator inside the instrument cluster and coolant temperature sensor installed on the engine.

The coolant temperature sensor is a thermistor, whose resistance value decreases as the temperature goes up.

The temperature gauge in the instrument cluster indicates the coolant temperature based on the signals from engine coolant temperature sensor ECT. After long driving or idling in hot weather, the pointer of temperature gauge may point beyond the mid-scale position. If the pointer moves into the red area of upper limit on the dial, then the engine is overheating.

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## Instrument Cluster Indicator

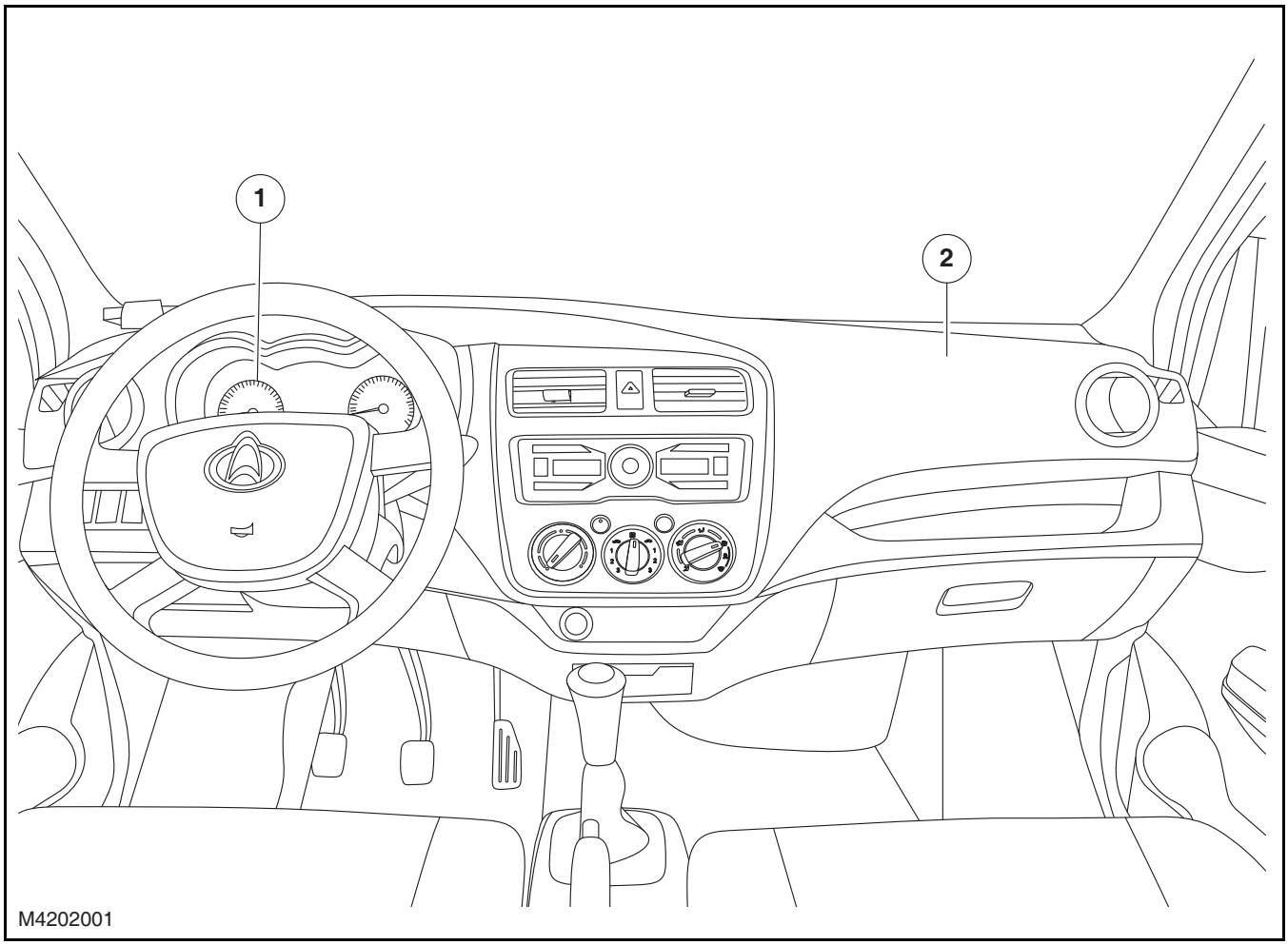
The indicators in the instrument cluster are used to indicate the functions or possible malfunctions of specific systems when driving. The indicators in the instrument cluster provide the users with warnings or instructions. The types of indicators in the instrument cluster are as follows:

| Indicator Symbol | Indicator | Color |
|---|---|---|
|  | Oil pressure warning lamp | Red |
|  | Charging indicator | Red |
|  | Engine malfunction indicator | Amber |
|  | Driver seat belt unfasten indicator | Red |
|  | Low beam indicator | Light green |
|  | High beam indicator | Dark blue |
|  | Front fog indicator | Dark blue |
|  | Rear fog indicator | Amber |
|  | Brake fluid level/parking brake indicator | Red |
|  | Left turn indicator | Light green |
|  | Right turn indicator | Light green |
|  | Fuel level indicator | Amber |
|  | Coolant temperature indicator | Red |
| EPS | EPS indicator (reserved) | Amber |

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# Components Location View

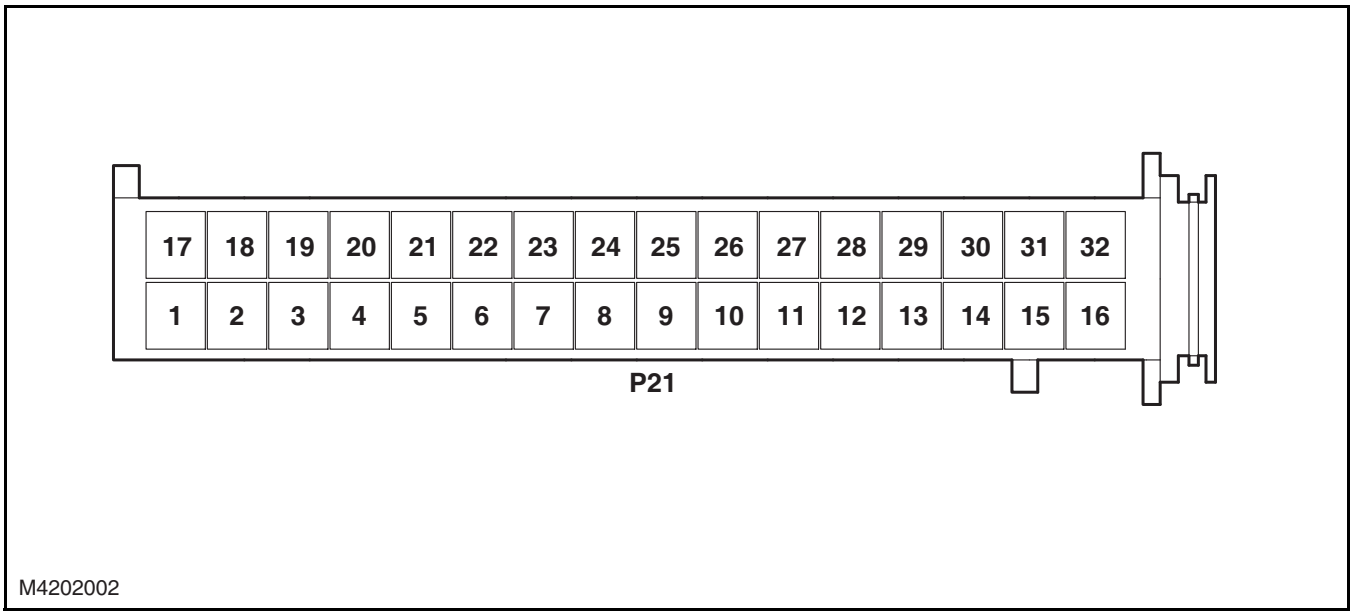



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Instrument cluster | 2 | Instrument panel |

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# Instrument Cluster Terminal List




| Terminal No. | Connection Wire | Terminal Description |
|---|---|---|
| P21-1 | 0.3 GN/YE | Right turn lamp signal |
| P21-2 | 0.3 GN/RD | Left turn lamp signal |
| P21-3 | 0.3 RD | Low beam indicator signal |
| P21-4 | 0.3 RD/WH | High beam indicator signal |
| P21-5 | 0.3 YE/GN | Instrument cluster power supply (IG1) |
| P21-6 | - | - |
| P21-7 | 0.5 GN/BK | Instrument cluster power supply (IG1) |
| P21-8 | 0.5 WH | Instrument cluster power supply (B+) |
| P21-9 | 0.5 BK | Instrument signal grounding |
| P21-10 | 0.3 YE/RD | Fuel level sensor signal |
| P21-11 | 0.3 GN | Vehicle speed signal input |
| P21-12 | 0.3 WH/BU | Crankshaft position sensor signal |
| P21-13 | 0.3 YE/WH | Coolant temperature sensor signal |
| P21-14 | - | - |
| P21-15 | - | - |
| P21-16 | - | - |
| P21-17 | 0.3 RD/YE | Background lamp power supply |
| P21-18 | 0.5 BK | Illumination grounding |
| P21-19 | 0.3 GY | Rear fog indicator signal |
| P21-20 | 0.3 LG | Front fog indicator signal |
| P21-21 | 0.3 BK/RD | Door open indicator signal |
| P21-22 | 0.3 GY/BK | Seat belt unfasten warning signal |
| P21-23 | 0.3 YE/BK | Oil pressure signal |

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| Terminal No. | Connection Wire | Terminal Description |
|---|---|---|
| P21-24 | 0.3 WH/RD | Battery charging indicator signal |
| P21-25 | - | - |
| P21-26 | - | - |
| P21-27 | 0.3 RD/BK | Brake fluid level & parking brake indicator signal |
| P21-28 | 0.3 VT/YE | Engine malfunction indicator signal |
| P21-29 | - | - |
| P21-30 | - | - |
| P21-31 | - | - |
| P21-32 | - | - |

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |
| Diagnostic tool |

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical or electrical damage.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Instrument panel<br>• Instrument cluster trim panel | • Fuse<br>• Circuit<br>• Control switch<br>• Instrument cluster |

3. Inspect the system circuit which is accessible or visible.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Instrument cluster illumination lamp does not illuminate with ignition switch "ON" and position lamp operating | • Circuit fault<br>• Instrument cluster | Refer to: Diagnosis Procedure for Inoperative Instrument Cluster Illumination Lamp with Ignition Switch "ON" and Position Lamp Operating (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Left turn indicator does not blink when turning left | • Circuit fault<br>• Instrument cluster | Refer to: Diagnosis Procedure for Inoperative Left Turn Indicator When Turning Left (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Right turn indicator does not blink when turning right | • Circuit fault<br>• Instrument cluster | Refer to: Diagnosis Procedure for Inoperative Right Turning Indicator When Turning Right (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Front fog indicator does not illuminate with ignition switch "ON" and front fog lamp operating | • Circuit fault<br>• Instrument cluster | Refer to: Diagnosis Procedure for Inoperative Front Fog Indicator with Ignition Switch "ON" and Front Fog Lamp Operating (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Rear fog indicator does not illuminate with ignition switch "ON" and rear fog lamp operating | • Circuit fault<br>• Instrument cluster | Refer to: Diagnosis Procedure for Inoperative Rear Fog Indicator with Ignition Switch "ON" and Rear Fog Lamp Operating (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| High beam indicator does not illuminate with ignition switch "ON" and high beam lamp operating | • Circuit fault<br>• Fuse<br>• Instrument cluster | Refer to: Diagnosis Procedure for Inoperative High Beam Indicator with Ignition Switch "ON" and High Beam Lamp Operating (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Low beam indicator does not illuminate with ignition switch "ON" and low beam lamp operating | • Circuit fault<br>• Fuse<br>• Instrument cluster | Refer to: Diagnosis Procedure for Inoperative Low Beam Indicator with Ignition Switch "ON" and Low Beam Lamp Operating (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Abnormal speedometer indication | • Fuse<br>• Circuit fault<br>• Instrument cluster<br>• Vehicle speed sensor | Refer to: Diagnostic Procedure for Abnormal Speedometer Indication (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Abnormal coolant temperature gauge indication | • Circuit fault<br>• Instrument cluster<br>• ECM | Refer to: Diagnostic Procedure for Abnormal Coolant Temperature Gauge Indication (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Abnormal fuel gauge indication | • Circuit fault<br>• Instrument cluster<br>• Fuel level sensor | Refer to: Diagnostic Procedure for Abnormal Fuel Gauge Indication (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |

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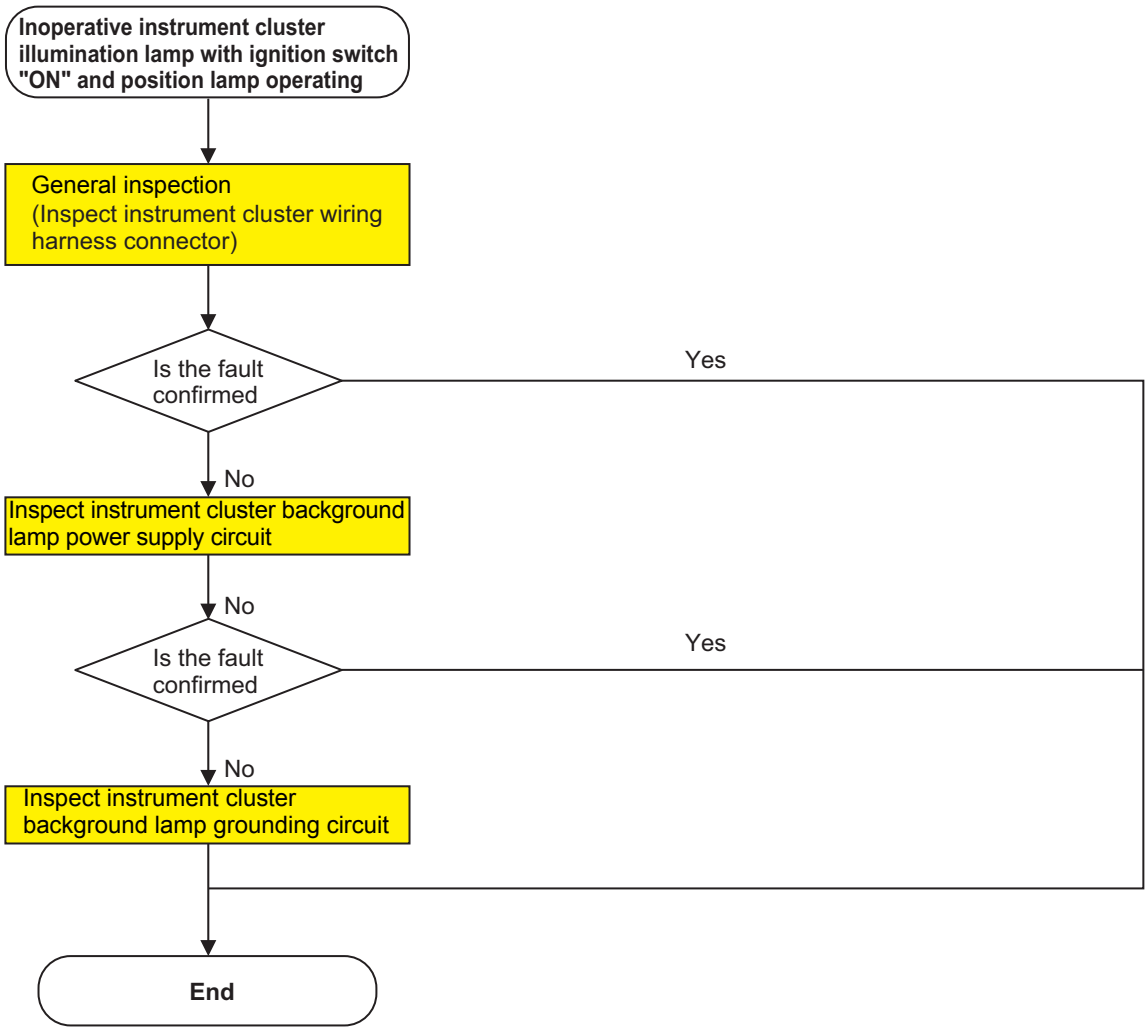


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Engine malfunction indicator does not illuminate with ignition switch "ON" | • Circuit fault<br>• Fuse<br>• Instrument cluster<br>• ECM | Refer to: Diagnosis Procedure for Inoperative Engine Malfunction Indicator with Ignition Switch "ON" (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Oil pressure warning indicator does not illuminate with ignition switch "ON" | • Circuit fault<br>• Fuse<br>• Instrument cluster<br>• Oil pressure sensor | Refer to: Diagnosis Procedure for Inoperative Oil Pressure Warning Indicator with Ignition Switch "ON" (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Charging indicator does not illuminate with ignition switch "ON" | • Circuit fault<br>• Fuse<br>• Instrument cluster<br>• Voltage regulator<br>• Alternator | Refer to: Diagnostic Procedure for Inoperative Charging Indicator with Ignition Switch "ON" (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Parking brake indicator does not illuminate with ignition switch "ON" and vehicle parked | • Circuit fault<br>• Fuse<br>• Instrument cluster<br>• Parking brake switch | Refer to: Diagnosis Procedure for Inoperative Parking Brake Indicator with Ignition Switch "ON" and Vehicle Parked (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |
| Seat belt unfasten indicator does not illuminate with ignition switch "ON" | • Circuit fault<br>• Fuse<br>• Instrument cluster<br>• Seat belt switch | Refer to: Diagnostic Procedure for Inoperative Seat Belt Unfasten Indicator with Ignition Switch "ON" (4.2.2 Instrument Cluster, Symptom Diagnosis and Testing). |

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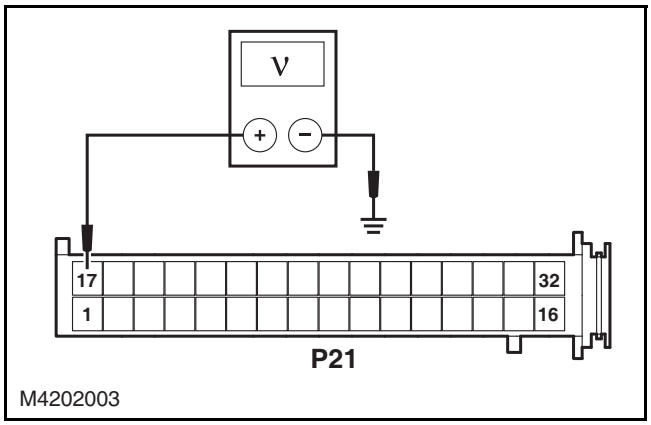
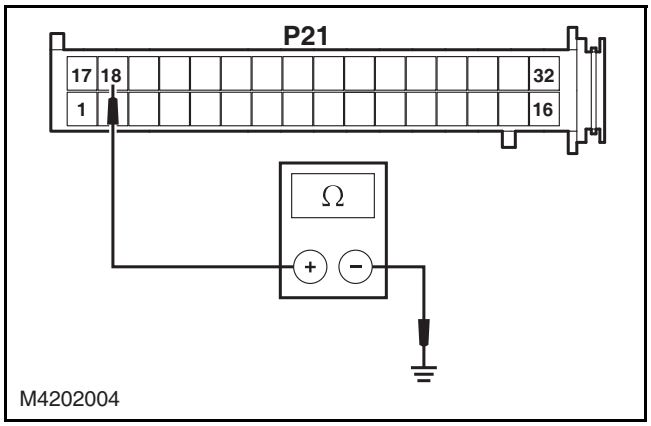


# Diagnosis Procedure for Inoperative Instrument Cluster Illumination Lamp with Ignition Switch "ON" and Position Lamp Operating



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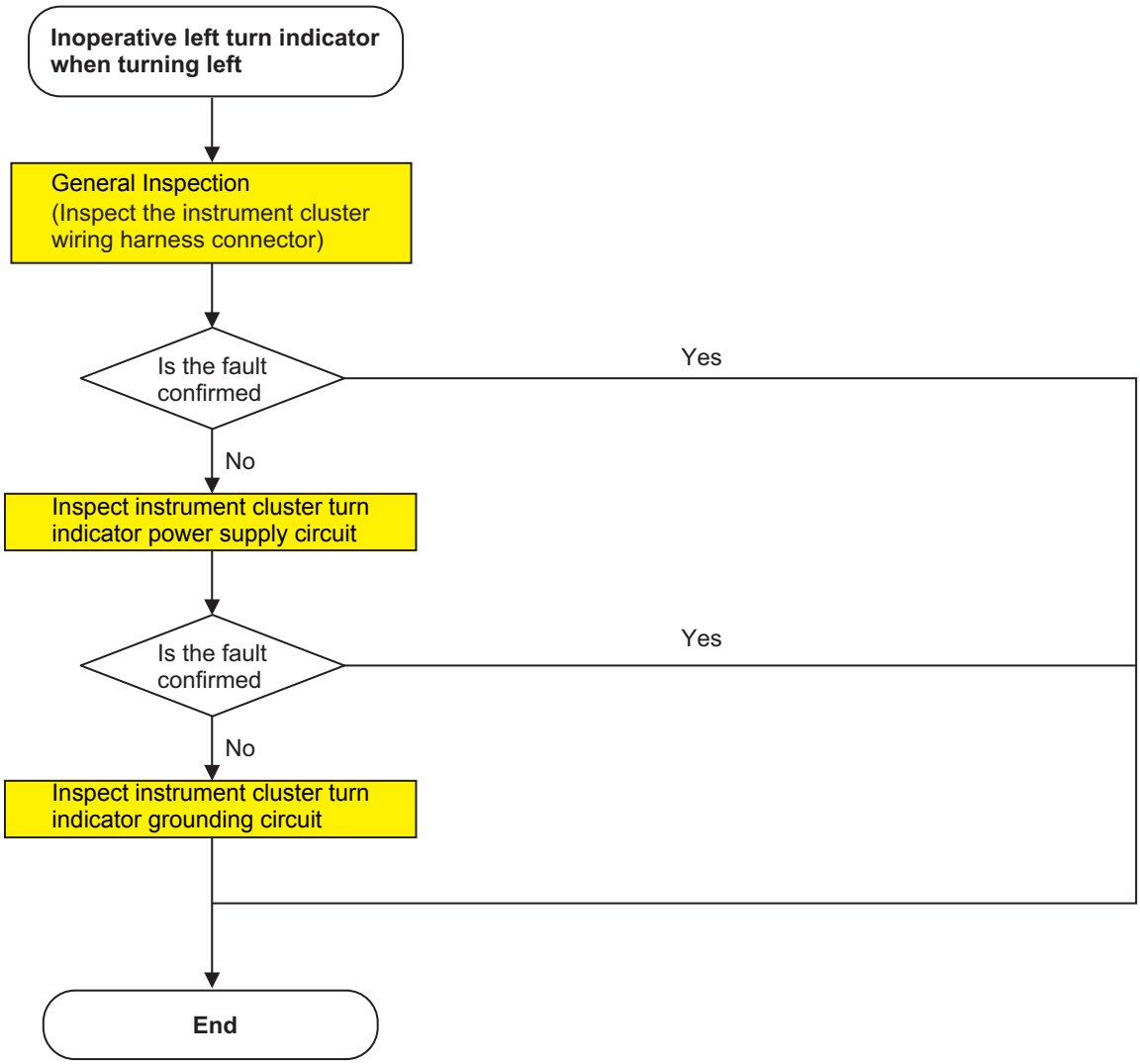


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster background lamp power supply circuit | |
|  <br>M4202003 | A. Disconnect the instrument cluster wiring harness connector P21.<br>B. Turn the ignition switch to "ON", and turn the combination switch to position lamp.<br>C. Measure the voltage between terminal 17 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the open circuit fault between terminal 8 of lighting combination switch wiring harness connector P30 and terminal 17 of instrument cluster wiring harness connector P21. |
| 3. Inspect instrument cluster background lamp grounding circuit | |
|  <br>M4202004 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 18 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 18 of instrument cluster wiring harness connector P21 and grounding G104. |

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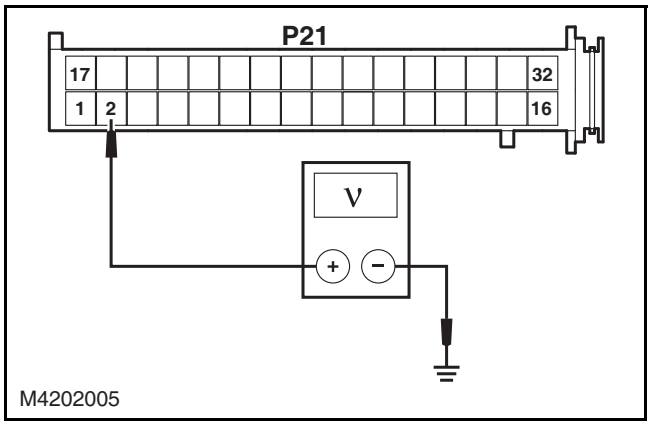
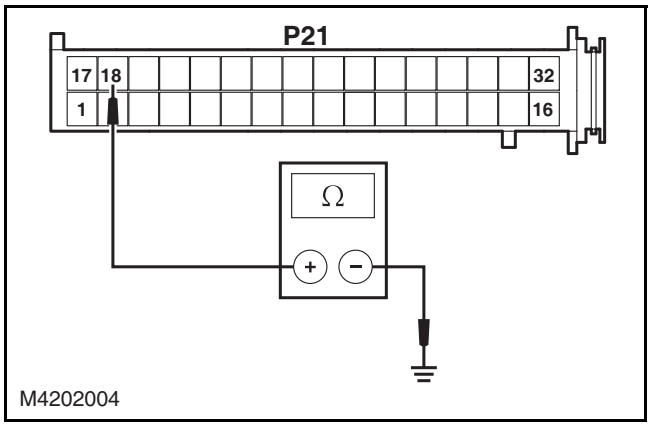


# Diagnosis Procedure for Inoperative Left Turn Indicator When Turning Left



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General Inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster turn indicator power supply circuit | |
|  <br>M4202005 | A. Disconnect the instrument cluster wiring harness connector P21.<br>B. Turn the ignition switch to "ON", and turn the combination switch to turn lamp.<br>C. Measure the voltage between terminal 2 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: changes from 0 V to 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the open circuit fault between terminal 13 of lighting combination switch wiring harness connector P30 and terminal 2 of instrument cluster wiring harness connector P21. |
| 3. Inspect instrument cluster turn indicator grounding circuit | |
|  <br>M4202004 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 18 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 18 of instrument cluster wiring harness connector P21 and grounding G104. |

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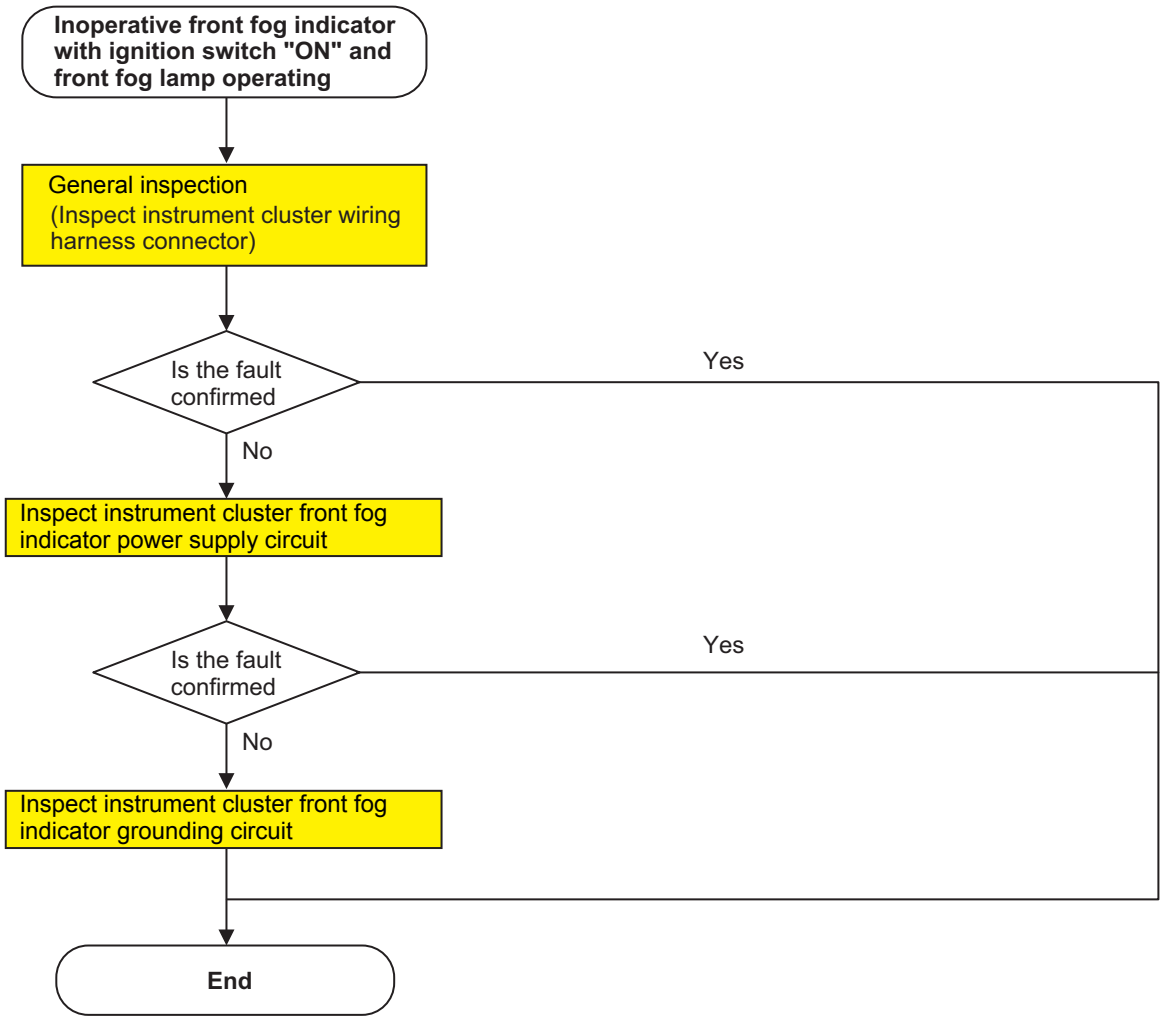
# Diagnosis Procedure for Inoperative Right Turn Indicator When Turning Right

**CAUTION: Diagnosis procedure for inoperative right turn indicator is similar to that for left turn indicator while the measured terminals are different.**

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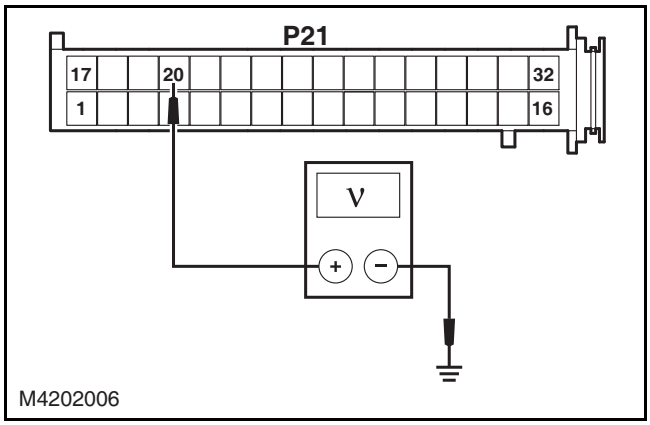
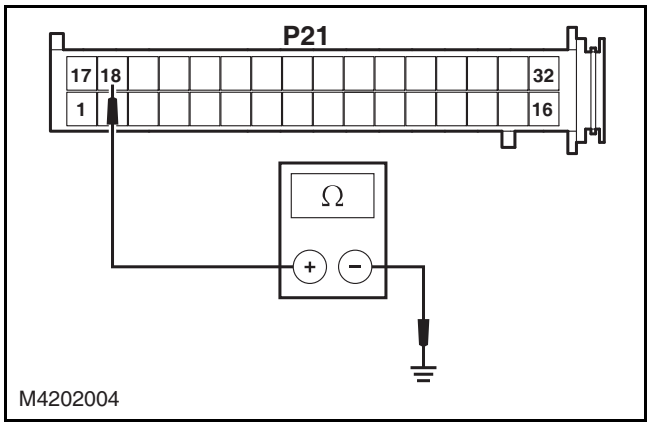


# Diagnosis Procedure for Inoperative Front Fog Indicator with Ignition Switch "ON" and Front Fog Lamp Operating



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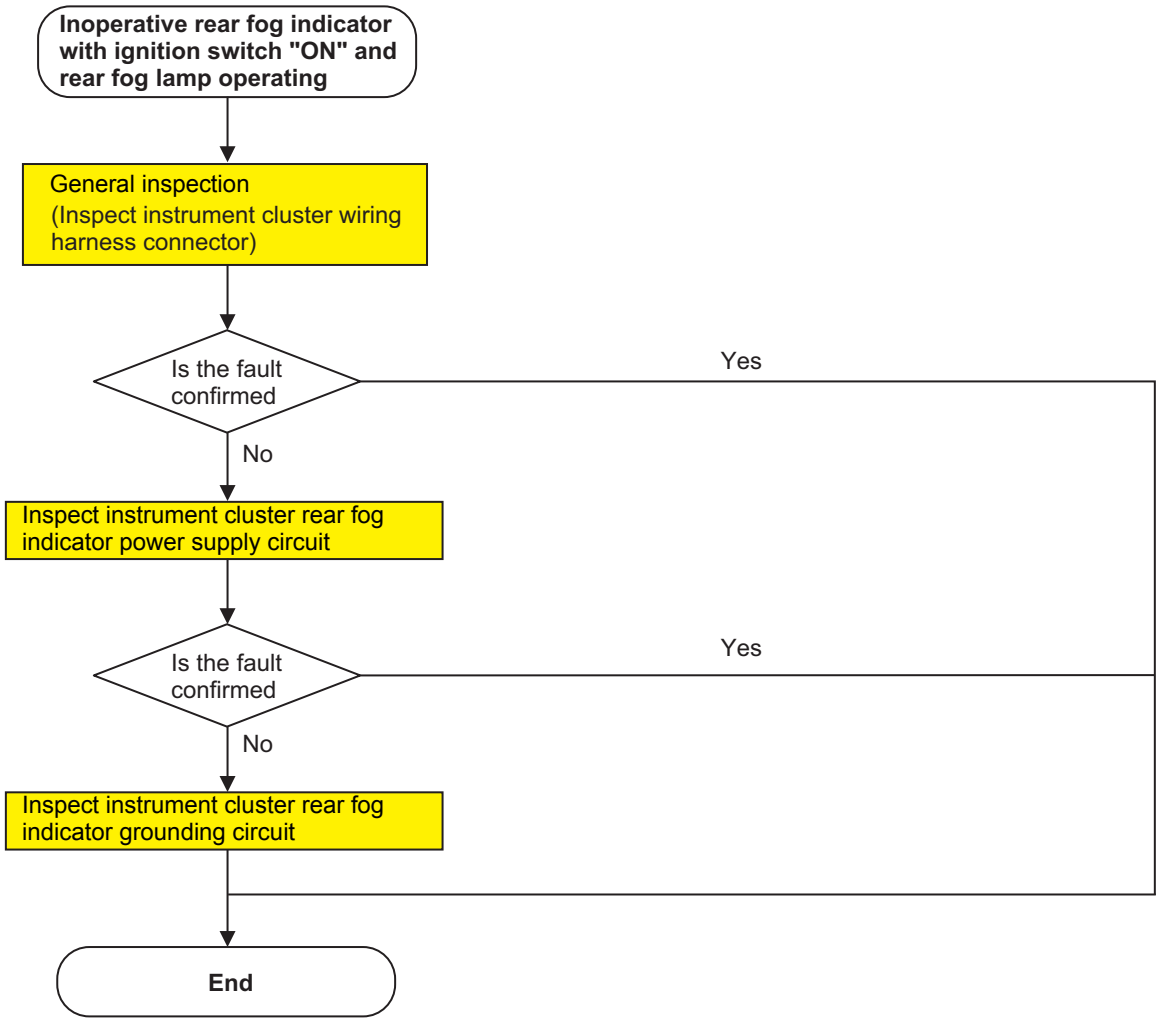


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster front fog indicator power supply circuit | |
|  <br>M4202006 | A. Disconnect the instrument cluster wiring harness connector P21.<br>B. Turn the ignition switch to "ON", and turn the combination switch to front fog lamp.<br>C. Measure the voltage between terminal 20 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the open circuit fault between terminal 74 of instrument panel fuse box relay IR06 and terminal 20 of instrument cluster wiring harness connector P21. |
| 3. Inspect instrument cluster front fog indicator grounding circuit | |
|  <br>M4202004 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 18 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 18 of instrument cluster wiring harness connector P21 and grounding G104. |

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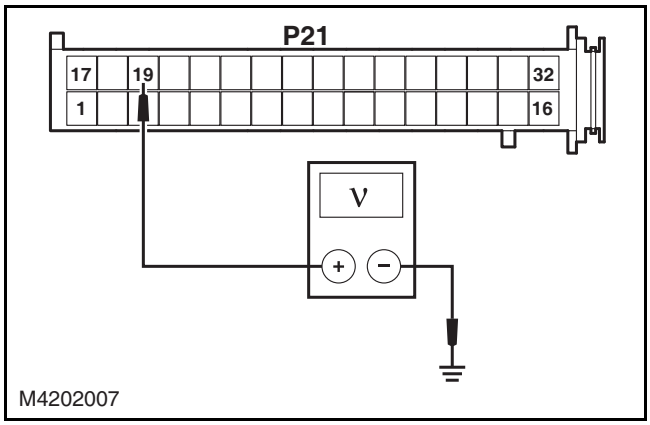
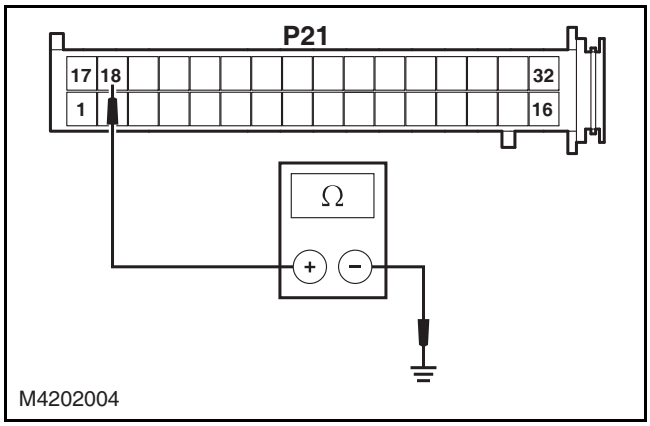


# Diagnosis Procedure for Inoperative Rear Fog Indicator with Ignition Switch "ON" and Rear Fog Lamp Operating



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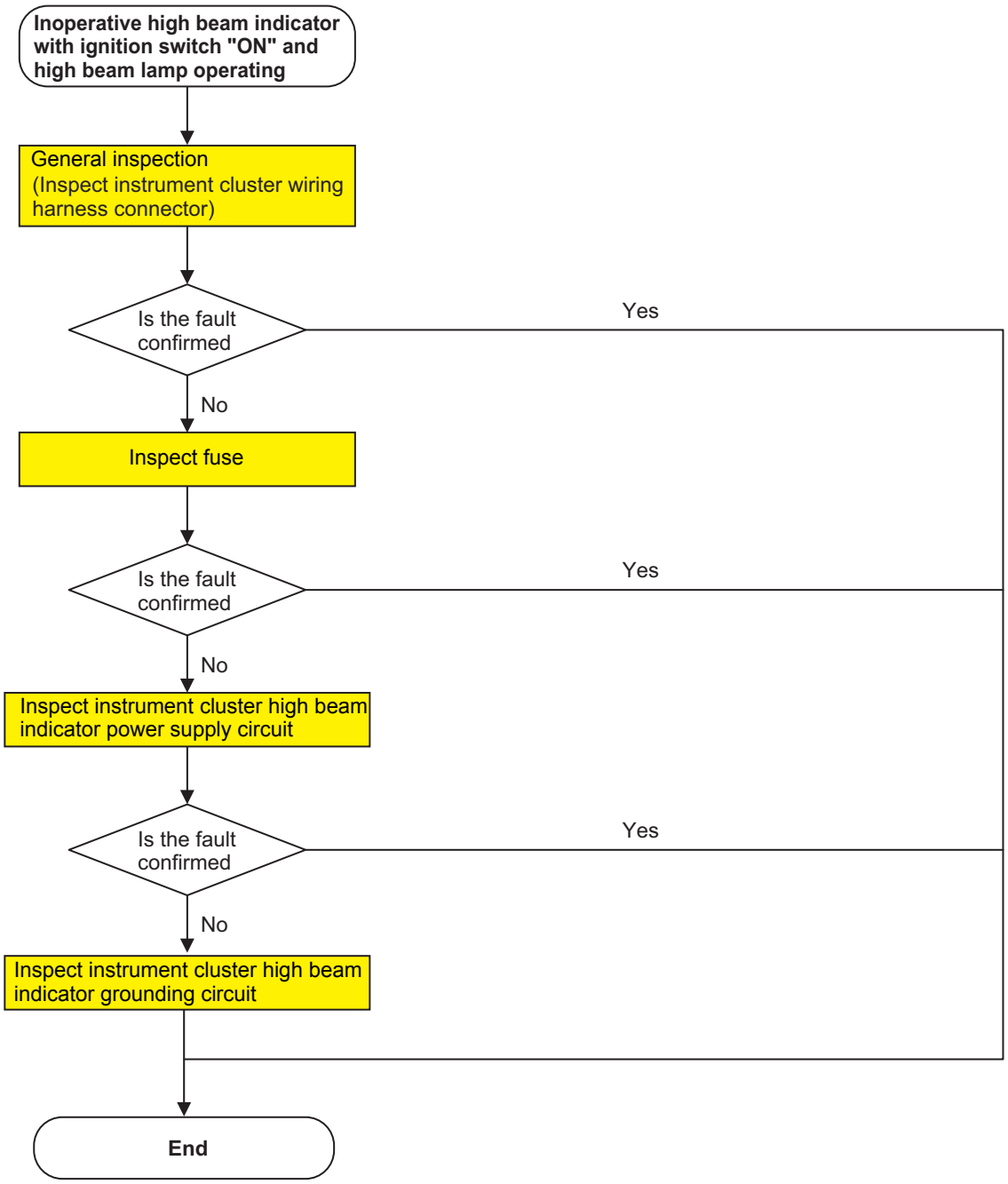


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster rear fog indicator power supply circuit | |
|  <br>M4202007 | A. Disconnect the instrument cluster wiring harness connector P21.<br>B. Turn the ignition switch to "ON", and turn the combination switch to rear fog lamp.<br>C. Measure the voltage between terminal 19 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of lighting combination switch wiring harness connector P30 and terminal 19 of instrument cluster wiring harness connector P21. |
| 3. Inspect instrument cluster rear fog indicator grounding circuit | |
|  <br>M4202004 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 18 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 18 of instrument cluster wiring harness connector P21 and grounding G104. |

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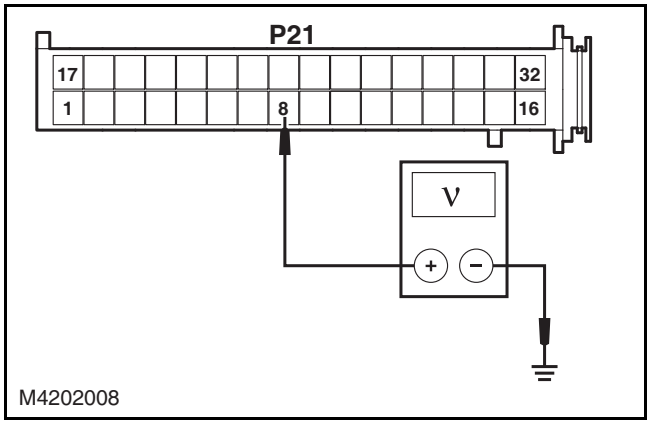


# Diagnosis Procedure for Inoperative High Beam Indicator with Ignition Switch "ON" and High Beam Lamp Operating



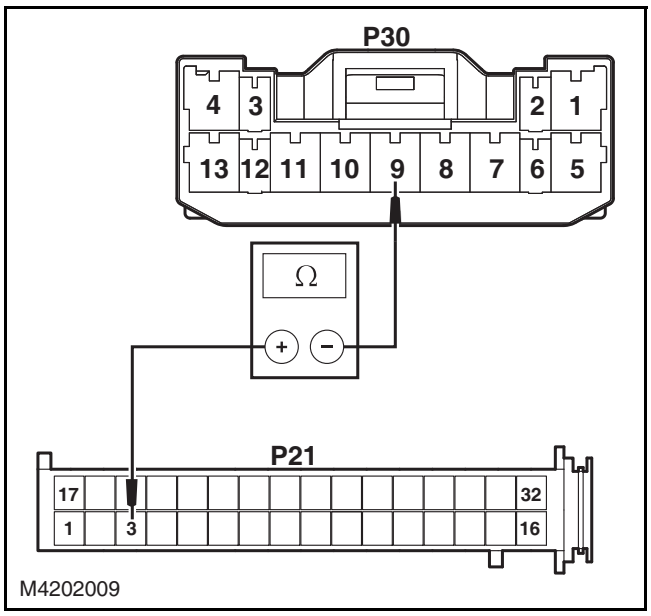
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect fuse | |
| | A. Inspect the instrument panel fuse box fuse IF07.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect instrument cluster high beam indicator power supply circuit | |
|  <br>M4202008 | A. Disconnect the instrument cluster wiring harness connector P21.<br>B. Turn the ignition switch to "ON".<br>C. Measure the voltage between terminal 8 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 8 of instrument cluster wiring harness connector P21 and terminal 14 of instrument panel fuse box fuse IF07. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect instrument cluster high beam indicator grounding circuit | |
|  | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21 and lighting combination switch wiring harness connector P30.<br>C. Measure the resistance between terminal 3 of instrument cluster wiring harness connector P21 and terminal 9 of lighting combination switch wiring harness connector P30.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of instrument cluster wiring harness connector P21 and terminal 9 of lighting combination switch wiring harness connector P30. |

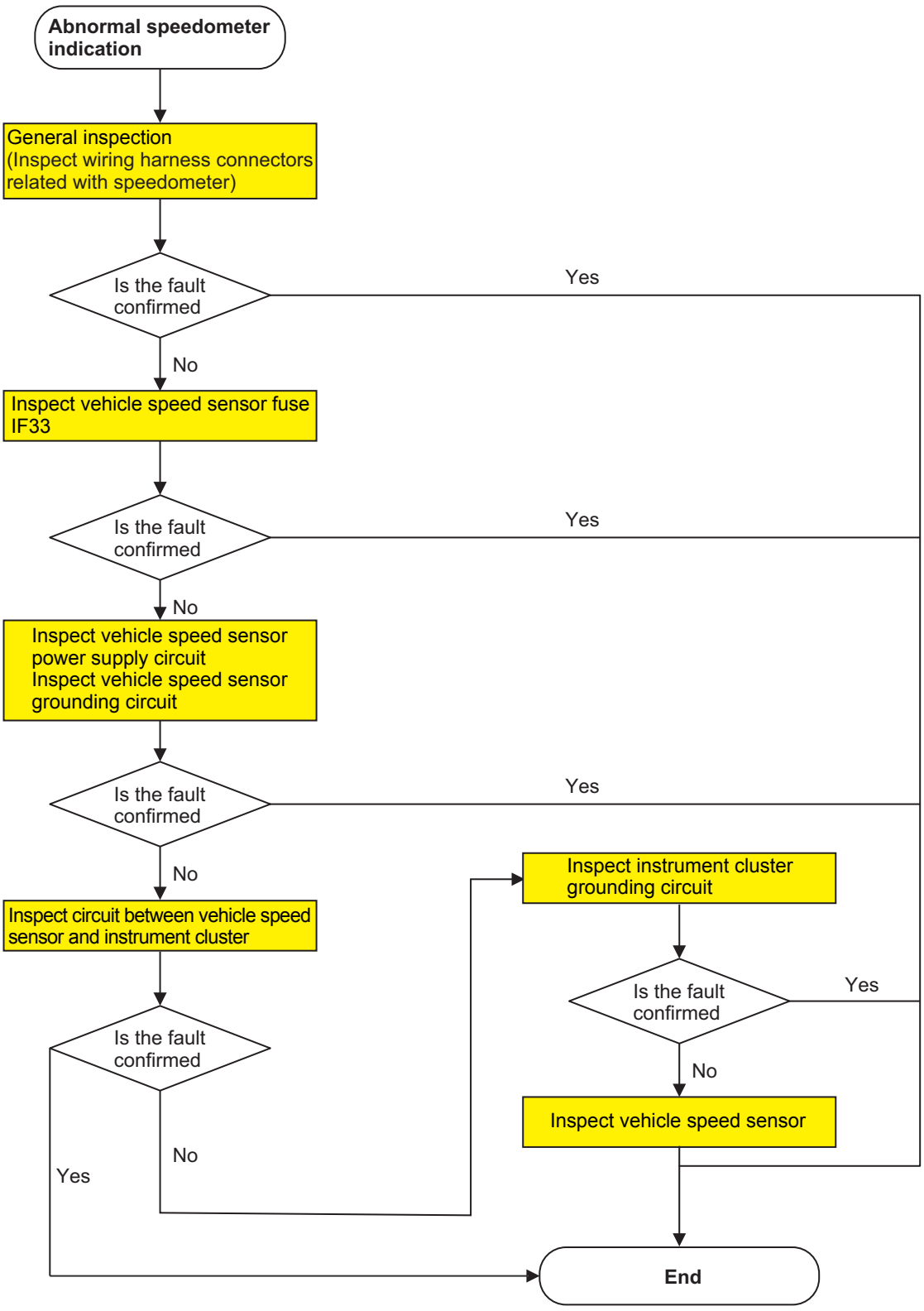
# Diagnosis Procedure for Inoperative Low Beam Indicator with Ignition Switch "ON" and Low Beam Lamp Operating

**CAUTION: Diagnosis procedure for inoperative low beam indicator with ignition switch "ON" and low beam lamp operating is similar to that for high beam indicator, but the measured terminals are different.**

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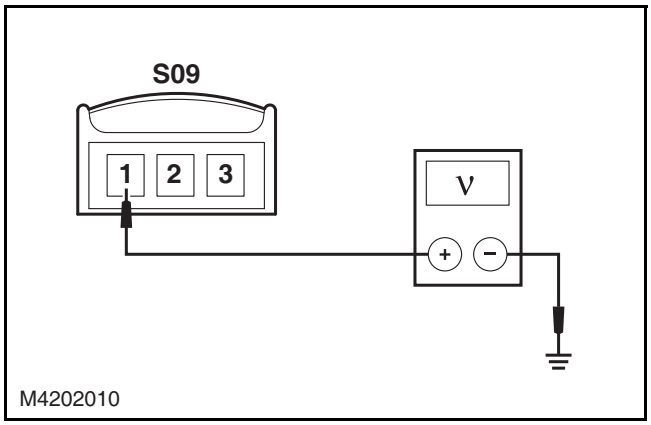


# Diagnostic Procedure for Abnormal Speedometer Indication



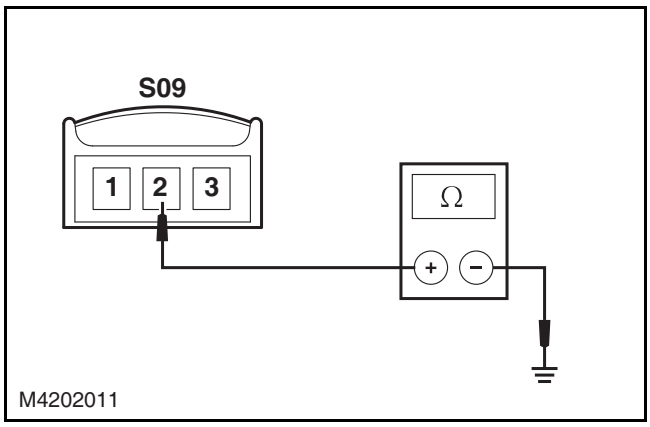
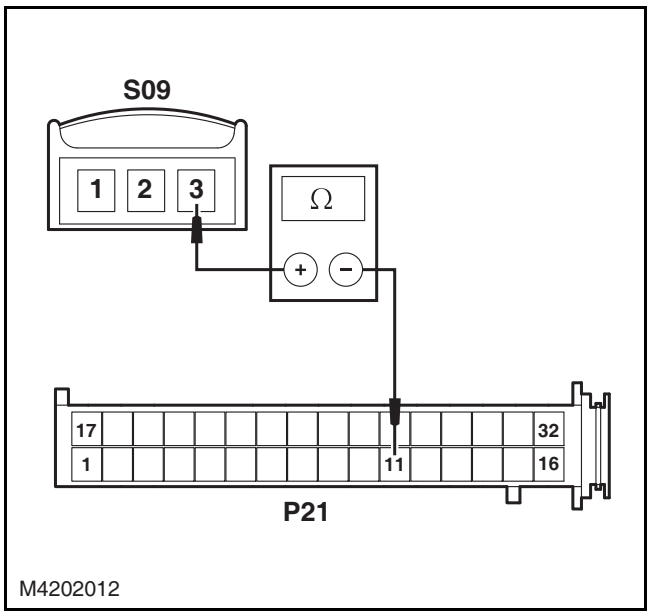
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related with the speedometer for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect vehicle speed sensor fuse IF33 | |
| | A. Inspect the vehicle speed sensor fuse IF33 in the instrument panel fuse box.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect vehicle speed sensor power supply circuit | |
|  | A. Disconnect the vehicle speed sensor wiring harness connector S09.<br>B. Turn the ignition switch to "ON".<br>C. Measure the voltage between terminal 1 of vehicle speed sensor wiring harness connector S09 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of vehicle speed sensor wiring harness connector S09 and terminal 66 of instrument panel fuse box fuse IF33. |

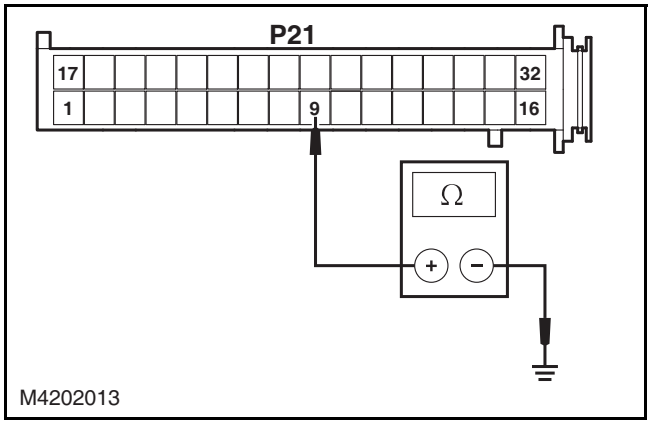
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect vehicle speed sensor grounding circuit | |
|  | A. Disconnect the vehicle speed sensor wiring harness connector S09.<br>B. Measure the resistance between terminal 2 of vehicle speed sensor wiring harness connector S09 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of vehicle speed sensor wiring harness connector S09 and grounding G104. |
| 5. Inspect circuit between vehicle speed sensor and instrument cluster | |
|  | A. Turn the ignition switch to "OFF".<br>B. Disconnect the vehicle speed sensor wiring harness connector S09 and instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 3 of vehicle speed sensor wiring harness connector S09 and terminal 11 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of vehicle speed sensor wiring harness connector S09 and terminal 11 of instrument cluster wiring harness connector P21. |

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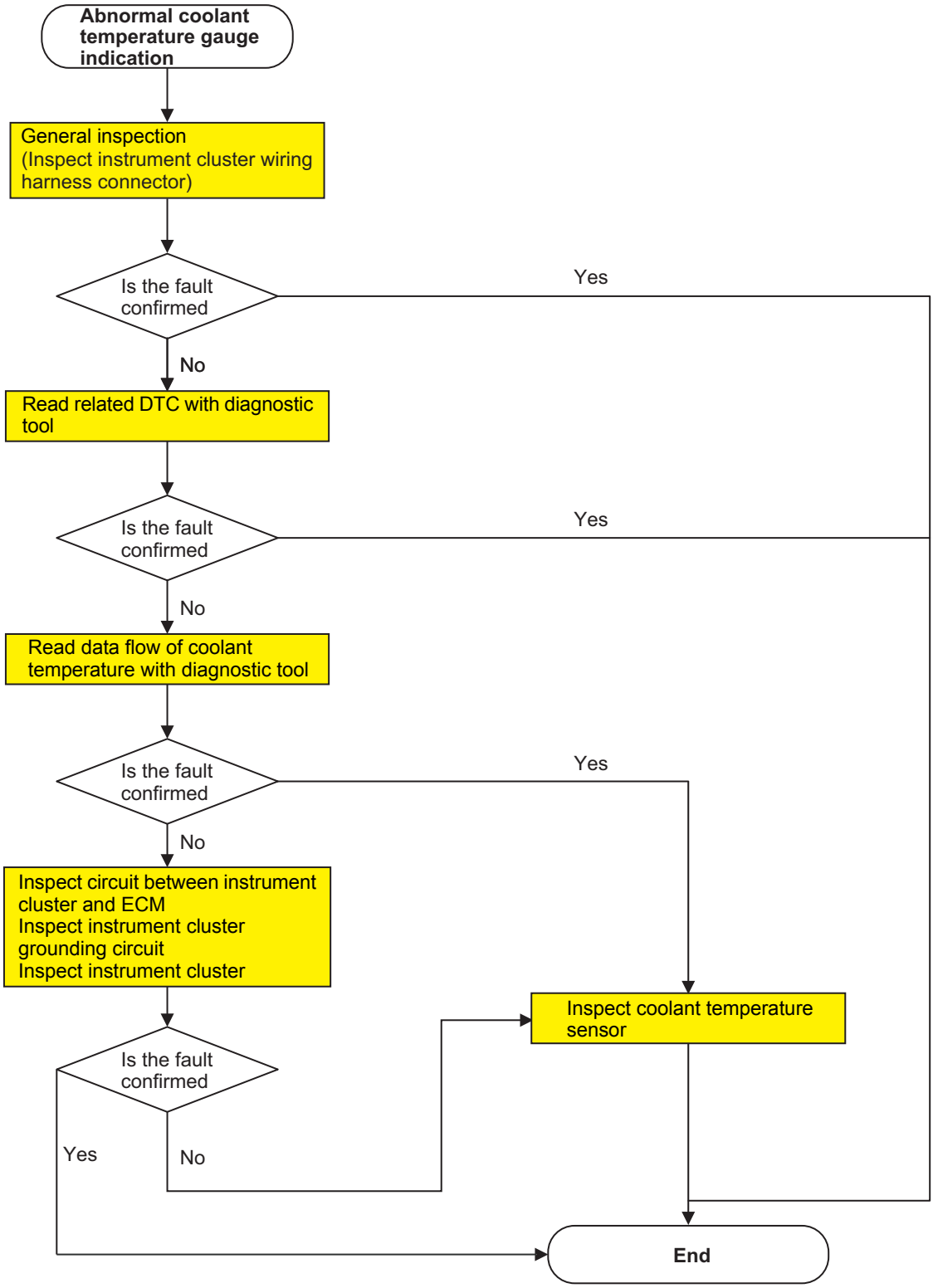


| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect instrument cluster grounding circuit | |
|  M4202013 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 9 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the open circuit fault between terminal 9 of instrument cluster wiring harness connector P21 and grounding G104. |
| 7. Inspect vehicle speed sensor | |
| | A. Replace the vehicle speed sensor with a good one.<br>Is the road test normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).** |

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# Diagnostic Procedure for Abnormal Coolant Temperature Gauge Indication (1.0 L)



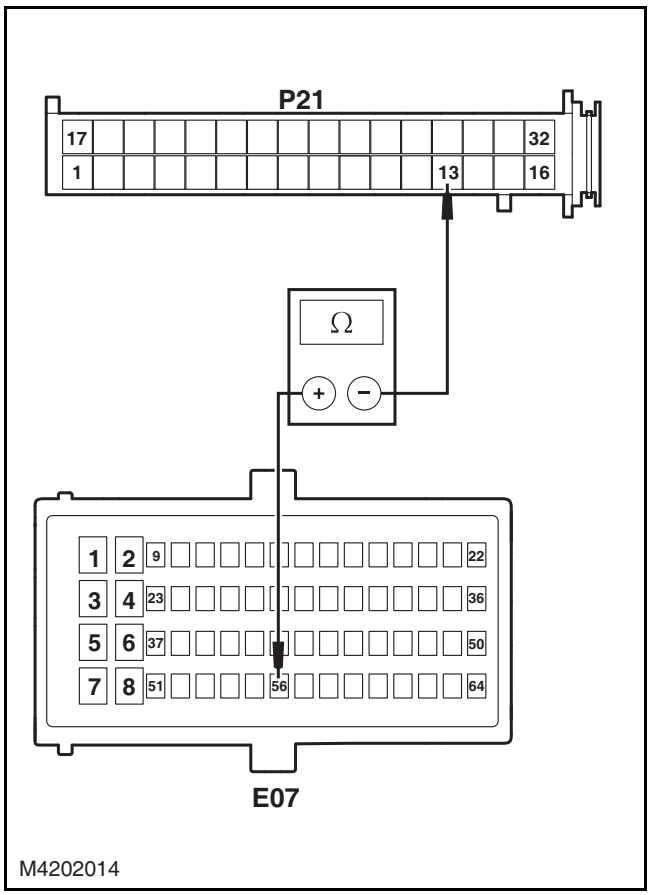
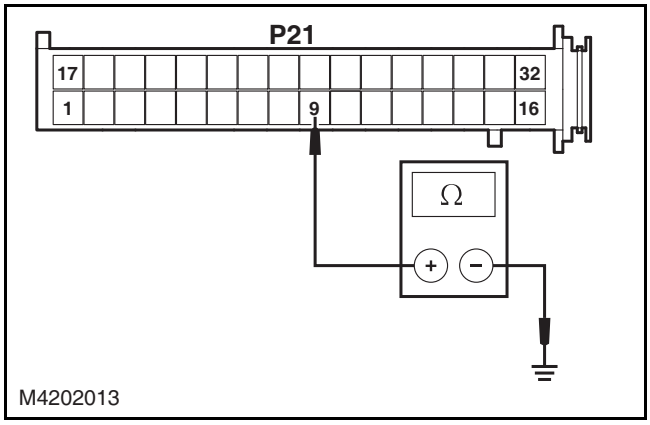
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Read related DTC with diagnostic tool | |
| | A. Connect the specific diagnostic tool.<br>B. Start the vehicle and read the engine DTC.<br>Is there any DTC related to coolant temperature sensor?<br>**Yes**<br>**Refer to: DTC Code List (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Read data flow of coolant temperature with diagnostic tool | |
| | A. Connect the specific diagnostic tool.<br>B. Start the vehicle and read the data flow of engine coolant temperature.<br>C. Measure the actual coolant temperature with a measurement tool.<br>Is the data read from the diagnostic tool the same with the actual coolant temperature?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 7. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between instrument cluster and ECM | |
|  M4202014 | A. Turn the ignition switch to "OFF" and disconnect the negative battery cable.<br>B. Disconnect the instrument cluster wiring harness connector P21 and ECM wiring harness connector E07.<br>C. Measure the resistance between terminal 13 of instrument cluster wiring harness connector P21 and terminal 56 of ECM wiring harness connector E07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 13 of instrument cluster wiring harness connector P21 and terminal 56 of ECM wiring harness connector E07. |
| 5. Inspect instrument cluster grounding circuit | |
|  M4202013 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 9 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 9 of instrument cluster wiring harness connector P21 and grounding G104. |

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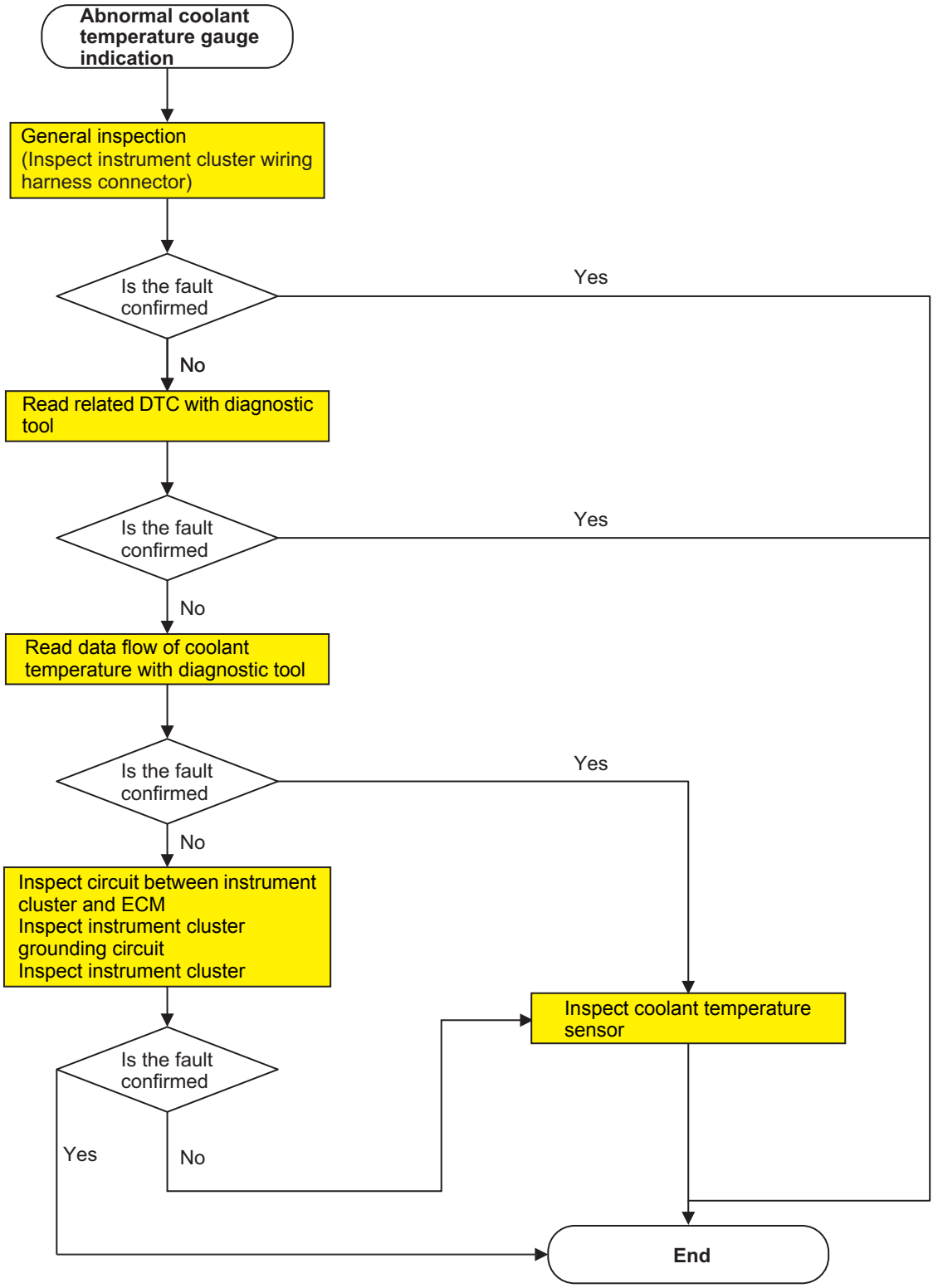


| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect instrument cluster | |
| | A. Replace the instrument cluster with a good one.<br>Is the coolant temperature gauge indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 7. |
| 7. Inspect coolant temperature sensor | |
| | A. Replace the coolant temperature sensor with a good one.<br>Is the coolant temperature gauge indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the ECM.<br>**Refer to: ECM (3.1.12 Electronic Control System - M7, Removal and Installation).** |

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# Diagnostic Procedure for Abnormal Coolant Temperature Gauge Indication (1.2 L)



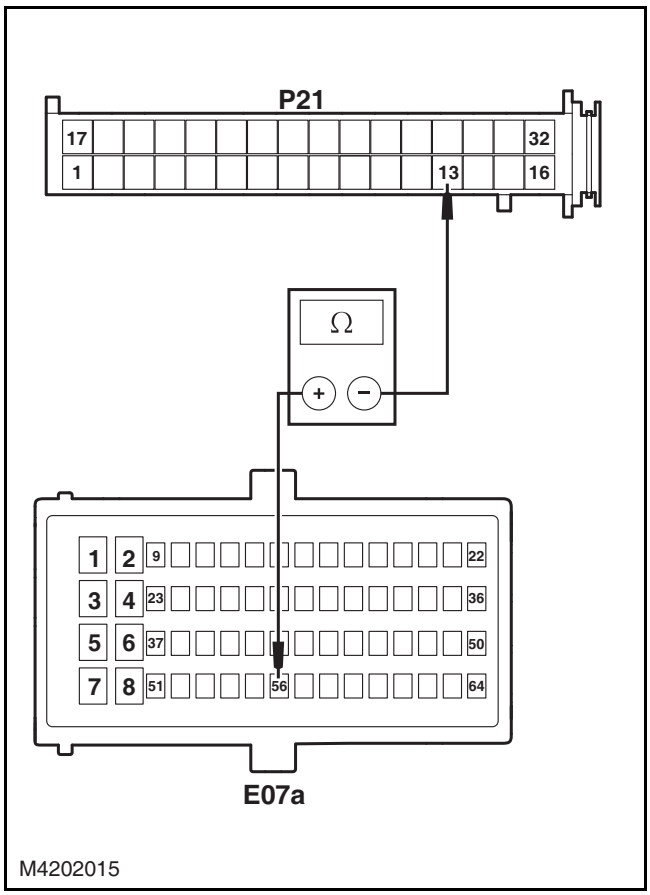
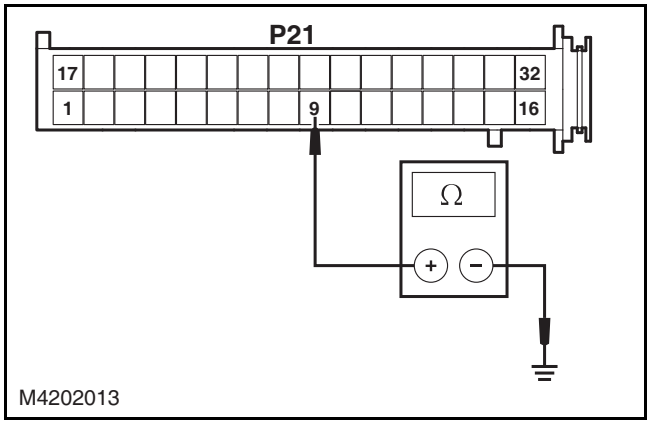
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Read related DTC with diagnostic tool | |
| | A. Connect the specific diagnostic tool.<br>B. Start the vehicle and read the engine DTC.<br>Is there any DTC related to coolant temperature sensor?<br>**Yes**<br>**Refer to: DTC Code List (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>**No**<br>Go to step 3. |
| 3. Read data flow of coolant temperature with diagnostic tool | |
| | A. Connect the specific diagnostic tool.<br>B. Start the vehicle and read the data flow of engine coolant temperature.<br>C. Measure the actual coolant temperature with a measurement tool.<br>Is the data read from the diagnostic tool the same with the actual coolant temperature?<br>**Yes**<br>Go to step 4.<br>**No**<br>Go to step 7. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between instrument cluster and ECM | |
|  <br>M4202015 | A. Turn the ignition switch to "OFF" and disconnect the negative battery cable.<br>B. Disconnect the instrument cluster wiring harness connector P21 and ECM wiring harness connector E07a.<br>C. Measure the resistance between terminal 13 of instrument cluster wiring harness connector P21 and terminal 56 of ECM wiring harness connector E07a.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 13 of instrument cluster wiring harness connector P21 and terminal 56 of ECM wiring harness connector E07a. |
| 5. Inspect instrument cluster grounding circuit | |
|  <br>M4202013 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the resistance between terminal 9 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 9 of instrument cluster wiring harness connector P21 and grounding G104. |

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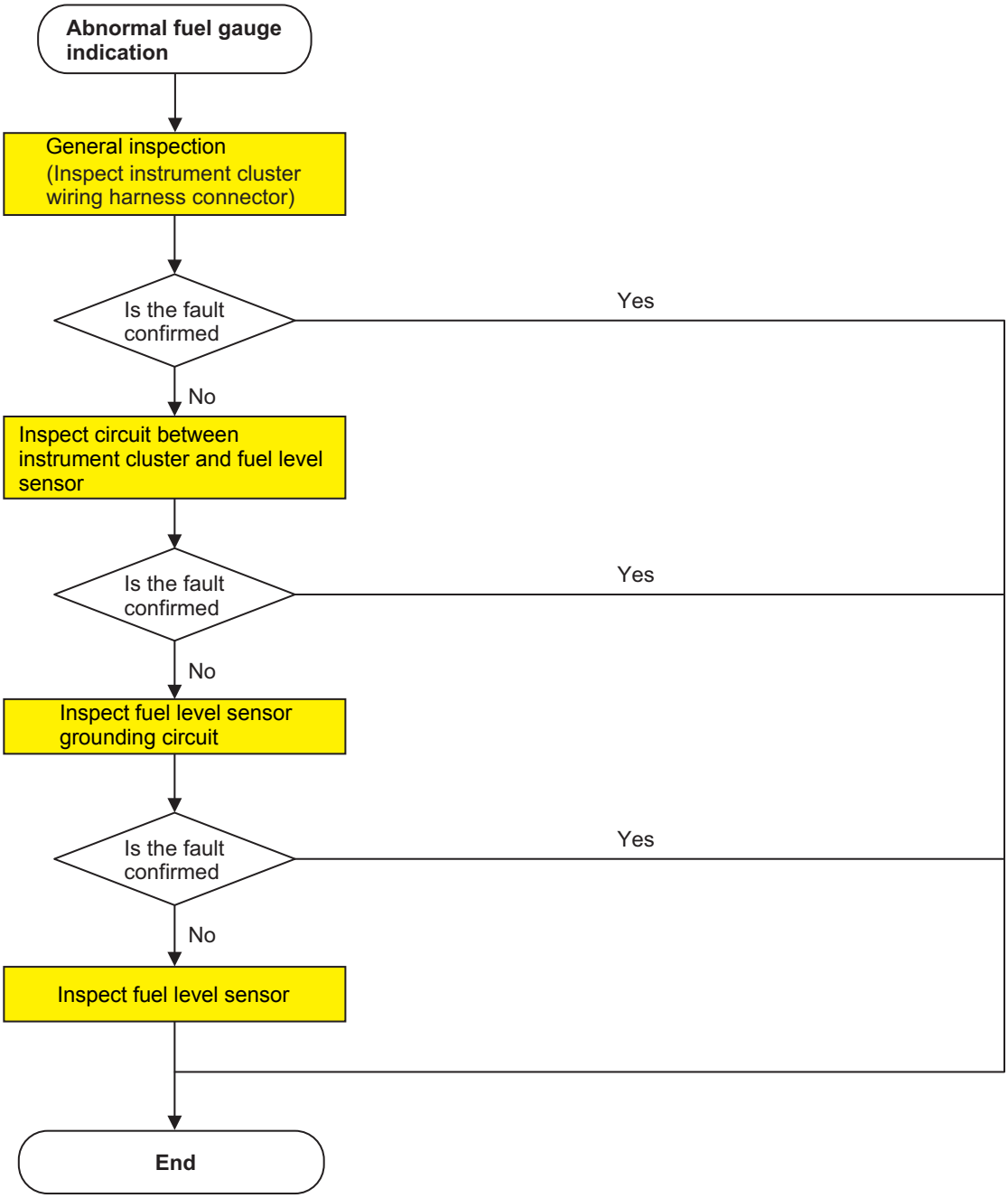


| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect instrument cluster | |
| | A. Replace the instrument cluster with a good one.<br>Is the coolant temperature gauge indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 7. |
| 7. Inspect coolant temperature sensor | |
| | A. Replace the coolant temperature sensor with a good one.<br>Is the coolant temperature gauge indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the ECM.<br>**Refer to: ECM (3.1.12 Electronic Control System - M7, Removal and Installation).** |

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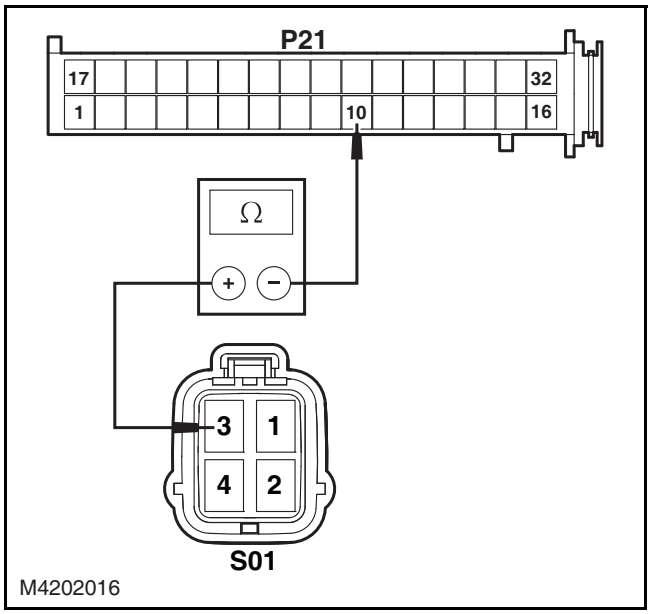
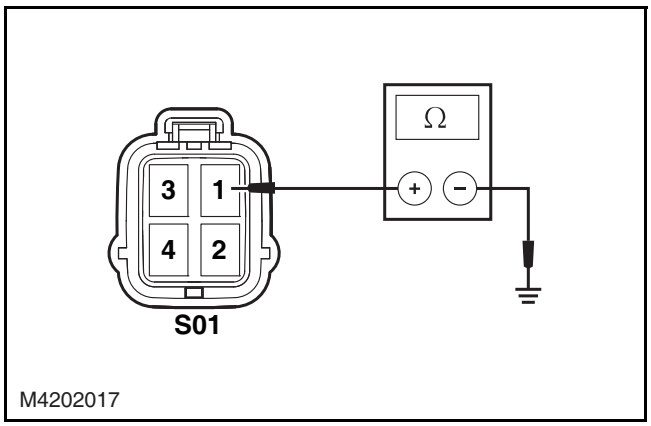


# Diagnostic Procedure for Abnormal Fuel Gauge Indication



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect circuit between instrument cluster and fuel level sensor | |
|  <br>M4202016 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21 and fuel level sensor wiring harness connector S01.<br>C. Measure the resistance between terminal 10 of instrument cluster wiring harness connector P21 and terminal 3 of fuel level sensor wiring harness connector S01.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the open circuit fault between terminal 10 of instrument cluster wiring harness connector P21 and terminal 3 of fuel level sensor wiring harness connector S01. |
| 3. Inspect fuel level sensor grounding circuit | |
|  <br>M4202017 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the fuel level sensor wiring harness connector S01.<br>C. Measure the resistance between terminal 1 of fuel level sensor wiring harness connector S01 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of fuel level sensor wiring harness connector S01 and grounding G104. |

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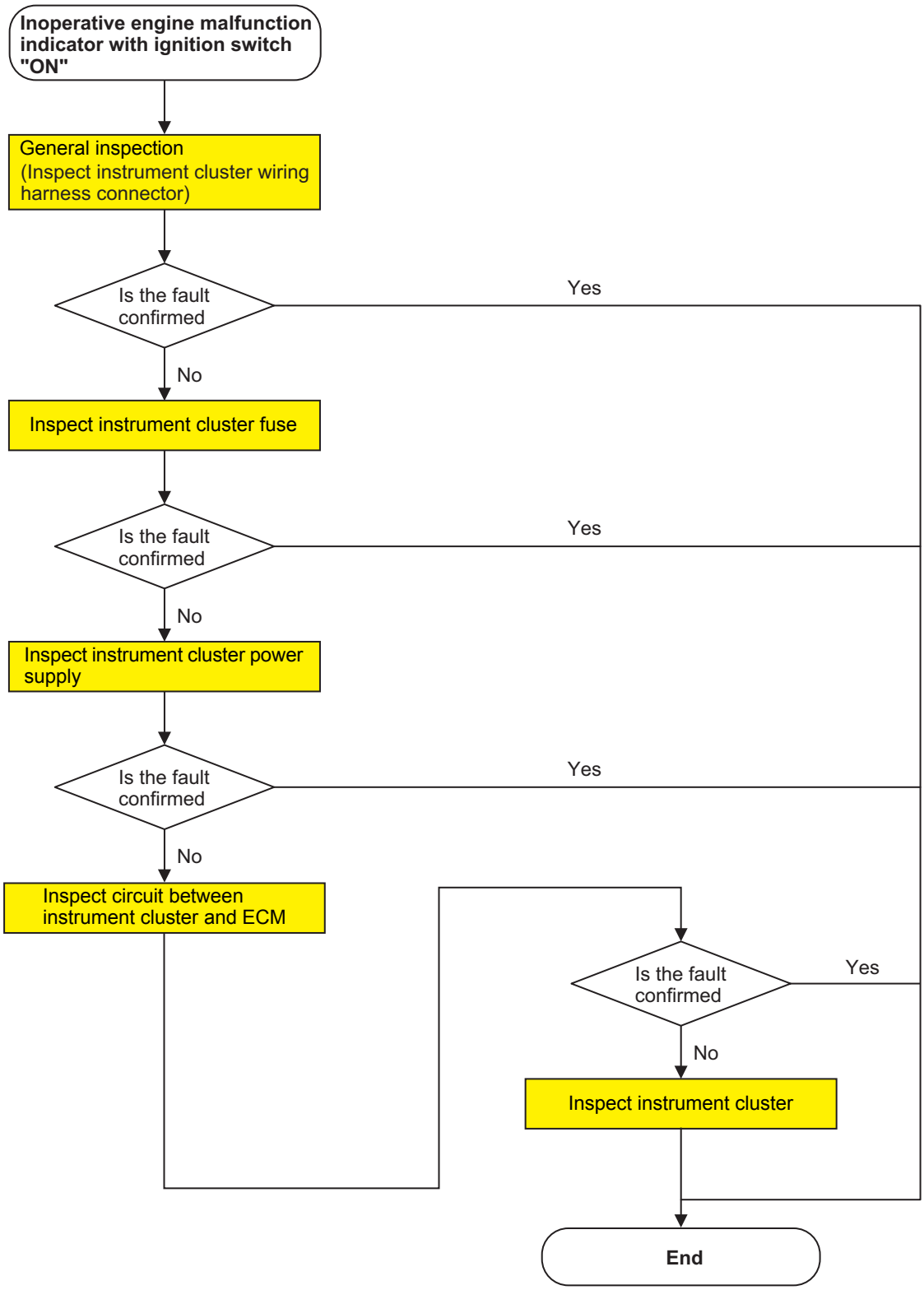


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect fuel level sensor | |
| | A. Turn the ignition switch to "OFF".<br>B. Replace the fuel level sensor.<br>**Refer to: Fuel Pump Assembly (3.1.7 Fuel System, Removal and Installation).**<br>Is the fuel gauge indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).** |

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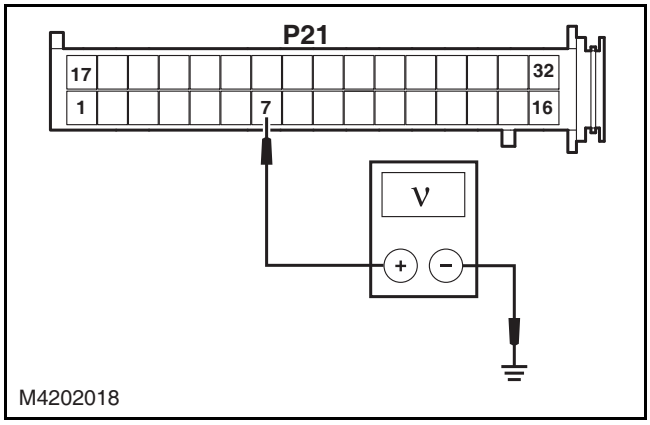


# Diagnosis Procedure for Inoperative Engine Malfunction Indicator with Ignition Switch "ON" (1.0 L)



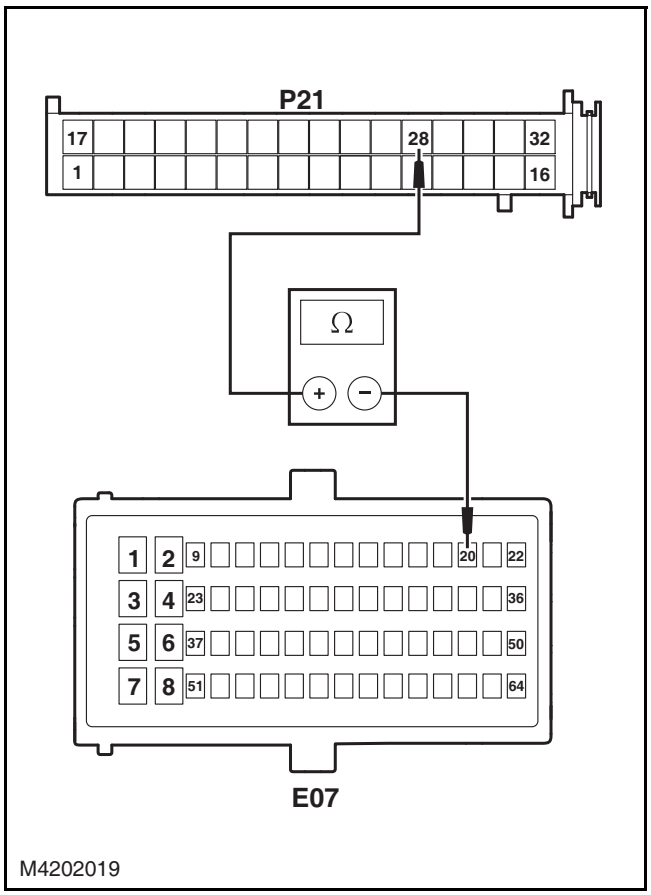
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster fuse | |
| | A. Inspect the instrument cluster fuse IF35.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect instrument cluster power supply | |
|  <br>M4202018 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the voltage between terminal 7 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of instrument cluster wiring harness connector P21 and terminal 70 of instrument panel fuse box fuse IF35. |

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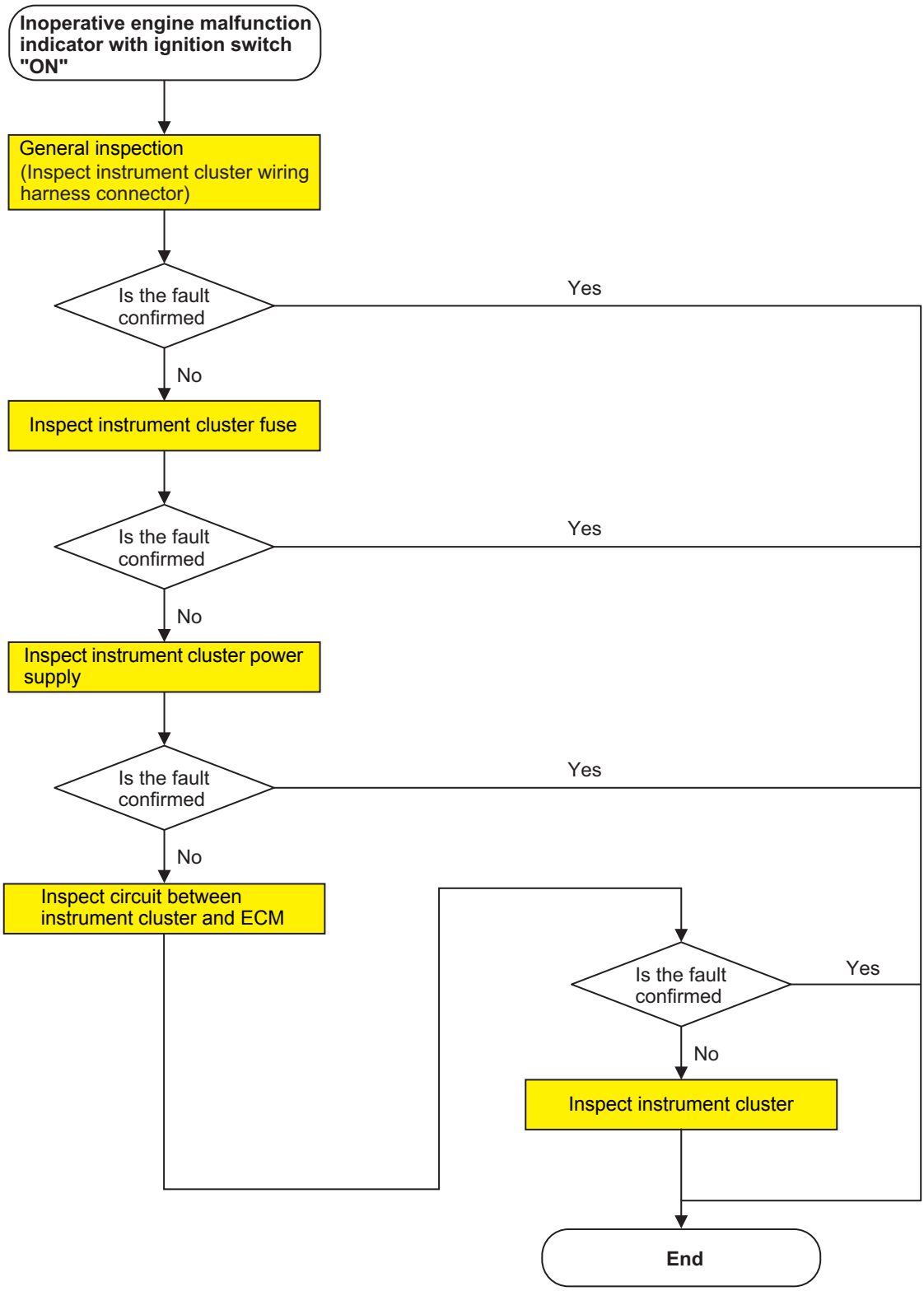


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between instrument cluster and ECM | |
|  <br>M4202019 | A. Turn the ignition switch to "OFF" and disconnect the negative battery cable.<br>B. Disconnect the ECM wiring harness connector E07.<br>C. Disconnect the instrument cluster wiring harness connector P21.<br>D. Measure the resistance between terminal 20 of ECM wiring harness connector E07 and terminal 28 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 20 of ECM wiring harness connector E07 and terminal 28 of instrument cluster wiring harness connector P21. |
| 5. Inspect instrument cluster | |
| | A. Replace the instrument cluster with a good one.<br>Is the indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the ECM.<br>**Refer to: ECM (3.1.12 Electronic Control System - M7, Removal and Installation).** |

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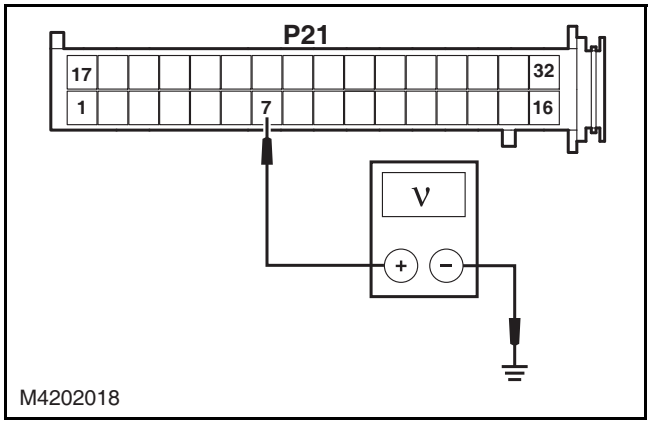


# Diagnosis Procedure for Inoperative Engine Malfunction Indicator with Ignition Switch "ON" (1.2 L)



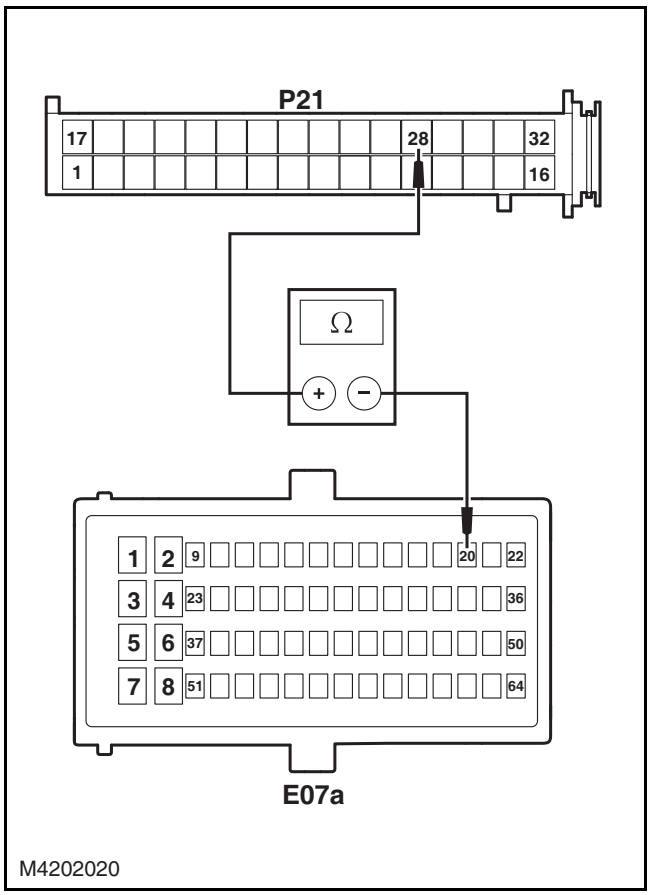
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster fuse | |
| | A. Inspect the instrument cluster fuse IF35.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect instrument cluster power supply | |
|  | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the voltage between terminal 7 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of instrument cluster wiring harness connector P21 and terminal 70 of instrument panel fuse box fuse IF35. |

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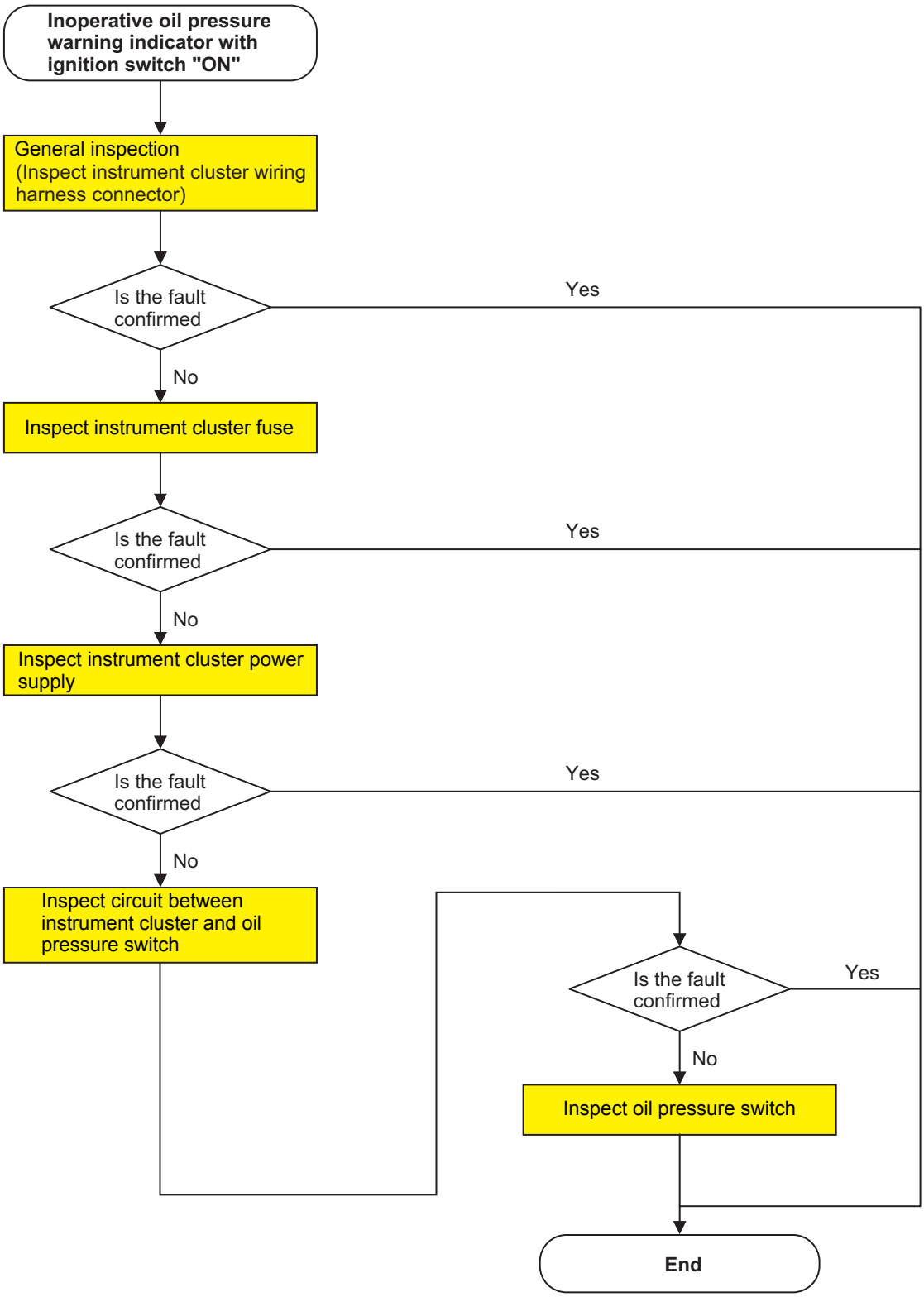


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between instrument cluster and ECM | |
|  M4202020 | A. Turn the ignition switch to "OFF" and disconnect the negative battery cable.<br>B. Disconnect the ECM wiring harness connector E07a.<br>C. Disconnect the instrument cluster wiring harness connector P21.<br>D. Measure the resistance between terminal 20 of ECM wiring harness connector E07a and terminal 28 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 20 of ECM wiring harness connector E07a and terminal 28 of instrument cluster wiring harness connector P21. |
| 5. Inspect instrument cluster | |
| | A. Replace the instrument cluster with a good one.<br>Is the indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the ECM.<br>**Refer to: ECM (3.1.12 Electronic Control System - M7, Removal and Installation).** |

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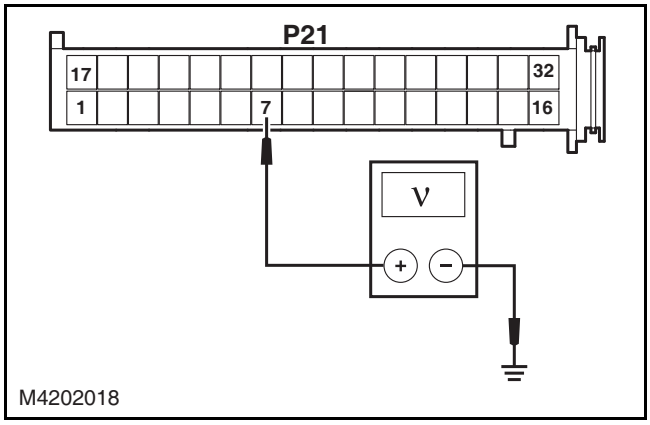


# Diagnosis Procedure for Inoperative Oil Pressure Warning Indicator with Ignition Switch "ON" (1.0 L)



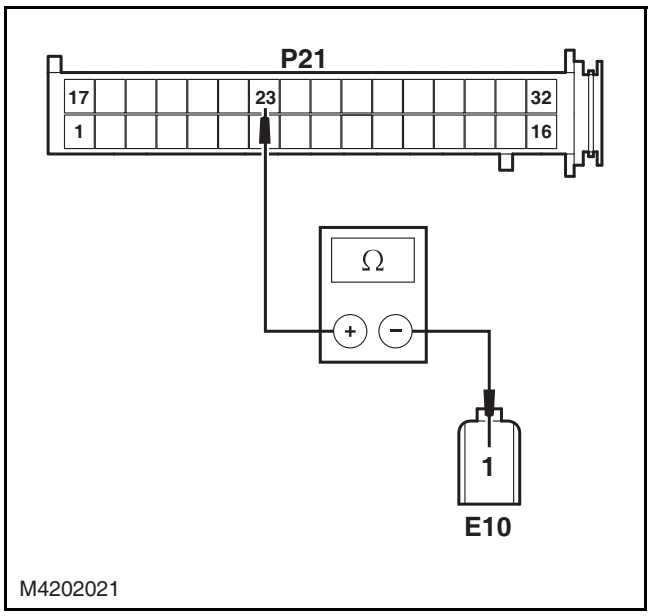
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster fuse | |
| | A. Inspect the instrument cluster fuse IF35.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect instrument cluster power supply | |
|  <br>M4202018 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the voltage between terminal 7 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of instrument cluster wiring harness connector P21 and terminal 70 of instrument panel fuse box fuse IF35. |

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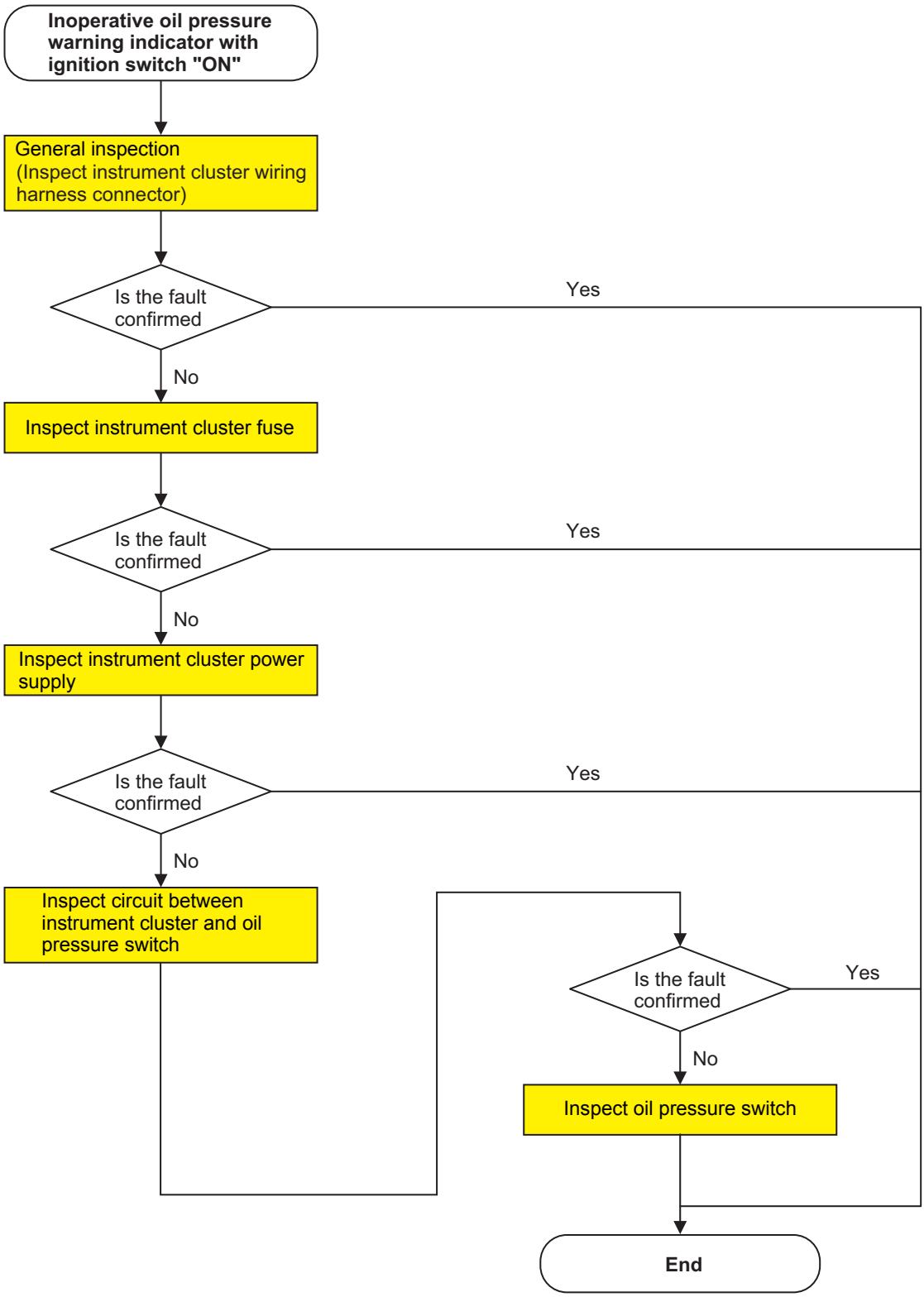


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between instrument cluster and oil pressure switch | |
|  | A. Turn the ignition switch to "OFF".<br>B. Disconnect the oil pressure switch wiring harness connector E10.<br>C. Disconnect the instrument cluster wiring harness connector P21.<br>D. Measure the resistance between terminal 1 of oil pressure switch wiring harness connector E10 and terminal 23 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of oil pressure switch wiring harness connector E10 and terminal 23 of instrument cluster wiring harness connector P21. |
| 5. Inspect oil pressure switch | |
| | A. Replace the oil pressure switch with a good one.<br>Is the indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).** |

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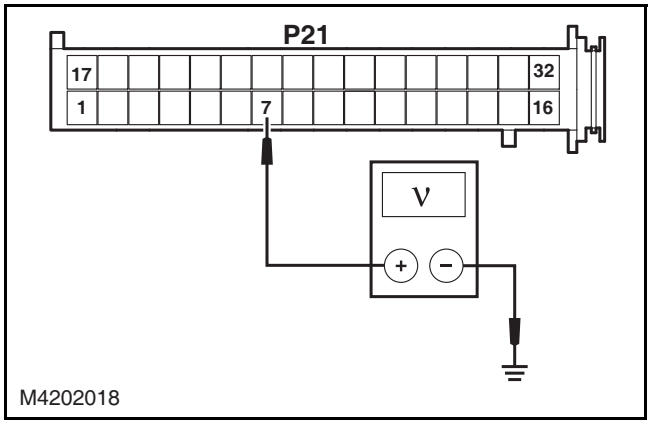


# Diagnosis Procedure for Inoperative Oil Pressure Warning Indicator with Ignition Switch "ON" (1.2 L)



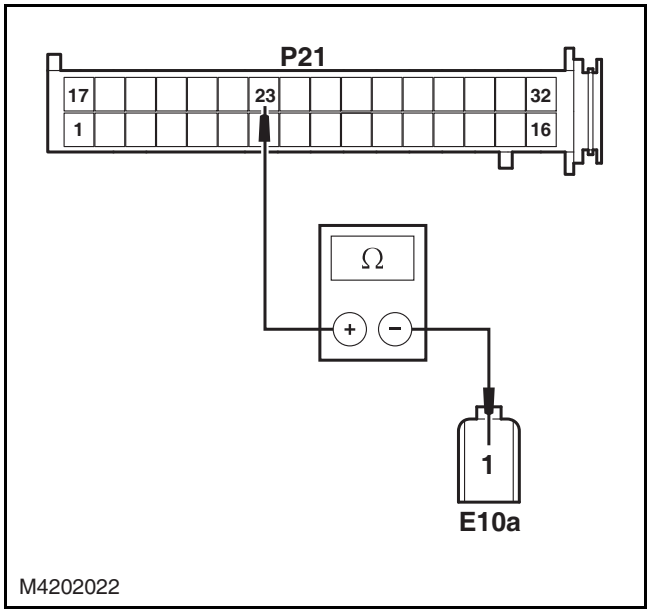
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster fuse | |
| | A. Inspect the instrument cluster fuse IF35.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect instrument cluster power supply | |
|  <br>M4202018 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the voltage between terminal 7 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of instrument cluster wiring harness connector P21 and terminal 70 of instrument panel fuse box fuse IF35. |

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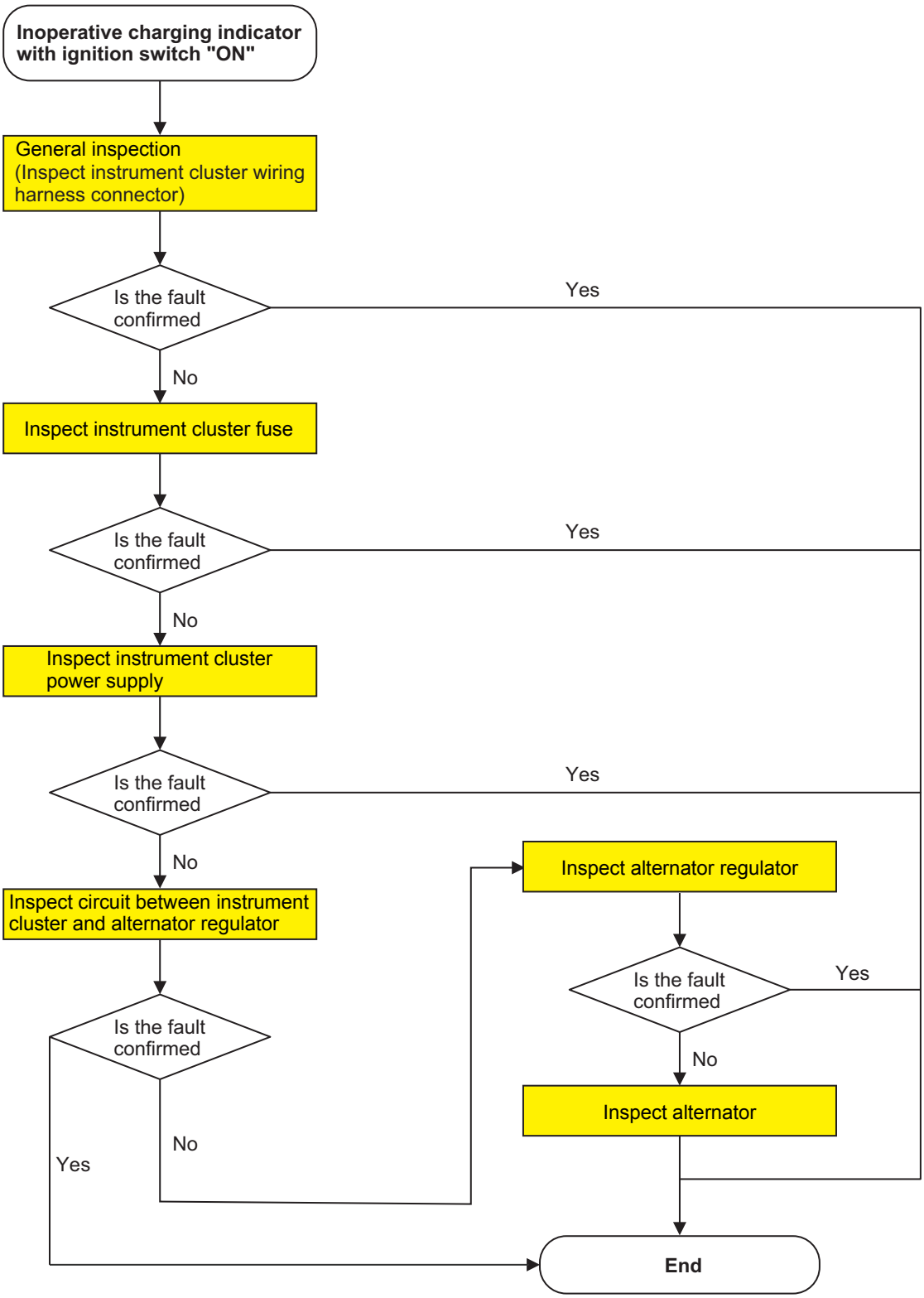


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between instrument cluster and oil pressure switch | |
|  <br>M4202022 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the oil pressure switch wiring harness connector E10a.<br>C. Disconnect the instrument cluster wiring harness connector P21.<br>D. Measure the resistance between terminal 1 of oil pressure switch wiring harness connector E10a and terminal 23 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of oil pressure switch wiring harness connector E10a and terminal 23 of instrument cluster wiring harness connector P21. |
| 5. Inspect oil pressure switch | |
| | A. Replace the oil pressure switch with a good one.<br>Is the indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).** |

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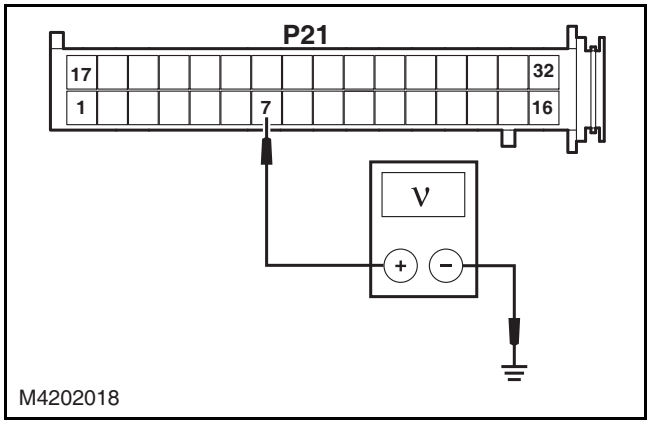


# Diagnostic Procedure for Inoperative Charging Indicator with Ignition Switch "ON"



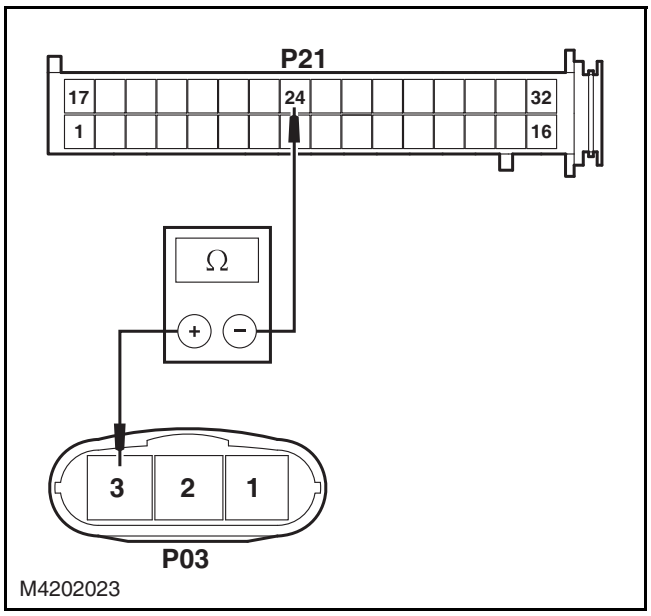
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster fuse | |
| | A. Inspect the instrument cluster fuse IF35.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect instrument cluster power supply | |
|  <br>M4202018 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the voltage between terminal 7 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of instrument cluster wiring harness connector P21 and terminal 70 of instrument panel fuse box fuse IF35. |

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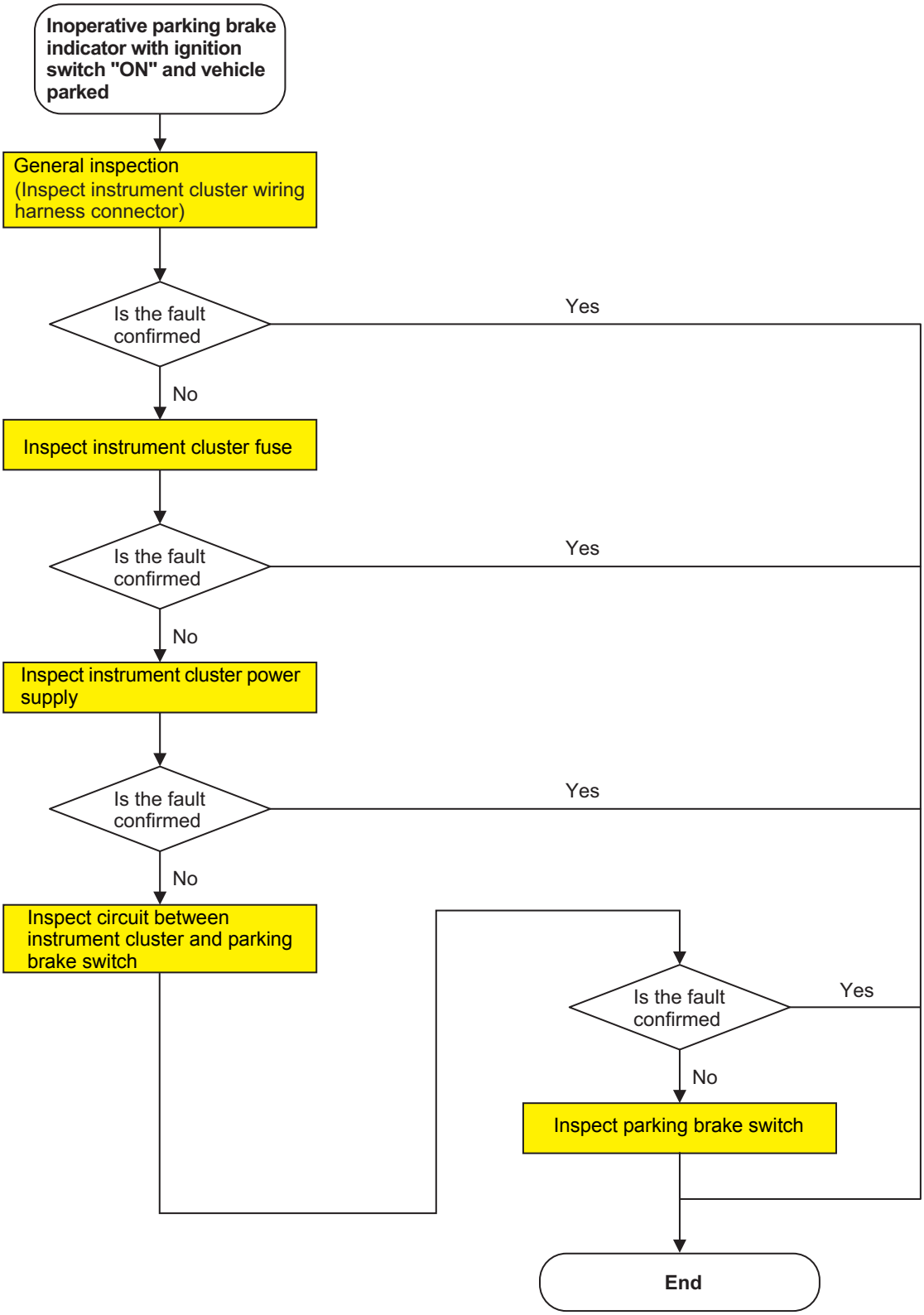


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between instrument cluster and alternator regulator | |
|  <br>M4202023 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the alternator wiring harness connector P03.<br>C. Disconnect the instrument cluster wiring harness connector P21.<br>D. Measure the resistance between terminal 3 of alternator wiring harness connector P03 and terminal 24 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of alternator wiring harness connector P03 and terminal 24 of instrument cluster wiring harness connector P21. |
| 5. Inspect alternator regulator | |
| | A. Replace the alternator regulator with a good one.<br>Is the indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 6. |
| 6. Inspect alternator | |
| | A. Replace the alternator with a good one.<br>Is the indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).** |

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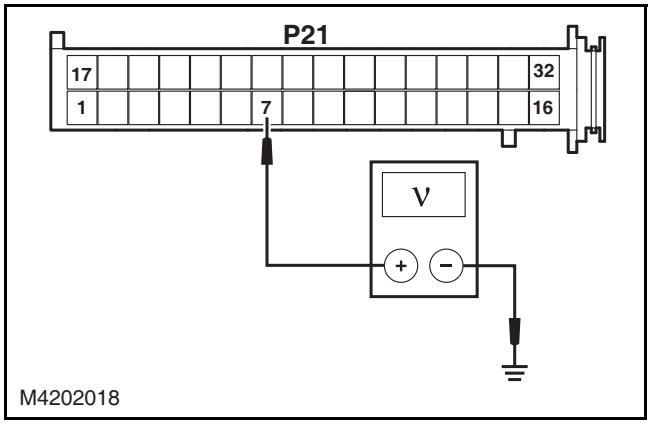


# Diagnosis Procedure for Inoperative Parking Brake Indicator with Ignition Switch "ON" and Vehicle Parked



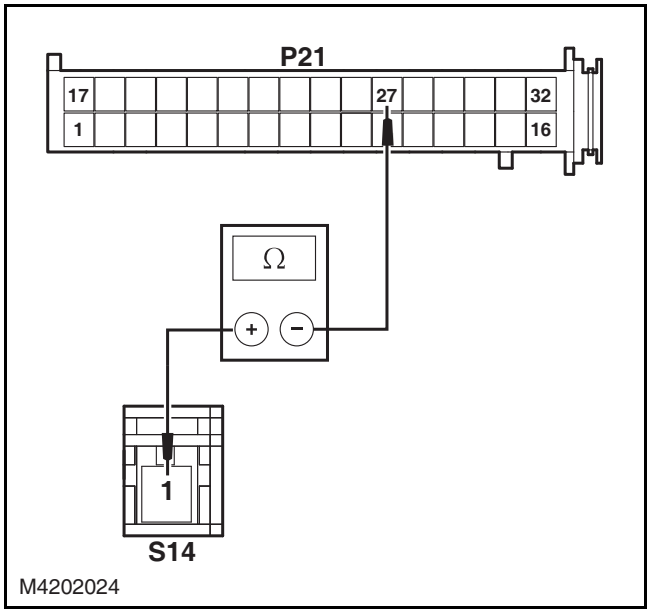
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster fuse | |
| | A. Inspect the instrument cluster fuse IF35.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect instrument cluster power supply | |
|  | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the voltage between terminal 7 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of instrument cluster wiring harness connector P21 and terminal 70 of instrument panel fuse box fuse IF35. |

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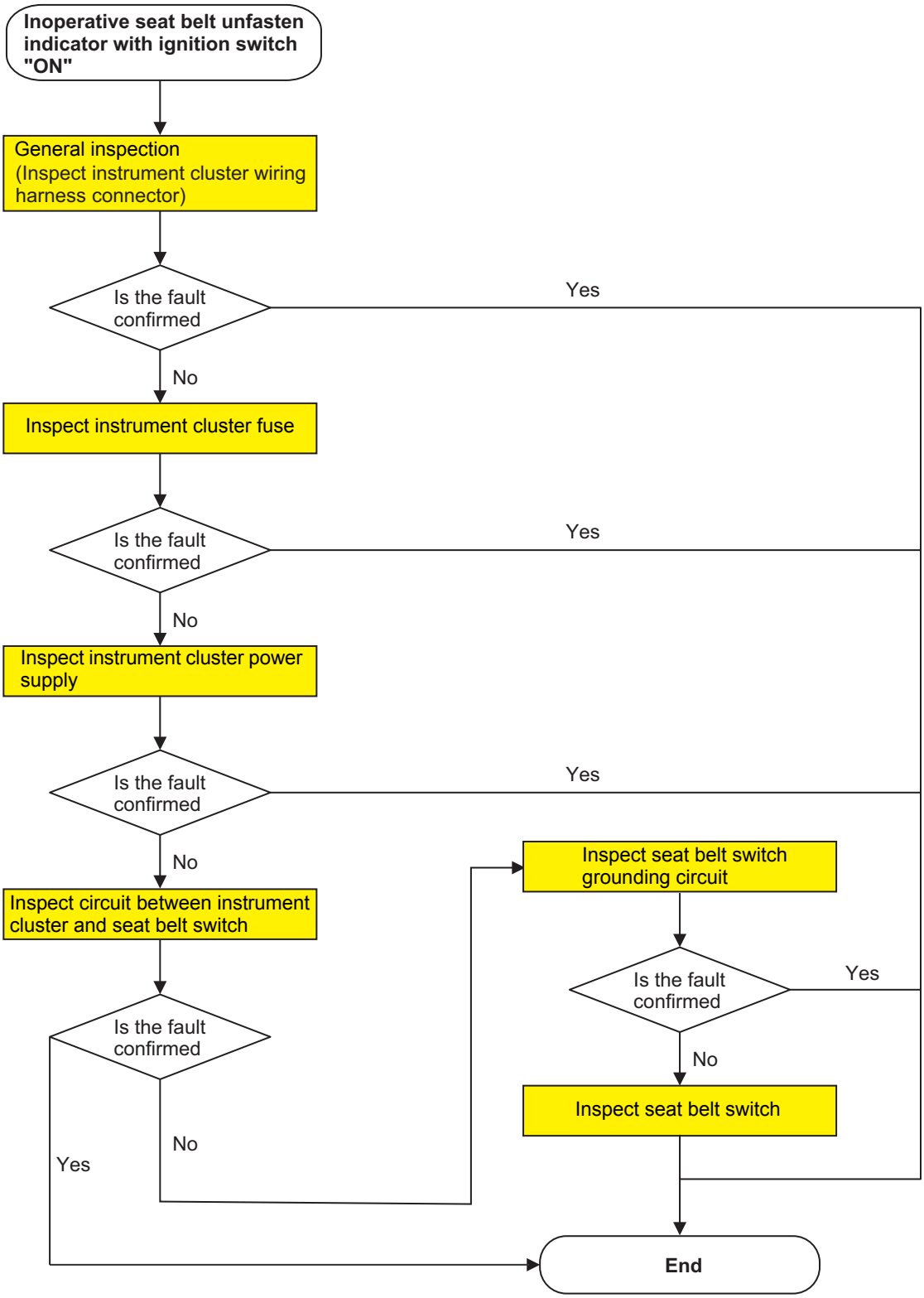


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between instrument cluster and parking brake switch | |
|  <br>M4202024 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the parking brake switch wiring harness connector S14.<br>C. Disconnect the instrument cluster wiring harness connector P21.<br>D. Measure the resistance between terminal 1 of parking brake switch wiring harness connector S14 and terminal 27 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of parking brake switch wiring harness connector S14 and terminal 27 of instrument cluster wiring harness connector P21. |
| 5. Inspect parking brake switch | |
| | A. Replace the parking brake switch with a good one.<br>Is the indication normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).** |

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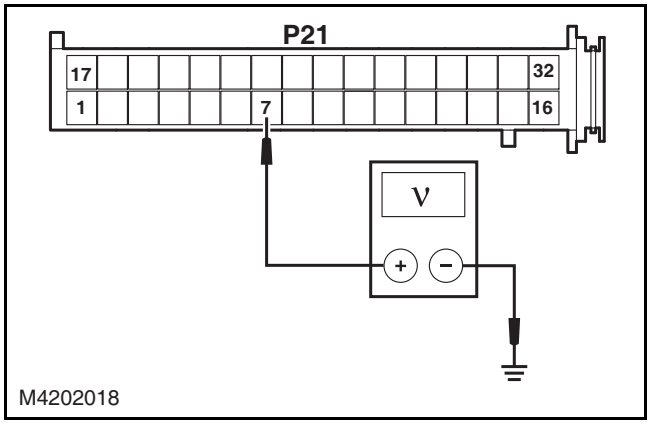


# Diagnostic Procedure for Inoperative Seat Belt Unfasten Indicator with Ignition Switch "ON"



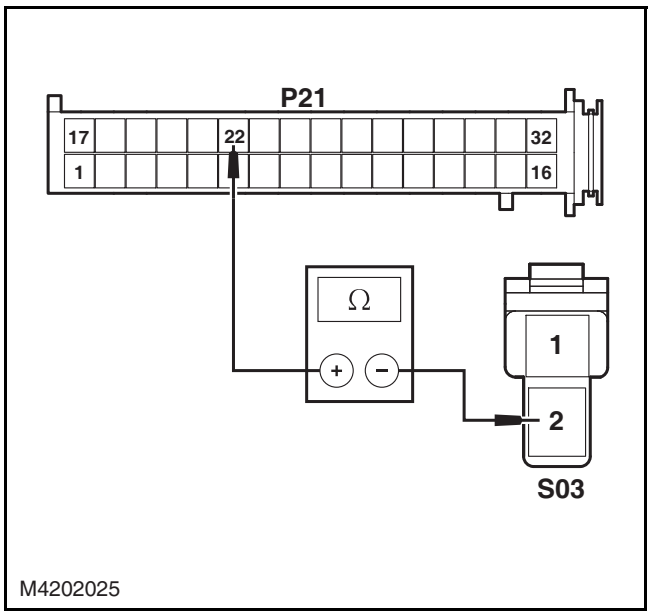
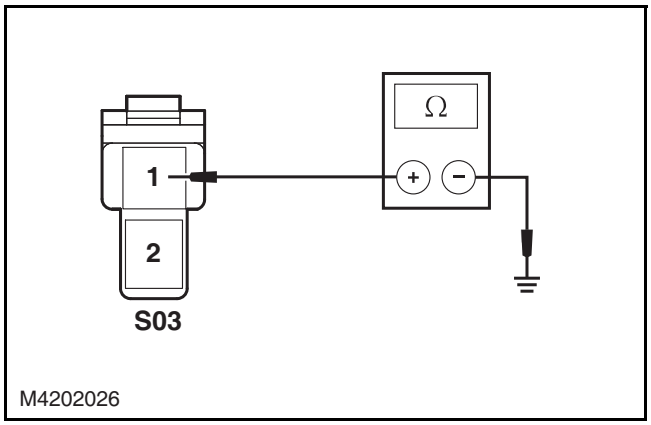
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the instrument cluster wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect instrument cluster fuse | |
| | A. Inspect the instrument cluster fuse IF35.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect instrument cluster power supply | |
|  <br>M4202018 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the instrument cluster wiring harness connector P21.<br>C. Measure the voltage between terminal 7 of instrument cluster wiring harness connector P21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of instrument cluster wiring harness connector P21 and terminal 70 of instrument panel fuse box fuse IF35. |

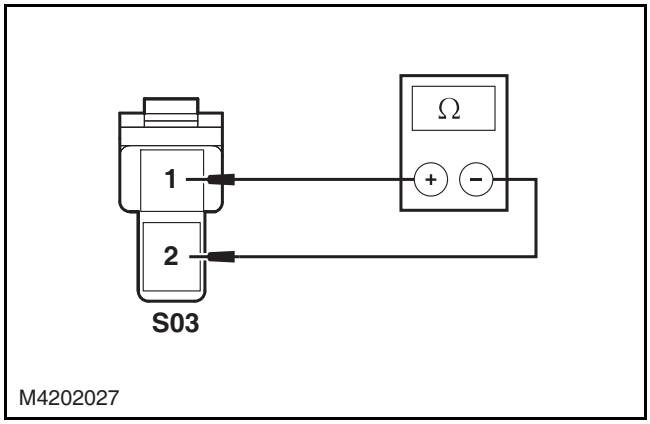
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between instrument cluster and seat belt switch | |
|  M4202025 | A. Turn the ignition switch to "OFF".<br>B. Disconnect the seat belt switch wiring harness connector S03.<br>C. Disconnect the instrument cluster wiring harness connector P21.<br>D. Measure the resistance between terminal 2 of seat belt switch wiring harness connector S03 and terminal 22 of instrument cluster wiring harness connector P21.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of seat belt switch wiring harness connector S03 and terminal 22 of instrument cluster wiring harness connector P21. |
| 5. Inspect seat belt switch grounding circuit | |
|  M4202026 | A. Disconnect the seat belt switch wiring harness connector S03.<br>B. Measure the resistance between terminal 1 of seat belt switch wiring harness connector S03 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between seat belt switch wiring harness connector S03 and the grounding G201. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect seat belt switch | |
|  <br>M4202027 | A. Disconnect the seat belt switch wiring harness connector S03.<br>B. Measure the resistance between terminals 1 and 2 of seat belt switch.<br>**Standard resistance: less than 1 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the instrument cluster.<br>**Refer to: Instrument Cluster (4.2.2 Instrument Cluster, Removal and Installation).**<br>**No**<br>Replace the seat belt switch. |

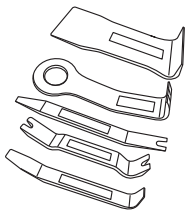
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## Removal and Installation

# Instrument Cluster

### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

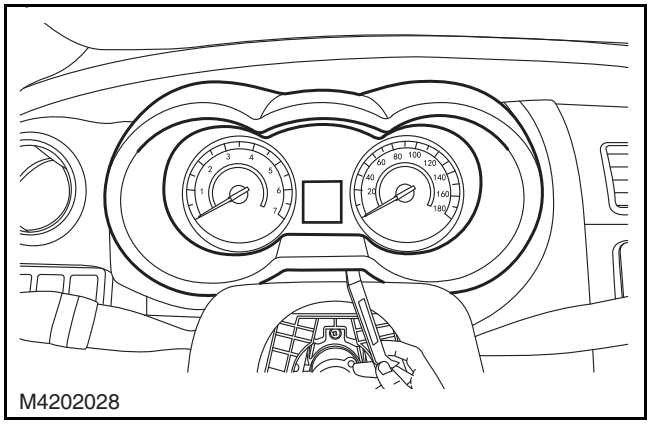
## Removal

1. Disconnect the negative battery cable.

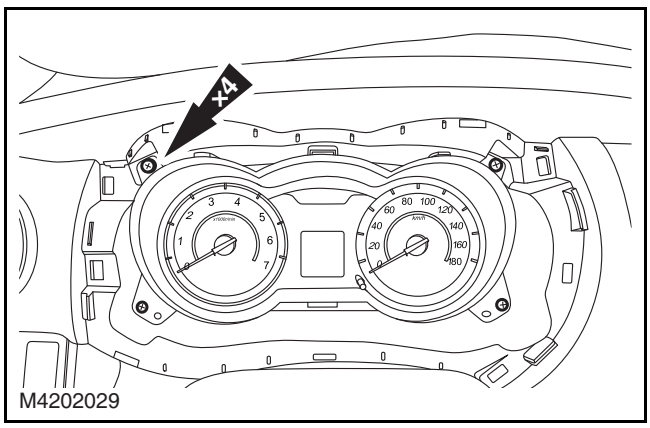
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Use the special tool to remove the instrument cluster cover.

   Special tool: CA501-002


M4202028

3. Remove 4 retaining screws from the instrument cluster.

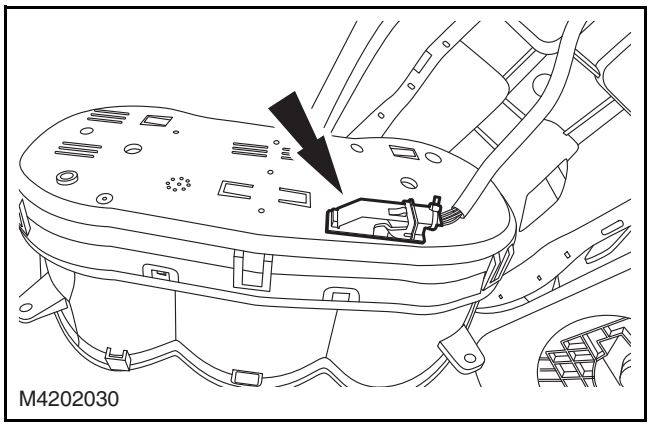


M4202029

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4. Disconnect the instrument cluster wiring harness connector and remove the instrument cluster.


M4202030

## Installation

1. Installation is in the reverse order of removal.

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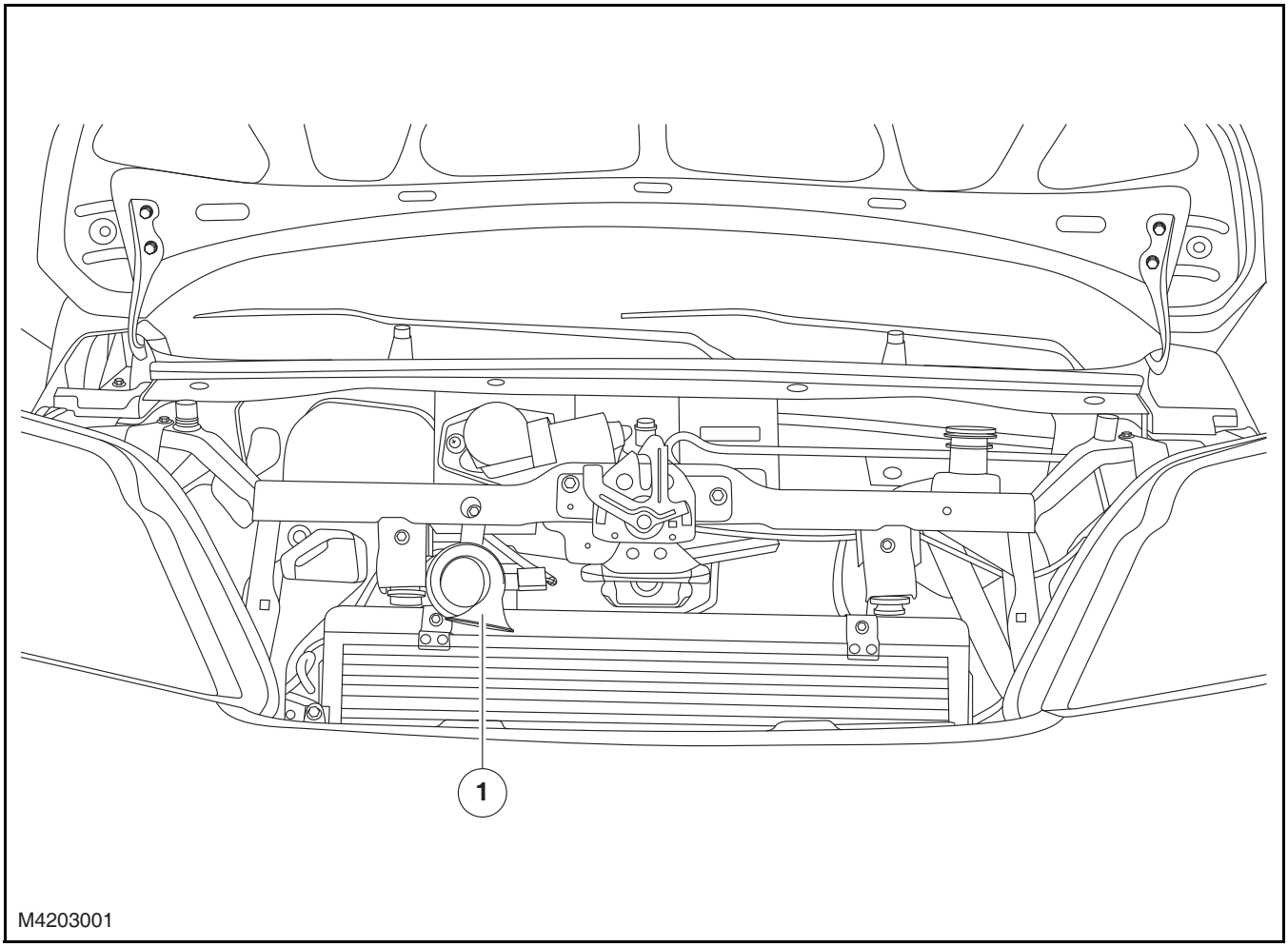
## Description and Operation

# System Overview

The horn is fixed on the crossmember in the front compartment and controlled by a relay which is grounded by the steering wheel. The horn circuit is switched on and horn starts to sound when the horn switch on the steering wheel is pressed.

# Components Location View

## Horn

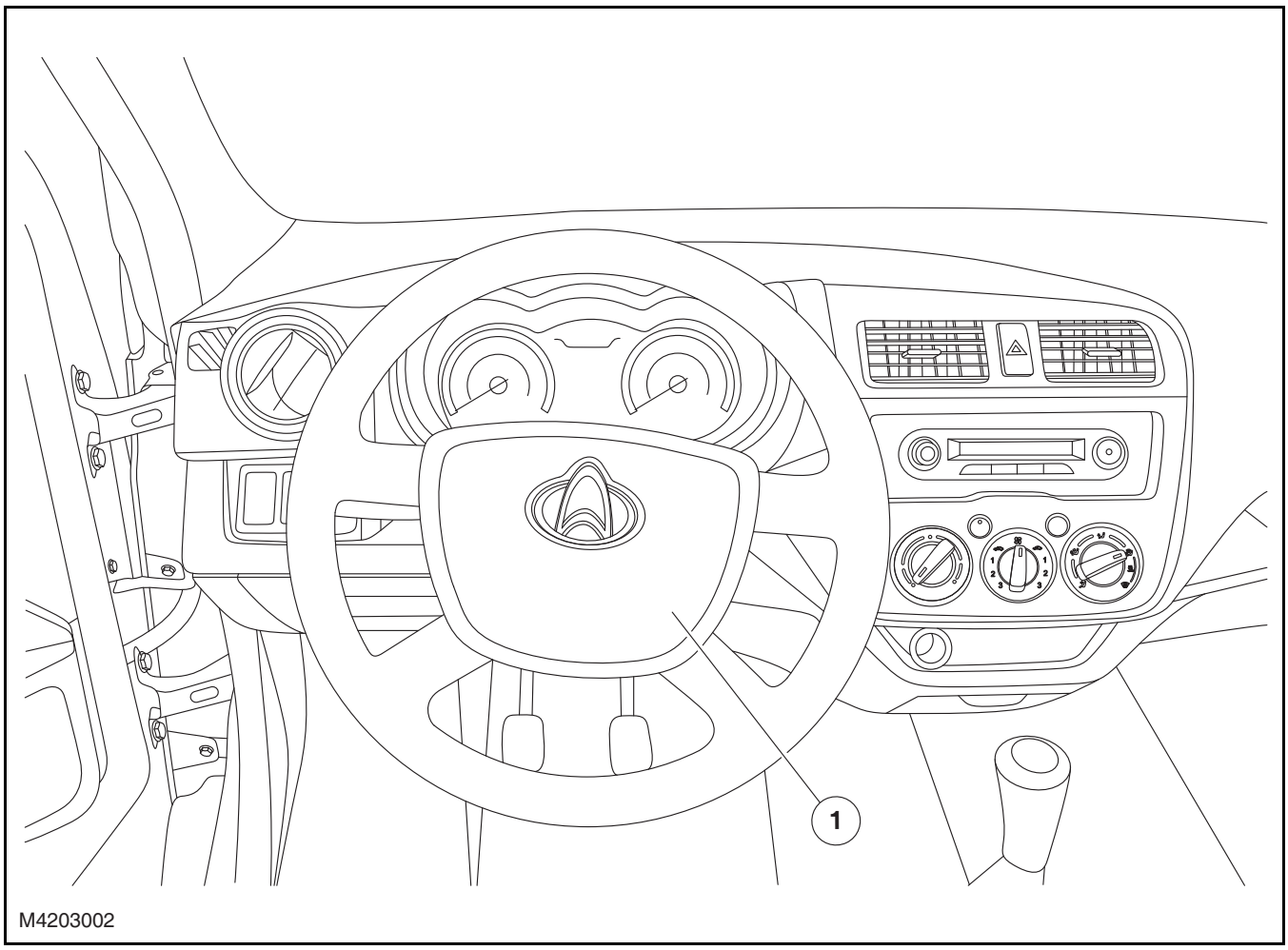



| Item | Description |
|---|---|
| 1 | Electrical horn assembly |

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## Horn Switch




| Item | Description |
|---|---|
| 1 | Horn switch |

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious mechanical or electrical damage or collision.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Steering wheel<br>• Horn | • Circuit<br>• Steering wheel horn switch |

3. Inspect the system circuit which is accessible or visible.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

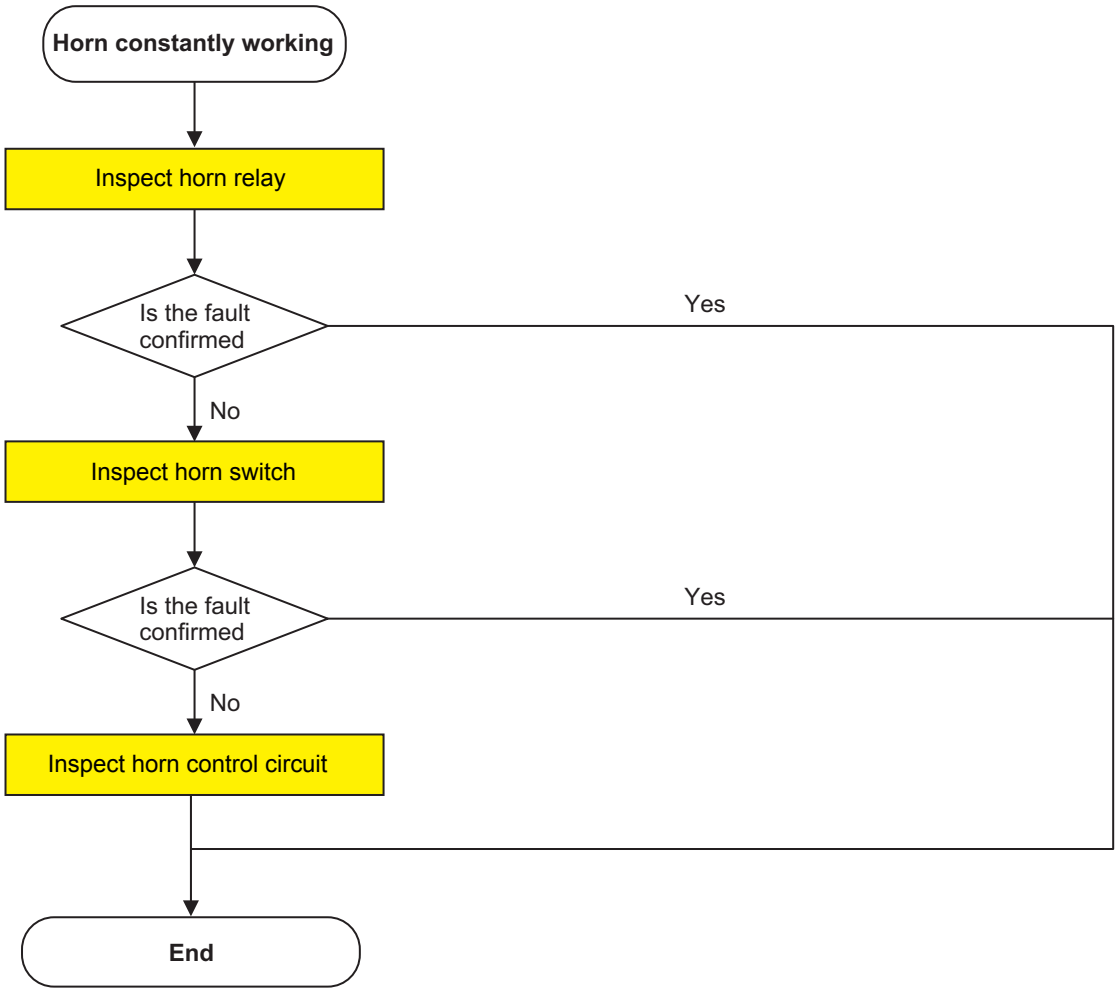
If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Horn constantly working | • Circuit<br>• Horn<br>• Horn switch | Refer to: Diagnosis Procedure for Horn Constantly Working (4.2.3 Horn, Symptom Diagnosis and Testing). |
| Horn does not sound | • Circuit<br>• Horn<br>• Horn switch | Refer to: Diagnosis Procedure for Horn Not Working (4.2.3 Horn, Symptom Diagnosis and Testing). |

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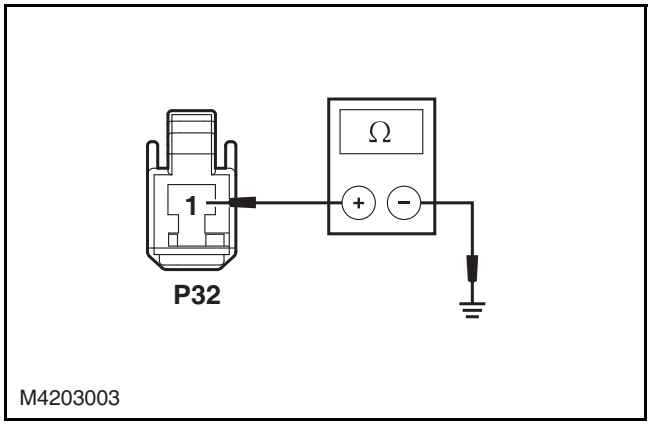


# Diagnosis Procedure for Horn Constantly Working



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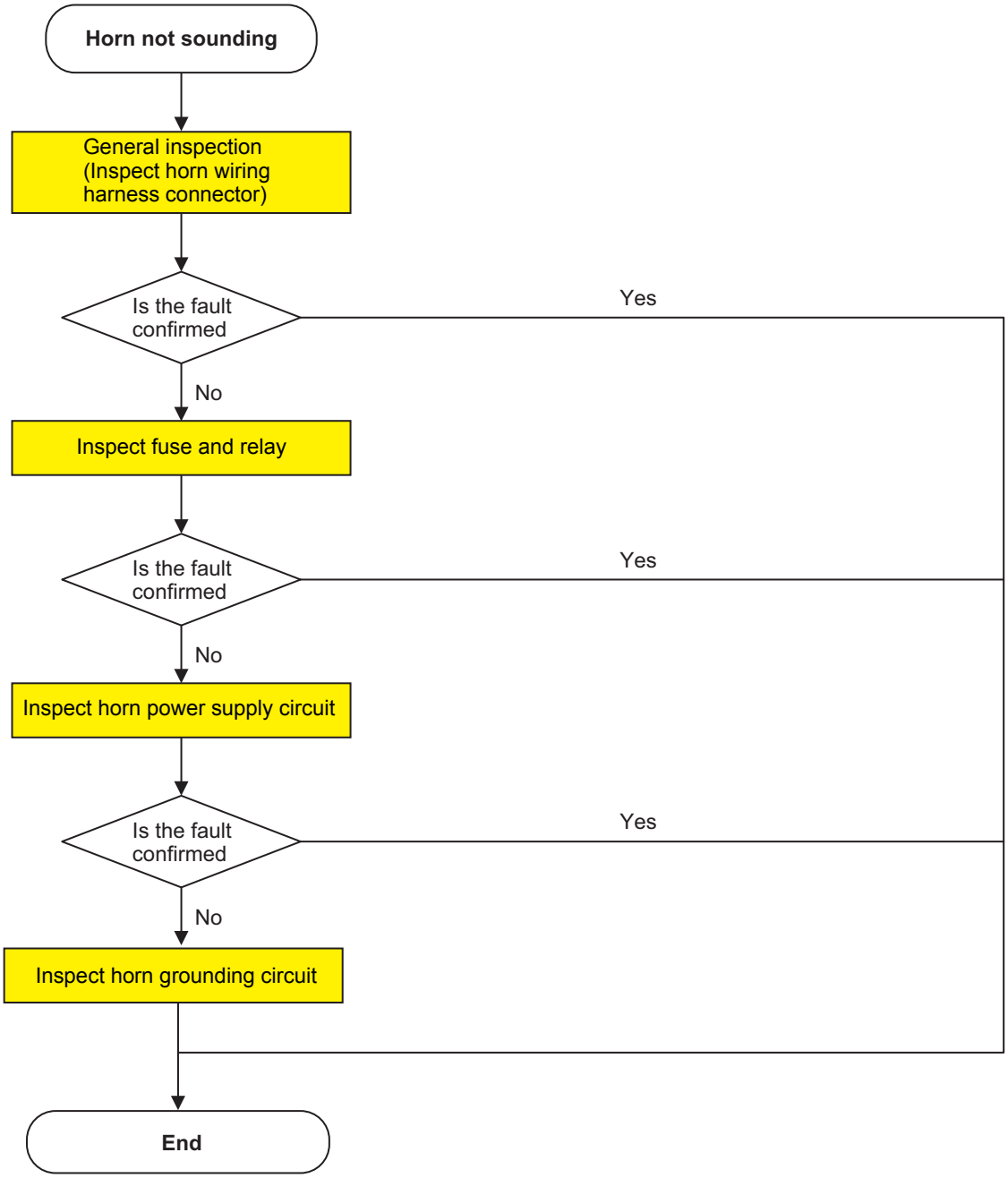


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect horn relay | |
| | A. Inspect the horn relay IR09.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the horn relay IR09. |
| 2. Inspect horn switch | |
| | A. Disconnect the horn switch wiring harness connector P32.<br>Is the horn still sounding constantly?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the horn switch, and replace the horn switch wiring harness connector P32 when necessary. |
| 3. Inspect horn control circuit | |
|  | A. Remove the instrument panel fuse box relay IR09.<br>B. Disconnect the horn wiring switch harness connector P32.<br>C. Measure the resistance between terminal 1 of horn switch wiring harness connector P32 and reliable grounding.<br>**Standard resistance: 10 MΩ or more**<br>Is the resistance value normal?<br>**Yes**<br>Inspect and repair the short circuit fault to power supply in terminal 2 of horn wiring harness connector P12.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of horn switch wiring harness connector P32 and terminal 85 of instrument panel fuse box relay IR09. |

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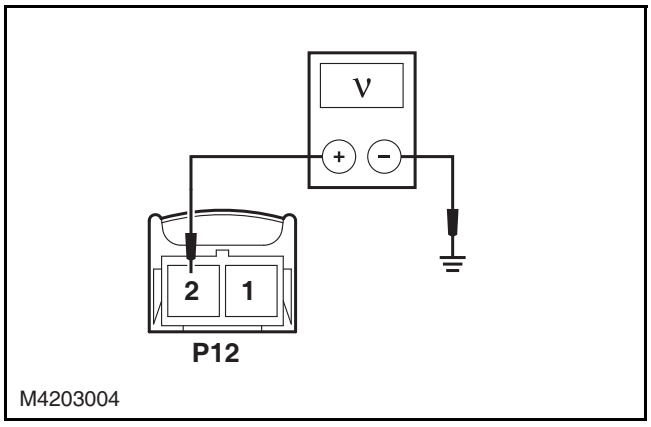


# Diagnosis Procedure for Horn Not Sounding



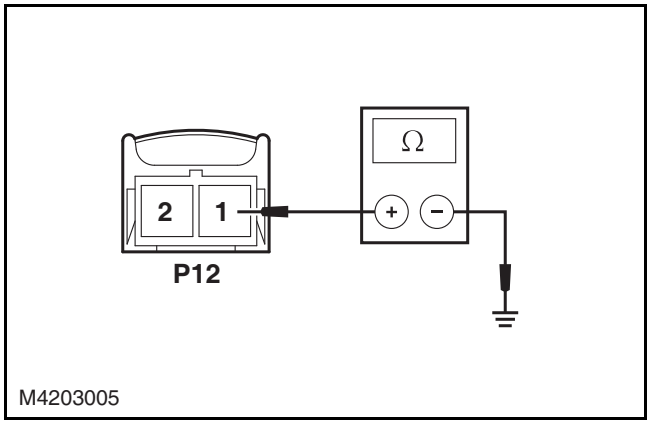
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the horn switch wiring harness connector for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect fuse and relay | |
| | A. Inspect the horn fuse IF12.<br>**Fuse rated capacity: 15 A**<br>B. Inspect the horn relay IR09.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity or the relay. |
| 3. Inspect horn power supply circuit | |
|  | A. Disconnect the horn switch wiring harness connector P12.<br>B. Press the horn switch and measure the voltage between terminal 2 of horn wiring harness connector P12 and reliable grounding with the multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the horn switch and the circuit fault between terminal 1 of horn switch wiring harness connector P32 and terminal 2 of horn wiring harness connector P12. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect horn grounding circuit | |
|  M4203005 | A. Disconnect the horn wiring harness connector P12.<br>B. Measure the resistance between terminal 1 of horn wiring harness connector P12 and reliable grounding with the multimeter.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the horn assembly.<br>**Refer to: Horn (4.2.3 Horn, Removal and Installation).**<br>**No**<br>Inspect and repair the circuit fault between terminal 1 of horn wiring harness connector P12 and grounding G105. |

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## Removal and Installation

# Horn

### Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

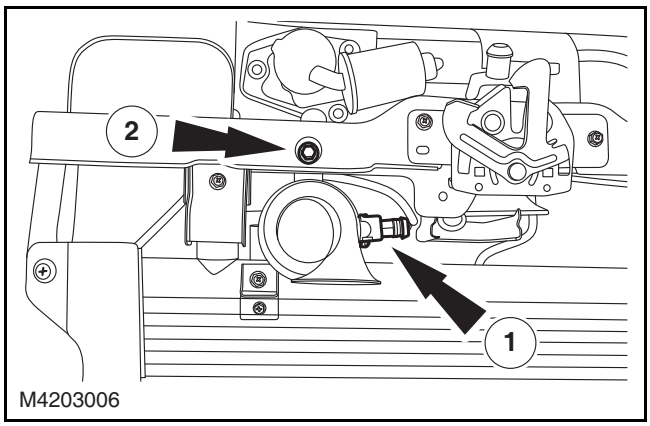
2. Remove the upper grille.

   **Refer to: Upper Grille (5.1.7 Bumper, Removal and Installation).**

3. Remove the horn.

   1 Disconnect the horn wiring harness connector.

   2 Remove the horn retaining bolt and remove the horn.




### Installation

1. Installation is in the reverse order of removal.

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## Specifications

# General Specifications

| Item | Rated Voltage | Max. Current | Reset Time | Durability |
|---|---|---|---|---|
| Cigarette lighter | 12 V (DC) | 10 A | Less than 18 s | 5000 |

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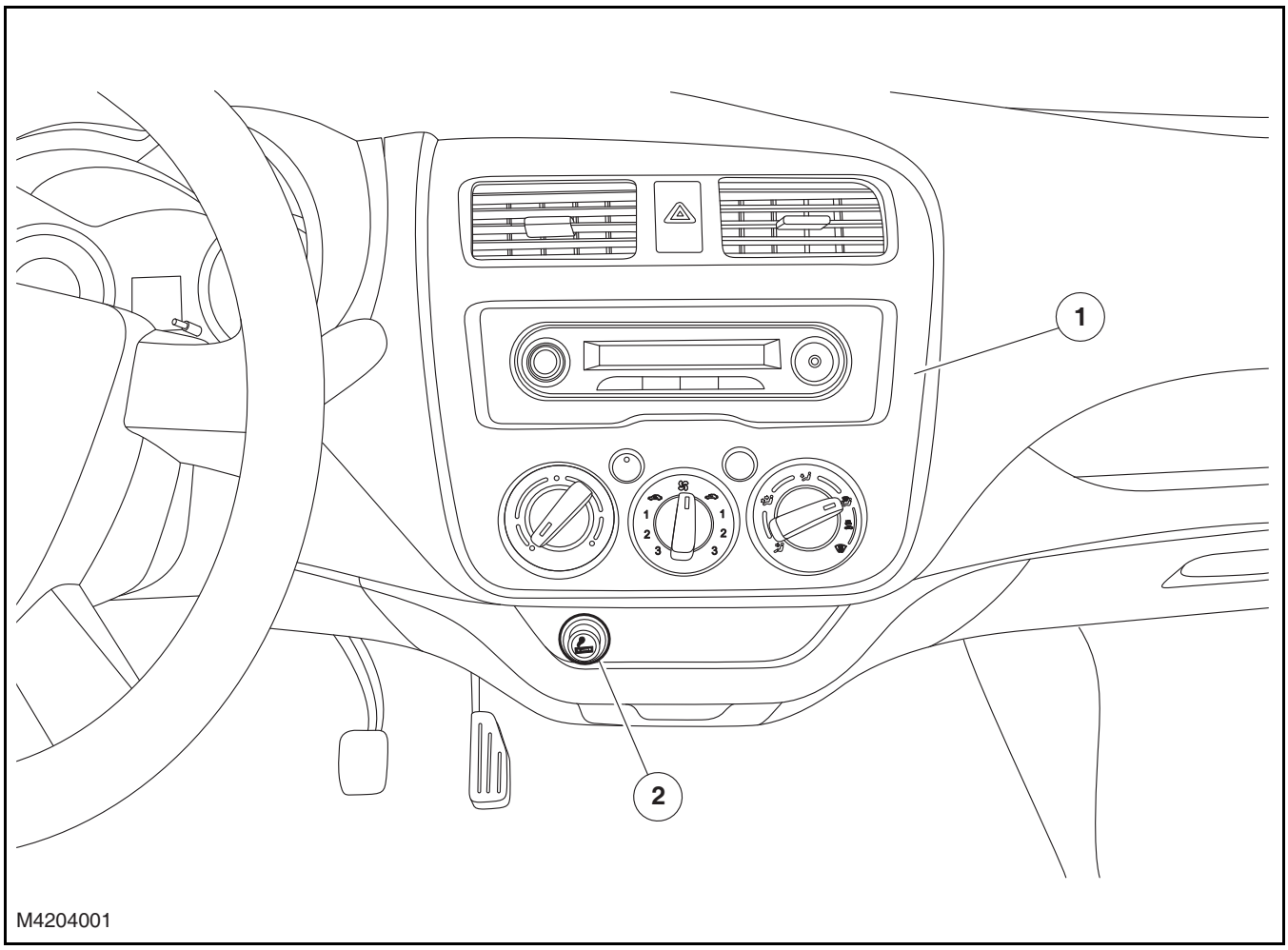
## Description and Operation

# System Overview

The cigarette lighter is installed on the instrument panel. It could be pulled out to use when it pops up automatically after its heating element becomes hot in seconds upon pressing the button.

**CAUTION: Be careful to avoid scalding from high temperature of the cigarette lighter in energizing position.**

# Components Location View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Center control panel assembly | 2 | Cigarette lighter |

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check for obvious mechanical or electrical damage and deformation due to collision.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Instrument panel<br>• Cigarette lighter retainer | • Fuse<br>• Circuit<br>• Cigarette lighter |

3. Inspect system circuit which is accessible or visible.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

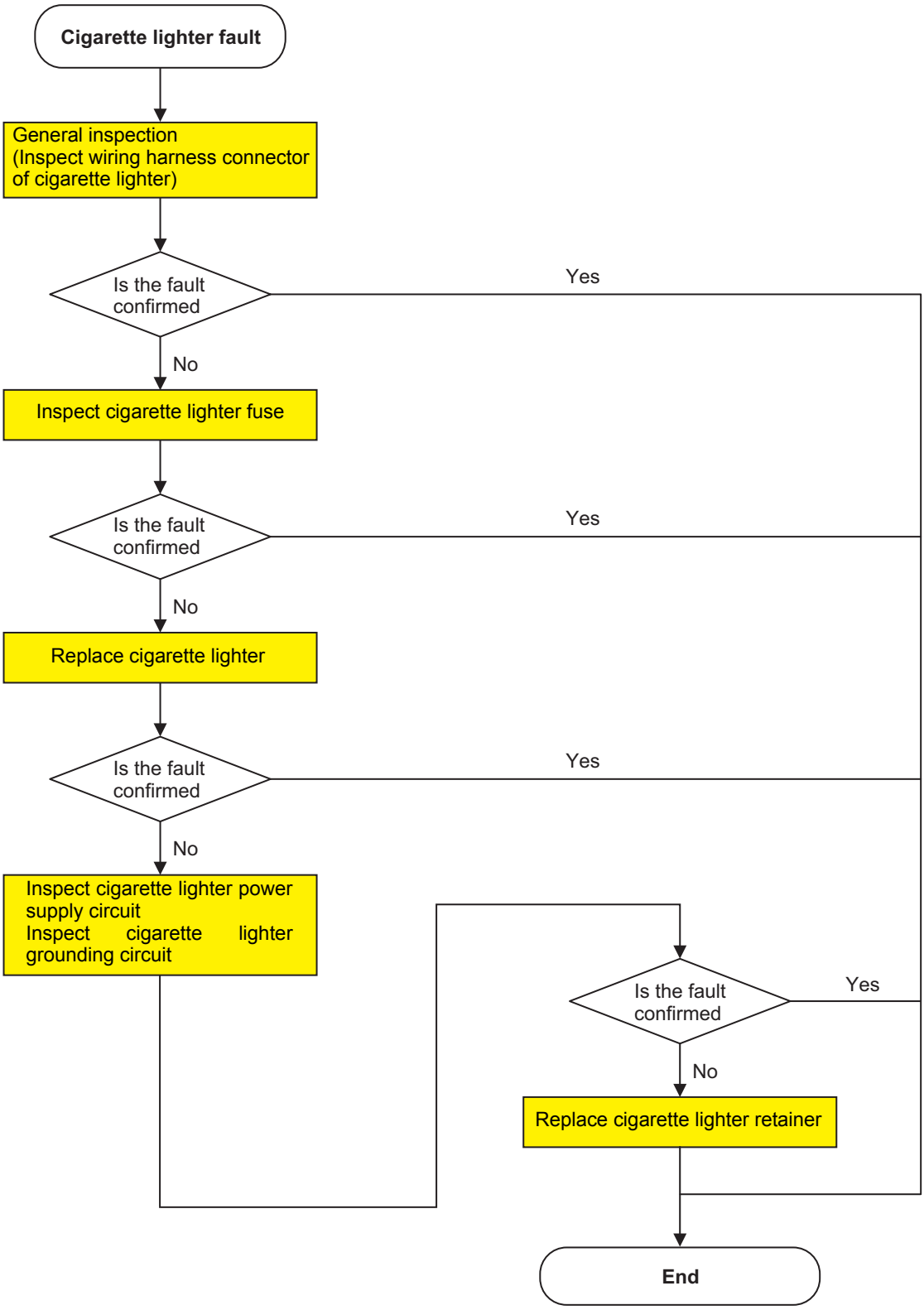
If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Cigarette lighter fault | • Fuse and circuit<br>• Cigarette lighter | Refer to: Diagnosis Procedure for Cigarette Lighter Fault (4.2.4 Cigarette Lighter, Symptom Diagnosis and Testing). |
| Cigarette lighter does not pop up | • Cigarette lighter<br>• Cigarette lighter retainer | • Replace the cigarette lighter<br>• Replace the cigarette lighter retainer |

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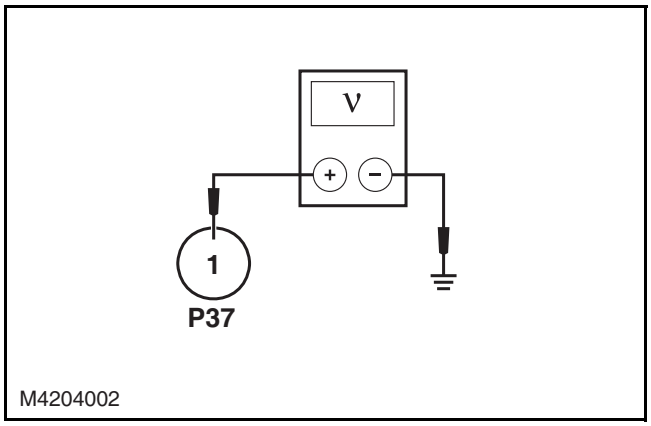


# Diagnosis Procedure for Cigarette Lighter Fault



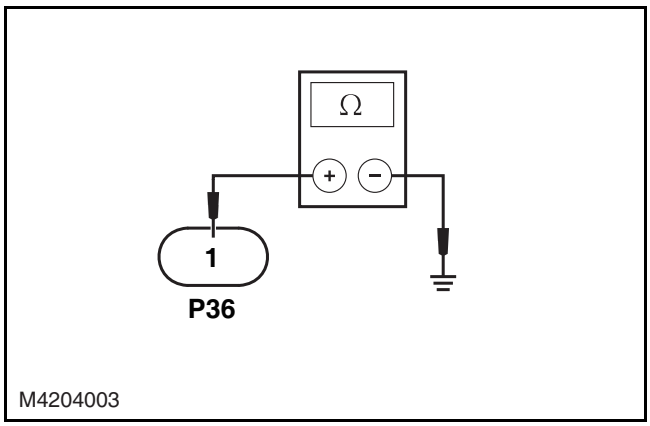
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connector of cigarette lighter for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect cigarette lighter fuse | |
| | A. Inspect the cigarette lighter fuse IF40.<br>**Fuse rated capacity: 15 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Replace cigarette lighter | |
| | A. Replace with a new cigarette lighter.<br>Does the cigarette lighter work normally?<br>**Yes**<br>Make sure that the system is normal.<br>**No**<br>Go to step 4. |
| 4. Inspect cigarette lighter power supply circuit | |
|  | A. Disconnect the cigarette lighter wiring harness connector P37.<br>B. Turn the ignition switch to "ACC".<br>C. Measure the voltage between terminal 1 of cigarette lighter wiring harness connector P37 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 80 of instrument panel fuse box fuse IF40 and terminal 1 of cigarette lighter wiring harness connector P37. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect cigarette lighter grounding circuit | |
|  <br>M4204003 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the cigarette lighter wiring harness connector P36.<br>C. Measure the resistance between terminal 1 of cigarette lighter wiring harness connector P36 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of cigarette lighter wiring harness connector P36 and grounding G106. |
| 6. Replace cigarette lighter retainer | |
| | A. Turn the ignition switch to "LOCK".<br>B. Replace the cigarette lighter retainer.<br>**Refer to: Cigarette Lighter (4.2.4 Cigarette Lighter, Removal and Installation).**<br>Make sure that the system is normal. |

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## Removal and Installation

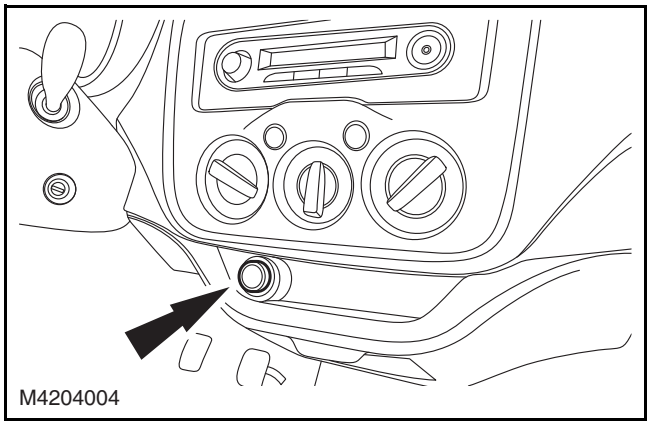
# Cigarette Lighter

### Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

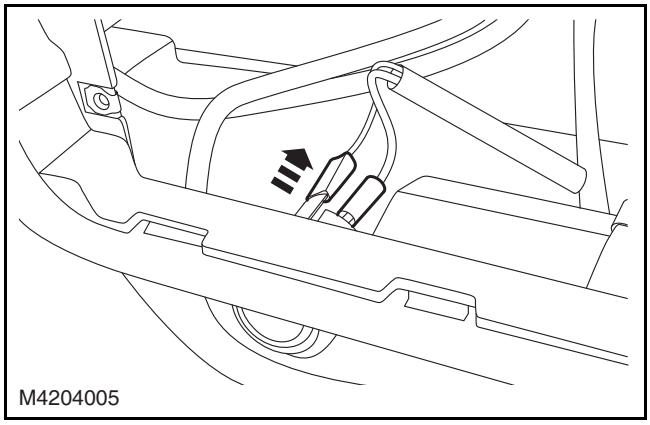
2. Remove the cigarette lighter from the center control panel.


M4204004

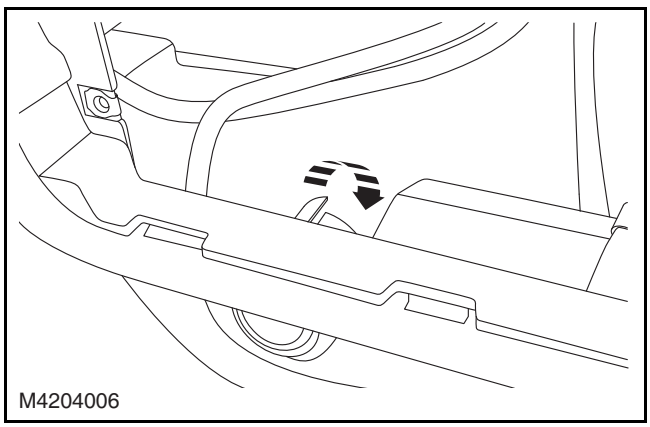
3. Remove the A/C controller.

   **Refer to: A/C Controller (5.1.6 Instrument Panel and Console, Removal and Installation).**

4. Disconnect the cigarette lighter wiring harness connector.


M4204005

5. Turn the cigarette lighter retainer counterclockwise, and remove the cigarette lighter retainer from the control panel.


M4204006

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## Installation

**1.** Installation is in the reverse order of removal.

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## Specifications

# General Specifications

| Item | Rated Voltage | Rated Current |
|---|---|---|
| Radio power supply | 12 V (DC) | - |

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## Description and Operation

# System Overview

When you turn on the radio and shift to "AM" or "FM", the antenna receives radio signals and sends them to the radio through feeder. The radio receives the radio signals and filters wave to tune the needed signals, then amplifies the audio signals through amplifier and finally outputs them through speakers.

# Components Description

### Roof Antenna

The roof antenna is located on the upper of A pillar, whose length can be adjusted.

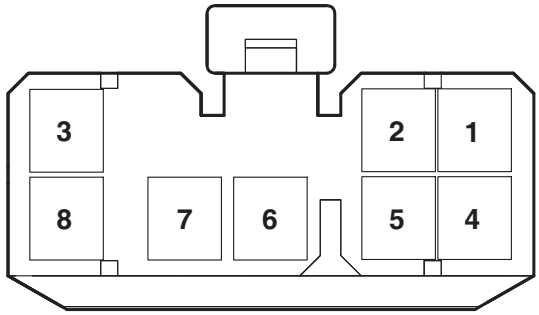
### Left and Right Speaker

The audio system of radio adopts two speakers which are located inside the left and right door.

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# Radio Terminal List




P34

M4205001

| Terminal No. | Connection Wire | Terminal Description |
|---|---|---|
| P34-1 | 0.5 WH | Radio power supply (+B) |
| P34-2 | 0.5 BU/RD | Front right speaker positive |
| P34-3 | 0.5 RD | Front left speaker positive |
| P34-4 | 0.85 BK | Radio GND |
| P34-5 | 0.85 WH/BK | Radio power supply (ACC) |
| P34-6 | 0.5 RD/YE | Background lamp power supply |
| P34-7 | 0.5 BU/BK | Front right speaker negative |
| P34-8 | 0.5 RD/BK | Front Left speaker negative |

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |

# Inspection and Verification

**CAUTION: When testing whether the audio entertainment system has poor reception or noise interference, park the vehicle outdoors far from metal buildings and power supply wires.**

1. Verify the customer concern.
2. Visually check if there are obvious mechanical or electrical damage and deformation due to collision.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Antenna<br>• Control panel | • Fuse<br>• Circuit<br>• Audio circuit<br>• Antenna and feeder |

3. Inspect system circuit that is accessible and visible.

**CAUTION: Twisted-pair cable can shield electronic components effectively from electrical interference. If the shielding layer of original circuits is damaged, install a new one.**

4. If an observed or reported concern is obvious and its cause has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the symptom chart.

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# Symptom Chart

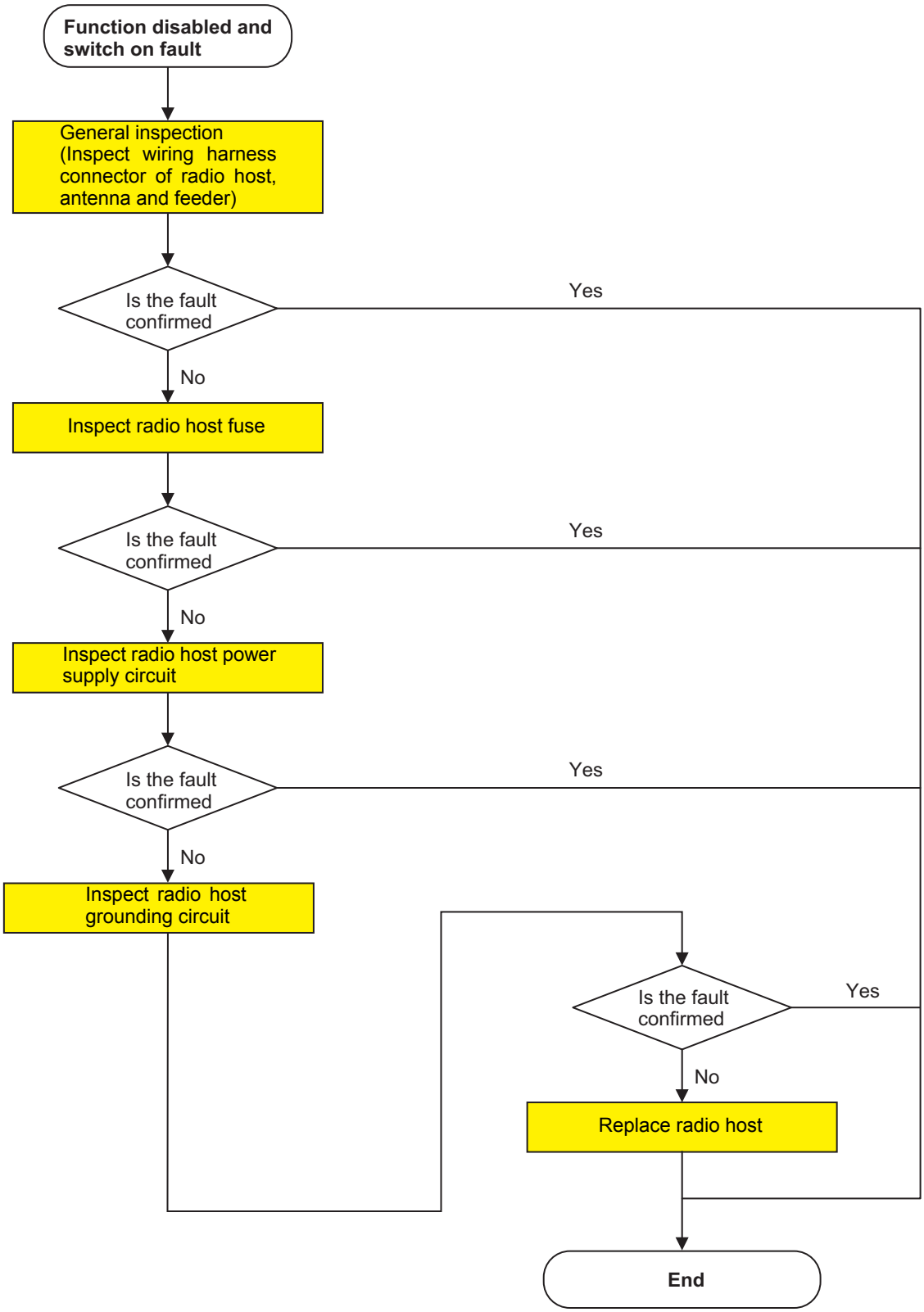
If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Function disabled, switch on fault | • Fuse<br>• Circuit<br>• Radio host | **Refer to: Diagnosis Procedure for Function Disabled and Switch on Fault (4.2.5 Information and Entertainment System, Symptom Diagnosis and Testing).** |
| No sound | • Fuse and circuit<br>• Speaker<br>• Radio host | **Refer to: Diagnosis Procedure for No Sound (4.2.5 Information and Entertainment System, Symptom Diagnosis and Testing).** |
| Wrong or no display on screen | • Screen does not light<br>• Screen fault | • Inspect and repair the screen circuit fault.<br>• Inspect and repair or replace the radio. |
| Sound is not clear | • Circuit interference<br>• Antenna and feeder<br>• Radio host | • Inspect and repair the circuit.<br>• Inspect and repair the antenna and feeder.<br>• Inspect and repair or replace the speaker.<br>• Inspect and repair or replace the radio host. |
| Poor or no radio signal reception | • Interference or shield at some places<br>• Antenna and feeder<br>• Radio host | • Change the place for receiving radio signals.<br>• Inspect and repair, replace the antenna and feeder.<br>• Inspect and repair or replace the radio host. |
| Single track when playing | • Audio circuit<br>• Speaker<br>• Radio host | • Inspect and repair the circuit.<br>• Inspect and repair or replace the speaker.<br>• Inspect and repair or replace the radio host. |

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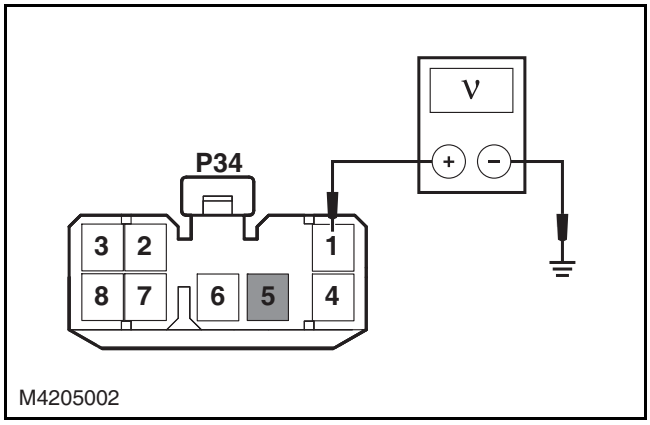


# Diagnosis Procedure for Function Disabled and Switch on Fault



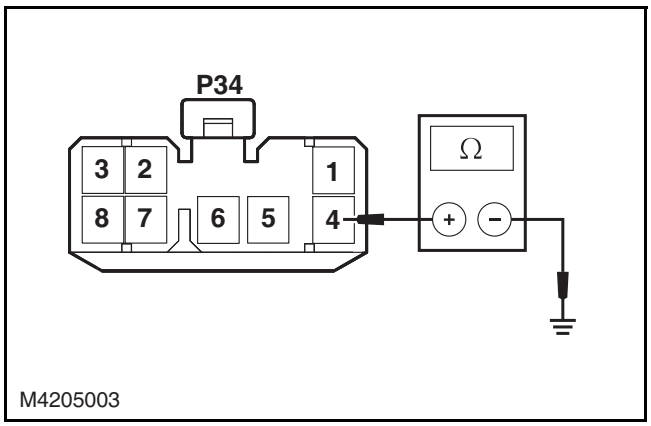
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connector of radio host, antenna and feeder for damage, aging, poor contact, looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect radio host fuse | |
| | A. Inspect the radio host fuse IF07, IF40.<br>**Fuse rated capacity: 10 A (IF07), 15 A (IF40)**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit and replace the fuse with rated capacity. |
| 3. Inspect radio host power supply circuit | |
|  <br>M4205002 | A. Disconnect the radio wiring harness connector P34.<br>B. Turn the ignition switch to "ACC".<br>C. Measure the voltage between terminals 1 and 5 of radio host wiring harness connector P34.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault of radio host power supply circuit. |

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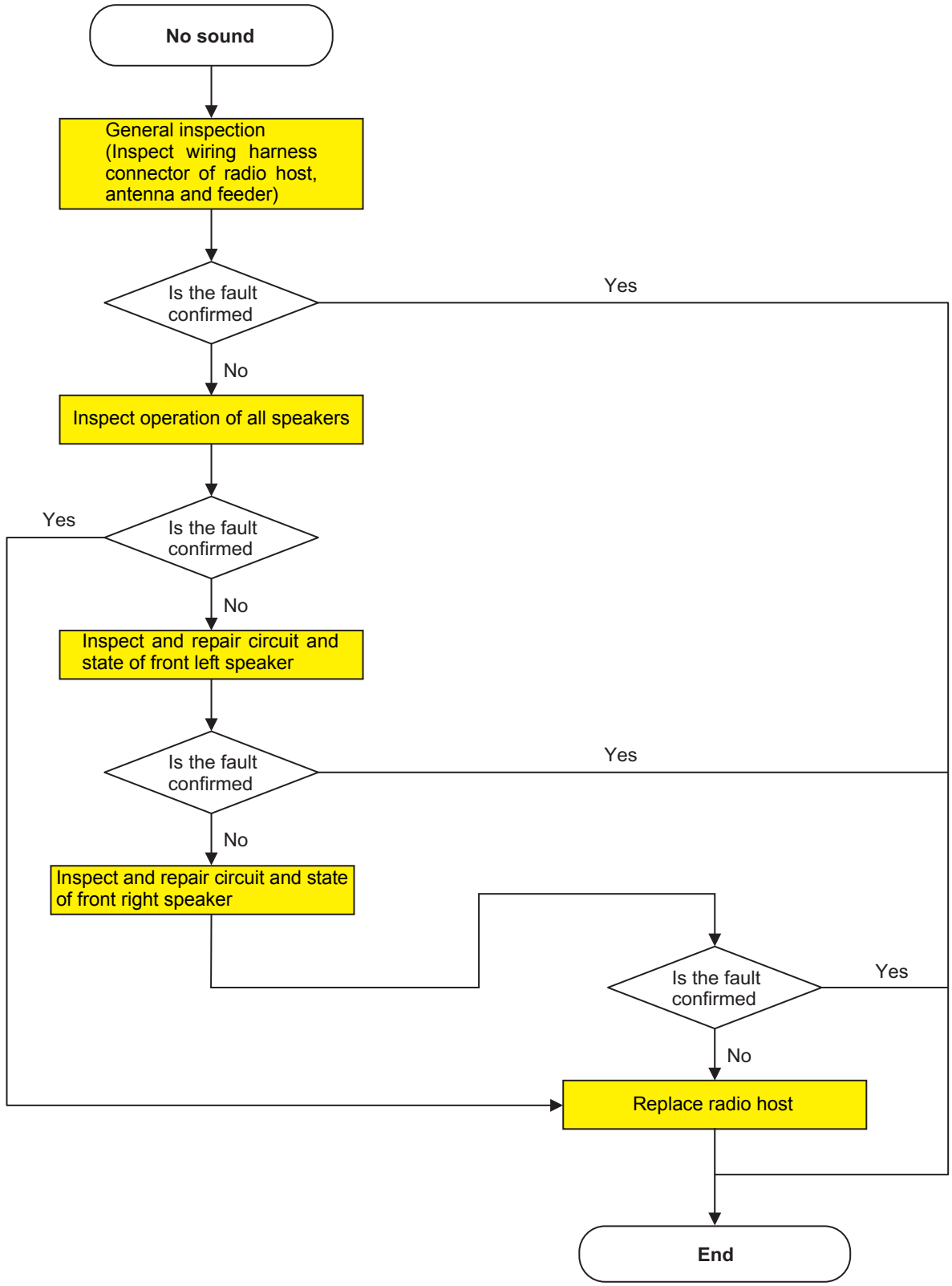


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect radio host grounding circuit | |
|  M4205003 | A. Turn the ignition switch to "LOCK".<br>B. Measure the resistance between terminal 4 of radio host wiring harness connector P34 and reliable grounding point.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between radio host grounding circuit and grounding point G106. |
| 5. Replace radio host | |
| | A. Turn the ignition switch to "LOCK".<br>B. Replace the radio host.<br>**Refer to: Radio (4.2.5 Information and Entertainment System, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for No Sound



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connector of radio host, antenna and feeder for damage, aging, poor contact, looseness and so on.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect operation of all speakers | |
| | A. Turn the ignition switch to "ACC".<br>B. Turn on the radio and enter playing state.<br>Do all the speakers not work?<br>**Yes**<br>Go to step 5.<br>**No**<br>Go to step 3. |
| 3. Inspect and repair circuit and state of front left speaker | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect and repair the front left speaker circuit, eliminating situations such as short circuit to ground, open circuit, loose wiring harness connector.<br>C. Replace the front left speaker.<br>**Refer to: Front Speaker (4.2.5 Information and Entertainment System, Removal and Installation).**<br>Is the system normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 4. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect and repair circuit and state of front right speaker | |
| | A. Turn the ignition switch to "LOCK".<br>B. Inspect and repair the front right speaker circuit, eliminating situations such as short circuit to ground, open circuit, loose wiring harness connector.<br>C.Replace the front right speaker.<br>**Refer to: Front Speaker (4.2.5 Information and Entertainment System, Removal and Installation).**<br>Is the system normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Go to step 5. |
| 5. Replace radio host | |
| | A. Turn the ignition switch to "LOCK".<br>B. Replace the radio host.<br>**Refer to: Radio Host (4.2.5 Information and Entertainment System, Removal and Installation).**<br>Make sure the system is normal. |

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## Removal and Installation

# Radio

### Removal

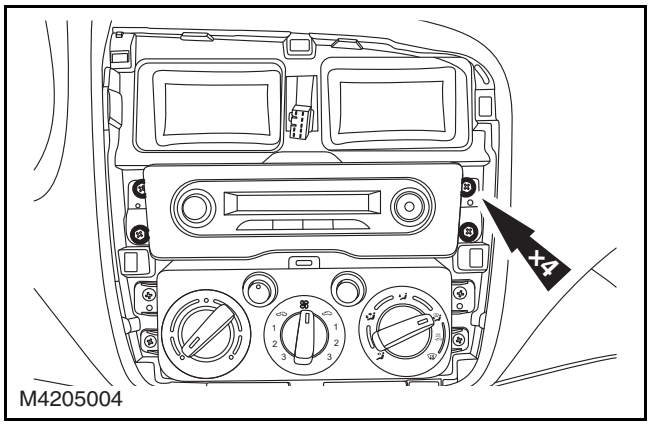
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

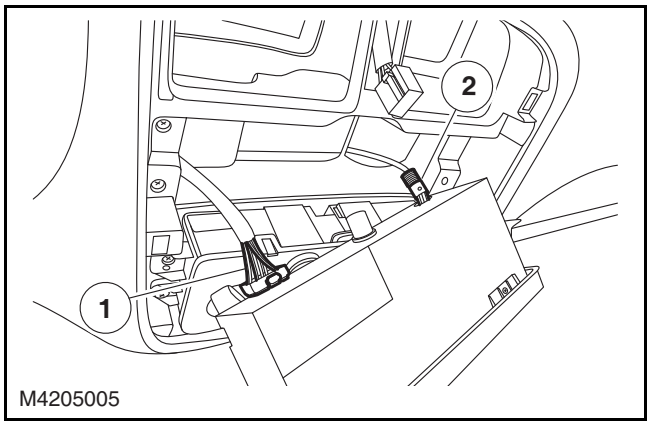
2. Remove the center control panel.

   **Refer to: Hazard Warning Lamp (4.2.6 Lighting System, Removal and Installation).**

3. Remove 4 retaining bolts from the radio.




4. Disconnect the radio wiring harness connector 1.
5. Disconnect the radio antenna connector 2, and remove the radio.




### Installation

1. Installation is in the reverse order of removal.

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# Speaker

## Removal

1. Disconnect the negative battery cable.

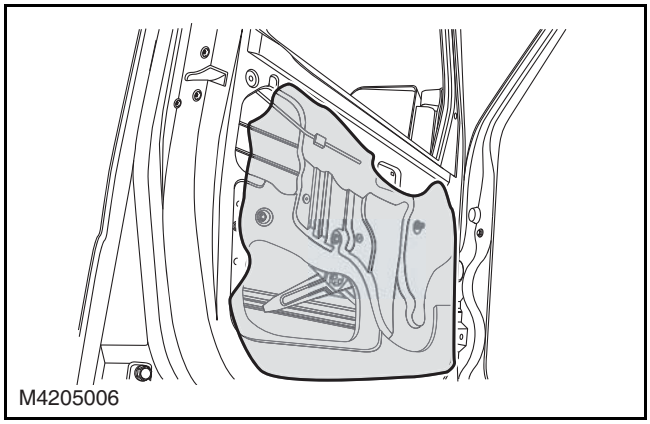
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the front door interior trim panel.

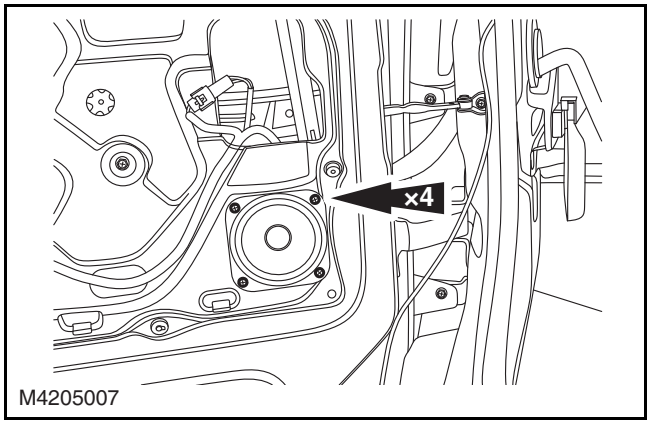
   **Refer to: Front Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**

3. Remove the front door water-proof film.

**CAUTION: Be careful to prevent damage to the water-proof film during removal. Do not touch the adhesive surface to avoid reduction in adhesion effect during reassembly.**

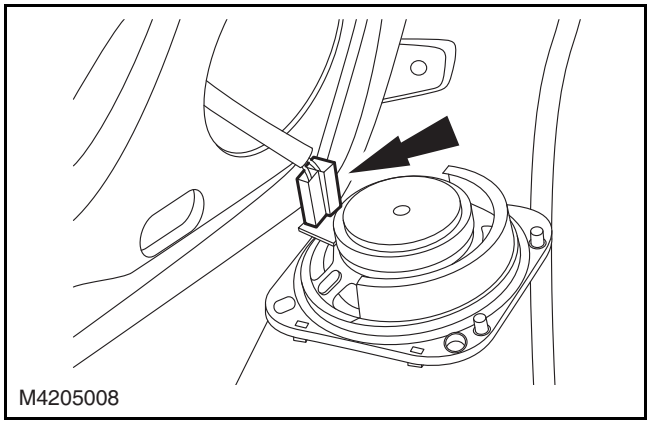

M4205006

4. Remove 4 retaining screws from the speaker.



M4205007

5. Disconnect the speaker wiring harness connector, and remove the speaker.


M4205008

## Installation

1. Installation is in the reverse order of removal.

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# Antenna

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the instrument panel.

   **Refer to: Instrument Panel (5.1.6 Instrument Panel and Console, Removal and Installation).**

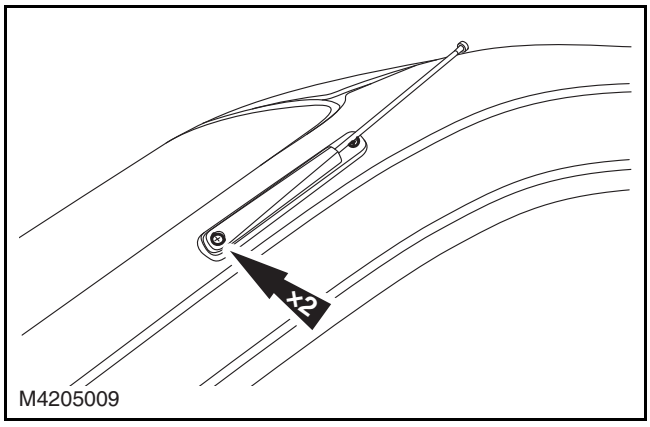
3. Remove the left A pillar trim panel.

   **Refer to: A Pillar Trim Panel (5.1.9 Interior Trim Panel and Ornamentation, Removal and Installation).**

4. Remove the roof lining.

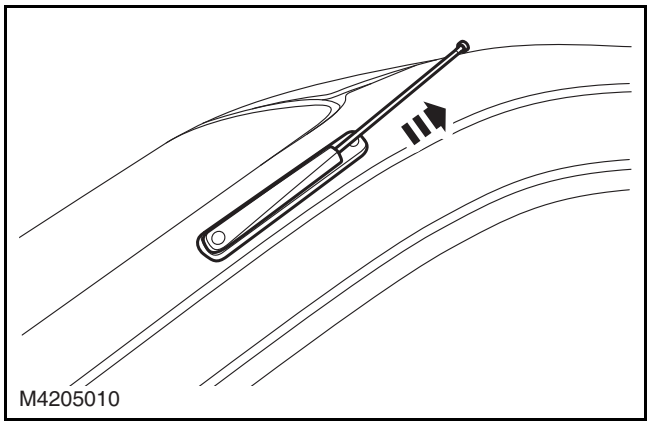
   **Refer to: Roof Lining (5.1.9 Interior Trim Panel and Ornamentation, Removal and Installation).**

5. Disconnect clip between antenna and vehicle body.
6. Remove the antenna retaining screw.



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7. Remove the antenna assembly from outside of the vehicle.


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## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Component Specifications

| Item | Bulb Name | Specifications |
|---|---|---|
| Headlamp assembly - low beam bulb | Single beam tungsten halogen bulb | H7 12V 55W |
| Headlamp assembly - high beam bulb | Single beam tungsten halogen bulb | H7 12V 55W |
| Headlamp assembly - position lamp bulb | Incandescent bulb | W5W 12V |
| Headlamp assembly - turn lamp bulb | Amber incandescent bulb | PY21W 12V |
| Front fog lamp | Single beam tungsten halogen bulb | H3 12V 55W |
| Rear combination lamp - turn lamp | Amber incandescent bulb | PY21W 12V |
| Rear combination lamp - brake lamp | Incandescent bulb | P21/5W 12V |
| Rear combination lamp - position lamp | Incandescent bulb | P21/5W 12V |
| Rear fog lamp | White incandescent bulb | P21W 12W |
| Backup lamp | White incandescent bulb | P21W 12V |
| License plate lamp | Incandescent bulb | W5W 12V |
| Reading lamp | Single beam tube incandescent bulb | W10W 12V |

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# Description and Operation

# System Overview

## Lighting Control

Lamps are illuminated when the knob at the end of lighting combination switch control lever is turned. There are 3 levels:

1. All lamps are off when the combination switch is "OFF".
2. The position lamp, tail lamp, license plate lamp and instrument panel background lamps are all illuminated when the lighting combination switch is in the middle.
3. Lamps including the above lamps as well as the headlamps are illuminated when the lighting combination switch is in the third position.

## High Beam Control

High beam control has two gears:

1. The high beam lamps are illuminated and the high beam indicator on the instrument cluster comes on when pushing the control lever to high beam gear with the low beam lamps on.
2. When the gear is not at the position of high beam, the high beam lamps are illuminated with the control lever is lifted up, and come off with the lever released, which can be used when overtaking.

## Turn Lamp

When the ignition switch is ON, the right turn lamp is illuminated when the control lever is pushed up; the left turn lamp is illuminated when the lever is pushed down.

## Fog Lamp Control

1. The front fog lamps are illuminated, and the front fog lamp indicator on the instrument panel comes on simultaneously when the control lever is turned to the first gear on the second segment with the end of lever in the middle.
2. The rear fog lamps are illuminated, and the rear fog lamp indicator on the instrument panel comes on simultaneously when the control lever is turned to the second gear on the second segment with the end of lever in the third position.

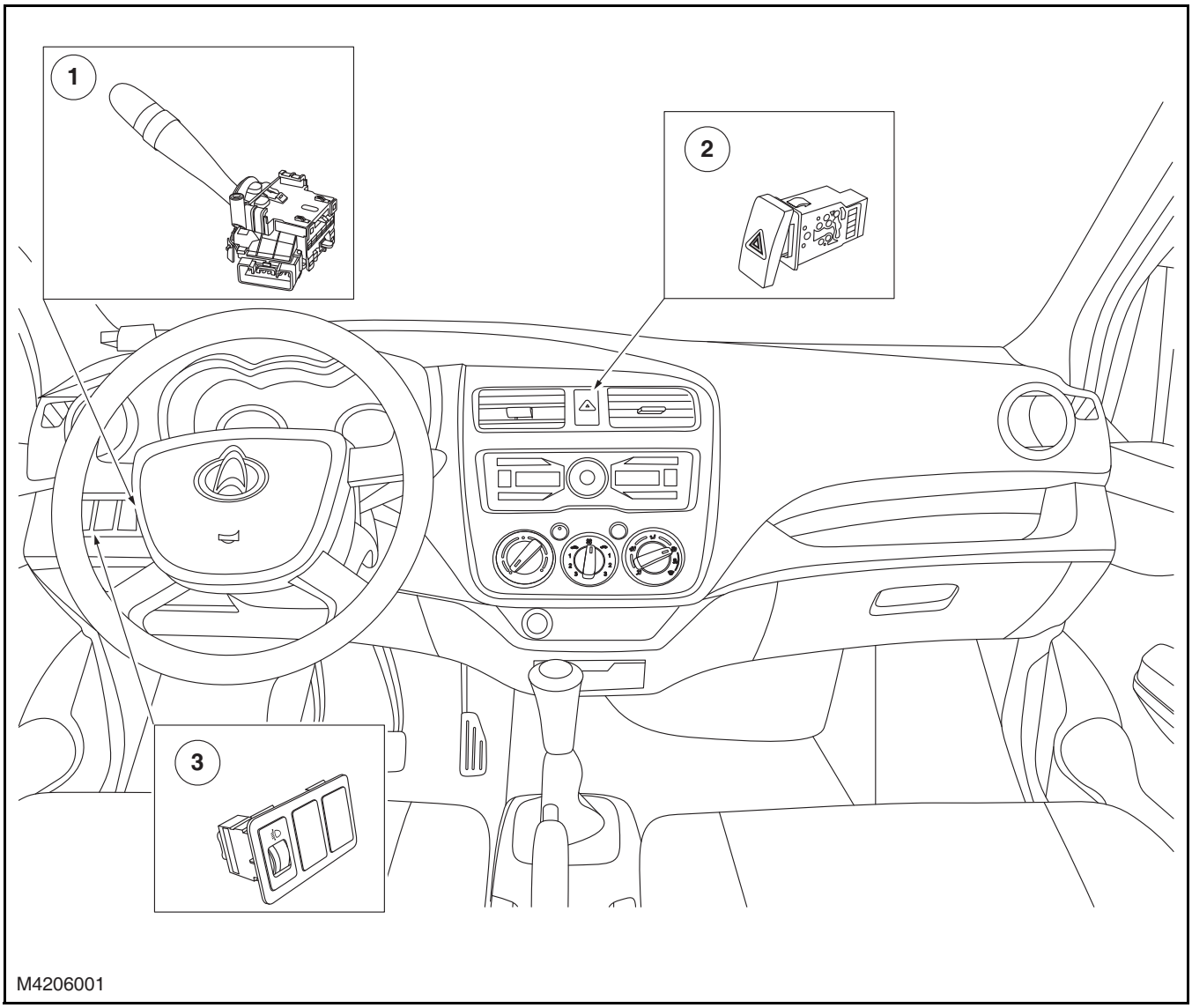
**Note: The rear fog lamp switch will also be turned off automatically when the headlamp switch is turned to "OFF".**

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# Components Location View

## Interior Component

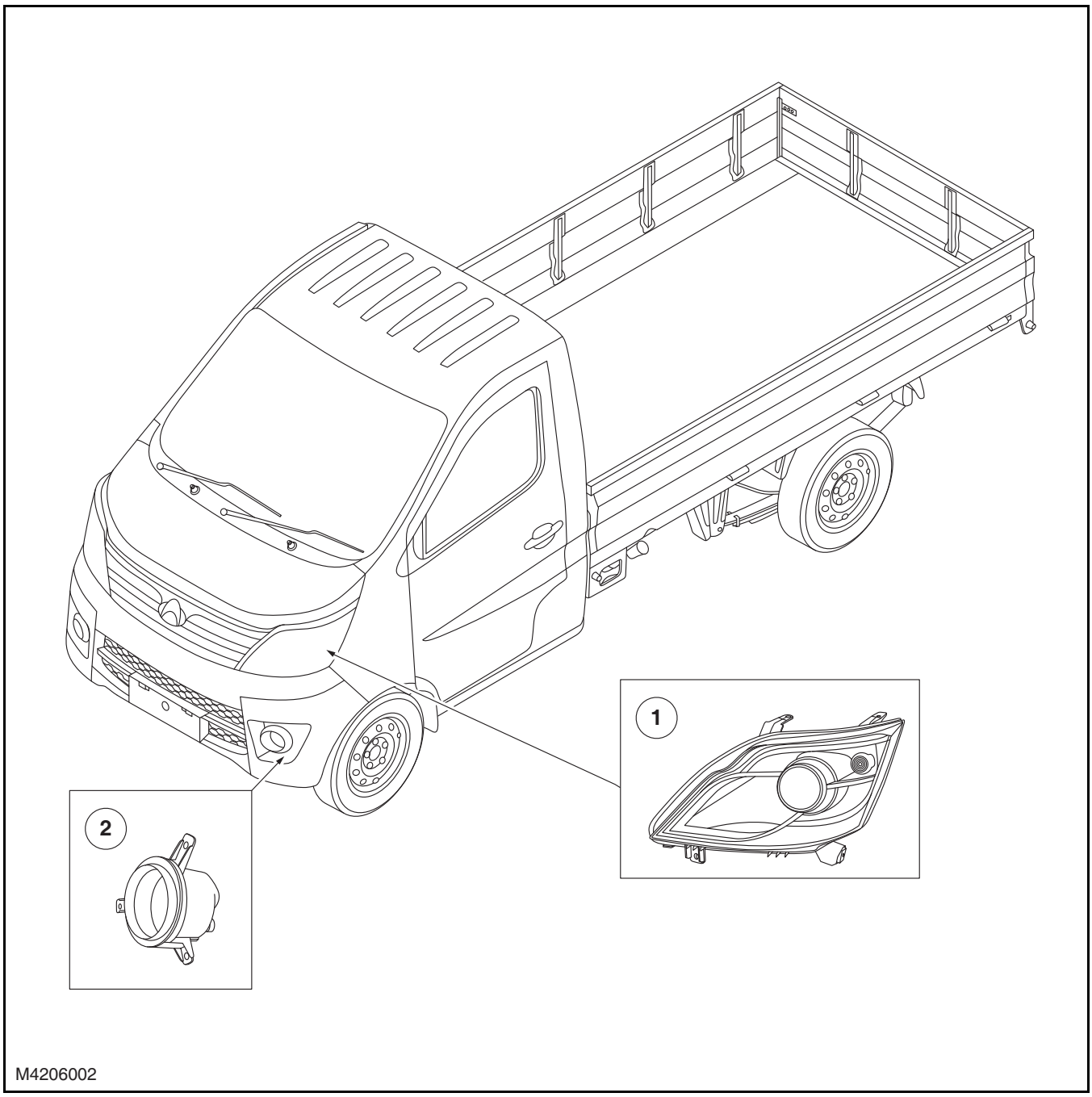



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Lighting combination switch | 3 | Lamp angle control switch |
| 2 | Hazard warning lamp switch | | |

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## Front Lighting

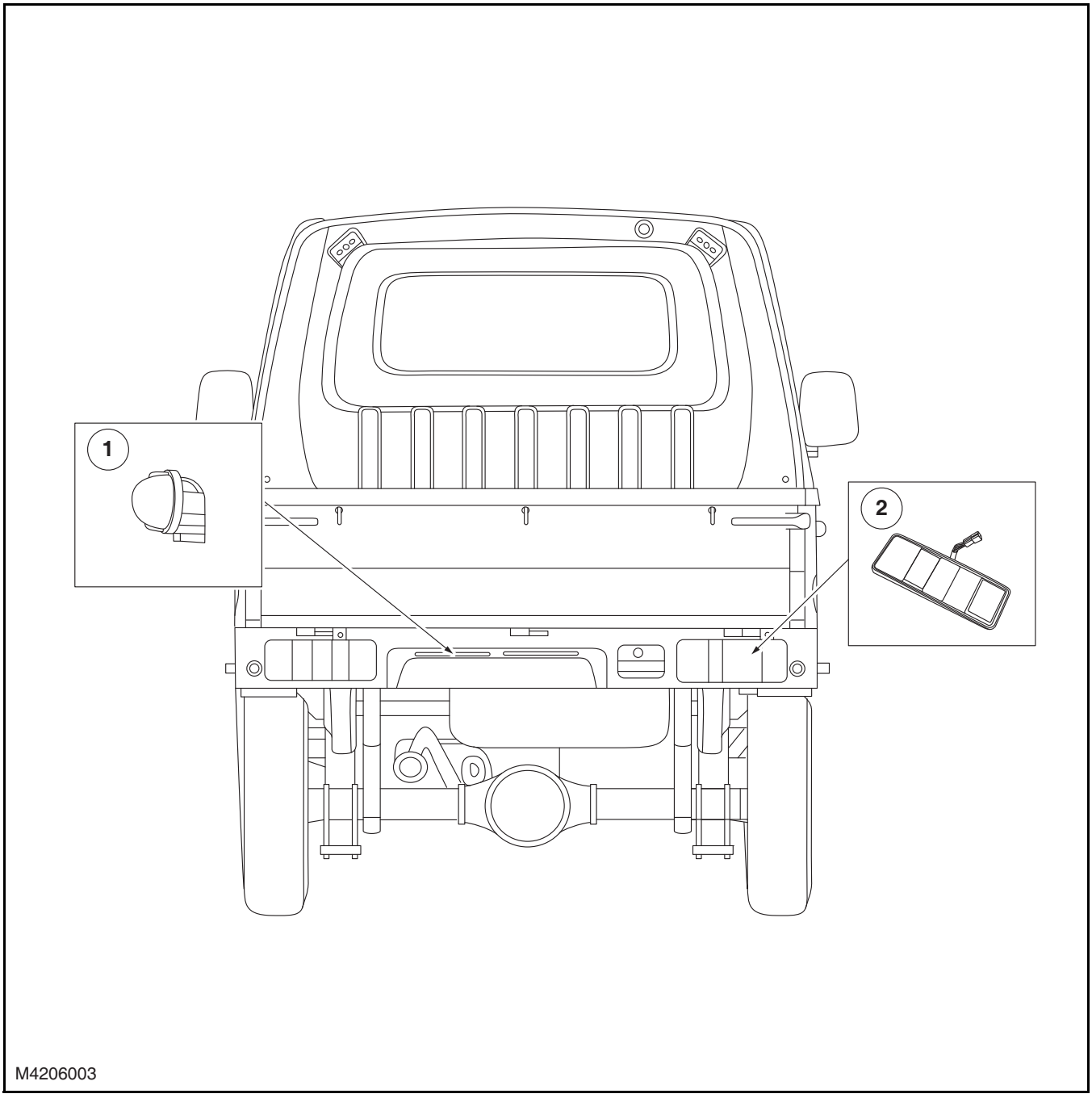



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Headlamp assembly | 2 | Front fog lamp assembly |

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## Rear Lighting

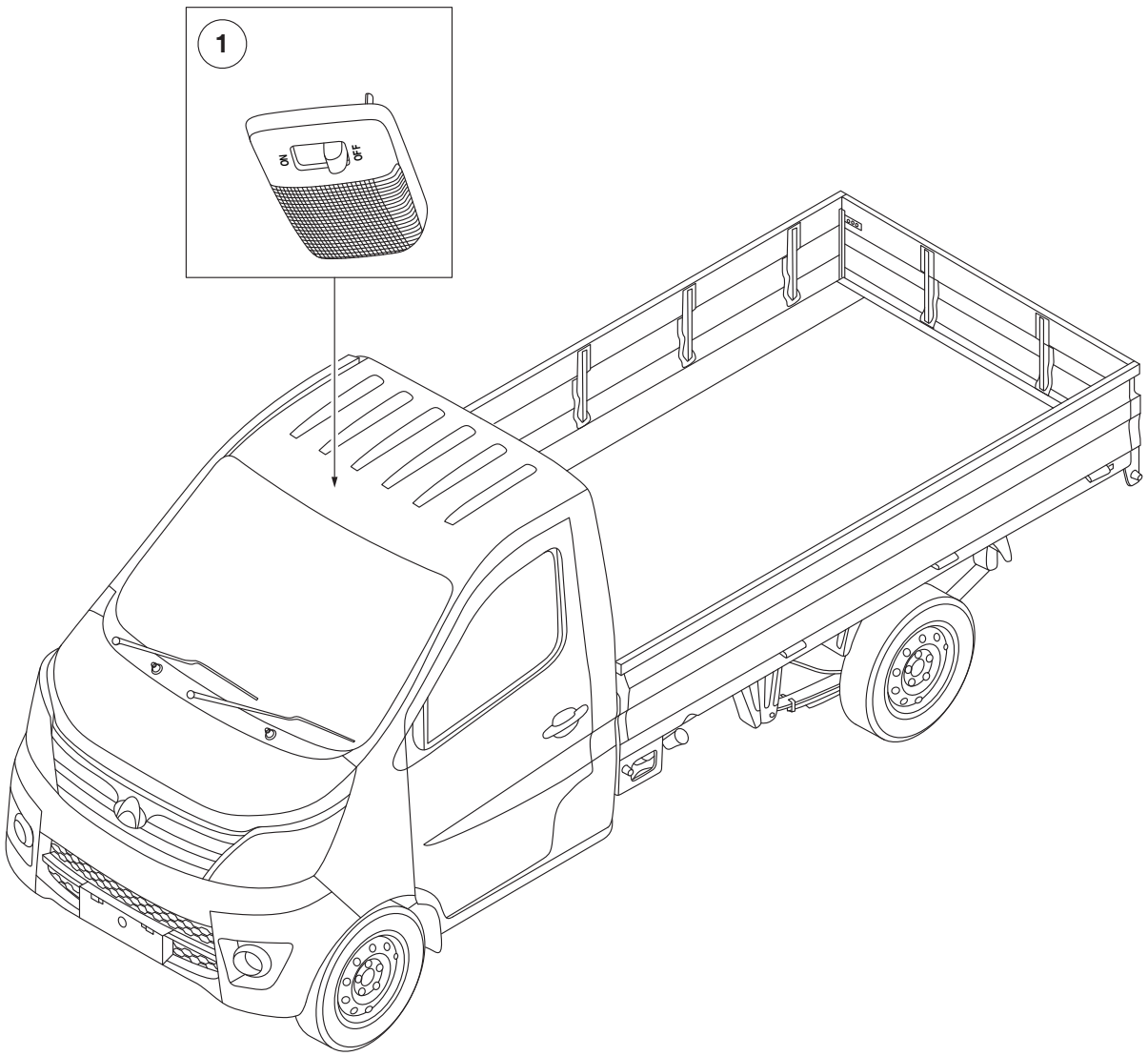



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | License plate lamp | 2 | Rear combination lamp |

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## Interior Lighting




M4206004

| Item | Description |
|---|---|
| 1 | Reading lamp |

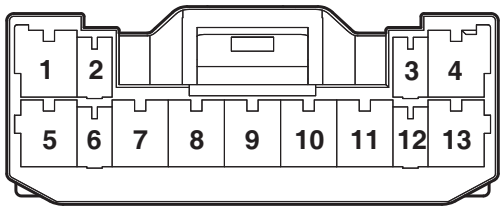
https://truckmanualshub.com/



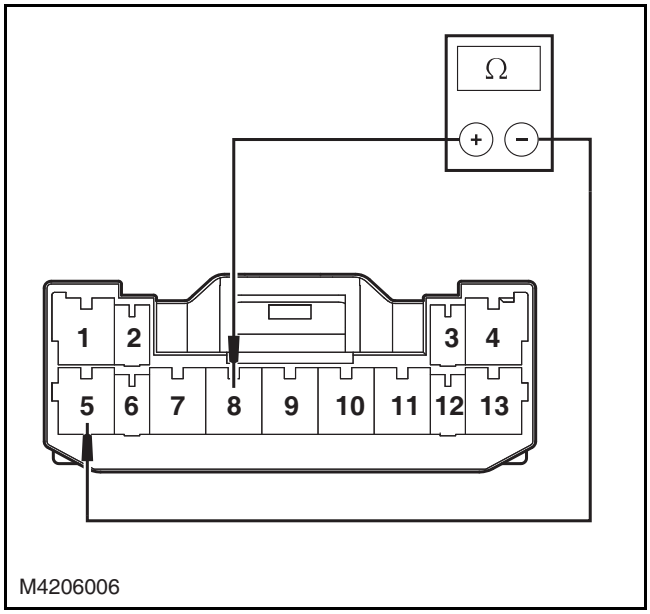
## General Inspection

# Test for Lighting Combination Switch

| P \ T | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OFF | | | | | | | | | | | | | |
| Position lamp | | | | | ○ | | ○ | ○ | | | | | |
| Low beam lamp | | | | | | | ○ | | | ○ | | | |
| High beam lamp | | | | | | | ○ | | ○ | | | | |
| Overtaking lamp | | | | | | | | | | | | | |
| Front fog lamp | ○ | | ○ | | | | | | | | | | |
| Rear fog lamp | ○ | ○ | | | | | | | | | | | |
| Left turn lamp | | | | | | | | | | | | | |
| Right turn lamp | | | | | | | | | | | | ○ | ○ |
| | | | | | | | | | | | ○ | ○ | |

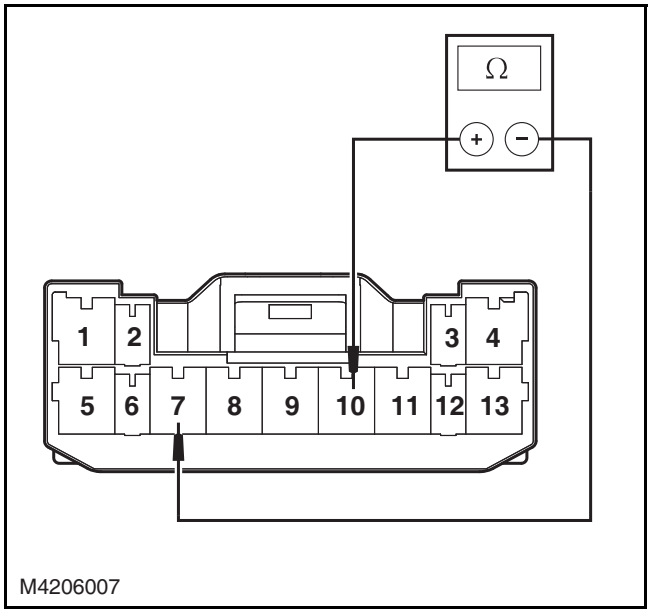
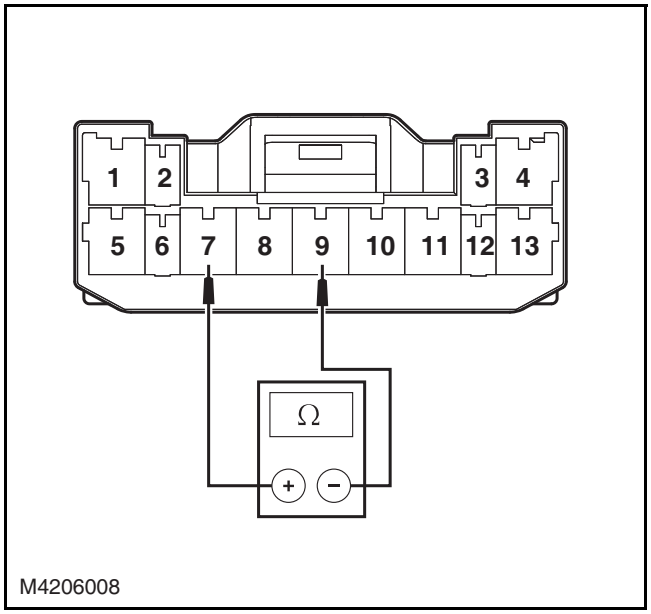



M4206005

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect position lamp switch | |
|  M4206006 | A. Turn the lighting combination switch to the position of position lamp.<br>B. Measure the continuity between terminals 5 and 8 of lighting combination switch.<br>**Standard resistance: less than 1 Ω**<br>C. Turn off the lighting combination switch.<br>D. Measure the connection between terminals 5 and 8 of lighting combination switch.<br>**Standard resistance: 10 MΩ or more**<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the lighting combination switch. |

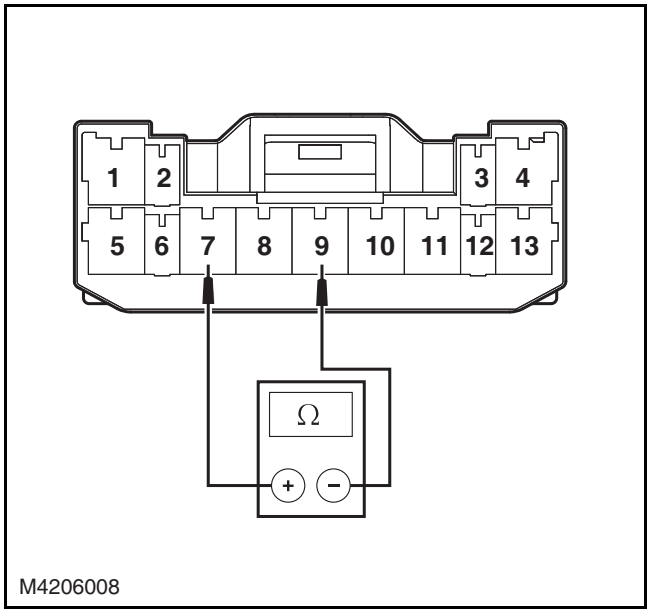
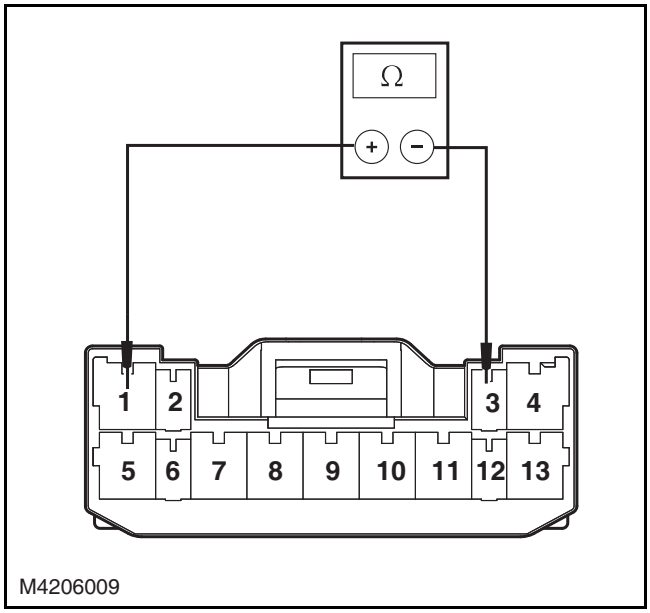
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 2. Inspect low beam lamp switch | |
|  <br>M4206007 | A. Turn the lighting combination switch to the position of low beam lamp.<br>B. Measure the continuity between terminals 7 and 10 of lighting combination switch.<br>**Standard resistance: less than 1 Ω**<br>C. Turn off the lighting combination switch.<br>D. Measure the connection between terminals 7 and 10 of lighting combination switch.<br>**Standard resistance: 10 MΩ or more**<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the lighting combination switch. |
| 3. Inspect high beam lamp switch | |
|  <br>M4206008 | A. Turn the lighting combination switch to the position of high beam lamp.<br>B. Measure the continuity between terminals 7 and 9 of lighting combination switch.<br>**Standard resistance: less than 1 Ω**<br>C. Turn off the lighting combination switch.<br>D. Measure the connection between terminals 7 and 9 of lighting combination switch.<br>**Standard resistance: 10 MΩ or more**<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the lighting combination switch. |

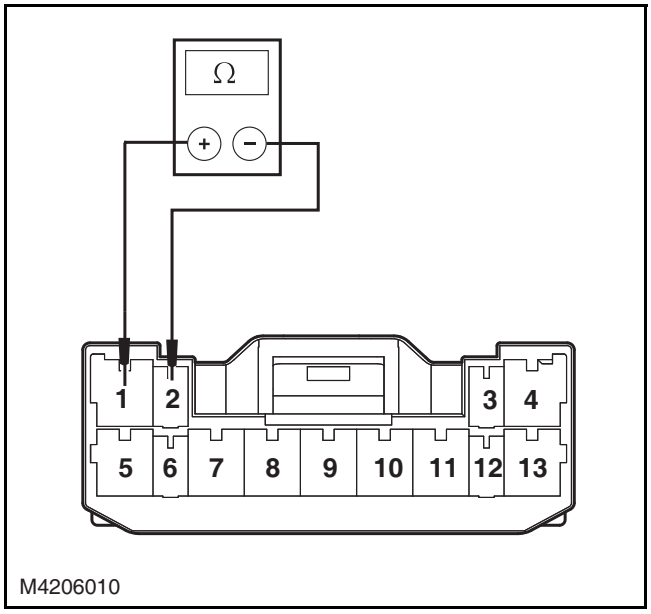
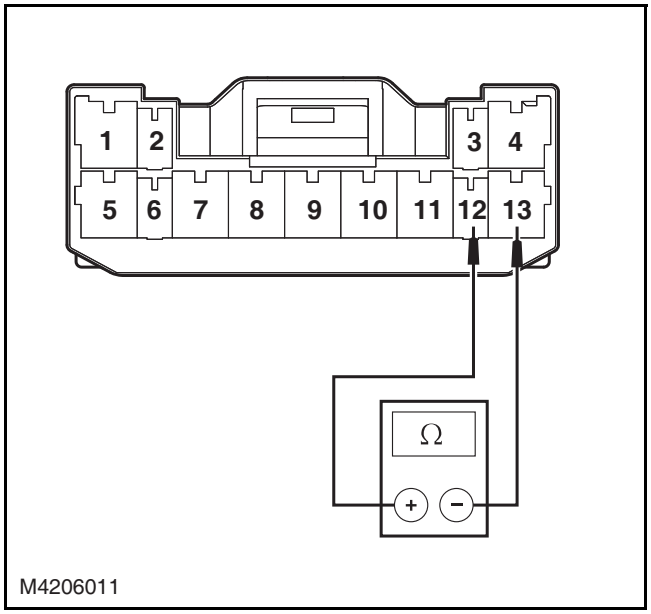
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect overtaking lamp switch | |
|  <br>M4206008 | **CAUTION: In this case, the lighting combination switch should be turned off first and then turned to the position of overtaking lamp.**<br>A. Turn the lighting combination switch to the position of overtaking lamp.<br>B. Measure the continuity between terminals 7 and 9 of lighting combination switch.<br>**Standard resistance: less than 1 Ω**<br>C. Turn off the lighting combination switch.<br>D. Measure the connection between terminals 7 and 9 of lighting combination switch.<br>**Standard resistance: 10 MΩ or more**<br>Is it normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the lighting combination switch. |
| 5. Inspect front fog lamp switch | |
|  <br>M4206009 | A. Turn on the front fog lamp switch of lighting combination switch.<br>B. Measure the continuity between terminals 1 and 3 of lighting combination switch.<br>**Standard resistance: less than 1 Ω**<br>C. Turn off the lighting combination switch.<br>D. Measure the connection between terminals 1 and 3 of lighting combination switch.<br>**Standard resistance: 10 MΩ or more**<br>Is it normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the lighting combination switch. |

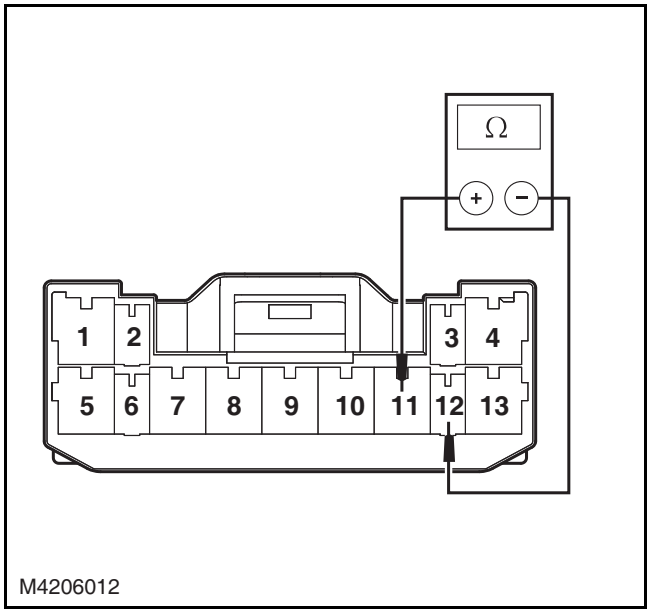
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect rear fog lamp switch | |
|  <br>M4206010 | A. Turn on the rear fog lamp switch of lighting combination switch.<br>B. Measure the continuity between terminals 1 and 2 of lighting combination switch.<br>**Standard resistance: less than 1 Ω**<br>C. Turn off the lighting combination switch.<br>D. Measure the connection between terminals 1 and 2 of lighting combination switch.<br>**Standard resistance: 10 MΩ or more**<br>Is it normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace the lighting combination switch. |
| 7. Inspect left turn lamp switch | |
|  <br>M4206011 | A. Turn on the left turn lamp switch of lighting combination switch.<br>B. Measure the continuity between terminals 12 and 13 of lighting combination switch.<br>**Standard resistance: less than 1 Ω**<br>C. Turn off the left turn lamp switch.<br>D. Measure the connection between terminals 12 and 13 of lighting combination switch.<br>**Standard resistance: 10 MΩ or more**<br>Is it normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Replace the lighting combination switch. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect right turn lamp switch | |
|  <br>M4206012 | A. Turn on the right turn lamp switch of lighting combination switch.<br>B. Measure the continuity between terminals 11 and 12 of lighting combination switch.<br>**Standard resistance: less than 1 Ω**<br>C. Turn off the right turn lamp switch.<br>D. Measure the connection between terminals 11 and 12 of lighting combination switch.<br>**Standard resistance: 10 MΩ or more**<br>Is it normal?<br>**Yes**<br>**Refer to: Symptom Chart (4.2.6 Lighting System, Symptom Diagnosis and Testing).**<br>**No**<br>Replace the lighting combination switch. |

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious electrical fault. Eliminate the cause of bulb damage.
3. Inspect system circuit which is accessible or visible.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Electrical |
|---|
| • Fuse |
| • Circuit |
| • Switch |
| • Bulb |

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## Symptom Chart

If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Diagnosis procedure for brake lamp fault | • Fuse<br>• Circuit<br>• Bulb<br>• Brake lamp switch | Refer to: Diagnosis Procedure for Brake Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for single brake lamp fault | • Circuit<br>• Bulb | Refer to: Diagnosis Procedure for One or More Brake Lamps Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for brake lamp constant on | • Brake lamp switch<br>• Circuit | Refer to: Diagnosis Procedure for Brake Lamp Constant ON (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for turn lamp fault | • Fuse<br>• Hazard warning lamp switch<br>• Lighting combination switch<br>• Circuit<br>• Bulb<br>• Turn lamp relay | Refer to: Diagnosis Procedure for Turn Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for one or more turn lamps fault | • Lighting combination switch<br>• Circuit<br>• Bulb | Refer to: Diagnosis Procedure for One or More Turn Lamps Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for one or more turn lamps constant on<br>(no blinking) | • Lighting combination switch<br>• Circuit | Refer to: Diagnosis Procedure for One or More Turn Lamps Fault (no blinking) (4.2.6 Lighting System, Symptom Diagnosis and Testing). |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Diagnosis procedure for hazard warning lamp fault | • Fuse<br>• Hazard warning lamp switch<br>• Bulb<br>• Circuit<br>• Turn lamp relay | Refer to: Diagnosis Procedure for Hazard Warning Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for position lamp fault | • Fuse<br>• Circuit<br>• Bulb<br>• Lighting combination switch | Refer to: Diagnosis Procedure for Position Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for position lamp constant on | • Circuit<br>• Lighting combination switch | Refer to: Diagnosis Procedure for Position Lamp Constant ON (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for front fog lamp fault | • Fuse<br>• Circuit<br>• Bulb<br>• Front fog lamp relay<br>• Lighting combination switch | Refer to: Diagnosis Procedure for Front Fog Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for front fog lamp constant on | • Front fog lamp relay<br>• Lighting combination switch<br>• Circuit | Refer to: Diagnosis Procedure for Front Fog Lamp Constant ON (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for rear fog lamp fault | • Fuse<br>• Lighting combination switch<br>• Circuit<br>• Bulb | Refer to: Diagnosis Procedure for Rear Fog Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for rear fog lamp constant on | • Lighting combination switch<br>• Circuit | Refer to: Diagnosis Procedure for Rear Fog Lamp Constant ON (4.2.6 Lighting System, Symptom Diagnosis and Testing). |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Diagnosis procedure for backup lamp fault | • Fuse<br>• Circuit<br>• Bulb<br>• Backup lamp switch | Refer to: Diagnosis Procedure for Backup Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for backup lamp constant on | • Circuit<br>• Backup lamp switch | Refer to: Diagnosis Procedure for Backup Lamp Constant ON (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for low beam lamp fault | • Fuse<br>• Circuit<br>• Bulb<br>• Lighting combination switch | Refer to: Diagnosis Procedure for Low Beam Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for one side low beam lamp fault | • Fuse<br>• Circuit<br>• Bulb | Refer to: Diagnosis Procedure for One Side Low Beam Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for low beam lamp constant on | • Circuit<br>• Lighting combination switch | Refer to: Diagnosis Procedure for Low Beam Lamp Constant ON (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for high beam lamp fault | • Fuse<br>• Circuit<br>• Bulb<br>• Lighting combination switch | Refer to: Diagnosis Procedure for High Beam Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for one side high beam lamp fault | • Fuse<br>• Circuit<br>• Bulb | Refer to: Diagnosis Procedure for One Side High Beam Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |

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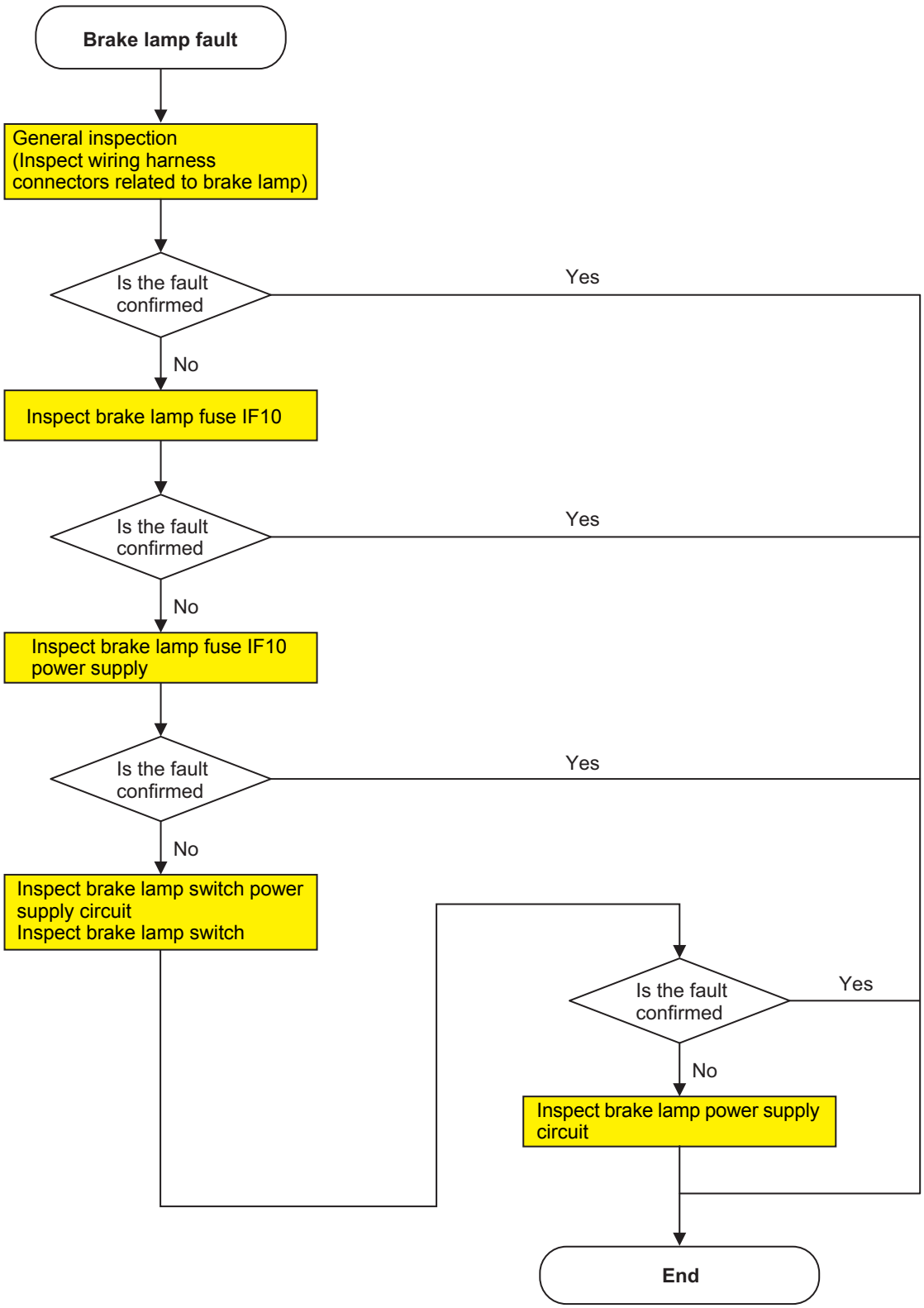


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Diagnosis procedure for high beam lamp constant on | • Circuit<br>• Lighting combination switch | Refer to: Diagnosis Procedure for High Beam Lamp Constant ON (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for overtaking lamp fault | • Fuse<br>• Circuit<br>• Bulb<br>• Lighting combination switch | Refer to: Diagnosis Procedure for Overtaking Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for license plate lamp fault | • Fuse<br>• Circuit<br>• Bulb<br>• Lighting combination switch | Refer to: Diagnosis Procedure for License Plate Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |
| Diagnosis procedure for reading lamp fault | • Fuse<br>• Reading lamp switch<br>• Circuit<br>• Bulb | Refer to: Diagnosis Procedure for Reading Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing). |

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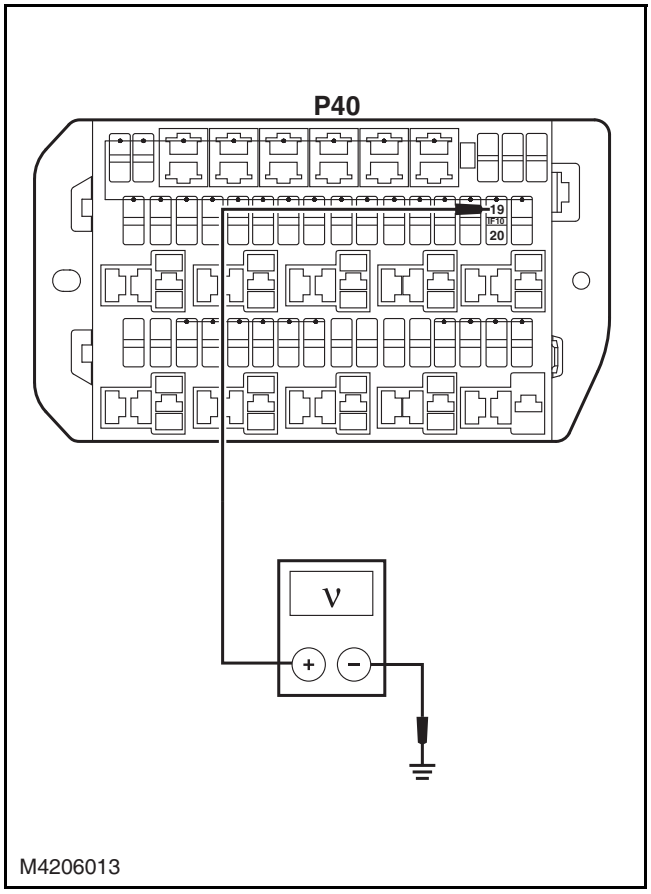


# Diagnosis Procedure for Brake Lamp Fault



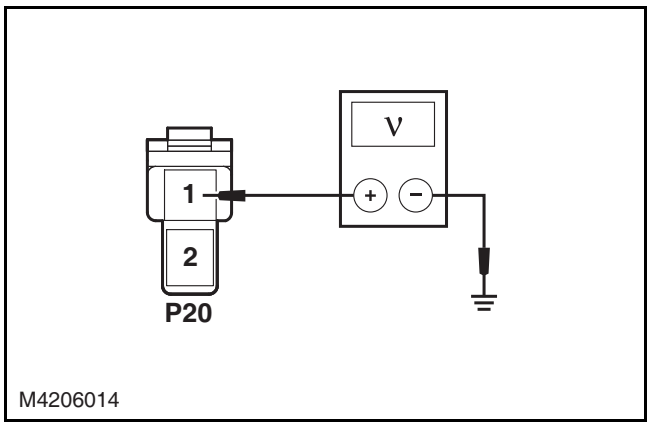
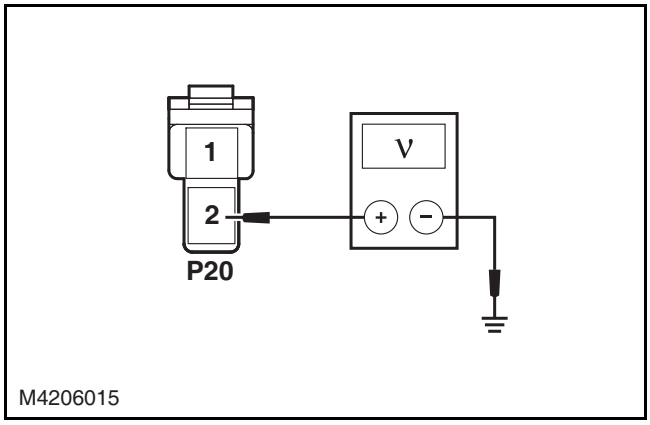
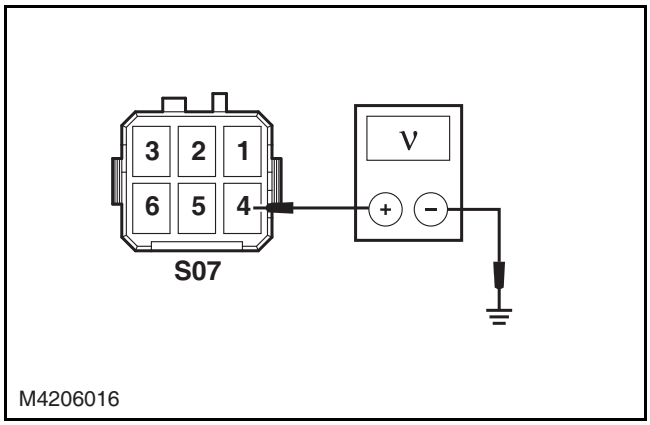
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the brake lamp for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect brake lamp fuse IF10 | |
| | A. Inspect the brake lamp fuse IF10.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect brake lamp fuse IF10 power supply | |
|  | A. Measure the voltage between terminal 19 of instrument panel fuse box fuse IF10 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 19 of instrument panel fuse box fuse IF10 and battery. |

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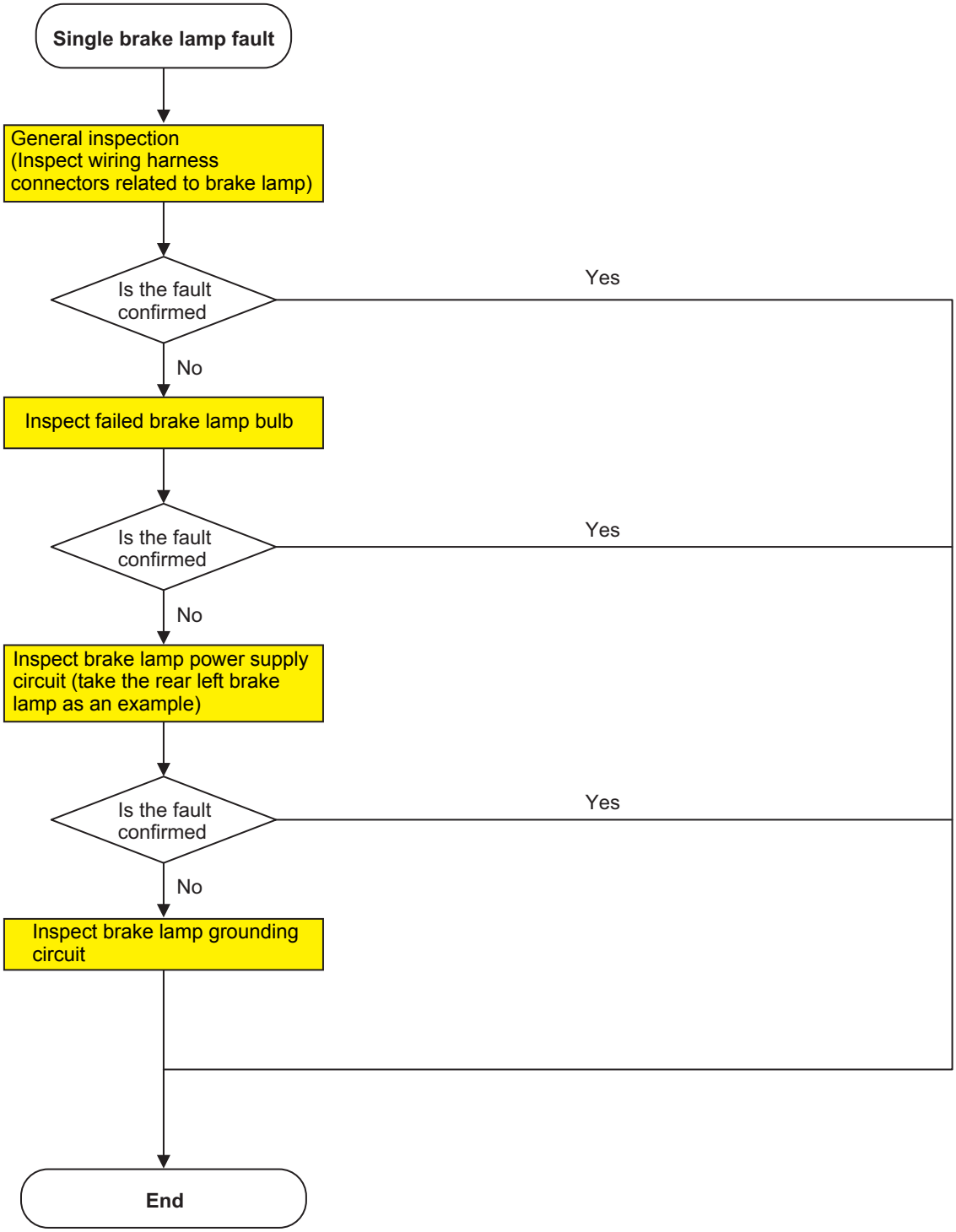


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect brake lamp switch power supply circuit | |
|  M4206014 | A. Measure the voltage between terminal 1 of brake lamp switch wiring harness connector P20 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of brake lamp switch wiring harness connector P20 and terminal 20 of instrument panel fuse box fuse IF10. |
| 5. Inspect brake lamp switch | |
|  M4206015 | A. Depress the brake pedal.<br>B. Measure the voltage between terminal 2 of brake lamp switch wiring harness connector P20 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the brake lamp switch. |
| 6. Inspect brake lamp power supply circuit | |
|  M4206016 | A. Disconnect the rear left combination lamp wiring harness connector S07.<br>B. Technician A depresses the brake pedal.<br>C. Technician B measures the voltage between terminal 4 of rear left combination lamp wiring harness connector S07 and reliable grounding with a multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 6 of rear left combination lamp wiring harness connector S07 and the ground point G201.<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of rear left combination lamp wiring harness connector S07 and terminal 2 of brake lamp switch wiring harness connector P20. |

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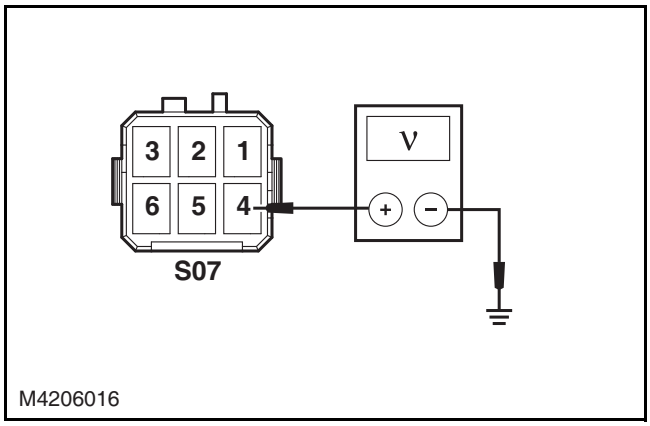


# Diagnosis Procedure for Single Brake Lamp Fault



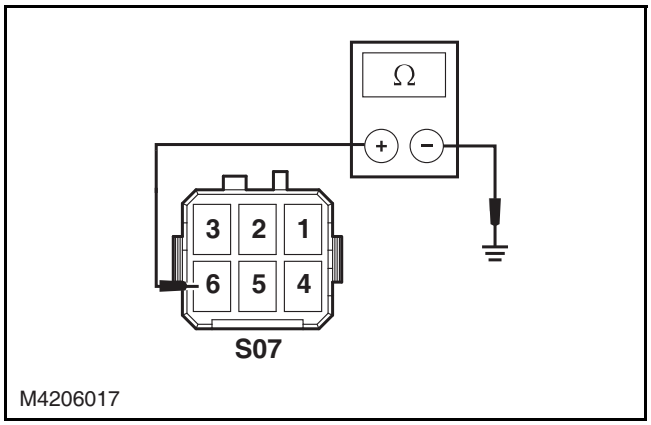
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the brake lamp for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect failed brake lamp bulb | |
| | A. Inspect the filament in the brake lamp bulb to see if it is in good condition.<br>B. Inspect the brake lamp bulb contact for oxidation or poor contact.<br>Is it abnormal?<br>**Yes**<br>Replace the brake lamp bulb, and solve the problem of oxidation.<br>**No**<br>Go to step 3. |
| 3. Inspect brake lamp power supply circuit (take the rear left brake lamp as an example) | |
|  | A. Disconnect the rear left combination lamp wiring harness connector S07.<br>B. Technician A depresses the brake pedal.<br>C. Technician B measures the voltage between terminal 4 of rear left combination lamp wiring harness connector S07 and reliable grounding with a multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of rear left combination lamp wiring harness connector S07 and terminal 2 of brake lamp switch wiring harness connector P20. |

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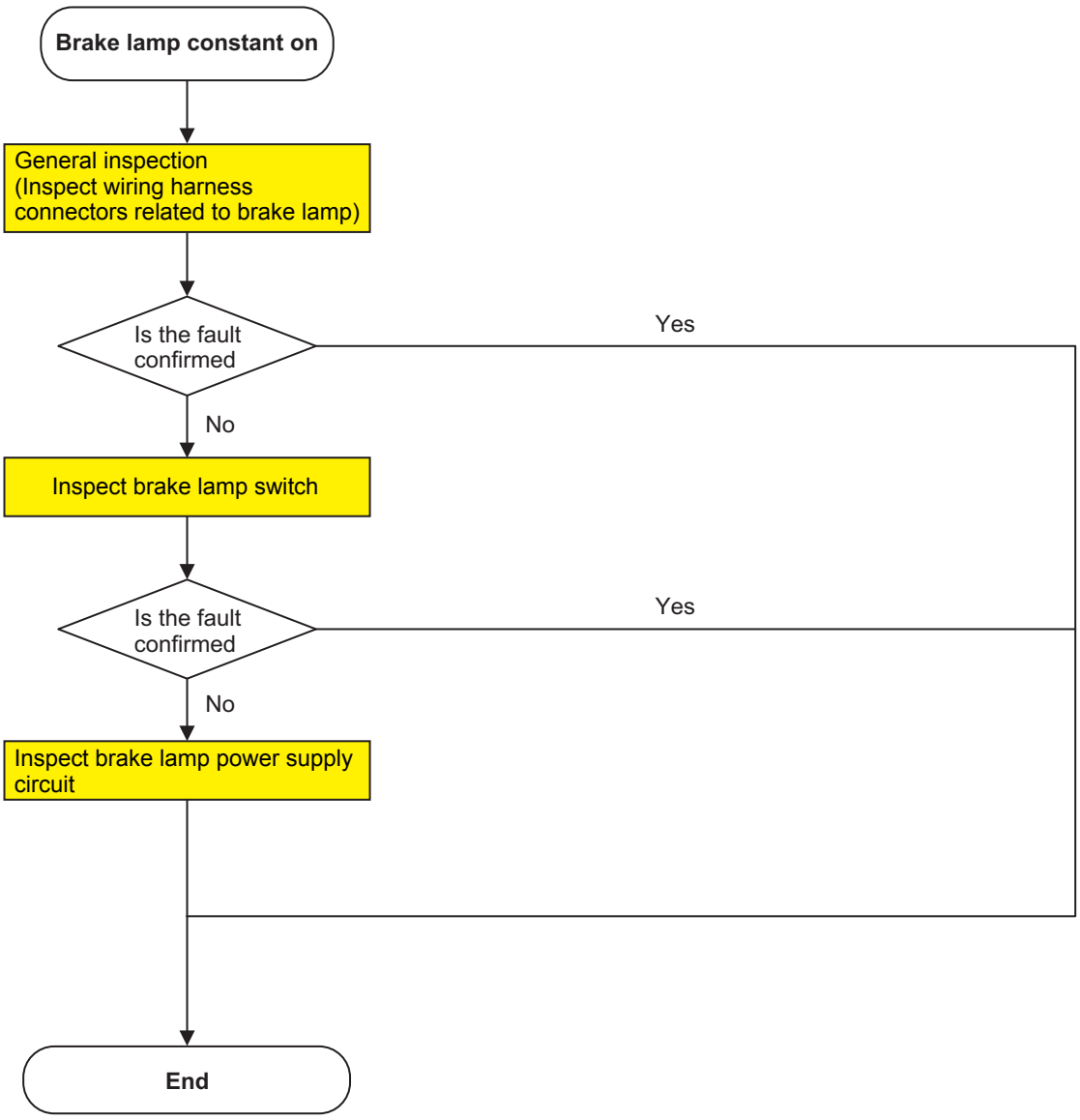


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect brake lamp grounding circuit | |
|  <br>M4206017 | A. Disconnect the rear left combination lamp wiring harness connector S07.<br>B. Measure the resistance between terminal 6 of rear left combination lamp wiring harness connector S07 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the rear left combination lamp.<br>**Refer to: Rear Combination Lamp (4.2.6 Lighting System, Removal and Installation).**<br>Make sure the maintenance has been finished.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of rear left combination lamp wiring harness connector S07 and the ground point G201. |

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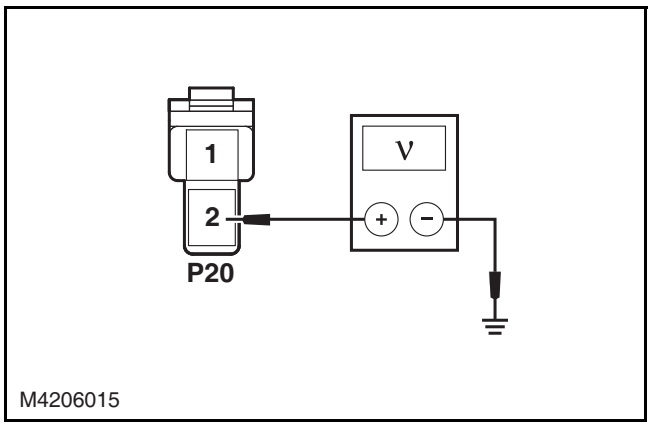


# Diagnosis Procedure for Brake Lamp Constant ON



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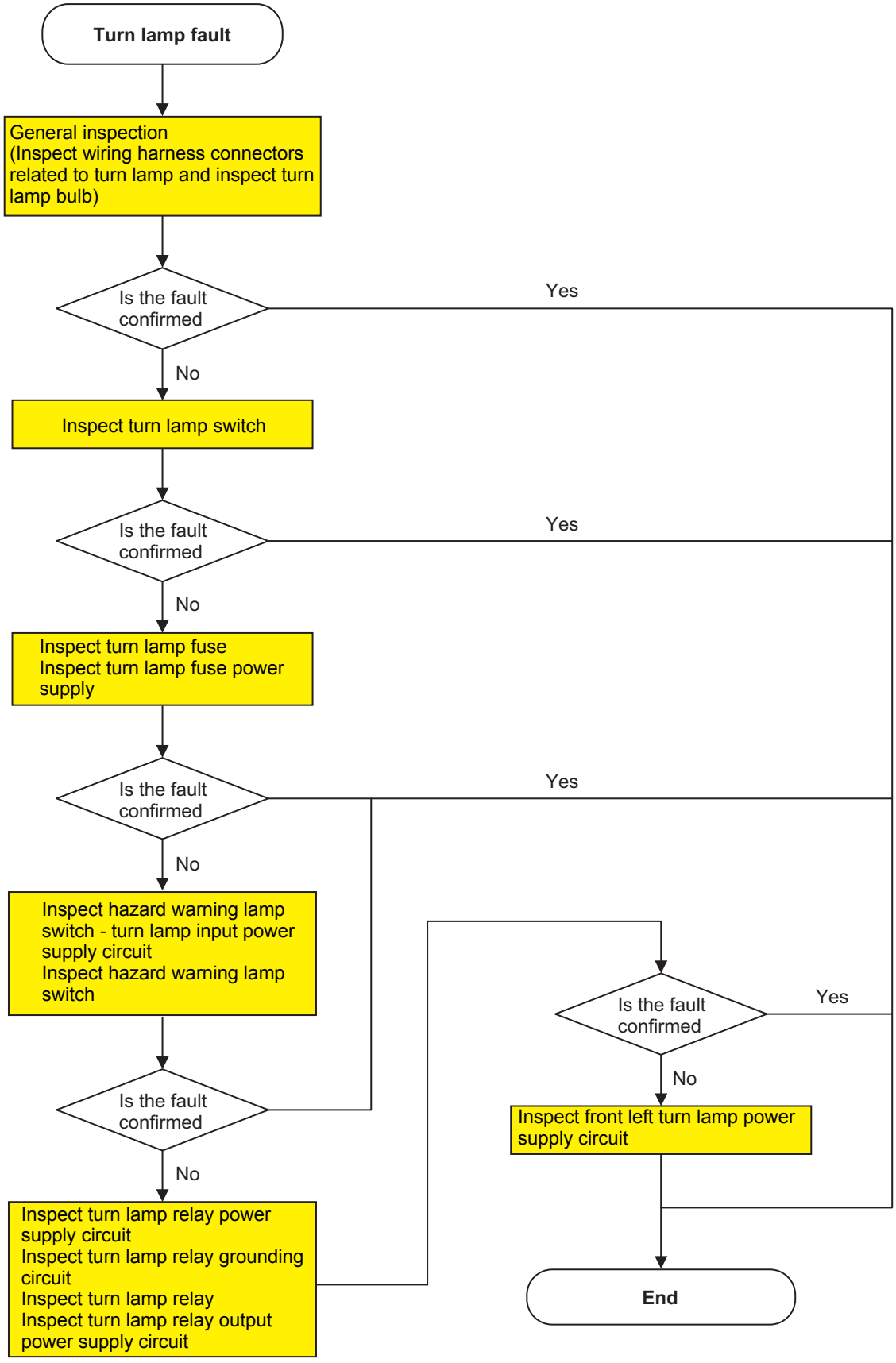


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the brake lamp for damage or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect brake lamp switch | |
| | A. Disconnect the brake lamp switch wiring harness connector P20.<br>Has the brake lamp gone off?<br>**Yes**<br>Replace the brake lamp switch.<br>**No**<br>Go to step 3. |
| 3. Inspect brake lamp power supply circuit | |
|  | A. Disconnect the brake lamp switch wiring harness connector P20.<br>B. Disconnect the rear combination lamp wiring harness connector S05 and S07.<br>C. Measure the voltage between terminal 2 of brake lamp switch wiring harness connector P20 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is the voltage value normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Inspect and repair the short circuit fault between power and terminal 2 of brake lamp switch wiring harness connector P20. |

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# Diagnosis Procedure for Turn Lamp Fault



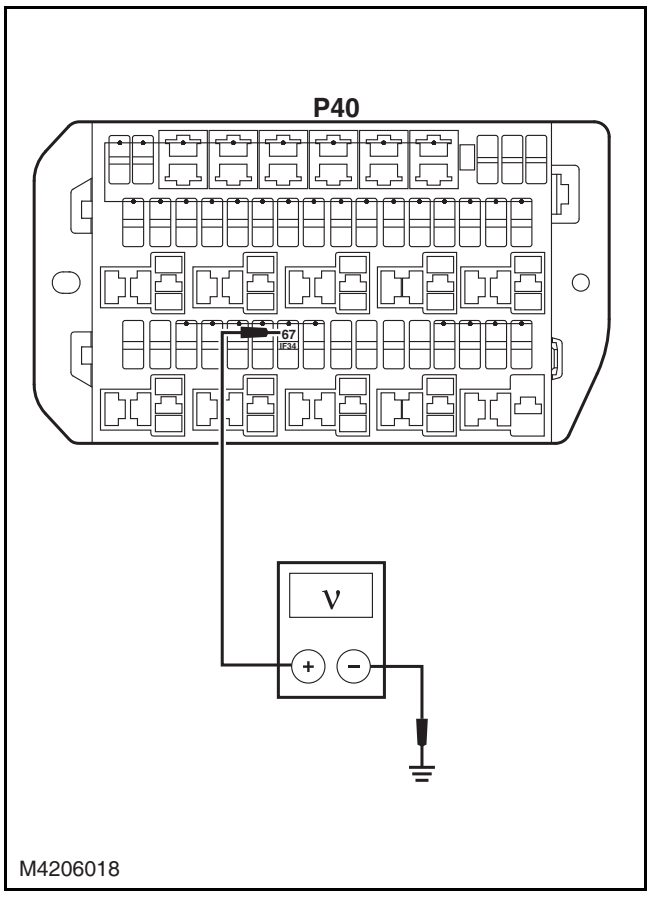
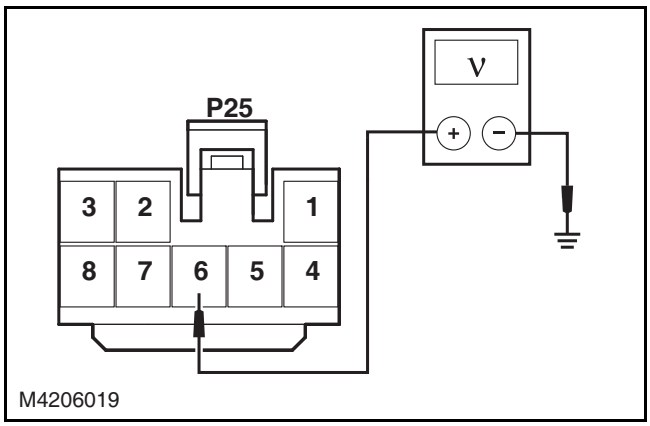
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the turn lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of turn lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect turn lamp switch | |
| | A. Inspect the turn lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>Is the lighting combination switch normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |
| 3. Inspect turn lamp fuse | |
| | A. Inspect the turn lamp fuse IF34.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

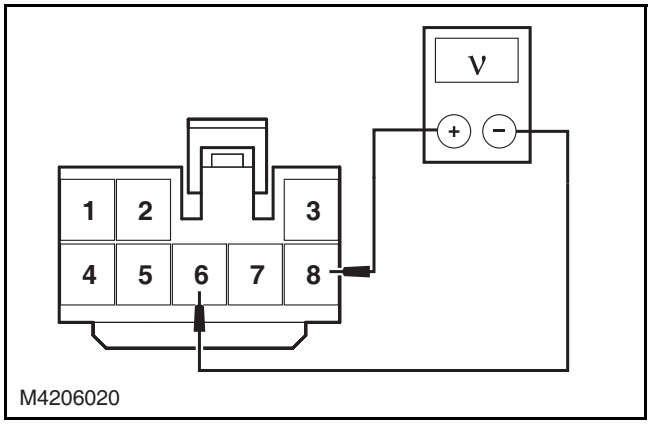
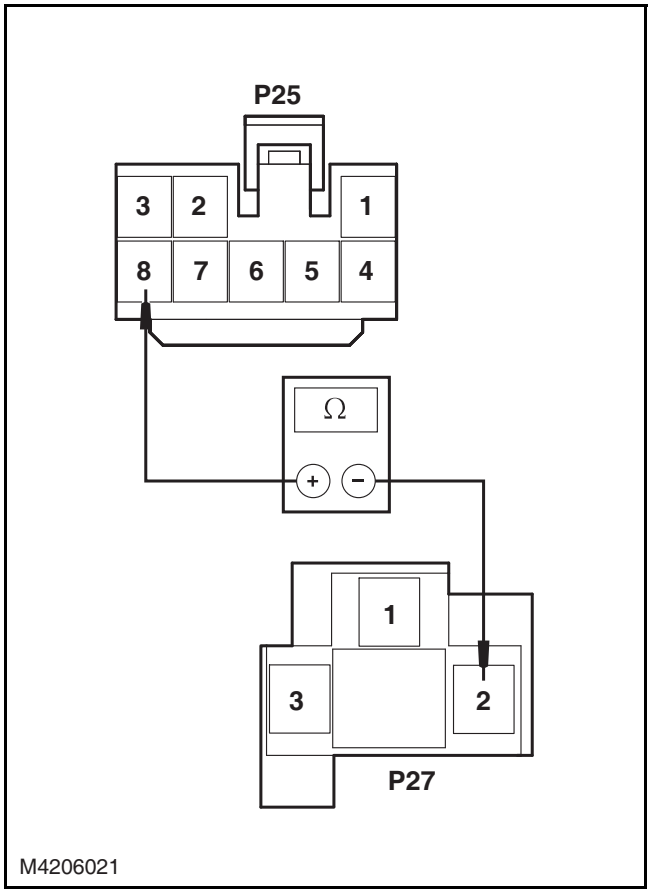
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect turn lamp fuse power supply | |
|  M4206018 | A. Turn the ignition switch to "ON".<br>B. Measure the voltage between terminal 67 of instrument panel fuse box fuse IF34 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 67 of instrument panel fuse box fuse IF34 and ignition switch IG1. |
| 5. Inspect hazard warning lamp switch - turn lamp input power supply circuit | |
|  M4206019 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the hazard warning lamp switch wiring harness connector P25.<br>C. Turn the ignition switch to "ON", and measure the voltage between terminal 6 of hazard warning lamp switch wiring harness connector P25 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of hazard warning lamp switch wiring harness connector P25 and terminal 68 of instrument panel fuse box fuse IF34. |

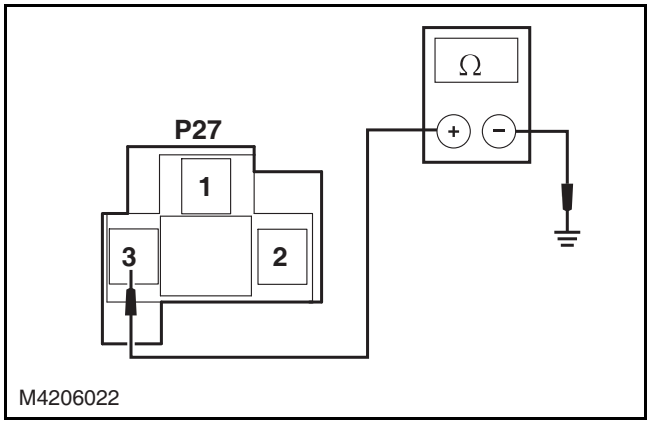
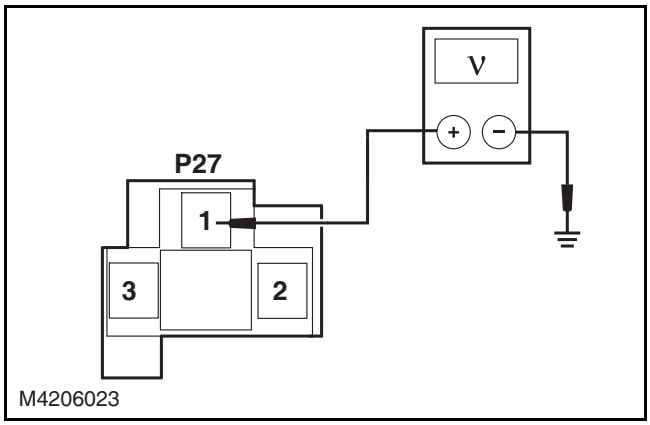
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect hazard warning lamp switch | |
|  M4206020 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the hazard warning lamp switch wiring harness connector P25.<br>C. Measure the resistance between terminals 6 and 8 of hazard warning lamp switch.<br>**Standard resistance: less than 1 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace the hazard warning lamp switch.<br>**Refer to: Hazard Warning Lamp Switch (4.2.6 Lighting System, Removal and Installation).** |
| 7. Inspect turn lamp relay power supply circuit | |
|  M4206021 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the hazard warning lamp switch wiring harness connector P25.<br>C. Disconnect the turn lamp relay wiring harness connector P27.<br>D. Measure the resistance between terminal 2 of turn lamp relay wiring harness connector P27 and terminal 8 of hazard warning lamp switch wiring harness connector P25.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of turn lamp relay wiring harness connector P27 and terminal 8 of hazard warning lamp switch wiring harness connector P25. |

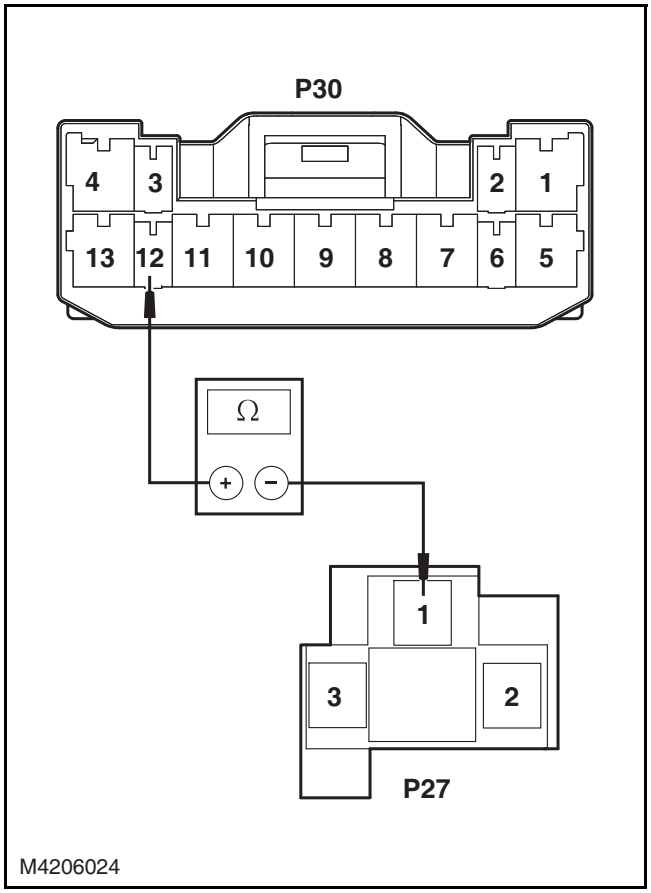
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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect turn lamp relay grounding circuit | |
|  <br>M4206022 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the turn lamp relay wiring harness connector P27.<br>C. Measure the resistance between terminal 3 of turn lamp relay wiring harness connector P27 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of turn lamp relay wiring harness connector P27 and the ground point G105. |
| 9. Inspect turn lamp relay | |
|  <br>M4206023 | A. Turn the ignition switch to "ON".<br>B. Turn on the left turn lamp switch of lighting combination switch.<br>C. Measure the voltage between terminal 1 of turn lamp relay wiring harness connector P27 and reliable grounding from the back.<br>**Standard voltage: changes from 0 V to 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Replace the turn lamp relay. |

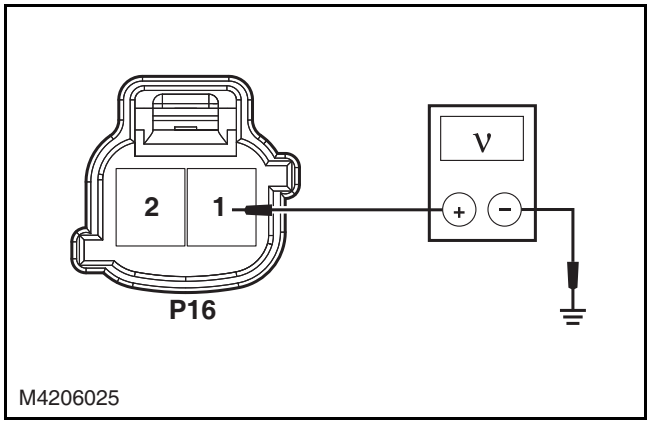
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| Test Conditions | Details/Results/Actions |
|---|---|
| 10.Inspect turn lamp relay output power supply circuit | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the lighting combination switch wiring harness connector P30.<br>C. Disconnect the turn lamp relay wiring harness connector P27.<br>D. Measure the resistance between terminal 1 of turn lamp relay wiring harness connector P27 and terminal 12 of lighting combination switch wiring harness connector P30.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 11.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of turn lamp relay wiring harness connector P27 and terminal 12 of lighting combination switch wiring harness connector P30. |

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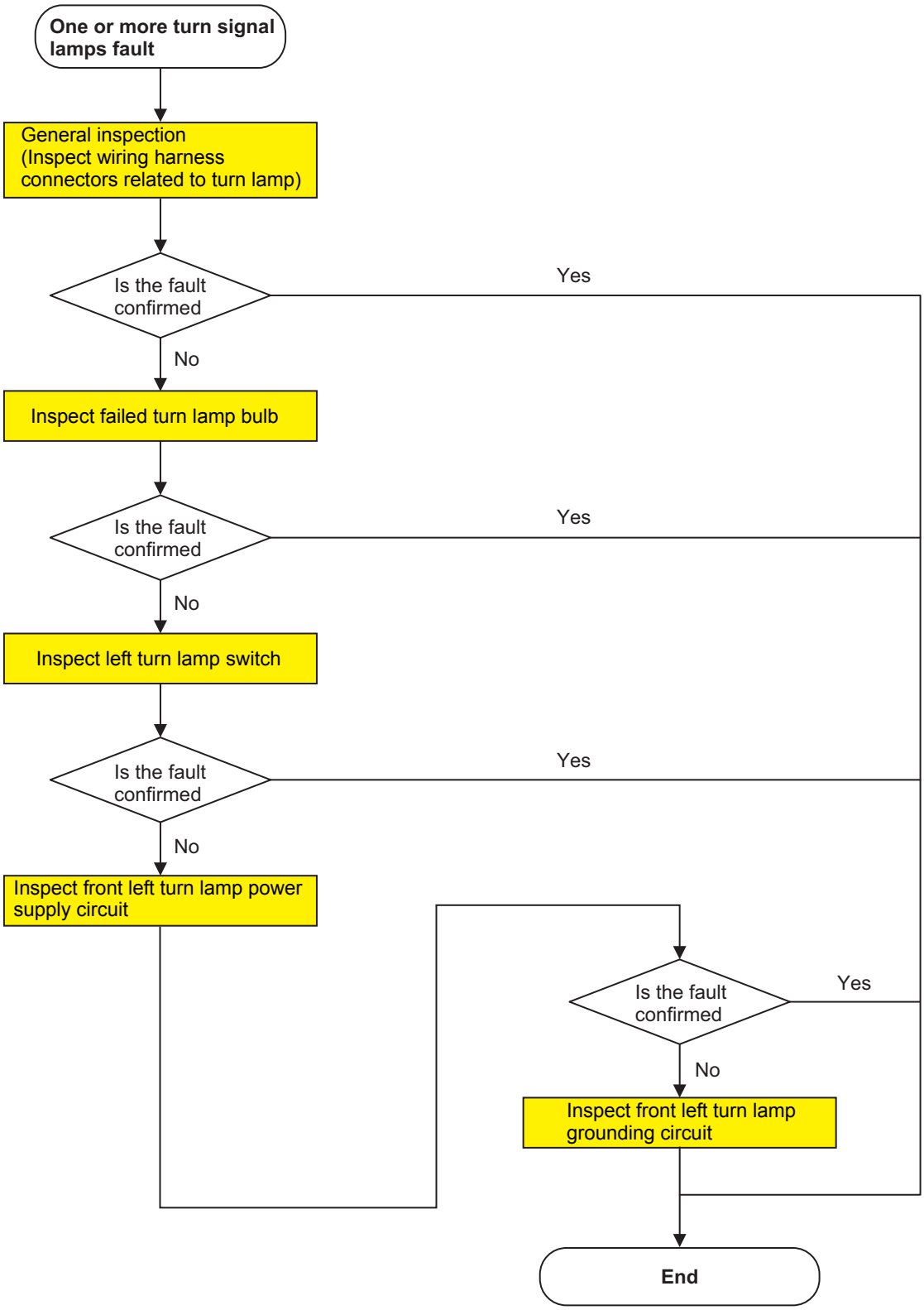
| Test Conditions | Details/Results/Actions |
|---|---|
| 11.Inspect front left turn lamp power supply circuit | |
|  <br>M4206025 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left turn lamp wiring harness connector P16.<br>C. Turn the ignition switch to "ON".<br>D. Turn on the left turn lamp switch of lighting combination switch.<br>E. Measure the voltage between terminal 1 of front left turn lamp wiring harness connector P16 and reliable grounding.<br>**Standard voltage: changes from 0 V to 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 2 of front left turn lamp wiring harness connector P16 and the ground point G103.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of front left turn lamp wiring harness connector P16 and terminal 13 of lighting combination switch wiring harness connector P30.<br>**CAUTION: Use different terminals to inspect other turn lamps in this way. Make sure the system is normal.** |

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# Diagnosis Procedure for One or More Turn Lamps Fault

**CAUTION: This process is carried out for left turn lamp fault only. Process for the right is similar.**



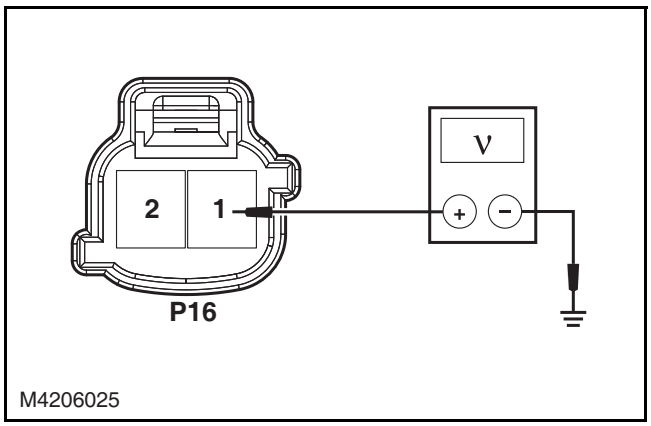
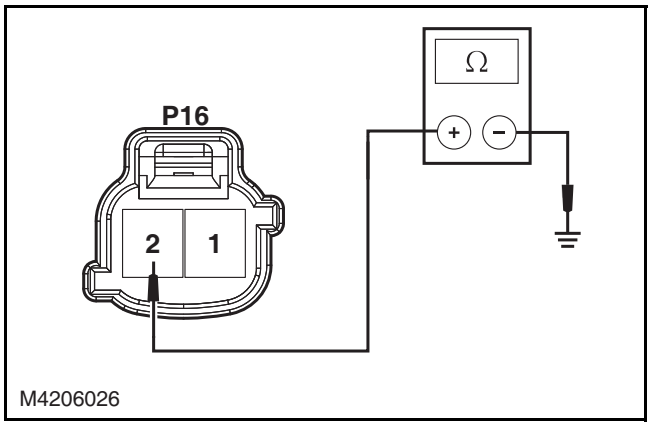
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the turn lamp for damage, poor contact, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect failed turn lamp bulb | |
| | A. Inspect the filament in the turn lamp bulb to see if it is in good condition.<br>B. Inspect the turn lamp bulb contact for oxidation or poor contact.<br>Is it abnormal?<br>**Yes**<br>Replace the turn lamp bulb, and solve the problem of oxidation.<br>**No**<br>Go to step 3. |
| 3. Inspect left turn lamp switch | |
| | A. Inspect the left turn lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>Is the lighting combination switch normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |

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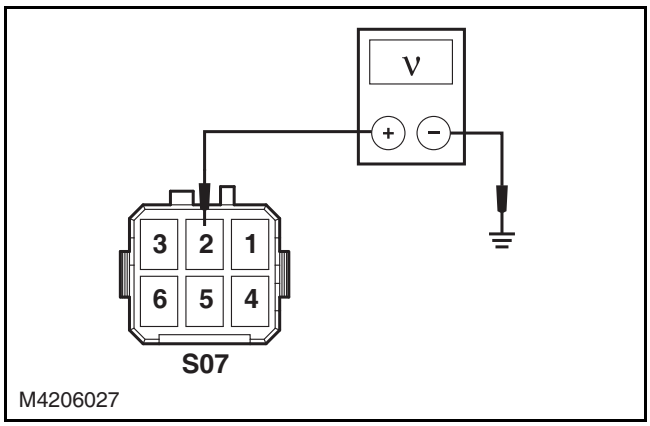
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect front left turn lamp power supply circuit | |
|  M4206025 | **CAUTION: Take the front left turn lamp as an example.**<br>A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left turn lamp wiring harness connector P16.<br>C. Turn the ignition switch to "ON".<br>D. Turn on the left turn lamp switch of lighting combination switch.<br>E. Measure the voltage between terminal 1 of front left turn lamp wiring harness connector P16 and reliable grounding.<br>**Standard voltage: changes from 0 V to 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of front left turn lamp wiring harness connector P16 and terminal 13 of lighting combination switch wiring harness connector P30. |
| 5. Inspect front left turn lamp grounding circuit | |
|  M4206026 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left turn lamp wiring harness connector P16.<br>C. Measure the resistance between terminal 2 of front left turn lamp wiring harness connector P16 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the left headlamp.<br>**Refer to: Headlamp (4.2.6 Lighting System, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of front left turn lamp wiring harness connector P16 and the ground point G103. |

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# Diagnosis Procedure for One or More Turn Lamps Constant ON (No Blinking)

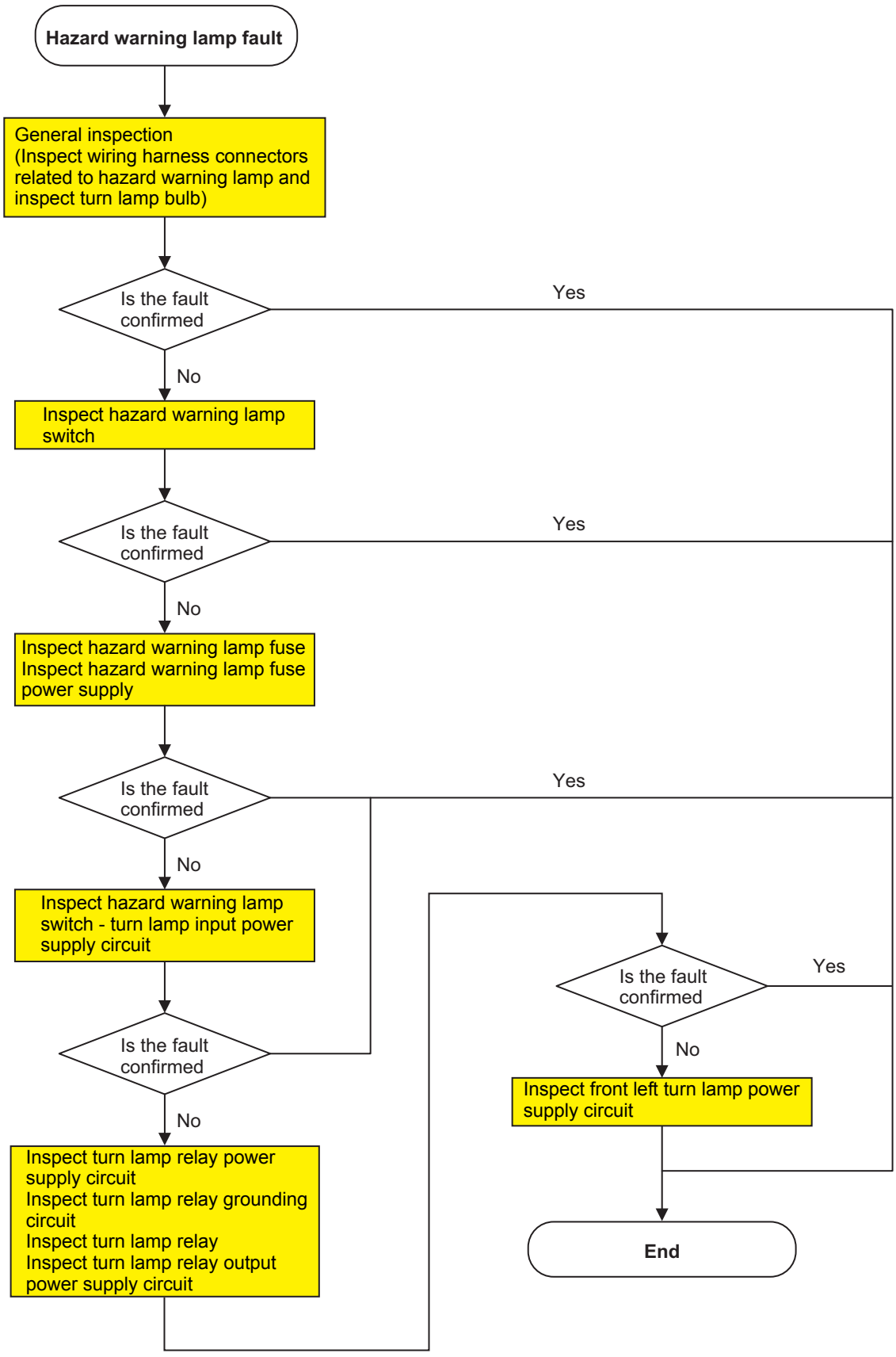
**CAUTION: This process is carried out for rear left turn lamp constant on only. Process for the others is similar.**

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the turn lamp for damage or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect rear left turn lamp power supply circuit | |
|  <br>M4206027 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the lighting combination switch wiring harness connector P30.<br>C. Disconnect the rear left combination lamp wiring harness connector S07.<br>D. Measure the voltage between terminal 2 of rear left combination lamp wiring harness connector S07 and reliable grounding.<br>**Standard voltage: changes from 0 V to 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the rear left combination lamp.<br>**Refer to: Rear Combination Lamp (4.2.6 Lighting System, Removal and Installation).**<br>**No**<br>Inspect and repair the short circuit fault between power and terminal 2 of rear left combination lamp wiring harness connector S07. |

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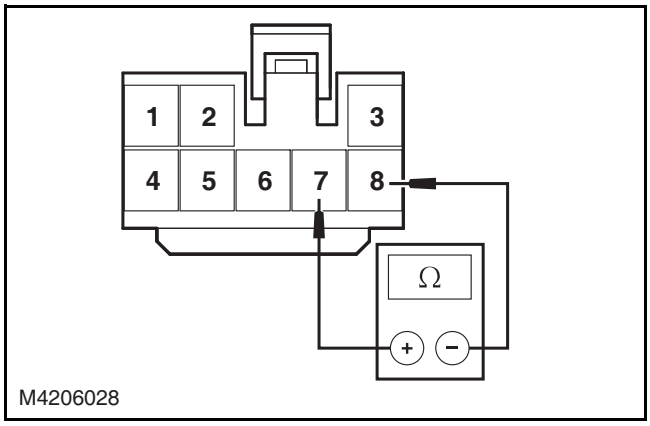
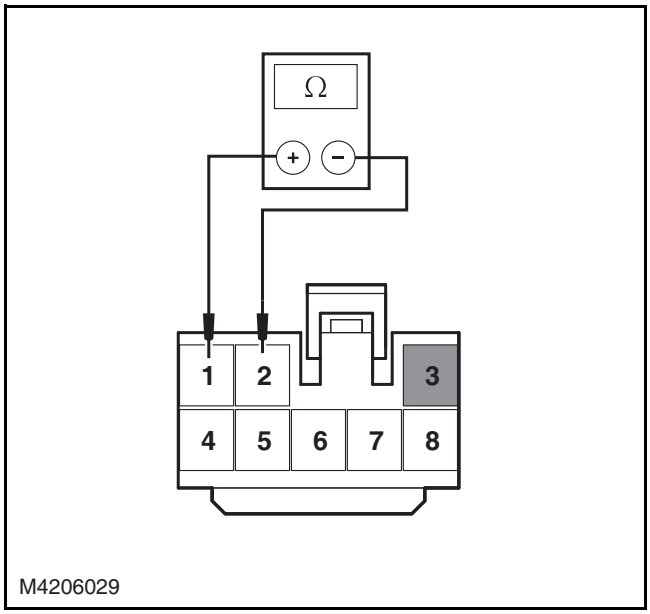


# Diagnosis Procedure for Hazard Warning Lamp Fault



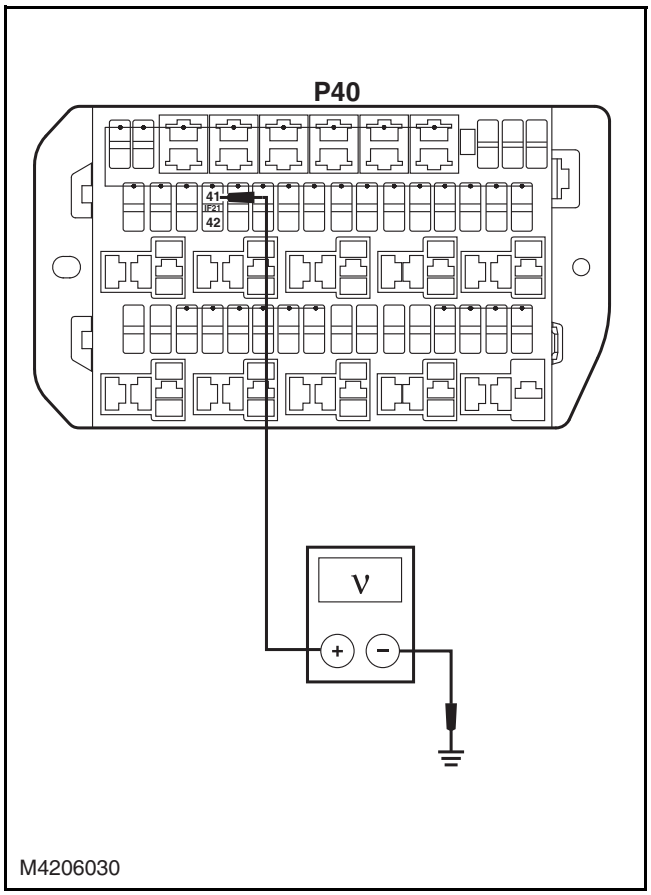
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the hazard warning lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of turn lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect hazard warning lamp switch | |
|  M4206028<br>  M4206029 | A. Turn the ignition switch to "OFF", and disconnect the hazard warning lamp switch wiring harness connector P25.<br>B. Press the hazard warning lamp switch.<br>C. Measure the resistance between terminals 7 and 8 of hazard warning lamp switch.<br>D. Press the hazard warning lamp switch, and measure the resistance between terminals 1 and 2, 3 of hazard warning lamp switch.<br>**Standard resistance: less than 1 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the hazard warning lamp switch.<br>**Refer to: Hazard Warning Lamp Switch (4.2.6 Lighting System, Removal and Installation).** |

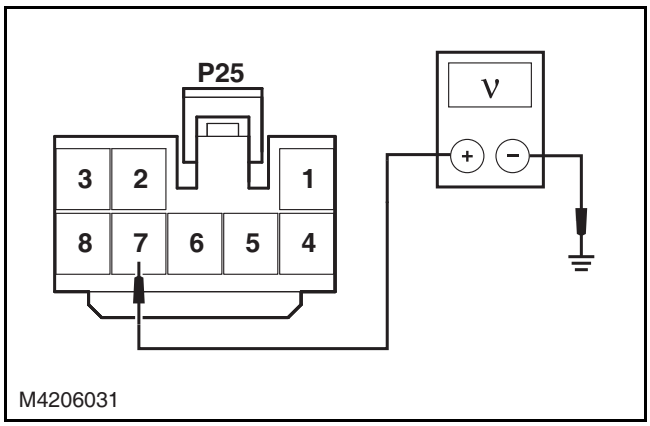
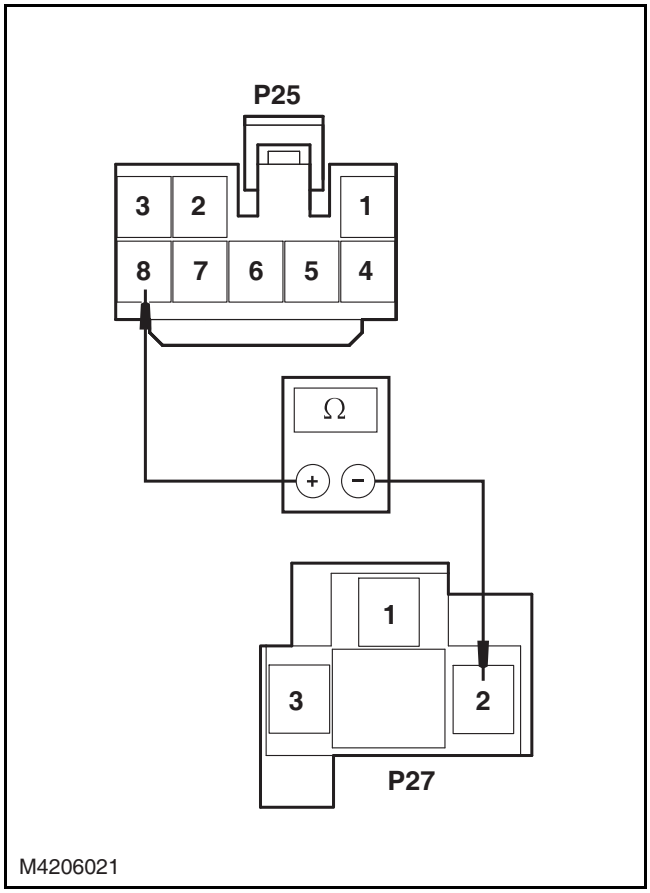
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect hazard warning lamp fuse | |
| | A. Inspect the hazard warning lamp fuse IF21.<br>**Fuse rated capacity: 15 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 4. Inspect hazard warning lamp fuse power supply | |
|  | A. Measure the voltage between terminal 41 of instrument panel fuse box fuse IF21 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 41 of instrument panel fuse box fuse IF21 and battery. |

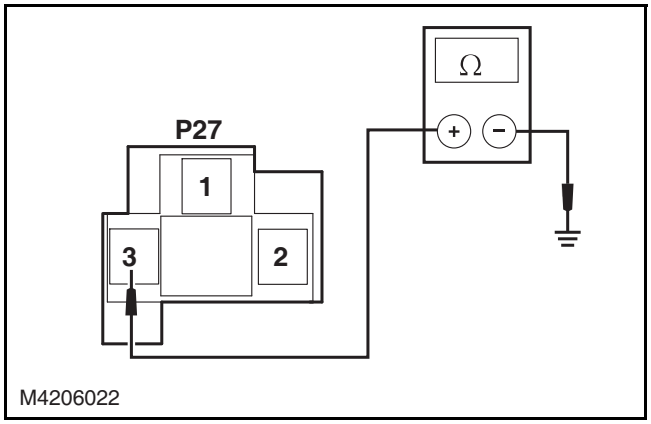
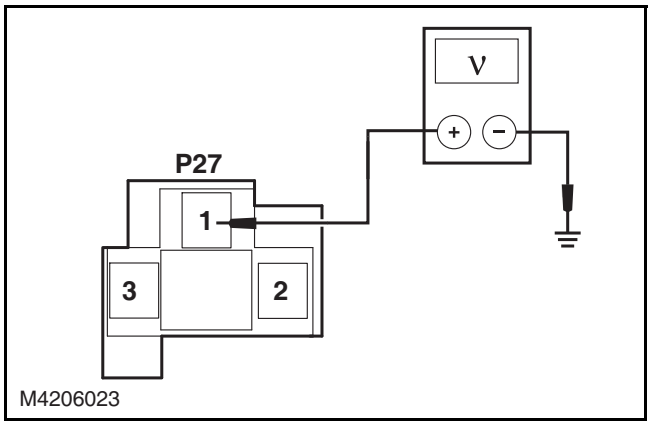
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect hazard warning lamp switch - turn lamp input power supply circuit | |
|  M4206031 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the hazard warning lamp switch wiring harness connector P25.<br>C. Turn the ignition switch to "ON", and measure the voltage between terminal 7 of hazard warning lamp switch wiring harness connector P25 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of hazard warning lamp switch wiring harness connector P25 and terminal 42 of instrument panel fuse box fuse IF21. |
| 6. Inspect turn lamp relay power supply circuit | |
|  M4206021 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the hazard warning lamp switch wiring harness connector P25.<br>C. Disconnect the turn lamp relay wiring harness connector P27.<br>D. Measure the resistance between terminal 2 of turn lamp relay wiring harness connector P27 and terminal 8 of hazard warning lamp switch wiring harness connector P25.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of turn lamp relay wiring harness connector P27 and terminal 8 of hazard warning lamp switch wiring harness connector P25. |

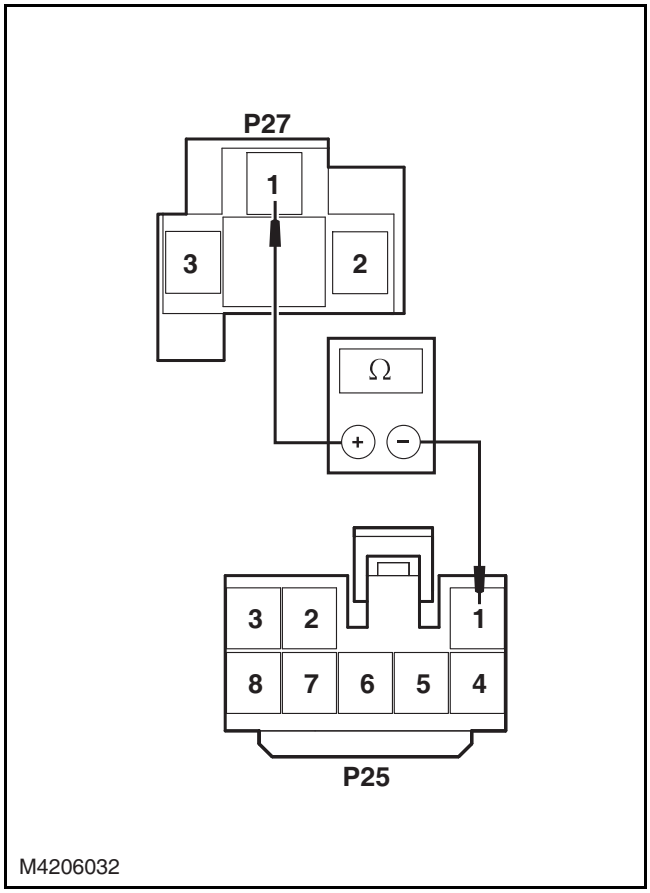
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect turn lamp relay grounding circuit | |
|  <br>M4206022 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the turn lamp relay wiring harness connector P27.<br>C. Measure the resistance between terminal 3 of turn lamp relay wiring harness connector P27 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of turn lamp relay wiring harness connector P27 and the ground point G105. |
| 8. Inspect turn lamp relay | |
|  <br>M4206023 | A. Turn the ignition switch to "ON".<br>B. Turn on the hazard warning lamp switch of lighting combination switch.<br>C. Measure the voltage between terminal 1 of turn lamp relay wiring harness connector P27 and reliable grounding from the back.<br>**Standard voltage: changes from 0 V to 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Replace the turn lamp relay. |

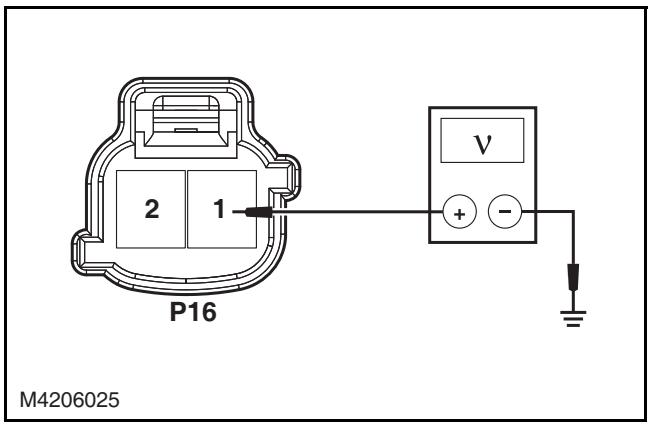
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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect turn lamp relay output power supply circuit | |
|  <br>M4206032 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the hazard warning lamp switch wiring harness connector P25.<br>C. Disconnect the turn lamp relay wiring harness connector P27.<br>D. Measure the resistance between terminal 1 of turn lamp relay wiring harness connector P27 and terminal 1 of hazard warning lamp switch wiring harness connector P25.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of turn lamp relay wiring harness connector P27 and terminal 1 of hazard warning lamp switch wiring harness connector P25. |

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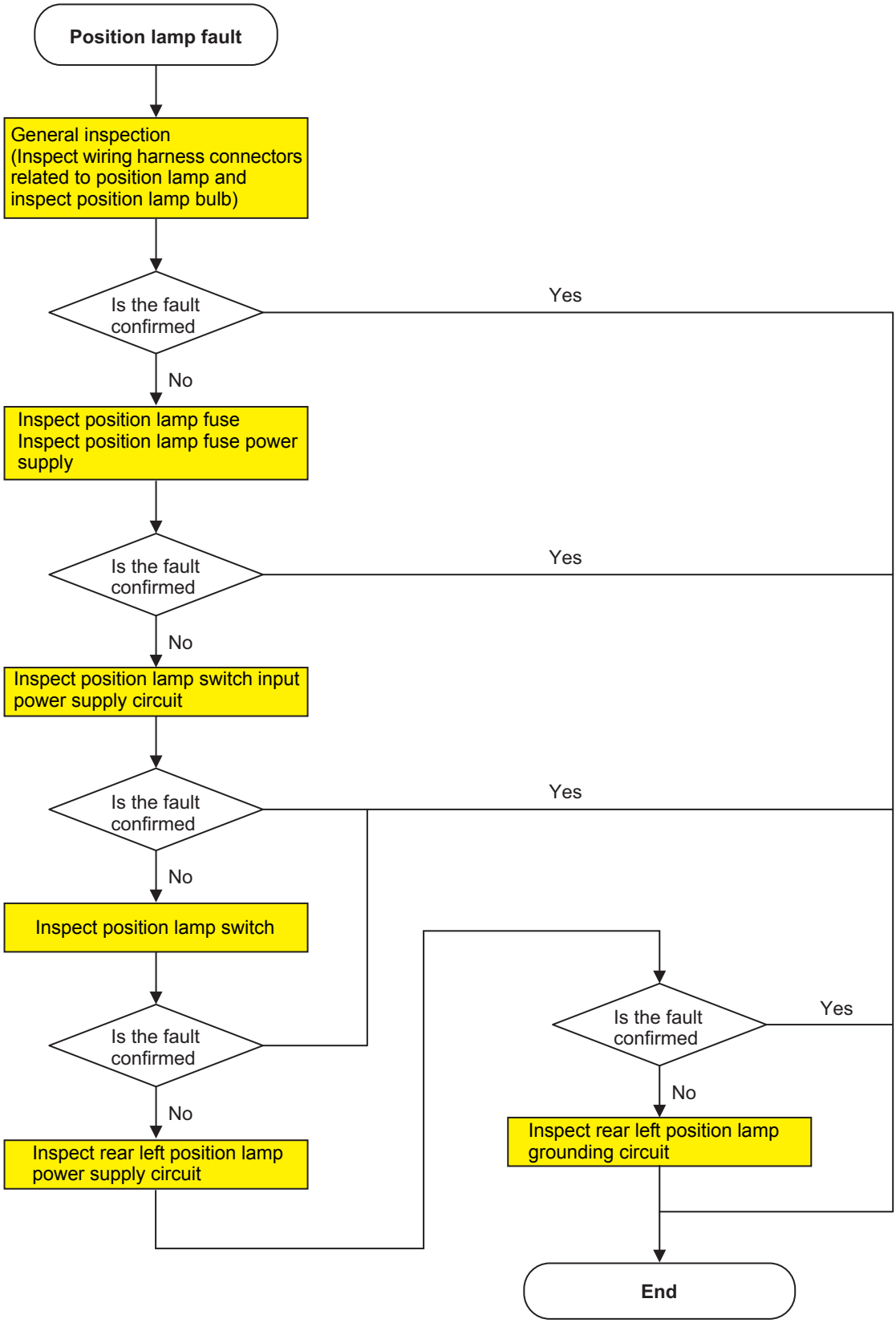


| Test Conditions | Details/Results/Actions |
|---|---|
| 10.Inspect front left turn lamp power supply circuit | |
|  <br>M4206025 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left turn lamp wiring harness connector P16.<br>C. Turn the ignition switch to "ON".<br>D. Turn on the hazard warning lamp switch of lighting combination switch.<br>E. Measure the voltage between terminal 1 of front left turn lamp wiring harness connector P16 and reliable grounding.<br>**Standard voltage: changes from 0 V to 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 2 of front left turn lamp wiring harness connector P16 and the ground point G103.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of front left turn lamp wiring harness connector P16 and terminal 3 of lighting combination switch wiring harness connector P25.<br>**CAUTION: Use different terminals to inspect other turn lamps in this way. Make sure the system is normal.** |

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# Diagnosis Procedure for Position Lamp Fault



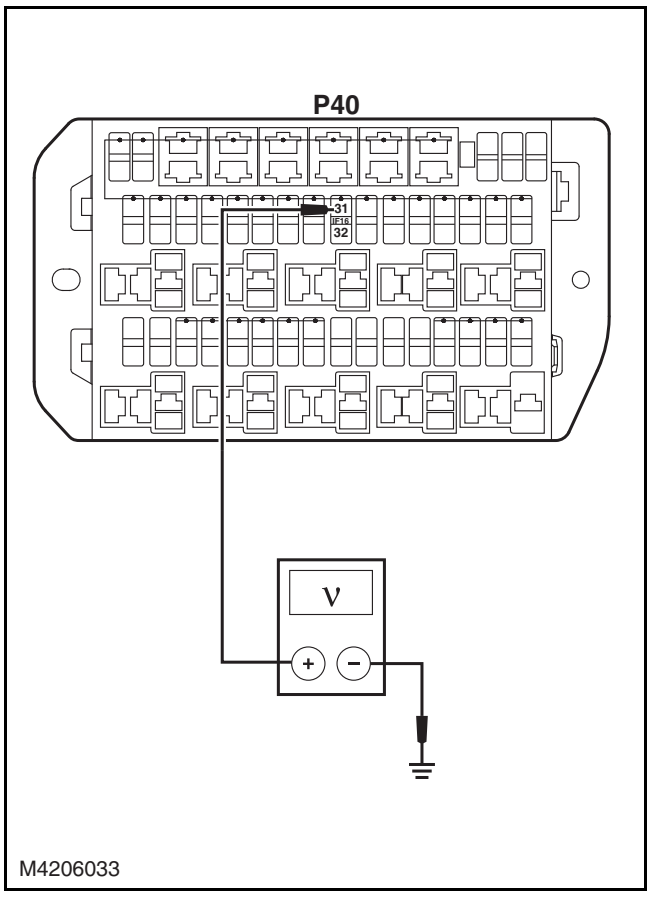
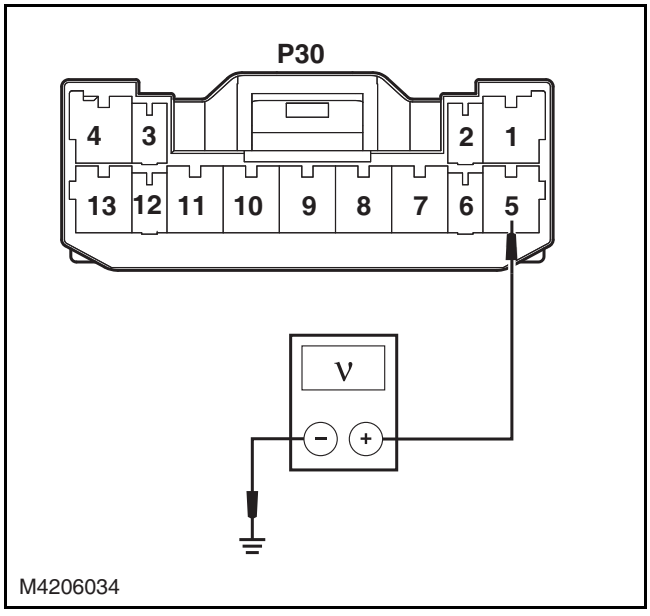
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the position lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of position lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect position lamp fuse | |
| | A. Inspect the fuse IF16.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

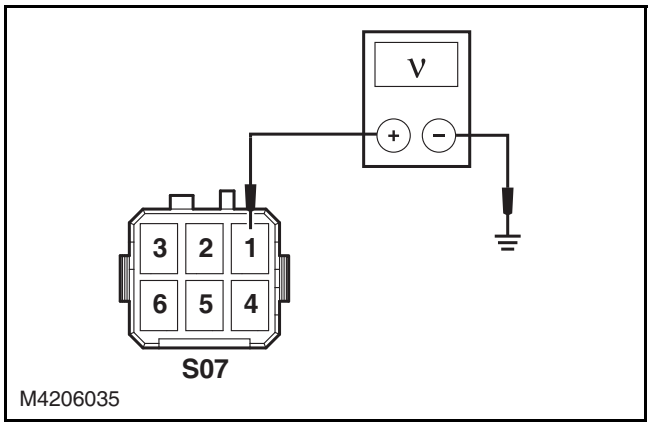
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect position lamp fuse power supply | |
|  M4206033 | A. Measure the voltage between terminal 31 of instrument panel fuse box fuse IF16 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 31 of instrument panel fuse box fuse IF16 and battery. |
| 4. Inspect position lamp switch input power supply circuit | |
|  M4206034 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the lighting combination switch wiring harness connector P30.<br>C. Measure the voltage between terminal 5 of lighting combination switch wiring harness connector P30 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of lighting combination switch wiring harness connector P30 and terminal 32 of instrument panel fuse box fuse IF16. |

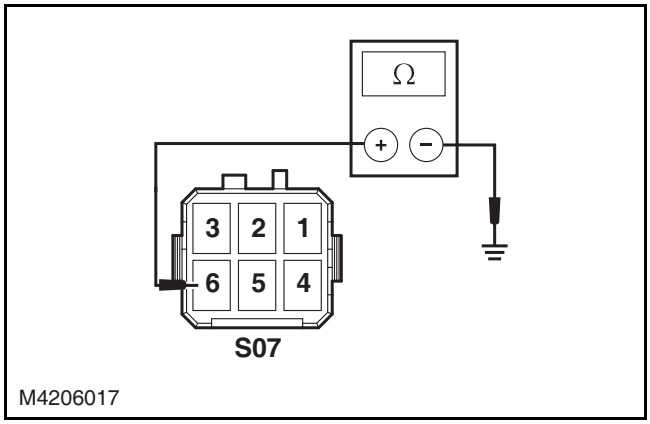
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect position lamp switch | |
| | A. Inspect the position lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>Is the lighting combination switch normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |
| 6. Inspect rear left position lamp power supply circuit | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the rear left combination lamp wiring harness connector S07.<br>C. Turn the ignition switch to "ON".<br>D. Turn on the position lamp.<br>E. Measure the voltage between terminal 1 of rear left combination lamp wiring harness connector S07 and reliable grounding with a multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the open circuit fault between terminal 8 of lighting combination switch wiring harness connector P30 and terminal 1 of rear left combination lamp wiring harness connector S07. |

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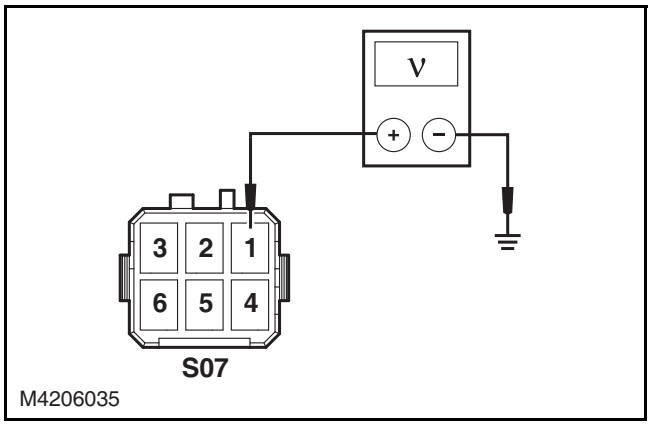


| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect rear left position lamp grounding circuit | |
|  <br>M4206017 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the rear left combination lamp wiring harness connector S07.<br>C. Measure the resistance between terminal 6 of rear left combination lamp wiring harness connector S07 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the rear left combination lamp<br>**Refer to: Rear Combination Lamp (4.2.6 Lighting System, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of rear left combination lamp wiring harness connector S07 and the ground point G201.<br>**CAUTION: Use different terminals to inspect other position lamps in this way. Make sure the system is normal.** |

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# Diagnosis Procedure for Position Lamp Constant ON

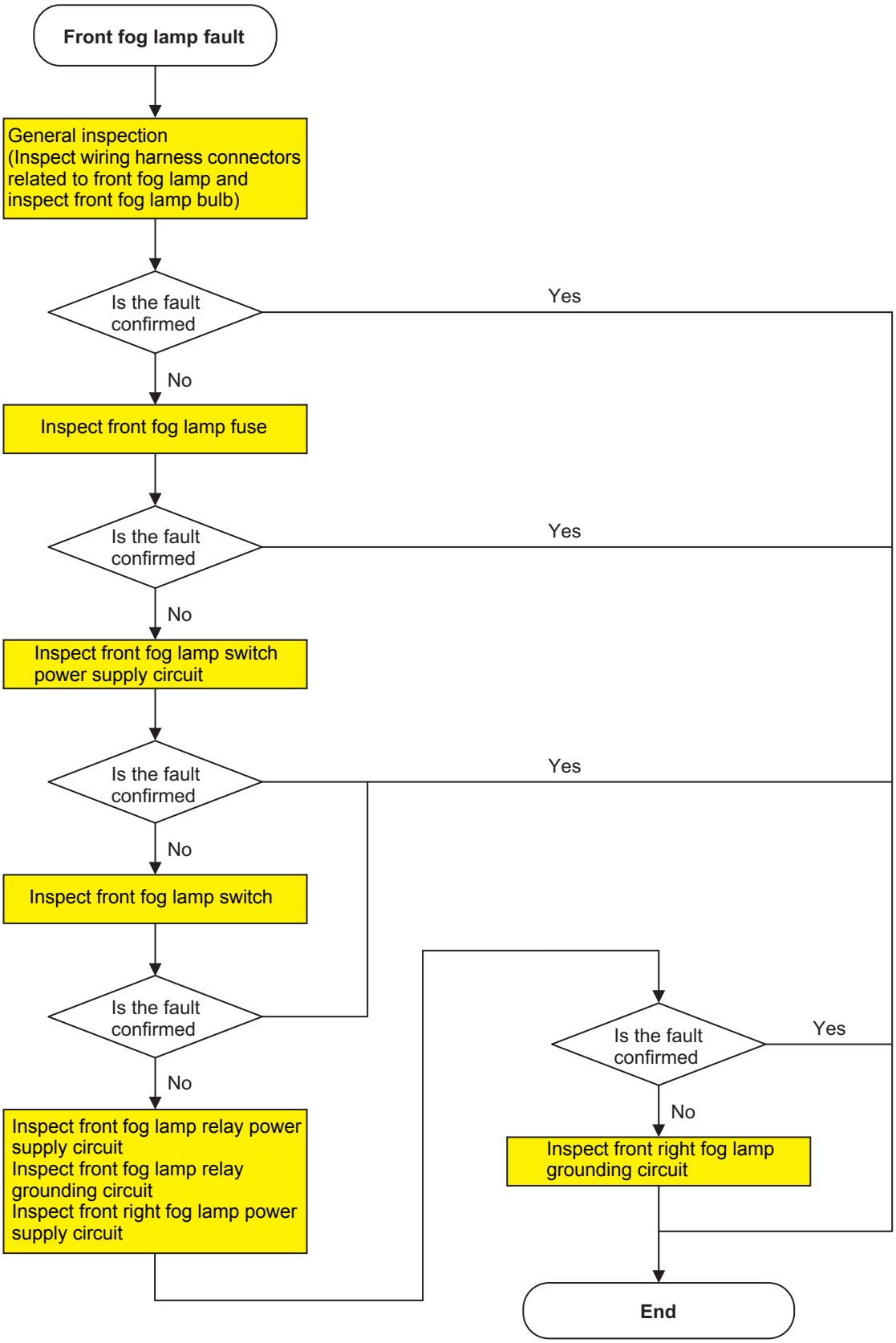
| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect lighting combination switch | |
| | A. Disconnect the lighting combination switch wiring harness connector P30.<br>Has the position lamp gone off?<br>**Yes**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).**<br>**No**<br>Go to step 2. |
| 2. Inspect rear left position lamp power supply circuit | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the rear left combination lamp wiring harness connector S07.<br>C. Disconnect the lighting combination switch wiring harness connector P30.<br>D. Measure the voltage between terminal 1 of rear left combination lamp wiring harness connector S07 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is the voltage value normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Inspect and repair the short circuit fault between power and terminal 1 of rear left combination lamp wiring harness connector S07. |

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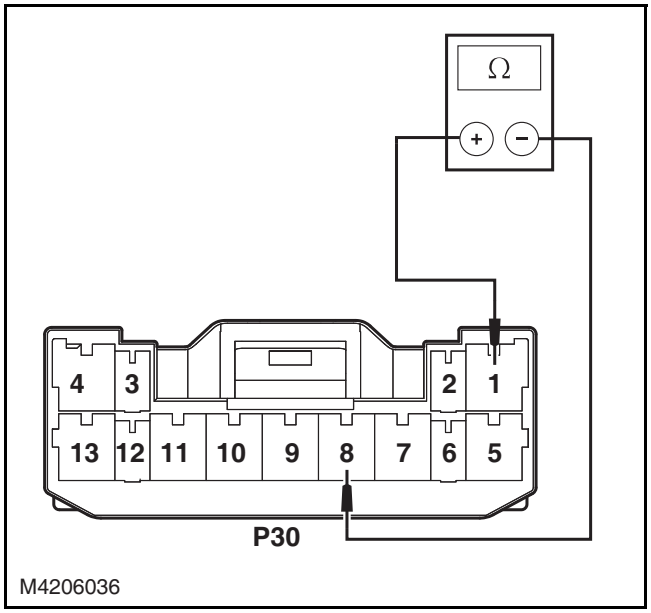
# Diagnosis Procedure for Front Fog Lamp Fault

**CAUTION: Normal work of front fog lamp is base on the normal work of position lamp, so the position lamp must be inspected for normal operation before carrying out this diagnosis procedure.**



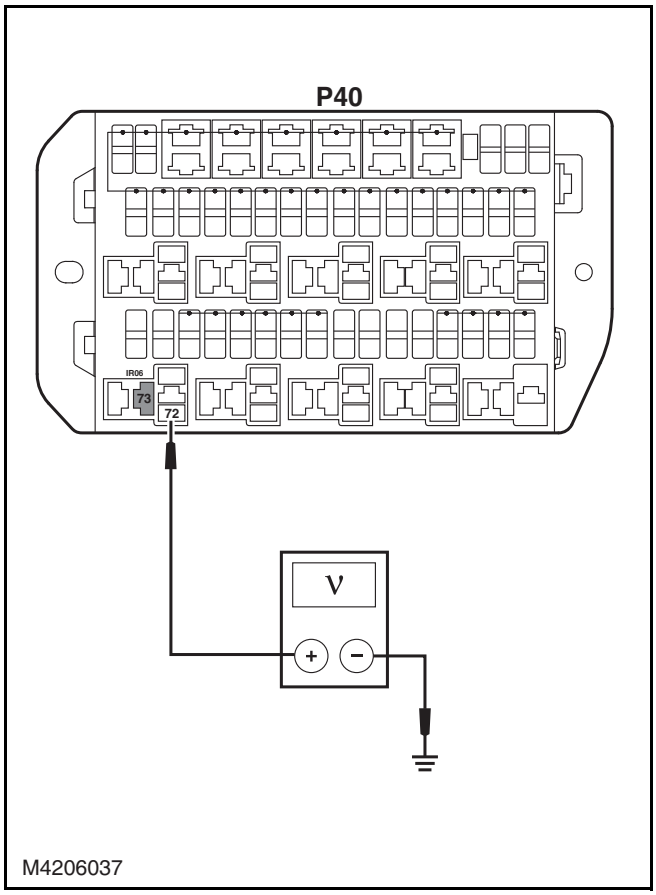
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the front fog lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of front fog lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect front fog lamp fuse | |
| | A. Inspect the front fog lamp fuse IF14.<br>**Fuse rated capacity: 15 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect front fog lamp switch power supply circuit | |
|  <br>M4206036 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the lighting combination switch wiring harness connector P30.<br>C. Measure the resistance between terminals 1 and 8 of lighting combination switch wiring harness connector P30.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminals 1 and 8 of lighting combination switch wiring harness connector P30. |

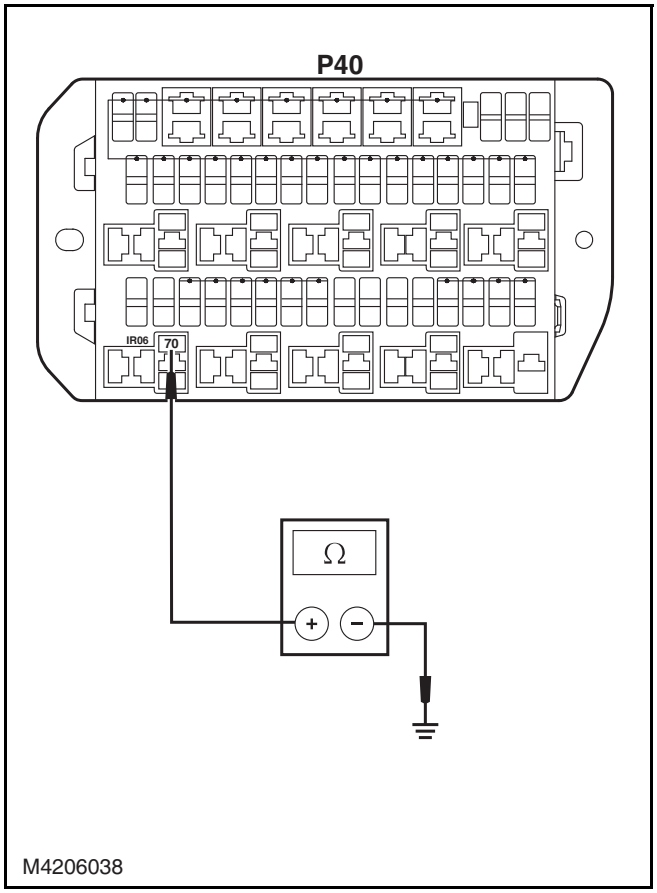
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect front fog lamp switch | |
| | A. Inspect the front fog lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>Is the lighting combination switch normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |
| 5. Inspect front fog lamp relay power supply circuit | |
|  | A. Remove the front fog lamp relay IR06.<br>B. Turn the lighting combination switch to position lamp.<br>C. Turn on the front fog lamp.<br>D. Separately measure the voltage between terminals 72, 73 of front fog lamp relay IR06 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 72 of front fog lamp relay IR06 and terminal 3 of lighting combination switch wiring harness connector P30.<br>Inspect and repair the open circuit fault between terminal 73 of front fog lamp relay IR06 and terminal 28 of instrument panel fuse box fuse IF14. |

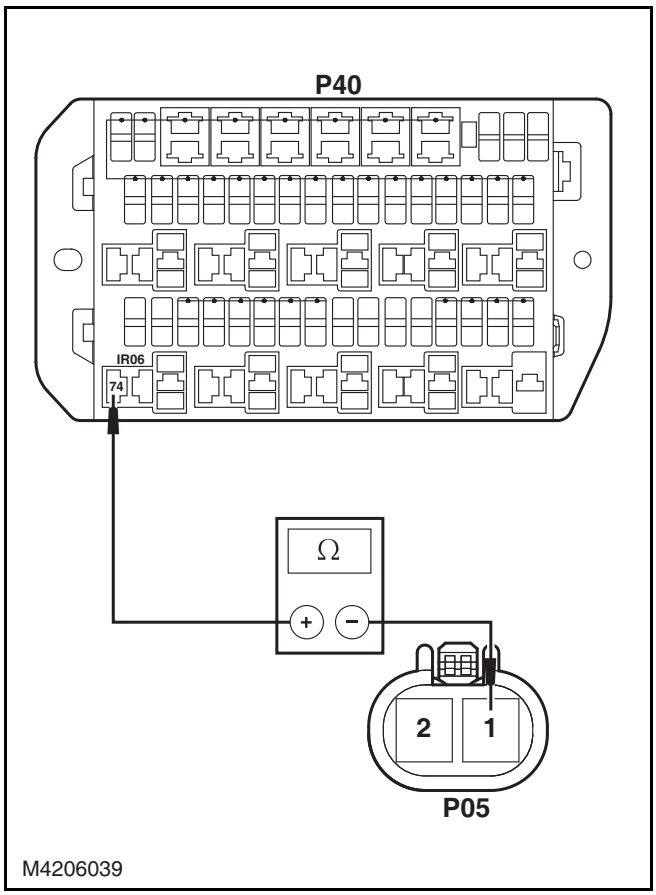
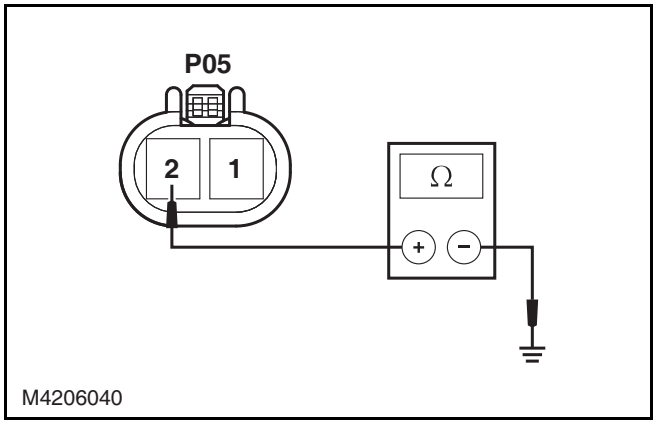
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect front fog lamp relay grounding circuit | |
|  | A. Remove the front fog lamp relay.<br>B. Measure the resistance between terminal 70 of front fog lamp relay IR06 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the open circuit fault between terminal 70 of front fog lamp relay IR06 and the ground point G103. |

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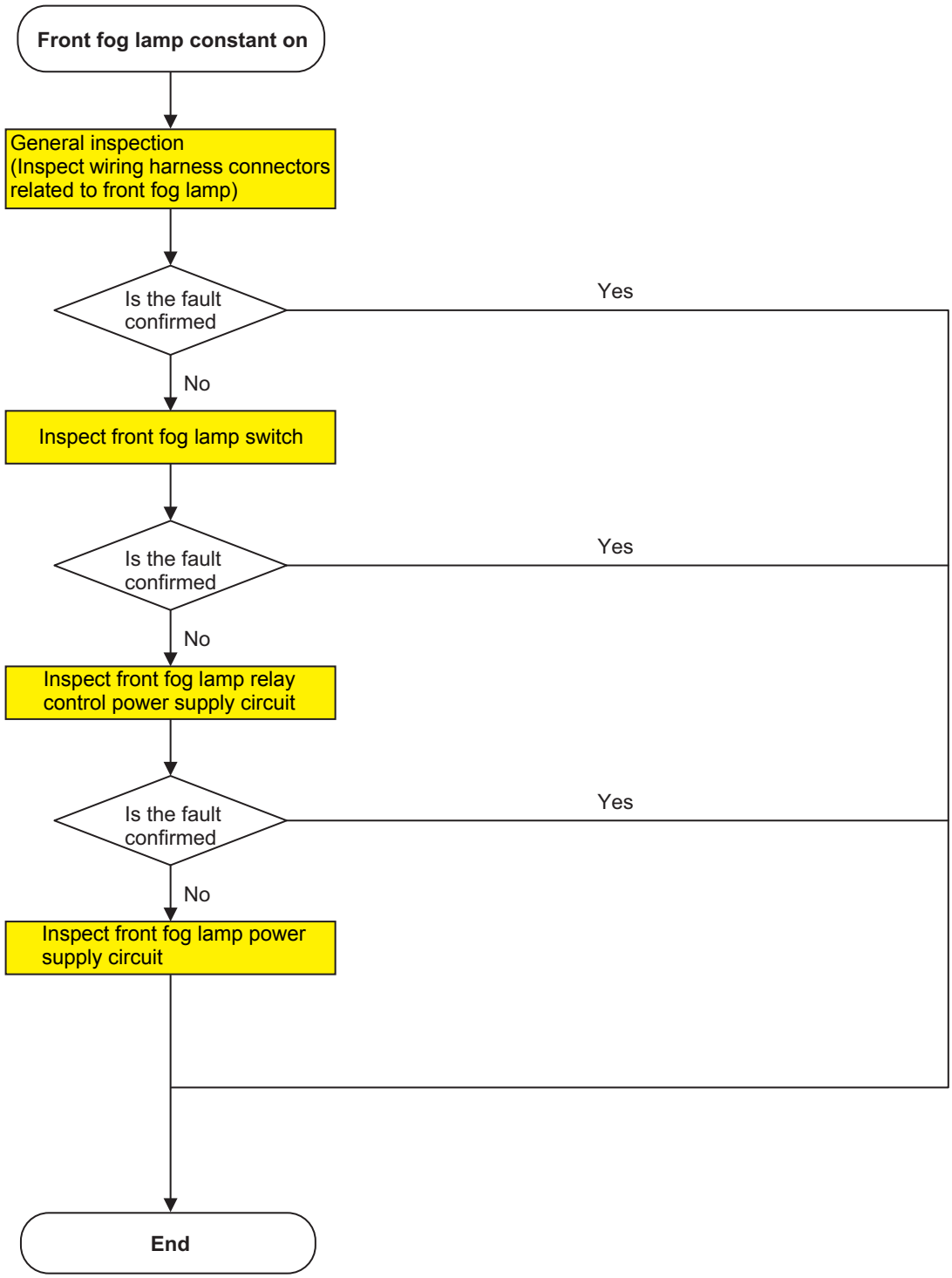
| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect front right fog lamp power supply circuit | |
|  <br>M4206039 | A. Remove the front fog lamp relay IR06.<br>B. Disconnect the front right fog lamp wiring harness connector P05.<br>C. Measure the resistance between terminal 1 of front right fog lamp wiring harness connector P05 and terminal 74 of front fog lamp relay IR06.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of front right fog lamp wiring harness connector P05 and terminal 74 of front fog lamp relay IR06. |
| 8. Inspect front right fog lamp grounding circuit | |
|  <br>M4206040 | A. Disconnect the front right fog lamp wiring harness connector P05.<br>B. Measure the resistance between terminal 2 of front right fog lamp wiring harness connector P05 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the front fog lamp relay.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of front right fog lamp wiring harness connector P05 and the ground point G106.<br>**CAUTION: Use different terminals to inspect the front left fog lamp in this way. Make sure the system is normal.** |

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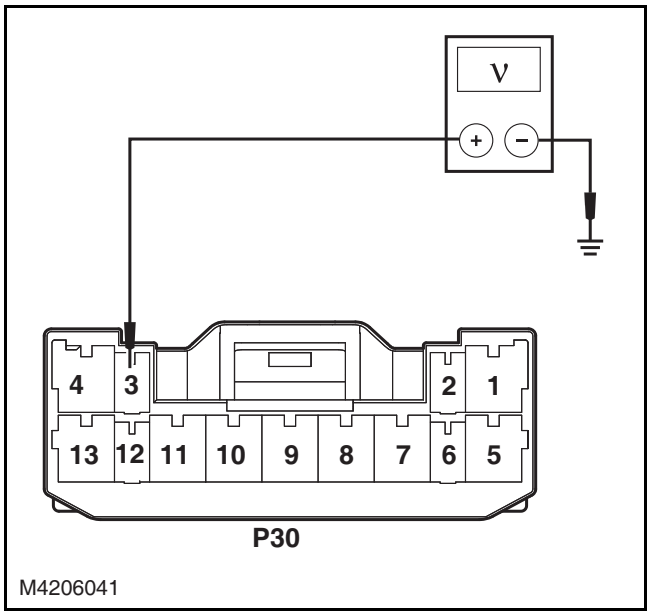
# Diagnosis Procedure for Front Fog Lamp Constant ON

**CAUTION: Normal work of front fog lamp is base on the normal work of position lamp, so inspect the position lamp must be inspected for normal operation before carrying out this diagnosis procedure.**



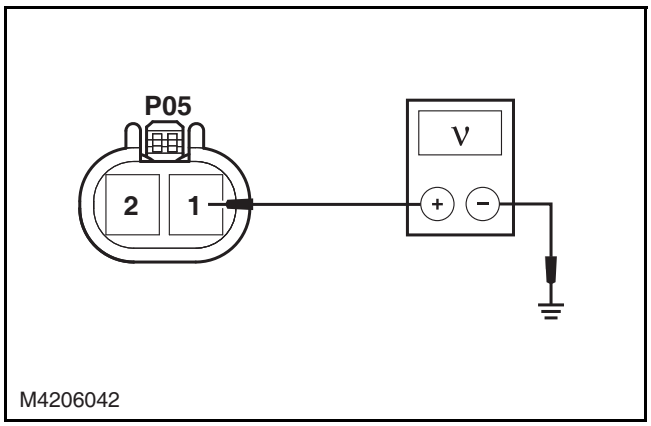
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the front fog lamp for damage or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect front fog lamp switch | |
| | A. Inspect the front fog lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>Is the lighting combination switch normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |
| 3. Inspect front fog lamp relay control power supply circuit | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the lighting combination switch wiring harness connector P30.<br>C. Disconnect the front fog lamp relay IR06.<br>D. Measure the voltage between terminal 3 of lighting combination switch wiring harness connector P30 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the short circuit fault between power and terminal 3 of lighting combination switch wiring harness connector P30. |

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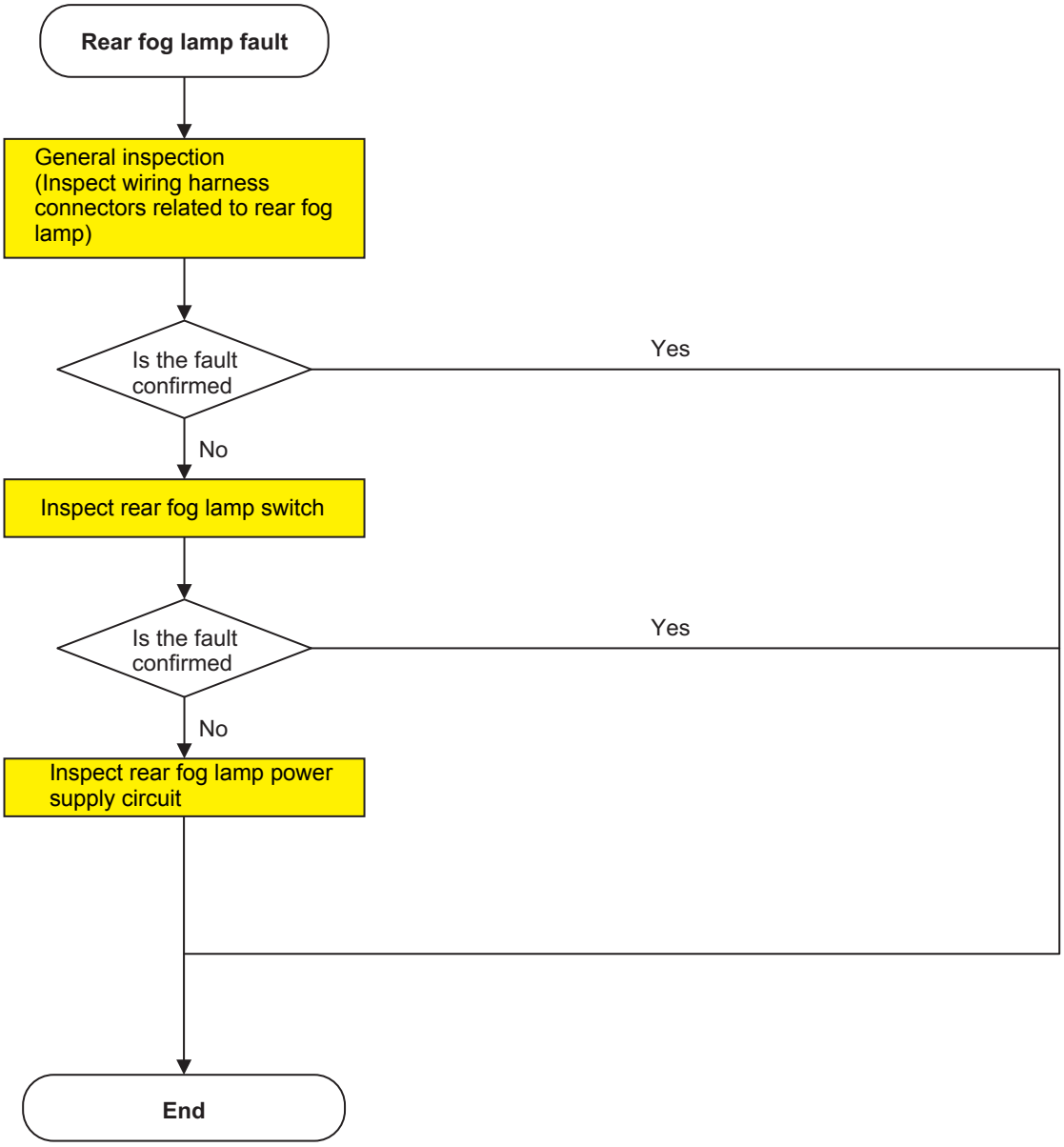
| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect front fog lamp power supply circuit | |
|  M4206042 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front fog lamp relay IR06.<br>C. Disconnect the front right fog lamp wiring harness connector P05.<br>D. Disconnect the front left fog lamp wiring harness connector P18.<br>E. Measure the voltage between terminal 1 of front right fog lamp wiring harness connector P05 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the front fog lamp relay IR06.<br>**No**<br>Inspect and repair the short circuit fault between power and terminal 1 of front right fog lamp wiring harness connector P05. |

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# Diagnosis Procedure for Rear Fog Lamp Fault

**CAUTION: Normal work of rear fog lamp is base on the normal work of position lamp, so inspect the position lamp must be inspected for normal operation before carrying out this diagnosis procedure.**



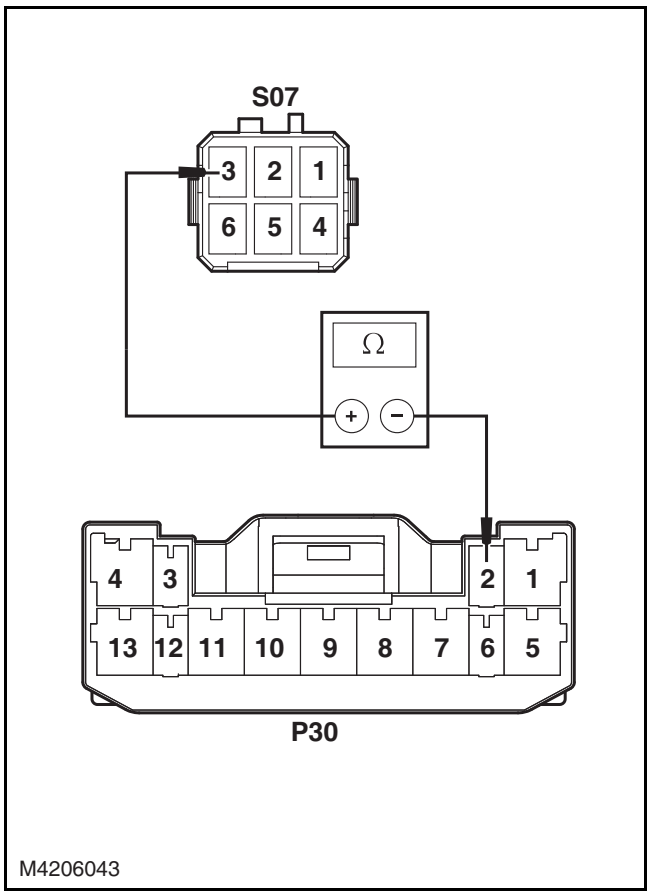
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the rear fog lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of rear fog lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect rear fog lamp switch | |
| | A. Inspect the rear fog lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>**Is the lighting combination switch normal?**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |

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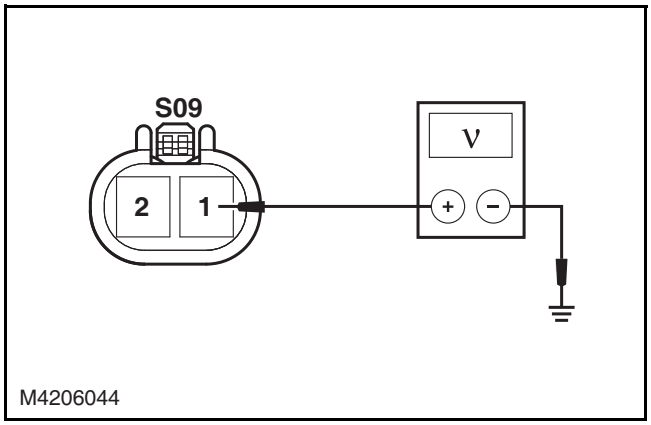


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect rear fog lamp power supply circuit | |
|  <br>M4206043 | A. Disconnect the lighting combination switch wiring harness connector P30.<br>B. Disconnect the rear left fog lamp wiring harness connector S07.<br>C. Measure the resistance between terminal 2 of lighting combination switch wiring harness connector P30 and terminal 3 of rear left fog lamp wiring harness connector S07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 6 of rear left fog lamp wiring harness connector S07 and the ground point G201.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of lighting combination switch wiring harness connector P30 and terminal 3 of rear left fog lamp wiring harness connector S07. |

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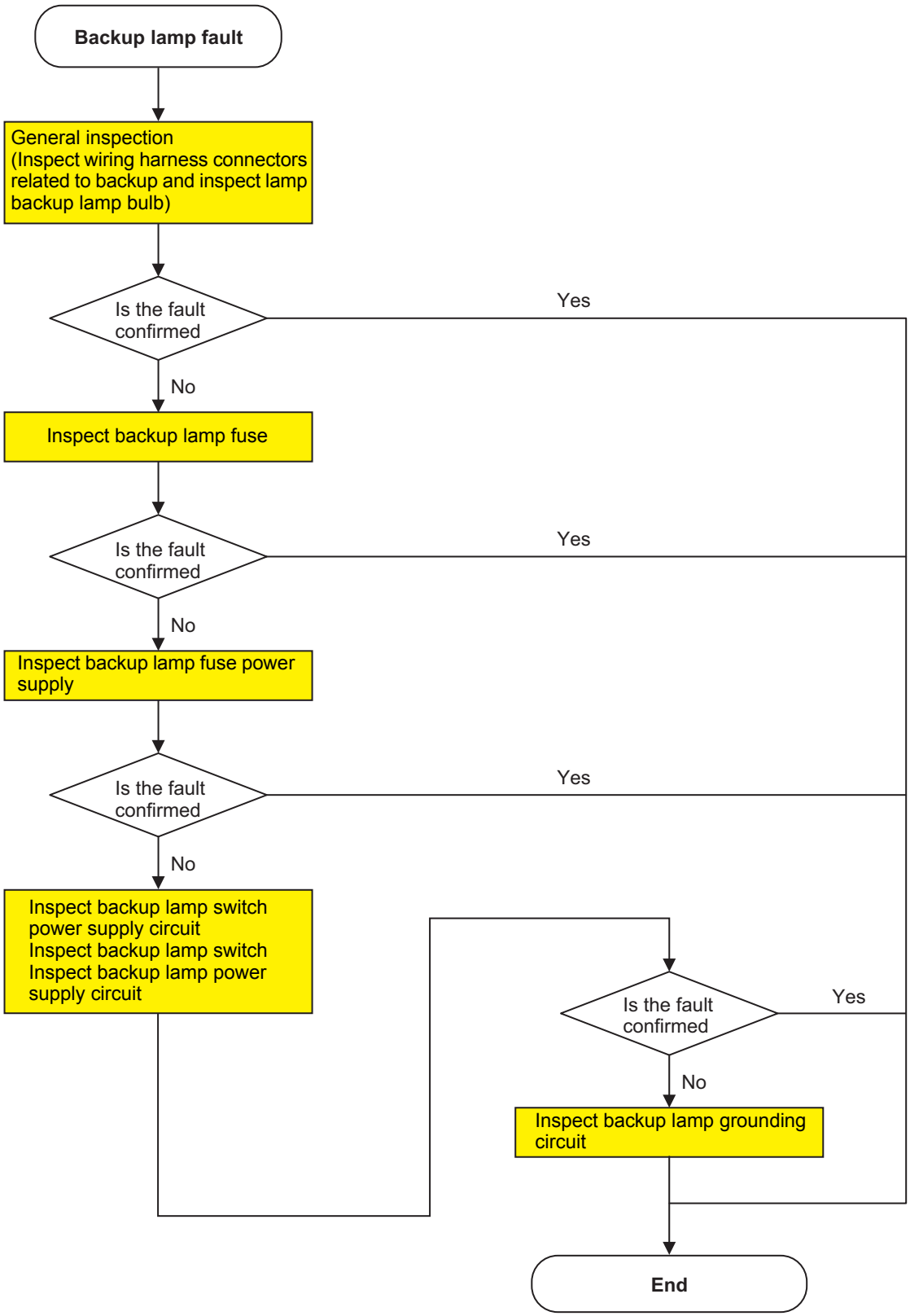
# Diagnosis Procedure for Rear Fog Lamp Constant ON

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the rear fog lamp for damage or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect rear fog lamp power supply circuit | |
|  <br>M4206044 | A. Disconnect the rear right fog lamp wiring harness connector S09.<br>B. Disconnect the lighting combination switch wiring harness connector P30.<br>C. Measure the voltage between terminal 1 of rear right fog lamp wiring harness connector S09 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).**<br>**No**<br>Inspect and repair the short circuit fault between power and terminal 1 of rear right fog lamp wiring harness connector S09. |

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# Diagnosis Procedure for Backup Lamp Fault



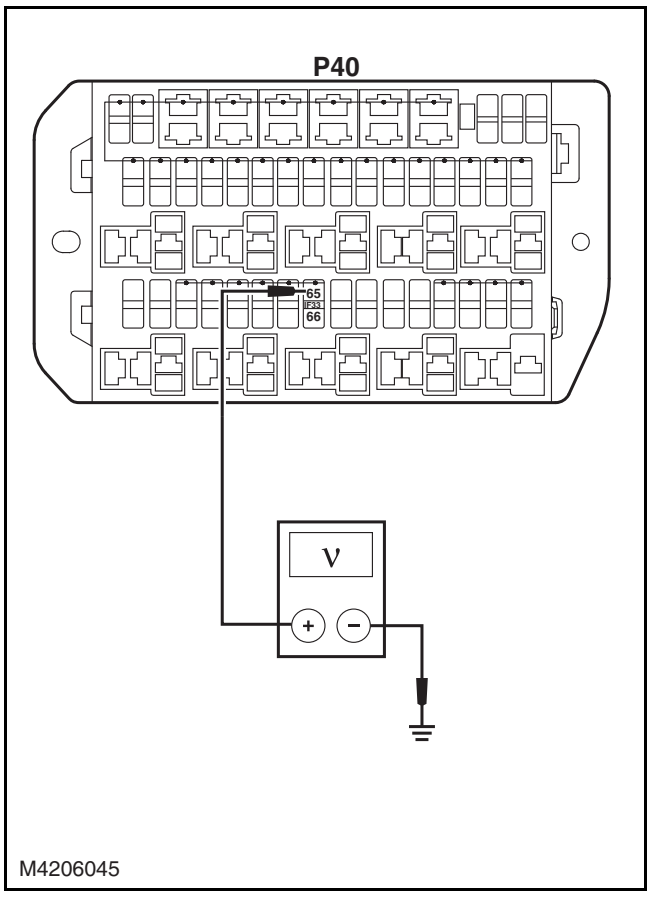
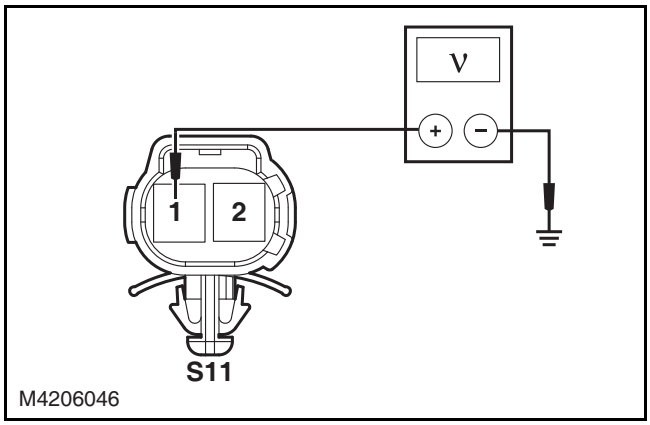
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the backup lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of backup lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect backup lamp fuse | |
| | A. Inspect the backup lamp fuse IF33.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

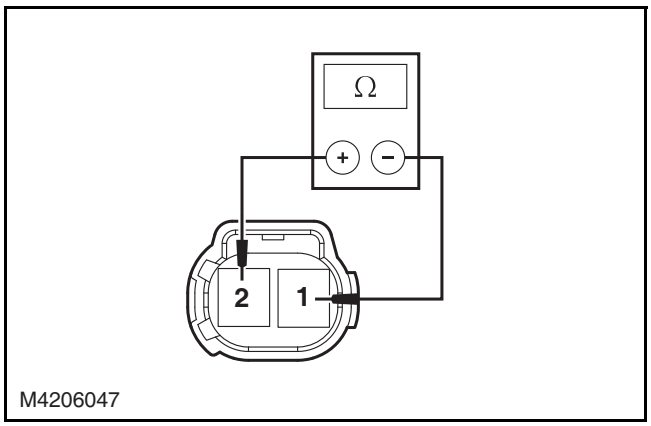
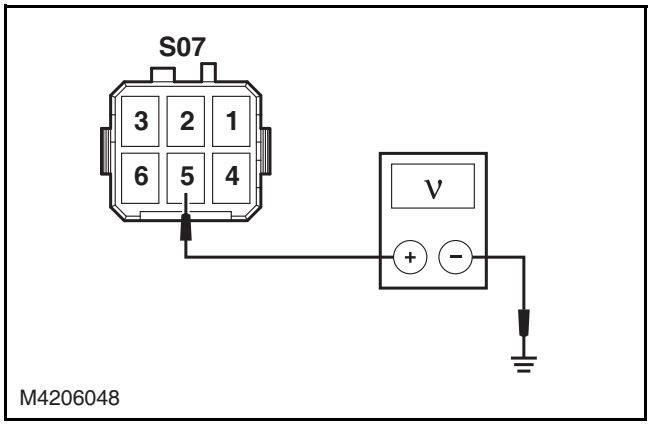
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect backup lamp fuse power supply | |
|  | A. Turn the ignition switch to "ON".<br>B. Measure the voltage between terminal 65 of instrument panel fuse box fuse IF33 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 65 of instrument panel fuse box fuse IF33 and ignition switch IG1. |
| 4. Inspect backup lamp switch power supply circuit | |
|  | A. Disconnect the backup lamp switch wiring harness connector S11.<br>B. Turn the ignition switch to "ON".<br>C. Measure the voltage between terminal 1 of backup lamp switch wiring harness connector S11 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of backup lamp switch wiring harness connector S11 and terminal 66 of instrument panel fuse box fuse IF33. |

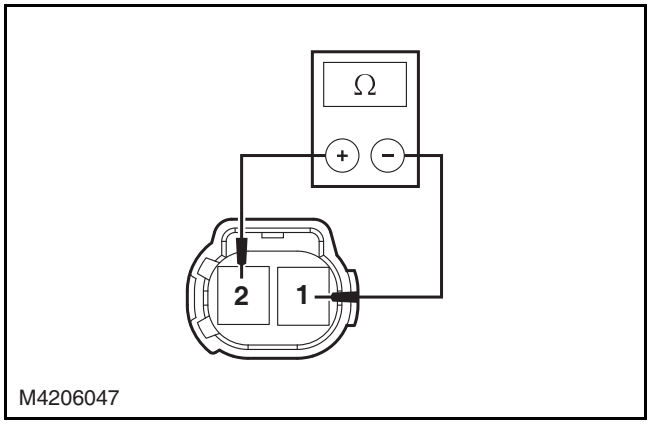
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect backup lamp switch | |
|  <br>M4206047 | A. Disconnect the backup lamp switch wiring harness connector S11.<br>B. Put the gear lever into the reversing gear.<br>C. Measure the resistance between terminals 1 and 2 of backup lamp switch connector on the component side.<br>**Standard resistance: less than 1 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the backup lamp switch. |
| 6. Inspect backup lamp power supply circuit | |
|  <br>M4206048 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the left backup lamp wiring harness connector S07.<br>C. Turn the ignition switch to "ON".<br>D. Put the gear lever into the reversing gear.<br>E. Measure the voltage between terminal 5 of left backup lamp wiring harness connector S07 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of left backup lamp wiring harness connector S07 and terminal 2 of backup lamp switch wiring harness connector S11. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect backup lamp grounding circuit | |
|  <br>M4206047 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the left backup lamp wiring harness connector S07.<br>C. Measure the resistance between terminal 6 of left backup lamp wiring harness connector S07 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the left backup lamp.<br>Make sure the maintenance has been finished.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of left backup lamp wiring harness connector S07 and the ground point G201. |

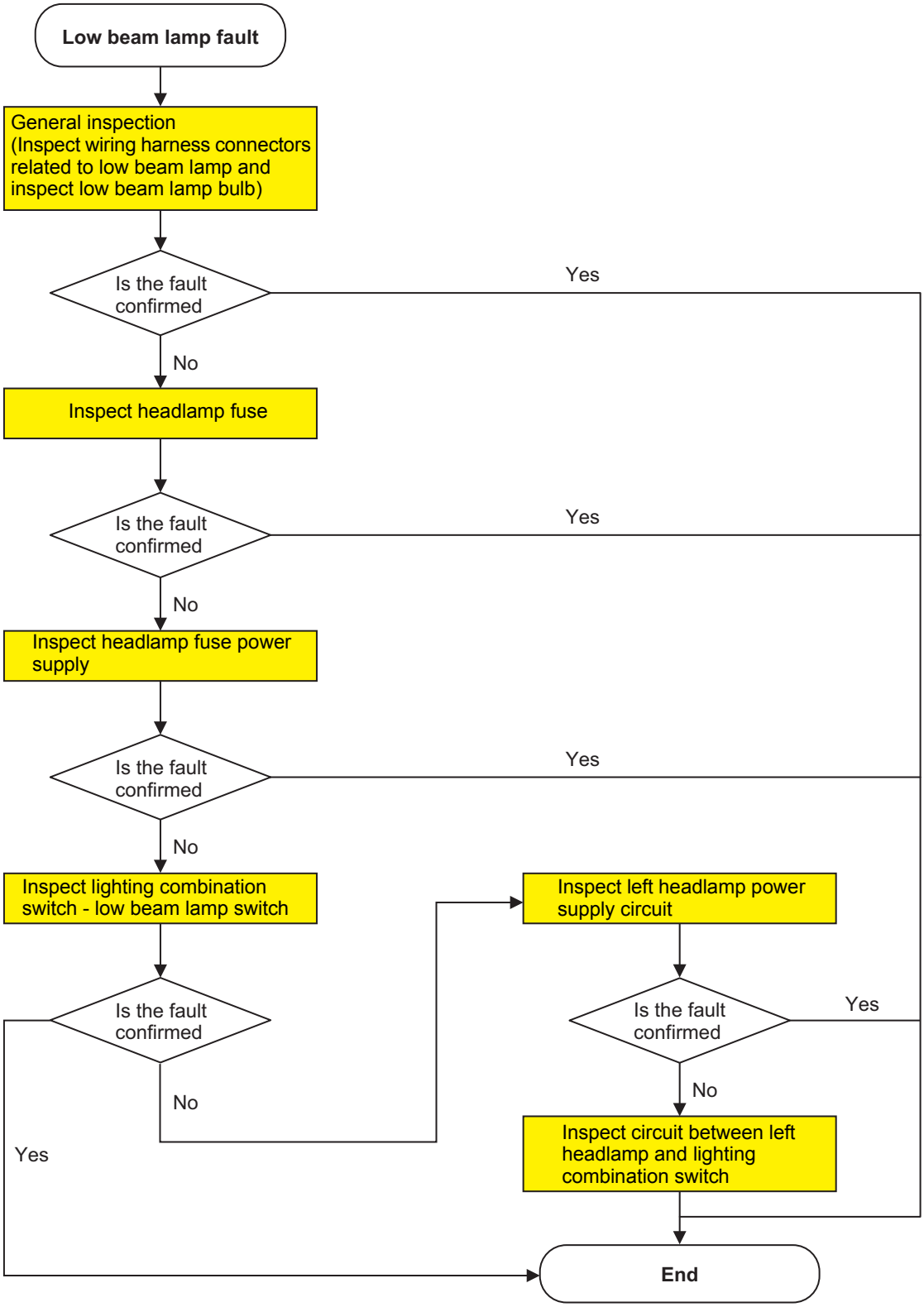
# Diagnosis Procedure for Backup Lamp Constant ON

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the backup lamp for damage or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect backup lamp switch | |
| | A. Disconnect the backup lamp switch wiring harness connector S11.<br>B. Observe whether the backup lamp has gone off.<br>Has the backup lamp gone off?<br>**Yes**<br>Replace the backup lamp switch.<br>**No**<br>Inspect and repair the short circuit fault between power and terminal 2 of backup lamp switch wiring harness connector S11. |

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# Diagnosis Procedure for Low Beam Lamp Fault



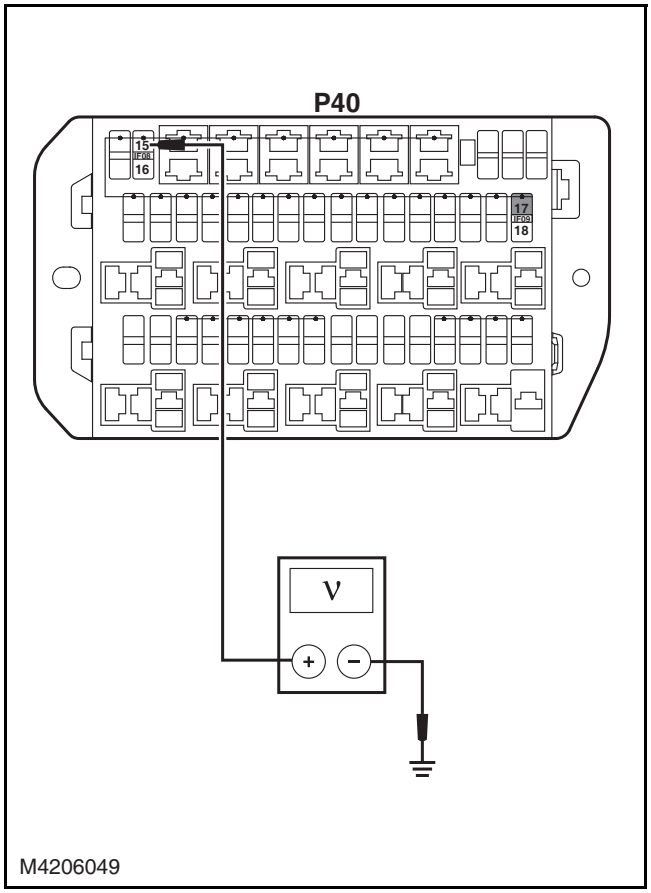
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the low beam lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of low beam lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect headlamp fuse | |
| | A. Inspect the fuse IF08, IF09.<br>**Fuse rated capacity: 15 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

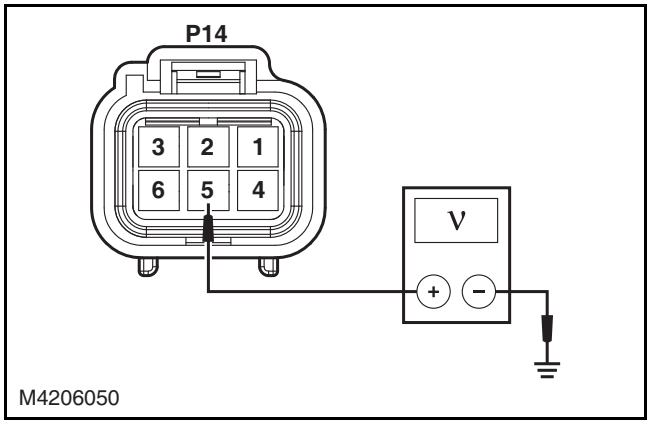
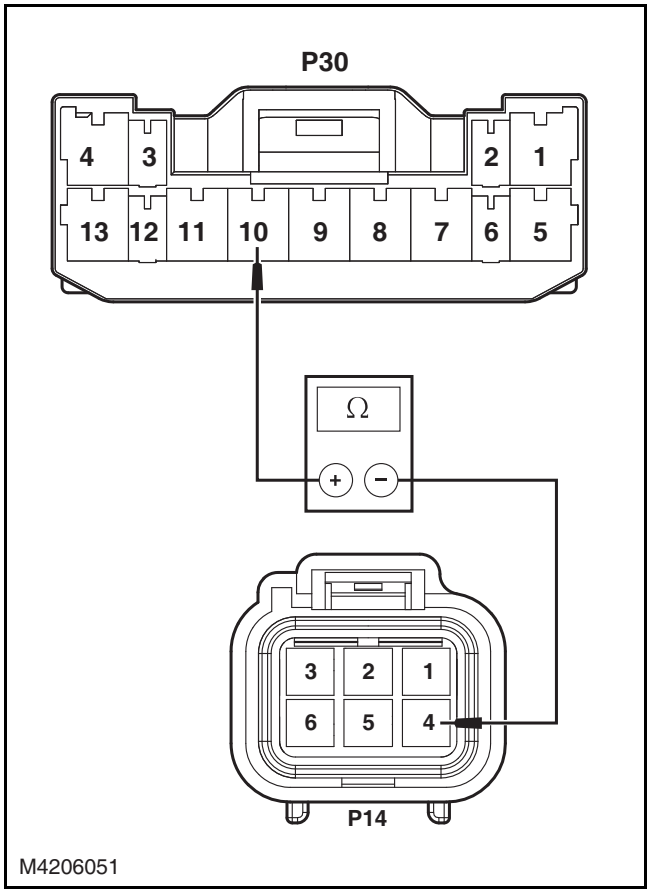
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect headlamp fuse power supply | |
|  | A. Measure the voltage between terminal 15 of instrument panel fuse box fuse IF08, terminal 17 of IF09 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 15 of instrument panel fuse box fuse IF08 and battery.<br>Inspect and repair the open circuit fault between terminal 17 of instrument panel fuse box fuse IF09 and battery. |
| 4. Inspect lighting combination switch - low beam lamp switch | |
| | A. Inspect the low beam lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>Is the lighting combination switch normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |

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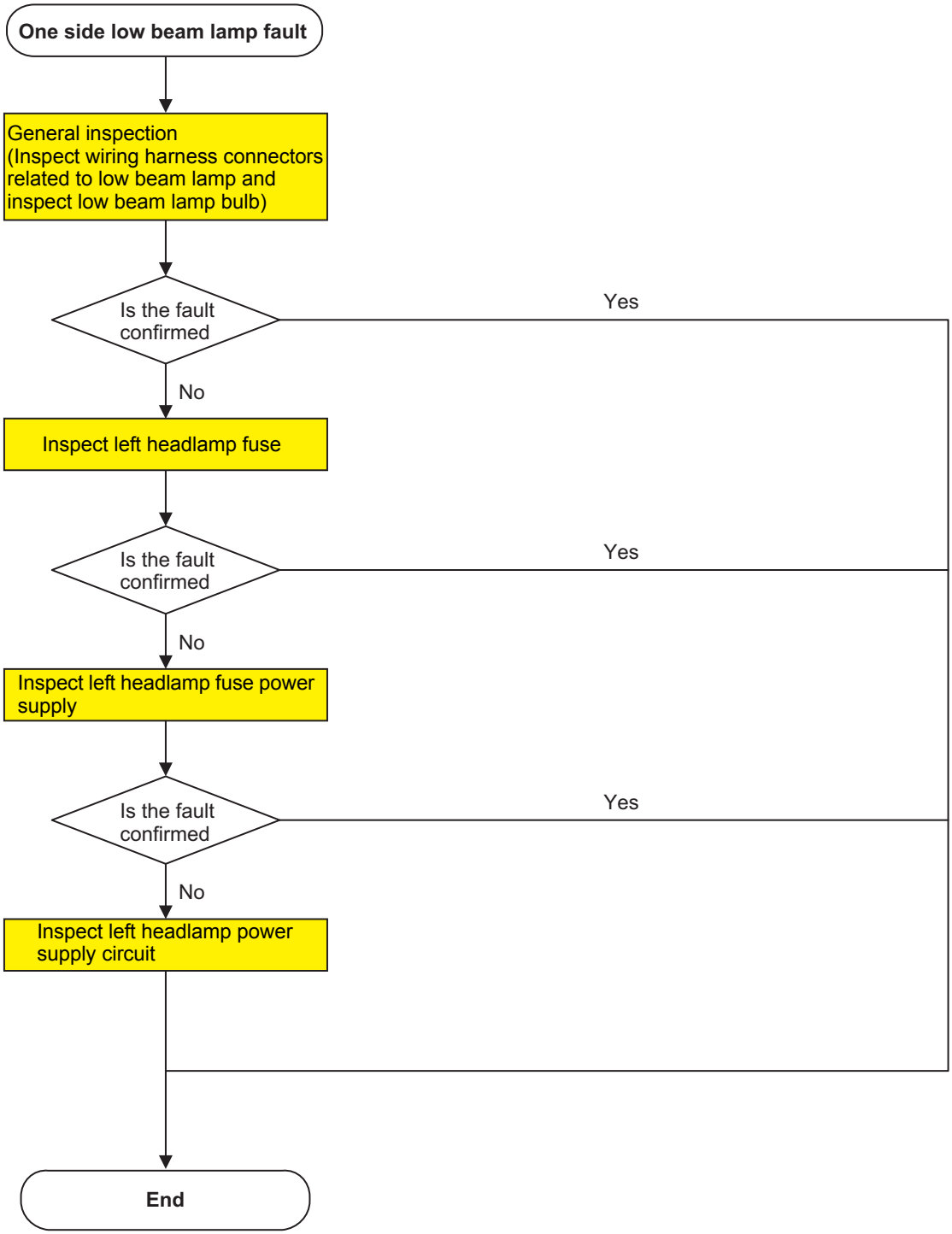
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect left headlamp power supply circuit | |
|  M4206050 | **CAUTION: Use different wiring harness terminals to inspect the low beam circuit of right headlamp in this way.**<br>A. Disconnect the left headlamp wiring harness connector P14.<br>B. Measure the voltage between terminal 5 of left headlamp wiring harness connector P14 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of left headlamp wiring harness connector P14 and terminal 16 of instrument panel fuse box fuse IF08. |
| 6. Inspect circuit between left headlamp and lighting combination switch | |
|  M4206051 | A. Disconnect the left headlamp wiring harness connector P14.<br>B. Disconnect the lighting combination switch wiring harness connector P30.<br>C. Measure the resistance between terminal 4 of left headlamp wiring harness connector P14 and terminal 10 of lighting combination switch wiring harness connector P30.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 7 of lighting combination switch wiring harness connector P30 and grounding point G103.<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of left headlamp wiring harness connector P14 and terminal 10 of lighting combination switch wiring harness connector P30. |

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# Diagnosis Procedure for One Side Low Beam Lamp Fault

**CAUTION: This process is carried out for left low beam lamp fault only. Process for the right is similar.**



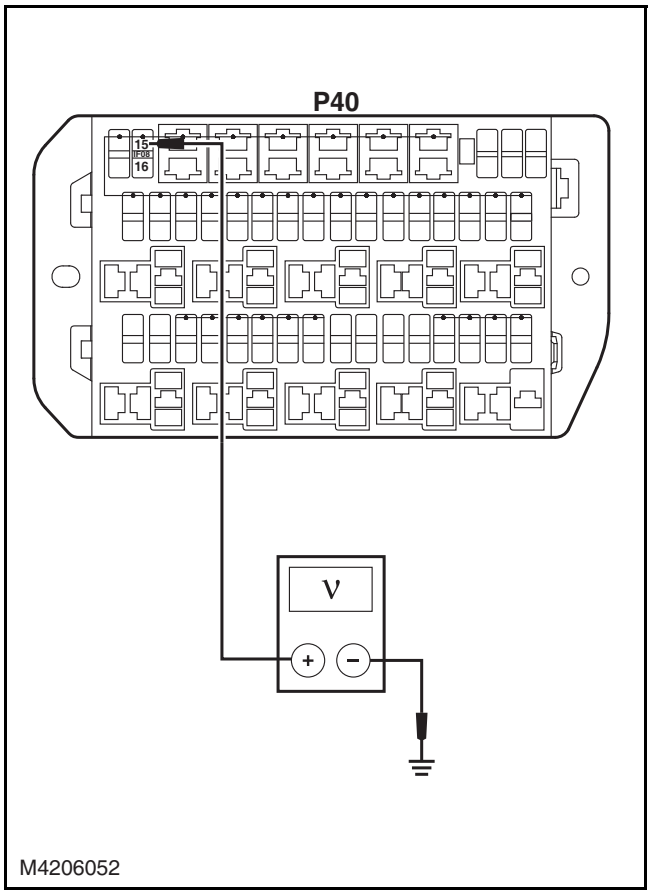
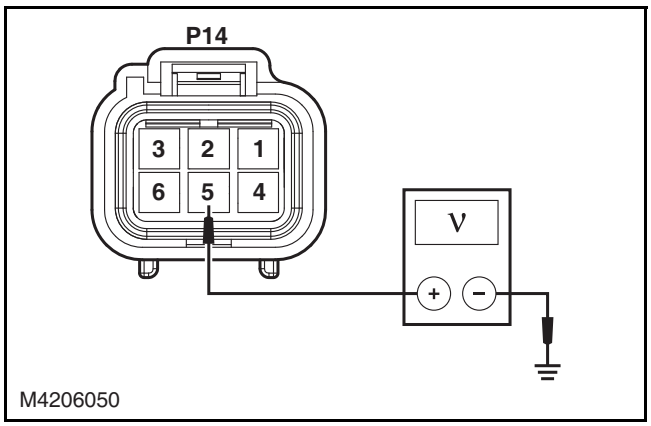
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the low beam lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of low beam lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect left headlamp fuse | |
| | A. Inspect the fuse IF08.<br>**Fuse rated capacity: 15 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect left headlamp fuse power supply | |
|  M4206052 | A. Inspect the voltage between terminal 15 of instrument panel fuse box fuse IF08 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 15 of instrument panel fuse box fuse IF08 and battery. |
| 4. Inspect left headlamp power supply circuit | |
|  M4206050 | A. Disconnect the left headlamp wiring harness connector P14.<br>B. Measure the voltage between terminal 5 of left headlamp wiring harness connector P14 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 4 of left headlamp wiring harness connector P14 and terminal 10 of lighting combination switch wiring harness connector P30.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of left headlamp wiring harness connector P14 and terminal 16 of instrument panel fuse box fuse IF08. |

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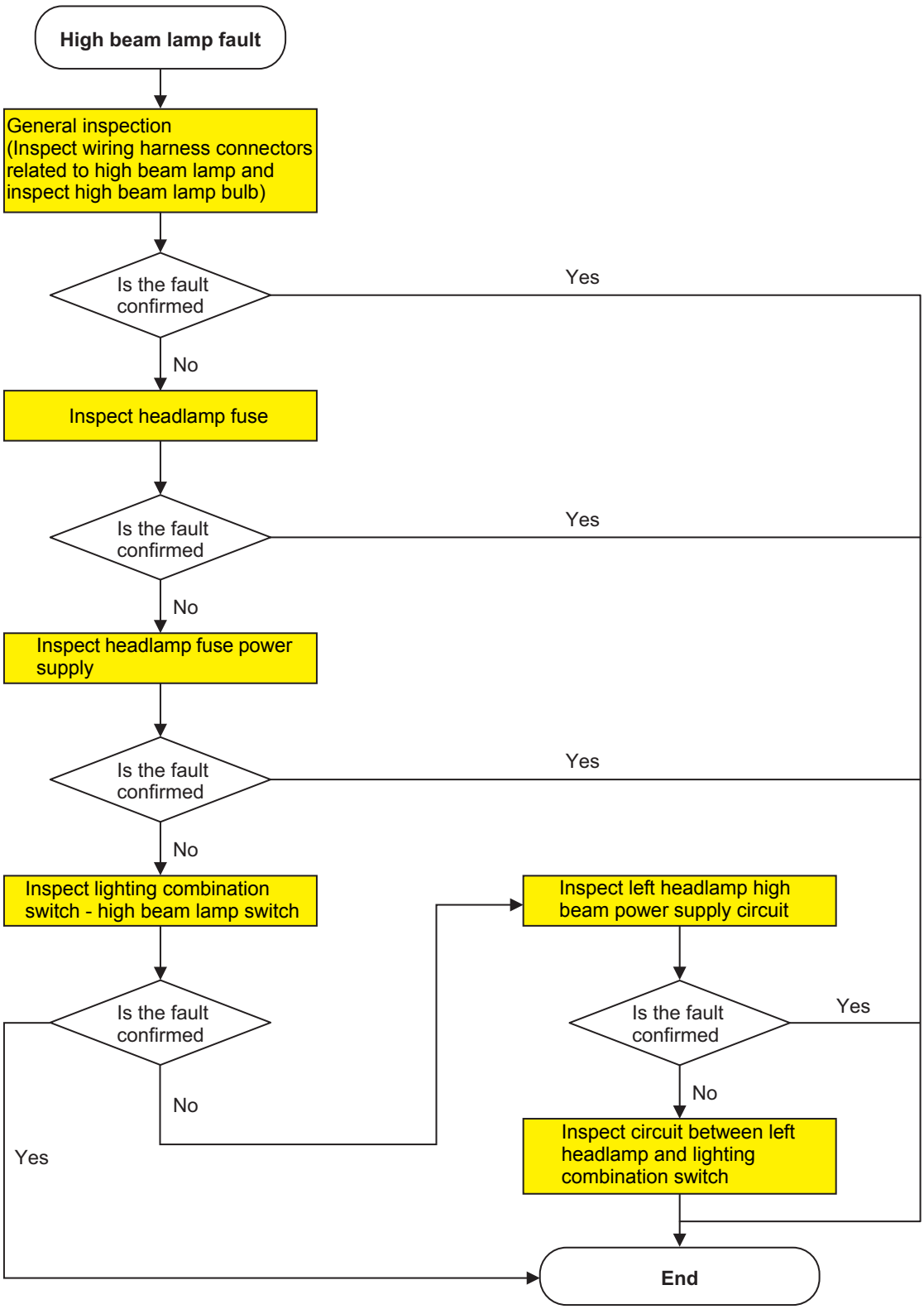
# Diagnosis Procedure for Low Beam Lamp Constant ON

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the low beam lamp for damage or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect lighting combination switch - low beam lamp switch | |
| | A. Inspect the low beam lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>Is the lighting combination switch normal?<br>**Yes**<br>Inspect and repair the short circuit fault to ground between headlamp low beam and lighting combination switch.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |

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# Diagnosis Procedure for High Beam Lamp Fault



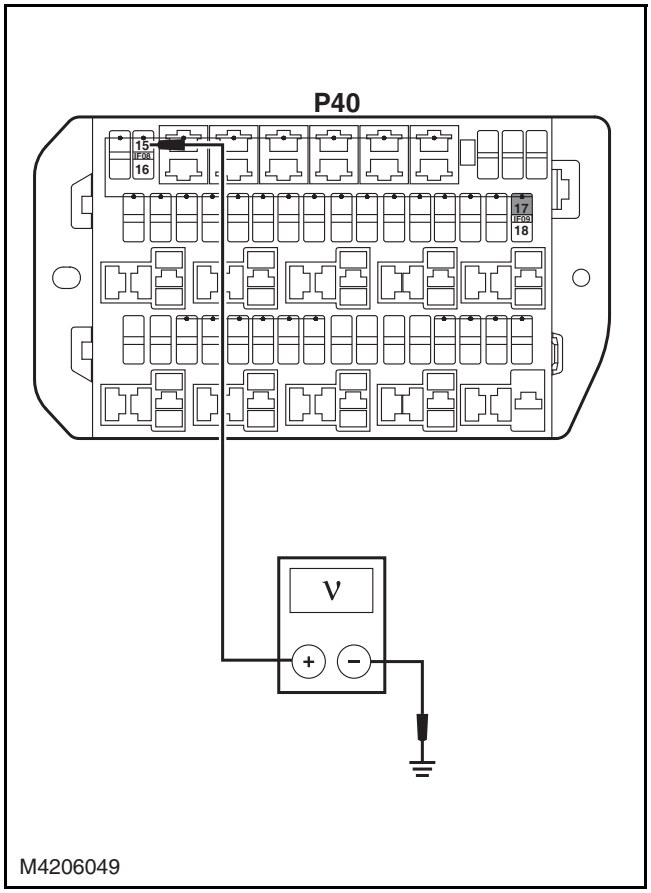
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the high beam lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of high beam lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect headlamp fuse | |
| | A. Inspect the fuse IF08, IF09.<br>**Fuse rated capacity: 15 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

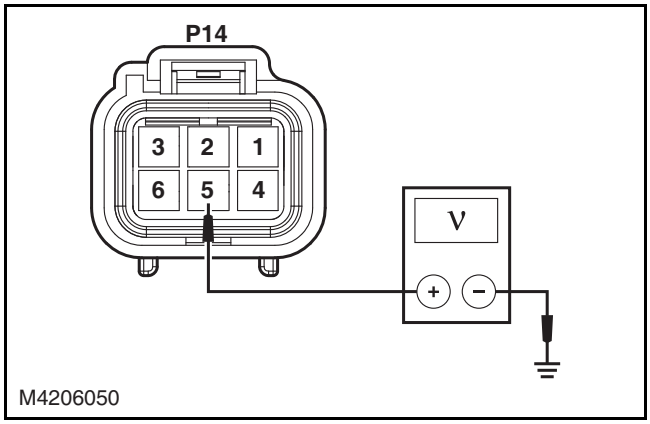
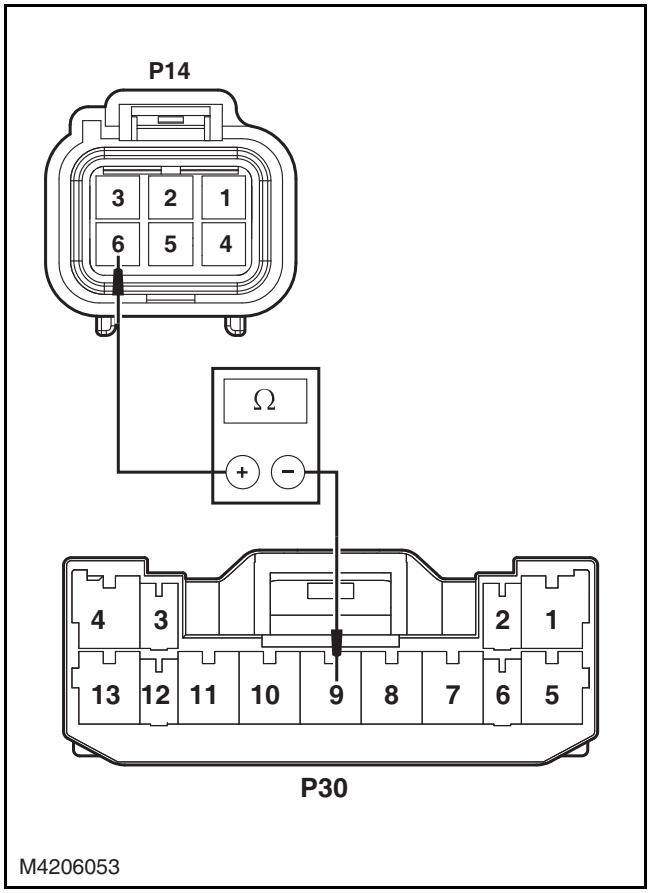
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect headlamp fuse power supply | |
|  M4206049 | A. Measure the voltage between terminal 15 of instrument panel fuse box fuse IF08, terminal 17 of IF09 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 15 of instrument panel fuse box fuse IF08 and battery.<br>Inspect and repair the open circuit fault between terminal 17 of instrument panel fuse box fuse IF09 and battery. |
| 4. Inspect lighting combination switch - high beam lamp switch | |
| | A. Inspect the high beam lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>Is the lighting combination switch normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |

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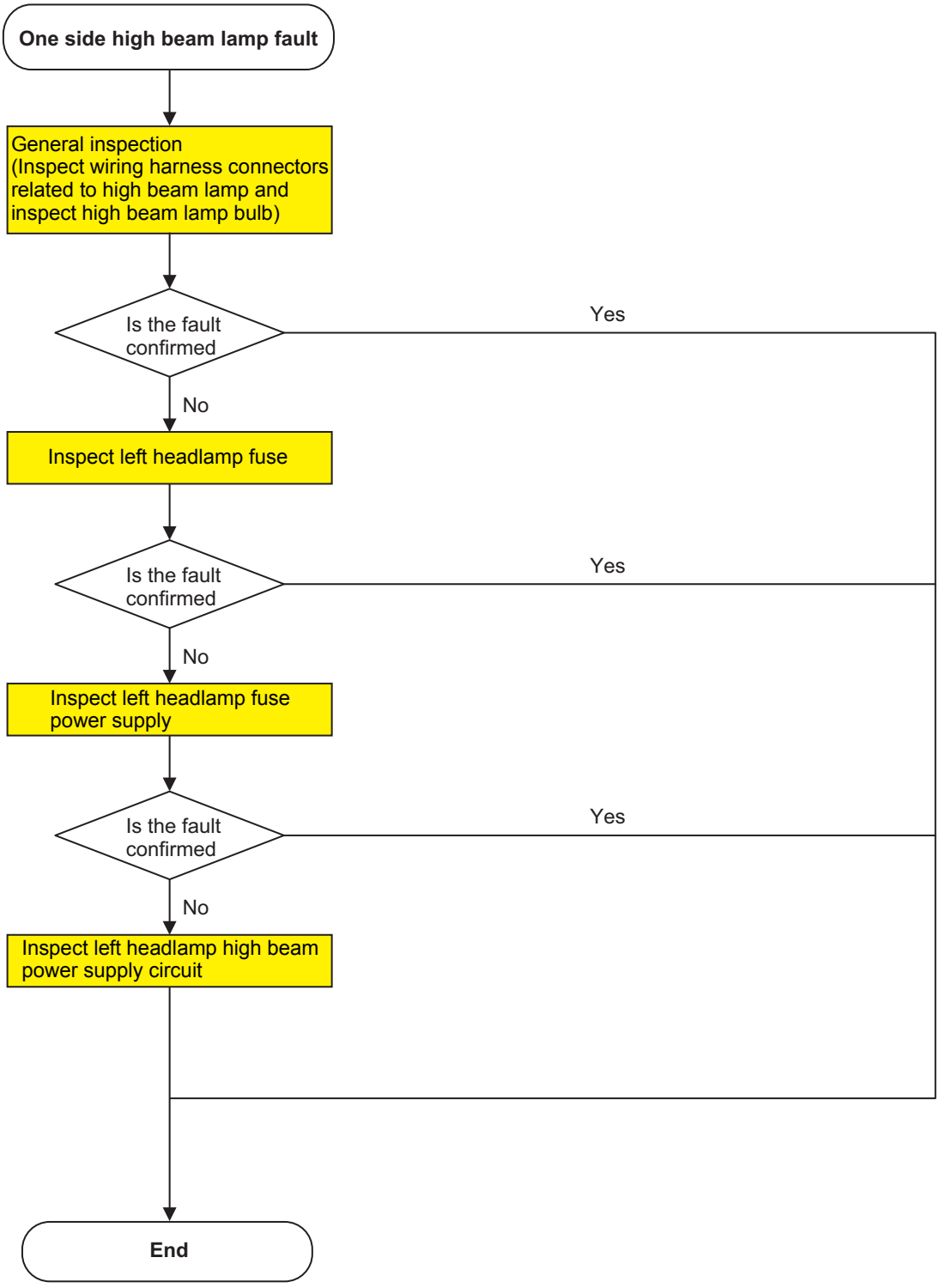
| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect left headlamp high beam power supply circuit | |
|  M4206050 | **CAUTION: Use different wiring harness terminals to inspect the low beam circuit of right headlamp in this way.**<br>A. Disconnect the left headlamp wiring harness connector P14.<br>B. Measure the voltage between terminal 5 of left headlamp wiring harness connector P14 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of left headlamp wiring harness connector P14 and terminal 16 of instrument panel fuse box fuse IF08. |
| 6. Inspect circuit between left headlamp and lighting combination switch | |
|  M4206053 | A. Disconnect the left headlamp wiring harness connector P14.<br>B. Disconnect the lighting combination switch wiring harness connector P30.<br>C. Measure the resistance between terminal 6 of left headlamp wiring harness connector P14 and terminal 9 of lighting combination switch wiring harness connector P30.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 7 of lighting combination switch wiring harness connector P30 and grounding point G103.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of left headlamp wiring harness connector P14 and terminal 9 of lighting combination switch wiring harness connector P30. |

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# Diagnosis Procedure for One Side High Beam Lamp Fault

**CAUTION: This process is carried out for left high beam lamp fault only. Process for the right is similar.**



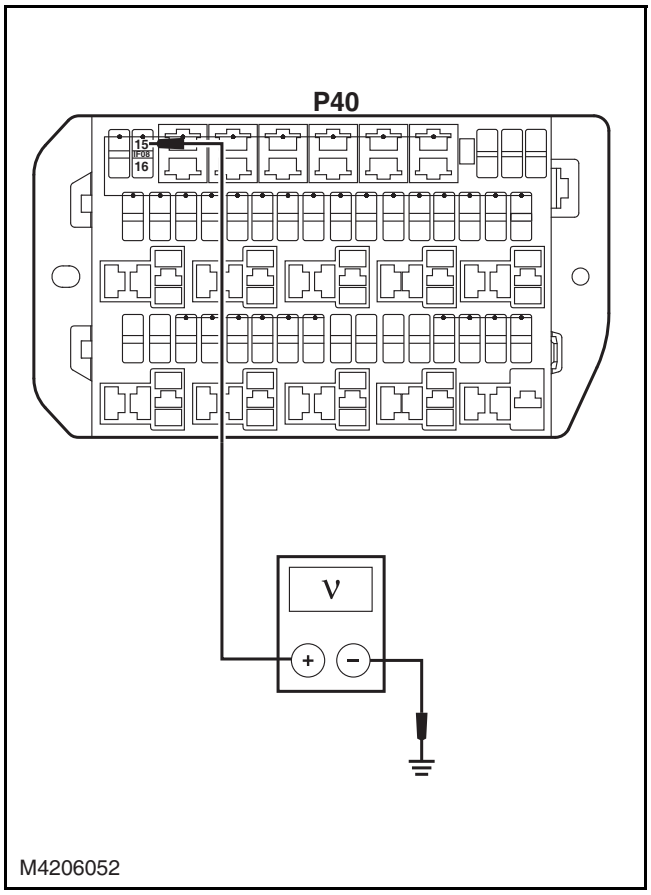
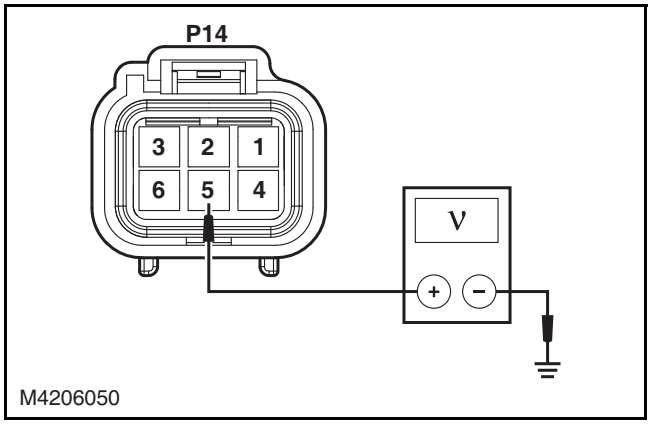
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the high beam lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of high beam lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect left headlamp fuse | |
| | A. Inspect the fuse IF08.<br>**Fuse rated capacity: 15 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect left headlamp fuse power supply | |
|  M4206052 | A. Inspect the voltage between terminal 15 of instrument panel fuse box fuse IF08 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 15 of instrument panel fuse box fuse IF08 and battery. |
| 4. Inspect left headlamp high beam power supply circuit | |
|  M4206050 | A. Disconnect the left headlamp wiring harness connector P14.<br>B. Measure the voltage between terminal 5 of left headlamp wiring harness connector P14 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 6 of left headlamp wiring harness connector P14 and terminal 9 of lighting combination switch wiring harness connector P30.<br>**No**<br>Inspect and repair the open circuit fault between terminal 5 of left headlamp wiring harness connector P14 and terminal 16 of instrument panel fuse box fuse IF08. |

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# Diagnosis Procedure for High Beam Lamp Constant ON

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the high beam lamp for damage or looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect lighting combination switch - high beam lamp switch | |
| | A. Inspect the high beam lamp switch.<br>**Refer to: Test for Lighting Combination Switch (4.2.6 Lighting System, General Inspection).**<br>Is the lighting combination switch normal?<br>**Yes**<br>Inspect and repair the short circuit fault to ground between headlamp high beam and lighting combination switch.<br>**No**<br>Replace the lighting combination switch.<br>**Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).** |

# Diagnosis Procedure for Overtaking Lamp Fault

**CAUTION: The overtaking lamp adopts the same control strategy as that of high beam, and the diagnosis procedure for overtaking lamp fault can refer to that for high beam fault.**

**Refer to: Diagnosis Procedure for High Beam Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing).**

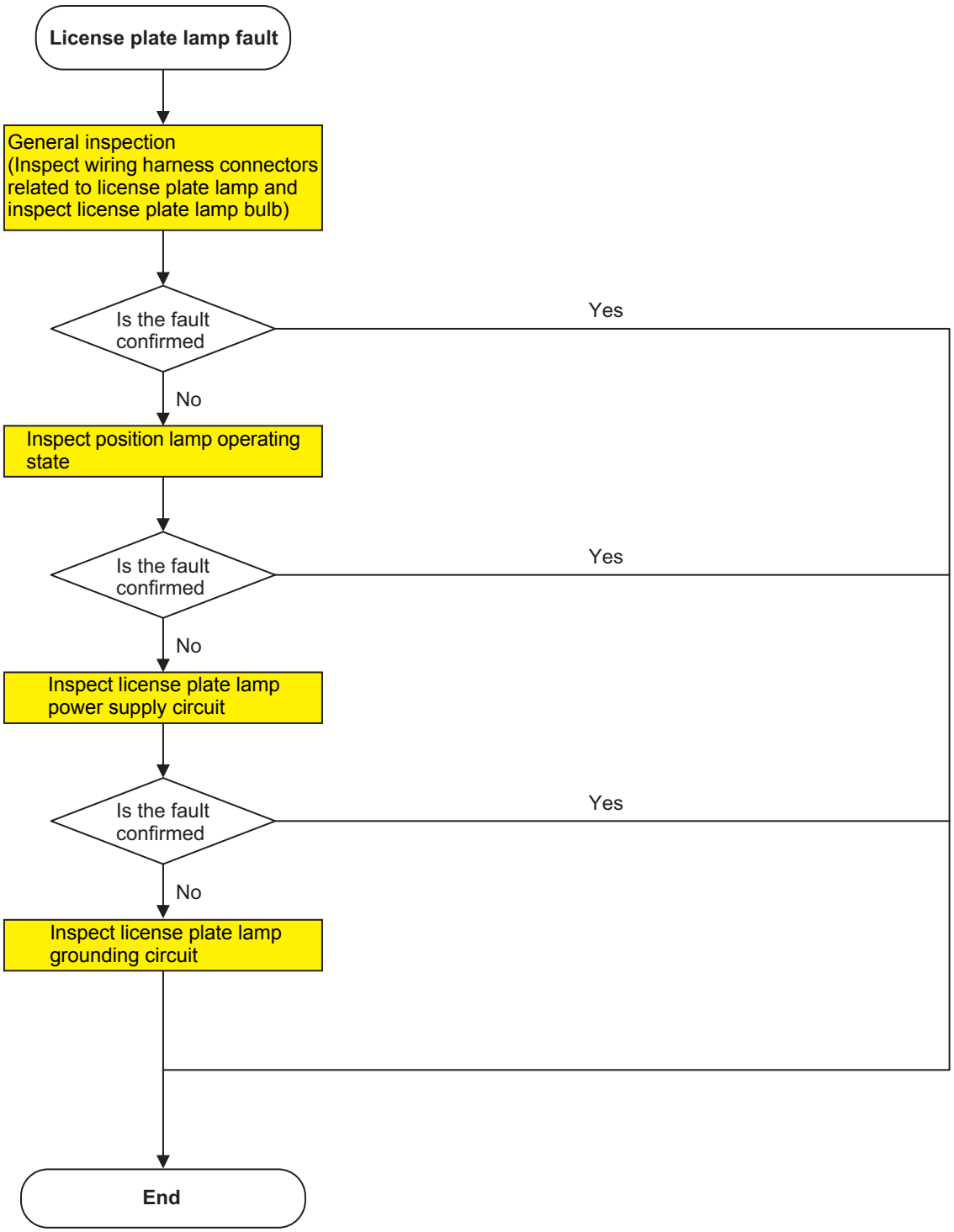
https://truckmanualshub.com/



# Diagnosis Procedure for License Plate Lamp Fault

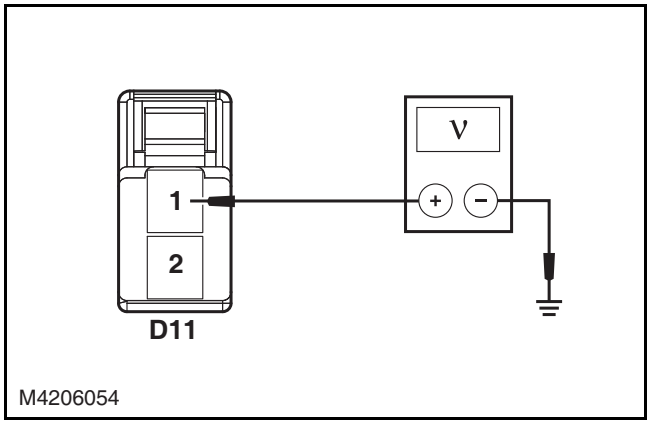
**CAUTION: Before carrying out this diagnosis procedure, verify the working condition of position lamp, and execute the diagnosis procedure for position lamp fault first when the position lamp works abnormally.**

**CAUTION: The diagnosis procedure is carried out with the left license plate lamp as an example. The diagnosis procedure for the right license plate lamp, similar to that of left license plate lamp, only uses different wiring harness connector.**



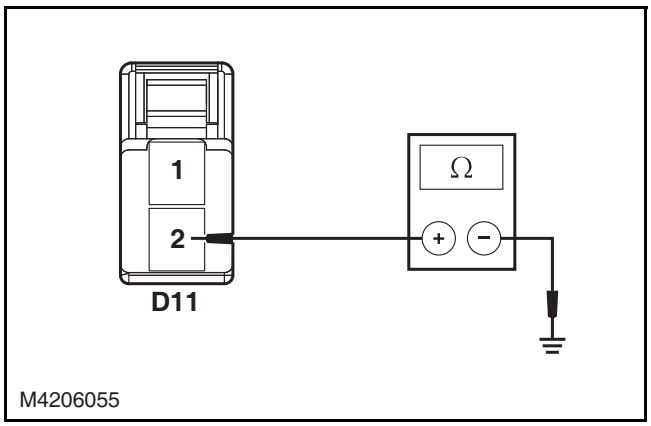
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the license plate lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of license plate lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect position lamp operating state | |
| | A. Inspect the operating state of position lamp.<br>Does the position lamp work normally?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect the position lamp.<br>**Refer to: Diagnosis Procedure for Position Lamp Fault (4.2.6 Lighting System, Symptom Diagnosis and Testing).** |
| 3. Inspect license plate lamp power supply circuit | |
|  | A. Disconnect the left license plate lamp wiring harness connector S08.<br>B. Turn the lighting combination switch to position lamp.<br>C. Measure the voltage between terminal 1 of left license plate lamp wiring harness connector S08 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of left license plate lamp wiring harness connector S08 and terminal 8 of lighting combination switch wiring harness connector P30. |

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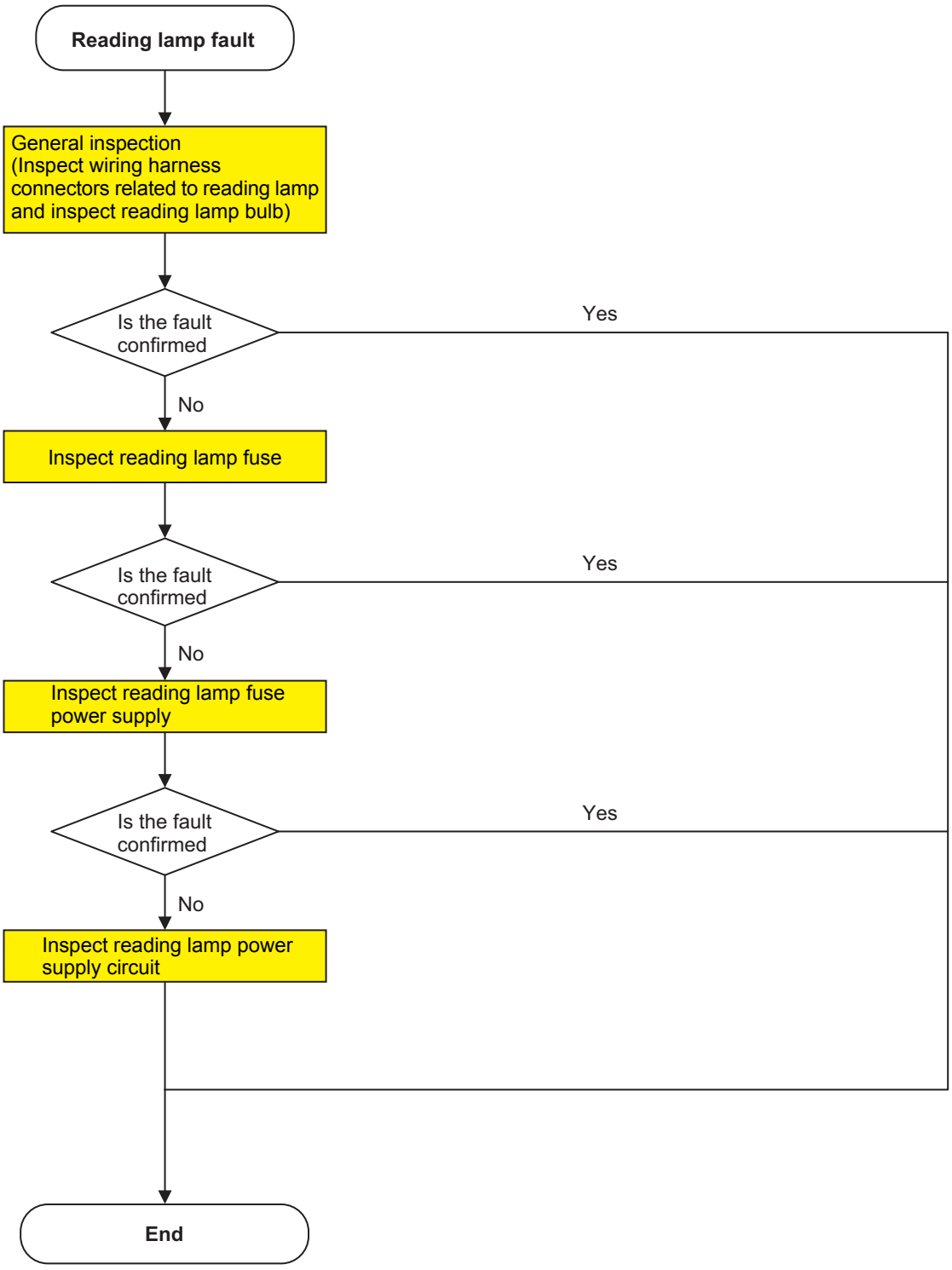


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect license plate lamp grounding circuit | |
|  | A. Disconnect the left license plate lamp wiring harness connector S08.<br>A. Measure the resistance between terminal 2 of left license plate lamp wiring harness connector S08 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of left license plate lamp wiring harness connector S08 and the ground point G201. |

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# Diagnosis Procedure for Reading Lamp Fault



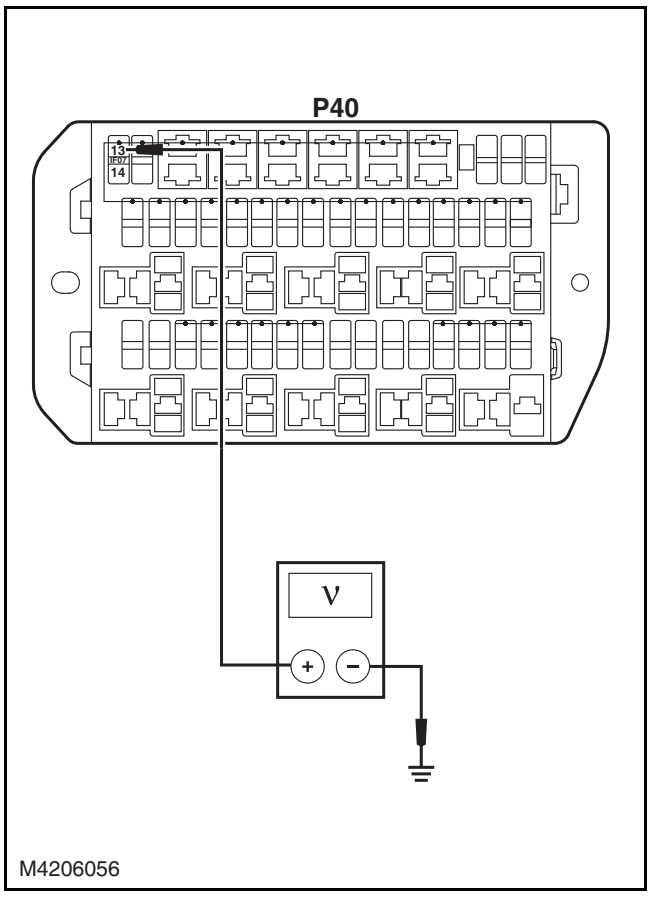
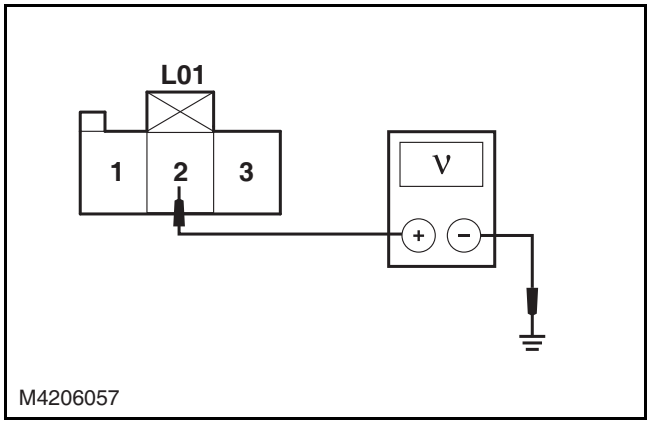
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the reading lamp for damage, poor contact, aging and looseness.<br>B. Inspect the filament and lamp holder of reading lamp bulb for abnormal conditions such as damage and oxidation.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect reading lamp fuse | |
| | A. Inspect the reading lamp fuse IF07.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

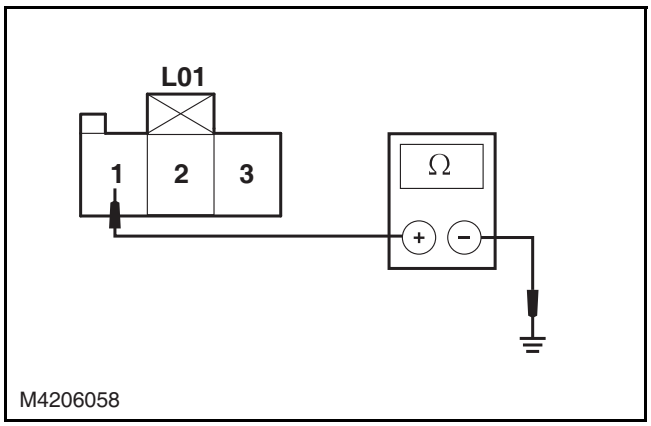
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect reading lamp fuse power supply | |
|  | A. Measure the voltage between terminal 13 of instrument panel fuse box fuse IF07 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 13 of instrument panel fuse box fuse IF07 and battery. |
| 4. Inspect reading lamp power supply circuit | |
|  | A. Disconnect the reading lamp wiring harness connector L01.<br>B. Measure the voltage between terminal 2 of reading lamp wiring harness connector L01 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of reading lamp wiring harness connector L01 and terminal 14 of instrument panel fuse box fuse IF07. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect reading lamp grounding circuit | |
|  M4206058 | A. Disconnect the reading lamp wiring harness connector L01.<br>B. Measure the resistance between terminal 1 of reading lamp wiring harness connector L01 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the reading lamp.<br>**Refer to: Reading Lamp (4.2.6 Lighting System, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of reading lamp wiring harness connector L01 and the ground point G106. |

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## Removal and Installation

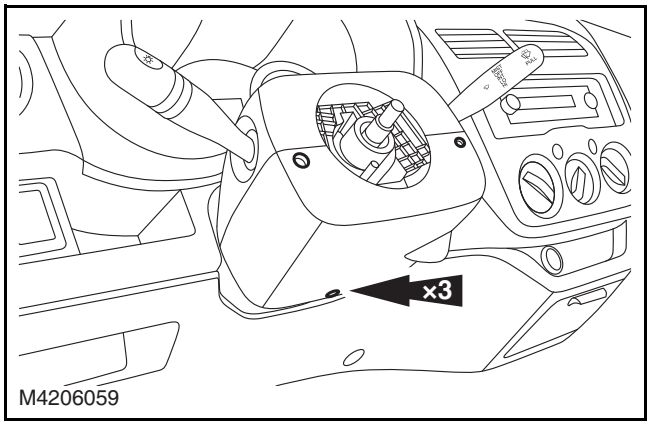
# Lighting Combination Switch

### Removal

1. Disconnect the negative battery cable.

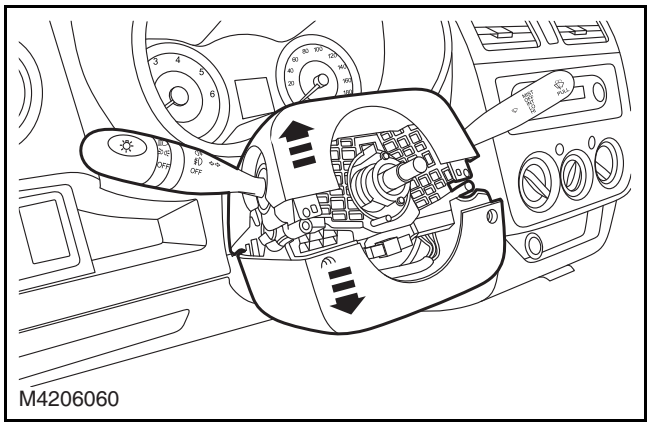
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove 3 retaining screws from the upper and lower housings of steering lock.

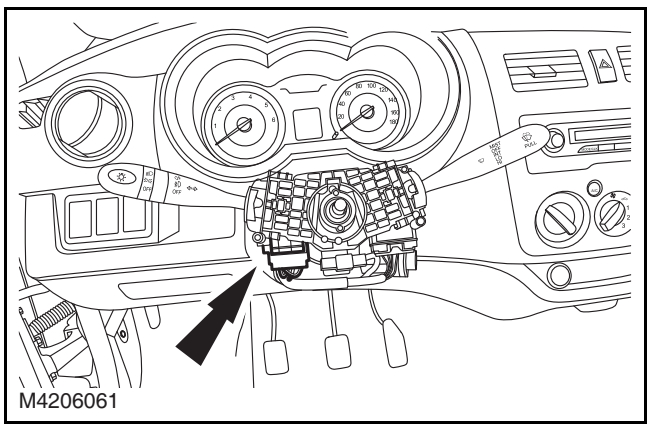


M4206059

3. Separate the upper and lower housings of steering lock.


M4206060

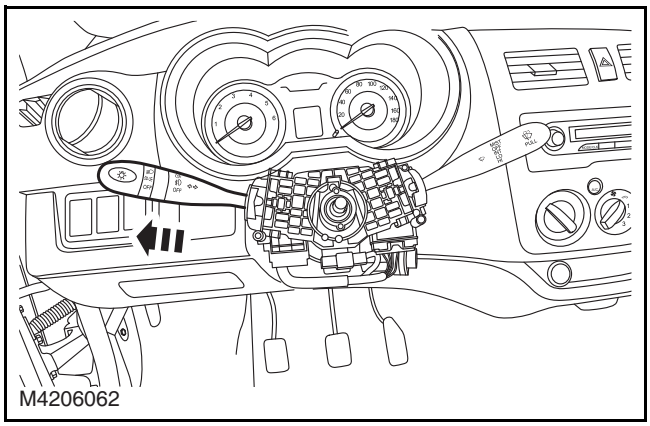
4. Disconnect the lighting combination switch wiring harness connector.


M4206061

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**5.** Remove the lighting combination switch.


M4206062

## Installation

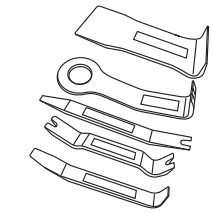
**1.** Installation is in the reverse order of removal.

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# Lamp Angle Control Switch

### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

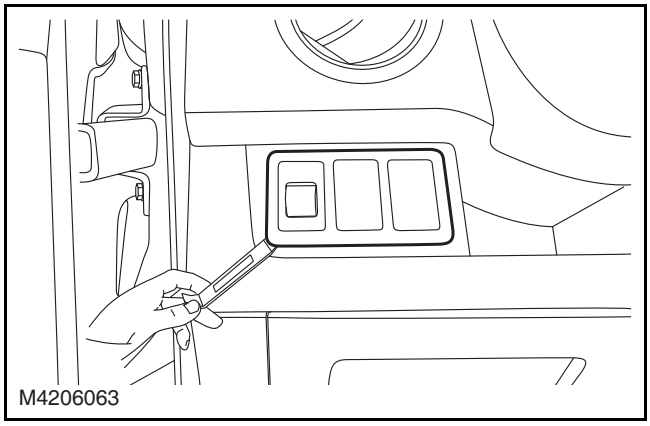
## Removal

1. Disconnect the negative battery cable.

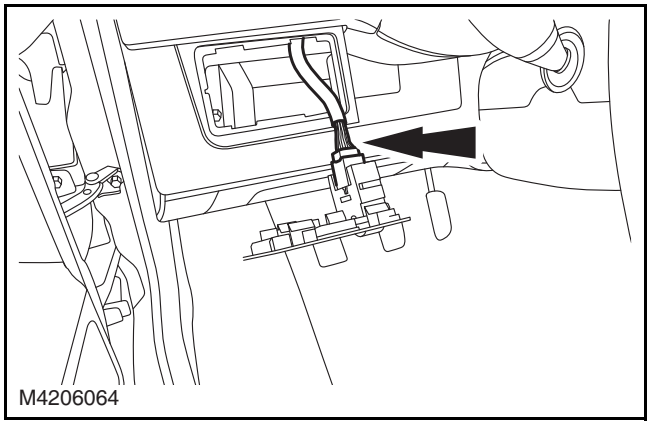
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Use the special tool to pry the lamp angle control switch panel.

   Special tool: CA501-002


M4206063

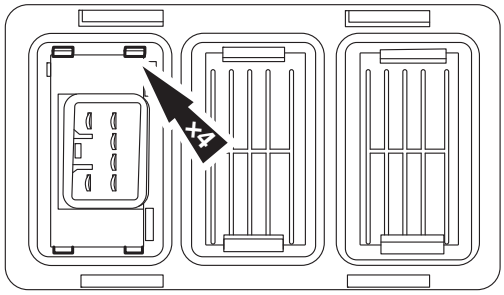
3. Disconnect the lamp angle control switch wiring harness connector, and remove the lamp control switch panel.


M4206064

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4. Disengage 4 retaining clips from the lamp angle control switch, and remove the lamp angle control switch.




M4206065

## Installation

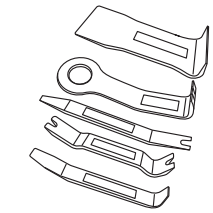
1. Installation is in the reverse order of removal.

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# Hazard Warning Lamp Switch

### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

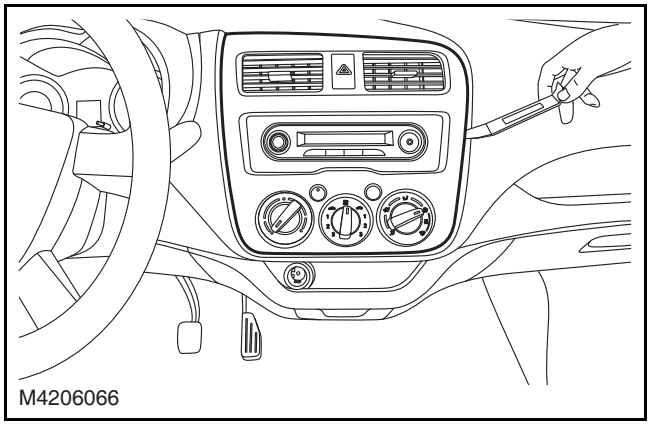
## Removal

1. Disconnect the negative battery cable.

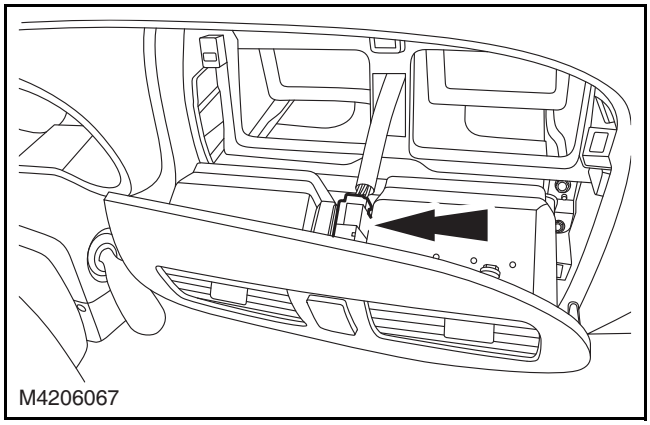
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Use the special tool to pry the center control panel.

   Special tool: CA501-002


M4206066

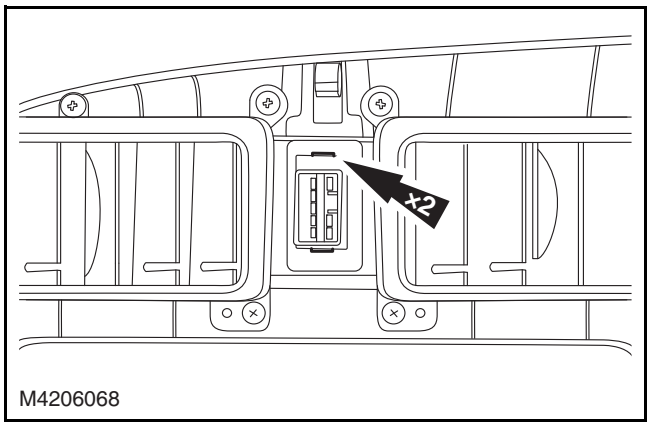
3. Disconnect the hazard warning lamp switch wiring harness connector, and remove the center control panel.


M4206067

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4. Disengage 2 retaining clips from the hazard warning lamp switch, and remove the hazard warning lamp switch.



M4206068

## Installation

1. Installation is in the reverse order of removal.

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# Headlamp

## Removal

1. Disconnect the negative battery cable.

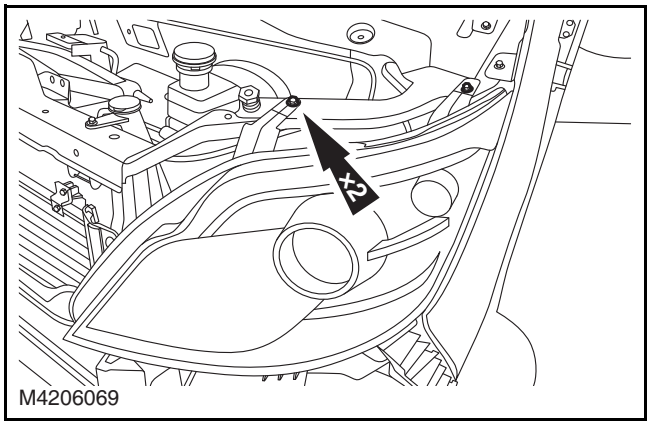
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the front bumper.

   **Refer to: Front Bumper (5.1.7 Bumper, Removal and Installation).**

3. Remove 2 retaining bolts from the upper part of headlamp.

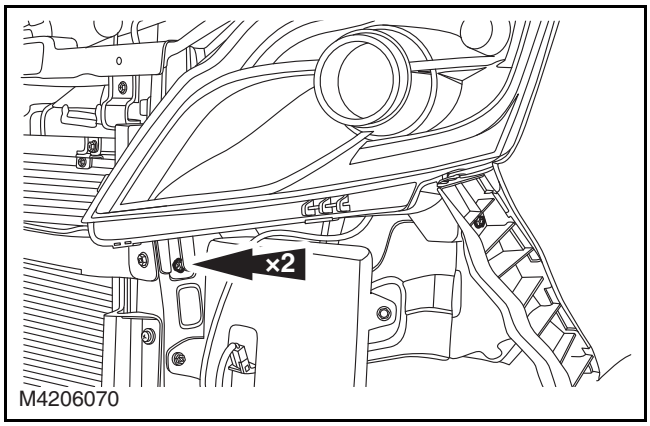
   Torque: 9 Nm



M4206069

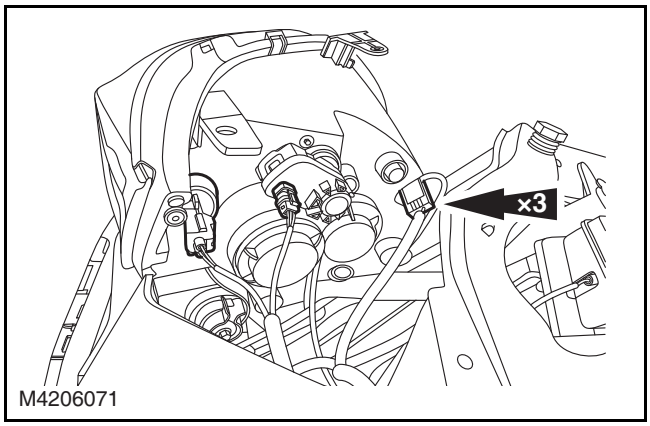
4. Remove 2 retaining bolts from the lower part of headlamp.

   Torque: 9 Nm



M4206070

5. Disconnect 3 wiring harnesses connectors from the headlamp, and remove the headlamp.



M4206071

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## Installation

1. Installation is in the reverse order of removal.

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# Front Fog Lamp

## Removal

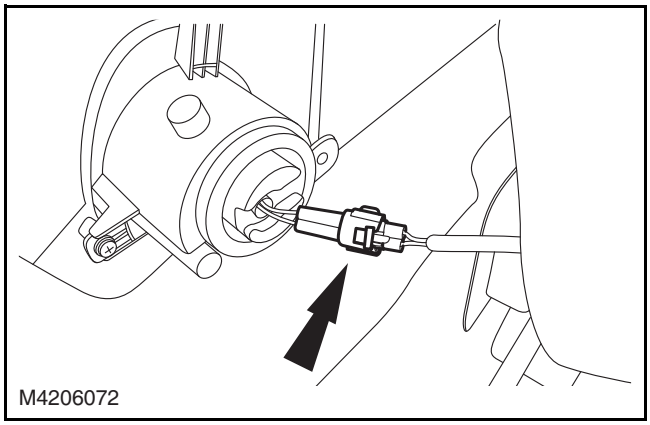
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

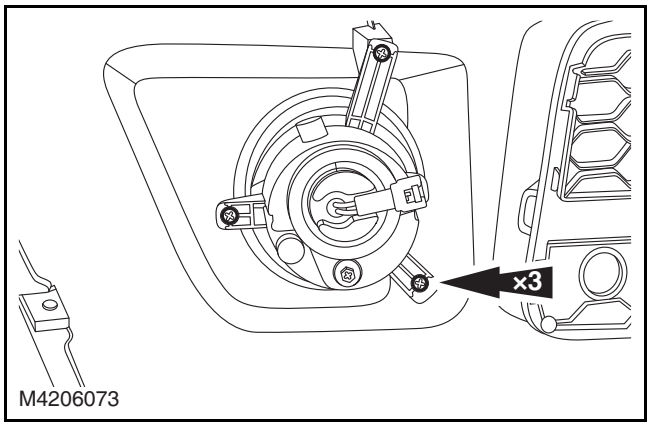
2. Remove the front bumper.

   **Refer to: Front Bumper (5.1.7 Bumper, Removal and Installation).**

3. Disconnect the front fog lamp wiring harness connector.




4. Remove 3 retaining screws from the front fog lamp, and remove the front fog lamp.




## Installation

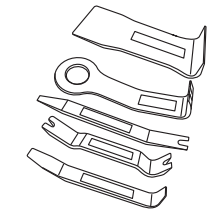
1. Installation is in the reverse order of removal.

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# Rear Combination Lamp

### Special Tool

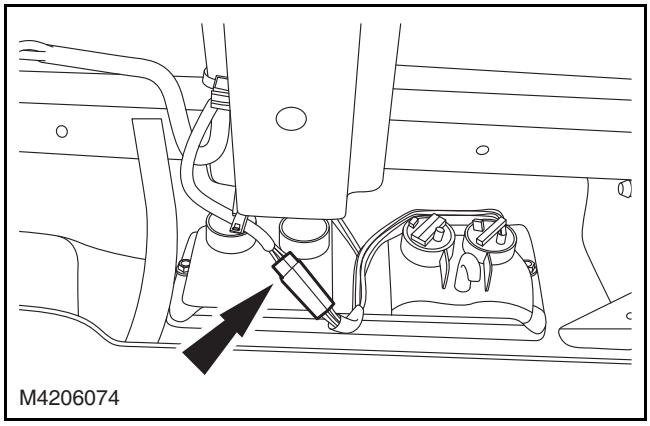
| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

## Removal

1. Disconnect the negative battery cable.

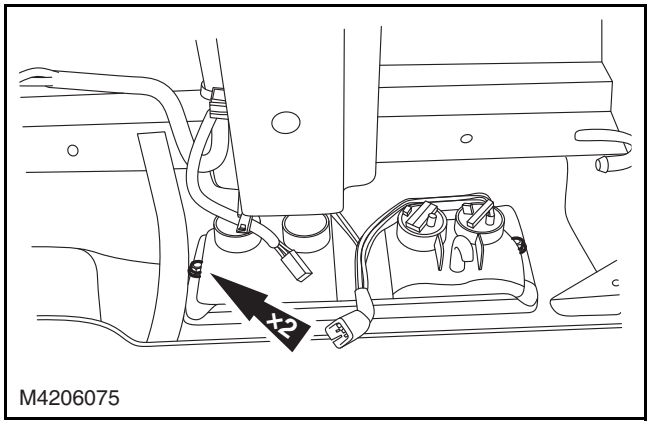
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect the rear combination lamp wiring harness connector.


M4206074

3. Remove 2 retaining nuts from the rear combination lamp, and remove the rear combination lamp.

   Torque: 11 Nm or less



M4206075

## Installation

1. Installation is in the reverse order of removal.

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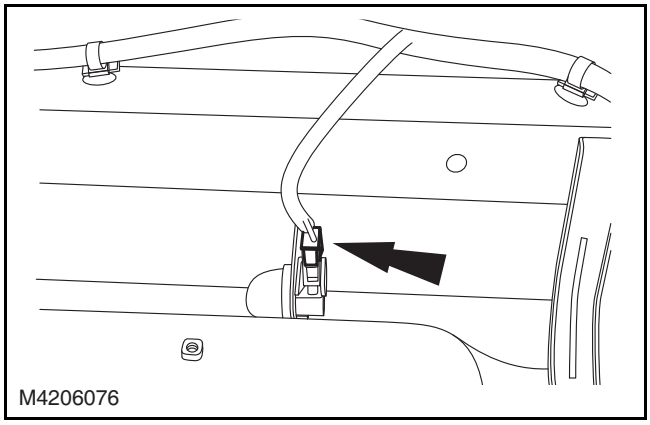
# License Plate Lamp

## Removal

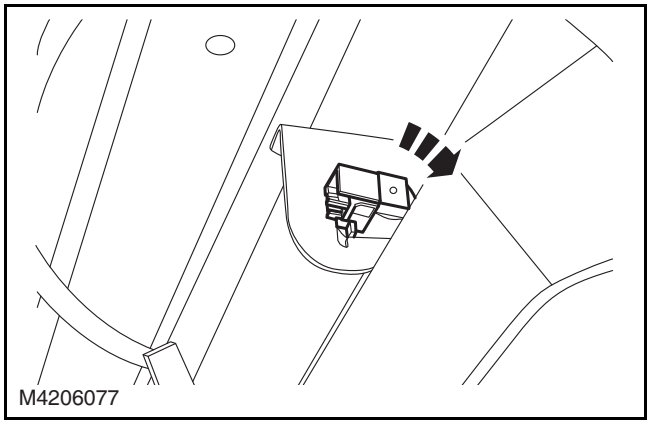
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Disconnect the license plate lamp wiring harness connector.


M4206076

3. Press the clip firmly in the direction of arrow shown in the figure, and remove it.
4. Remove the license plate lamp.


M4206077

## Installation

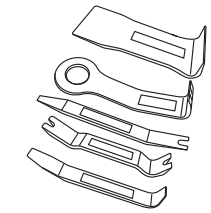
1. Installation is in the reverse order of removal.

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# Reading Lamp

### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

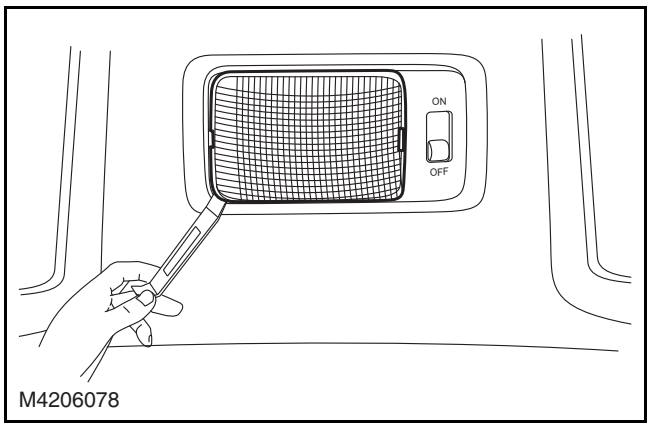
## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

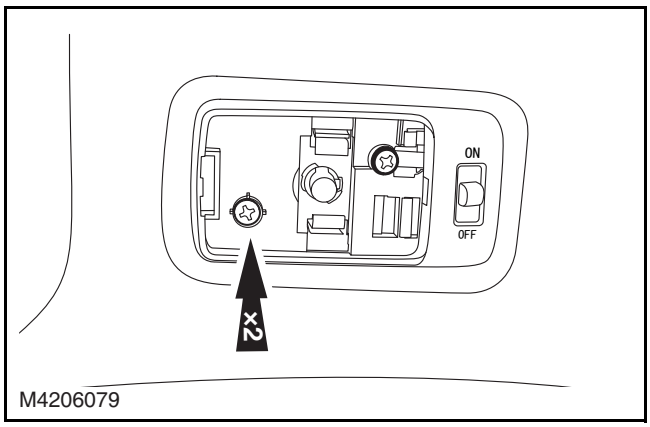
2. Using the special tool to pry the reading lamp cover.

   Special tool: CA501-002



M4206078

3. Remove 2 retaining screws from the reading lamp.

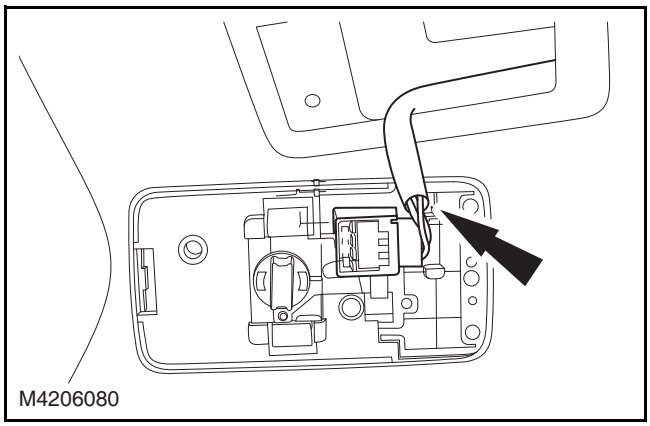


M4206079

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4. Disconnect the reading lamp wiring harness connector, and remove the reading lamp.




## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# General Specifications

| Item | Specifications | Capacity (L) |
|---|---|---|
| Washer fluid | ZT-30 (summer)<br>ZT-30B (winter) | 1.5 |
| Master wiper | 500 mm | - |
| Sub wiper | 425 mm | - |

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Front wiper linkage nut | 18 ~ 22 | 13 ~ 16 | - |
| Wiper motor retaining bolt | 13 ± 2 | - | - |
| Wiper linkage retaining nut | 13 ± 2 | - | - |
| Washer reservoir retaining bolt | 6 ~ 9 | - | 53 ~ 80 |

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## Description and Operation

# System Overview

The front wiper system consists of wiper motor, link, wiper arm, blade as well as wiper/washer switch. The front wiper circuit is equipped with an automatic stop unit, which consists of a worm gear and a cam disc. It intends to keep the integrity of circuit temporarily when the wiper/ washer switch is turned off and to cut off circuit until the wiper arm returns to original position. The wiper system is driven by a permanent magnet motor, and the front wiper motor is installed on the cowl and directly connected with the front wiper linkage. There are 2 wiper motor speeds (high and low speed) with intermittent operation available. The wiper switch is part of the wiper/washer system. The front wiper switch is fitted on the stalk on the right side of steering column.

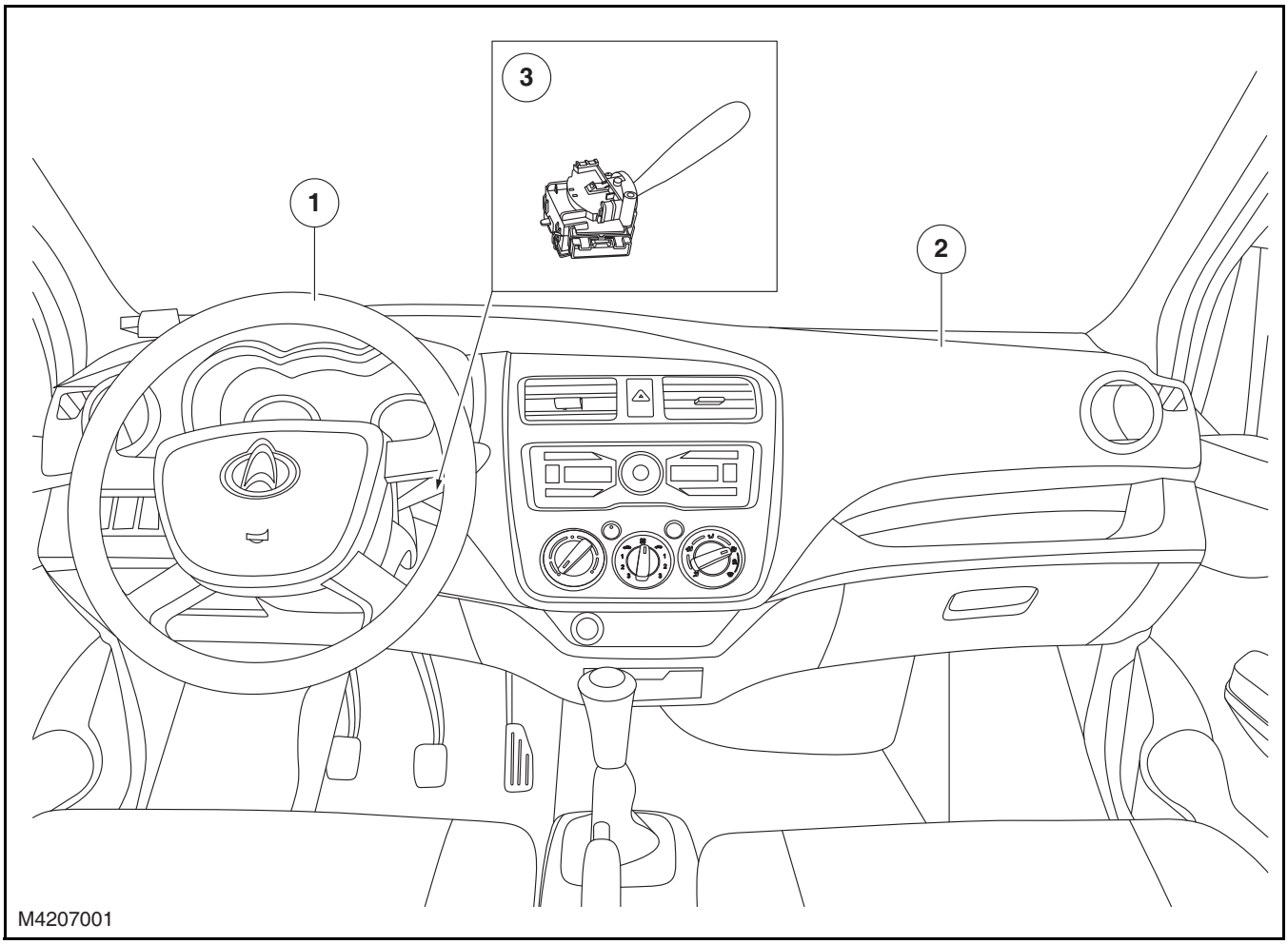
The front washer system consists of washer reservoir, washer motor, hose, washer nozzle and wiper/ wiper switch. The front washer reservoir is installed under the left headlamp, and the washer motor is connected to the washer reservoir. The washer fluid is transported to the two washer nozzles on the cowl ornamentation assembly. The washer switch is a part of wiper combination switch.

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# Components Location View

## Wiper Combination Switch

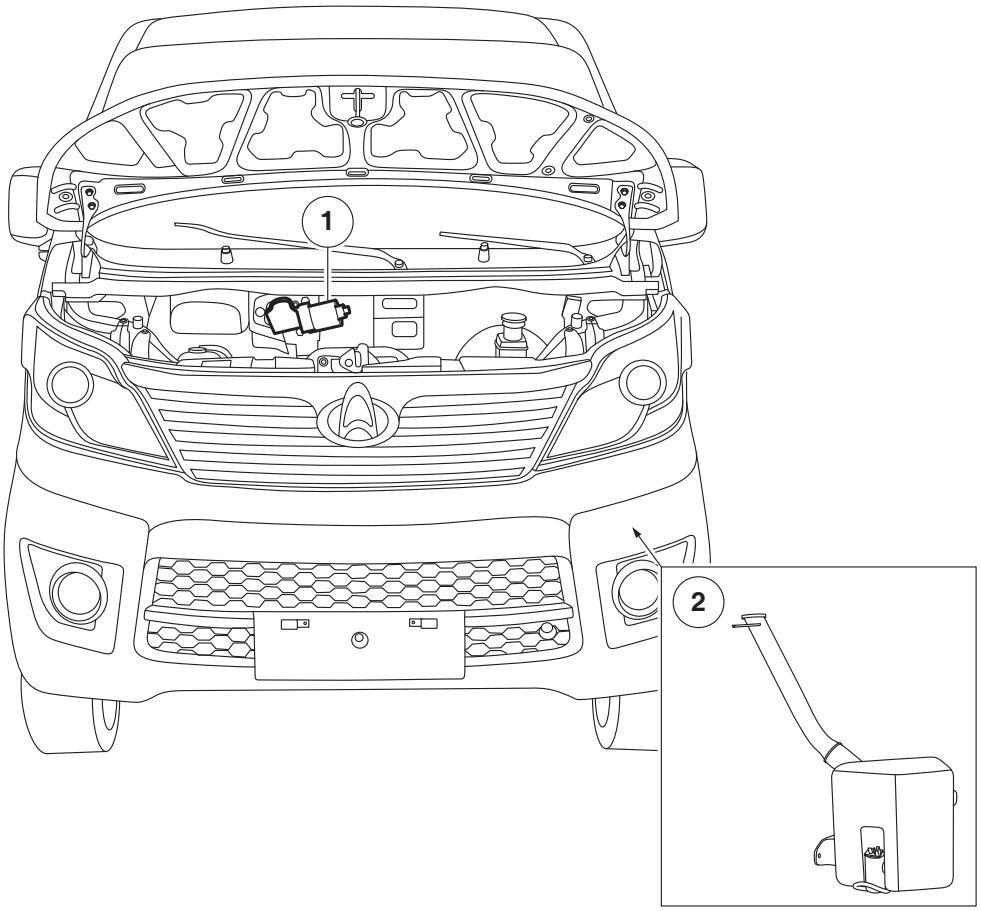



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Steering wheel | 3 | Wiper combination switch |
| 2 | Instrument panel | | |

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## Front Wiper



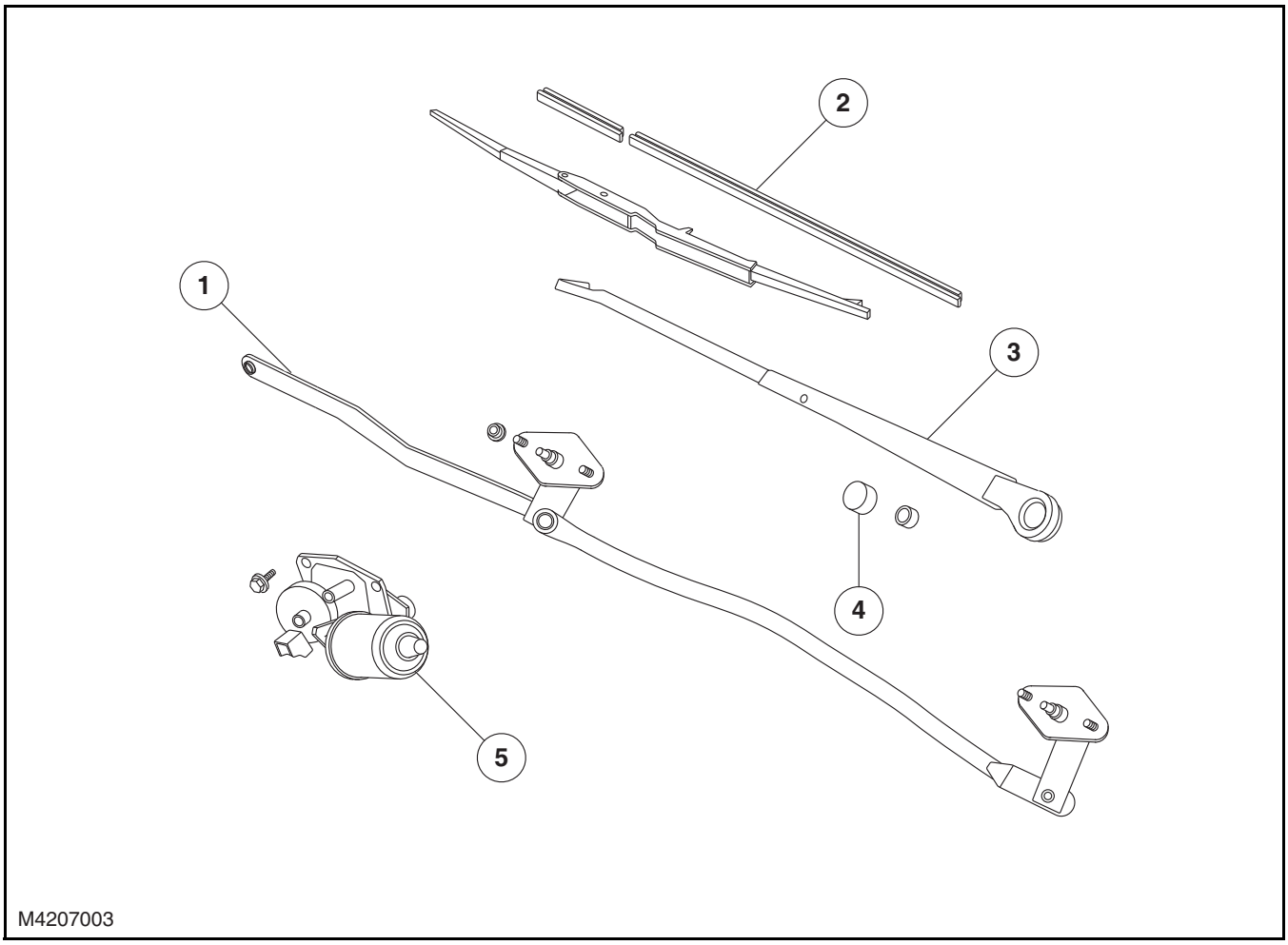

M4207002

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Front wiper motor | 2 | Washer reservoir |

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## Components Exploded View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Front wiper linkage | 4 | Wiper arm port cover |
| 2 | Front wiper | 5 | Front wiper motor |
| 3 | Front wiper arm assembly | | |

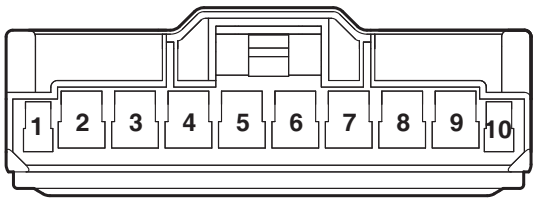
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## General Inspection

# Test for Wiper Combination Switch

The wiper combination switch can be tested according to the wiper combination switch level table to determine the performance of the switch and provide further maintenance solution.




| T / P | 3 | 5 | 4 | 2 | 7 | 6 |
|---|---|---|---|---|---|---|
| OFF | | ○ | ○ | | | |
| INT | ○ | ○ | | | | |
| LO | ○ | | ○ | | | |
| HI | ○ | | | ○ | | |
| WASH | ○ | ○ | | | ○ | |

M4207004

# Wiper Abnormal Noise Treatment

Principles: To determine the location of the sound. Clean, adjust and repair the part making abnormal noise, and replace the parts as necessary.

**CAUTION: Do not use wiper to clean dust on the dry windshield, otherwise it may damage the windshield and the wiper blade. It may also cause abnormal noise. Clear snow and frost on the windshield before using wiper in winter.**

Execute the following steps when the abnormal noise of wiper occurs.

1. Inspect the windshield, and clear foreign matter on it. Replace when there is a thick scratch or crack on the windshield. Inspect whether the wiper blade and wiper arm are deformed or damaged. Repair or replace according to the corresponding conditions.
2. Replace qualified washing fluid for the windshield to ensure normal operation of wiper blade.
3. Lift the wiper blade and wiper arm from the windshield, and repeat wiping operation, which is helpful to determine whether the noise comes from the contact between wiper blade and windshield or the malfunction of the wiper system itself.
4. Use qualified windshield washing fluid provided by Changan Automobile to clean the windshield. After cleaning, if the water does not form droplets but evenly distributes throughout the glass surface, it indicates that the glass is already clean.
5. When cleaning the wiper blade, lift each blade assembly from the windshield to wipe and clean the blade with a piece of cloth soaked with washer fluid, until the black deposit disappears. Then wash the wiper blade with clean drinking water.
6. Replace the failed components of wiper system.

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there are obvious mechanical or electrical damage and deformation due to collision.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Front windshield<br>• Nozzle<br>• Washer fluid pipeline<br>• Washer fluid reservoir<br>• Wiper blade<br>• Wiper arm<br>• Wiper linkage | • Fuse<br>• Circuit<br>• Wiper combination switch<br>• Front wiper motor<br>• Front washer motor |

3. Inspect system circuit that is accessible and visible.
4. If an observed or reported concern is obvious and its cause has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Front windshield wiper failure | • Circuit<br>• Front wiper linkage is not installed in right place<br>• Front wiper linkage<br>• Wiper combination switch<br>• Front wiper motor | Refer to: Diagnosis Procedure for Front Windshield Wiper (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |
| Front windshield wiper cannot be stopped | • Circuit<br>• Wiper return signal fault<br>• Wiper combination switch<br>• Front wiper motor | Refer to: Diagnosis Procedure for Front Windshield Wiper Constantly Running (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |
| Wiper does not work in low speed level | • Circuit<br>• Low speed level signal fault<br>• Wiper switch<br>• Front wiper motor | Refer to: Diagnosis Procedure for Inoperative Wiper in Low Speed Level (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |
| Wiper does not work in high speed level | • Circuit<br>• High speed level signal fault<br>• Wiper switch<br>• Front wiper motor | Refer to: Diagnosis Procedure for Inoperative Wiper in High Speed Level (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |
| Wiper does not work in intermittent level | • Circuit<br>• Wiper switch<br>• Wiper intermittent signal fault<br>• Front wiper motor | Refer to: Diagnosis Procedure for Inoperative Wiper in Intermittent Level (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |

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| Symptom | Possible Causes | Solutions |
|---|---|---|
| Wiper works constantly in intermittent level | • Circuit<br>• Wiper intermittent signal fault<br>• Wiper switch<br>• Front wiper motor | Refer to: Diagnosis Procedure for Wiper Constantly Running in Intermittent Level (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |
| Windshield is dirty after wiping | • Circuit<br>• Washer fluid does not meet standard<br>• Battery voltage is low<br>• Wiper blade<br>• Windshield scratch, crack<br>• Wiper linkage<br>• Front wiper motor | Refer to: Diagnosis Procedure for Windshield is Dirty after Wiping (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |
| Wiper is shaking during operation | • Circuit<br>• Wiper linkage is not installed in right place<br>• Washer fluid does not meet standard<br>• Battery voltage is low<br>• Wiper blade<br>• Wiper linkage<br>• Windshield scratch, crack<br>• Front wiper motor | Refer to: Diagnosis Procedure for Shaking Wiper During Operation (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |
| Abnormal noise during wiping | • Circuit<br>• Washer fluid does not meet standard<br>• Battery voltage is low<br>• Wiper blade<br>• Wiper linkage is not installed in right place<br>• Wiper linkage<br>• Windshield scratch, crack<br>• Front wiper motor | Refer to: Diagnosis Procedure for Abnormal Noise During Wiping (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |

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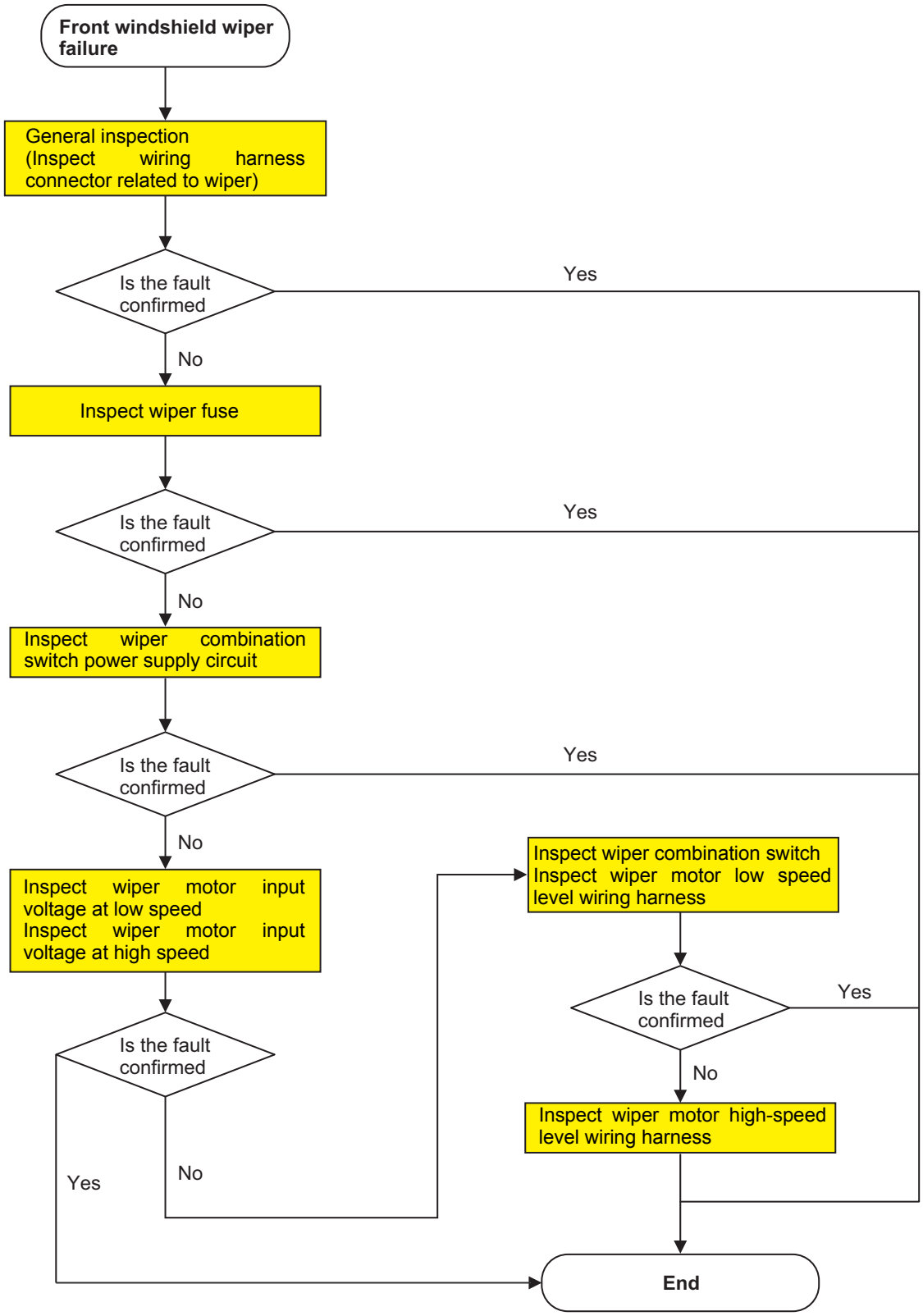


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Front wiper cannot go back to initial position | • Wiper linkage is not installed in right place<br>• Wiper linkage<br>• Circuit<br>• Wiper switch<br>• Front wiper motor return signal fault<br>• Front wiper motor | Refer to: Diagnosis Procedure for Front Wiper cannot Go Back to Initial Position (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |
| Front spray cannot reach windshield | • Insufficient washer fluid<br>• Washer nozzle<br>• Hose<br>• Washer motor | Refer to: Diagnosis Procedure for Inaccurate Water Injection (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |
| Washer does not work | • Insufficient washer fluid<br>• Washer nozzle<br>• Hose<br>• Front washer switch<br>• Front washer motor | Refer to: Diagnosis Procedure for Inoperative Washer (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing). |

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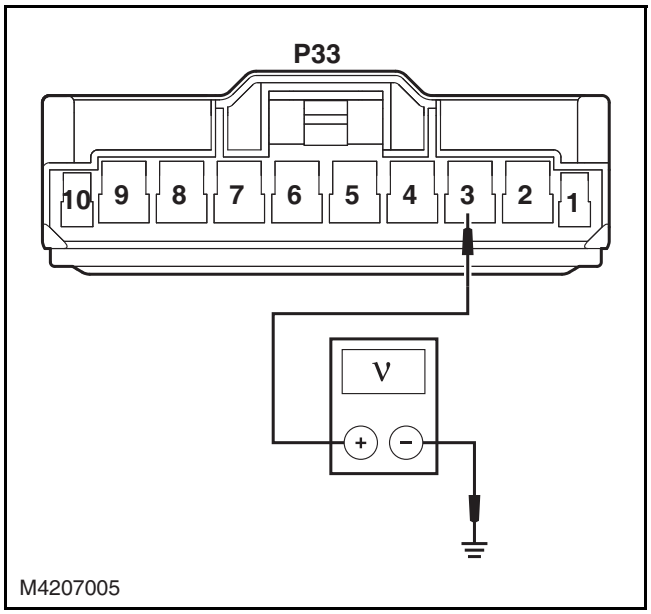


# Diagnosis Procedure for Front Windshield Wiper Failure



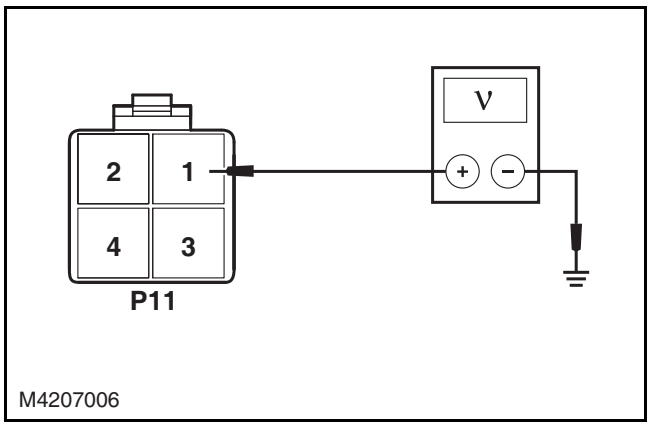
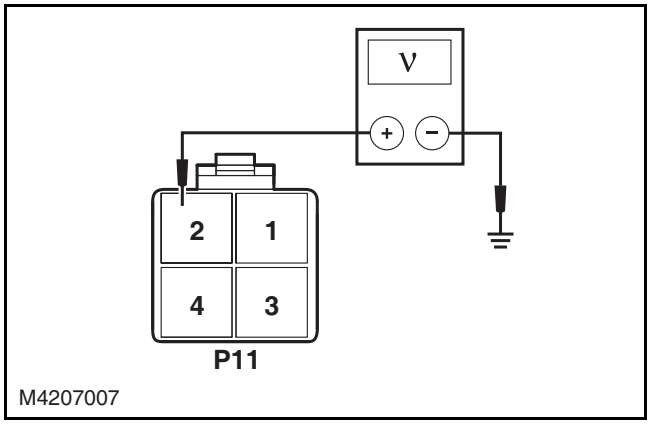
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the wiper for damage, aging, poor contact and looseness.<br>B. Inspect the wiper linkage installation position and overall status.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect wiper fuse | |
| | A. Inspect the wiper combination switch fuse IF25.<br>**Fuse rated capacity: 20 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect wiper combination switch power supply circuit | |
|  | A. Turn the ignition switch to "LOCK", and disconnect the wiper combination switch wiring harness connector P33.<br>B. Turn the ignition switch to "ON".<br>C. Measure the voltage between terminal 3 of combination switch wiring harness connector P33 and body grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of combination switch wiring harness connector P33 and terminal 50 of instrument panel fuse box fuse IF25. |

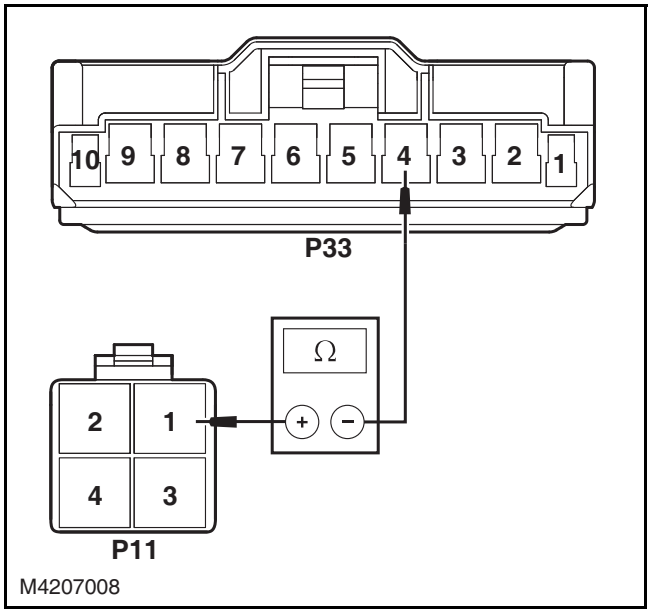
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect wiper motor input voltage at low speed | |
|  M4207006 | A. Turn the ignition switch to "LOCK", and disconnect the wiper motor wiring harness connector P11.<br>B. Turn the ignition switch to "ON".<br>C. Turn the wiper combination switch to "LO".<br>D. Measure the voltage between terminal 1 of wiper motor wiring harness connector P11 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal.<br>**No**<br>Go to step 5. |
| 5. Inspect wiper motor input voltage at high speed | |
|  M4207007 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper motor wiring harness connector P11.<br>C. Turn the ignition switch to "ON".<br>D. Turn the wiper combination switch to "HI".<br>E. Measure the voltage between terminal 2 of wiper motor wiring harness connector P11 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal.<br>**No**<br>Go to step 6. |

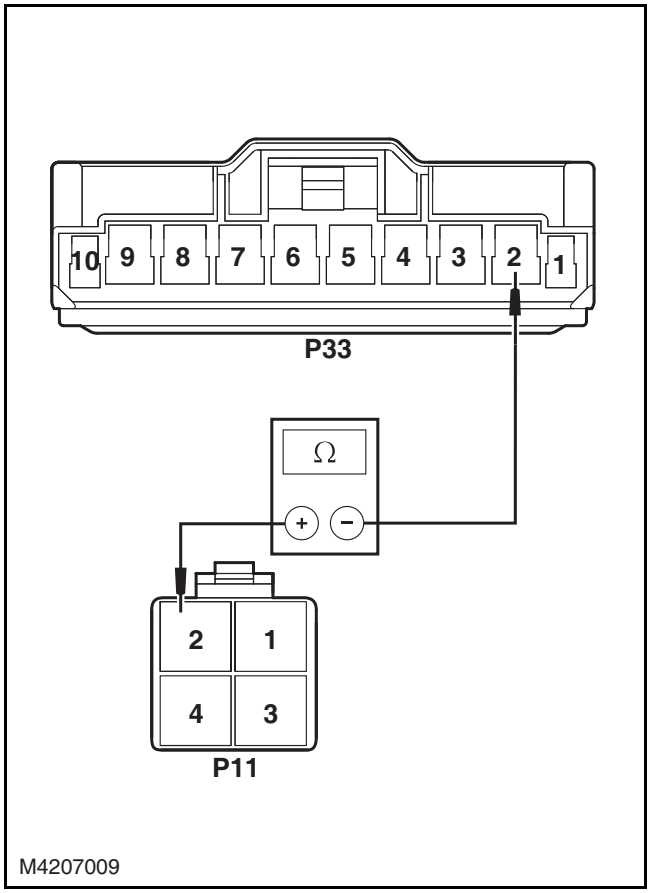
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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect wiper combination switch | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper combination switch wiring harness connector P33.<br>C. Inspect the wiper combination switch performance in accordance with the wiper combination switch level table.<br>Is it normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Replace the wiper combination switch.<br>**Refer to: Wiper Combination Switch (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |
| 7. Inspect wiper motor low speed level wiring harness | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper motor wiring harness connector P11.<br>C. Disconnect the wiper combination switch wiring harness connector P33.<br>D. Measure the resistance between terminal 4 of wiper combination switch wiring harness connector P33 and terminal 1 of wiper motor wiring harness connector P11.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Repair or replace the wiring harness. |

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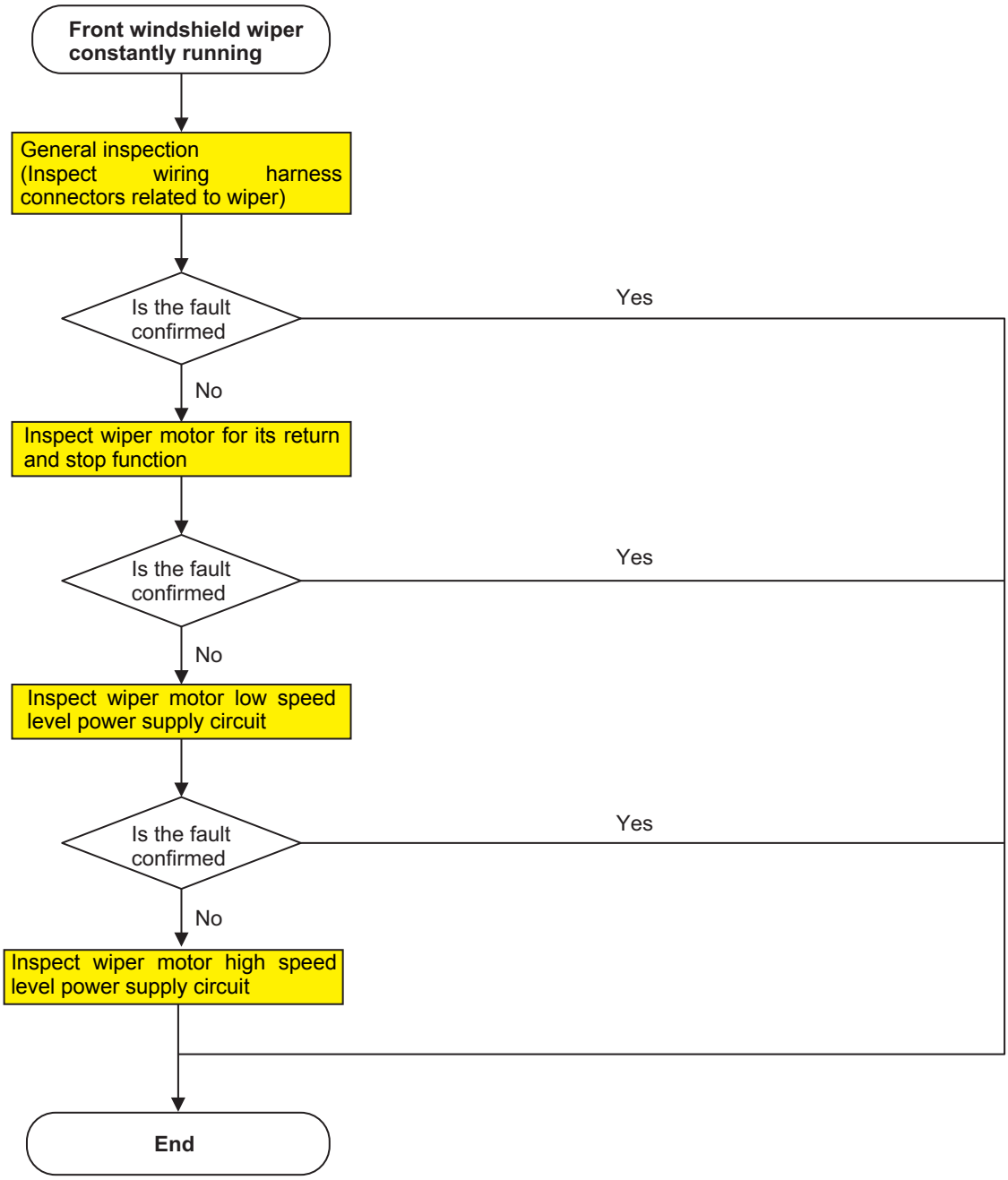


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect wiper motor high-speed level wiring harness | |
|  <br>M4207009 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper motor wiring harness connector P11 and wiper combination switch wiring harness connector P33.<br>C. Measure the resistance between terminal 2 of wiper combination switch wiring harness connector P33 and terminal 2 of wiper motor wiring harness connector P11.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Remove the wiper motor, inspect for any loose attachments with the body and reinstall the wiper motor.<br>Make sure the system is normal.<br>**No**<br>Repair or replace the wiring harness. |

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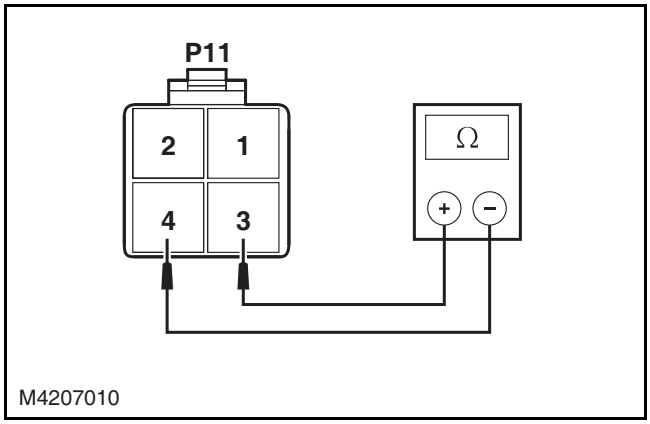


# Diagnosis Procedure for Front Windshield Wiper Constantly Running



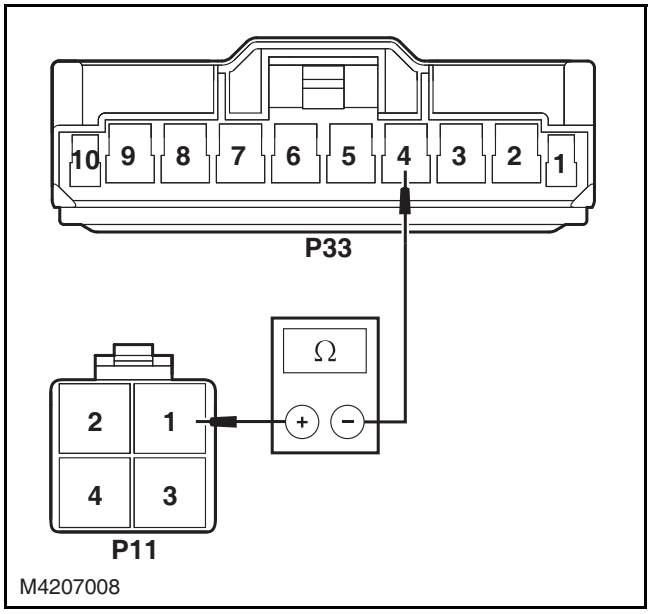
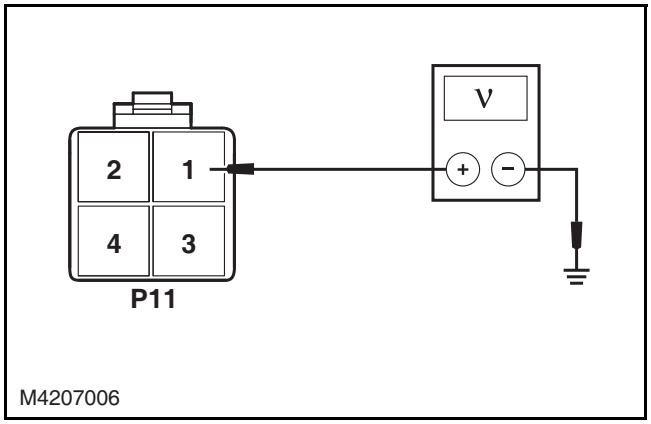
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the wiper for damage and aging.<br>B. Inspect the wiper linkage installation position and overall status.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect wiper motor for its return and stop function | |
|  <br>M4207010 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper motor wiring harness connector P11.<br>C. Measure the resistance between terminals 3 and 4 of wiper motor side wiring harness connector.<br>**Standard resistance: 10 MΩ or more**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

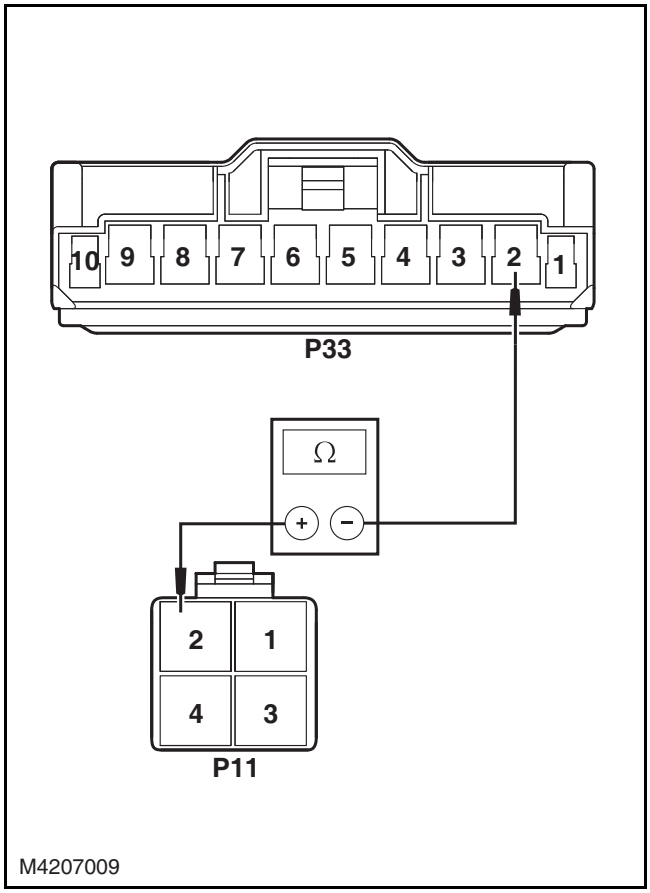
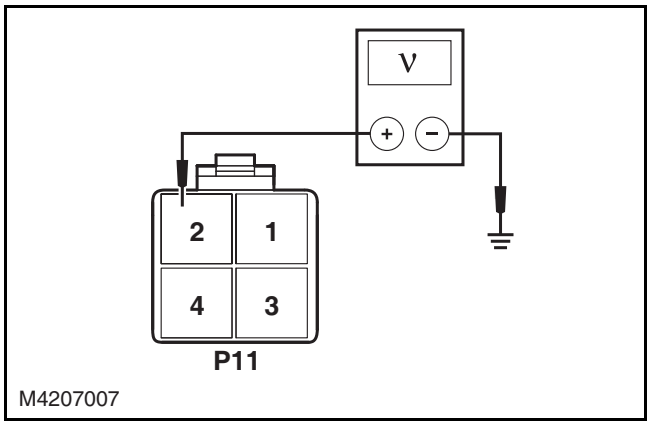
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect wiper motor low speed level power supply circuit | |
|  M4207008 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper combination switch wiring harness connector P33.<br>C. Disconnect the wiper motor wiring harness connector P11.<br>D. Measure the resistance between terminal 4 of wiper combination switch wiring harness connector P33 and terminal 1 of wiper motor wiring harness connector P11.<br>**Standard resistance: less than 5 Ω**<br>E. Measure the voltage between terminal 1 of wiper motor wiring harness connector P11 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the circuit fault between terminal 1 of wiper motor wiring harness connector P11 and terminal 4 of wiper combination switch wiring harness connector P33. |
|  M4207006 | |

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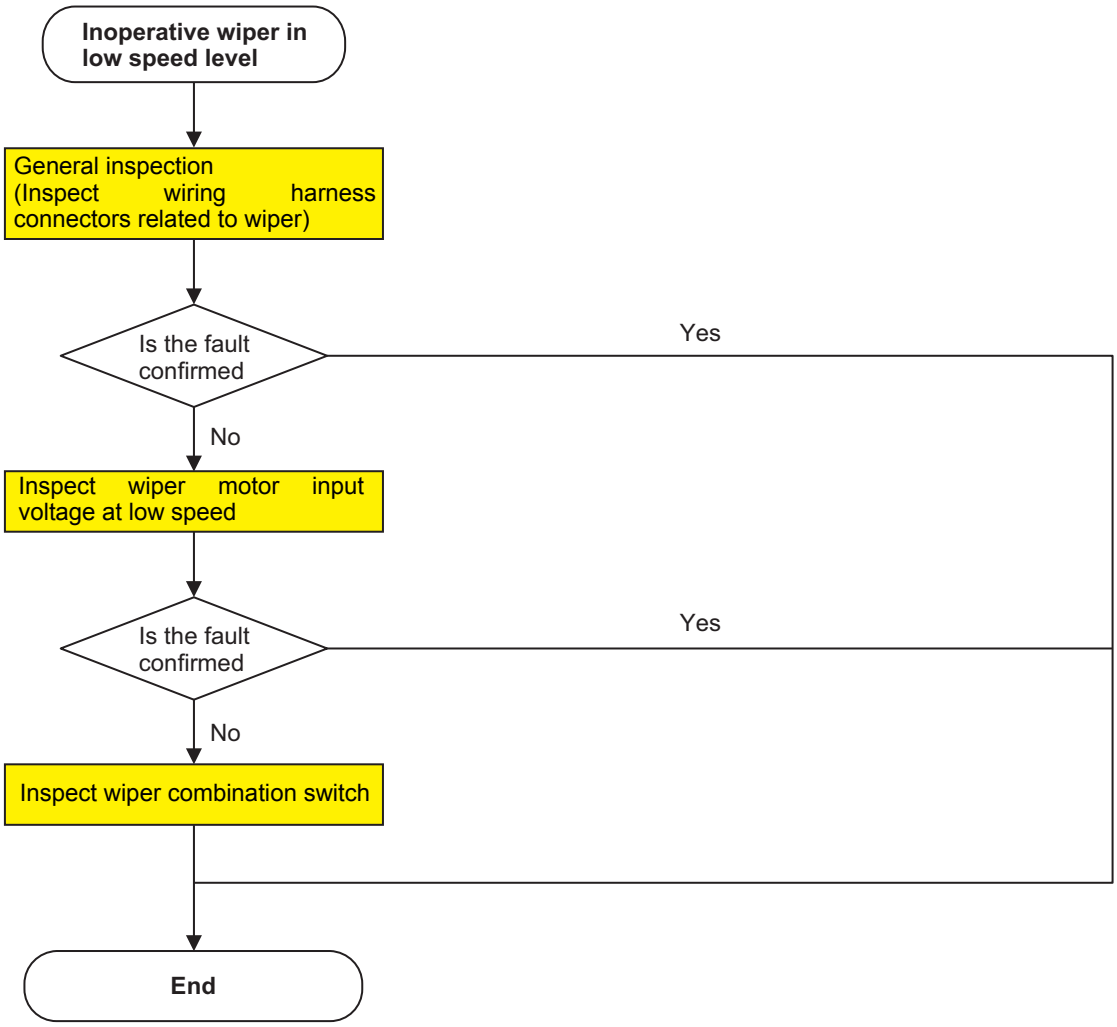


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect wiper motor high speed level power supply circuit | |
|  M4207009 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper combination switch wiring harness connector P33.<br>C. Disconnect the wiper motor wiring harness connector P11.<br>D. Measure the resistance between terminal 2 of wiper combination switch wiring harness connector P33 and terminal 2 of wiper motor wiring harness connector P11.<br>**Standard resistance: less than 5 Ω**<br>E. Measure the voltage between terminal 2 of wiper motor wiring harness connector P11 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is it normal?<br>**Yes**<br>Replace the wiper combination switch.<br>**Refer to: Wiper Combination Switch (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal.<br>**No**<br>Inspect and repair the circuit fault between terminal 2 of wiper combination switch wiring harness connector P33 and terminal 2 of wiper motor wiring harness connector P11. |
|  M4207007 | |

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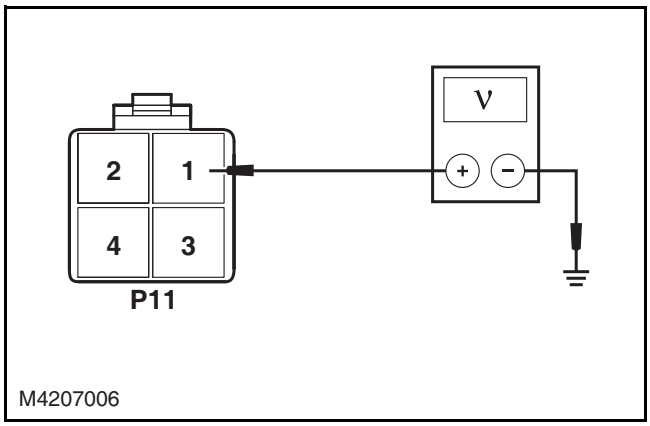


# Diagnosis Procedure for Inoperative Wiper in Low Speed Level



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the wiper for damage, aging, poor contact and looseness.<br>B. Inspect the wiper linkage installation position and overall status.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect wiper motor input voltage at low speed | |
|  | A. Turn the ignition switch to "LOCK", and disconnect the wiper motor wiring harness connector P11.<br>B. Turn the ignition switch to "ON".<br>C. Turn the wiper combination switch to "LO".<br>D. Measure the voltage between terminal 1 of wiper motor wiring harness connector P11 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal.<br>**No**<br>Go to step 3. |

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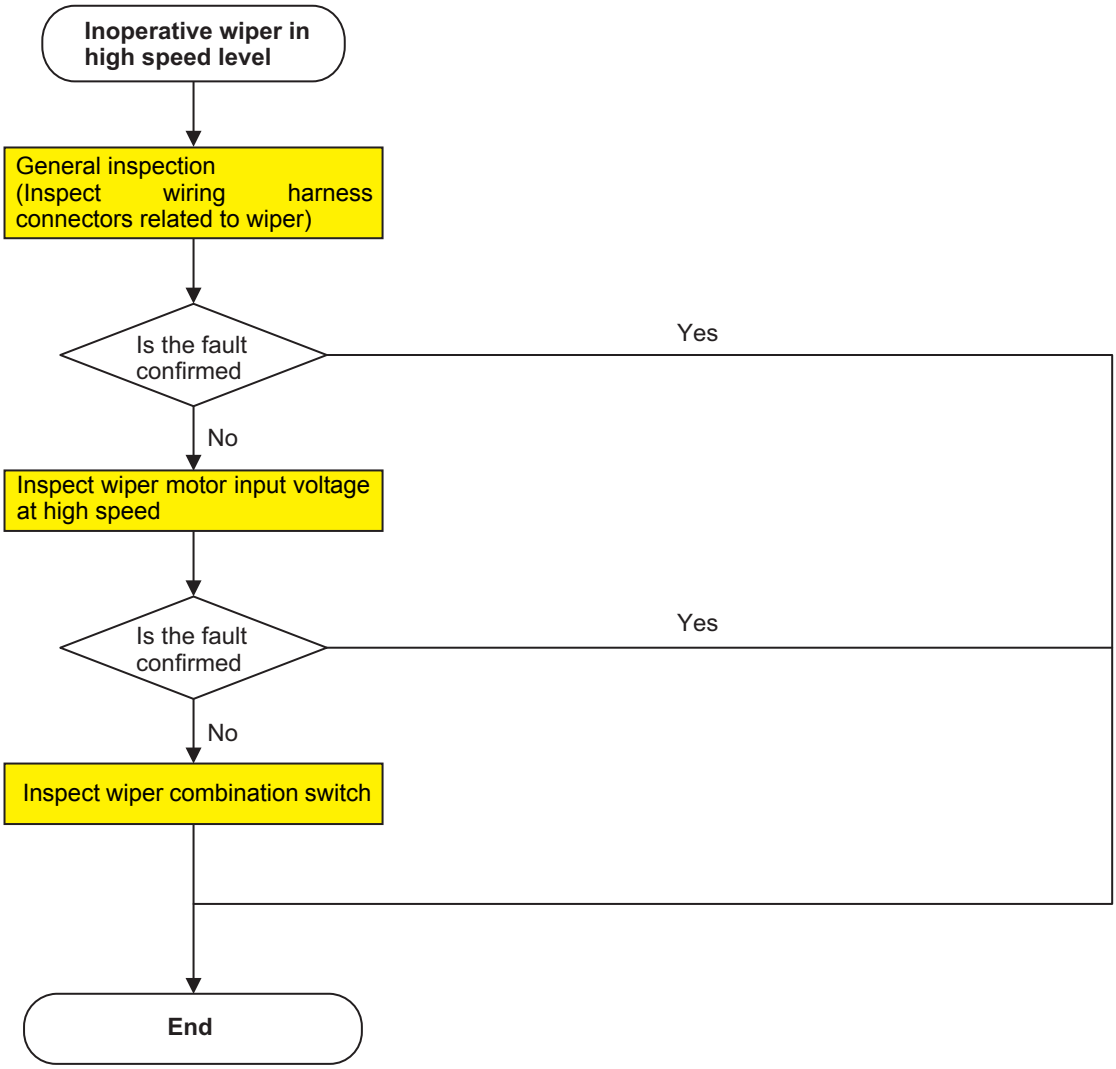


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect wiper combination switch | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper combination switch wiring harness connector P33.<br>C. Inspect the wiper combination switch performance in accordance with the wiper combination switch level table.<br>Is it normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 4 of wiper combination switch wiring harness connector P33 and terminal 1 of wiper motor wiring harness connector P11.<br>**No**<br>Replace the wiper combination switch.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

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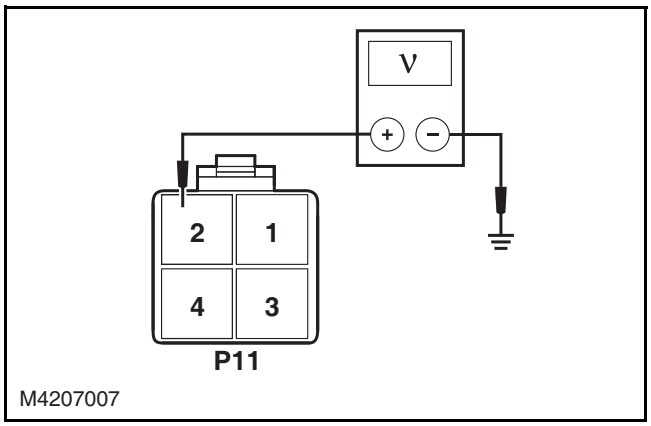


# Diagnosis Procedure for Inoperative Wiper in High Speed Level



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the wiper for damage, aging, poor contact and looseness.<br>B. Inspect the wiper linkage installation position and overall status.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect wiper motor input voltage at high speed | |
|  <br>M4207007 | A. Turn the ignition switch to "LOCK", and disconnect the wiper motor wiring harness connector P11.<br>B. Turn the ignition switch to "ON".<br>C. Turn the wiper combination switch to "HI".<br>D. Measure the voltage between terminal 2 of wiper motor wiring harness connector P11 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal.<br>**No**<br>Go to step 3. |

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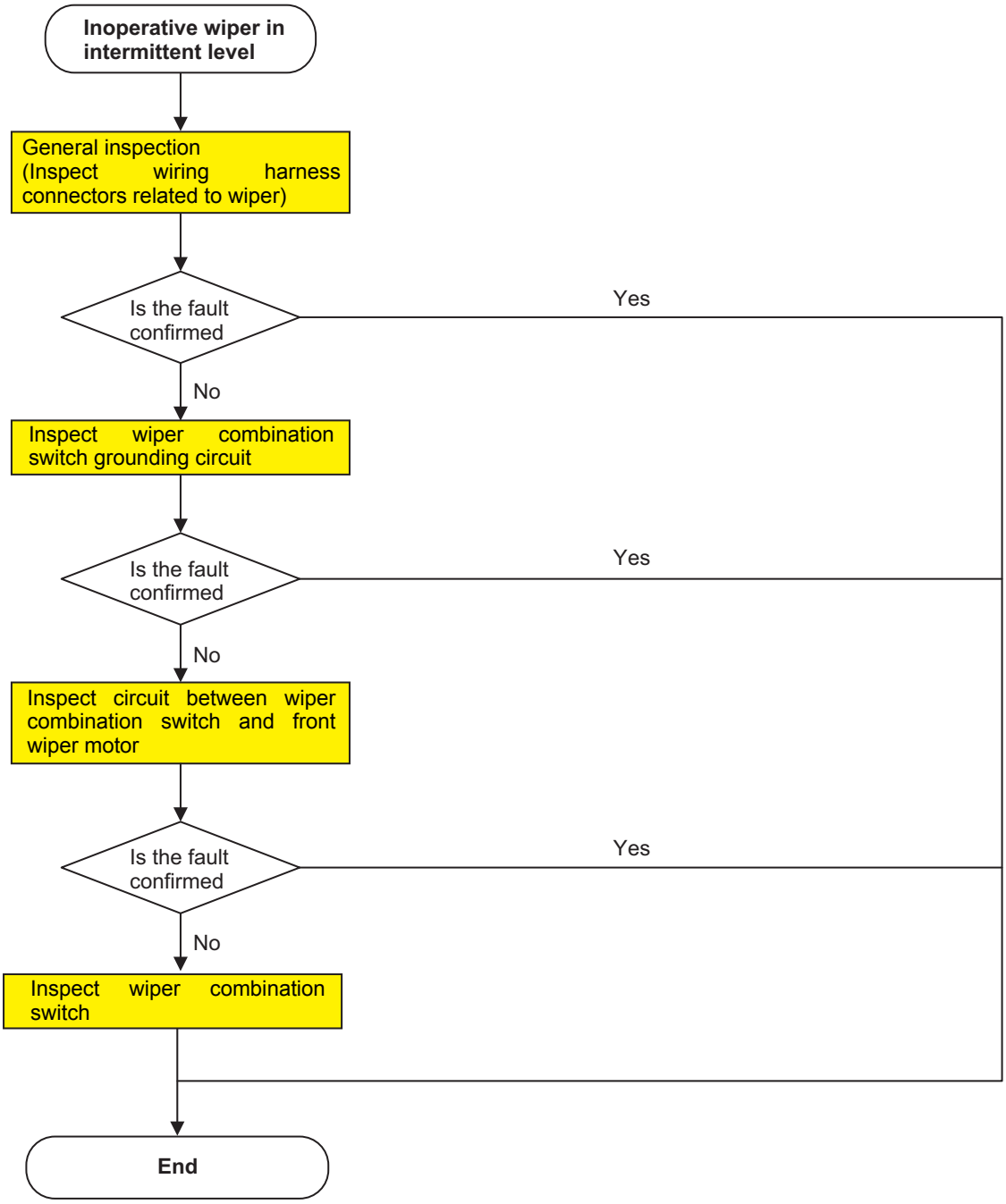
| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect wiper combination switch | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper combination switch wiring harness connector P33.<br>C. Inspect the wiper combination switch performance in accordance with the wiper combination switch level table.<br>Is it normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 2 of wiper combination switch wiring harness connector P33 and terminal 2 of wiper motor wiring harness connector P11.<br>**No**<br>Replace the wiper combination switch.<br>**Refer to: Wiper Combination Switch (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

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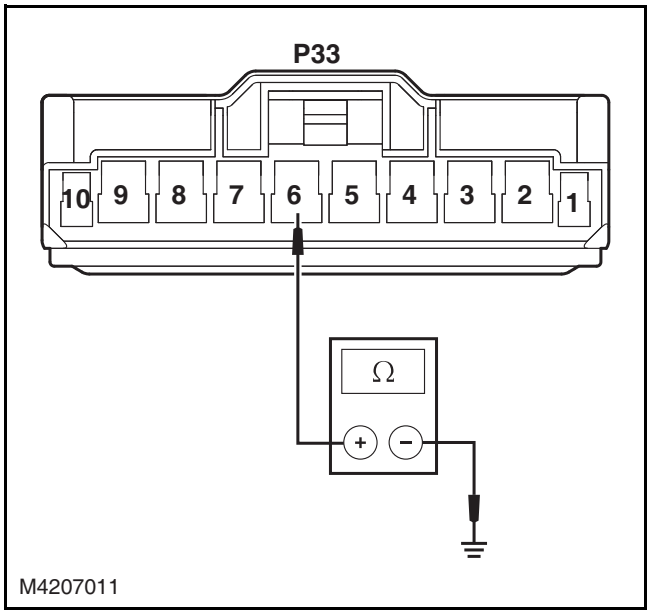
# Diagnosis Procedure for Inoperative Wiper in Intermittent Level

**CAUTION: Identify that the wiper motor works normally at low speed before this procedure is carried out. Inoperative wiper motor at low speed, refer to: Diagnosis Procedure for Inoperative Wiper at Low Speed (4.2.7 Wiper and Washer, Symptom Diagnosis and Testing).**



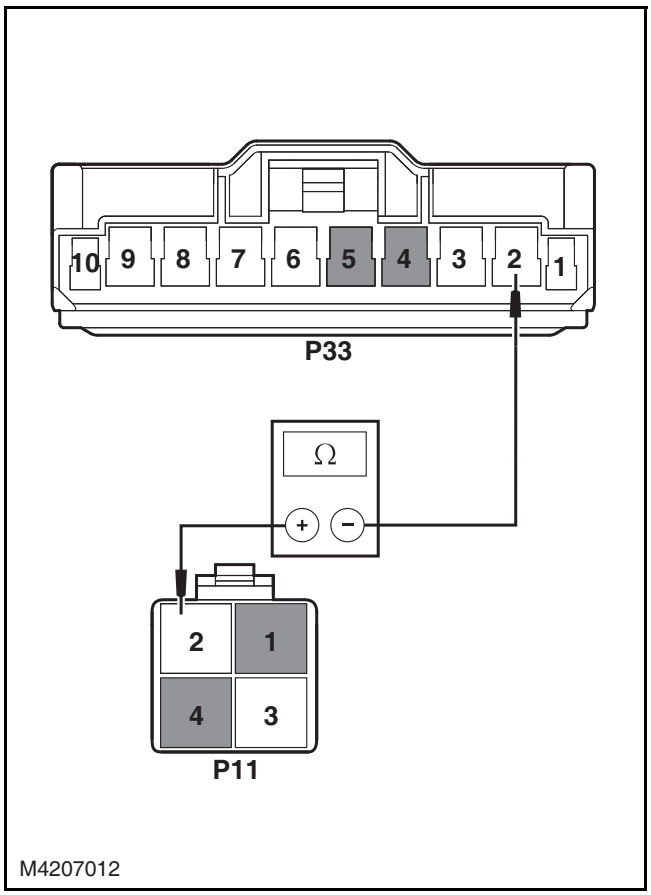
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the wiper for damage, aging, poor contact and looseness.<br>B. Inspect the wiper linkage installation position and overall status.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect wiper combination switch grounding circuit | |
|  | A. Turn the ignition switch to "LOCK", and disconnect the wiper combination switch wiring harness connector P33.<br>B. Measure the resistance between terminal 6 of wiper combination switch wiring harness connector P33 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of wiper combination switch wiring harness connector P33 and grounding point G103. |

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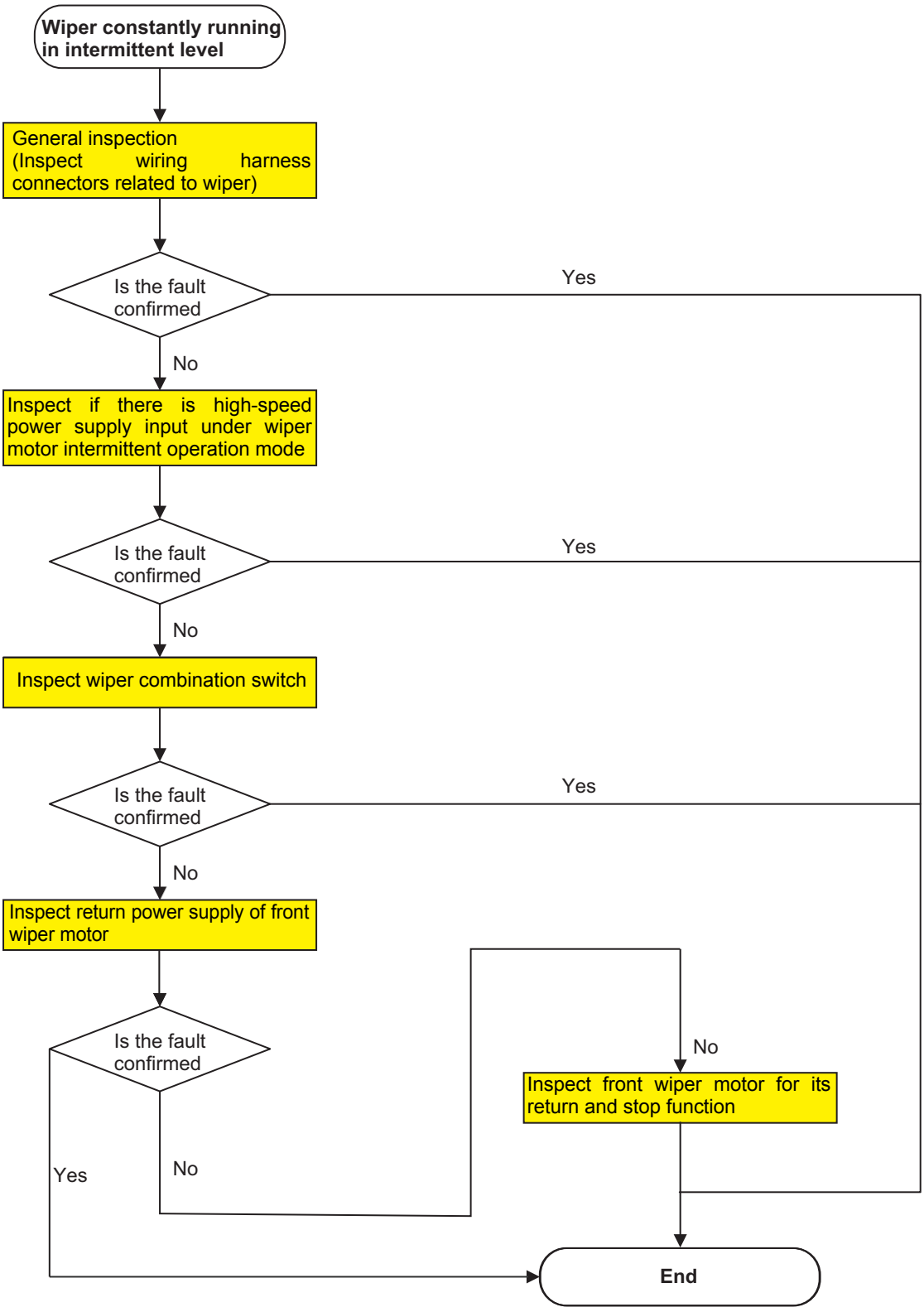


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect circuit between wiper combination switch and front wiper motor | |
|  M4207012 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the wiper combination switch wiring harness connector P33 and front wiper motor wiring harness connector P11.<br>C. Measure the resistance between terminals 2, 4, 5 of wiper combination switch wiring harness connector P33 and terminals 2, 1, 4 of front wiper motor wiring harness connector P11.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminals 2, 4, 5 of wiper combination switch wiring harness connector P33 and terminals 2, 1, 4 of front wiper motor wiring harness connector P11. |
| 4. Inspect wiper combination switch | |
| | A. Turn the ignition switch to "LOCK", and disconnect the wiper combination switch wiring harness connector P33.<br>B. Inspect the wiper combination switch performance in accordance with the wiper combination switch level table.<br>Is it normal?<br>**Yes**<br>Replace the wiper motor.<br>Make sure the system is normal.<br>**Refer to: Wiper Motor (4.2.7 Wiper and Washer, Removal and Installation).**<br>**No**<br>Replace the wiper combination switch.<br>Make sure the system is normal.<br>**Refer to: Wiper Combination Switch (4.2.7 Wiper and Washer, Removal and Installation).** |

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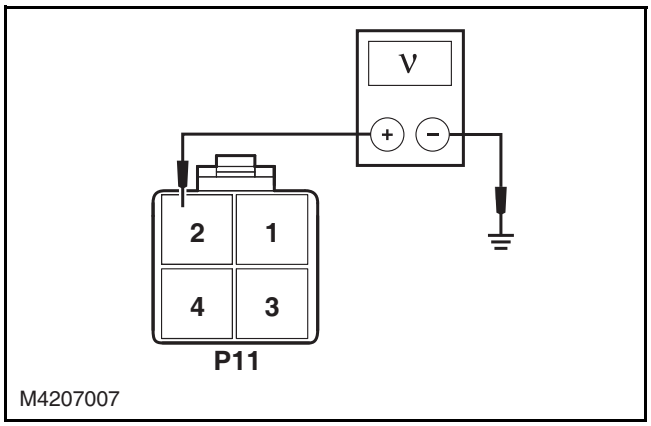


# Diagnosis Procedure for Wiper Constantly Running in Intermittent Level



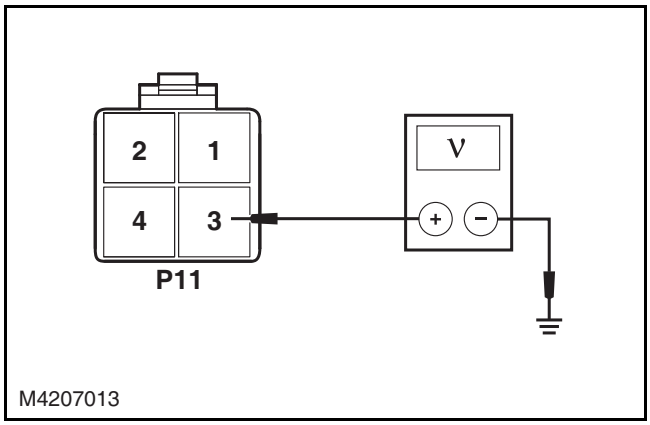
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the wiper for damage, aging, poor contact and looseness.<br>B. Inspect the wiper linkage installation position and overall status.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect if there is high-speed power supply input under wiper motor intermittent operation mode | |
|  <br>M4207007 | A. Turn the ignition switch to "LOCK", and disconnect the wiper motor wiring harness connector P11.<br>B. Turn the ignition switch to "ON".<br>C. Turn the wiper combination switch to "INT".<br>D. Measure the voltage between terminal 2 of wiper motor wiring harness connector P11 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Replace the wiper combination switch.<br>**Refer to: Wiper Combination Switch (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

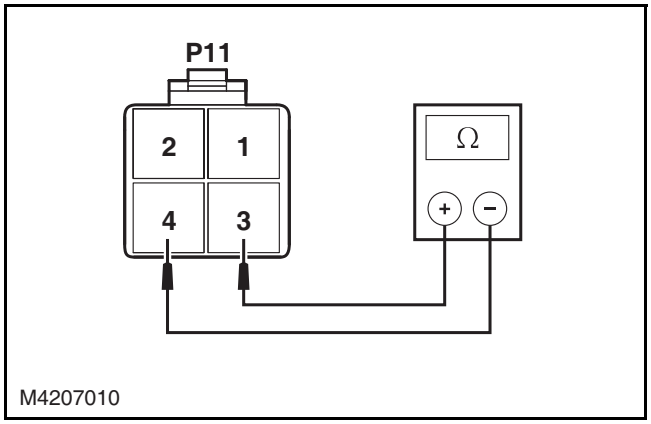
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect wiper combination switch | |
| | A. Turn the ignition switch to "LOCK", and disconnect the wiper combination switch wiring harness connector P33.<br>B. Inspect the wiper combination switch performance in accordance with the wiper combination switch level table.<br>Is it normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the wiper combination switch.<br>**Refer to: Wiper Combination Switch (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |
| 4. Inspect return power supply of front wiper motor | |
|  | A. Turn the ignition switch to "LOCK", and disconnect the front wiper motor wiring harness connector P11.<br>B. Turn the ignition switch to "ON".<br>C. Measure the voltage between terminal 3 of wiper motor wiring harness connector P11 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of front wiper motor wiring harness connector P11 and terminal 50 of instrument panel fuse box fuse IF25. |

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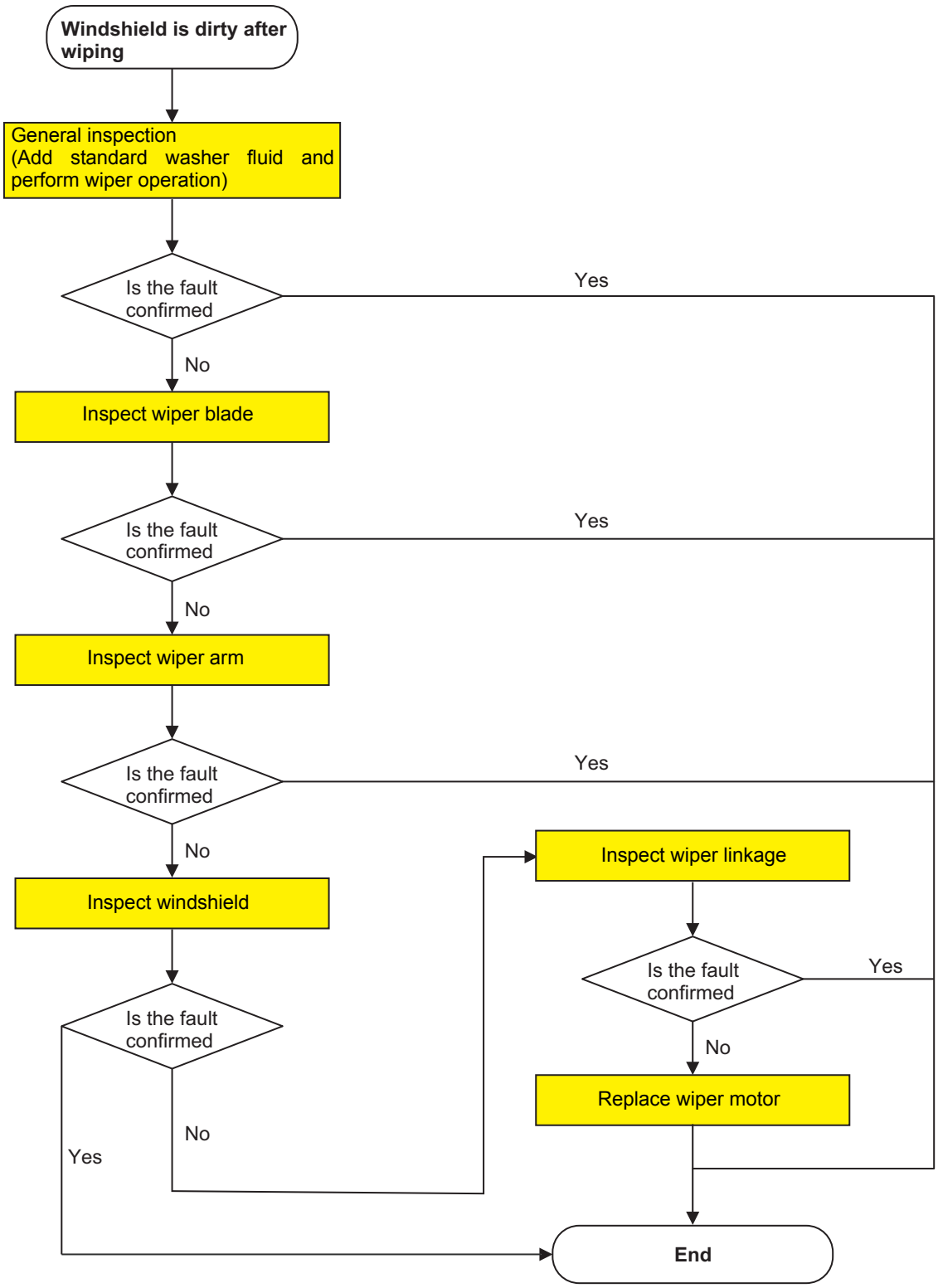


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect front wiper motor for its return and stop function | |
|  M4207010 | A. Turn the ignition switch to "LOCK" and disconnect the wiper motor wiring harness connector P11 when the wiper motor is at moving position.<br>B. Measure the resistance between terminals 3 and 4 of wiper motor side.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 4 of front wiper motor wiring harness connector P11 and terminal 5 of wiper combination switch wiring harness connector P33.<br>**No**<br>Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for Windshield is Dirty after Wiping



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Add washer fluid meeting the standard of Changan Automobile and perform wiper operation.<br>Is it normal?<br>**Yes**<br>Make sure that the maintenance has been finished.<br>**No**<br>Go to step 2. |
| 2. Inspect wiper blade | |
| | A. Inspect the cleanliness of wiper blade.<br>B. Inspect the wiper blade for deformation, aging and damage.<br>Is the performance of wiper blade normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Clean the wiper blade with the special washing fluid and replace as necessary. |
| 3. Inspect wiper arm | |
| | A. Inspect the installation position of wiper arm.<br>B. Inspect the wiper arm for elasticity.<br>Is the performance of wiper arm normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Adjust the installation position of wiper arm and replace as necessary. |
| 4. Inspect windshield | |
| | A. Inspect the cleanliness of windshield.<br>B. Inspect the windshield for scratch and damage.<br>Is the performance of windshield normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Clean the front windshield with the special washing fluid and replace as necessary. |

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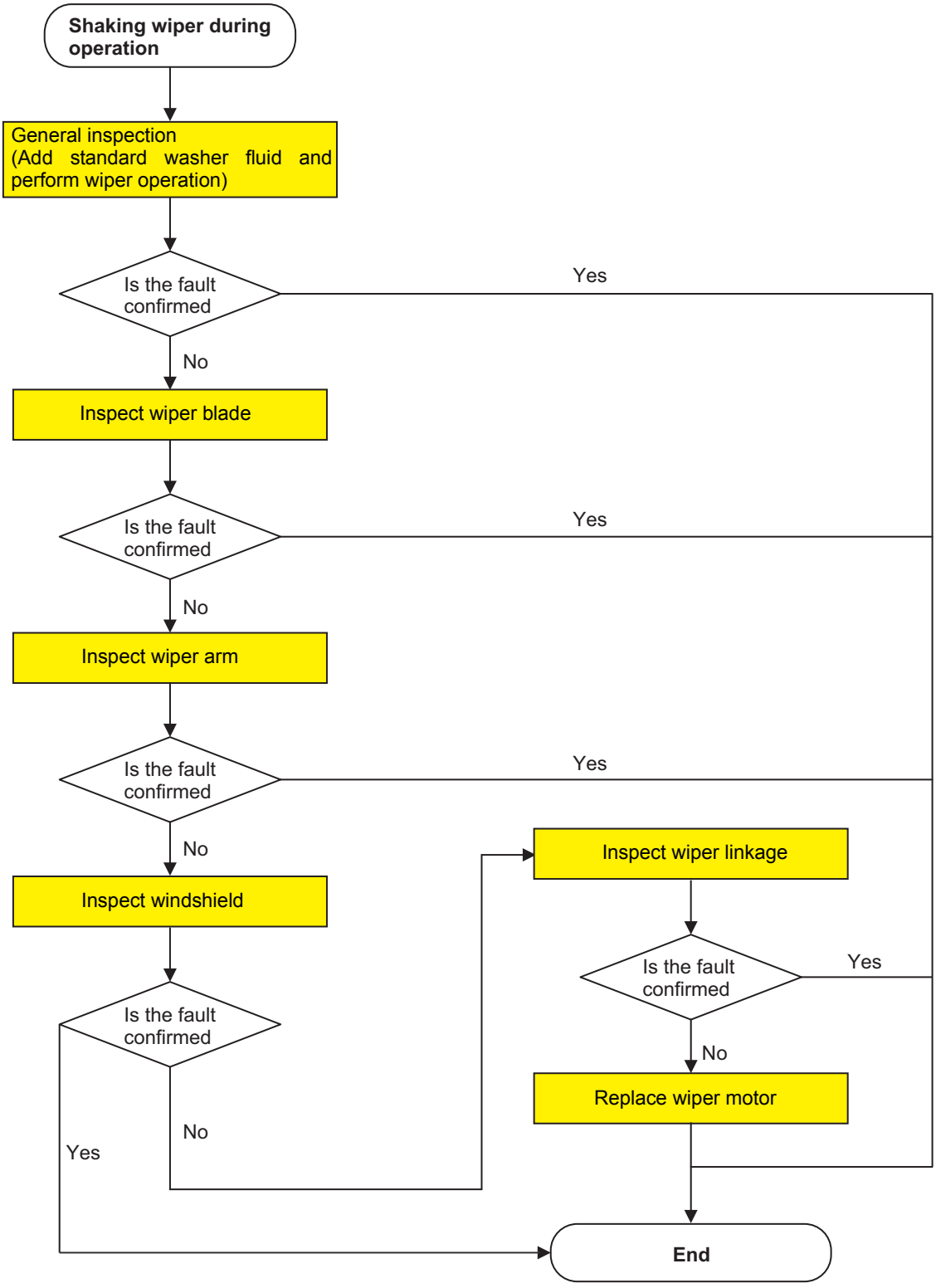


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect wiper linkage | |
| | A. Inspect the installation of wiper linkage.<br>B. Inspect the wiper linkage for deformation and damage.<br>Is the performance of wiper arm normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Adjust the wiper linkage installation position, repair the deformed parts and replace the damaged wiper linkage. |
| 6. Replace wiper motor | |
| | A. Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for Shaking Wiper During Operation



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Add washer fluid meeting the standard of Changan Automobile and perform wiper operation.<br>Is it normal?<br>**Yes**<br>Repair is completed.<br>**No**<br>Go to step 2. |
| 2. Inspect wiper blade | |
| | A. Inspect the cleanliness of wiper blade.<br>B. Inspect the wiper blade for deformation, aging and damage.<br>Is the performance of wiper blade normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Clean the wiper blade with the special washing fluid and replace as necessary. |
| 3. Inspect wiper arm | |
| | A. Inspect the installation position of wiper arm.<br>B. Inspect the wiper arm for elasticity.<br>Is the performance of wiper arm normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Adjust the installation position of wiper arm and replace as necessary. |
| 4. Inspect windshield | |
| | A. Inspect the cleanliness of windshield.<br>B. Inspect the windshield for scratch and damage.<br>Is the performance of windshield normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Clean the front windshield with the special washing fluid and replace as necessary. |

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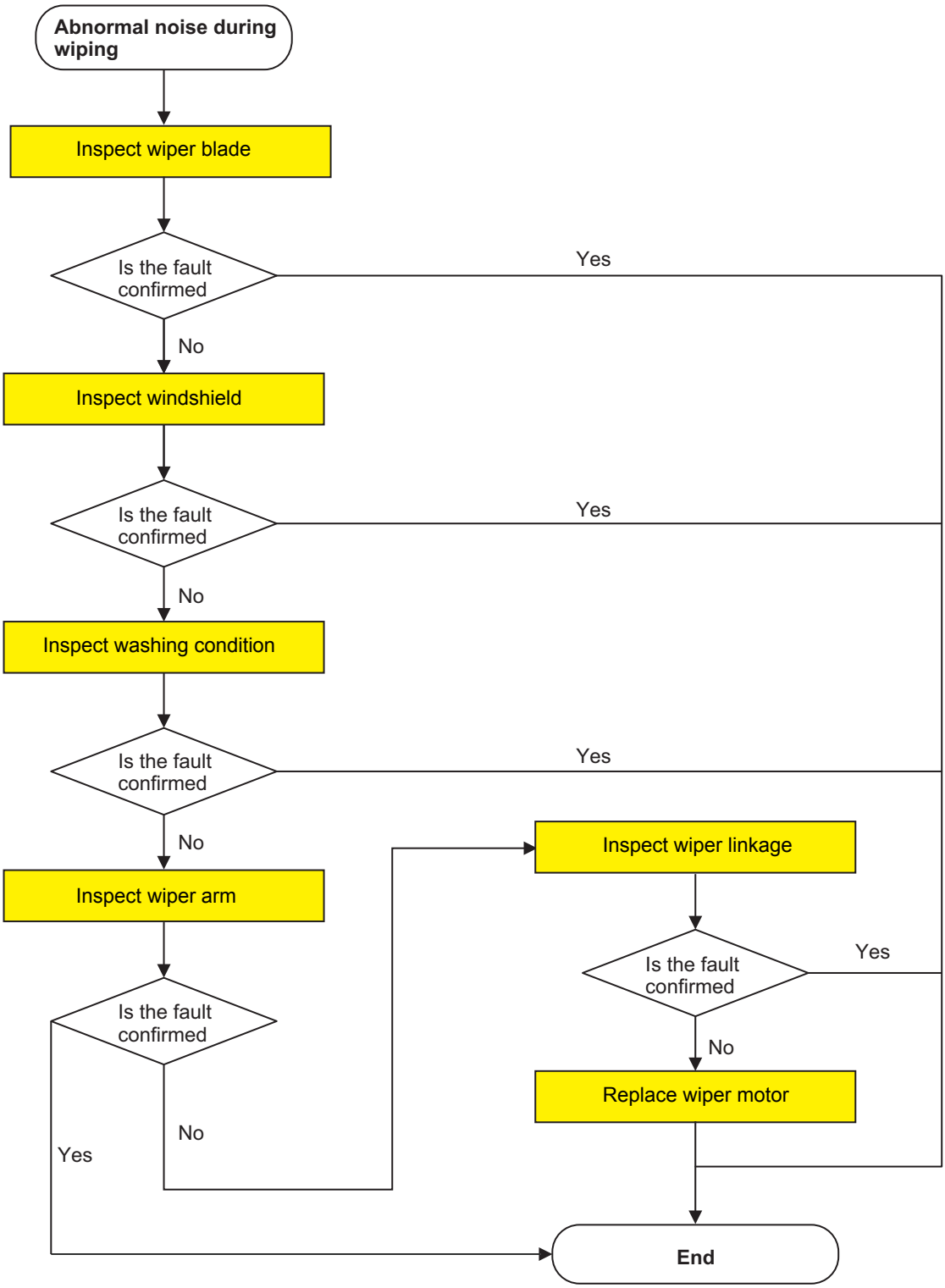


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect wiper linkage | |
| | A. Inspect the installation of wiper linkage.<br>B. Inspect the wiper linkage for deformation and damage.<br>Is the wiper linkage normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Adjust the wiper linkage installation position, repair the deformed parts and replace the damaged wiper linkage. |
| 6. Replace wiper motor | |
| | A. Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for Abnormal Noise During Wiping



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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect wiper blade | |
| | A. Inspect the cleanliness of wiper blade.<br>B. Inspect the wiper blade for deformation, aging and damage.<br>Is the performance of wiper blade normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Clean the wiper blade with the special washing fluid and replace as necessary. |
| 2. Inspect windshield | |
| | A. Inspect the cleanliness of windshield.<br>B. Inspect the windshield for scratch and damage.<br>Is the performance of the windshield normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Clean the front windshield with the special washing fluid and replace as necessary. |
| 3. Inspect washing condition | |
| | A. Add washer fluid meeting the standard of Changan Automobile and perform wiper operation.<br>Does the abnormal noise still exist?<br>**Yes**<br>Repair is completed.<br>**No**<br>Go to step 4. |
| 4. Inspect wiper arm | |
| | A. Inspect the installation position of wiper arm.<br>B. Inspect the wiper arm for elasticity.<br>Is the performance of wiper arm normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Adjust the installation position of wiper arm and replace as necessary. |

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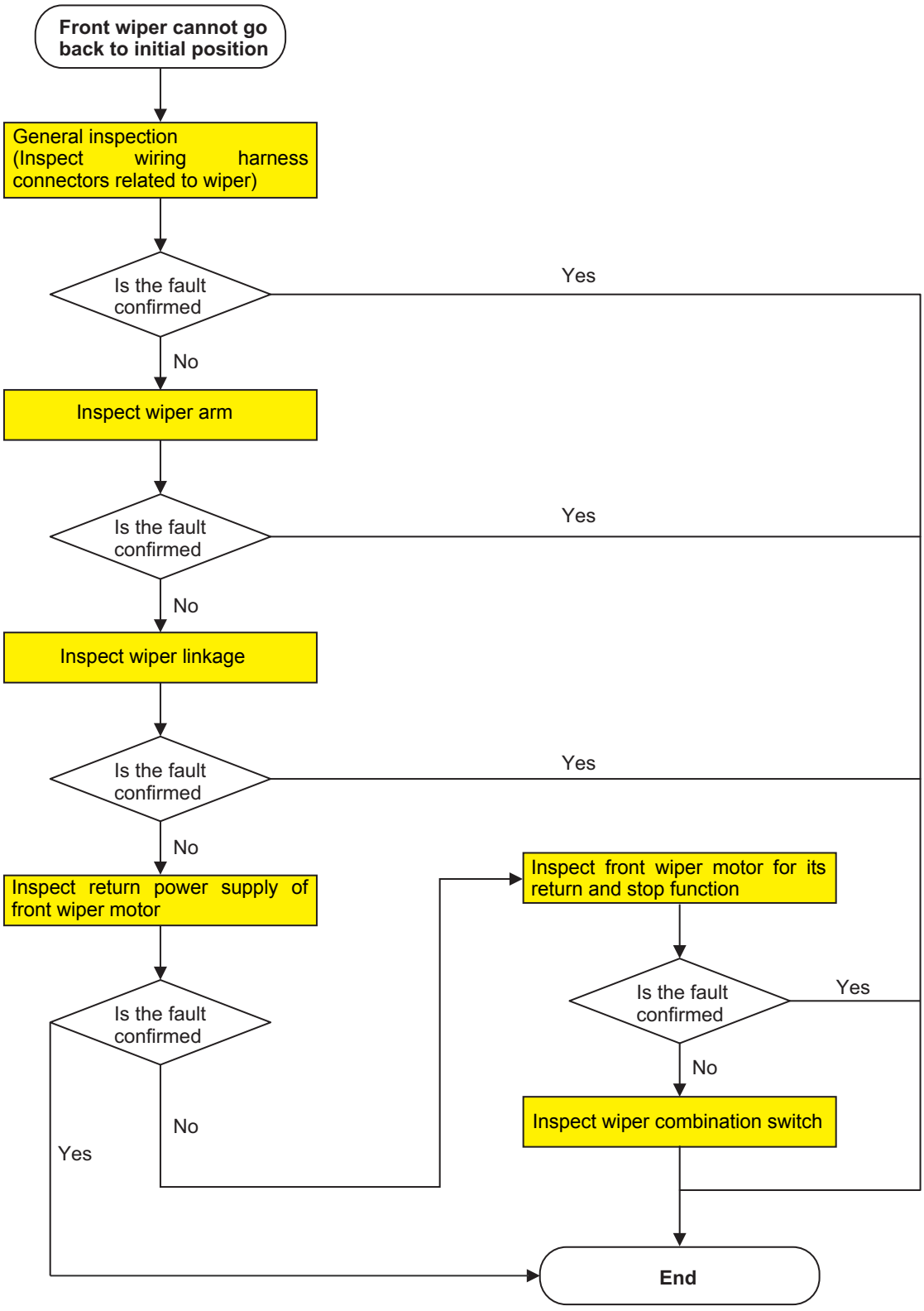


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect wiper linkage | |
| | A. Inspect the installation of wiper linkage.<br>B. Inspect the wiper linkage for deformation and damage.<br>Is the performance of wiper linkage normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Adjust the wiper linkage installation position, repair the deformed parts and replace the damaged wiper linkage. |
| 6. Replace wiper motor | |
| | A. Turn the ignition switch to "LOCK", and disconnect the wiper motor wiring harness connector.<br>Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for Front Wiper cannot Go Back to Initial Position



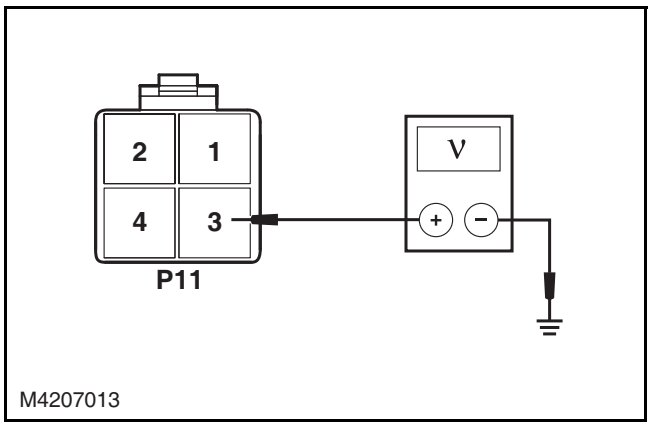
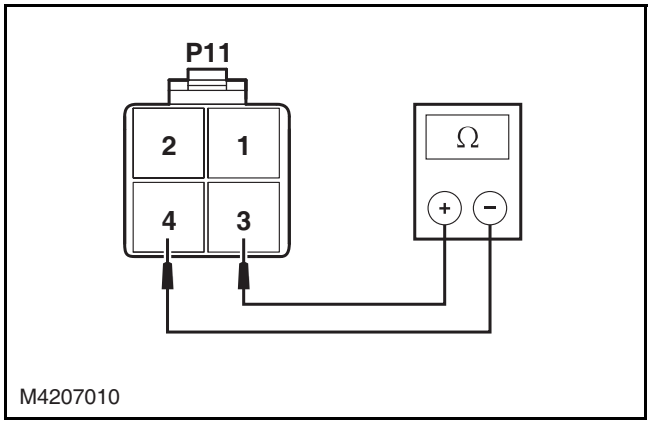
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the wiper for damage, aging, poor contact and looseness.<br>B. Inspect the wiper linkage installation position and overall status.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect wiper arm | |
| | A. Inspect the installation position of front wiper arm.<br>B. Inspect the front wiper arm for elasticity.<br>Is the performance of front wiper arm normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Adjust the installation position of front wiper arm and replace as necessary. |
| 3. Inspect wiper linkage | |
| | A. Inspect the installation condition of wiper linkage.<br>B. Inspect the wiper linkage for deformation and damage.<br>Is the performance of wiper linkage normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Adjust the wiper linkage installation position, repair the deformed parts and replace the wiper linkage as necessary. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect return power supply of front wiper motor | |
|  M4207013 | A. Turn the ignition switch to "LOCK", and disconnect the front wiper motor wiring harness connector P11.<br>B. Turn the ignition switch to "ON".<br>C. Measure the voltage between terminal 3 of wiper motor wiring harness connector P11 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 3 of front wiper motor wiring harness connector P11 and terminal 50 of instrument panel fuse box fuse IF25. |
| 5. Inspect front wiper motor for its return and stop function | |
|  M4207010 | A. Turn the ignition switch to "ON".<br>B. Turn the wiper combination switch to "LO".<br>C. Turn the ignition switch to "LOCK" and disconnect the wiper motor wiring harness connector P11 when the wiper motor is at moving position.<br>D. Measure the resistance between terminals 3 and 4 of wiper motor side.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Replace the wiper motor.<br>**Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

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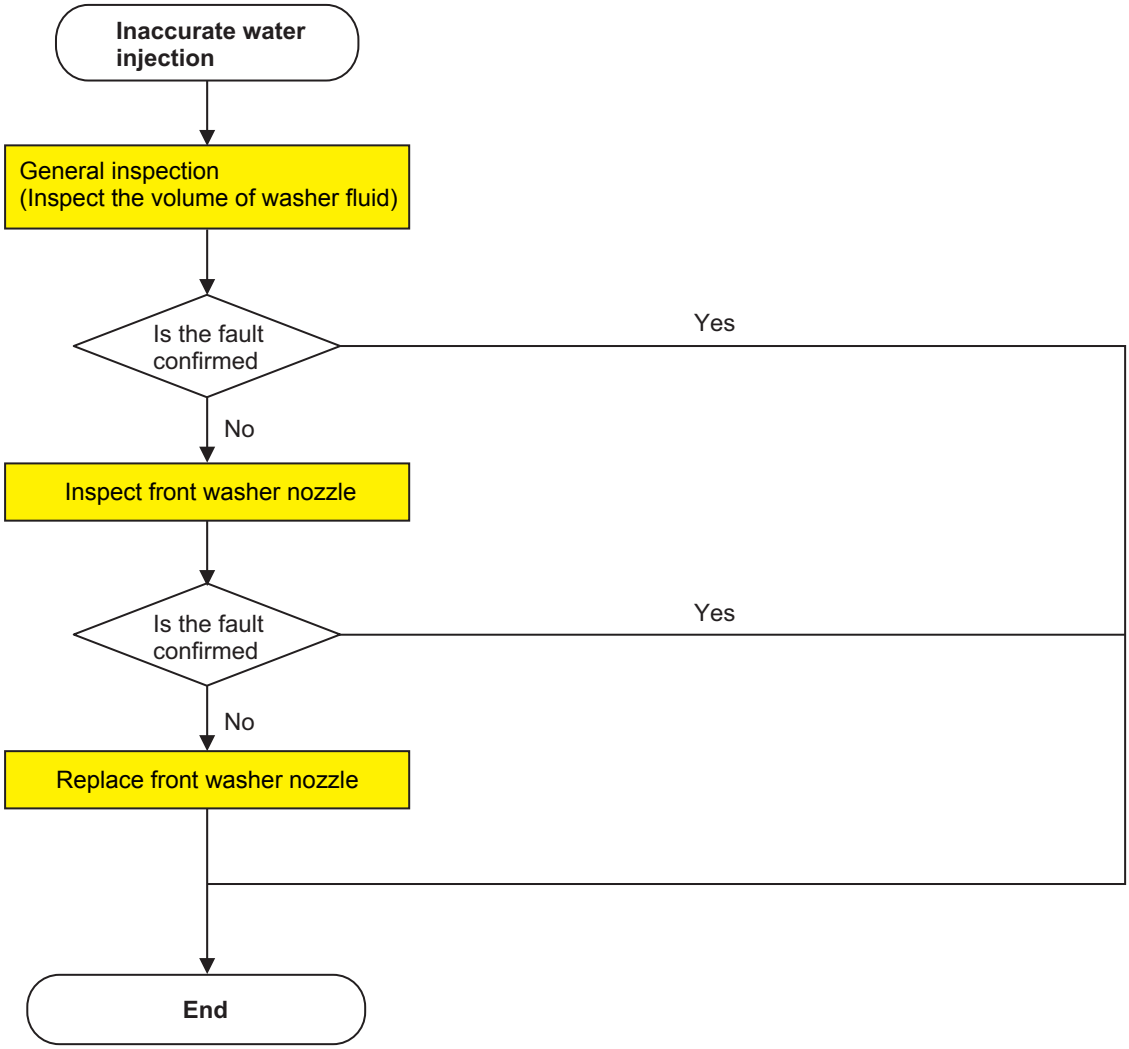


| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect wiper combination switch | |
| | A. Turn the ignition switch to "LOCK", and disconnect the wiper combination switch wiring harness connector P33.<br>B. Inspect the wiper combination switch performance in accordance with the wiper combination switch level table.<br>Is it normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 4 of front wiper motor wiring harness connector P11 and terminal 5 of wiper combination switch wiring harness connector P33.<br>**No**<br>Replace the wiper combination switch.<br>**Refer to: Wiper Combination Switch (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for Inaccurate Water Injection



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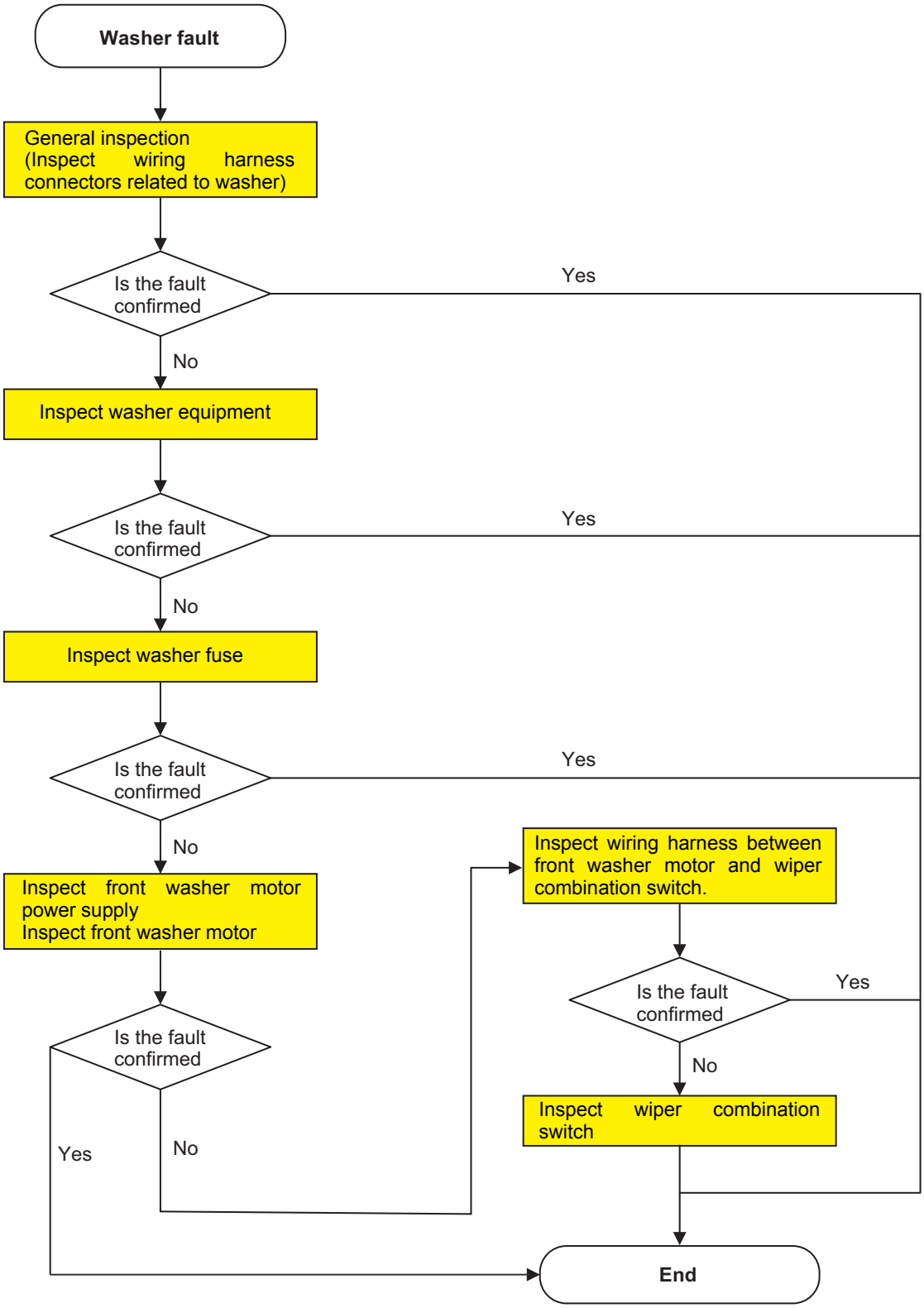


| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the volume of washer fluid.<br>B. Inspect the washer fluid pipe for any deformation, bending and damage.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect front washer nozzle | |
| | A. Inspect the spray angle and position during washing operation.<br>B. Adjust the washer nozzle.<br>Is it normal?<br>**Yes**<br>Make sure that the maintenance has been finished.<br>**No**<br>Go to step 3. |
| 3. Replace front washer nozzle | |
| | A. Replace the washer nozzle.<br>**Refer to: Washer Equipment (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal. |

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# Diagnosis Procedure for Washer Fault



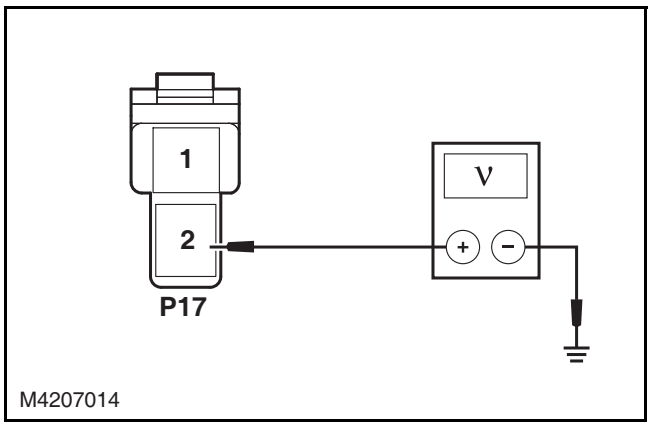
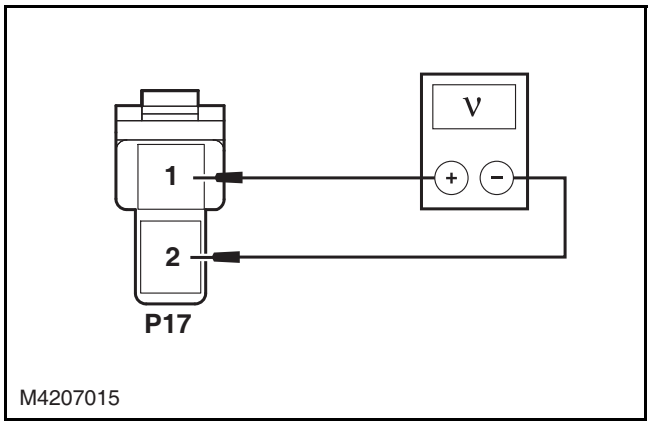
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors related to the washer for damage, aging and looseness.<br>Is it normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect washer equipment | |
| | A. Inspect the volume of washer fluid.<br>B. Inspect the washer pipe for any deformation, bending and damage.<br>C. Inspect the washer nozzle for any crack and damage.<br>Is it normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Repair the fault. |
| 3. Inspect washer fuse | |
| | A. Inspect the washer fuse IF25.<br>**Fuse rated capacity: 20 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

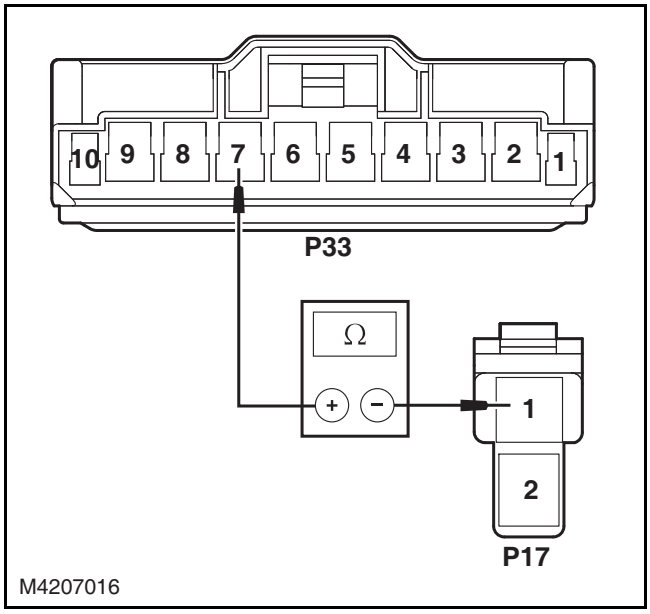
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect front washer motor power supply | |
|  M4207014 | A. Turn the ignition switch to "LOCK", and disconnect the front washer motor wiring harness connector P17.<br>B. Measure the voltage between terminal 2 of front washer motor wiring harness connector P17 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of front washer motor wiring harness connector P17 and terminal 50 of instrument panel fuse box fuse IF25. |
| 5. Inspect front washer motor | |
|  M4207015 | A. Turn the ignition switch to "LOCK", and disconnect the front washer motor wiring harness connector P17.<br>B. Turn the ignition switch to "ON".<br>C. Turn the wiper combination switch to "WASH".<br>D. Measure the voltage between terminals 1 and 2 of front washer motor wiring harness connector P17.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the front washer motor.<br>**Refer to: Washer Equipment (4.2.7 Wiper and Washer, Removal and Installation).**<br>Make sure the system is normal.<br>**No**<br>Go to step 6. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect wiring harness between front washer motor and wiper combination switch. | |
|  | A. Turn the ignition switch to "LOCK", disconnect the wiper combination switch wiring harness connector P33 and disconnect the front washer motor wiring harness connector P17.<br>B. Measure the resistance between terminal 7 of wiper combination switch wiring harness connector P33 and terminal 1 of front washer motor wiring harness connector P17.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of wiper combination switch wiring harness connector P33 and terminal 1 of front washer motor wiring harness connector P17. |
| 7. Inspect wiper combination switch | |
| | A. Disconnect the wiper combination switch wiring harness connector P33.<br>B. Inspect the wiper combination switch performance in accordance with the wiper combination switch level table.<br>Is it normal?<br>**Yes**<br>Inspect and repair the open circuit fault between terminal 6 of wiper combination switch wiring harness connector P33 and grounding point G103.<br>**No**<br>Replace the wiper combination switch.<br>**Refer to: Wiper Combination Switch (4.2.7 Wiper and Washer, Removal and Installation).**<br>The system is normal. |

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## Removal and Installation

# Wiper Combination Switch

### Removal

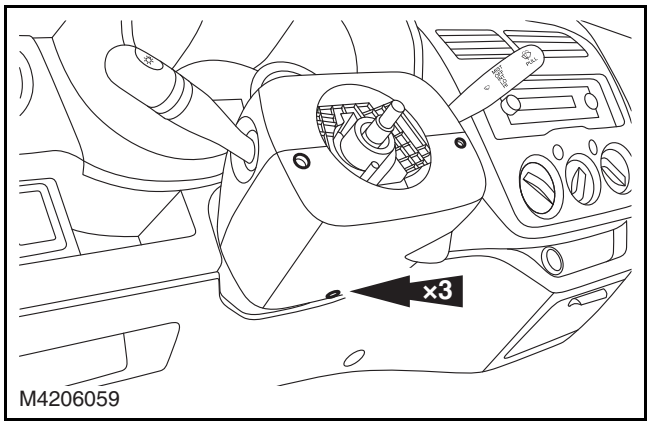
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the steering wheel.

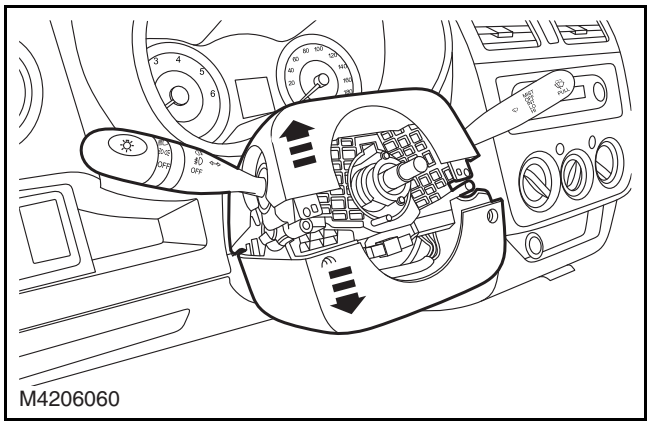
   **Refer to: Steering Wheel (2.4.4 Steering Column, Removal and Installation).**

3. Remove 3 retaining screws from the upper and lower housings of steering lock.



M4206059

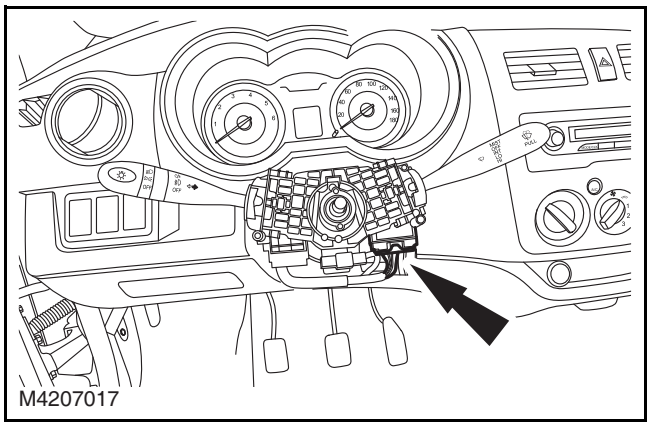
4. Separate the upper and lower housings of steering lock.


M4206060

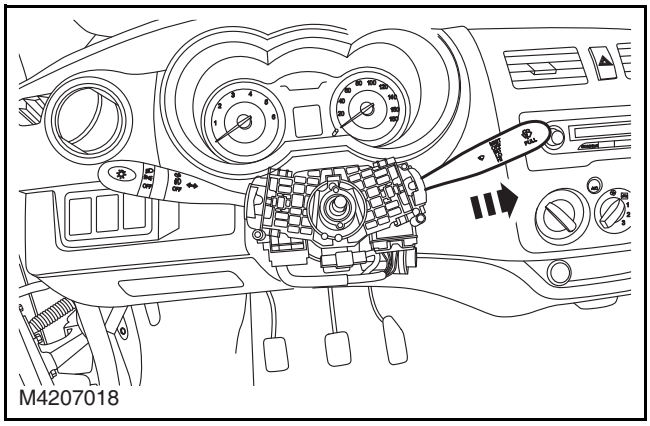
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**5.** Disconnect the wiper combination switch wiring harness connector.


M4207017

**6.** Remove the wiper combination switch.


M4207018

## Installation

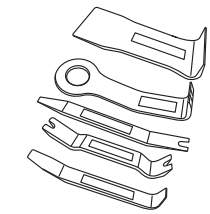
**1.** Installation is in the reverse order of removal.

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# Wiper Motor and Drive Arm

### Special Tool

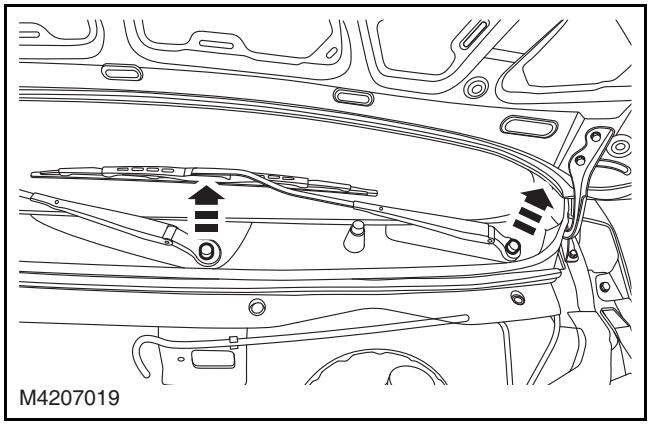
| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

## Removal

1. Disconnect the negative battery cable.

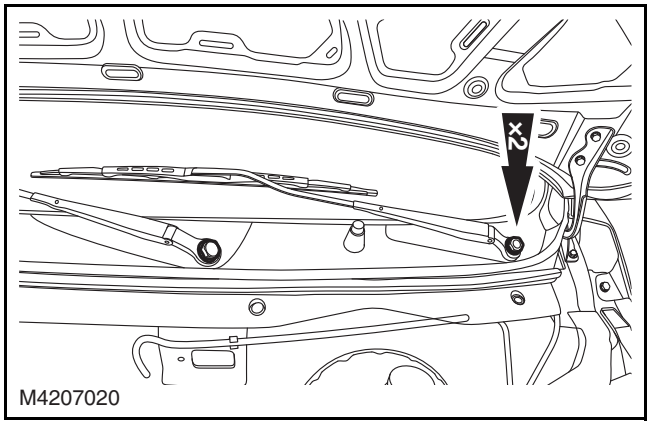
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove 2 retaining bolt covers from the master and sub wiper arms.


M4207019

3. Remove 2 retaining nuts from the master and sub wiper arms, and remove the wiper arm.

   Torque: 18 ~ 22 Nm



M4207020

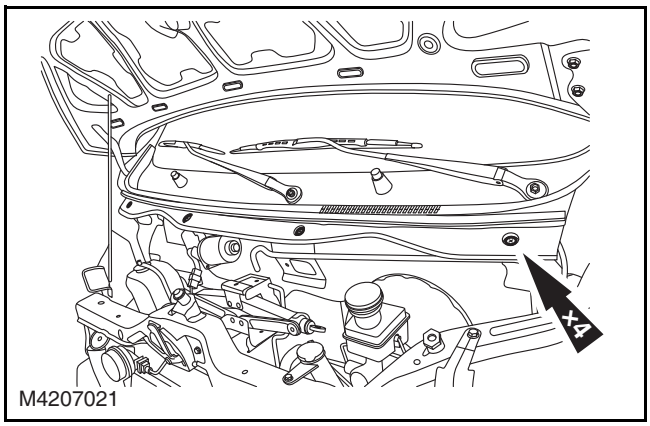
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**4.** Remove the cowl ornamentation.

**CAUTION: Do not damage the washer hose when separating the cowl ornamentation and front windshield.**

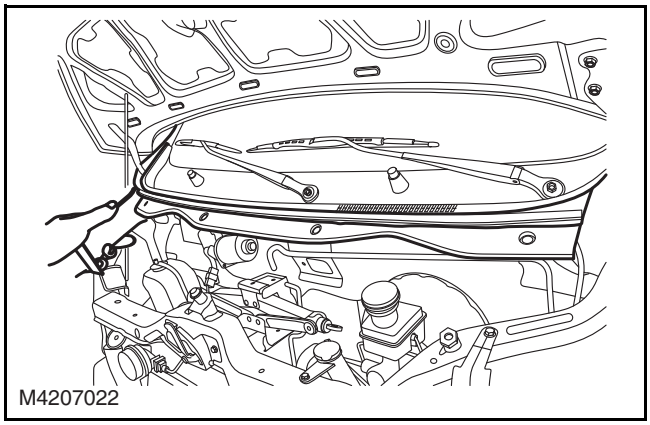
1 Remove 4 retaining clips from the cowl ornamentation.



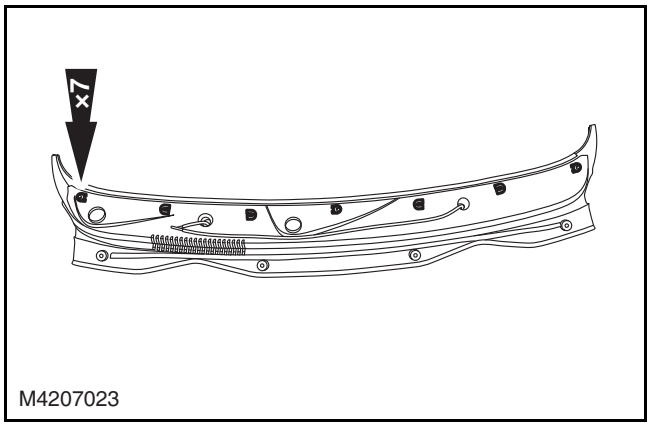
M4207021

2 Use the special tool to pry the cowl ornamentation.

Special tool: CA501-002


M4207022

3 The clip position is as shown in the figure.

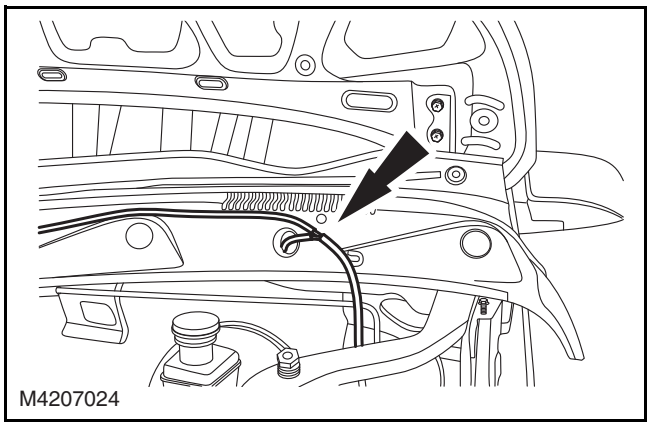


M4207023

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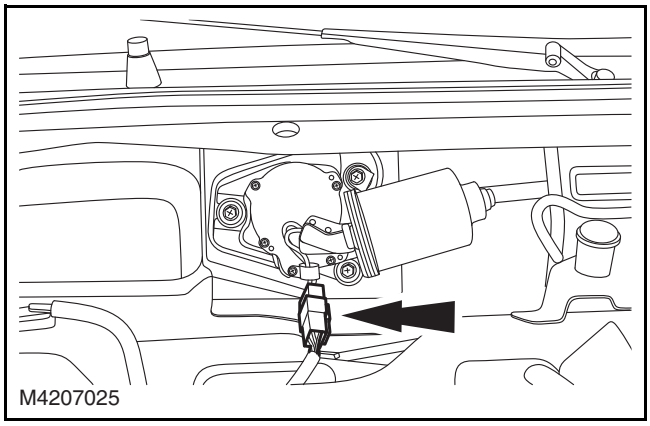


**5.** Disconnect the washer hose from the washer nozzle.


M4207024

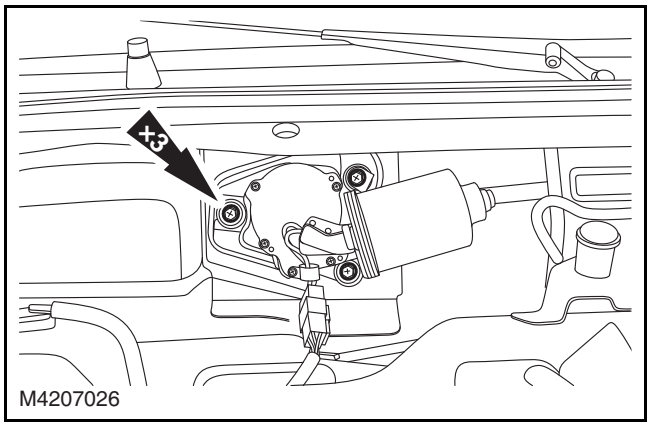
**6.** Remove the wiper motor.

1 Disconnect the wiper motor wiring harness connector.


M4207025

2 Remove 3 retaining bolts from the wiper motor, and remove the wiper motor.

Torque: 13 ± 2 Nm

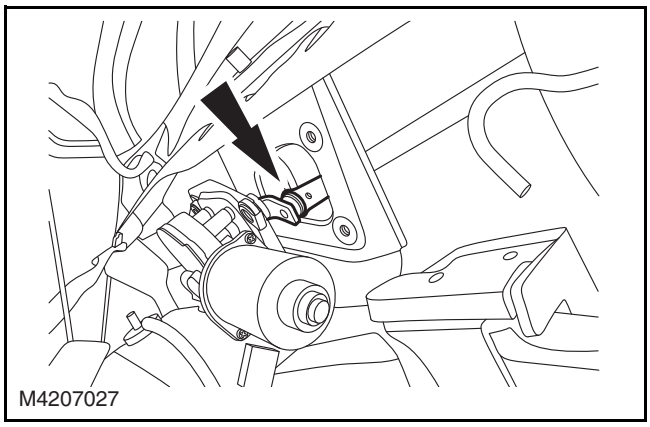


M4207026

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**7.** Separate the wiper motor crank ball joint from the wiper linkage.

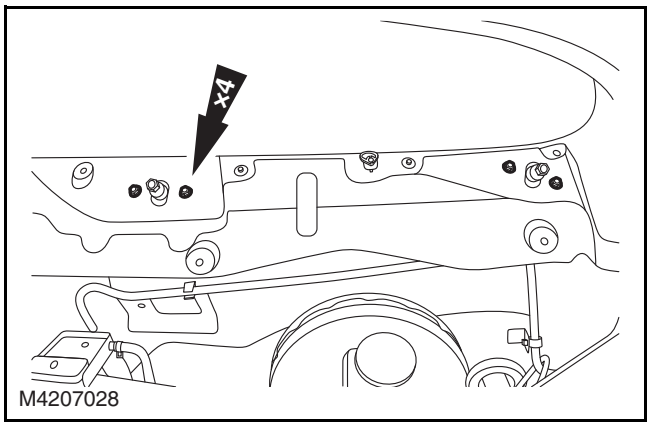

M4207027

**8.** Remove the wiper linkage.

1 Remove 4 retaining nuts from the wiper linkage.

Torque: 13 ± 2 Nm

2 Remove the wiper linkage.



M4207028

## Installation

**1.** Installation is in the reverse order of removal.

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# Washer Equipment

## Removal

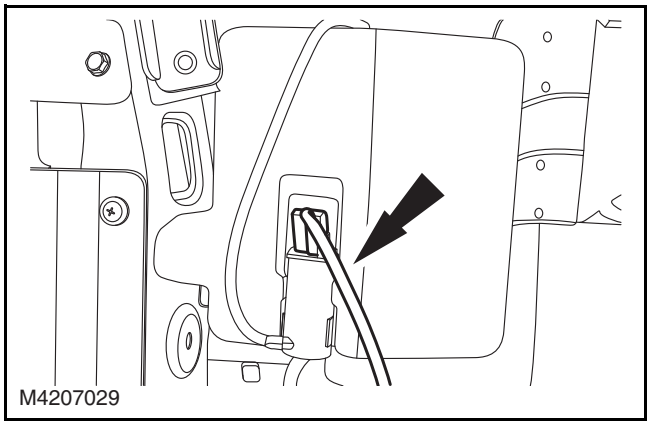
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the front bumper.

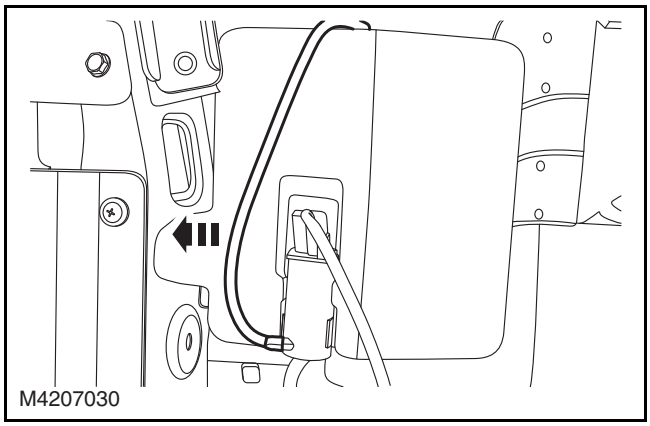
   **Refer to: Front Bumper (5.1.7 Bumper, Removal and Installation).**

3. Disconnect the washer wiring harness connector.

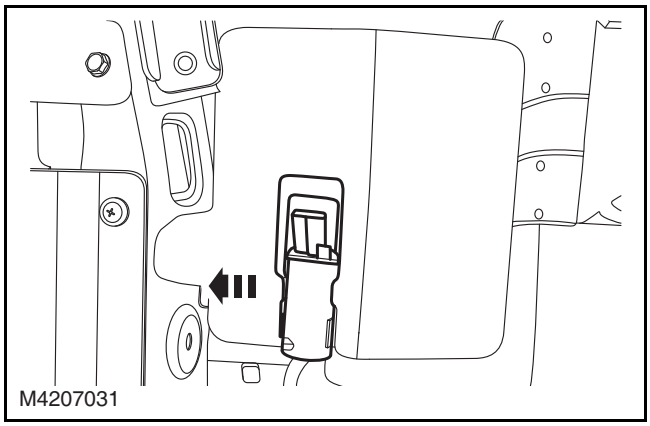



4. Disconnect the washer hose.

**CAUTION: Drain the washer fluid before disconnecting the washer hose.**




5. Remove the washer motor.



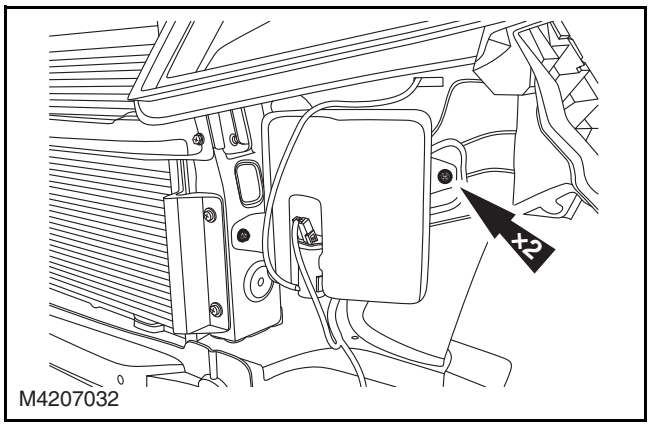
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**6.** Remove the washer reservoir.

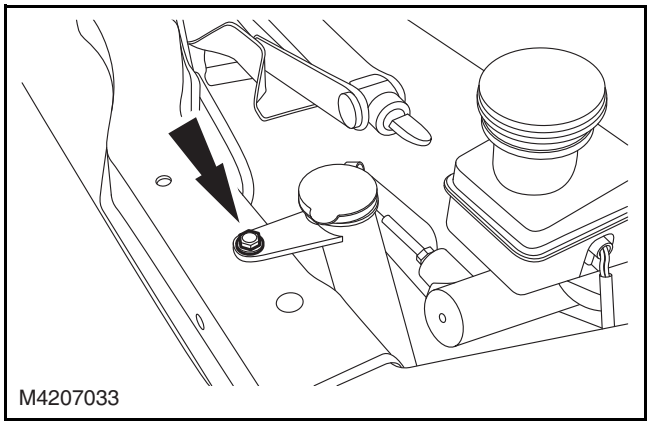
1 Remove 2 retaining bolts from the lower of washer reservoir.

Torque: 6 ~ 9 Nm




2 Remove the retaining bolt from the upper of washer reservoir, and remove the washer reservoir.

Torque: 6 ~ 9 Nm




## Installation

**1.** Installation is in the reverse order of removal.

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## Description and Operation

# System Overview

### Door Lock Function

When the ignition switch is turned to "OFF", or the key is pulled out, press the "lock" button of remote controller facing the vehicle, and all the doors will be locked. Meanwhile, the turn lamps blink once.

### Door Unlock Function

When the ignition switch is turned to "OFF", or the key is pulled out, press the "unlock" button of remote controller facing the vehicle, and all the doors will be unlocked. Meanwhile, the turn lamps blink twice.

### Remote Control Disabling Function

When the key is inserted into the ignition lock and turned to "ACC", the remote control function will be disabled.

### Central Control Function

When use the key to lock/unlock the front left door lock, or operate the lock button of front left door inside handle, the other door locks will do the same operation together.

### Remote Control Key Programming

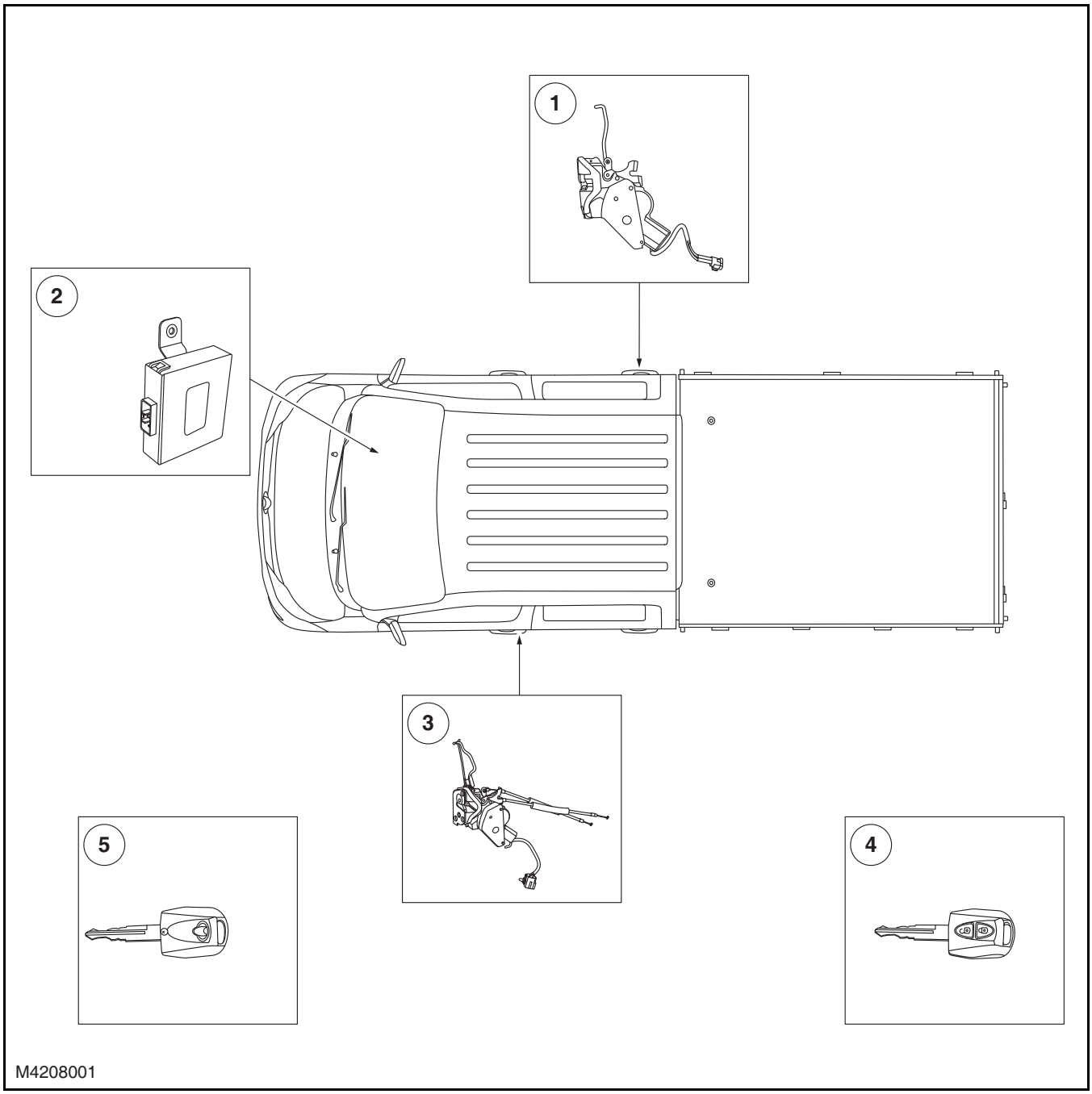
Perform the key programming according to the following procedures:

1. The ignition key switches five times between "OFF" and "ACC" in 15 s;
2. It returns to "OFF", and the turn lamps remain on, so that the learning key function is enabled;
3. Meanwhile press the unlock button of remote controller (it is effective if pressing within 10 s).
4. After key learning completion, the turn lamps come off. Exit the learn mode.

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# Components Location View




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Rear door lock latch | 4 | Key with remote control transmitter |
| 2 | Central lock controller | 5 | Mechanical key |
| 3 | Front door lock latch | | |

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |
| Diagnostic tool |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there are obvious mechanical or electrical damage and deformation due to collision.
3. Inspect system circuit that is accessible and visible.
4. If an observed or reported concern is obvious and its cause has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Lock latch<br>• Door misaligned<br>• Door inside handle<br>• Door outside handle<br>• Remote controller<br>• Door lock core<br>• Cable | • Door lock actuator<br>• Battery<br>• Fuse<br>• Wiring harness or connector<br>• Central lock controller |

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## Symptom Chart

If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| All functions of remote controller failure | • Remote controller fails to match | • Match the key again. |
| | • Remote control distance is too far, or strong interfering resource is nearby (mobile phone, launching pad, etc.) | • Eliminate the interference. |
| | • Remote controller battery is depleted | |
| | • A poor contact between remote controller and battery | • Replace or reinstall the remote controller battery. |
| | • Low battery voltage | • Charge the battery, and replace as necessary. |
| | • Remote controller is damaged | • Replace the remote controller. |
| | • Central lock controller | • Replace the central lock controller. |
| Single door lock does not work | • Wiring harness connector is loose | • Reconnect the wiring harness connector. |
| | • Door lock is damaged | • Replace the door lock. |
| | • Wiring harness fault | • Replace the wiring harness. |
| One or more doors cannot be locked or opened | • Door lock or door cable fault | • Replace the door lock or door cable. |
| Manual open and close door functions failure | • Lock core | • Reassemble the lock core or replace the vehicle lock core. |
| | • Door lock or outside handle assembly | • Replace the door lock or outside handle assembly. |
| Central control lock failure | • Door lock fuse | **Refer to: Diagnosis Procedure for Central Lock Failure (4.2.8 Central Door Lock, Symptom Diagnosis and Testing).** |
| | • Thermal protection for the door lock motor | |
| | • Wiring harness connector is loose | |
| | • Battery voltage | |
| | • Circuit | |
| | • Door lock motor | |
| | • Central lock controller | |

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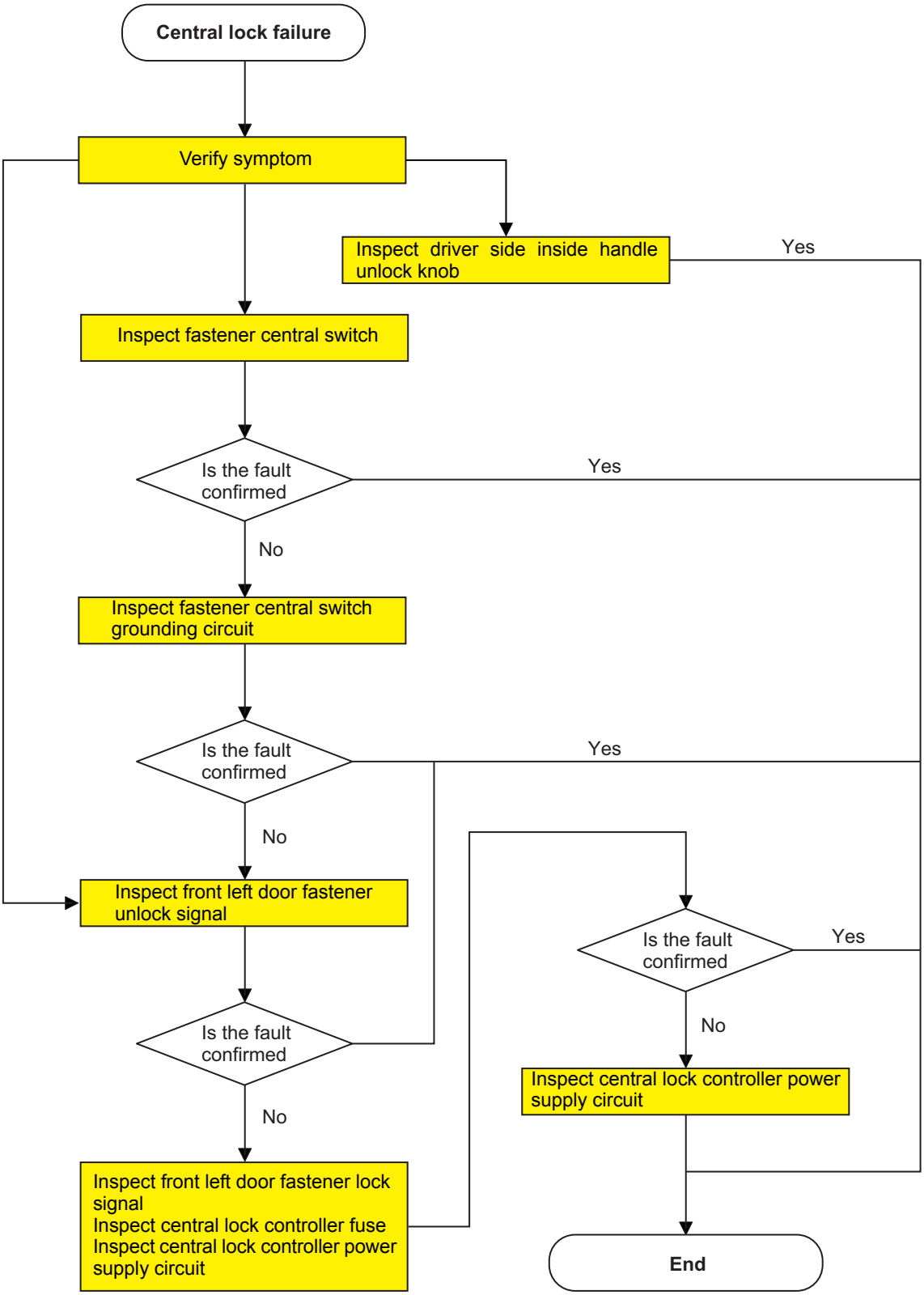


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Driver side door central lock failure | • Door lock motor<br>• Circuit<br>• Central lock controller | Refer to: Diagnosis Procedure for Driver Side Door Central Lock Failure (4.2.8 Central Door Lock, Symptom Diagnosis and Testing). |
| Passenger side door central lock failure | • Door lock motor<br>• Circuit<br>• Central lock controller | Refer to: Diagnosis Procedure for Passenger Side Door Central Lock Failure (4.2.8 Central Door Lock, Symptom Diagnosis and Testing). |
| Trunk lock opening failure | • Trunk cable<br>• Trunk lock latch<br>• Improper adjustment | • Replace the trunk cable.<br>• Replace the trunk lock latch.<br>• Adjust the trunk lock. |
| Central lock is normal but remote controller fails. | • Remote controller fails to match correctly<br>• Remote controller<br>• Central lock controller | Refer to: Diagnosis Procedure for Remote Controller Failure with Central Lock Normal (4.2.8 Central Door Lock, Symptom Diagnosis and Testing). |

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# Diagnosis Procedure for Central Lock Failure



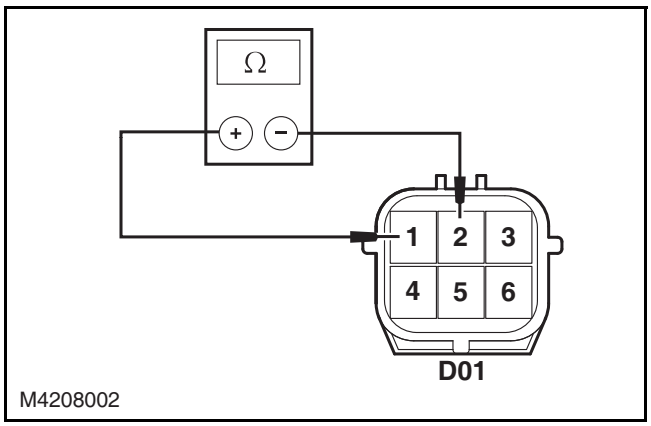
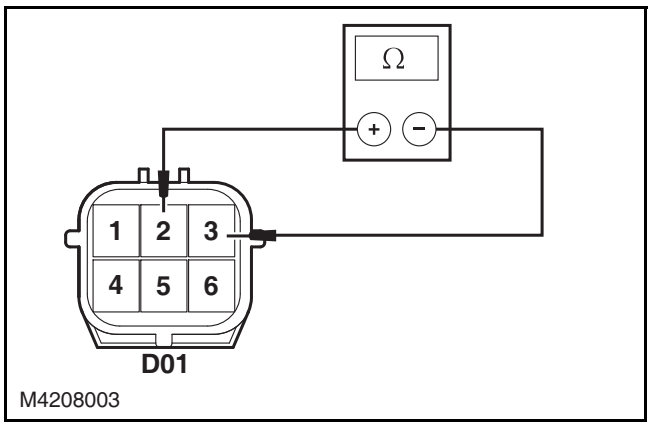
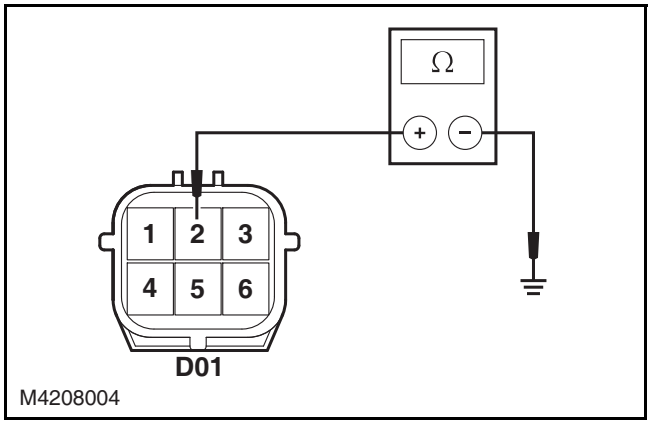
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify symptom | |
| | A. Press the lock button on the remote controller.<br>B. Press the unlock knob on the driver side inside handle.<br>C. Use a mechanical key to execute the lock/unlock function from the outside of driver side door.<br>D. Verify the operation result.<br>Does the central lock not work during all the operations above?<br>**Yes**<br>Go to step 5.<br>**No**<br>If the central lock does not work when pressing the lock button on the remote controller, inspect the remote controller battery.<br>If the central lock does not work when pressing the unlock knob on the driver side inside handle, go to step 2.<br>If the central lock does not work when using a mechanical key to execute the lock/unlock function from the outside of driver side door, go to step 3. |
| 2. Inspect driver side inside handle unlock knob | |
| | A. Remove the front left door trim panel.<br>**Refer to: Front Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**<br>B. Inspect the connection cable between unlock knob on the driver side inside handle and door lock latch.<br>Is the connection normal?<br>**Yes**<br>Replace the front left door lock latch.<br>**No**<br>Inspect and repair the connection cable between unlock knob on the driver side inside handle and door lock latch, and replace as necessary. |

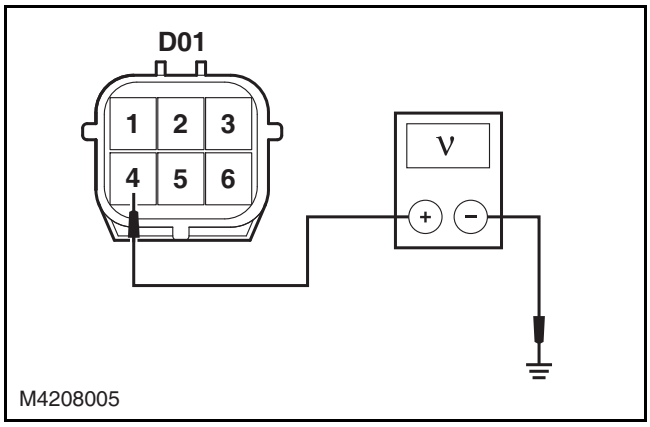
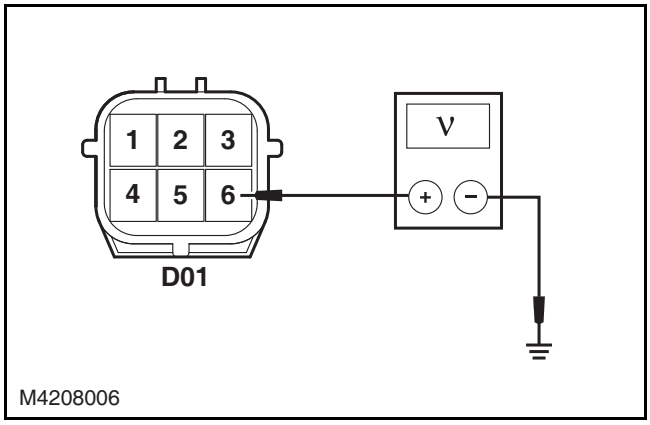
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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect fastener central switch | |
|  M4208002<br>  M4208003 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left door fastener wiring harness connector D01, and take out terminals 1 and 2 from it.<br>C. Connect the front left door fastener wiring harness connector D01, and insert the key into the front left door lock core to perform unlock function.<br>D. Measure the resistance between terminals 1 and 2 of front left door fastener.<br>**Standard resistance: less than 5 Ω**<br>E. Take out the terminals 2 and 3 of front left door fastener wiring harness connector D01.<br>F. Insert the key into the front left door lock core to perform lock function, and measure the resistance between terminals 2 and 3 of front left door fastener.<br>**Standard resistance: less than 5 Ω**<br>Is the switch normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the front left door lock latch.<br>**Refer to: Front Door Lock Latch (4.2.8 Central Door Lock, Removal and Installation).** |
| 4. Inspect fastener central switch grounding circuit | |
|  M4208004 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left door fastener wiring harness connector D01.<br>C. Measure the resistance between terminal 2 of front left door fastener wiring harness connector D01 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of front left door fastener wiring harness connector D01 and grounding point G103. |

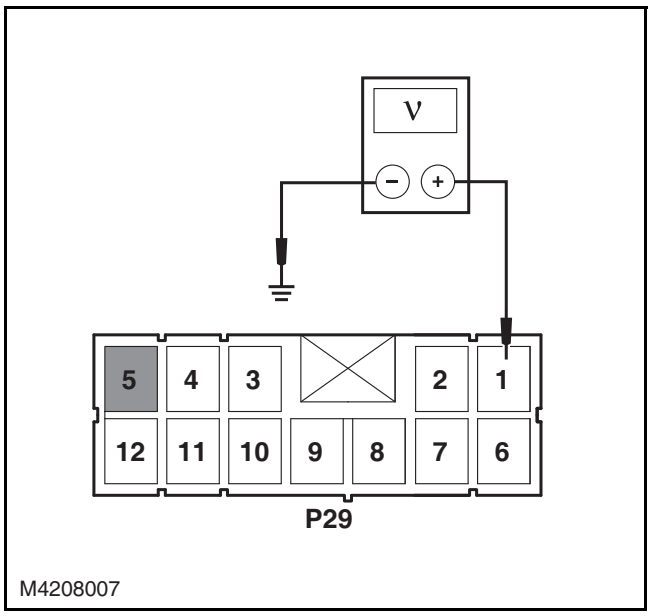
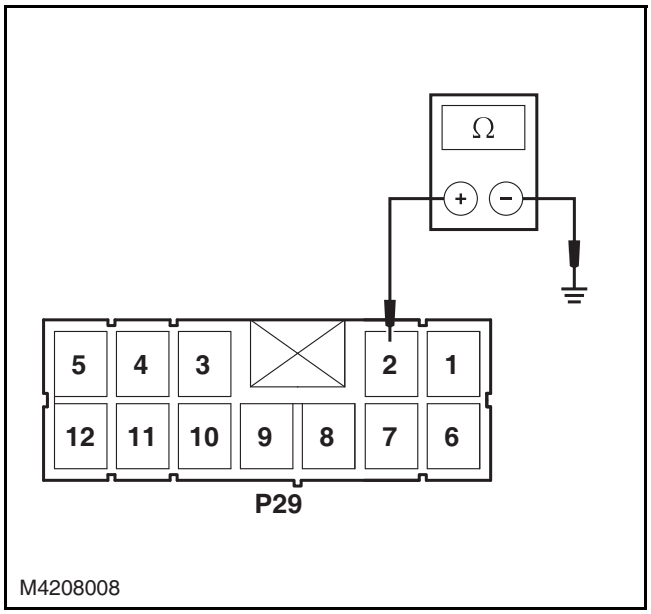
https://truckmanualshub.com/



| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect front left door fastener unlock signal | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left door fastener wiring harness connector D01, and take out the terminal 4 from it.<br>C. Connect the front left door fastener wiring harness connector D01, and perform unlock function.<br>D. Measure the voltage between the removed terminal 4 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of front left door fastener wiring harness connector D01 and terminal 8 of central lock controller wiring harness connector P29. |
| 6. Inspect front left door fastener lock signal | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left door fastener wiring harness connector D01, and take out the terminal 6 from it.<br>C. Connect the front left door fastener wiring harness connector D01, and perform lock function.<br>D. Measure the voltage between the removed terminal 6 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of front left door fastener wiring harness connector D01 and terminal 9 of central lock controller wiring harness connector P29. |
| 7. Inspect central lock controller fuse | |
| | A. Inspect the central lock controller fuse IF22, IF40.<br>**Rated capacity: 20 A (IF22), 15A (IF40)**<br>Is the fuse normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

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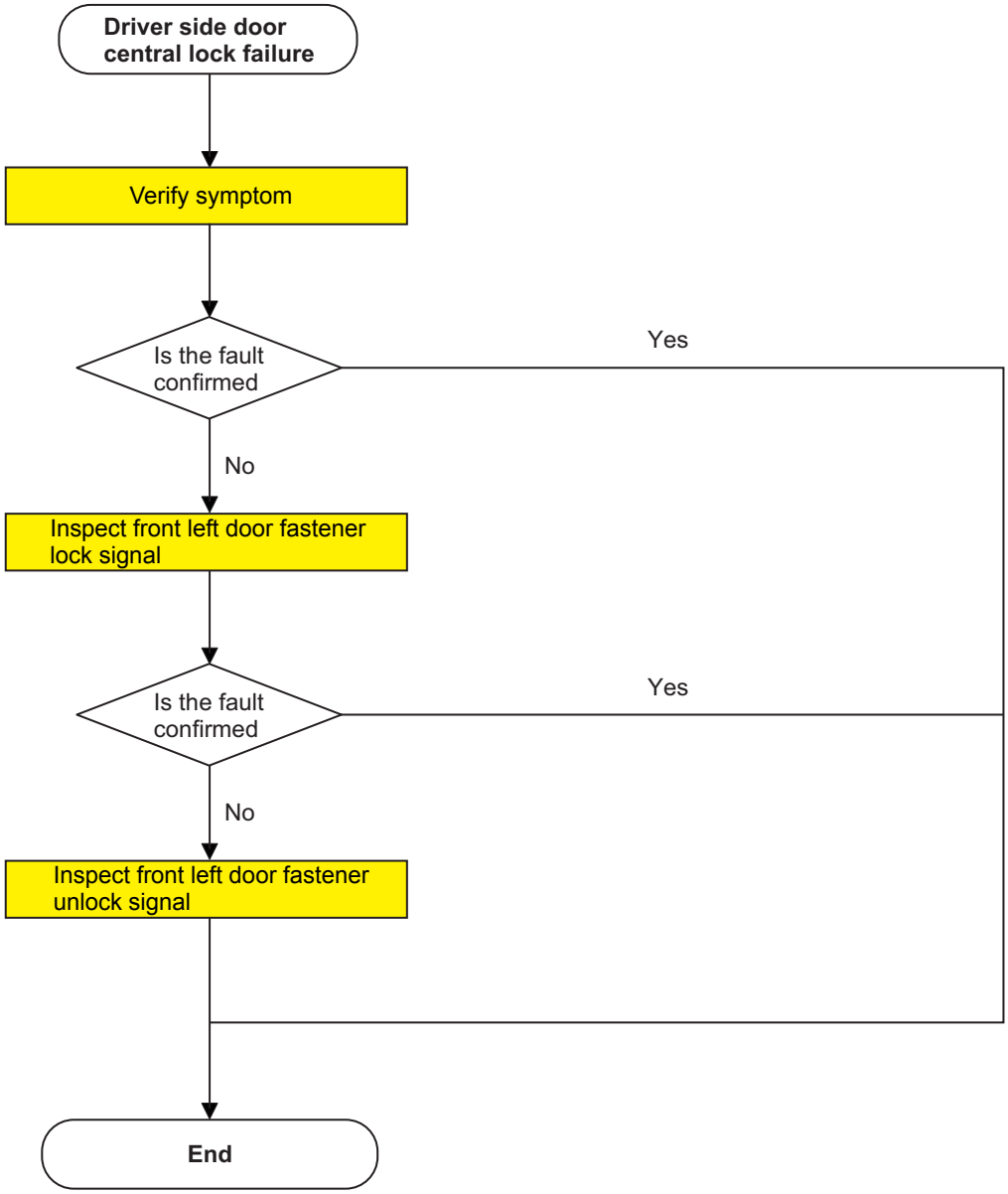


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect central lock controller power supply circuit | |
|  M4208007 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the central lock controller wiring harness connector P29.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminals 1 and 5 of central lock controller wiring harness connector P29 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the central lock controller power supply malfunction circuit. |
| 9. Inspect central lock controller power supply circuit | |
|  M4208008 | A. Turn the ignition switch to "LOCK", and disconnect the negative battery cable.<br>B. Disconnect the central lock controller wiring harness connector P29.<br>C. Measure the resistance between terminal 2 of central lock controller wiring harness connector P29 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the central lock controller.<br>**Refer to: Central Lock Controller (4.2.10 Body Control System, Removal and Installation).**<br>Make sure the system is normal.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of central lock controller wiring harness connector P29 and grounding point G105. |

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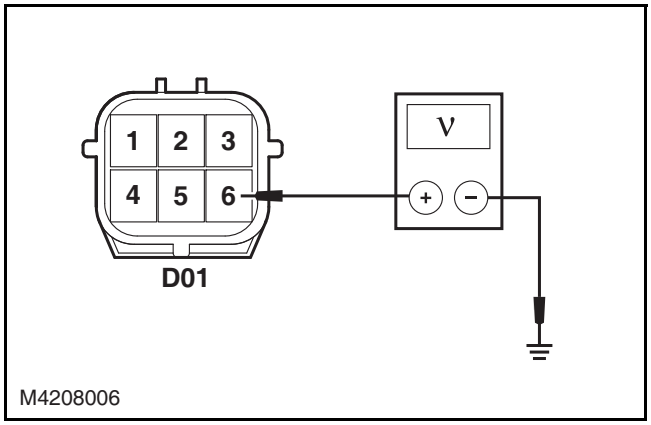


# Diagnosis Procedure for Driver Side Door Central Lock Failure



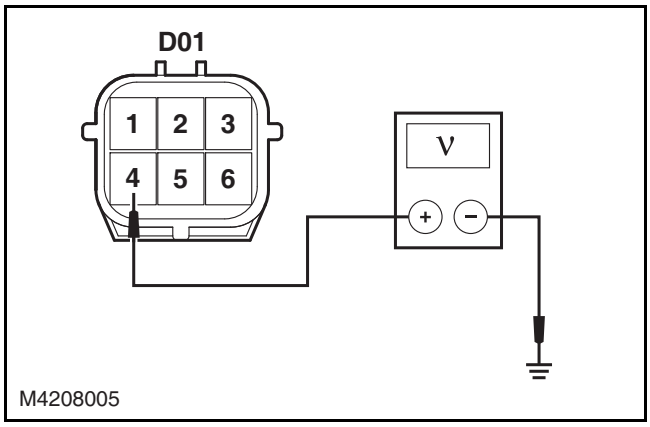
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify symptom | |
| | A. Press the unlock knob on the driver side inside handle.<br>B. Verify the failure.<br>Does only the driver side door central lock fail?<br>**Yes**<br>Go to step 2.<br>**No**<br>**Refer to: Symptom Chart (4.2.8 Central Door Lock, Symptom Diagnosis and Testing).** |
| 2. Inspect front left door fastener lock signal | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left door fastener wiring harness connector D01, and take out the terminal 6 from it.<br>C. Connect the front left door fastener wiring harness connector D01, and perform lock function.<br>D. Measure the voltage between the removed terminal 6 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of front left door fastener wiring harness connector D01 and terminal 9 of central lock controller wiring harness connector P29. |

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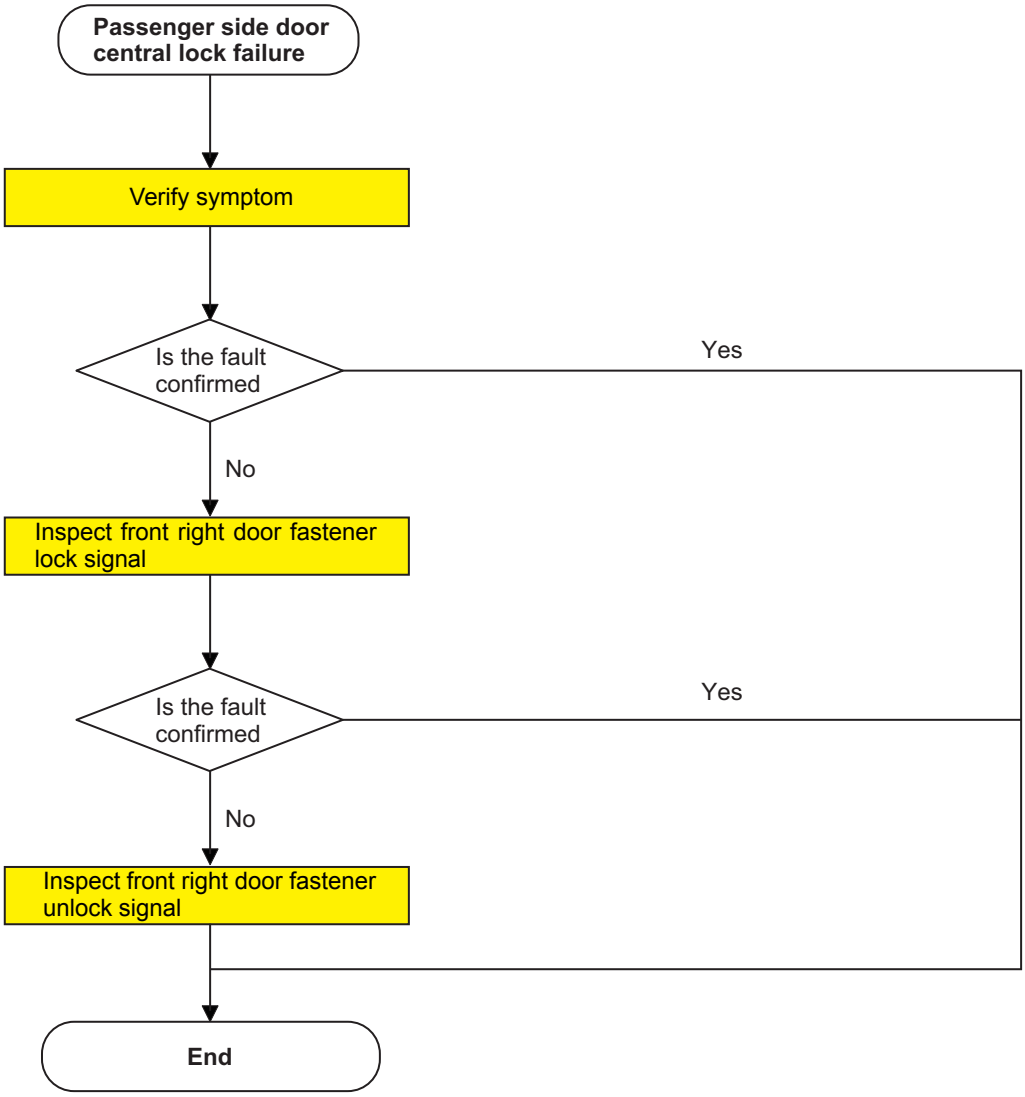


| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect front left door fastener unlock signal | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front left door fastener wiring harness connector D01, and take out the terminal 4 from it.<br>C. Connect the front left door fastener wiring harness connector D01, and perform unlock function.<br>D. Measure the voltage between the removed terminal 4 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the front left door lock latch.<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of front left door fastener wiring harness connector D01 and terminal 8 of central lock controller wiring harness connector P29. |

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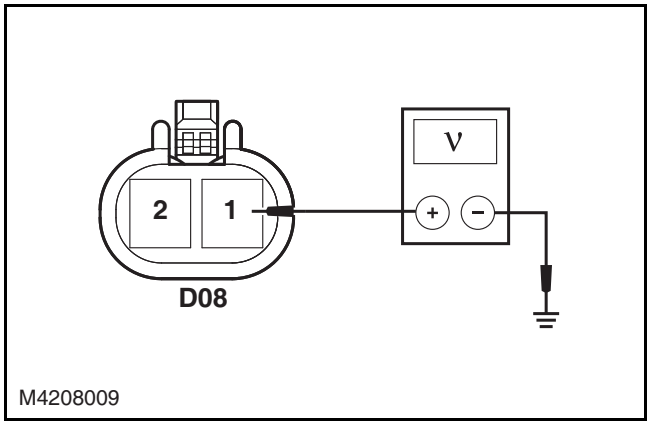


# Diagnosis Procedure for Passenger Side Door Central Lock Failure



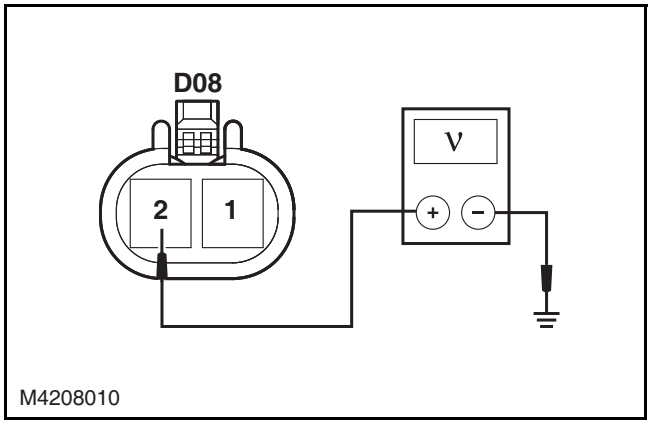
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify symptom | |
| | A. Press the unlock knob on the driver side inside handle.<br>B. Verify the failure.<br>Does only the passenger side door central lock fail?<br>**Yes**<br>Go to step 2.<br>**No**<br>**Refer to: Symptom Chart (4.2.8 Central Door Lock, Symptom Diagnosis and Testing).** |
| 2. Inspect front right door fastener lock signal | |
|  | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front right door fastener wiring harness connector D08, and take out the terminal 1 from it.<br>C. Connect the front right door fastener wiring harness connector D08, and perform lock function.<br>D. Measure the voltage between the removed terminal 1 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of front right door fastener wiring harness connector D08 and terminal 9 of central lock controller wiring harness connector P29. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 3. Inspect front right door fastener unlock signal | |
|  <br>M4208010 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the front right door fastener wiring harness connector D08, and take out the terminal 2 from it.<br>C. Connect the front right door fastener wiring harness connector D08, and perform unlock function.<br>D. Measure the voltage between the removed terminal 2 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Replace the front right door lock latch.<br>**No**<br>Inspect and repair the open circuit fault between terminal 2 of front right door fastener wiring harness connector D08 and terminal 8 of central lock controller wiring harness connector P29. |

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# Diagnosis Procedure for Remote Controller Failure with Central Lock Normal

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Inspect remote controller battery | |
| | A. Inspect the voltage of remote controller battery.<br>**Standard voltage: more than 2.9 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace the remote controller battery. |
| 2. Programme remote controller key again | |
| | A. Match the remote controller.<br>**Refer to: Remote Control Key Programming (4.2.8 Central Door Lock, Description and Operation).**<br>Does it return to normal?<br>**Yes**<br>The system is normal.<br>**No**<br>Replace with a new remote controller and program it. |

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## Removal and Installation

# Front Door Lock Latch

Refer to: Front Door Lock Latch (5.1.8 Handles, Locks and Latches, Removal and Installation)

# Rear Door Lock Latch

Refer to: Rear Door Lock Latch (5.1.8 Handles, Locks and Latches, Removal and Installation)

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## Specifications

# General Specifications

| Item | Rated Voltage | Rated Current |
|---|---|---|
| Window motor | 12 V (DC) | - |

# Torque Specifications

| Item | Nm | lb-ft | Lb-in |
|---|---|---|---|
| Window glass regulator | 8 ~ 12 | - | - |

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## Description and Operation

# System Overview

Power windows are provided for both the front doors in the standard configuration, and just press the glass regulator button when the door glass up/down is needed. The power window main switch is on the front left door interior trim panel. The left button of power window main switch controls the front left door glass up/down, and the right button controls the front right door glass up/down; the switches on the right door control the right door glass. For the power window switch, push it to lower the window glass automatically (glass open). Pull it to raise the window glass (glass closed).

### Auto Down Function

The driver window has "Auto Down" function which can be activated by pressing the driver window switch fully and then releasing it. To stop the window before it reaches the bottom, slightly pull the switch.

### Lock Switch Function

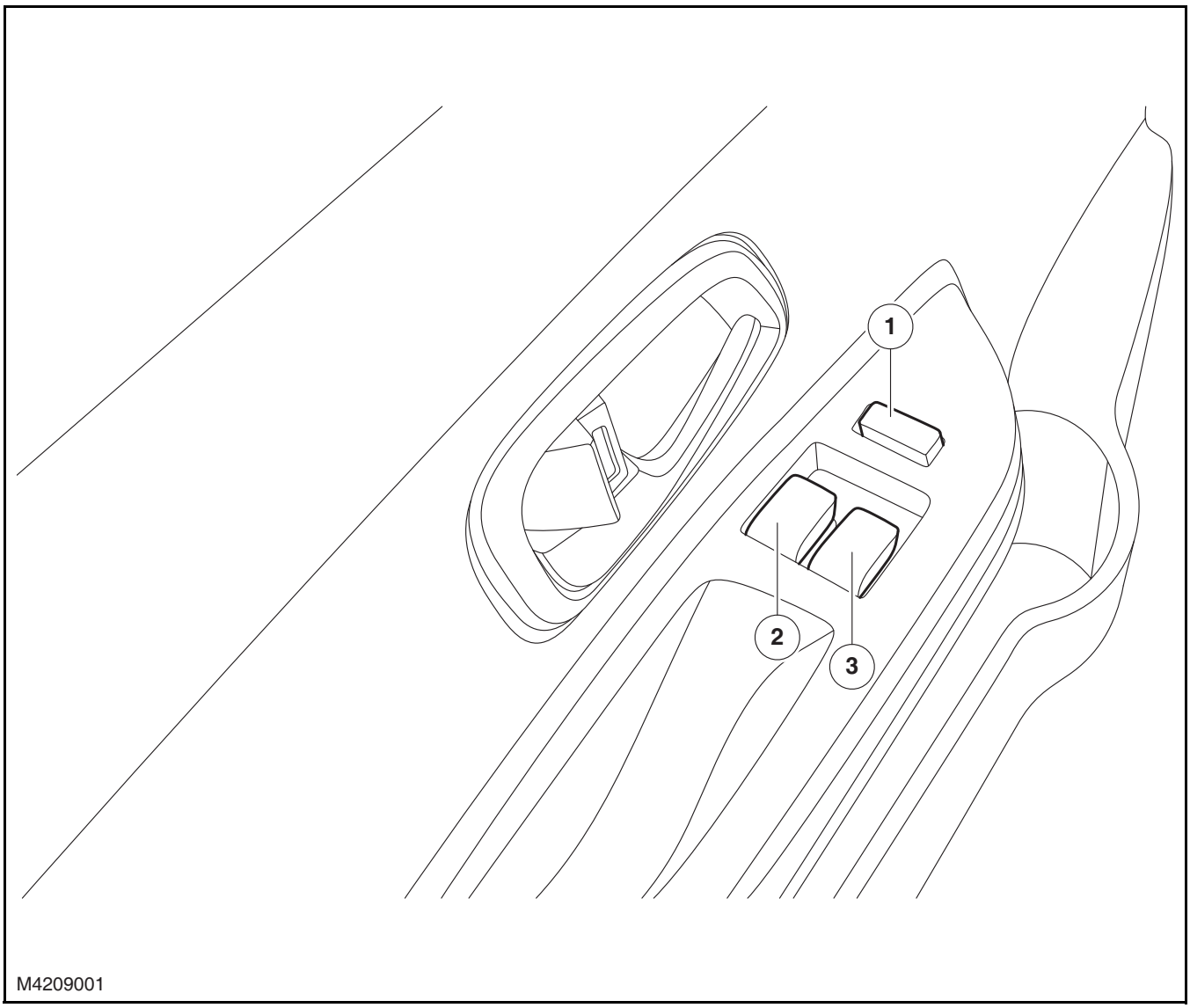
The driver door is equipped with a lock switch used for the passenger windows. Once it is pressed, the passenger windows cannot be raised/lowered. To return to normal operation, press the lock switch again and then release it.

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# Components Location View

## Power Window Switch

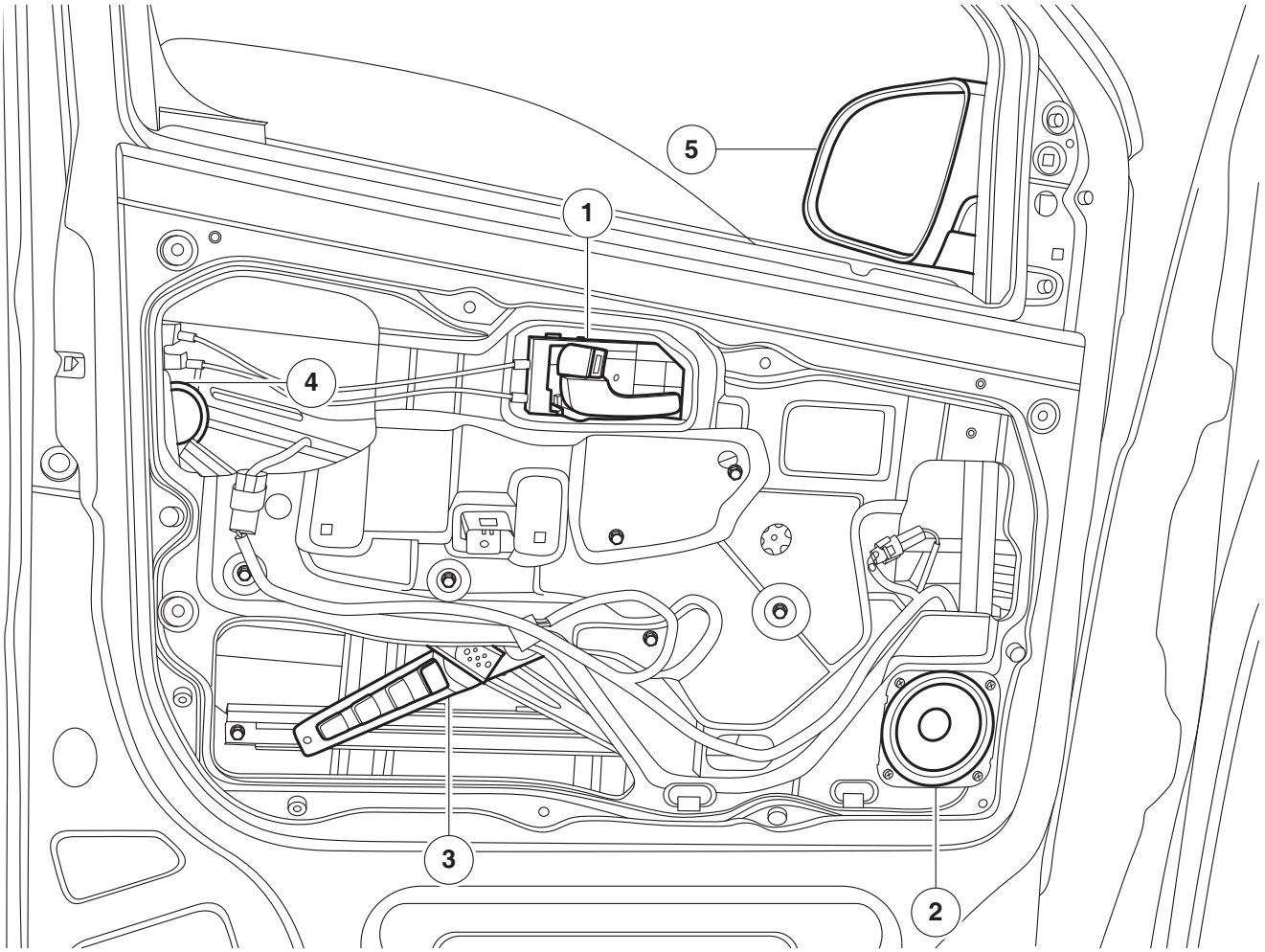



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Window lock switch | 3 | Passenger side window regulator switch |
| 2 | Driver side window regulator switch | | |

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## Driver Side Door Component



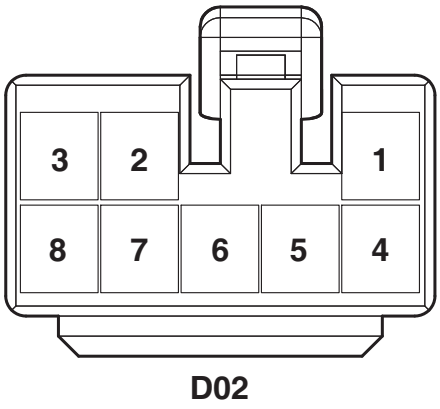

M4209002

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Inside handle | 4 | Door lock motor assembly |
| 2 | Front door speaker | 5 | Rearview mirror |
| 3 | Window glass regulator | | |

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# Driver Side Power Window Switch Terminal View




M4209003

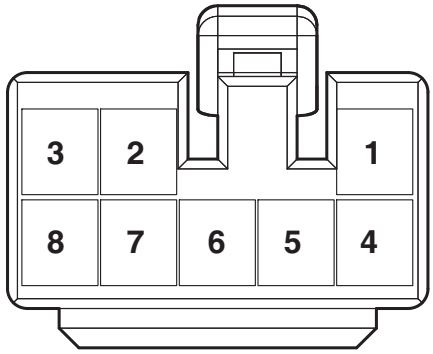
**Driver Side Power Window Switch Terminal Definition**

| Terminal No. | Connection Wire | Terminal Description |
|---|---|---|
| D02-1 | 2.0 BK | GND |
| D02-2 | 2.0 RD/WH | Passenger side door glass up control |
| D02-3 | 2.0 GN/WH | Passenger side door glass down control |
| D02-4 | 2.0 RD | Driver side door glass up power supply |
| D02-5 | - | - |
| D02-6 | 2.0 RD/YE | Front right door control power supply output |
| D02-7 | 2.0 WH/BN | Power window main switch power supply |
| D02-8 | 2.0 GN | Driver side door glass down power supply |

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# Passenger Side Power Window Switch Terminal View




D07

M4209004

**Passenger Side Power Window Switch Terminal Definition**

| Terminal No. | Connection Wire | Terminal Description |
|---|---|---|
| D07-1 | 2.0 RD | Passenger side door glass up power supply |
| D07-2 | 2.0 GN/WH | Passenger side glass down signal controlled by driver side |
| D07-3 | 2.0 GN | Passenger side door glass down power supply |
| D07-4 | 2.0 BK | GND |
| D07-5 | - | - |
| D07-6 | 2.0 RD/WH | Passenger side glass up signal controlled by driver side |
| D07-7 | 2.0 RD/YE | Front right door control power supply |
| D07-8 | 2.0 BU/YE | Front right door power window switch power supply |

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## Symptom Diagnosis and Testing

### General Equipment

| |
|---|
| Digital multimeter |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check for obvious mechanical or electrical damage and deformation due to collision.

### Visual Inspection Chart

| Mechanical | Electrical |
|---|---|
| • Window seal<br>• Window frame<br>• Door<br>• Door interior trim panel | • Fuse<br>• Window regulator motor<br>• Circuit<br>• Window regulator switch |

3. Inspect the system circuit which is accessible or visible.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

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## Symptom Chart

If the fault occurs and cannot confirm the cause by basic inspection, diagnose and repair it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| All power windows fail to work | • Circuit fault<br>• Window switch<br>• Fuse | **Refer to: Diagnosis Procedure for All Power Windows Failing to Work (4.2.9 Power Window, Symptom Diagnosis and Testing).** |
| Only one power window fails to work | • Circuit fault<br>• Window switch | **Refer to: Diagnosis Procedure for Driver Side Power Window Failing to Work (4.2.9 Power Window, Symptom Diagnosis and Testing).**<br>**Refer to: Diagnosis Procedure for Passenger Side Power Window Failing to Work (4.2.9 Power Window, Symptom Diagnosis and Testing).** |
| Inching down function fault | • Power window main switch fault | **Refer to: Diagnosis Procedure for Inching Down Function Fault (4.2.9 Power Window, Symptom Diagnosis and Testing).** |
| Power window unable to reach top | • Circuit fault<br>• Window glass regulator motor<br>• Glass guide rail<br>• Glass run<br>• Door | • Inspect and repair the circuit.<br>• Replace the window glass regulator motor.<br>• Inspect and repair or replace the glass guide rail.<br>• Inspect and repair or replace the glass run.<br>• Inspect and repair the door. |

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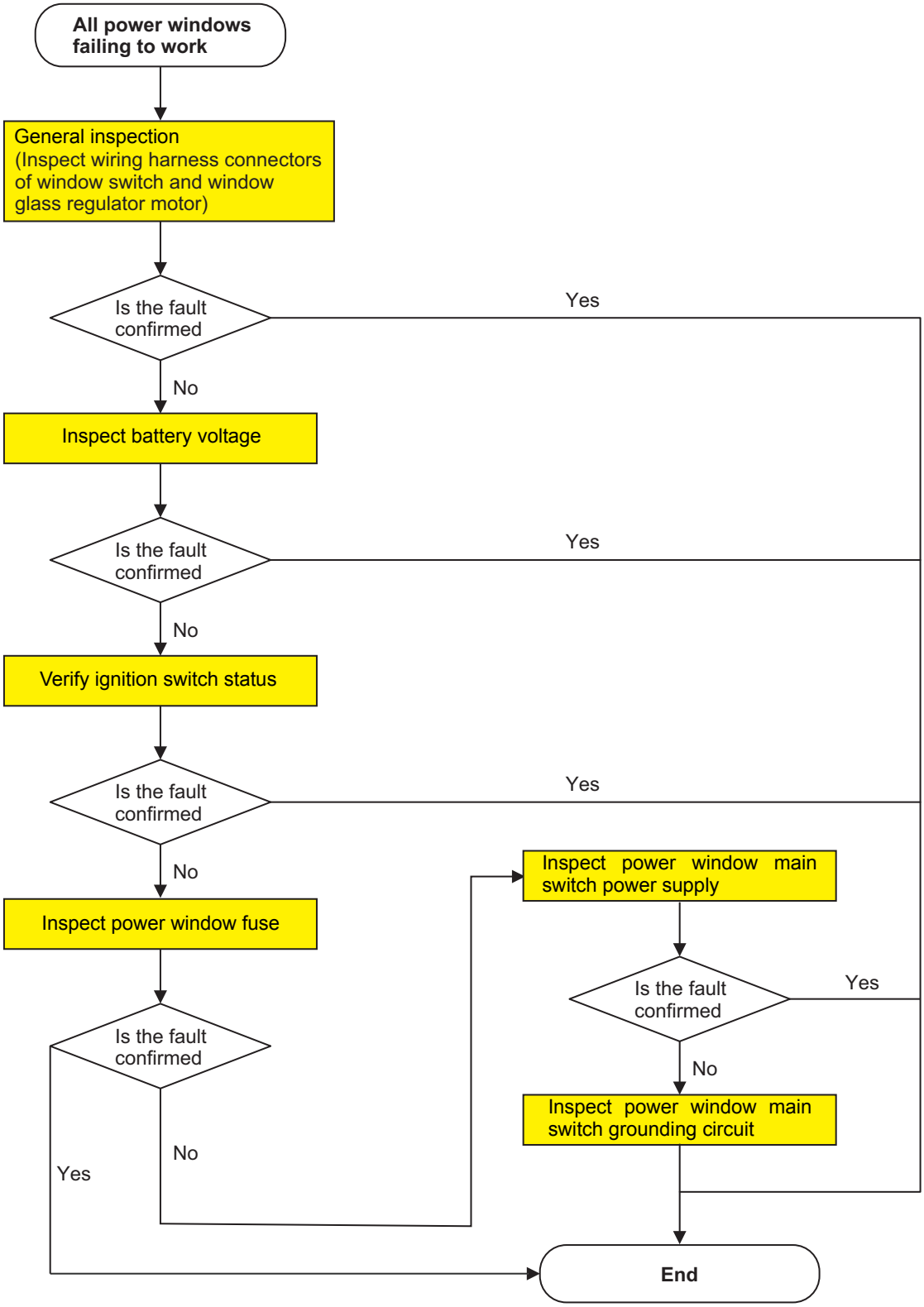


| Symptom | Possible Causes | Solutions |
|---|---|---|
| Power window displacement in regulating | • Window glass regulator motor<br>• Glass guide rail<br>• Glass run<br>• Door | • Replace the window glass regulator motor.<br>• Inspect and repair or replace the glass guide rail.<br>• Inspect and repair or replace the glass run.<br>• Inspect and repair the door. |
| Power window regulating slowly | • Circuit fault<br>• Low battery voltage<br>• Window glass regulator motor<br>• Glass guide rail<br>• Glass run<br>• Door | • Inspect and repair the circuit.<br>• Inspect and repair the charging system.<br>• Replace the battery.<br>• Inspect and repair or replace the glass guide rail.<br>• Inspect and repair or replace the glass run.<br>• Inspect and repair the door.<br>• Replace the window glass regulator motor. |

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# Diagnosis Procedure for All Power Windows Failing to Work



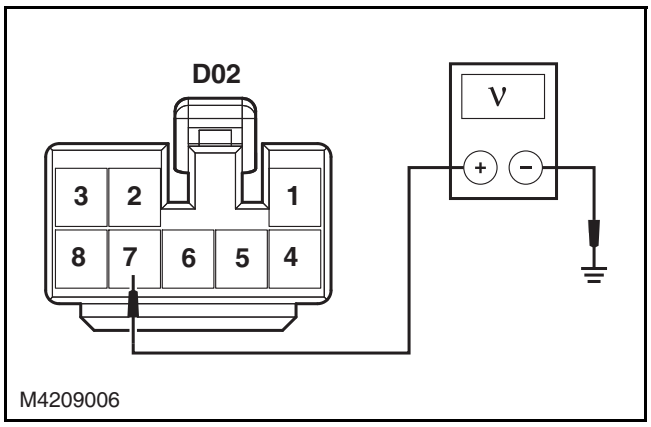
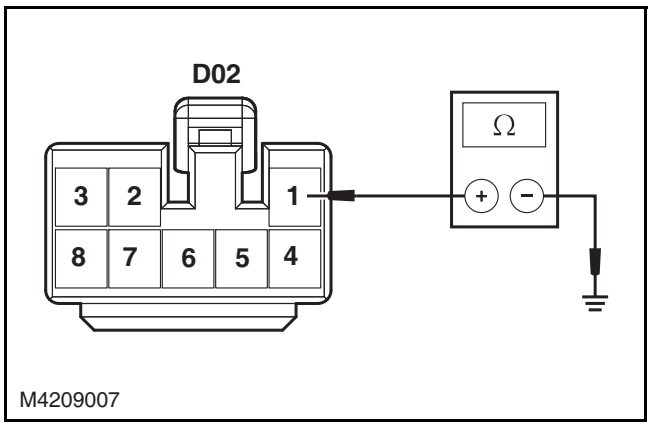
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors of window switch and window glass regulator motor for damage, poor contact, aging or looseness.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect battery voltage | |
| | A. Turn the ignition switch to "ON", and use the multimeter to inspect the battery voltage.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the charging system.<br>**Refer to: Battery Undercharge, Battery Overcharge (3.1.10 Charging System, Symptom Diagnosis and Testing).** |
| 3. Verify ignition switch status | |
| | A. Turn the ignition switch to "ACC".<br>Is the ignition switch status normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the ignition switch. |
| 4. Inspect power window fuse | |
| | A. Inspect the power window fuse IF27 and IF28.<br>**Fuse IF27 rated capacity: 30 A**<br>**Fuse IF28 rated capacity: 20 A**<br>Are the fuses normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |

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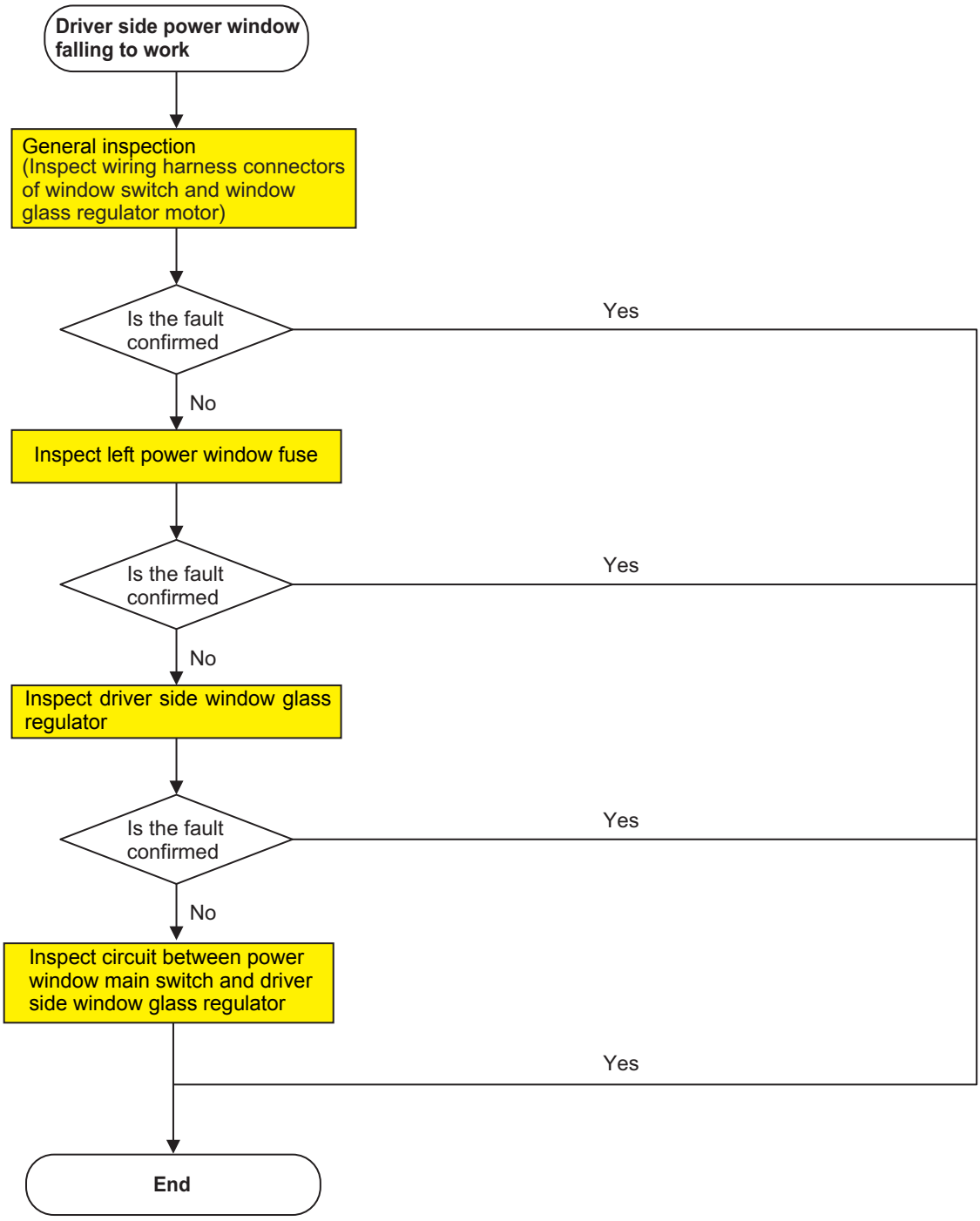


| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Inspect power window main switch power supply | |
|  M4209006 | A. Turn the ignition switch to "ON".<br>B. Disconnect the power window main switch wiring harness connector D02.<br>C. Measure the voltage between terminal 7 of power window main switch wiring harness connector D02 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 7 of power window main switch wiring harness connector D02 and terminal 54 of instrument panel fuse box fuse IF27. |
| 6. Inspect power window main switch grounding circuit | |
|  M4209007 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the power window main switch wiring harness connector D02.<br>C. Measure the resistance between terminal 1 of power window main switch wiring harness connector D02 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Replace the power window main switch.<br>**No**<br>Inspect and repair the open circuit fault between terminal 1 of power window main switch wiring harness connector D02 and grounding G103. |

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# Diagnosis Procedure for Driver Side Power Window Failing to Work



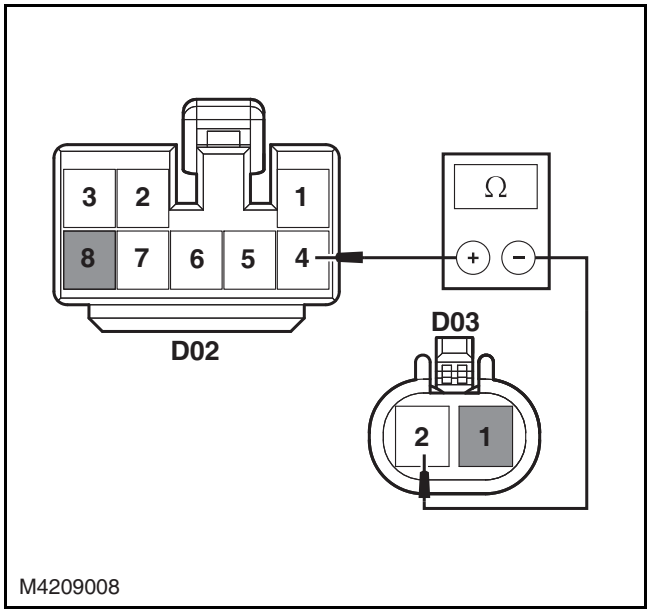
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors of window switch and window glass regulator motor for damage, poor contact, aging or looseness.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect left power window fuse | |
| | A. Inspect the left power window fuse IF27.<br>**Fuse rated capacity: 30 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect driver side window glass regulator | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the driver side window glass regulator wiring harness connector D03.<br>C. Apply power supply voltage of 12 V to the driver side window glass regulator, and inspect the window glass regulator operation.<br>Is the operation normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Replace the driver side window glass regulator. |

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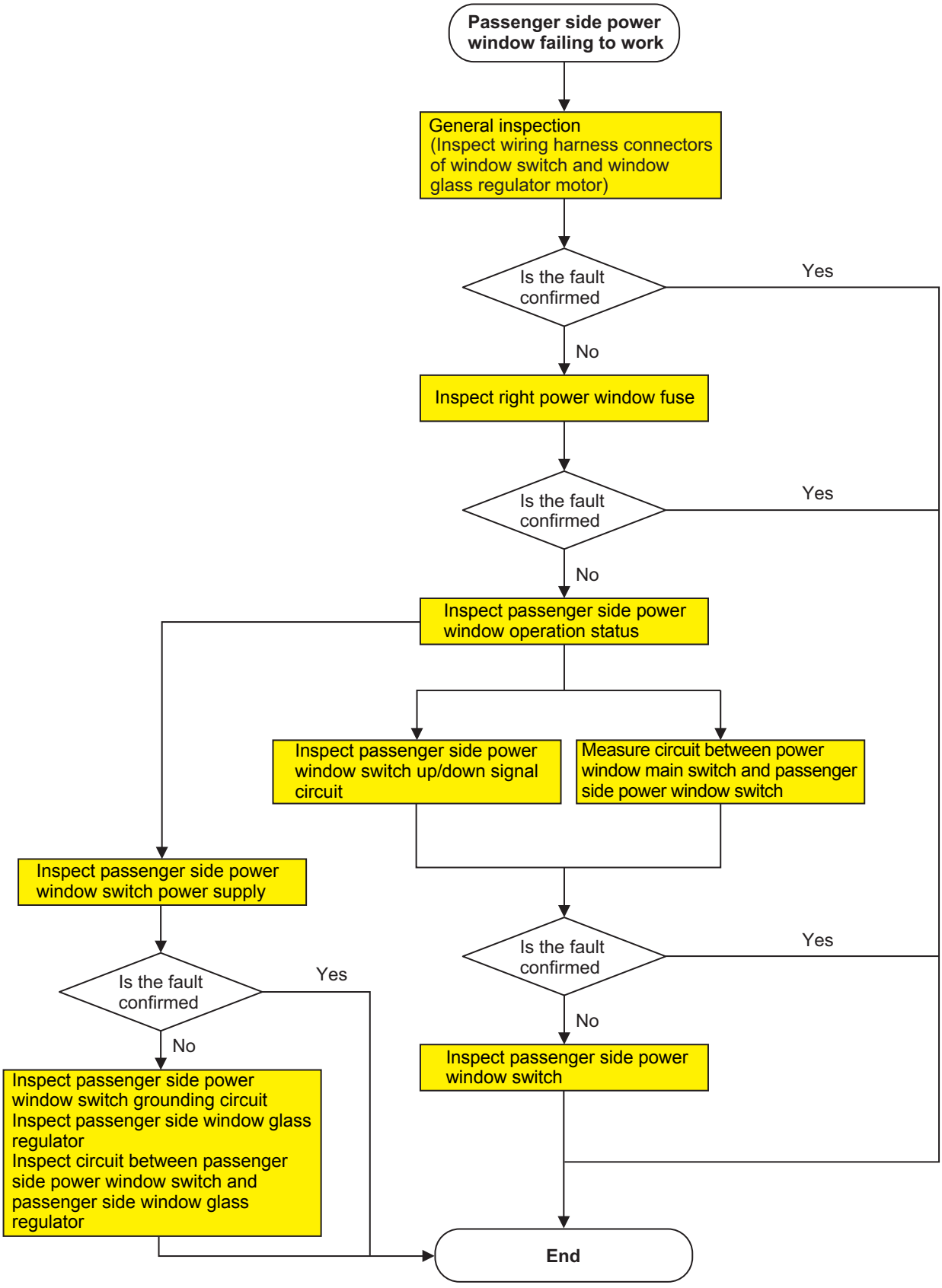


| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect circuit between power window main switch and driver side window glass regulator | |
|  <br>M4209008 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the power window main switch wiring harness connector D02 and driver side window glass regulator wiring harness connector D03.<br>C. Measure the resistance between terminals 4, 8 of power window main switch wiring harness connector D02 and terminals 2, 1 of driver side window glass regulator wiring harness connector D03.<br>**Yes**<br>Replace the power window main switch.<br>**Refer to: Power Window Switch (4.2.9 Power Window, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminals 4, 8 of power window main switch wiring harness connector D02 and terminals 2, 1 of driver side window glass regulator wiring harness connector D03. |

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# Diagnosis Procedure for Passenger Side Power Window Failing to Work



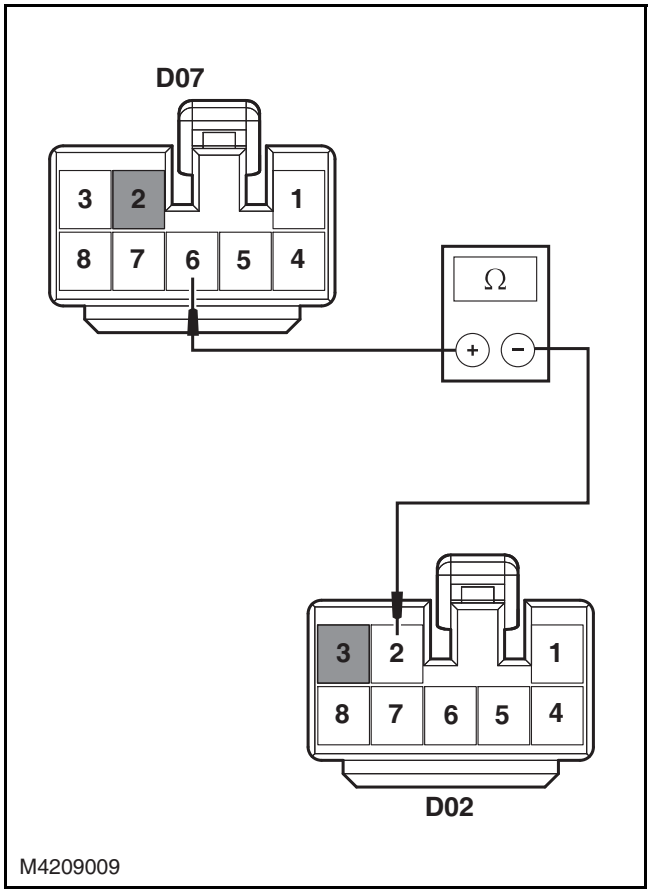
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. General inspection | |
| | A. Inspect the wiring harness connectors of window switch and window glass regulator motor for damage, poor contact, aging or looseness.<br>Are they normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Repair the fault. |
| 2. Inspect right power window fuse | |
| | A. Inspect the right power window fuse IF28.<br>**Fuse rated capacity: 20 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the fuse circuit, and replace the fuse with rated capacity. |
| 3. Inspect passenger side power window operation status | |
| | A. Turn the ignition switch to "ON".<br>B. Operate the power window main switch to control the passenger side power window up/down.<br>C. Operate the passenger side power window switch to control the passenger side power window up/down.<br>D. Go to corresponding step according to the passenger side power window up/down status.<br>The passenger side power window up/down can be controlled only by the passenger side power window switch.<br>Go to step 4.<br>The passenger side power window up/down can be controlled only by the power window main switch.<br>Go to step 5.<br>The passenger side power window up/down can not be controlled by both the power window main switch and passenger side power window switch.<br>Go to step 7. |

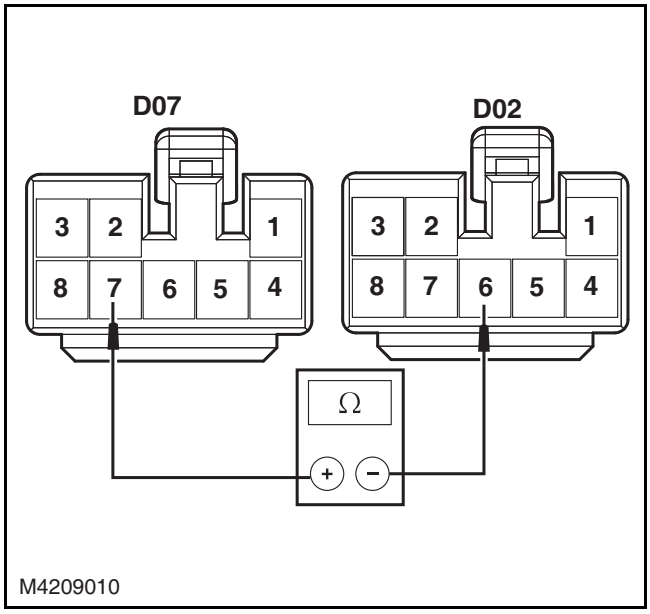
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect passenger side power window switch up/down signal circuit | |
|  <br>M4209009 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the power window switch wiring harness connector D02.<br>C. Disconnect the passenger side power window switch wiring harness connector D07.<br>D. Measure the resistance between terminals 2, 3 of power window main switch wiring harness connector D02 and terminals 6, 2 of passenger side power window switch wiring harness connector D07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminals 2, 3 of power window main switch wiring harness connector D02 and terminals 6, 2 of passenger side power window switch wiring harness connector D07. |

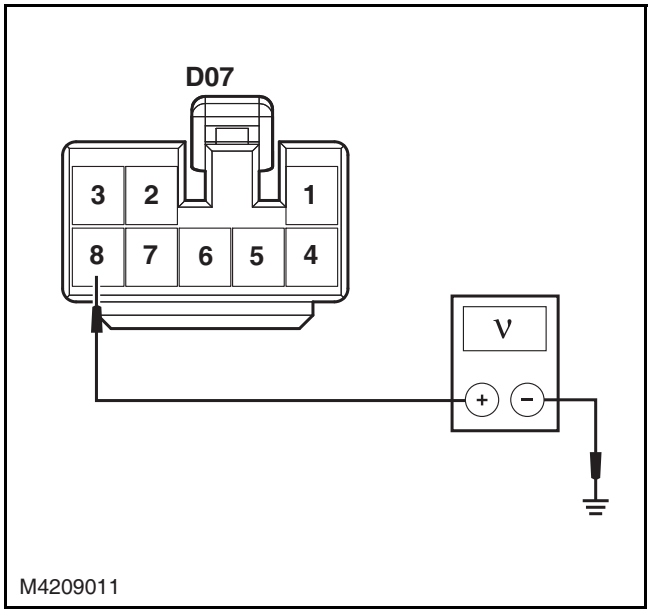
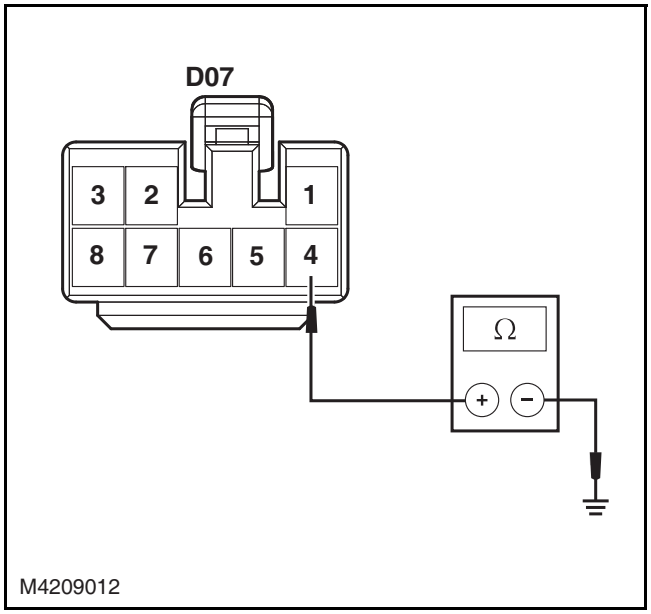
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| Test Conditions | Details/Results/Actions |
|---|---|
| 5. Measure circuit between power window main switch and passenger side power window switch | |
|  <br>M4209010 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the power window main switch wiring harness connector D02.<br>C. Disconnect the passenger side power window switch wiring harness connector D07.<br>D. Measure the resistance between terminal 6 of power window main switch wiring harness connector D02 and terminal 7 of passenger side power window switch wiring harness connector D07.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 6 of power window main switch wiring harness connector D02 and terminal 7 of passenger side power window switch wiring harness connector D07. |
| 6. Inspect passenger side power window switch | |
| | A. Replace the passenger side power window switch with a good one.<br>Is the operation normal?<br>**Yes**<br>Replace the passenger side power window switch.<br>**No**<br>Replace the power window main switch. |

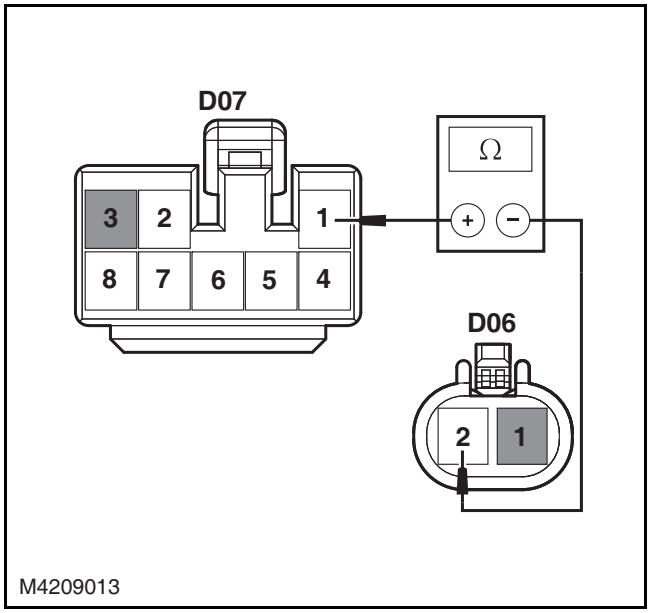
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| Test Conditions | Details/Results/Actions |
|---|---|
| 7. Inspect passenger side power window switch power supply | |
|  M4209011 | A. Turn the ignition switch to "ON".<br>B. Disconnect the passenger side power window switch wiring harness connector D07.<br>C. Measure the voltage between terminal 8 of passenger side power window switch wiring harness connector D07 and reliable grounding.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage value normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the open circuit fault between terminal 8 of passenger side power window switch wiring harness connector D07 and terminal 56 of instrument panel fuse box fuse IF28. |
| 8. Inspect passenger side power window switch grounding circuit | |
|  M4209012 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the passenger side power window switch wiring harness connector D07.<br>C. Measure the resistance between terminal 4 of passenger side power window switch wiring harness connector D07 and reliable grounding.<br>**Standard resistance: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Inspect and repair the open circuit fault between terminal 4 of passenger side power window switch wiring harness connector D07 and grounding G105. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 9. Inspect passenger side window glass regulator | |
| | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the passenger side window glass regulator wiring harness connector D06.<br>C. Apply power supply voltage of 12 V to the passenger side window glass regulator, and inspect the regulator operation.<br>Is the operation normal?<br>**Yes**<br>Go to step 10.<br>**No**<br>Replace the passenger side window glass regulator.<br>**Refer to: Glass Regulator (4.2.9 Power Window, Removal and Installation).** |
| 10. Inspect circuit between passenger side power window switch and passenger side window glass regulator | |
|  <br>M4209013 | A. Turn the ignition switch to "LOCK".<br>B. Disconnect the passenger side power window switch wiring harness connector D07 and passenger side window glass regulator wiring harness connector D06.<br>C. Measure the resistance between terminals 1, 3 of passenger side power window switch wiring harness connector D07 and terminals 2, 1 of passenger side window glass regulator wiring harness connector D06.<br>**Yes**<br>Replace the passenger side power window switch.<br>**Refer to: Power Window Switch (4.2.9 Power Window, Removal and Installation).**<br>**No**<br>Inspect and repair the open circuit fault between terminals 1, 3 of passenger side power window switch wiring harness connector D07 and terminals 2, 1 of passenger side window glass regulator wiring harness connector D06. |

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# Diagnosis Procedure for Inching Down Function Fault

| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Replace power window main switch | |
| | A. Turn the ignition switch to "LOCK".<br>B. Replace the window switch.<br>**Refer to: Power Window Switch (4.2.9 Power Window, Removal and Installation).**<br>The system is normal. |

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## Removal and Installation

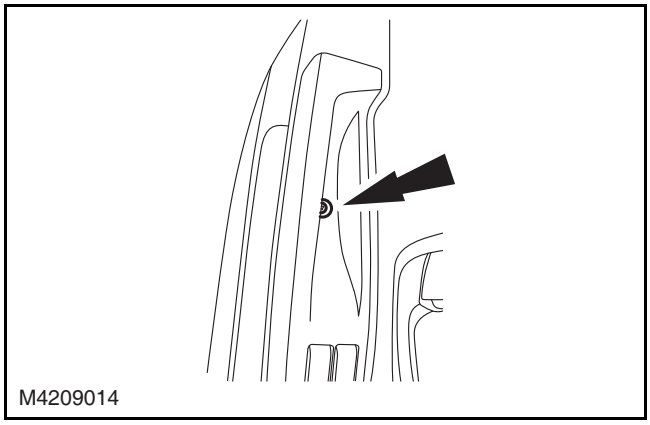
# Power Window Switch

### Removal

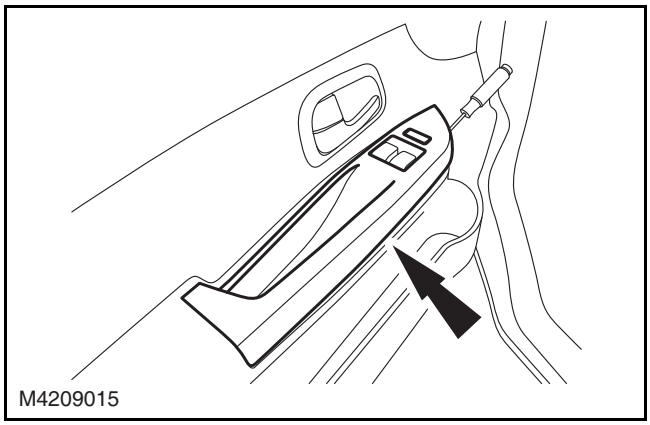
1. Disconnect the negative battery cable.

   **Refer to: Battery Inspection (3.1.10 Charging System, General Inspection).**

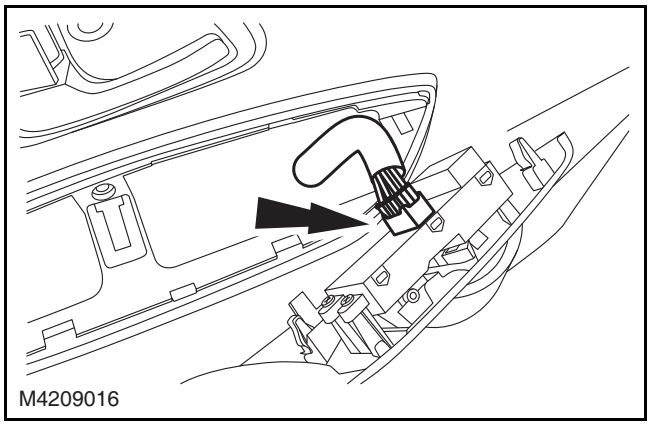
2. Remove the retaining screw from the inside handle trim cover.


M4209014

3. Using a screwdriver with its tip wrapped with protective tape, remove the inside handle trim cover.


M4209015

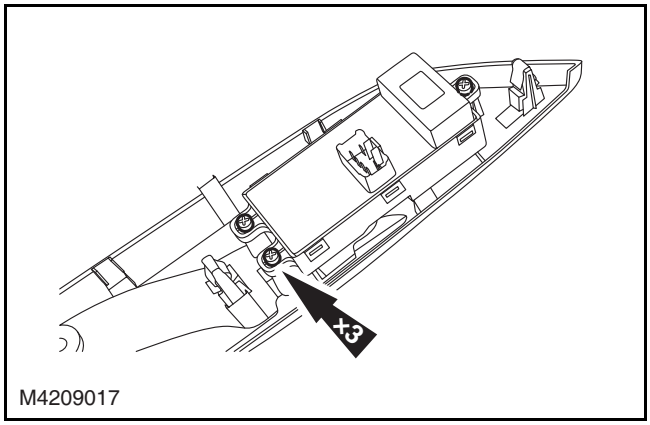
4. Disconnect the power window switch wiring harness connector.


M4209016

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**5.** Remove 3 retaining screws from the power window switch and remove the power window switch.



M4209017

## Installation

**1.** Installation is in the reverse order of removal.

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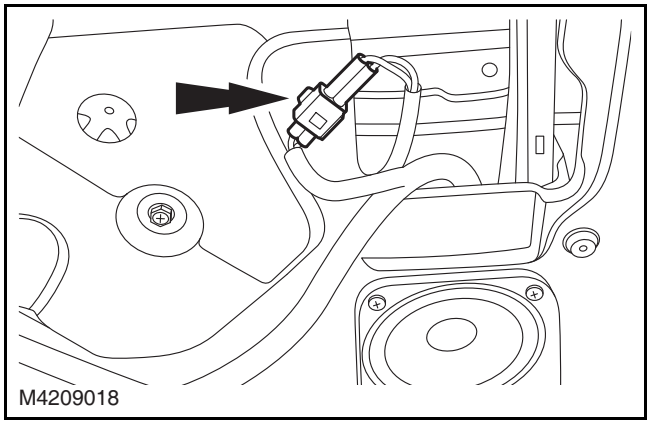
# Front Door Glass Regulator

## Removal

1. Remove the front door glass.

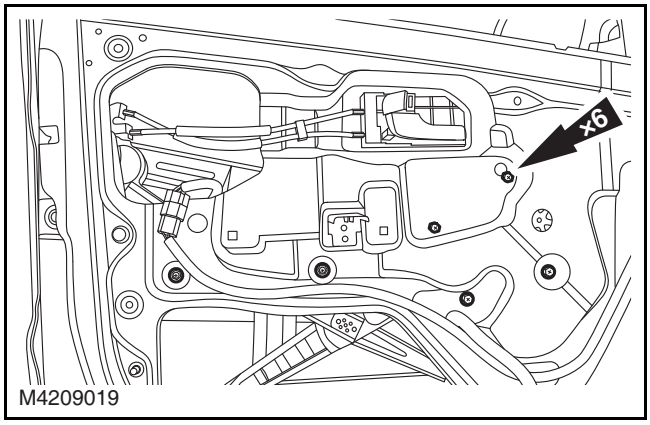
   **Refer to: Front Door Glass (5.1.2 Door, Removal and Installation).**

2. Disconnect the front door glass regulator wiring harness connector.

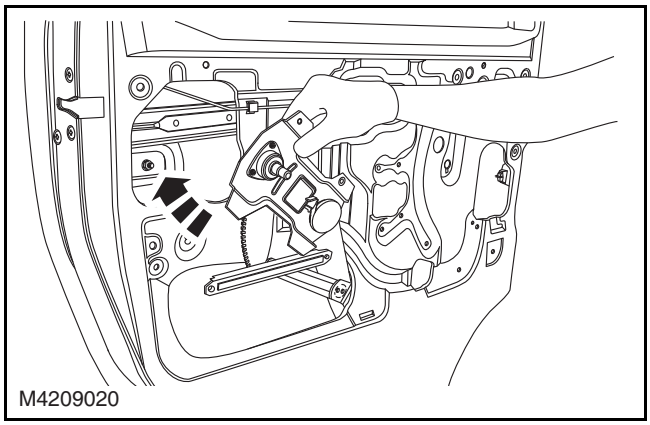



3. Remove 6 retaining bolts from the front door glass regulator.

   Torque: 8 Nm




4. Remove the front door glass regulator.




## Installation

1. Installation is in the reverse order of removal.

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# Rear Door Glass Regulator

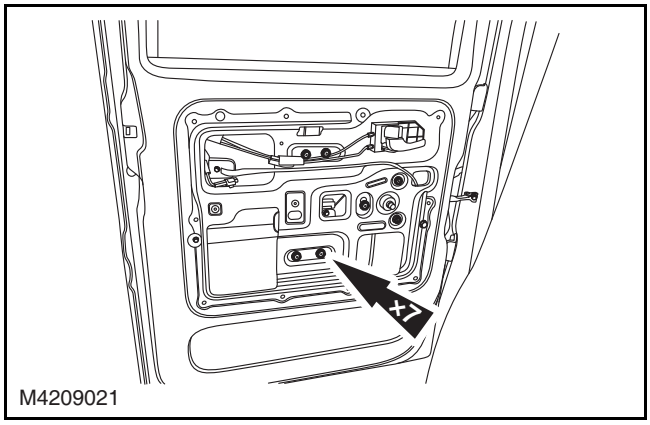
## Removal

1. Remove the rear door glass.

   **Refer to: Rear Door Glass (5.1.2 Door, Removal and Installation).**

2. Remove 7 retaining bolts from the rear door glass regulator and remove the rear door glass regulator.

   Torque: 8 ~ 12 Nm



M4209021

## Installation

1. Installation is in the reverse order of removal.

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## Description and Operation

# Overview

The body control system consists of central lock controller, body remote key PCB, left turn lamp, right turn lamp, four-door lock motor and other components.

Main functions of central lock controller include:

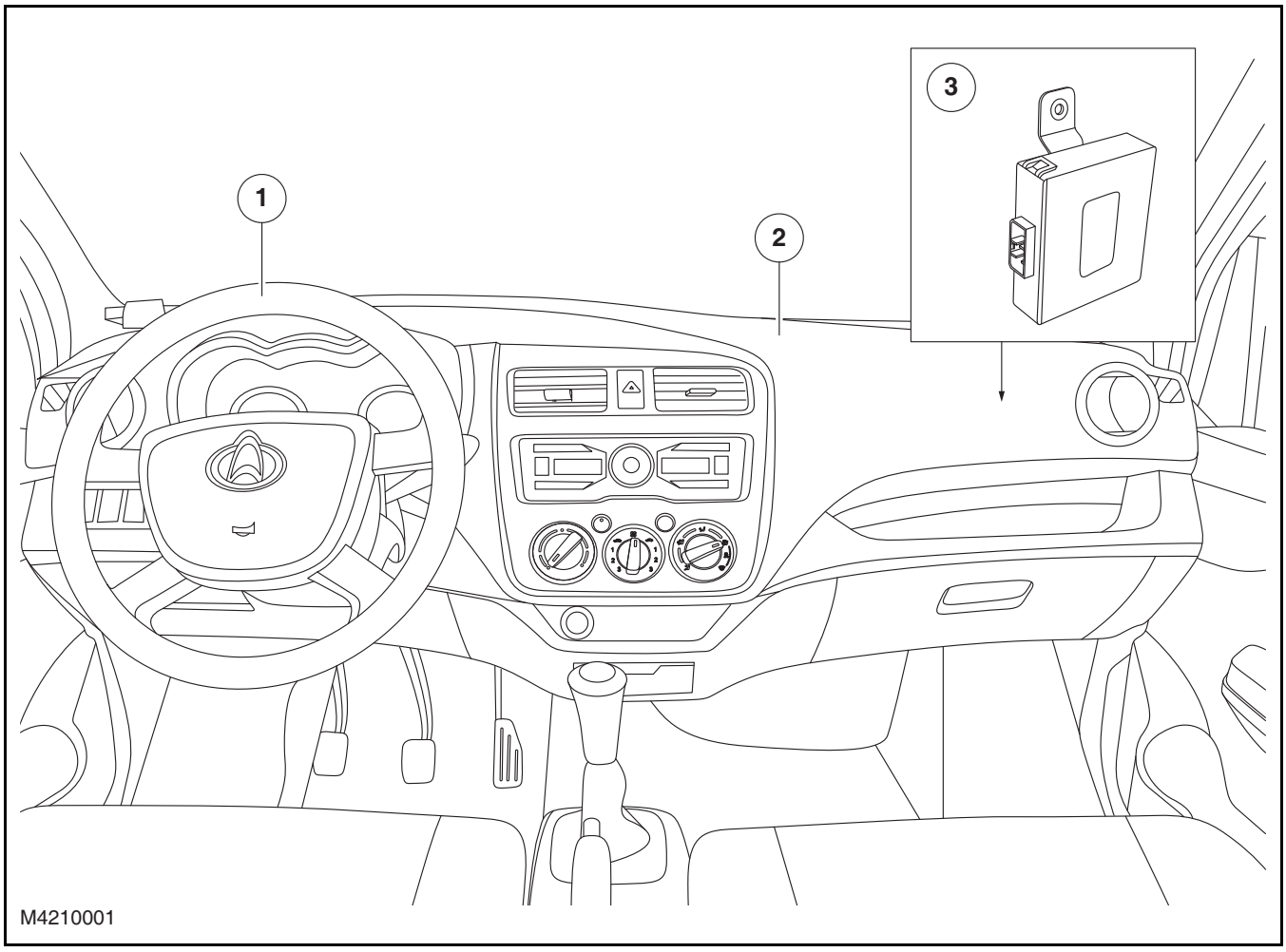
- Turn lamp unlock signal
- Code learning mode
- Door locking function
- Door unlocking function

When the remote controller is locked, the double flash indicator blinks once. When the remote controller is unlocked, the double flash indicator blinks twice.

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# Components Location View

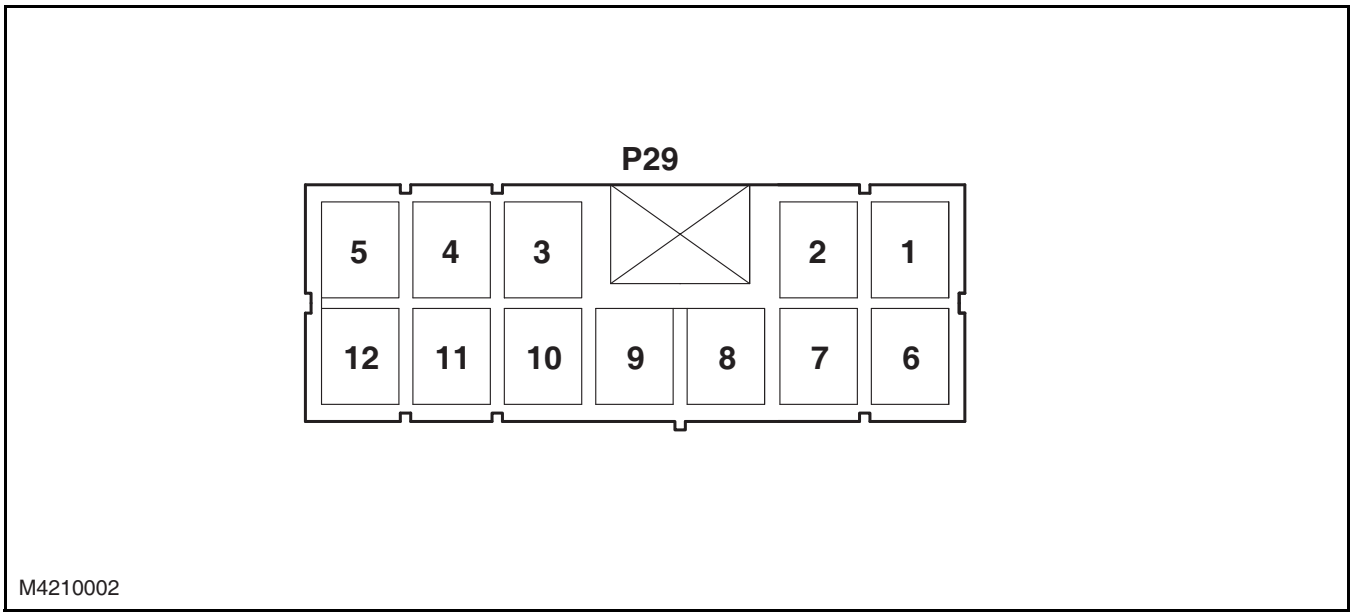



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Steering wheel | 3 | Central lock controller |
| 2 | Instrument panel | | |

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## Terminal View




## Central Lock Controller Terminal Definition

| Terminal No. | Connection Wire | Terminal Description | Input/Output |
|---|---|---|---|
| P29-1 | 1.25 RD/WH | Central lock controller power supply (B+) | - |
| P29-2 | 1.25 BK | Central lock controller ground | - |
| P29-3 | - | - | - |
| P29-4 | - | - | - |
| P29-5 | 1.25 WH/BK | Central lock controller power supply (ACC) | - |
| P29-6 | 0.5 GN/YE | Right turn lamp | Output |
| P29-7 | 0.5 GN/RD | Left turn lamp | Output |
| P29-8 | 0.85 WH | Door unlocking power supply | Output |
| P29-9 | 0.85 BU | Door locking power supply | Output |
| P29-10 | 0.5 BK/RD | Door signal switch | Input |
| P29-11 | 0.5 YE | Locking switch signal A | Input |
| P29-12 | 0.5 WH/YE | Locking switch signal B | Input |

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## Removal and Installation

# Central Lock Controller

### Removal

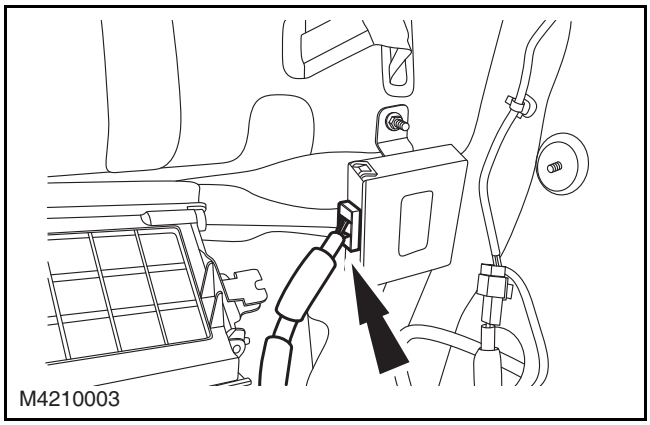
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

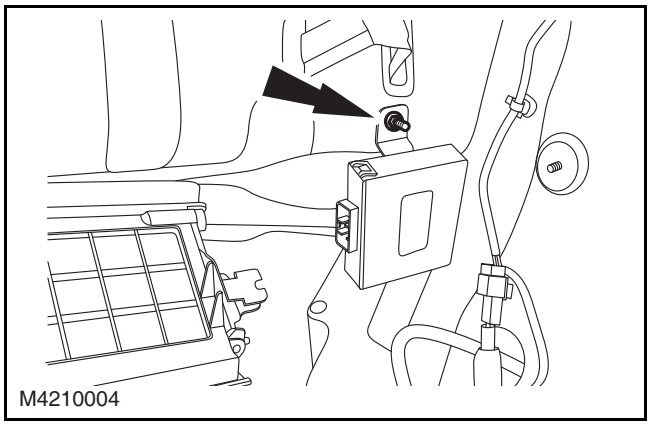
2. Remove the instrument panel assembly.

   **Refer to: Instrument Panel (5.1.6 Instrument Panel and Console, Removal and Installation).**

3. Disconnect the central lock controller wiring harness connector.


M4210003

4. Remove the retaining bolt from the central lock controller, and remove the central lock controller.


M4210004

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## Installation

1. Installation is in the reverse order of removal.
2. For models with remote controller, match a key after replacing the remote controller with a new one.

   **Refer to: Remote Control Key Programming (4.2.8 Central Door Lock, Description and Operation).**

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## Description and Operation

# General Description

The vehicle only adopts a K-LINE communication method currently.

# Description of K-LINE Bus

The K line is used for the diagnostic communication between the external testing tools and the on-board ECM. The transmission rate is 10.47 kbps. The voltage switches between 0 V and 12 V when transmitting signals: 12 V, logic "1"; 0 V, logic "0".

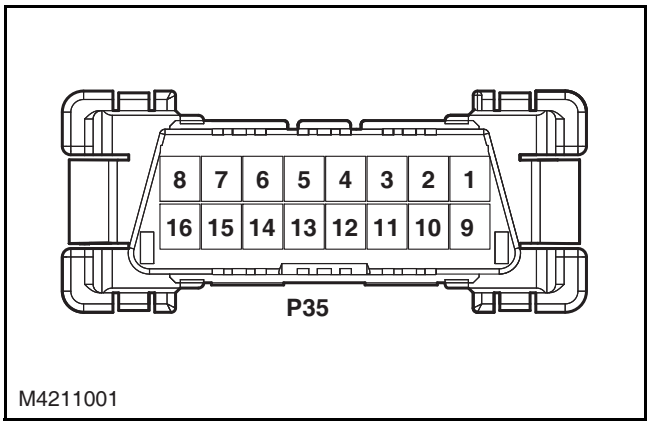
# Description of DLC

Data Link Connector (DLC) is the result of the discussion and regulation among the automobile manufacturers in the world. This wiring harness connector is needed when using diagnostic tool to communicate with the vehicle and to program the communication system used on the vehicle.

This wiring harness connector should meet the following requirements:

- It should be the standard 16-pin wiring harness connector and can be connected with all diagnostic tools.
- It always supplies battery power for diagnostic tool through terminal 8.
- It always supplies grounding for diagnostic tool through terminals 12 and 13.
- The terminal 15 is used to communicate with the vehicle system.

# DLC View




| Terminal No. | Connection Wire | Terminal Description |
|---|---|---|
| P35-1 | - | - |
| P35-2 | - | - |
| P35-3 | - | - |
| P35-4 | - | - |
| P35-5 | - | - |
| P35-6 | - | - |
| P35-7 | - | - |
| P35-8 | 0.5 PK/BU | DLC Power supply |
| P35-9 | - | - |
| P35-10 | - | - |
| P35-11 | - | - |
| P35-12 | 0.5 BK | GND |
| P35-13 | 0.5 BK | GND |
| P35-14 | - | - |
| P35-15 | 0.5 LG/WH | K-line |
| P35-16 | - | - |

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## Symptom Diagnosis and Testing

**General Equipment**

| |
|---|
| Digital multimeter |
| Diagnostic tool |

# Inspection and Verification

1. Verify the customer concern.
2. Visually check if there is obvious mechanical fault.
3. Inspect the system circuit which is accessible or visible.
4. If an obvious cause for an observed or reported concern has been found, solve the fault before proceeding to the next step.
5. If the cause is not visually evident, verify the symptom by referring to the Symptom Chart.

**Visual Inspection Chart**

| Electrical |
|---|
| • Battery<br>• Fuse<br>• Wiring harness connector of electrical equipment loose or corroded<br>• Wiring harness |

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## Symptom Chart

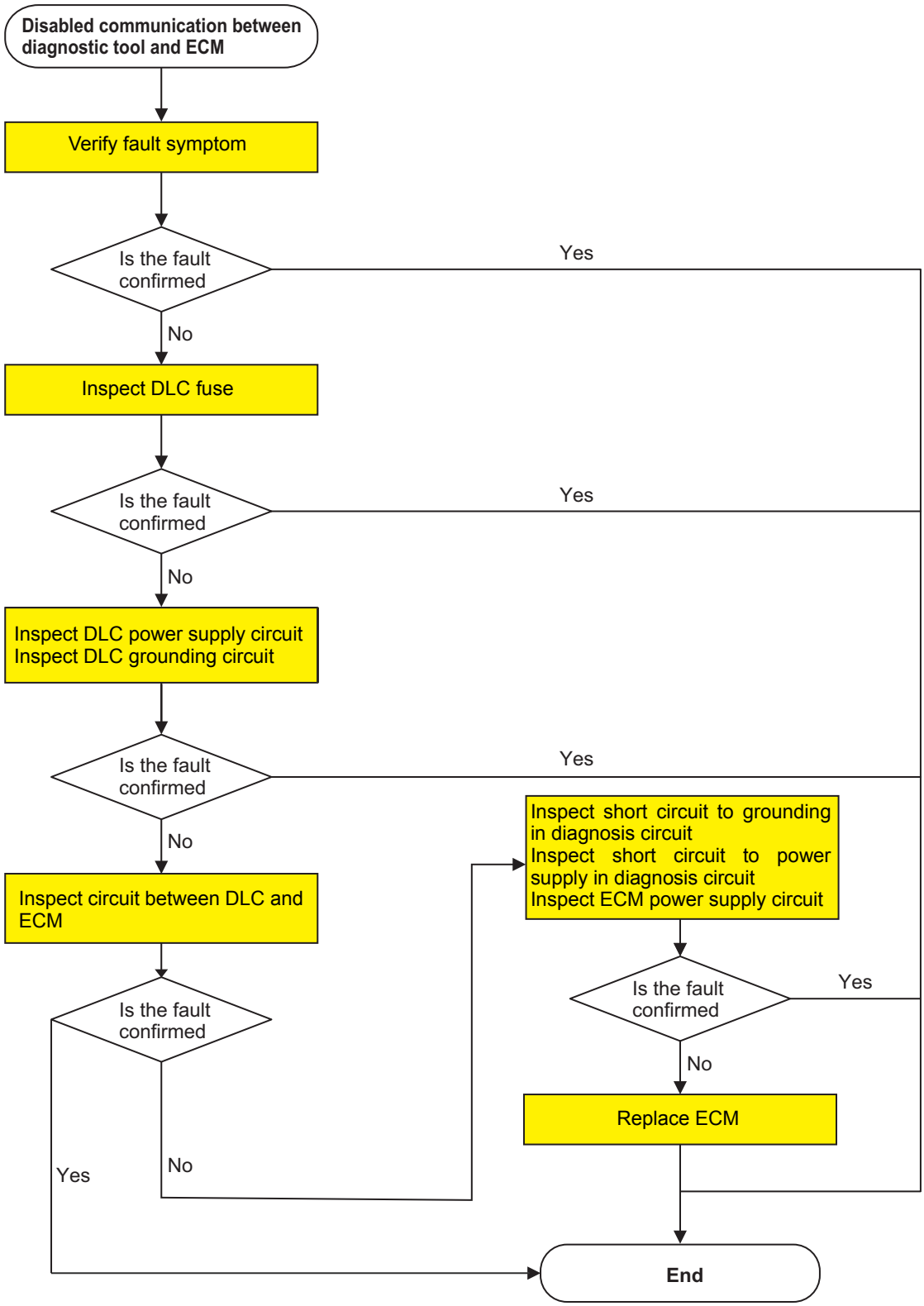
If the fault occurs and cannot confirm the cause by basic inspection, diagnose and eliminate it in order of the following table.

| Symptom | Possible Causes | Solutions |
|---|---|---|
| Diagnosis tool cannot communicate with ECM | • Diagnostic tool<br>• Circuit<br>• ECM | Refer to: Diagnosis Procedure for Disabled Communication between Diagnostic Tool and ECM (4.2.11 On-board Network System, Diagnosis and Testing). |

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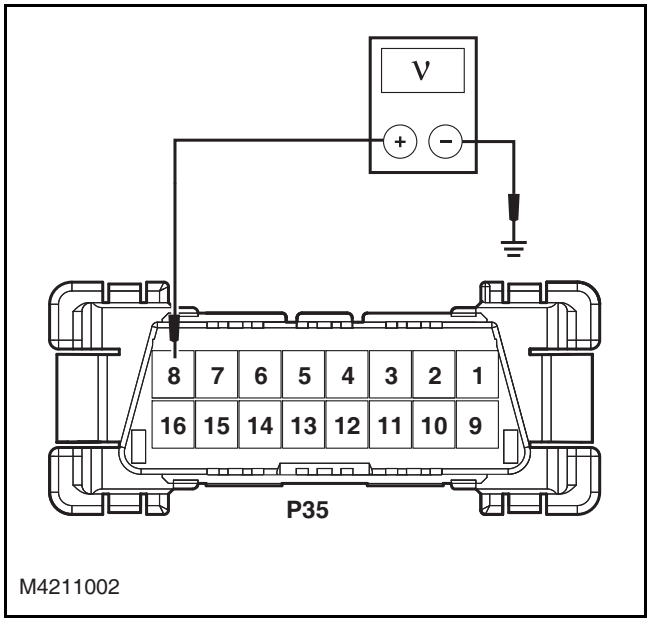


# Diagnosis Procedure for Disabled Communication between Diagnostic Tool and ECM (1.0 L)



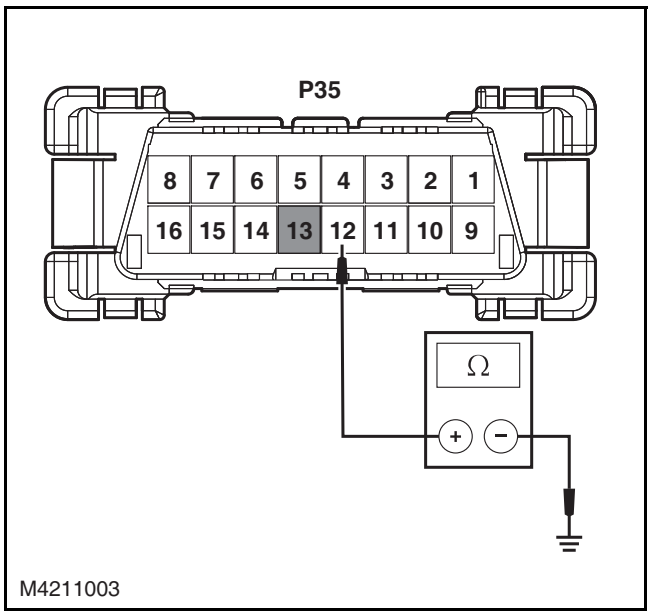
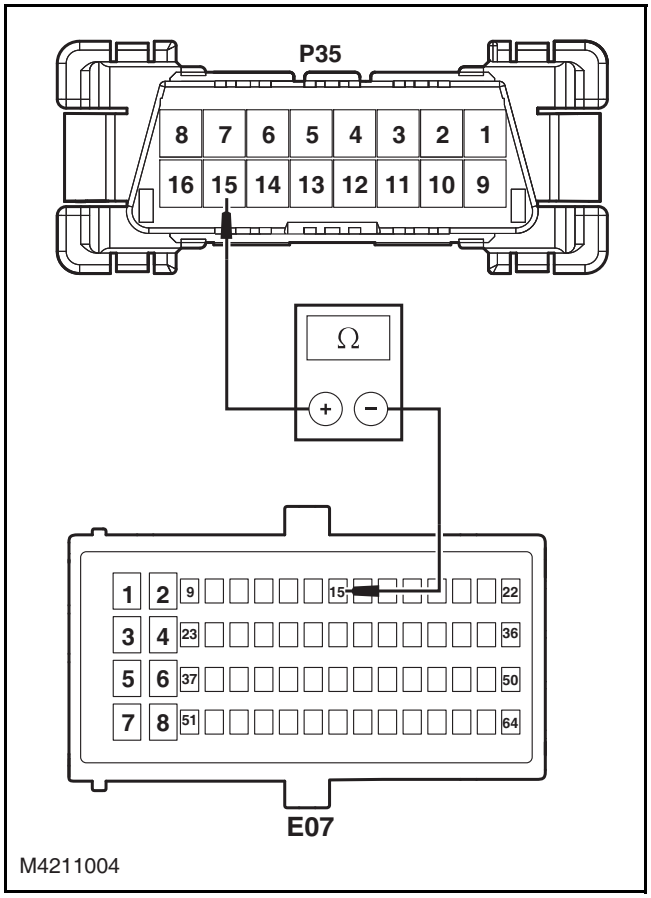
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify fault symptom | |
| | A. Use a normal vehicle.<br>B. Try to communicate with ECM.<br>Is the communication with ECM normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace with a new diagnostic tool. |
| 2. Inspect DLC fuse | |
| | A. Inspect the DLC fuse IF11.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the circuit, and replace the fuse with rated capacity. |
| 3. Inspect DLC power supply circuit | |
|  <br>M4211002 | A. Measure the voltage between terminal 8 of DLC wiring harness connector P35 and reliable grounding with a multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 8 of DLC wiring harness connector P35 and terminal 22 of instrument panel fuse box fuse IF11. |

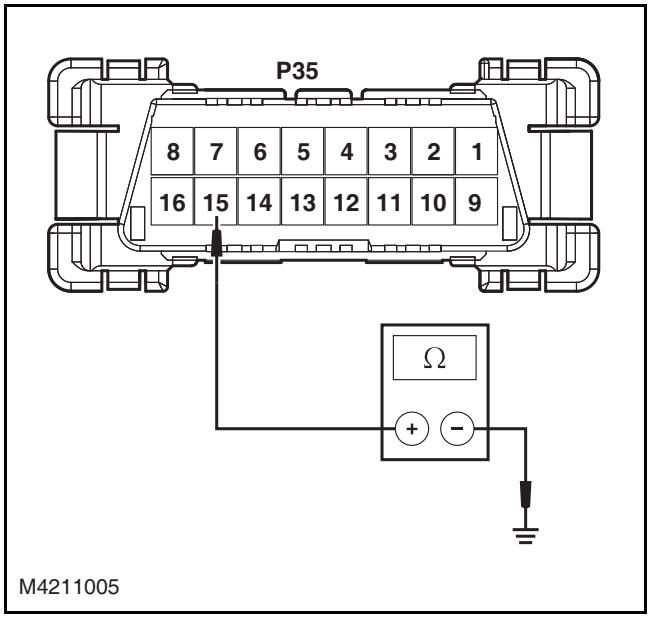
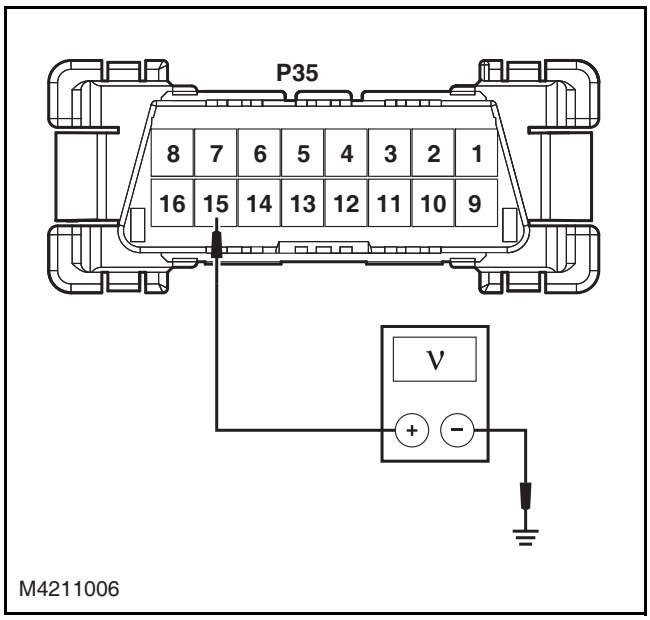
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect DLC grounding circuit | |
|  M4211003 | A. Measure the resistance between terminals 12 and 13 of DLC wiring harness connector P35 and reliable grounding with a multimeter.<br>**Standard resistance value: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminals 12 and 13 of DLC wiring harness connector P35 and grounding G106. |
| 5. Inspect circuit between DLC and ECM | |
|  M4211004 | A. Turn the ignition switch to "LOCK" and disconnect the negative battery cable.<br>B. Disconnect the ECM wiring harness connector E07.<br>C. Measure the resistance between terminal 15 of ECM wiring harness connector E07 and terminal 15 of DLC wiring harness connector P35.<br>**Standard resistance value: less than 5 Ω**<br>Is the voltage normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 15 of ECM wiring harness connector E07 and terminal 35 of DLC wiring harness connector P35. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect short circuit to grounding in diagnosis circuit | |
|  M4211005 | A. Turn the ignition switch to "LOCK" and disconnect the negative battery cable.<br>B. Disconnect the ECM wiring harness connector E07.<br>C. Measure the resistance between terminal 15 of DLC wiring harness connector P35 and reliable grounding.<br>**Standard resistance: 10 MΩ or more**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the short circuit to grounding between terminal 15 of DLC wiring harness connector P35 and terminal 15 of ECM wiring harness connector E07. |
| 7. Inspect short circuit to power supply in diagnosis circuit | |
|  M4211006 | A. Turn the ignition switch to "LOCK" and disconnect the negative battery cable.<br>B. Disconnect the ECM wiring harness connector E07.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 15 of DLC wiring harness connector P35 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is the voltage normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the short circuit to power supply between terminal 15 of DLC wiring harness connector P35 and terminal 15 of ECM wiring harness connector E07. |

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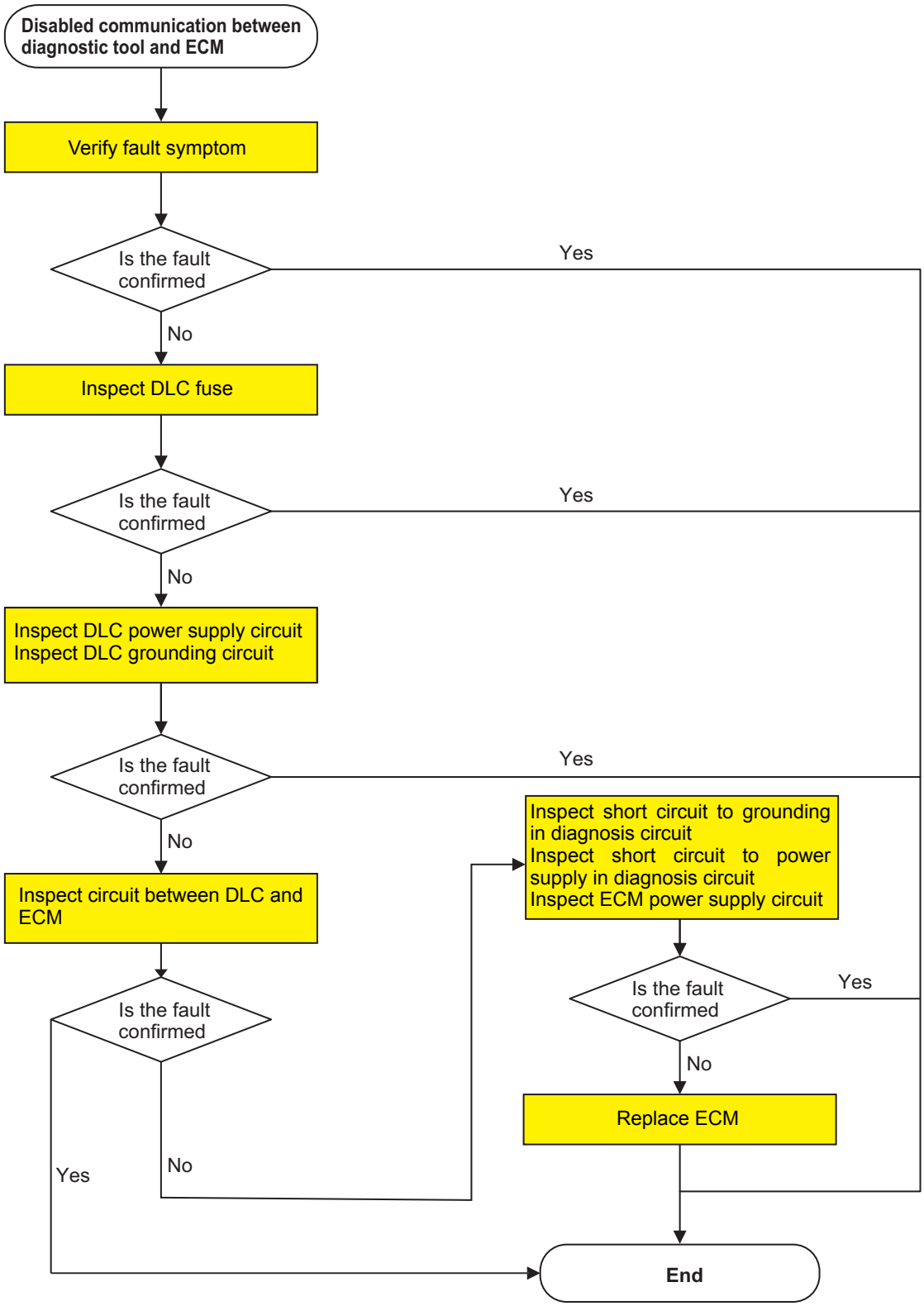


| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect ECM power supply circuit | |
| | A. Inspect ECM power supply circuit.<br>**Refer to: DTC Diagnostic Procedure Index (3.1.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>Is the power supply circuit normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Repair the fault part. |
| 9. Replace ECM | |

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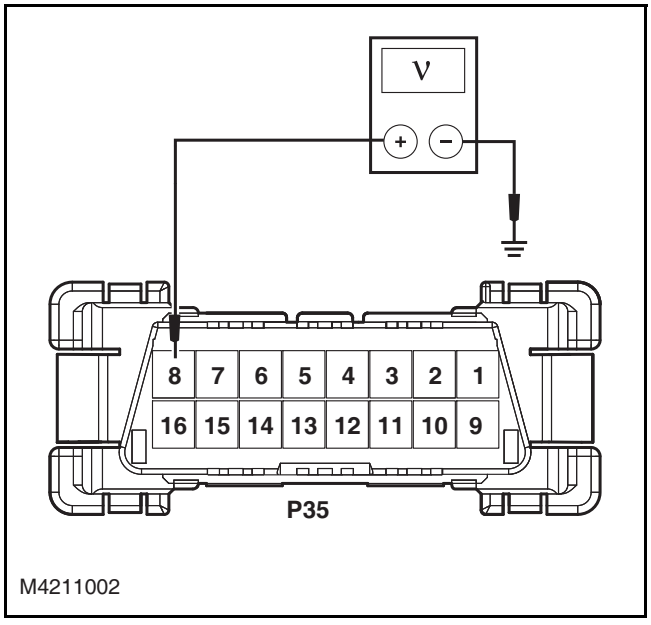


# Diagnosis Procedure for Disabled Communication between Diagnostic Tool and ECM (1.2 L)



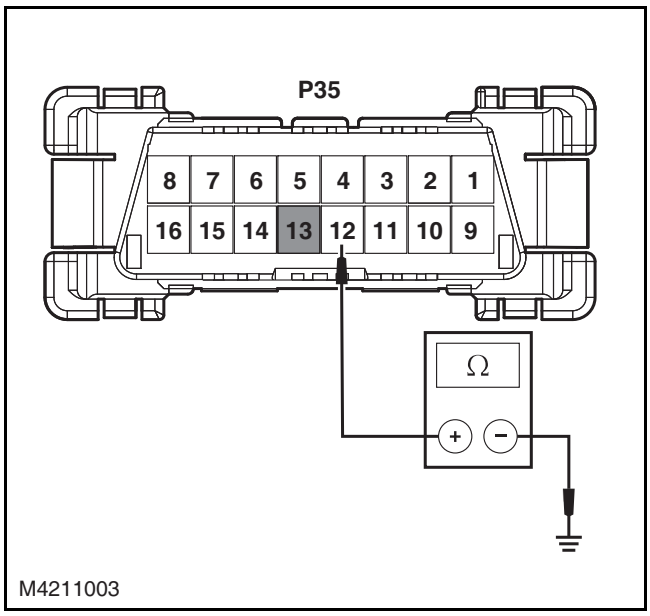
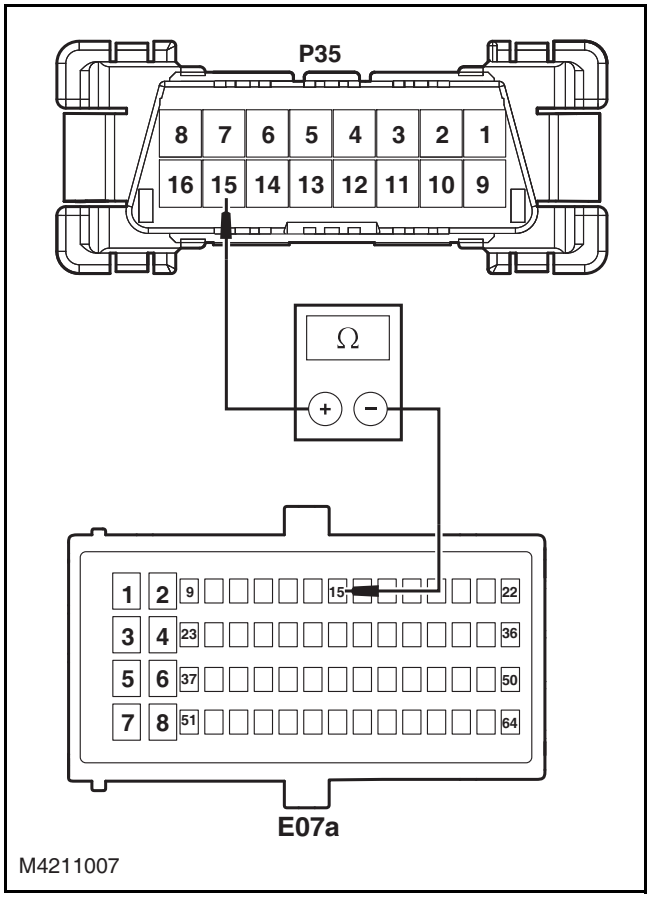
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| Test Conditions | Details/Results/Actions |
|---|---|
| 1. Verify fault symptom | |
| | A. Use a normal vehicle.<br>B. Try to communicate with ECM.<br>Is the communication with ECM normal?<br>**Yes**<br>Go to step 2.<br>**No**<br>Replace with a new diagnostic tool. |
| 2. Inspect DLC fuse | |
| | A. Inspect the DLC fuse IF11.<br>**Fuse rated capacity: 10 A**<br>Is the fuse normal?<br>**Yes**<br>Go to step 3.<br>**No**<br>Inspect and repair the circuit, and replace the fuse with rated capacity. |
| 3. Inspect DLC power supply circuit | |
|  | A. Measure the voltage between terminal 8 of DLC wiring harness connector P35 and reliable grounding with a multimeter.<br>**Standard voltage: 11 ~ 14 V**<br>Is the voltage normal?<br>**Yes**<br>Go to step 4.<br>**No**<br>Inspect and repair the open circuit fault between terminal 8 of DLC wiring harness connector P35 and terminal 22 of instrument panel fuse box fuse IF11. |

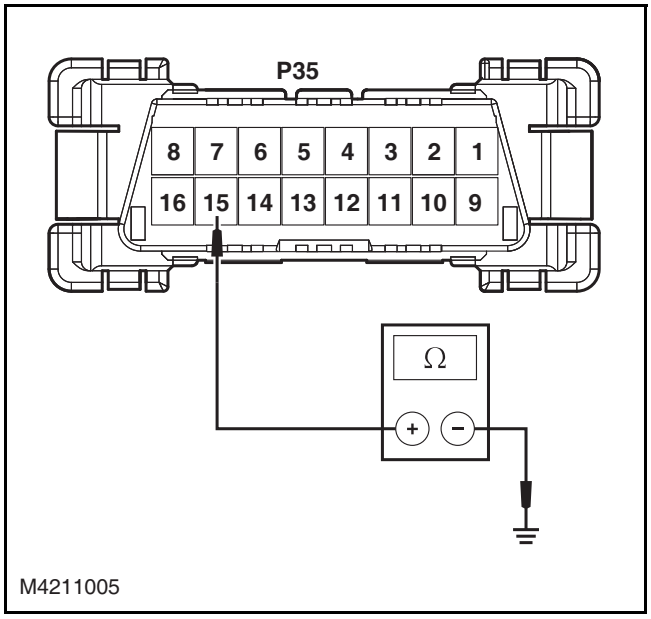
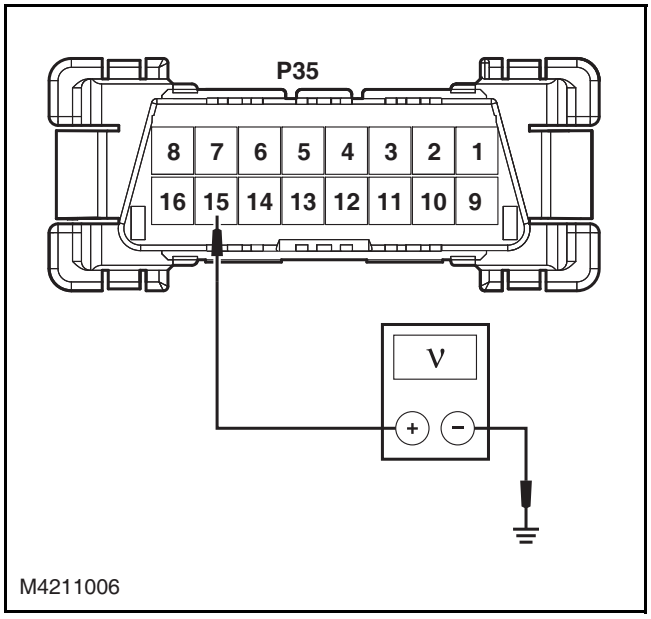
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| Test Conditions | Details/Results/Actions |
|---|---|
| 4. Inspect DLC grounding circuit | |
|  M4211003 | A. Measure the resistance between terminals 12 and 13 of DLC wiring harness connector P35 and reliable grounding with a multimeter.<br>**Standard resistance value: less than 5 Ω**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 5.<br>**No**<br>Inspect and repair the open circuit fault between terminals 12 and 13 of DLC wiring harness connector P35 and grounding G106. |
| 5. Inspect circuit between DLC and ECM | |
|  M4211007 | A. Turn the ignition switch to "LOCK" and disconnect the negative battery cable.<br>B. Disconnect the ECM wiring harness connector E07a.<br>C. Measure the resistance between terminal 15 of ECM wiring harness connector E07a and terminal 15 of DLC wiring harness connector P35.<br>**Standard resistance value: less than 5 Ω**<br>Is the voltage normal?<br>**Yes**<br>Go to step 6.<br>**No**<br>Inspect and repair the open circuit fault between terminal 15 of ECM wiring harness connector E07a and terminal 35 of DLC wiring harness connector P35. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 6. Inspect short circuit to grounding in diagnosis circuit | |
|  M4211005 | A. Turn the ignition switch to "LOCK" and disconnect the negative battery cable.<br>B. Disconnect the ECM wiring harness connector E07a.<br>C. Measure the resistance between terminal 15 of DLC wiring harness connector P35 and reliable grounding.<br>**Standard resistance: 10 MΩ or more**<br>Is the resistance value normal?<br>**Yes**<br>Go to step 7.<br>**No**<br>Inspect and repair the short circuit to grounding between terminal 15 of DLC wiring harness connector P35 and terminal 15 of ECM wiring harness connector E07a. |
| 7. Inspect short circuit to power supply in diagnosis circuit | |
|  M4211006 | A. Turn the ignition switch to "LOCK" and disconnect the negative battery cable.<br>B. Disconnect the ECM wiring harness connector E07a.<br>C. Turn the ignition switch to "ON".<br>D. Measure the voltage between terminal 15 of DLC wiring harness connector P35 and reliable grounding.<br>**Standard voltage: 0 V**<br>Is the voltage normal?<br>**Yes**<br>Go to step 8.<br>**No**<br>Inspect and repair the short circuit to power supply between terminal 15 of DLC wiring harness connector P35 and terminal 15 of ECM wiring harness connector E07a. |

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| Test Conditions | Details/Results/Actions |
|---|---|
| 8. Inspect ECM power supply circuit | |
| | A. Inspect ECM power supply circuit.<br>**Refer to: DTC Diagnostic Procedure Index (3.2.12 Electronic Control System - M7, DTC Diagnosis and Testing).**<br>Is the power supply circuit normal?<br>**Yes**<br>Go to step 9.<br>**No**<br>Repair the fault part. |
| 9. Replace ECM | |

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# GROUP 5
# Body

SECTION PAGE

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# 5.1 Body and Accessories

## 2014 MD/MS201

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## Specifications

# General Specifications

| Item | Specifications |
|---|---|
| 1K adhesive | WSKM-2G309-B |
| 2K adhesive | ESK-M2G369-A1 |
| 2K hardener | ESK-M2G369-A2 |

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## Description and Operation

# System Overview

The front windshield is fixed to the body by adhesive, which forms a driving space together with the body, door and other windows, and also offers a good view for the driver. The adhesive can bond the front/rear windshield to the car window frame, in the meantime, it can also form a tight waterproof surface on the window frame. Clear the adhesive on the window frame and apply glue for fixing again when replacing the front/rear windshield.

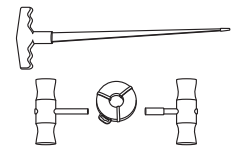
https://truckmanualshub.com/



## Removal and Installation

# Front Windshield

### Special Tool

| | |
|---|---|
|  CA501-001 | Windshield Glue-Remover CA501-001 |

### General Equipment

| |
|---|
| Heat gun |
| Glass glue cutter |
| Glue gun |

## Removal

1. Remove the A pillar trim panels on both sides.

   **Refer to: A Pillar Trim Panel (5.1.9 Interior Trim Panel and Ornamentation, Removal and Installation).**

2. Remove the front cover ornamentation and wiper arms.

   **Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**

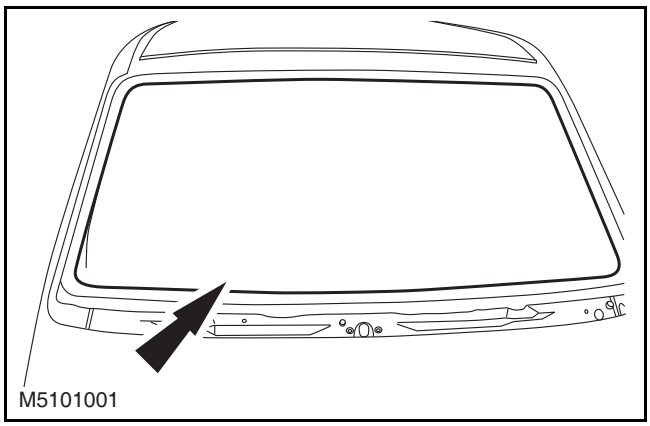
3. Remove the interior rearview mirror.

   **Refer to: Interior Rearview Mirror (5.1.5 Rearview Mirror, Removal and Installation).**

4. Use the special tool to remove the front windshield.

   Special tool: CA501-001

**WARNING: Please wear gloves and goggles when using the special tool to protect against the fragments generated in cutting. Wear earplugs when cutting. Failure to follow the instructions may cause personal injury.**

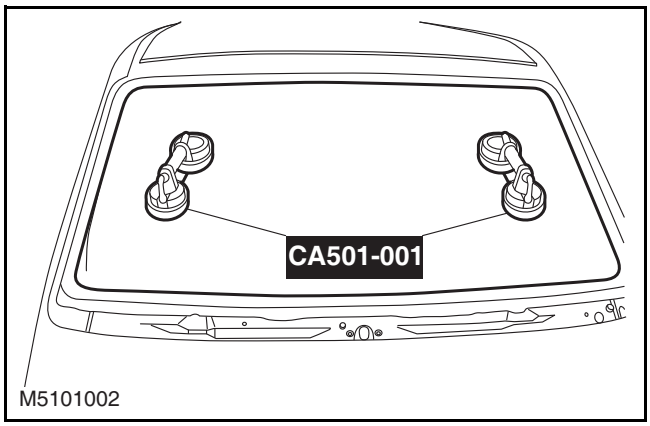

M5101001

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5. Use the glass sucker to remove the front windshield with the help of other technicians.

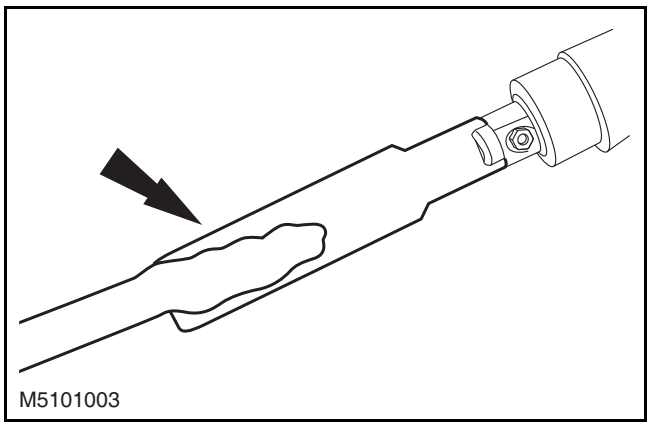
   Special tool: CA501-001



M5101002

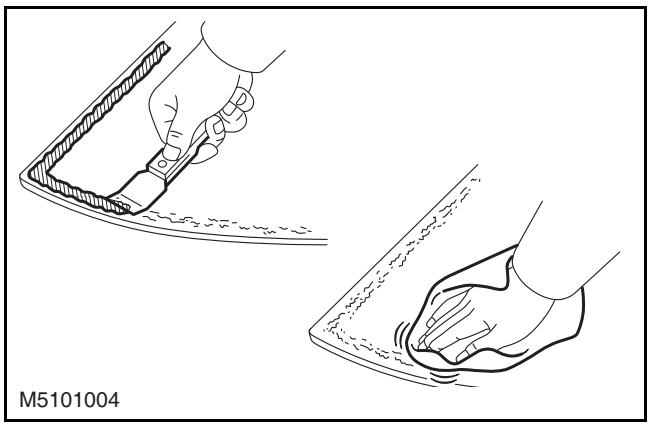
## Installation

1. Remove the remaining adhesive in the slot flange of front windshield.


M5101003

2. Use the scraper to remove the adhesive on the glass and clean the glass.

**WARNING: Please avoid touching the cleaned surface, otherwise it will affect the bonding effect.**


M5101004

3. Inspect the damaged metal fragments, iron rust, or any other irrelevant materials in the welding seam seal area, which tend to cause damage to the glass.

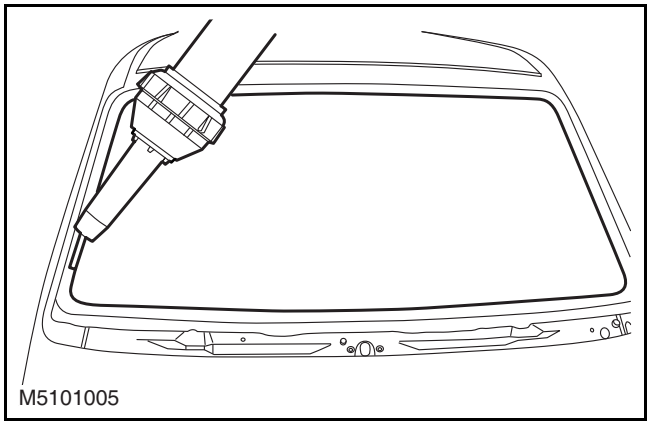
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4. Control the temperature of heat gun around 25°C, remove the moisture in the slot flange of front windshield and glass glue.

   General tool: heat gun

**CAUTION: Remove all moisture in adhesive surface to ensure the bonding effect.**

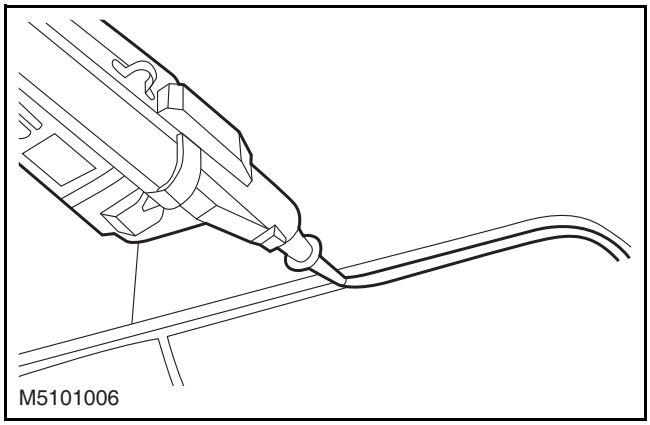

M5101005

5. Apply PU adhesive for about 8 ~ 10 mm in width along adhesive line against the edge of windshield frames.

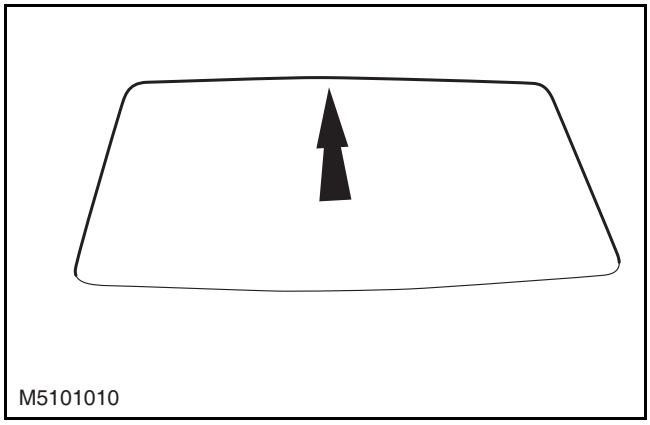
**CAUTION: If the ambient temperature is below 10°C, heat the PU adhesive for about 15 mins on the stove or use heat gun to heat it to about 25°C.**

**CAUTION: Reapply adhesive for 20 mm where has no adhesive tape in order to protect against water leakage.**

**CAUTION: In order to reduce working time, the first 100 mm of PU adhesive can be abandoned.**


M5101006

6. Install the front windshield weatherstrip.

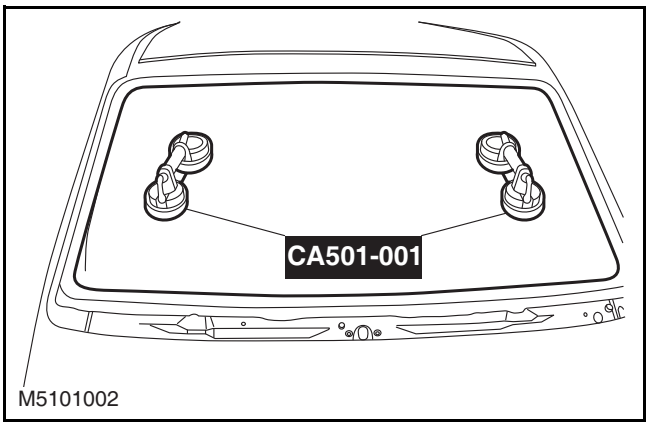

M5101010

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7. Use the glass sucker to install the front windshield with the help of other technicians.

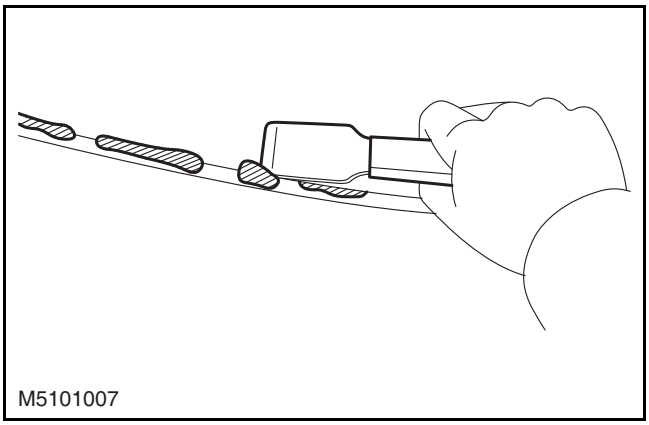
   Special tool: CA501-001




**WARNING: Please keep the door open before installing the glass in case it may affect bonding effect because the pressure in the vehicle may increase if the door is closed.**

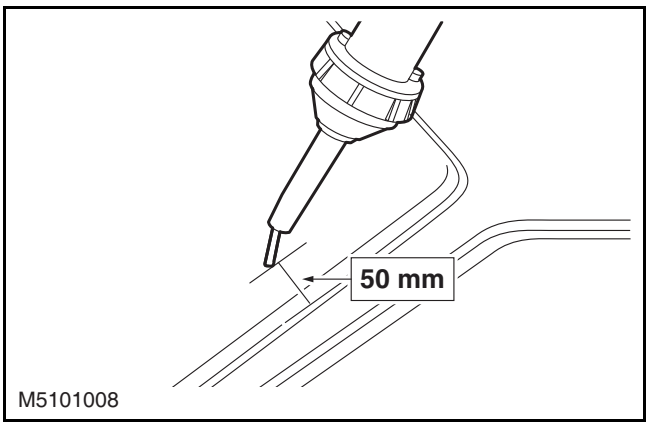
**CAUTION: Press every part of the glass evenly, so that the glass can bond firmly with adhesive.**

8. Use scraper to remove the excessive or overflowing adhesive.




9. Press the glass tightly until adhesive hardened.

**CAUTION: If the normal temperature is below 10°C, heat the surface (25°C) in a distance of about 50 mm for 15 mins (inside or outside of the vehicle) by using heat gun.**



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10. Install the interior rearview mirror.

    **Refer to: Interior Rearview Mirror (5.1.5 Rearview Mirror, Removal and Installation).**

11. Install the front cover ornamentation and wiper arms.

    **Refer to: Wiper Motor and Drive Arm (4.2.7 Wiper and Washer, Removal and Installation).**

12. Install the A pillar trim panels on both sides.

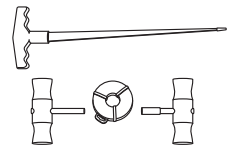
    **Refer to: A Pillar Trim Panel (5.1.9 Interior Trim Panel and Ornamentation, Removal and Installation).**

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# Back Door Glass

### Special Tool

| | |
|---|---|
|  CA501-001 | Windshield Glue-Remover CA501-001 |

### General Equipment

| |
|---|
| Heat gun |
| Glass glue cutter |
| Glue gun |

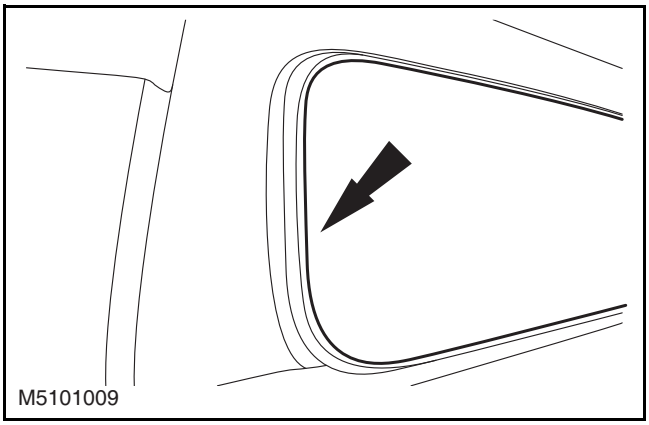
## Removal

1. Remove the high mounted stop lamp.

   **Refer to: High Mounted Stop Lamp (4.2.6 Lighting System, Removal and Installation).**

2. Use the special tool to remove the back door glass.

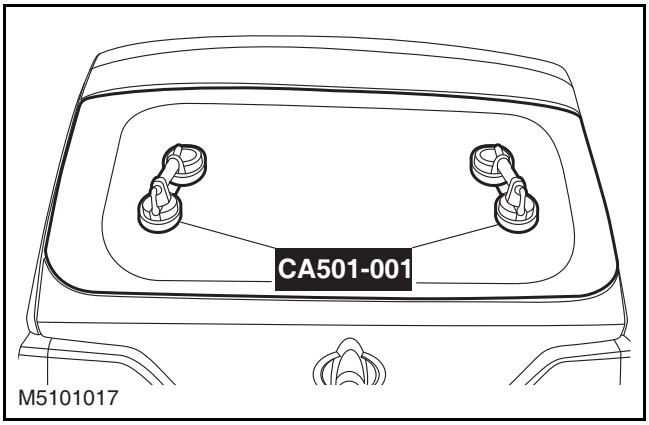
   Special tool: CA501-001




**WARNING: Please wear gloves and goggles when using the special tool to protect against the fragments generated in cutting. Wear earplugs when cutting. Failure to follow the instructions may cause personal injury.**

3. Use glass sucker to remove the back door glass with the help of other technicians.

   Special tool: CA501-001

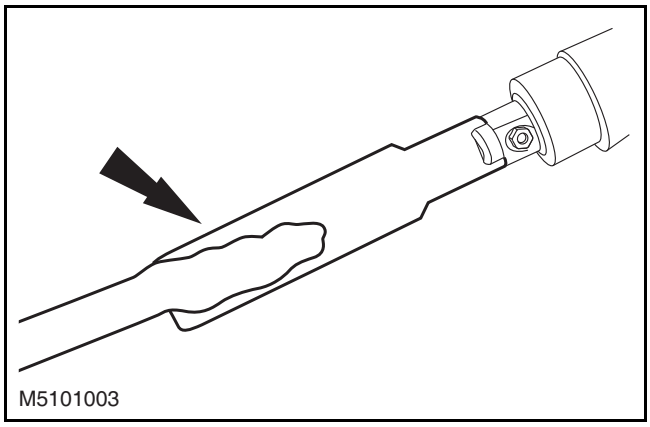


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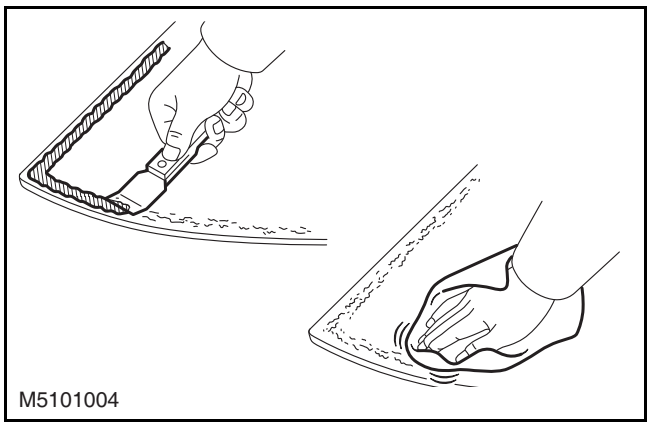
## Installation

1. Remove the remaining adhesive in the slot flange of the back door glass.


M5101003

2. Use the scraper to remove the adhesive on the glass and clean the glass.

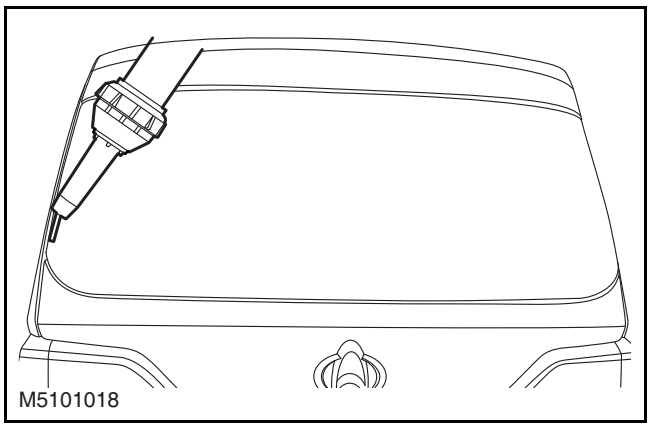
**WARNING: Please avoid touching the cleaned surface, otherwise it will affect the bonding effect.**


M5101004

3. Inspect the damaged metal fragments, iron rust, or any other irrelevant materials in the welding seam seal area, which tend to cause damage to the glass.
4. Control the temperature of heat gun around 25°C, remove the moisture in the slot flange of back door glass and glass glue.

   General tool: heat gun

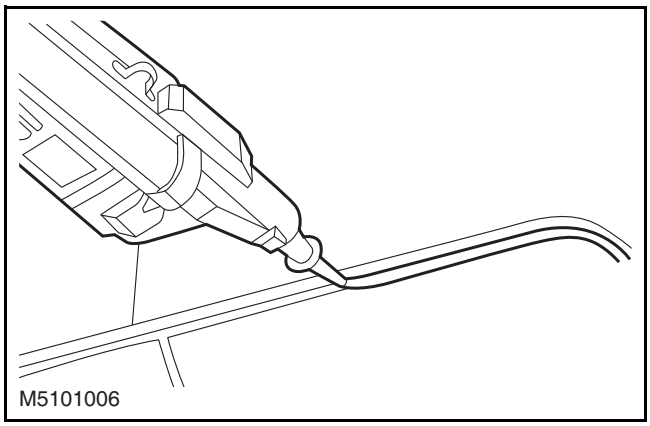
**CAUTION: Remove all moisture in adhesive surface to ensure the bonding effect.**


M5101018

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5. Apply PU adhesive for about 8 ~ 10 mm in width along adhesive line against the edge of windshield frames.



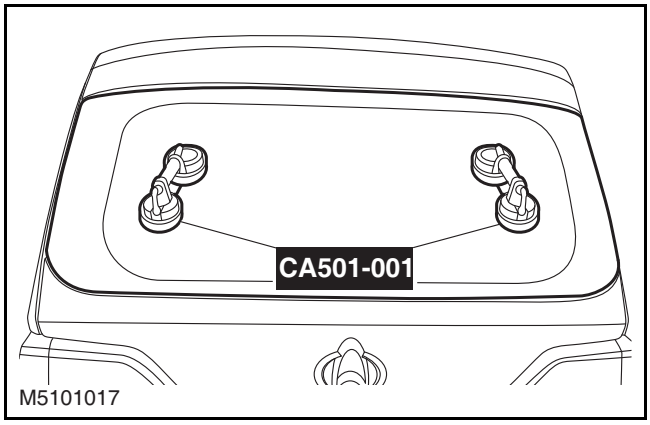

**CAUTION: If the ambient temperature is below 10°C, heat the PU adhesive for about 15 mins on the stove or use heat gun to heat it to about 25°C.**

**CAUTION: Reapply adhesive for 20 mm where has no adhesive tape in order to protect against water leakage.**

**CAUTION: In order to reduce working time, the first 100 mm of PU adhesive can be abandoned.**

6. Use glass sucker to install the back door glass with the help of other technicians.

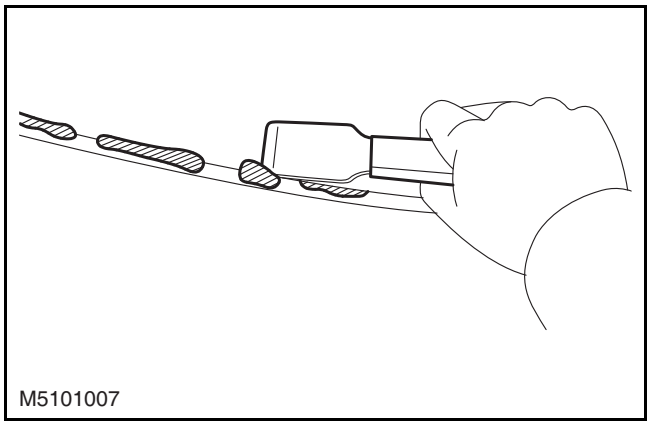
   Special tool: CA501-001




**WARNING: Please keep the door open before installing the glass in case it may affect bonding effect because the pressure in the vehicle may increase if the door is closed.**

**CAUTION: Press every part of the glass evenly, so that the glass can bond firmly with adhesive.**

7. Use scraper to remove the excessive or overflowing adhesive.

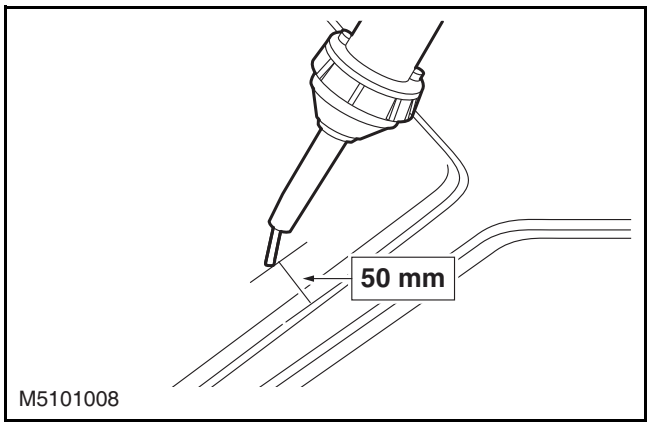


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8. Press the glass tightly until adhesive hardened.

**CAUTION: If the normal temperature is below 10°C, heat the surface (25°C) in a distance of about 50 mm for 15 mins (inside or outside of the vehicle) by using heat gun.**




9. Install the high mounted stop lamp.

**Refer to: High Mounted Stop Lamp (4.2.6 Lighting System, Removal and Installation).**

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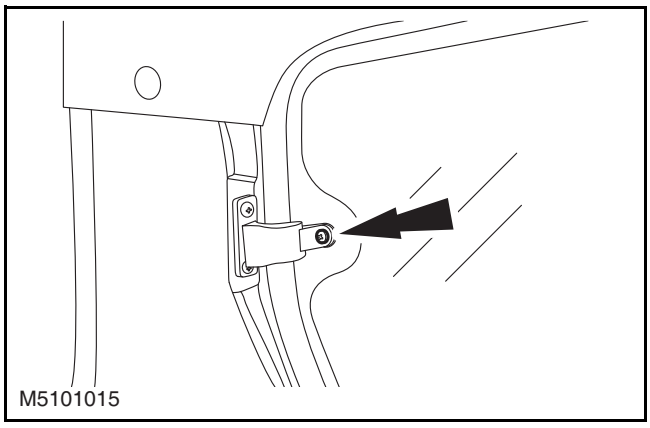


# Rear Quarter Glass

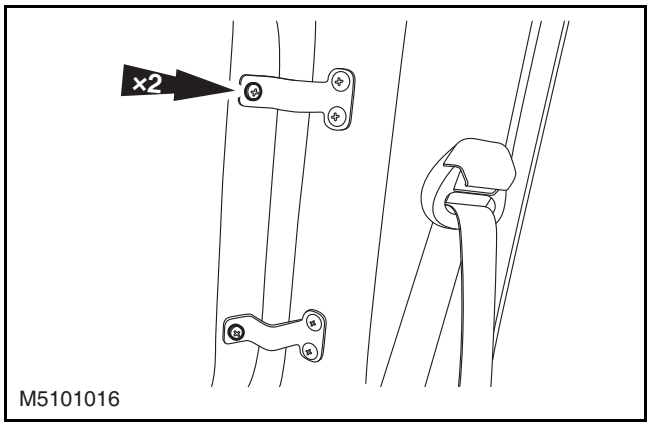
## Removal

**CAUTION: Other technicians shall assist to hold the strip from outside of the vehicle when removing the rear quarter glass. Otherwise, the glass may drop and cause damage.**

1. Remove the retaining screw between rear quarter glass and glass switch.




2. Remove 2 retaining screws from the rear quarter glass hinge, and remove the rear quarter glass.




## Installation

1. Installation is in the reverse order of removal.

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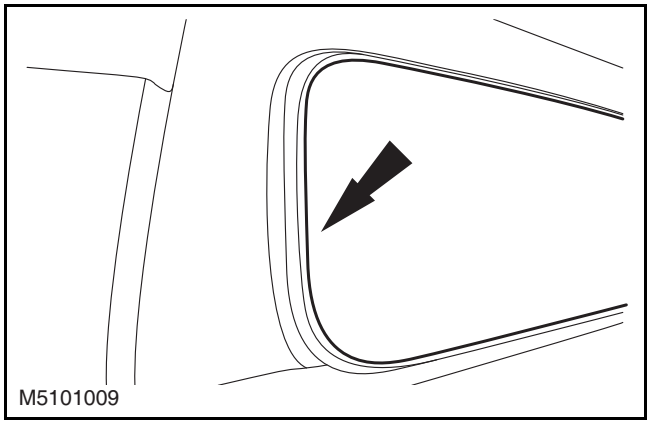
# Rear Window Glass

**General Equipment**

| |
|---|
| String |
| Rear window weatherstrip |

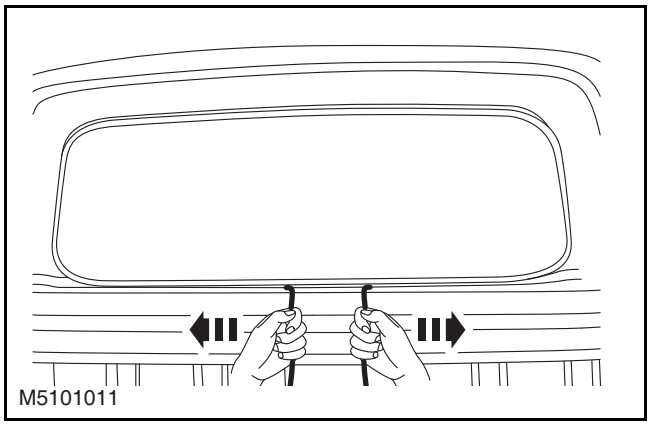
## Removal

1. Pull two corners on one side of rear window weatherstrip out of the metal plate in the cab, and tap the glass out lightly.
2. Catch the glass and weatherstrip from outside of the rear quarter panel, and remove the rear window weatherstrip to get the rear window glass.




## Installation

1. Install the weatherstrip and glass cooperatively.
2. Round the weatherstrip cooperated with the glass one circle with a string.
3. Two people, one inside the vehicle and another outside the vehicle, hold the two ends of rope at the same time, and snap the weatherstrip into the frame in the way of clamping to install the glass in place.



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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Front door glass retaining bolt | 5 | - | 44 |
| Rear door glass retaining bolt | 5 | - | 44 |

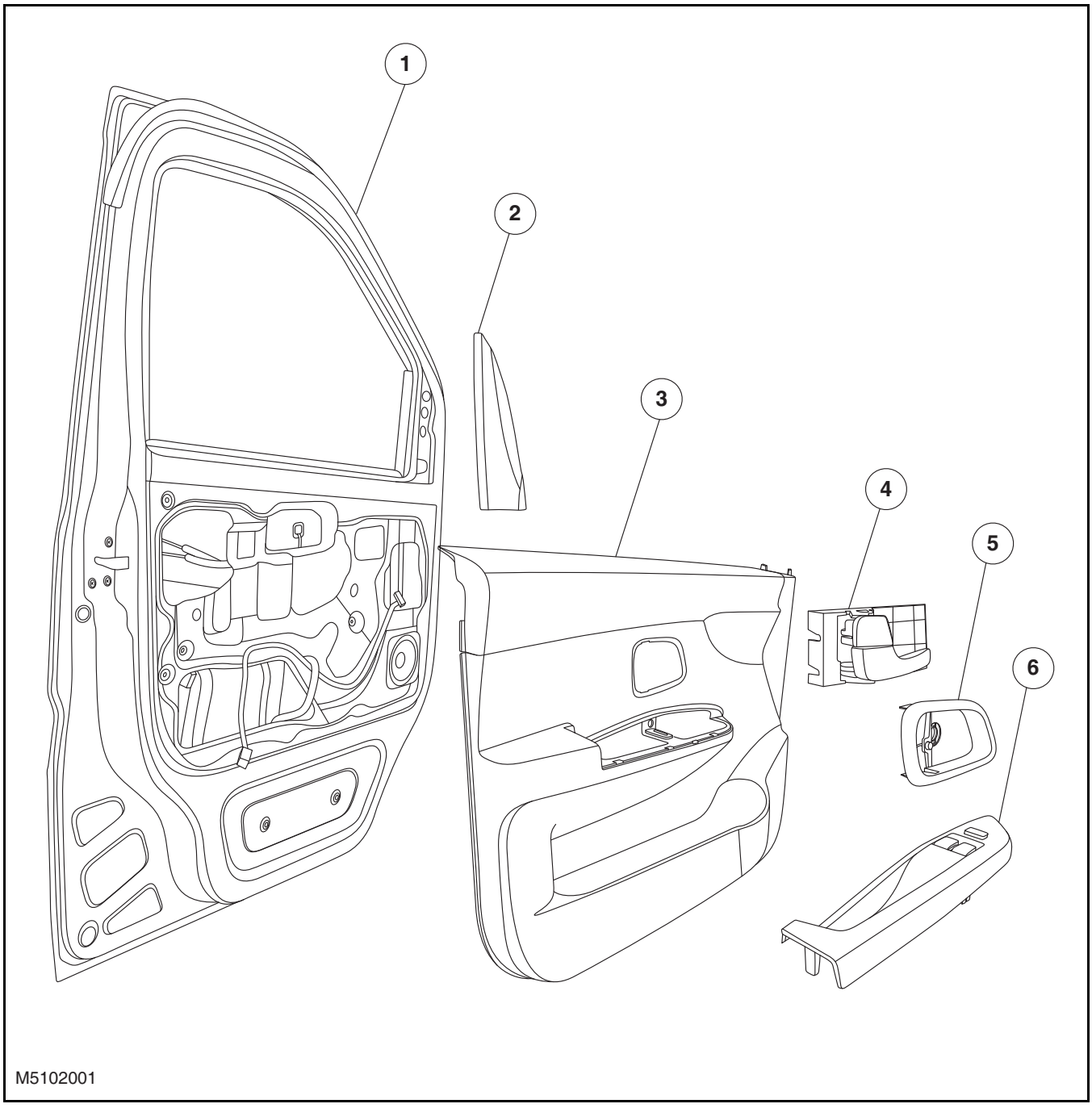
https://truckmanualshub.com/



## Description and Operation

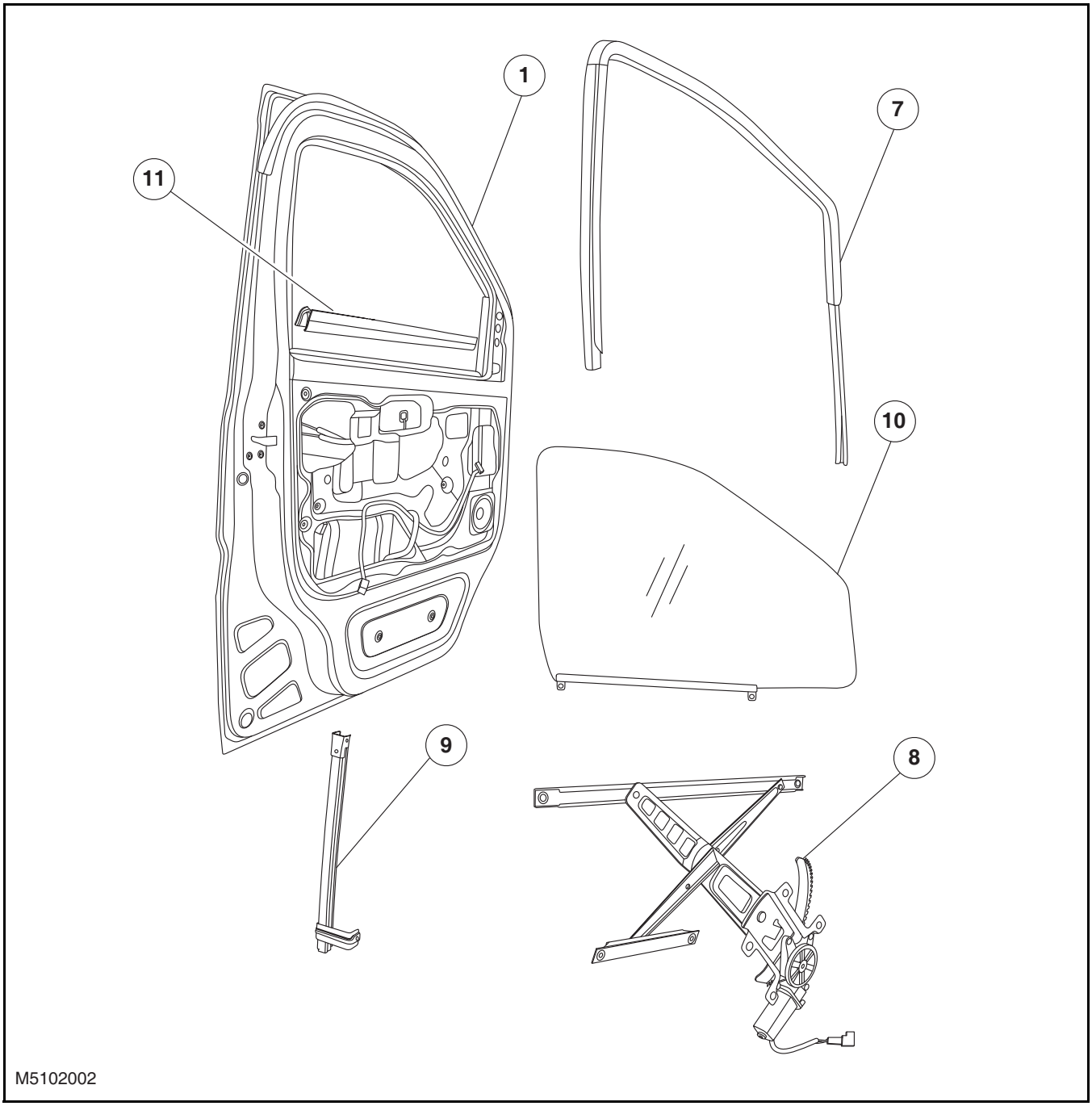
# Components Exploded View

### Front Door



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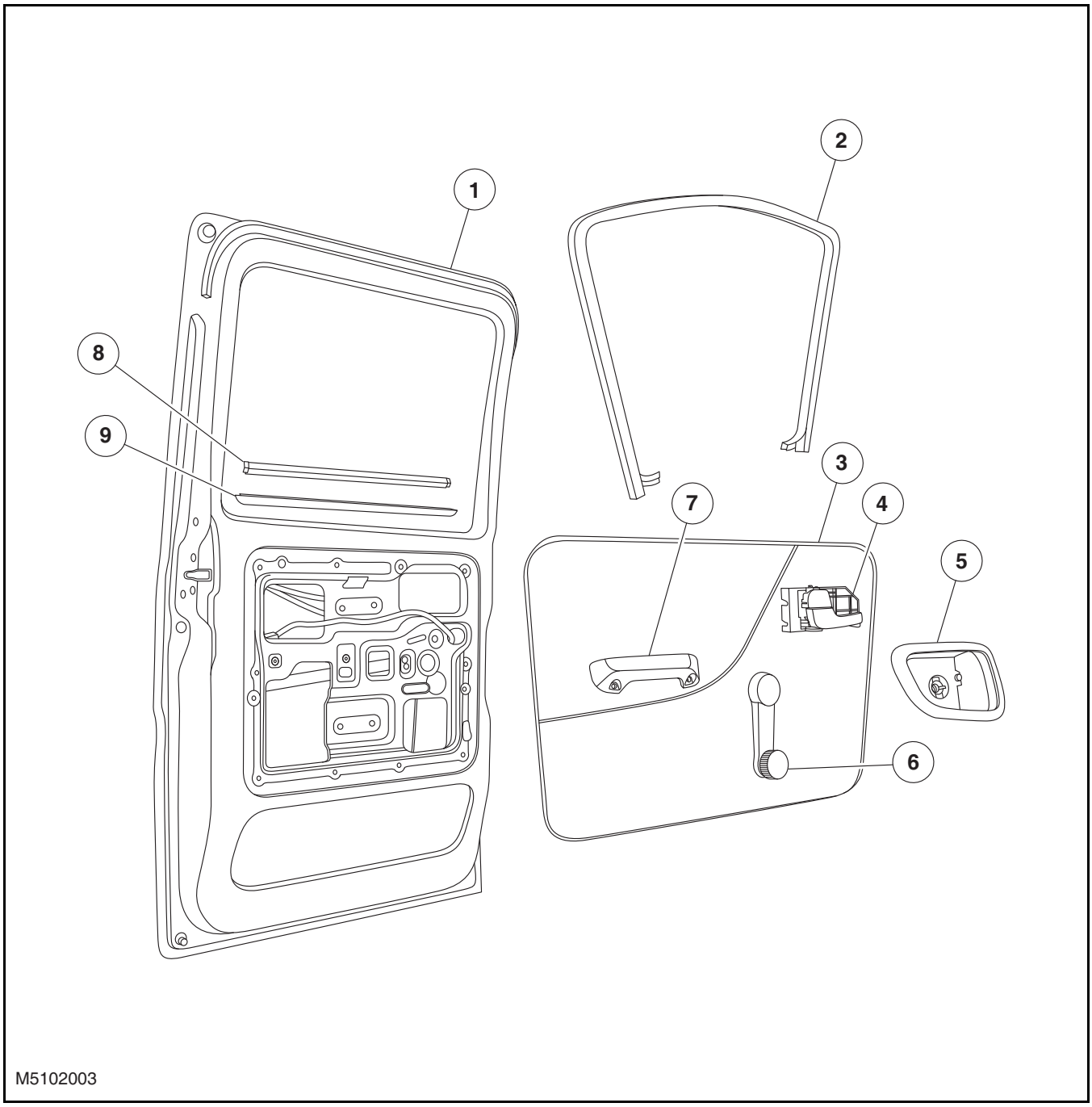



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Front door | 7 | Front door glass run |
| 2 | Front door quarter door garnish | 8 | Front door glass regulator |
| 3 | Front door interior trim panel | 9 | Front door rear slot |
| 4 | Front door inside handle | 10 | Front door glass |
| 5 | Front door inside handle protector | 11 | Front door weatherstrip |
| 6 | Front door inside handle trim cover | | |

https://truckmanualshub.com/

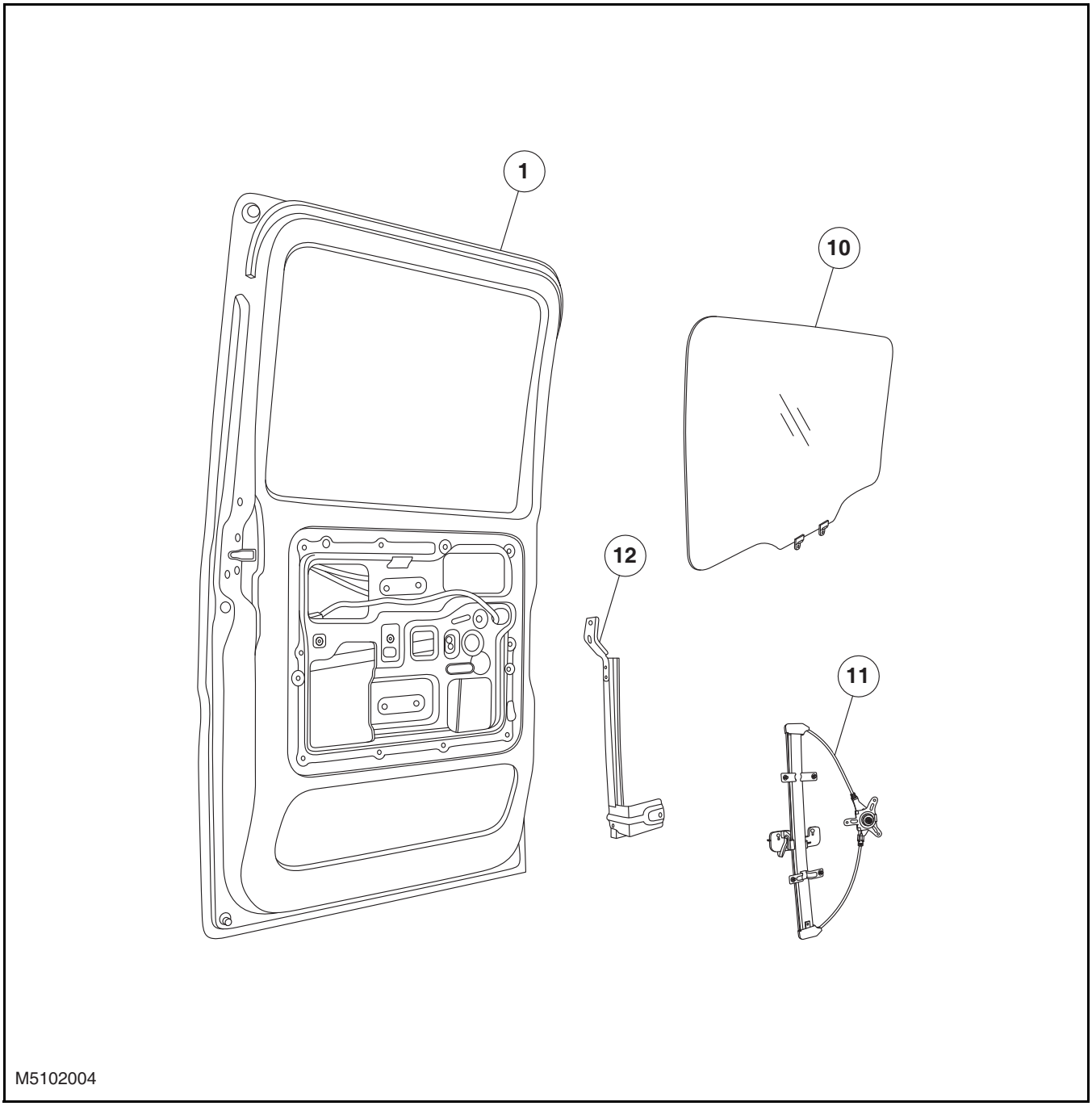


## Rear Door



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| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Rear Door | 7 | Rear door outside handle |
| 2 | Rear door glass run | 8 | Rear door outer weatherstrip |
| 3 | Rear door interior trim panel | 9 | Rear door inner weatherstrip |
| 4 | Rear door inside handle | 10 | Rear door glass |
| 5 | Rear door inside handle protector | 11 | Rear door glass regulator |
| 6 | Rear door glass regulator handle | 12 | Rear door rear slot |

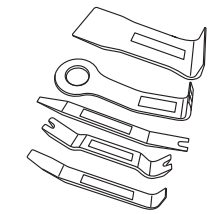
https://truckmanualshub.com/



## Removal and Installation

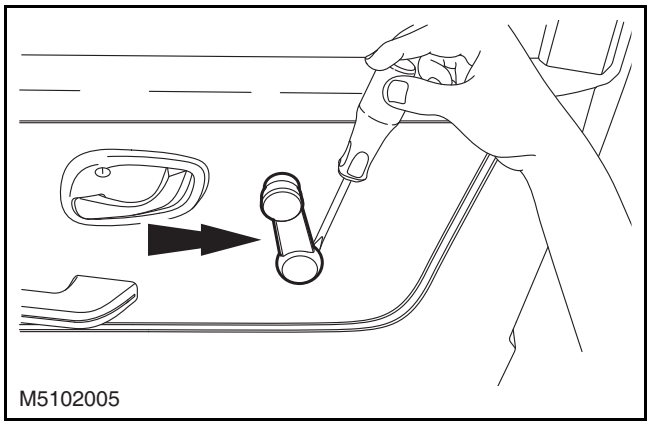
# Front Door Interior Trim Panel (Models with Manual Regulator)

**Special Tool**

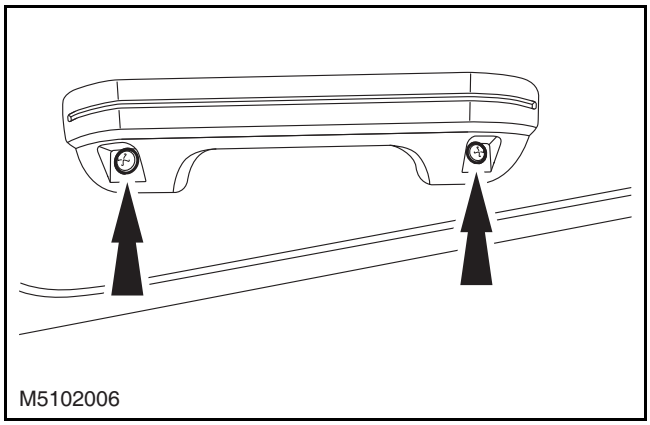
| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

## Removal

**1.** Using a screwdriver wrapped with protective tape, pry off the handle jump ring of front door glass regulator, and remove the handle, jump ring and dust cover.


M5102005

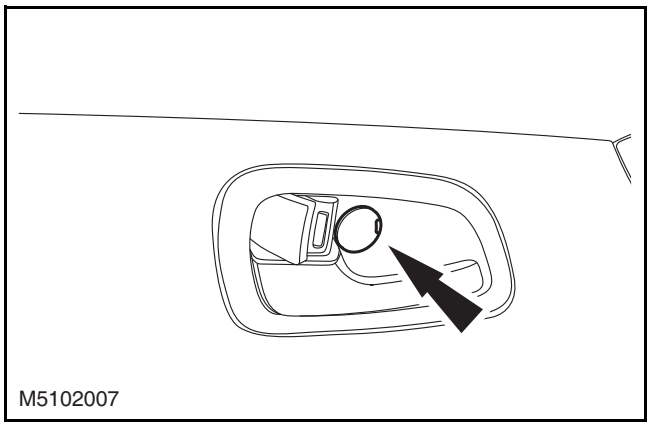
**2.** Remove 2 retaining screws from the front door inside handle and remove the inside handle.


M5102006

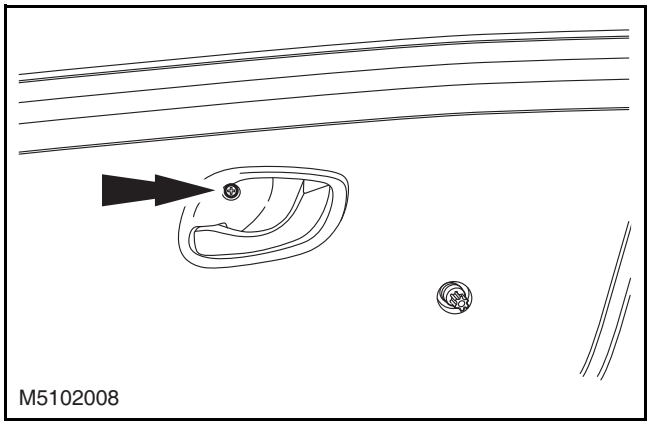
https://truckmanualshub.com/



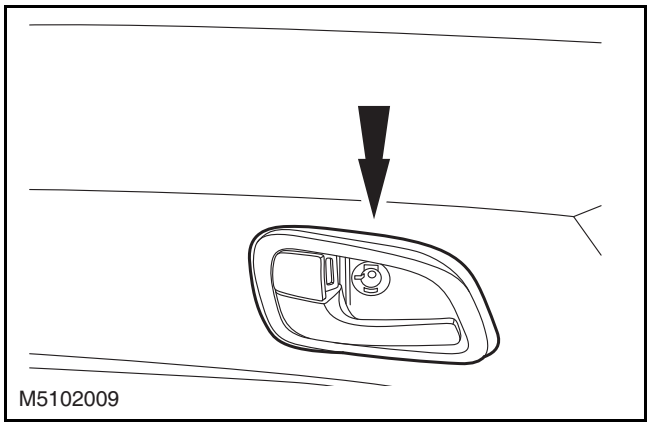
**3.** Remove the retaining screw cover from the front door inside handle.


M5102007

**4.** Remove the front door inside handle retaining screw.

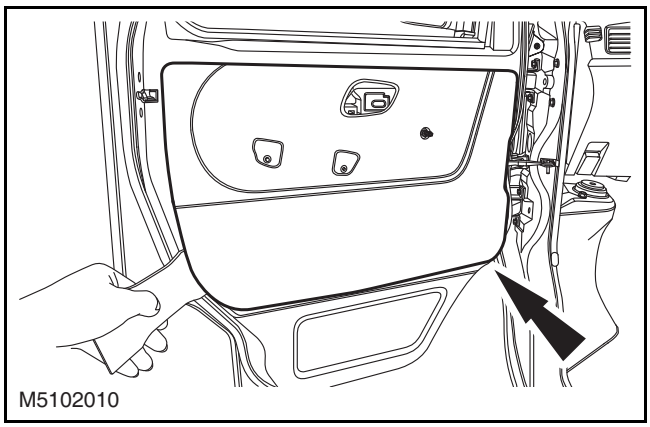

M5102008

**5.** Using a screwdriver wrapped with protective tape, remove the front door inside handle protector.


M5102009

**6.** Use the special tool to disengage the front door interior trim panel clips and remove it.

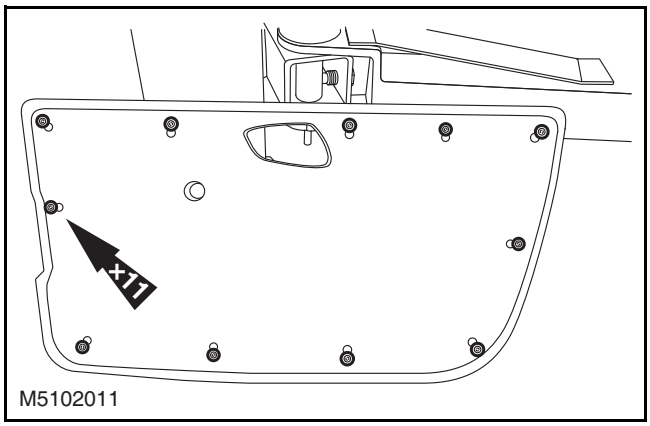
Special tool: CA501-002


M5102010

https://truckmanualshub.com/



7. The front door interior trim panel clip position is shown in the figure.




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Front door interior trim panel clip is disposable component, install a new one.**

**CAUTION: Put the jump ring on the handle when installing the glass regulator. Then, assemble the glass regulator.**

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# Front Door Interior Trim Panel (Models with Power Regulator)

### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

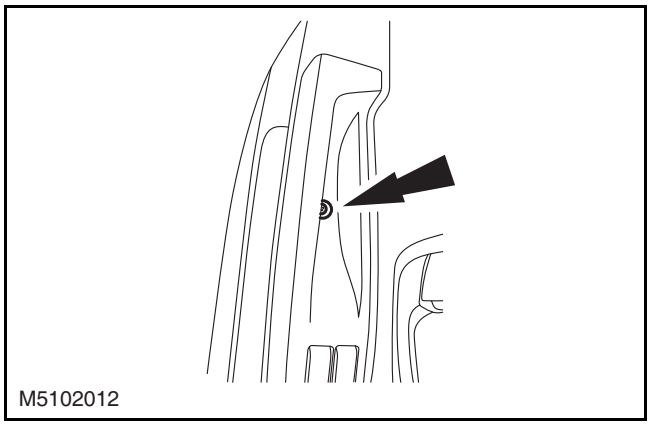
## Removal

1. Disconnect the negative battery cable.

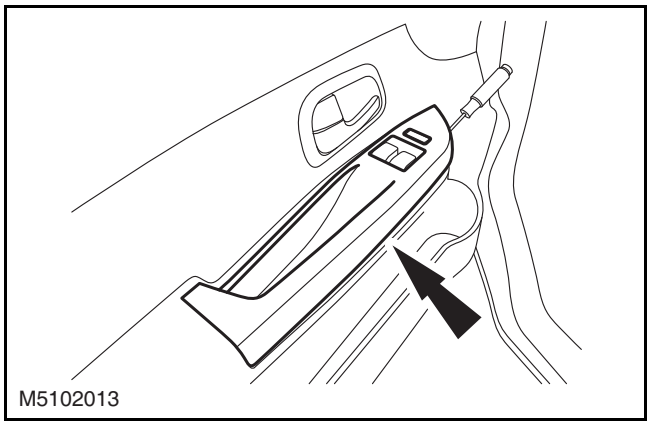
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the front door inside handle trim cover.

   1 Remove the retaining screw from the front door inside handle trim cover.


M5102012

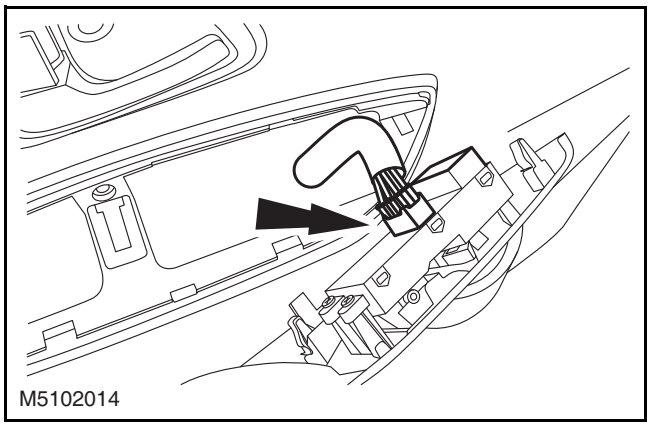
   2 Using a screwdriver wrapped with protective tape, remove the front door inside handle trim cover.


M5102013

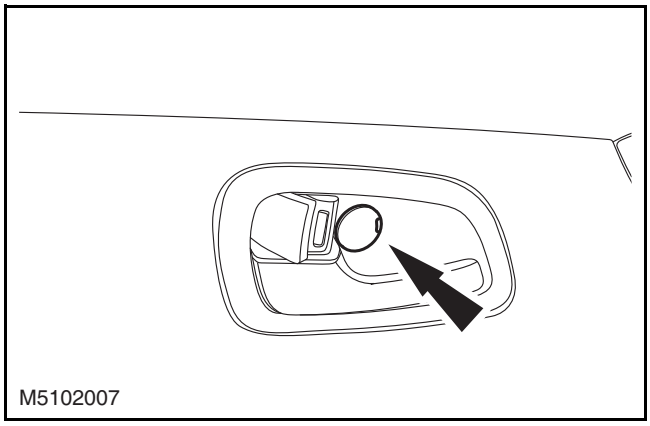
https://truckmanualshub.com/



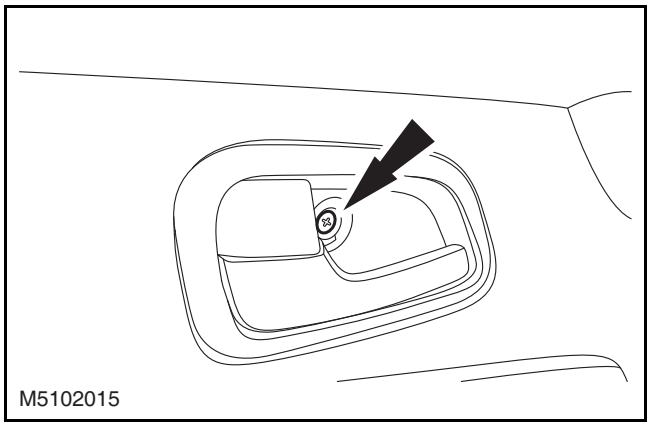
**3.** Disconnect the power window switch connector.


M5102014

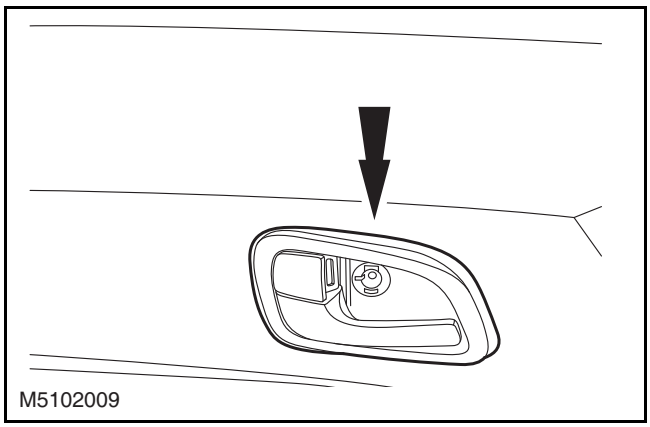
**4.** Remove the retaining screw cover from the front door inside handle.


M5102007

**5.** Remove the front door inside handle retaining screw.


M5102015

**6.** Using a screwdriver wrapped with protective tape, remove the front door inside handle protector.

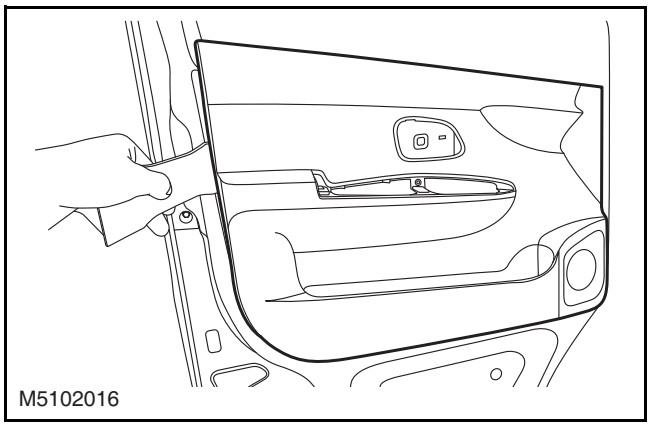

M5102009

https://truckmanualshub.com/

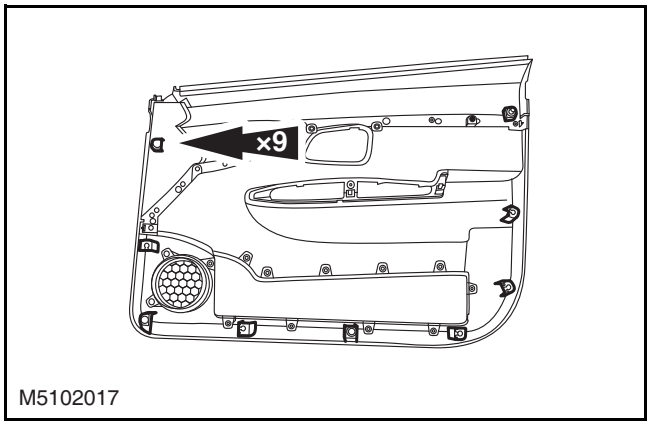


7. Use the special tool to disengage the front door interior trim panel clip and remove it.

   Special tool: CA501-002


M5102016

8. The position of front door interior trim panel clip is shown in the figure.



M5102017

## Installation

1. Installation is in the reverse order of removal.

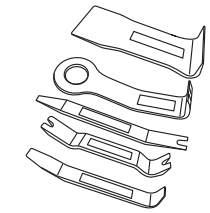
**CAUTION: Front door interior trim panel clip is disposable component, install a new one.**

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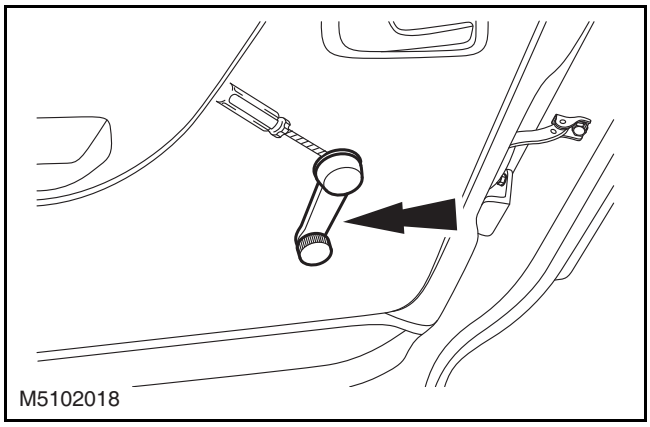
# Rear Door Interior Trim Panel

**Special Tool**

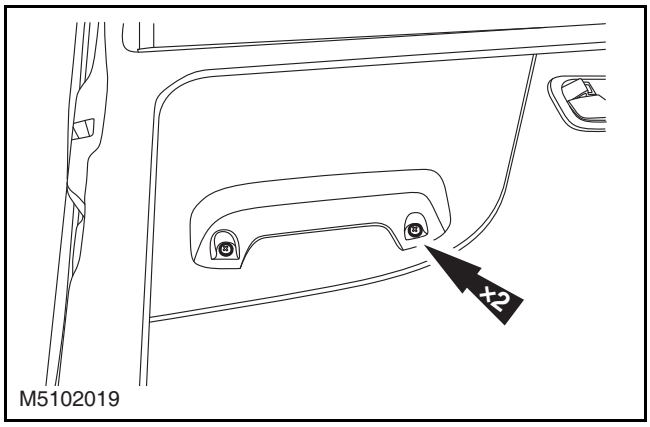
| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

## Removal

**1.** Using a screwdriver wrapped with protective tape, pry the rear door glass regulator handle jump ring, and remove the handle, jump ring and dust boot.

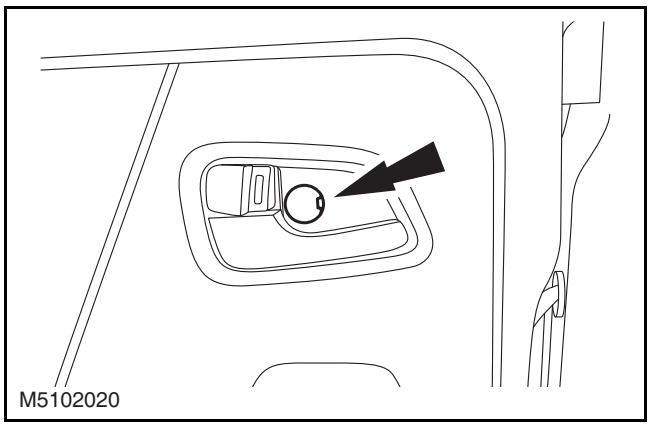

M5102018

**2.** Remove 2 retaining screws from the rear door inside handle, and remove the inside handle.



M5102019

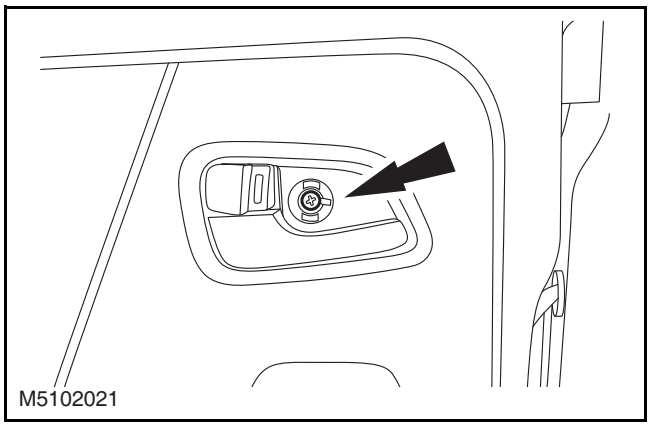
**3.** Remove the retaining screw cover from the rear door inside handle.


M5102020

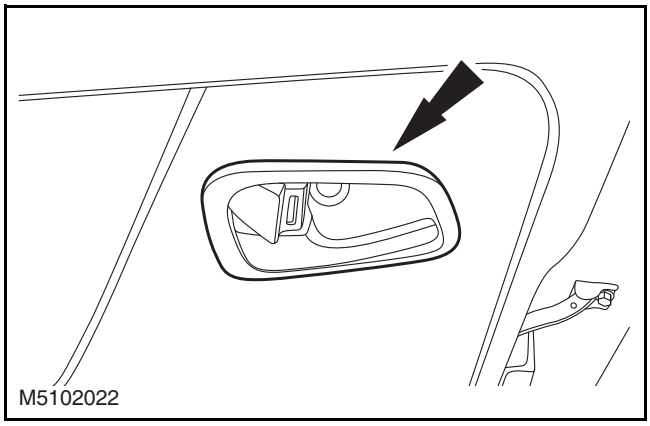
https://truckmanualshub.com/



**4.** Remove the rear door inside handle retaining screw.

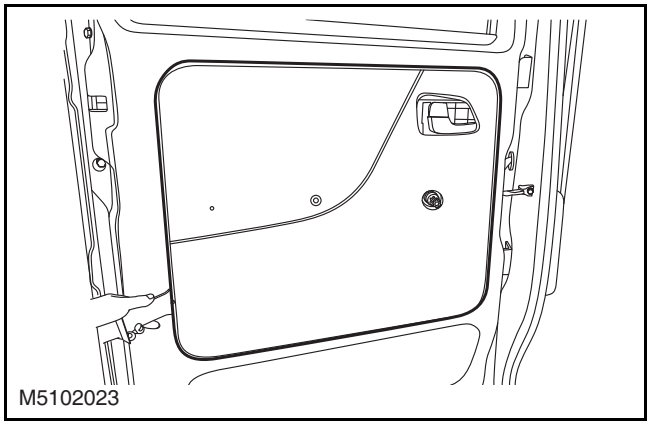



**5.** Using a screwdriver wrapped with protective tape, remove the rear door inside handle protector.

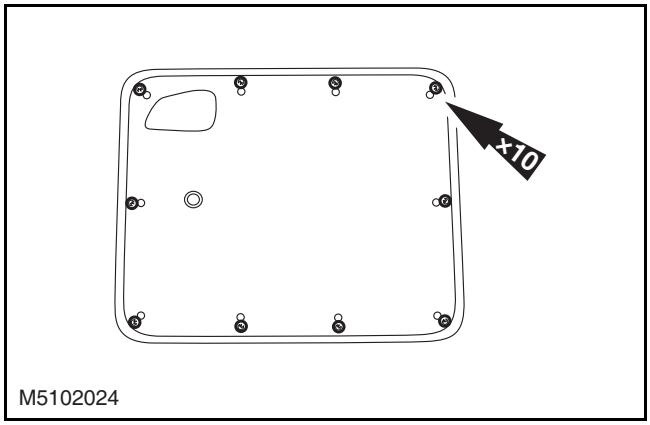



**6.** Use the special tool to disengage the rear door interior trim panel clip, and remove the rear door interior trim panel.

Special tool: CA501-002




**7.** The position of rear door interior trim panel clip is shown in the figure.



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## Installation

1. Installation is in the reverse order of removal.

**CAUTION: The rear door interior trim panel clip is disposable component, use a new one when reinstalling.**

**CAUTION: Put the jump ring on the handle when installing the glass regulator. Then, assemble the glass regulator.**

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# Front Door Glass

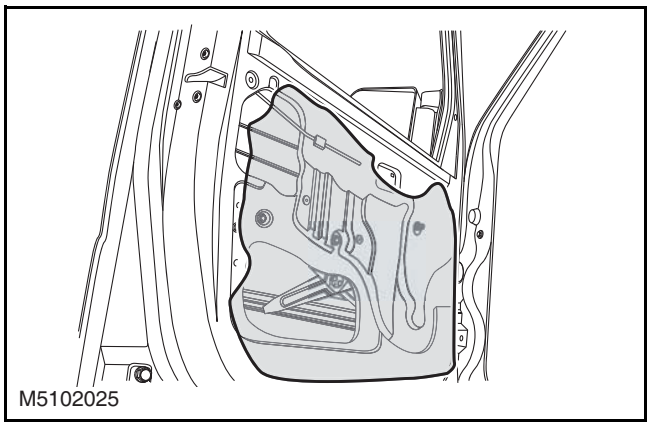
## Removal

1. Remove the front door interior trim panel.

   **Refer to: Front Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**

2. Uncover the front door water-proof film.

**CAUTION: Be careful to prevent damaging the water-proof film during removal. Do not touch the adhesive surface to avoid reduction in adhesion effect during reassembly.**


M5102025

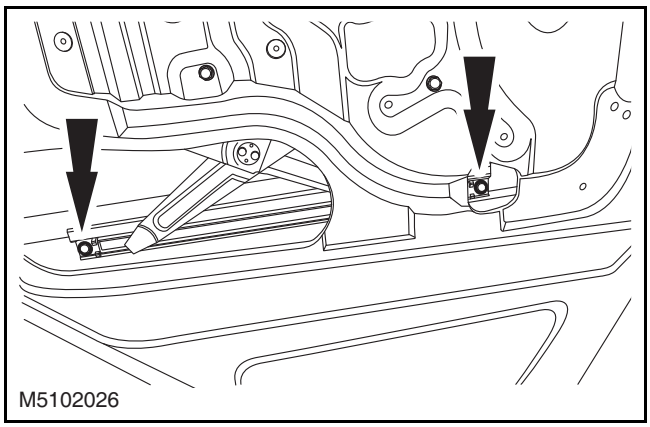
3. Remove the front door rear slot.

   **Refer to: Front Door Rear Slot (5.1.2 Door, Removal and Installation).**

4. Adjust the height of front door glass for convenient removal and installation.
5. Remove 2 retaining bolts from the front door glass.

   Torque: 5 Nm

**CAUTION: Support the front door glass to prevent it from dropping, causing damage.**

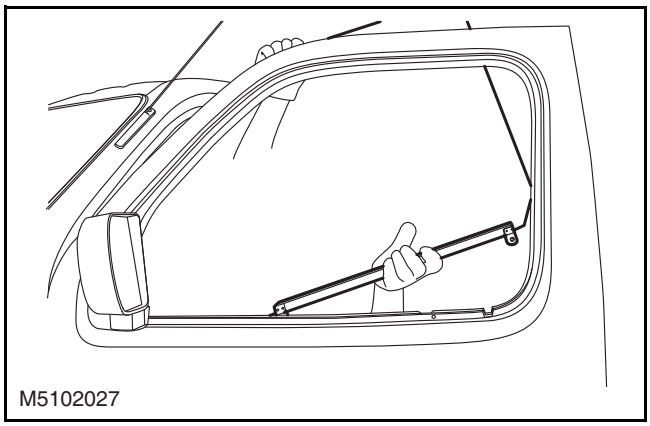

M5102026

https://truckmanualshub.com/



6. Remove the front door glass.

**CAUTION: When treating the glass, be careful to prevent damage.**



M5102027

## Installation

1. Installation is in the reverse order of removal.

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# Rear Door Glass

## Removal

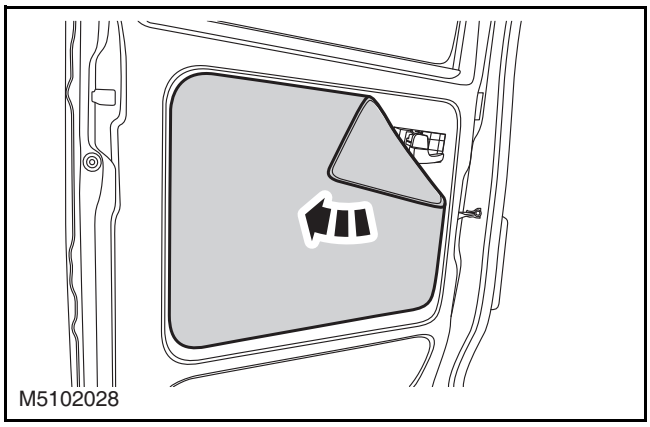
1. Remove the rear door interior trim panel.

   **Refer to: Rear Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**

2. Uncover the rear door water-proof film.

   Torque: 5 Nm

**CAUTION: Be careful to prevent damaging the water-proof film during removal. Do not touch the adhesive surface to avoid reduction in adhesion effect during reassembly.**



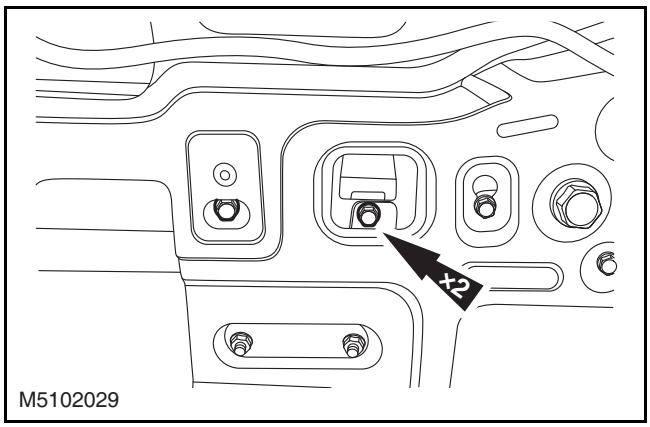

3. Remove the rear door rear slot.

   **Refer to: Rear Door Rear Slot (5.1.2 Door, Removal and Installation).**

4. Adjust the height of the rear door glass for convenient removal and installation.
5. Remove 2 retaining bolts from the rear door glass.

   Torque: 5 Nm

**CAUTION: Support the rear door glass to prevent it from dropping, causing damage.**



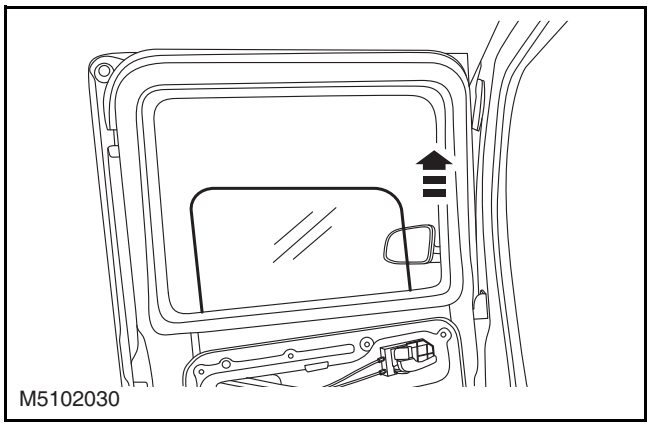
https://truckmanualshub.com/



6. Remove the rear door glass.

   Torque: 5 Nm

**CAUTION: When treating the glass, be careful to prevent damage.**




## Installation

1. Installation is in the reverse order of removal.

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# Front Door Rear Slot

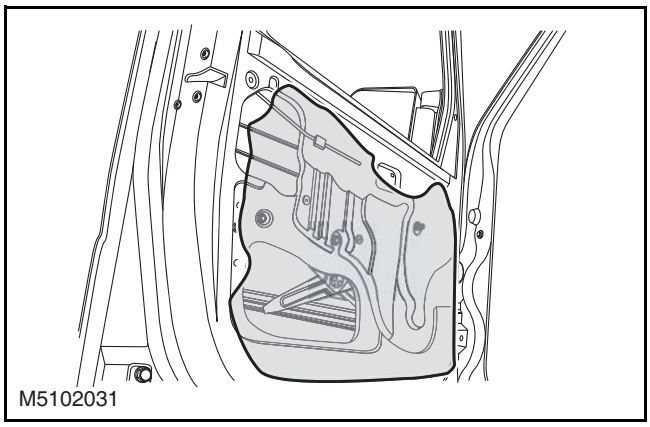
## Removal

1. Remove the front door interior trim panel.

   **Refer to: Front Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**

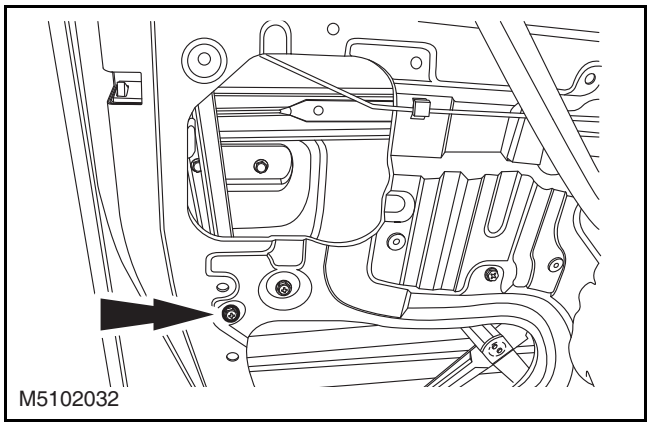
2. Uncover the front door water-proof film.

**CAUTION: Be careful to prevent damage to the water-proof film during removal. Do not touch the adhesive surface to avoid reduction in adhesion effect during reassembly.**

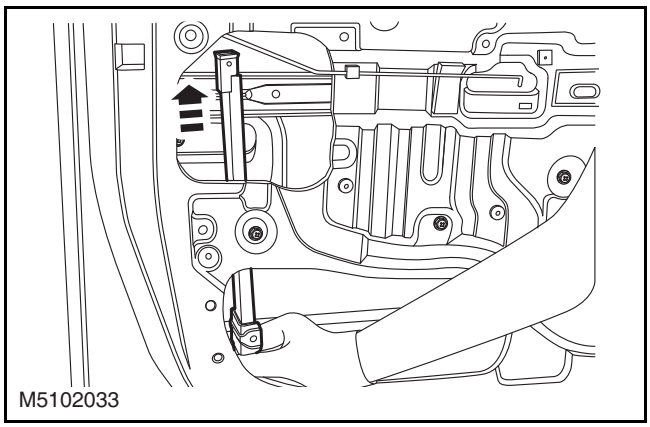

M5102031

3. Remove the retaining bolt from the front door rear slot.

   Torque: 8 ~ 12 Nm


M5102032

4. Remove the front door rear slot.


M5102033

## Installation

1. Installation is in the reverse order of removal.

https://truckmanualshub.com/



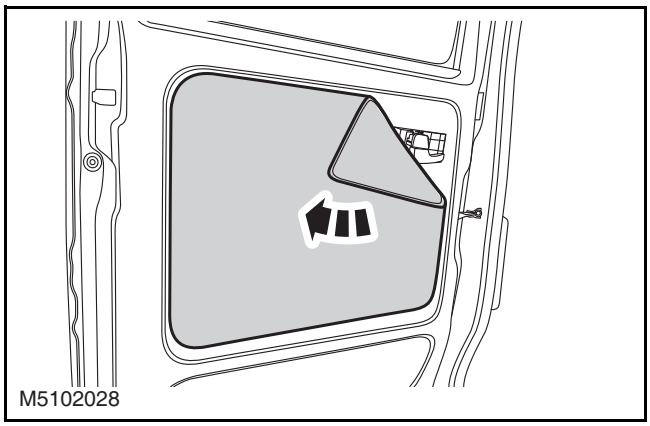
# Rear Door Rear Slot

## Removal

1. Remove the rear door interior trim panel.

   **Refer to: Rear Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**

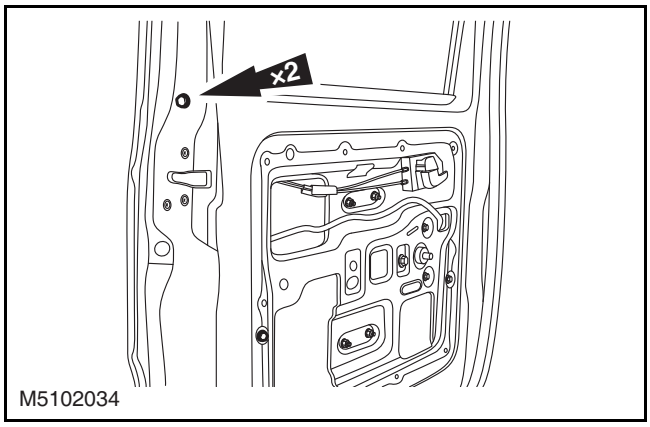
2. Uncover the rear door water-proof film.



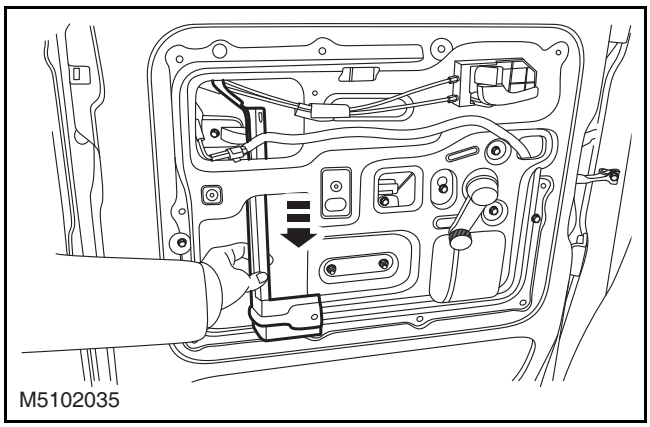

**CAUTION: Be careful to prevent damage to the water-proof film during removal. Do not touch the adhesive surface to avoid reduction in adhesion effect during reassembly.**

3. Remove the retaining bolts from the rear door rear slot.

   Torque: 8 ~ 12 Nm




4. Remove the rear door rear slot.




## Installation

1. Installation is in the reverse order of removal.

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# Front Door Glass Run

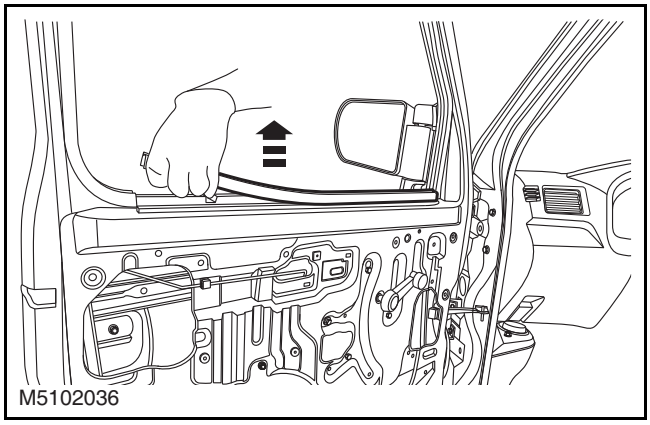
## Removal

1. Remove the front door glass.

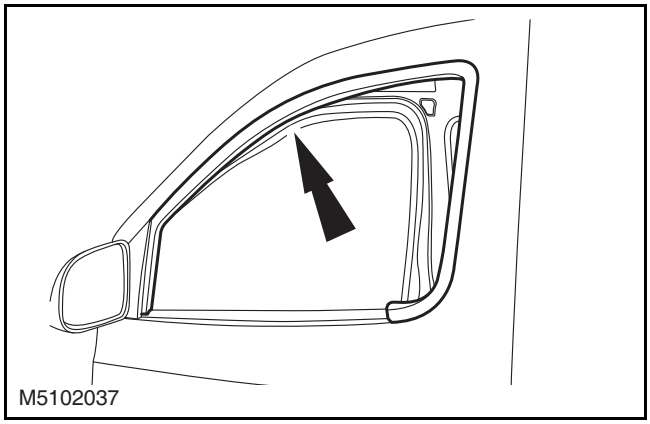
   **Refer to: Front Door Glass (5.1.2 Door, Removal and Installation).**

2. Remove the front door weatherstrip.

   **Note: For models with power glass regulator, remove the outer weatherstrip; For models with manual glass regulator, remove the inner and outer weatherstrips.**


M5102036

3. Remove the front door glass run.


M5102037

## Installation

1. Installation is in the reverse order of removal.

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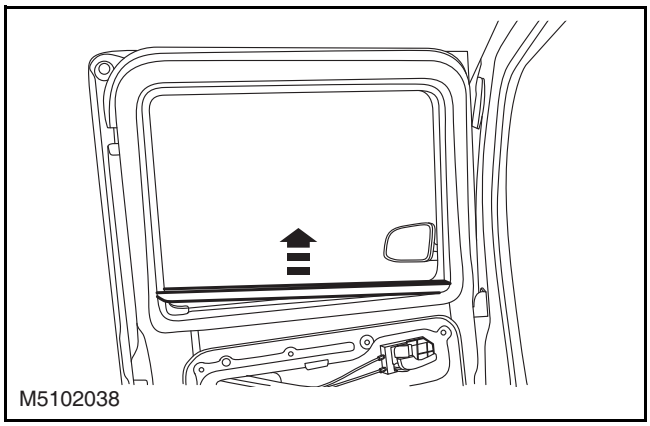
# Rear Door Glass Run

## Removal

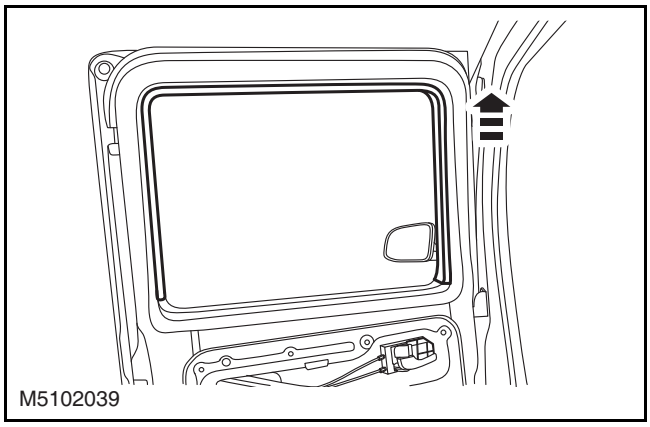
1. Remove the rear door interior trim panel.

   **Refer to: Rear Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**

2. Remove the rear door weatherstrip.


M5102038

3. Remove the rear door glass run.


M5102039

## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Front seat rear hinge retaining bolt | 25 ~ 45 | 18 ~ 33 | - |
| Front seat belt buckle retaining bolt | 45 ~ 60 | 33 ~ 44 | - |
| Rear seat retaining bolt | 20 ~ 24 | 15 ~ 18 | - |
| Rear seat belt retaining bolt | 45 ~ 60 | 33 ~ 44 | - |

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## Description and Operation

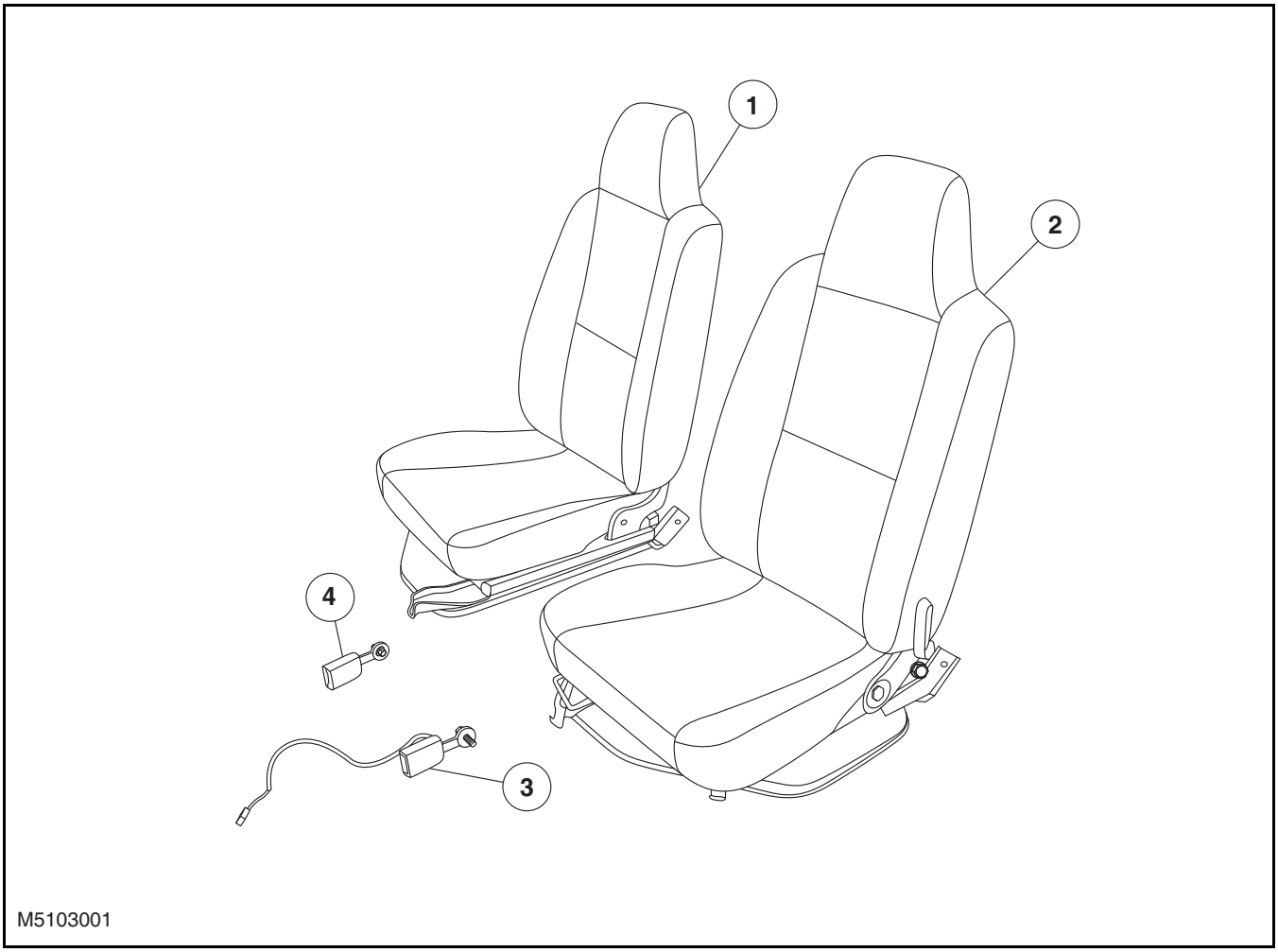
# System Overview

MD201 is one model with single row of seats. Driver seat can slide forward and rearward and adjust the backrest angle. Both driver seat and front passenger seat are retaining headrest. The lock function of seat backrest is normal and reliable, and the backrest can put down.

MS201 is one model with double rows of seats. Front seats can adjust the backrest angle and headrest height. driver side seat can slide forward and rearward. Rear seats is 3-people type with retaining headrest and cannot adjust the backrest angle. The material is common.

# Components Location View

### Front Seat (For Model MD201)

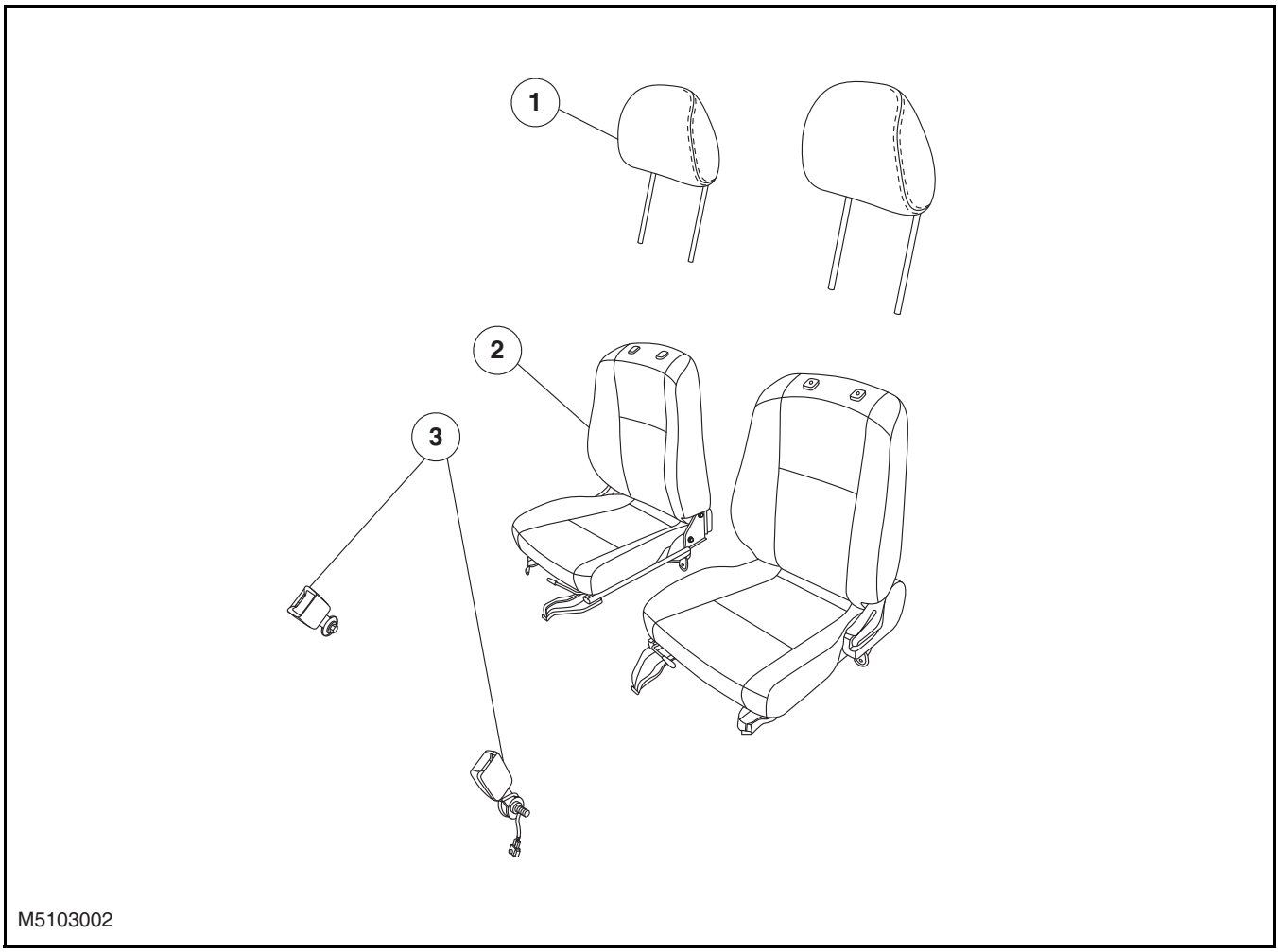



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Front passenger seat assembly | 3 | Driver side seat belt buckle |
| 2 | Driver seat assembly | 4 | Front passenger side seat belt buckle |

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## Front Seat (For Model MS201)

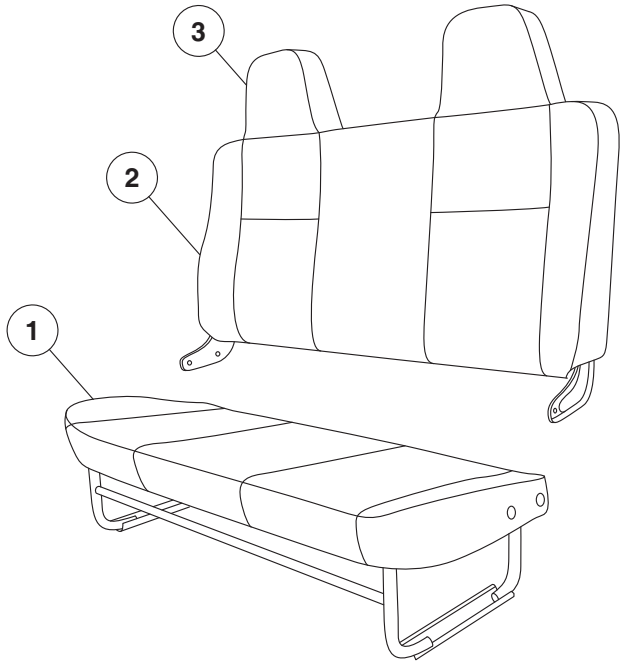



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Headrest | 3 | Seat belt buckle |
| 2 | Seat | | |

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## Rear Seat




M5103003

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Rear seat assembly | 3 | Retaining headrest |
| 2 | Integrated backrest | | |

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## Removal and Installation

# Front Seat

### Removal

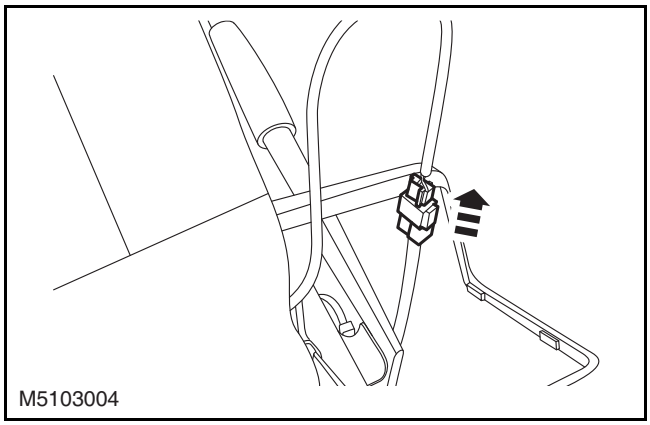
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the console.

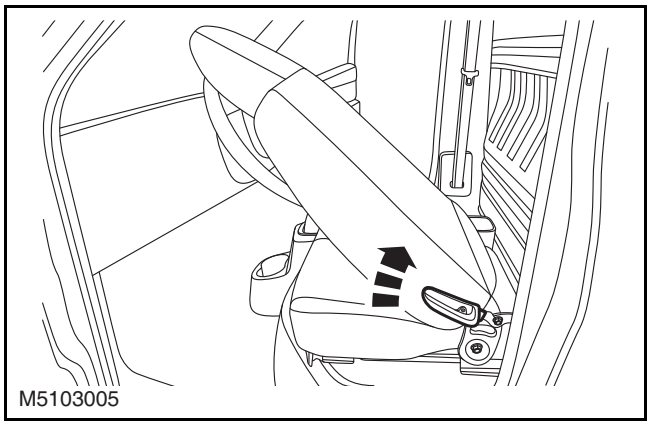
   **Refer to: Console (5.1.6 Instrument Panel and Console, Removal and Installation).**

3. Disconnect the driver seat belt buckle switch wiring harness connector.




4. Remove 2 retaining bolts from the rear part of front seat. (For Model MD201).

   1 Pull up the seat angle adjusting handle and fold down the front seat backrest.



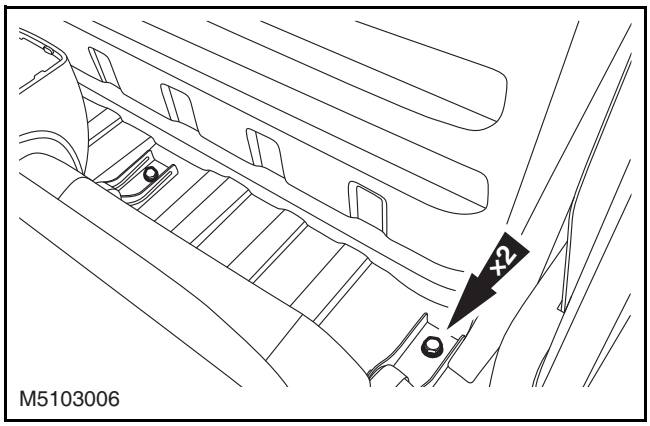
https://truckmanualshub.com/



2 Move the seat to the foremost position (for driver side seat).

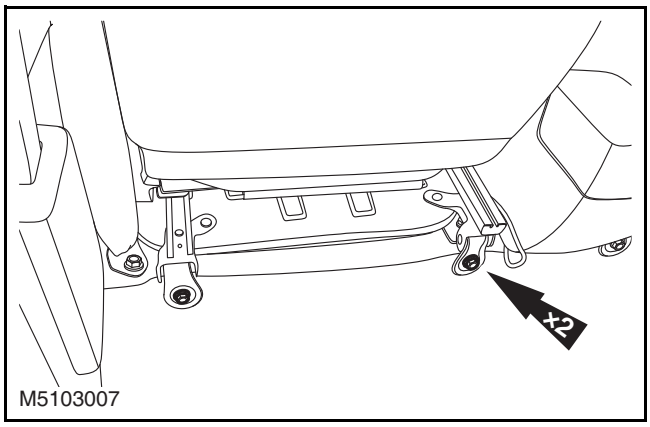
3 Remove 2 retaining bolts from the rear part of seat.

Torque: 25 ~ 45 Nm

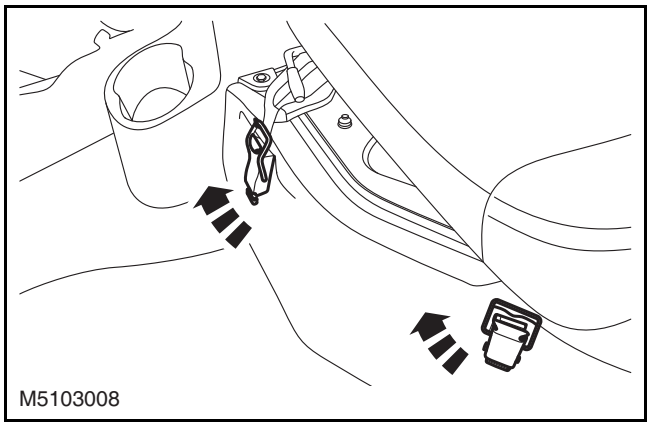



**5.** Remove 2 retaining bolts from the rear part of front seat. (For Model MS201)

Torque: 25 ~ 45 Nm




**6.** Disengage 2 hooks on the front side of seat, and remove the seat assembly.




## Installation

**1.** Installation is in the reverse order of removal.

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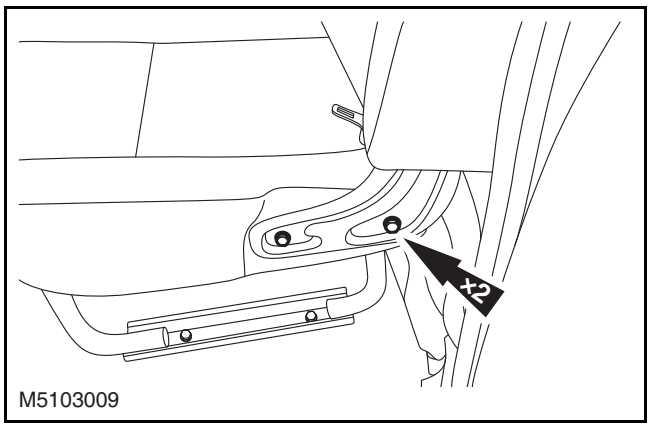


# Rear Seat

## Removal

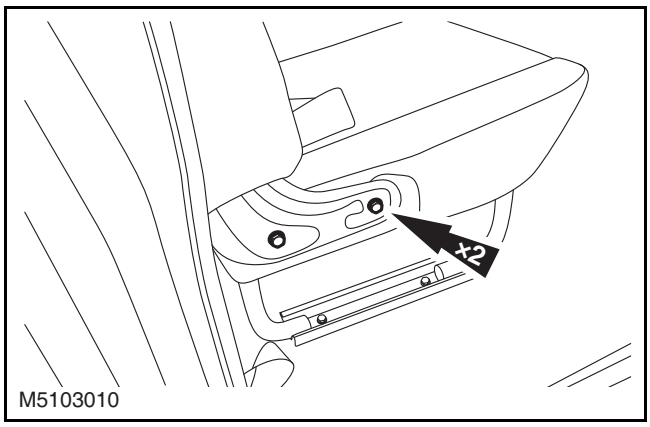
1. Remove 2 retaining bolts on the left side of seat backrest.

   Torque: 20 ~ 24 Nm



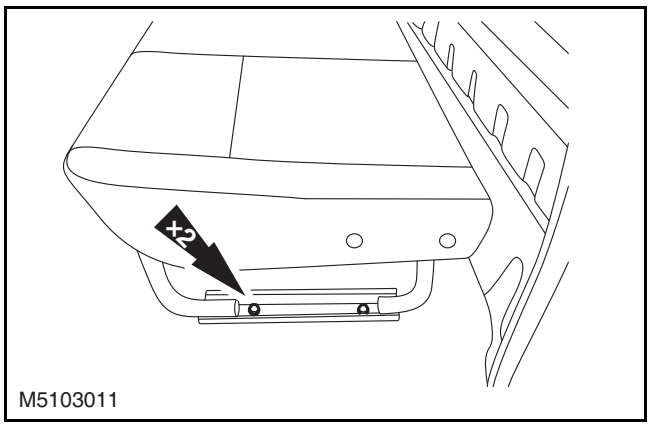

2. Remove 2 retaining bolts on the right side of seat backrest and remove the seat backrest.

   Torque: 20 ~ 24 Nm




3. Remove 2 retaining bolts on the left side of rear seat cushion bracket.

   Torque: 20 ~ 24 Nm

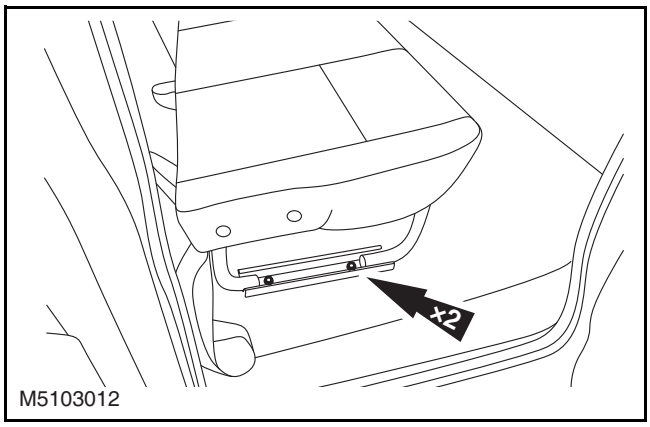


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4. Remove 2 retaining bolts on the right side of rear seat cushion bracket, and remove the rear seat cushion.

   Torque: 20 ~ 24 Nm




## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Seat belt retractor upper retaining bolt | 9 | - | 80 |
| Seat belt retractor lower retaining screw | 45 ~ 60 | 33 ~ 44 | - |
| Front seat belt buckle retaining bolt | 45 ~ 60 | 33 ~ 44 | - |
| Seat belt lower anchor retaining bolt | 45 ~ 60 | 33 ~ 44 | - |
| Seat belt upper anchor retaining bolt | 45 ~ 60 | 33 ~ 44 | - |
| Double buckles retaining bolt | 45 ~ 60 | 33 ~ 44 | - |
| Single tab retaining bolt | 45 ~ 60 | 33 ~ 44 | - |
| Single tab (include the buckle) retaining bolt | 45 ~ 60 | 33 ~ 44 | - |

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## Description and Operation

# System Overview

The seat belt, which is equipped in the vehicle, is the major device to protect the passenger. The front seat uses three-diagonal-surrounding belt; the rear seat uses two-point belt.

Front seat belt buckle is installed on seat frame respectively, and rear seat buckle is installed on vehicle.

The front seat belt is equipped with a retractor with emergent locking function. The locking function will be activated when the seat belt is completely pulled out from retractor quickly. The locking function can prevent seat belt from being pulled out to an excessive length. When the seat belt is rolled back to retractor completely, this function can be cancelled. After cancelling the locking function, the seat belt is unlocked and can be pulled out from the retractor. The driver seat belt indicator is located on the instrument cluster to remind driver to fasten seat belt.

**WARNING: Child seat, if equipped, can only be used in forward seat position, child seat should be installed and secured as instructed by manufacturer.**

**WARNING: Inspect the seat belt system carefully after every collision. The newly installed seat belt can be used only after an inspection of professional technician to make sure there is no malfunction.**

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## Removal and Installation

# Front Seat Belt

### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

## Removal

1. Disconnect the negative battery cable.

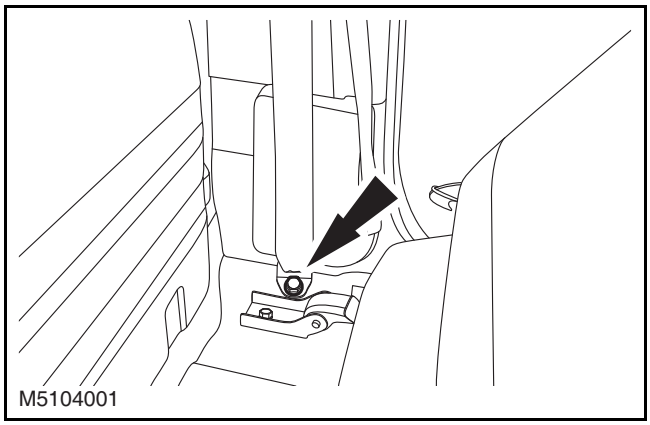
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the seat belt lower anchor retaining bolt.

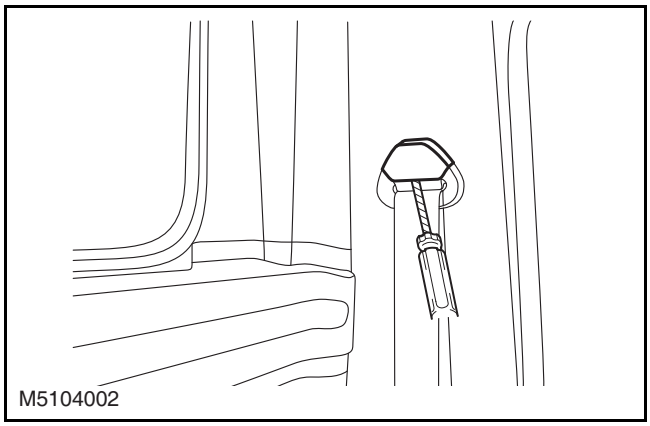
   Torque: 45 ~ 60 Nm

   **Note: Fold down backrest and move seat to the foremost position.**

**CAUTION: There is a protective paper washer on the seat belt anchor retaining bolt. Please ensure that the septa and the paper washer are always on the anchor in the removal and installation process.**


M5104001

3. Using a screwdriver wrapped with protective tape, pry the seat belt decorative cover.


M5104002

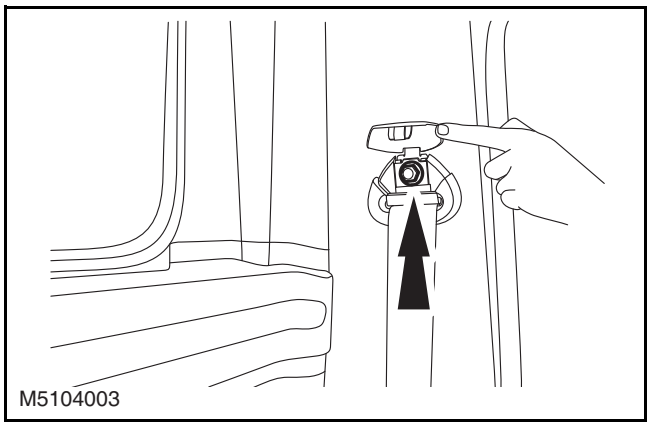
https://truckmanualshub.com/



4. Remove the seat belt upper anchor retaining bolt.

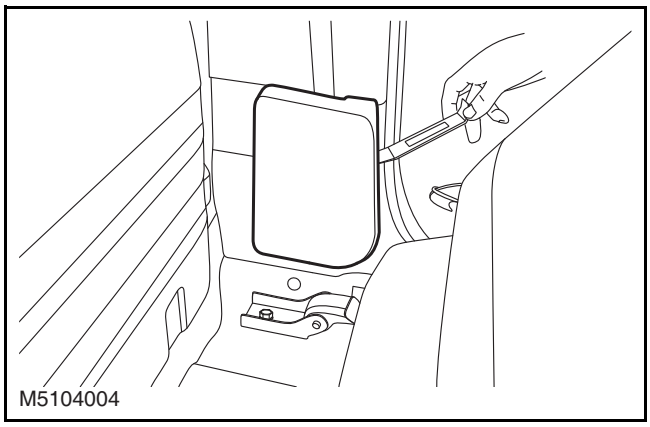
   Torque: 45 ~ 60 Nm

**CAUTION: There is a protective paper washer on the seat belt anchor retaining bolt. Please ensure that the septa and the paper washer are always on the anchor in the removal and installation process.**




5. Use the special tool to remove the front seat belt retractor cover.

   Special tool: CA501-002 Interior and Exterior Trim Panel Remover

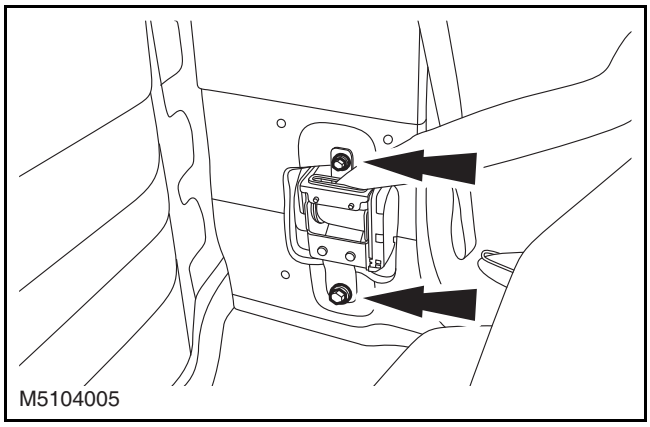



6. Remove 2 seat belt retractor retaining bolts, and remove the seat belt retractor.

   Torque for upper bolt: 9 Nm

   Torque for lower bolt: 45 ~ 60 Nm

**CAUTION: There is a protective paper washer on the seat belt anchor retaining bolt. Please ensure that the septa and the paper washer are always on the anchor in the removal and installation process.**



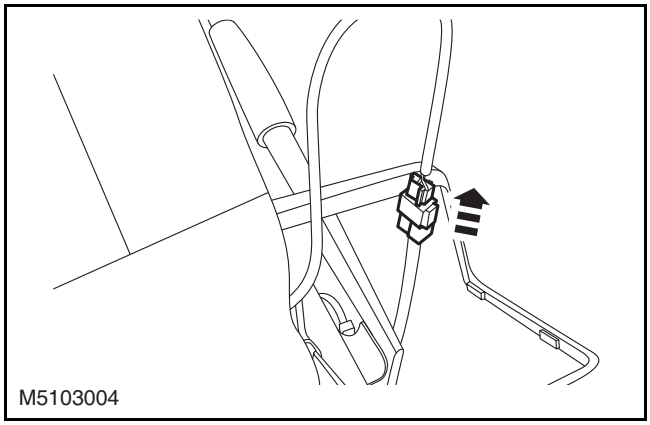

7. Remove the console.

   **Refer to: Console (5.1.6 Instrument Panel and Console, Removal and Installation).**

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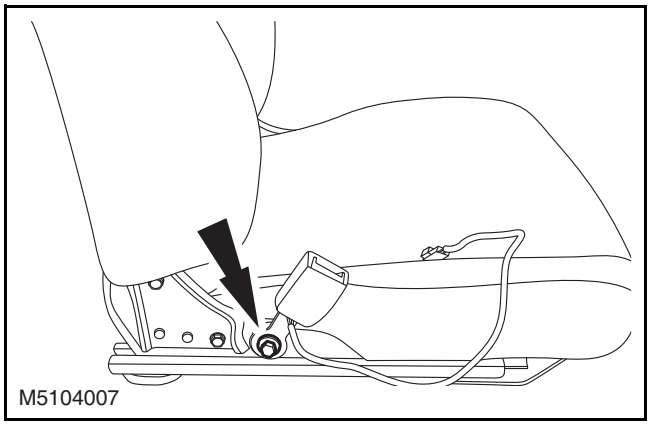
8. Disconnect the driver seat belt buckle wiring harness connector.




9. Remove the driver seat belt buckle retaining bolt, and remove the driver seat belt buckle.

   Torque: 45 ~ 60 Nm

**CAUTION: There is a protective paper washer on the seat belt buckle retaining bolt. Please ensure that the septa and the paper washer are always on the anchor in the removal and installation process.**




## Installation

1. Installation is in the reverse order of removal.

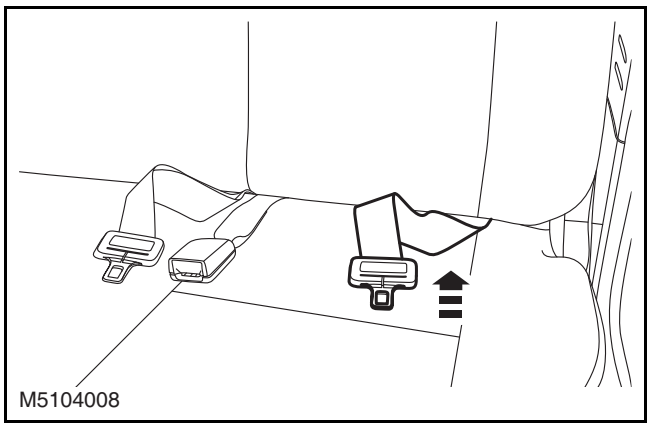
https://truckmanualshub.com/



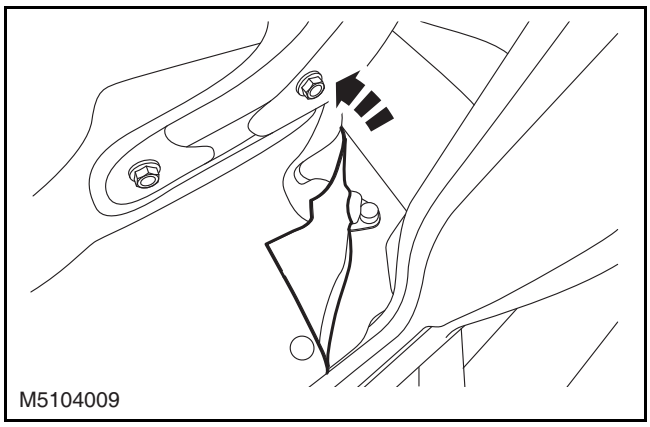
# Rear Left Seat Belt

## Removal

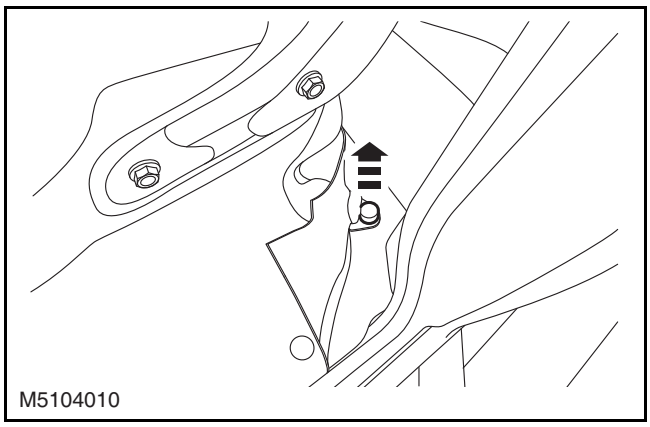
1. Pull out the single tab from the seat backrest and seat cushion.




2. Raise the floor carpet to proper position.




3. Remove the plastic cap from the single tab retaining bolt.



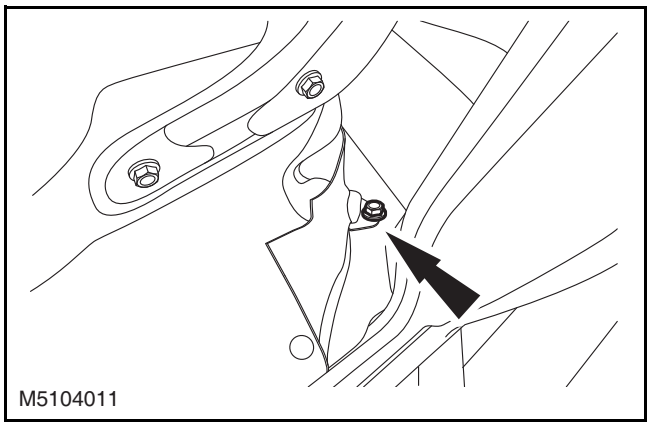
https://truckmanualshub.com/



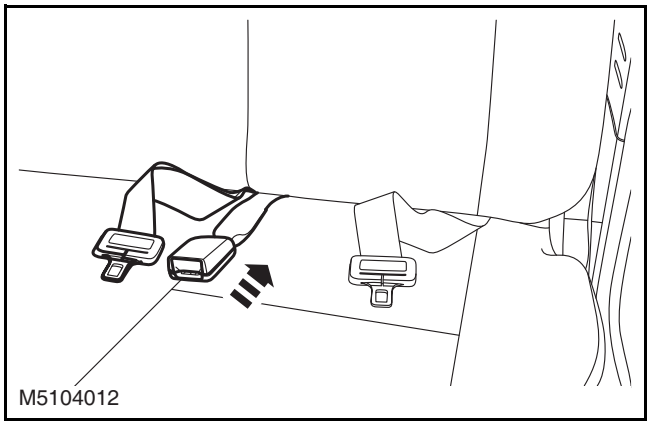
4. Remove the single tab retaining bolt, and remove the buckle.

   Torque: 45 ~ 60 Nm

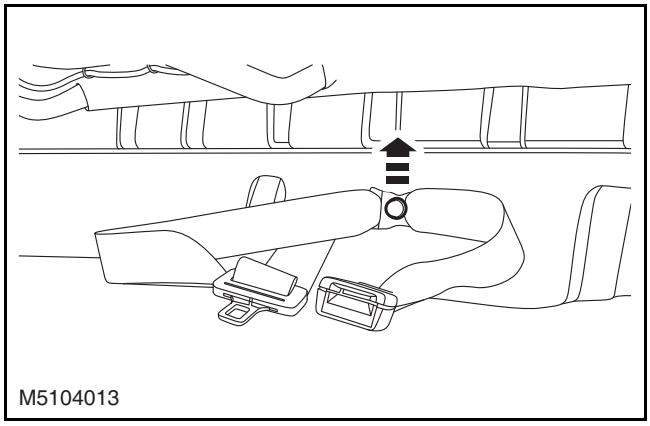
**CAUTION: There is a protective paper washer on the seat belt anchor retaining bolt. Please ensure that the septa and the paper washer are always on the anchor in the removal and installation process.**




5. Pull out the tab (include the buckle) from the seat backrest and seat cushion.



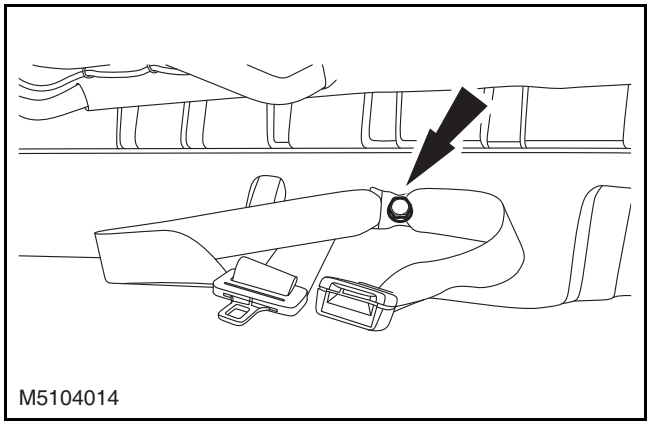

6. Remove the plastic cap from the tab (include the buckle) retaining bolt.




7. Remove the tab assembly (include the buckle) retaining bolt and remove the tab (include the buckle).

   Torque: 45 ~ 60 Nm

**CAUTION: There is a protective paper washer on the seat belt anchor retaining bolt. Please ensure that the septa and the paper washer are always on the anchor in the removal and installation process.**



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## Installation

**1.** Installation is in the reverse order of removal.

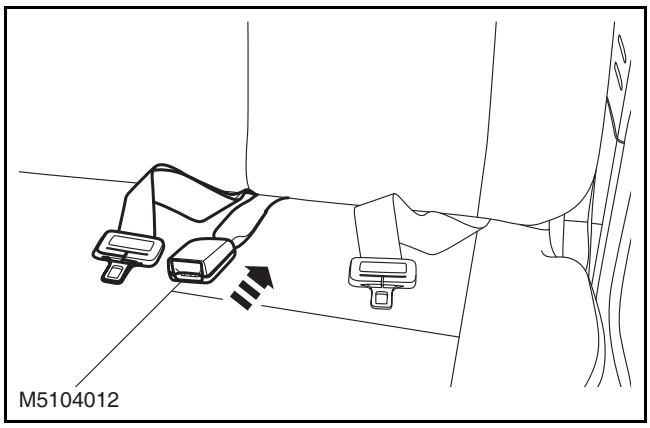
https://truckmanualshub.com/



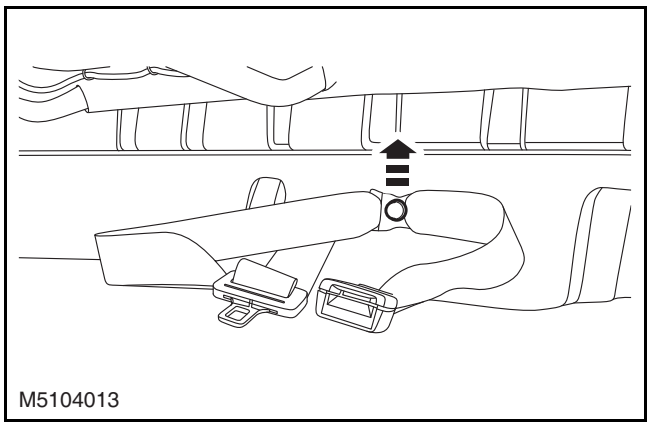
# Rear Middle Seat Belt

## Removal

1. Pull out the tab (include the buckle) from the seat backrest and seat cushion.


M5104012

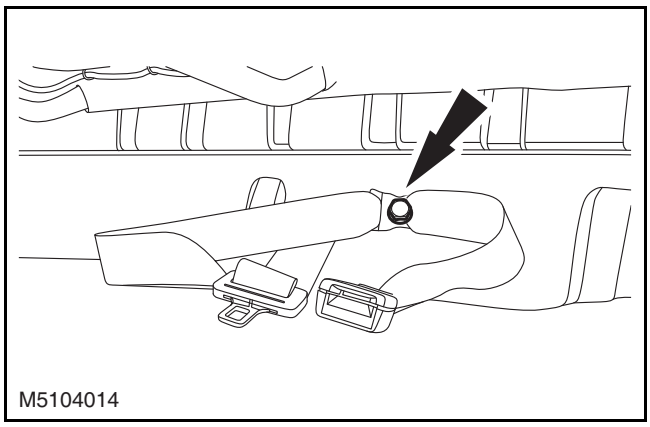
2. Remove the plastic cap from the tab (include the buckle) retaining bolt.


M5104013

3. Remove the tab assembly (include the buckle) and remove the tab (include the buckle).

   Torque: 45 ~ 60 Nm

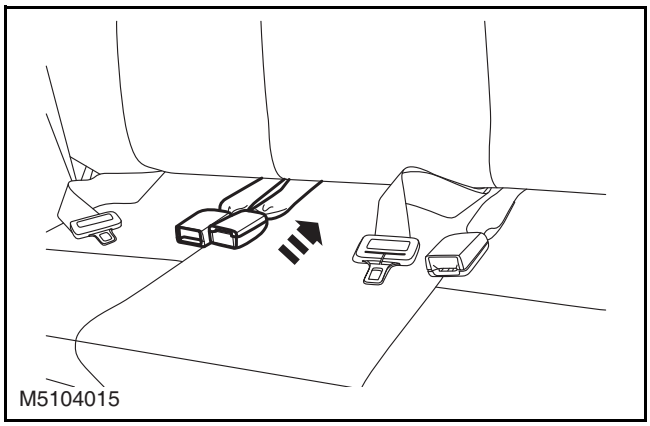
**CAUTION: There is a protective paper washer on the seat belt anchor retaining bolt. Please ensure that the septa and the paper washer are always on the anchor in the removal and installation process.**


M5104014

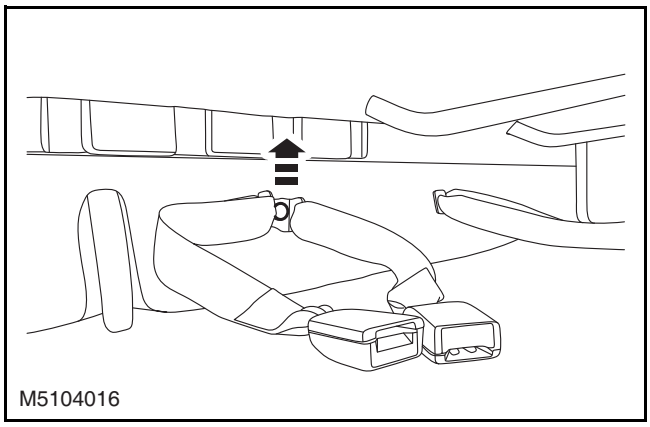
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4. Pull out the double buckles from the seat backrest and seat cushion.



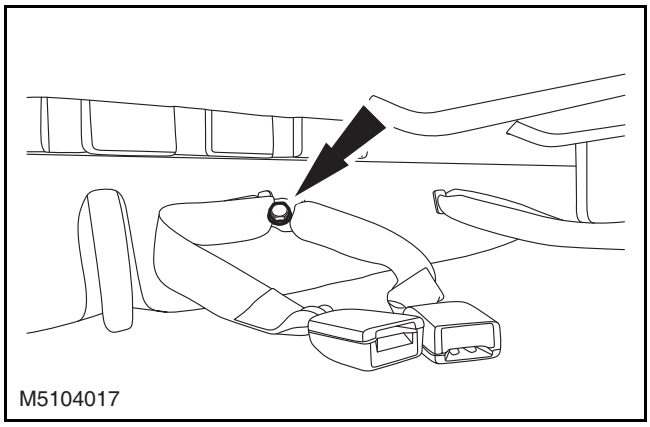

5. Remove the plastic cap from the double buckles retaining bolt.




6. Remove the double buckles retaining bolt and remove the buckles.

   Torque: 45 ~ 60 Nm

**CAUTION: There is a protective paper washer on the seat belt anchor retaining bolt. Please ensure that the septa and the paper washer are always on the anchor in the removal and installation process.**




## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Interior mirror retaining screw | Less than 9 | - | Less than 80 |
| Exterior mirror retaining bolt | 9 ± 1 | - | - |

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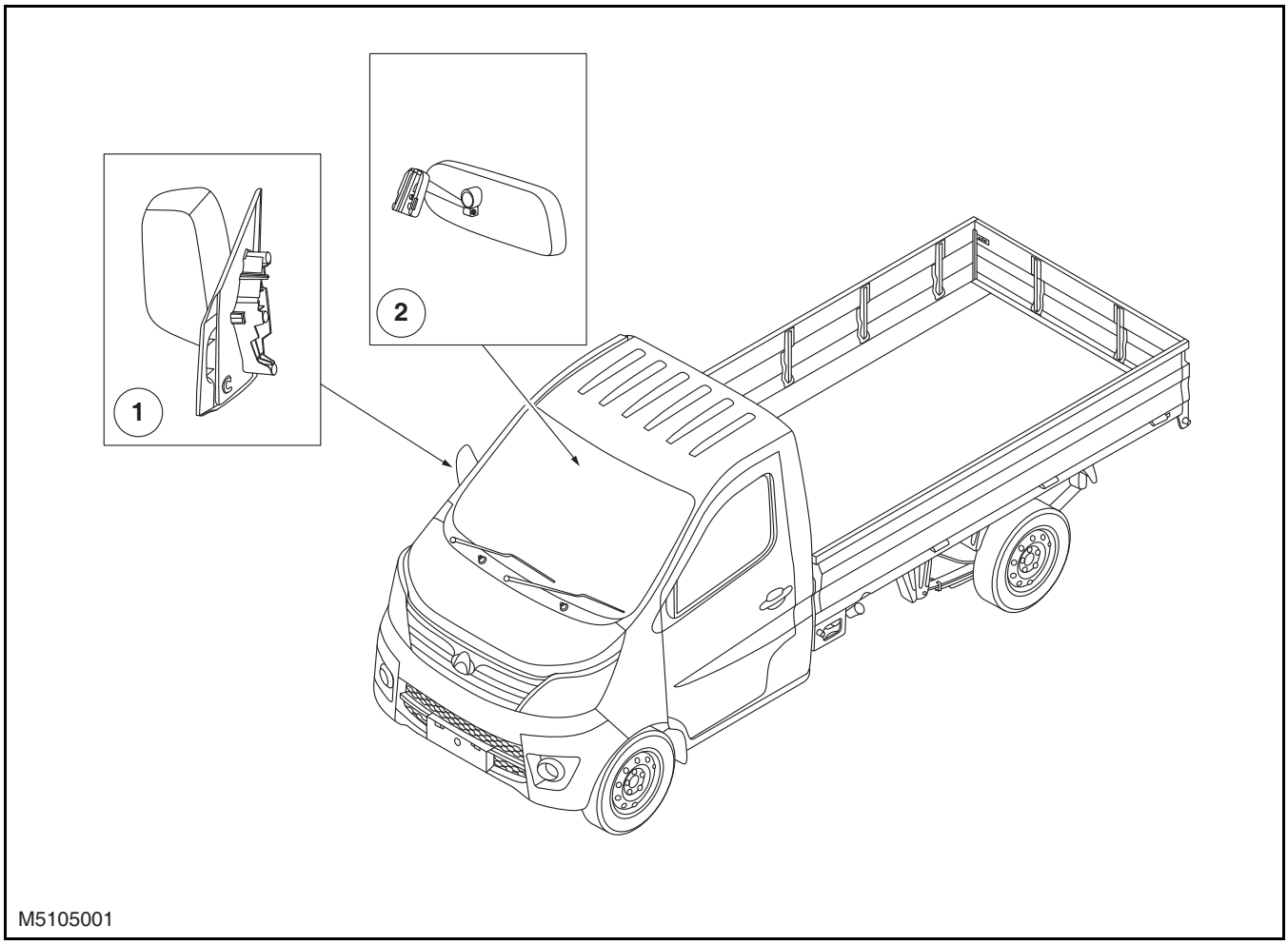
## Description and Operation

# System Overview

Vehicle rearview mirror is a major safety device for driver to observe the rear and side rear. The rearview mirrors include interior and exterior mirrors, MD201 exterior mirror can be integrally adjusted and the glasses of MS201 interior mirror can be manually adjusted; driving requirements can be met through adjusting rearview mirrors. The rearview mirror has greatly improved the safety and comfort of driver.

# Components Location View

### MD201

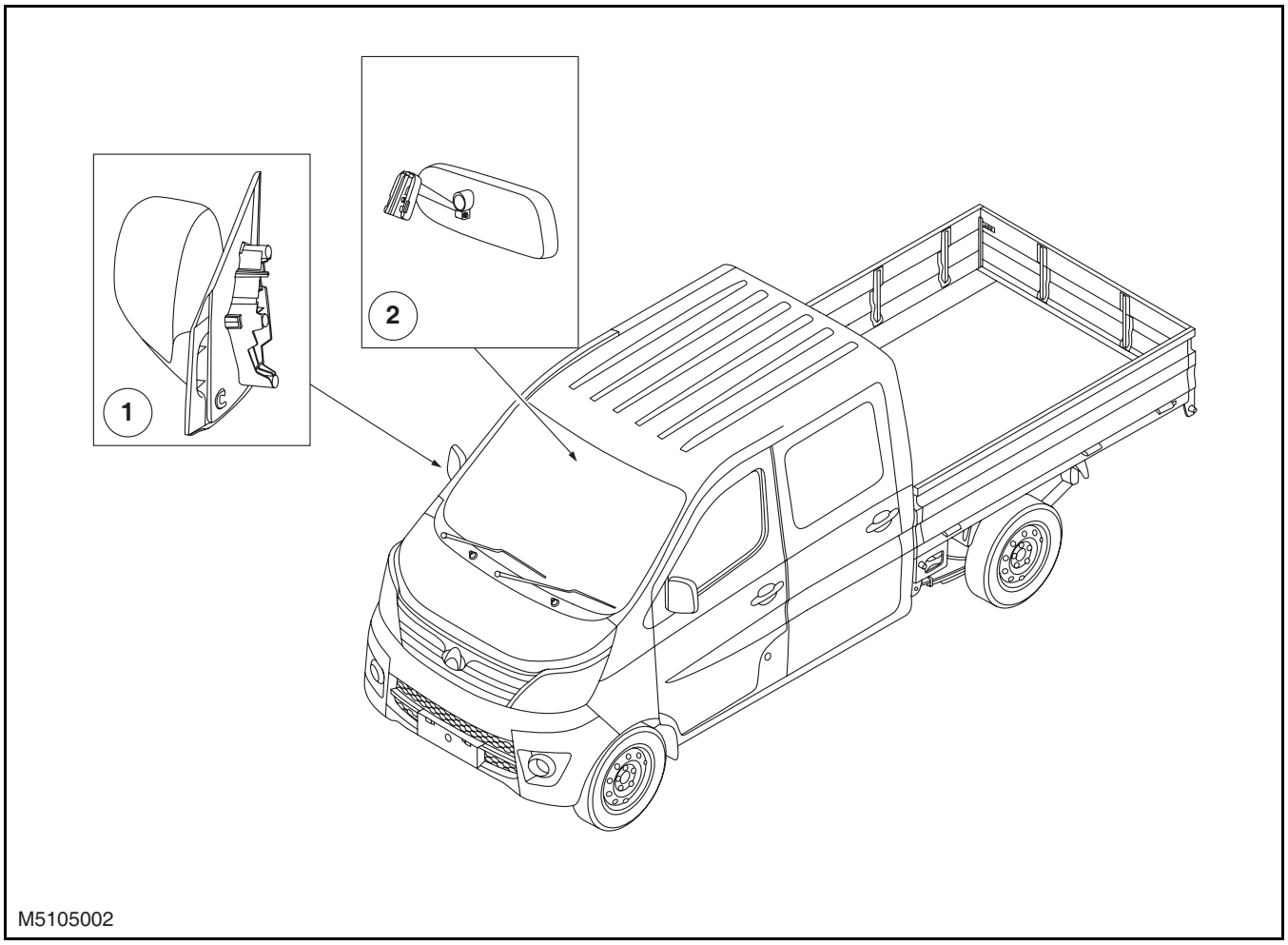



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## MS201




| Item | Description |
|---|---|
| 1 | Exterior mirror assembly |
| 2 | Interior mirror assembly |

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## Removal and Installation

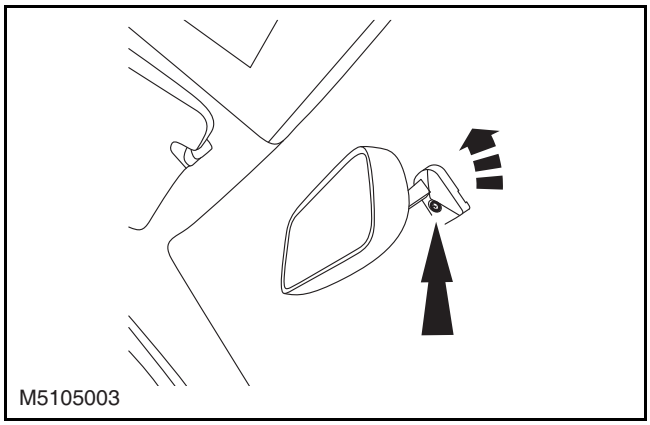
# Interior Mirror

### Removal

1. Loosen the interior mirror retaining bolt to proper position.

   Torque: less than 9 Nm

2. Hold the interior mirror by hand to slide it upward along windshield, until the mirror base slides out fully.




### Installation

1. Installation is in the reverse order of removal.

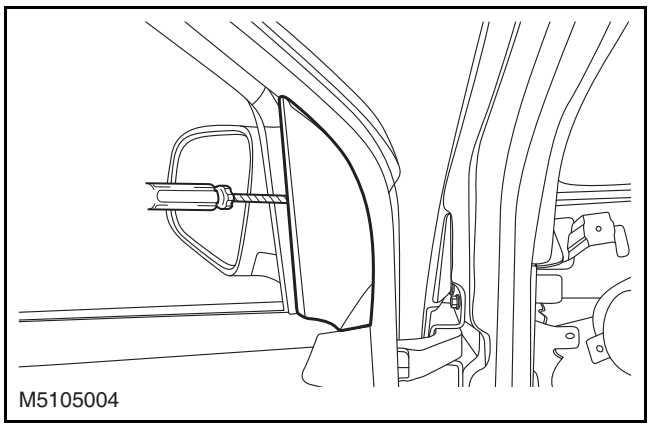
https://truckmanualshub.com/



# Exterior Mirror

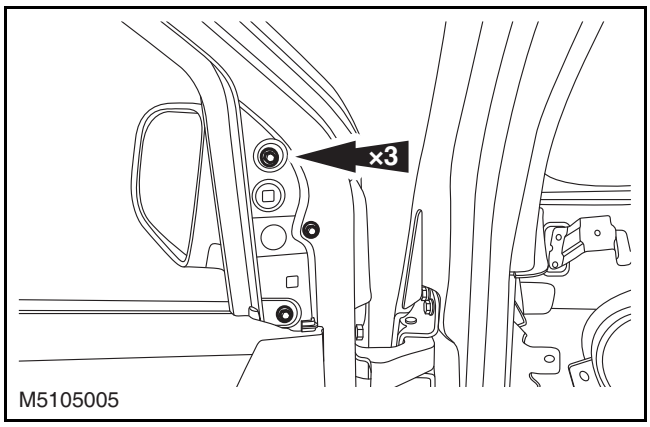
## Removal

1. Using a screwdriver wrapped with protective tape, pry out the front door quarter window ornamentation.


M5105004

2. Remove 3 exterior mirror retaining bolts.

   Torque: 9 ± 1 Nm



M5105005

3. Hold the exterior mirror by both hands to pull outward so that the exterior mirror can be removed.

## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Instrument panel crossmember retaining bolt | 25 ~ 30 | 18 ~ 22 | - |

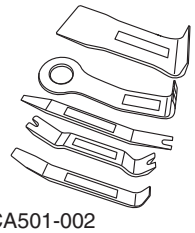
https://truckmanualshub.com/



## Removal and Installation

# Instrument Panel

### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

## Removal

1. Put the steering wheel at horizontal position.

**CAUTION: Make sure that the wheels are in straight-ahead driving position.**

2. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

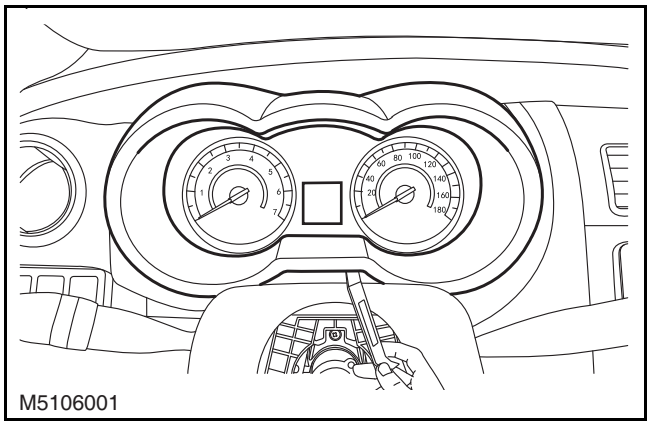
3. Remove the steering column.

   **Refer to: Steering Column (2.4.3 Steering Column, Removal and Installation).**

4. Remove the instrument cluster.

   1 Use the special tool to remove the instrument cluster cover.

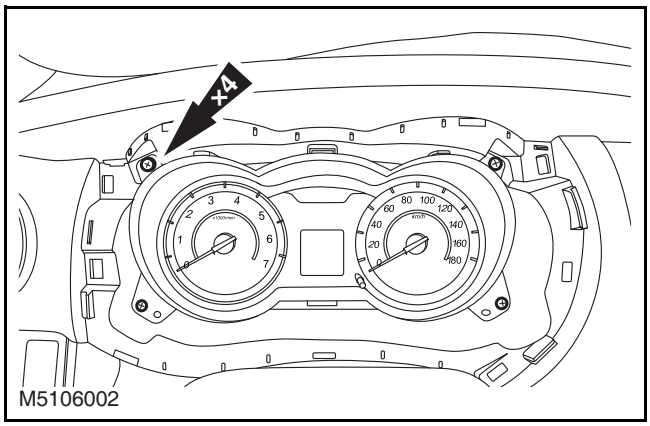
   Special tool: CA501-002


M5106001

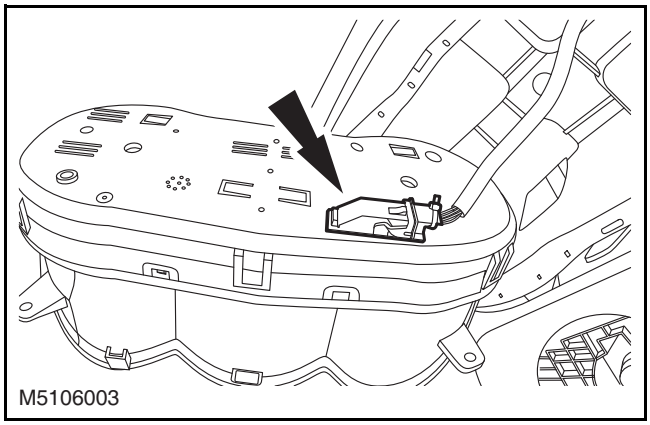
https://truckmanualshub.com/



2 Remove 4 retaining screws from the instrument cluster.




3 Disconnect the instrument cluster wiring harness connector and remove the instrument cluster.



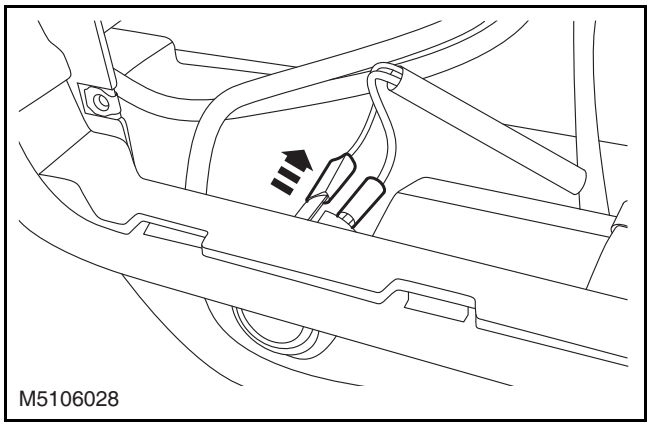

**5.** Remove the lamp angle control switch.

**Refer to: Lamp Angle Control Switch (4.2.6 Lighting System, Removal and Installation).**

**6.** Remove the radio assembly.

**Refer to: Radio (4.2.5 Information and Entertainment System, Removal and Installation).**

**7.** Disconnect the cigarette lighter wiring harness connector.



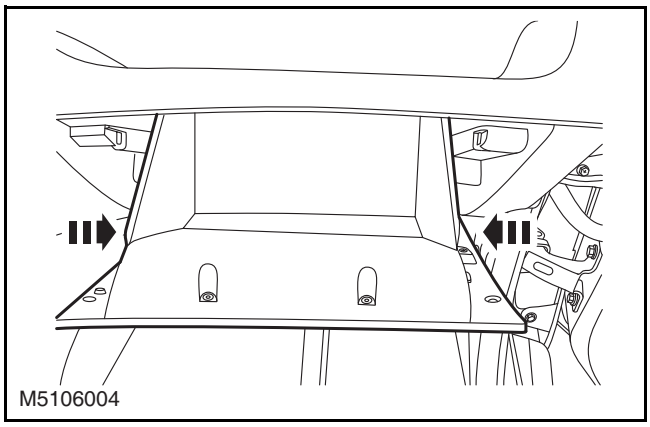
https://truckmanualshub.com/



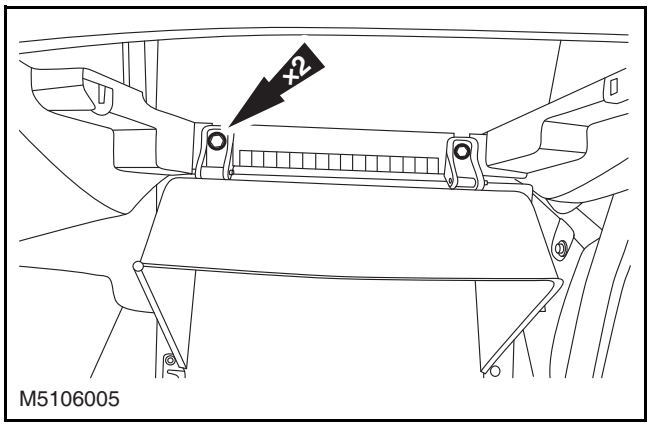
**8.** Remove the glove box.

1 Open the glove box.

2 Pull the glove box out by pressing the left and right panels firmly in the direction of the arrow shown in the figure.


M5106004

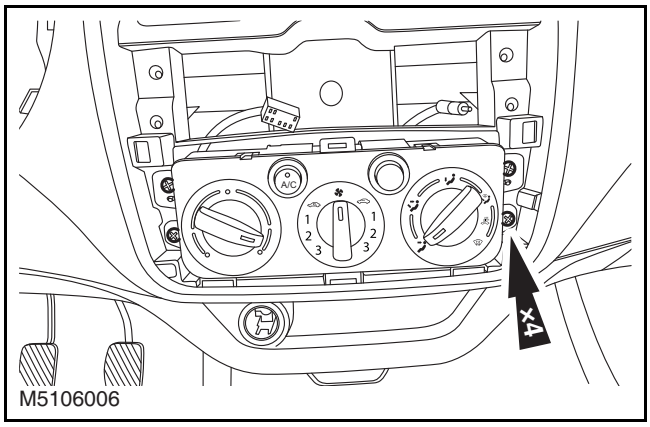
3 Remove 2 retaining bolts from the glove box, and remove the glove box.



M5106005

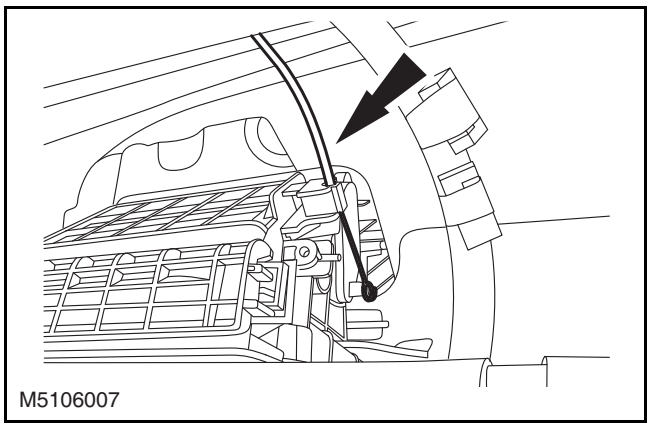
**9.** Remove the A/C controller.

1 Remove 4 retaining screws from the A/C controller.



M5106006

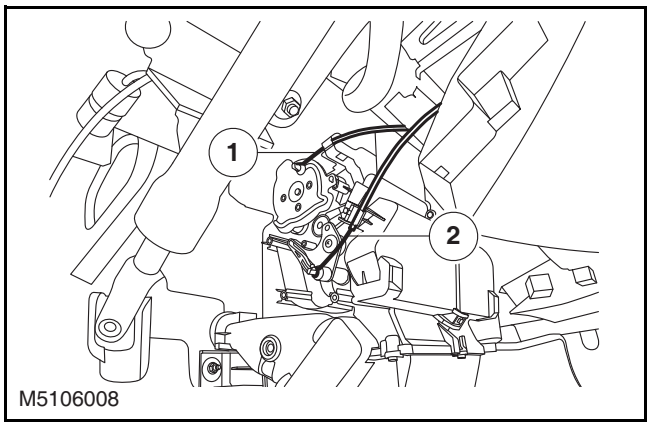
2 Disconnect the A/C inside and outside circulation control cable.


M5106007

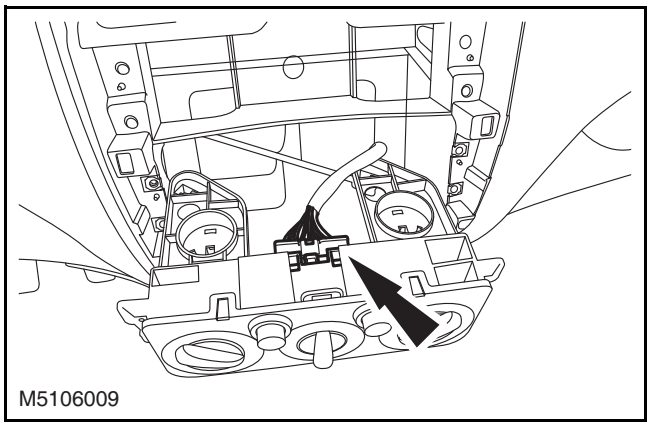
https://truckmanualshub.com/



3 Disconnect the A/C mode vent control cable (1) and A/C warm and cold vent control cable (2).



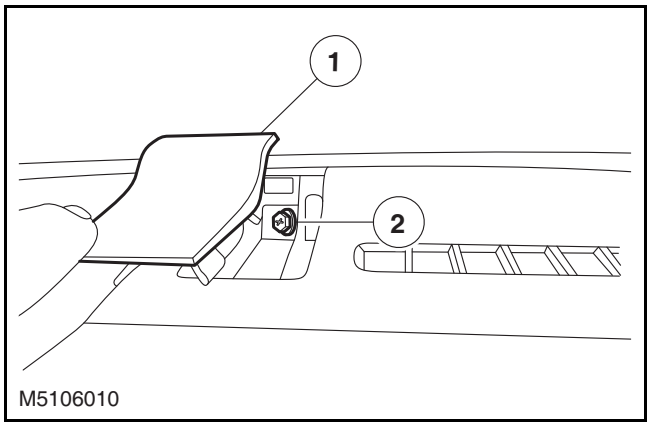

4 Disconnect the wiring harness connector and remove the A/C controller.




**10.** Remove the retaining bolt of small instrument panel cover at front windshield.

1 Use the special tool to remove the small instrument panel cover (1) at front windshield and then remove the retaining bolt (2).

Special tool: CA501-002



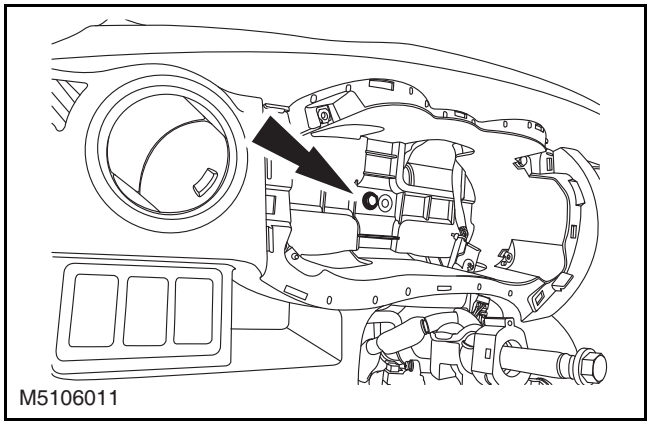

**11.** Remove the right and center small instrument panel covers at the front windshield.

**Note: Removal procedures of small instrument panel covers on the right side and center are the same as that of cover on the left side.**

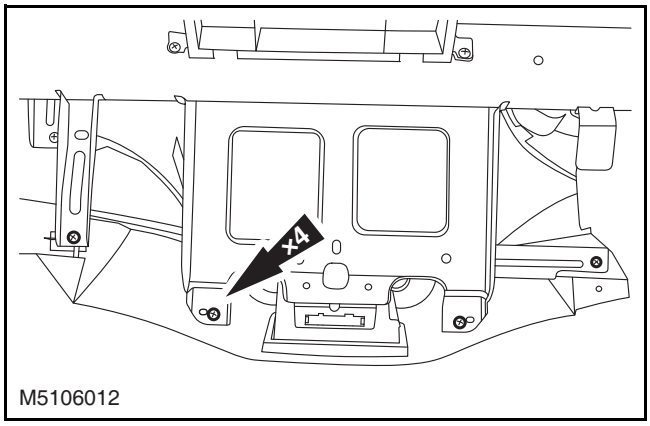
https://truckmanualshub.com/



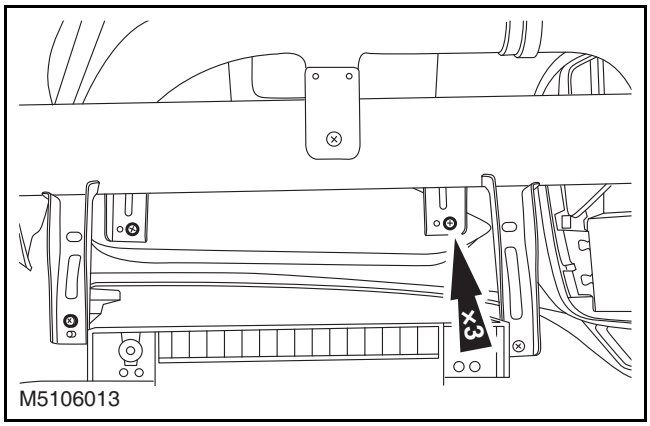
**12.** Remove the retaining bolt on the top of instrument panel.



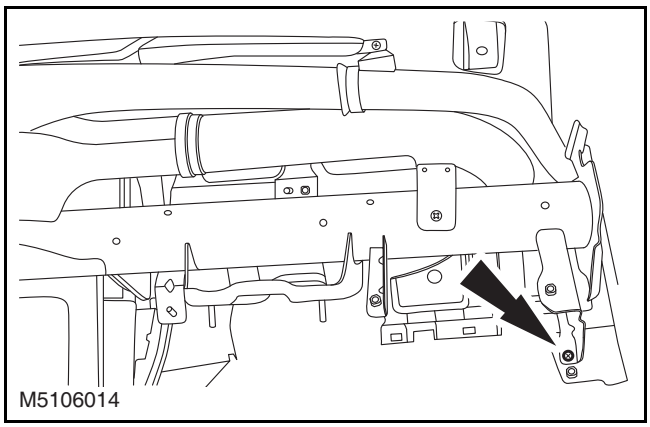

**13.** Remove 4 retaining screws from the center of instrument panel.




**14.** Remove 3 retaining screws on the right side of instrument panel.




**15.** Remove the retaining screw on the lower left side of instrument panel.

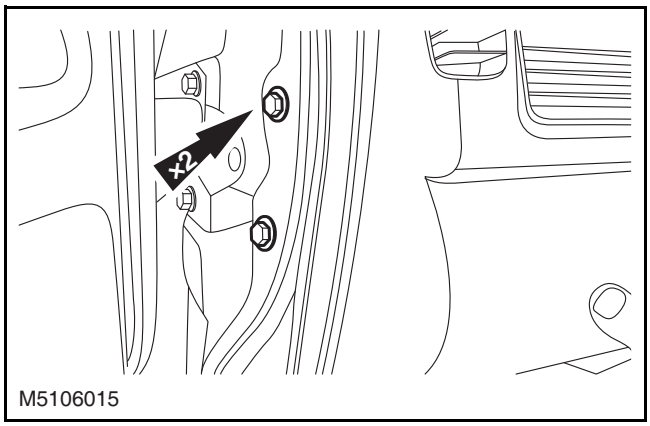


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**16.** Remove 2 retaining bolts from the left side of instrument panel crossmember.

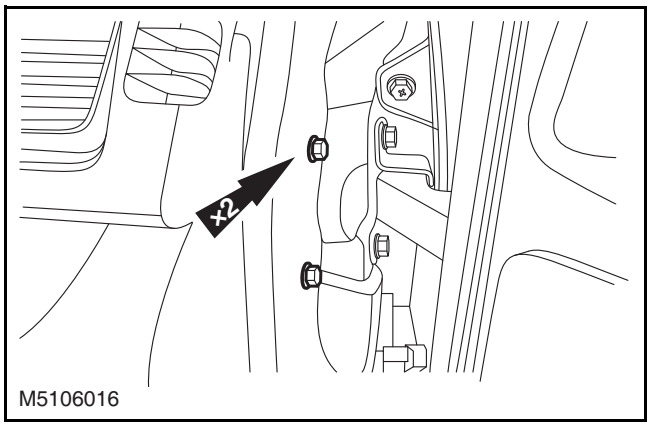
Torque: 25 ~ 30 Nm



M5106015

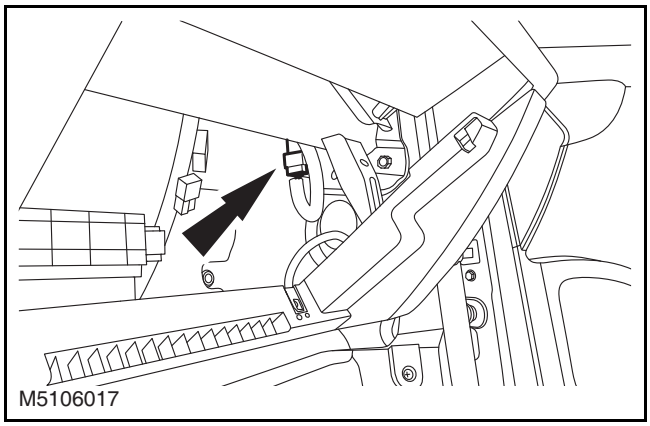
**17.** Remove 2 retaining bolts from the right side of instrument panel crossmember.

Torque: 25 ~ 30 Nm

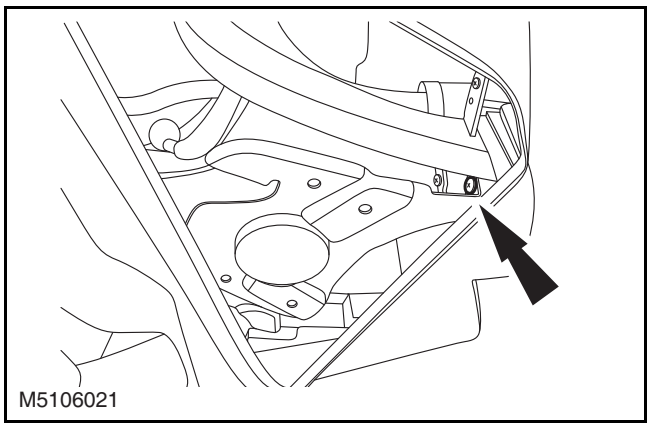


M5106016

**18.** Disconnect the dome wiring harness connector.


M5106017

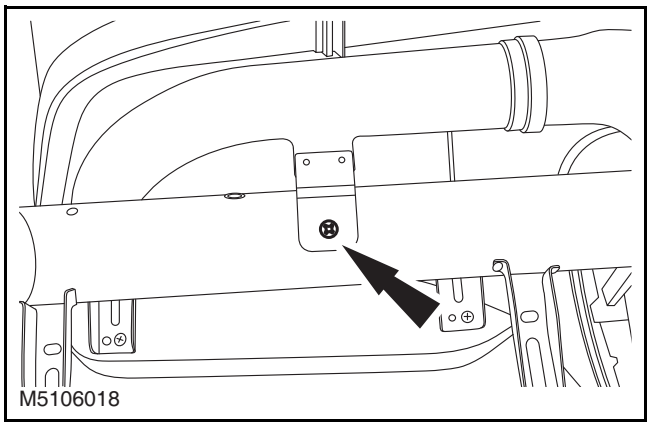
**19.** Move the instrument panel outward to the proper position and remove the retaining screw on the upper left side.


M5106021

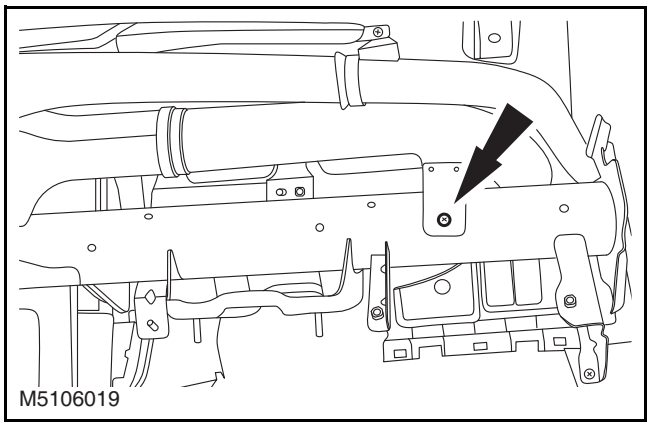
https://truckmanualshub.com/



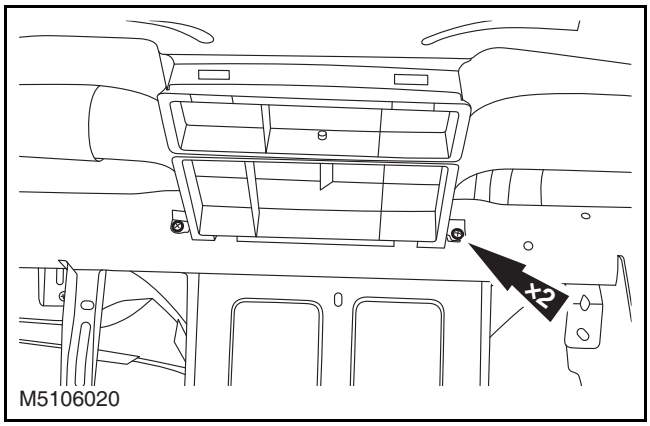
**20.** Remove the retaining screw from the left air pipe.




**21.** Remove the retaining screw from the right air pipe.




**22.** Remove 2 retaining screws from the center defroster pipe.




**23.** Remove the instrument panel.

## Installation

**1.** Installation is in the reverse order of removal.

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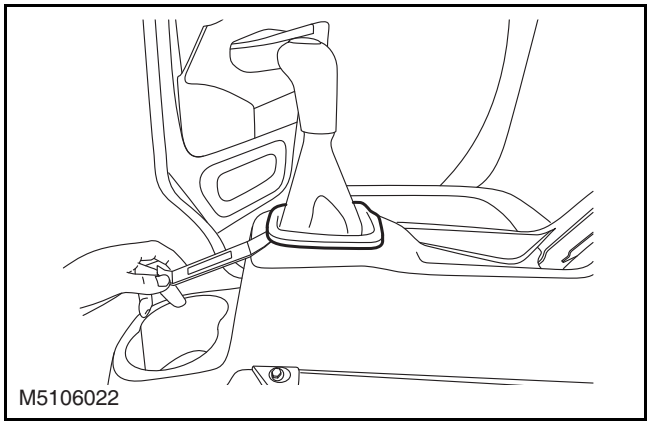


# Console

## Removal

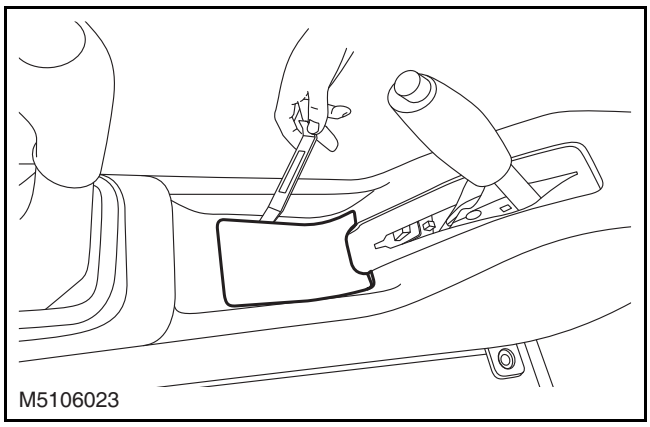
**1.** Use the special tool to remove the gear shift mechanism dust cover.

Special tool: CA501-002



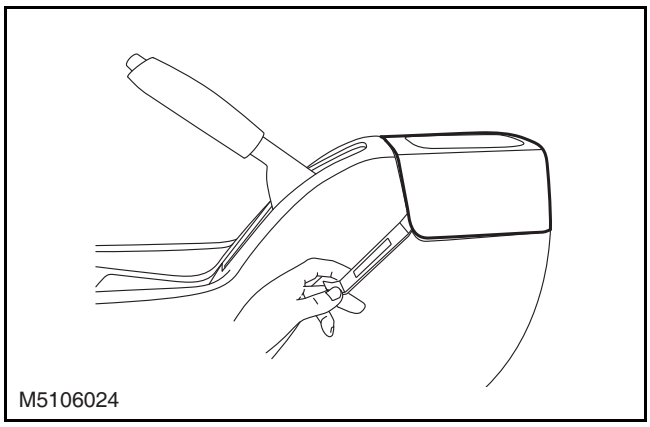

**2.** Use the special tool to pry out the hand brake cover.

Special tool: CA501-002




**3.** Use the special tool to pry out the console rear cup holder.

Special tool: CA501-002

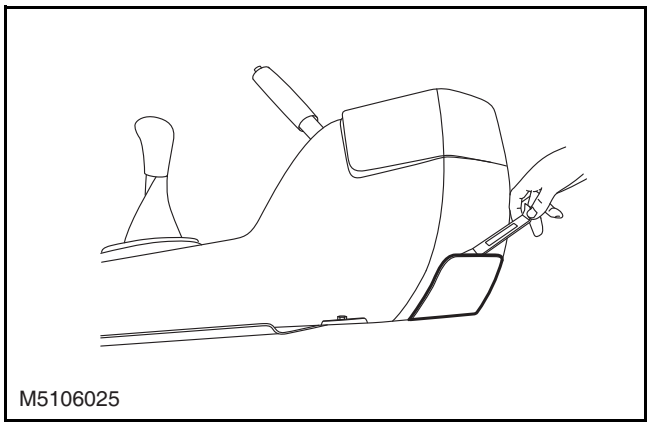


https://truckmanualshub.com/



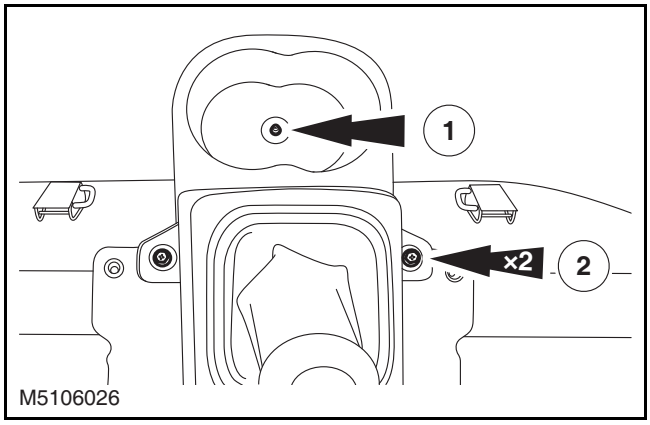
**4.** Use the special tool to pry out the console rear cover.

Special tool: CA501-002


M5106025

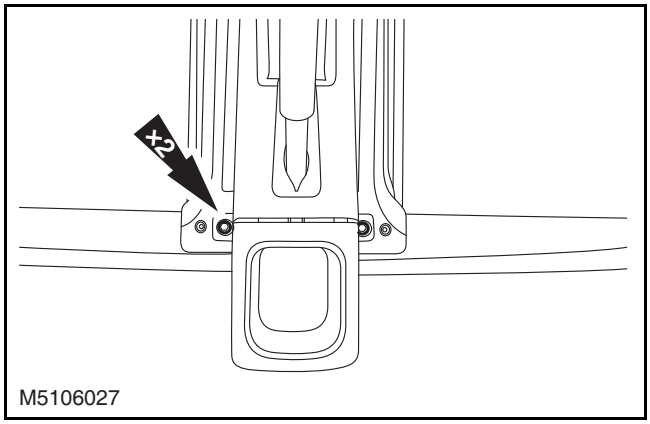
**5.** Turn over the front seats.

**6.** Remove the retaining screw (1) and 2 retaining bolts (2) from the front of console.



M5106026

**7.** Remove 2 retaining bolts on the rear of console.



M5106027

**8.** Remove the console assembly.

## Installation

**1.** Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Front bumper upper retaining bolt | 9 | - | 80 |
| Front bumper lower retaining bolt | 9 | - | 80 |
| Upper grill retaining bolt | 9 | - | 80 |

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## Removal and Installation

# Front Bumper

### Removal

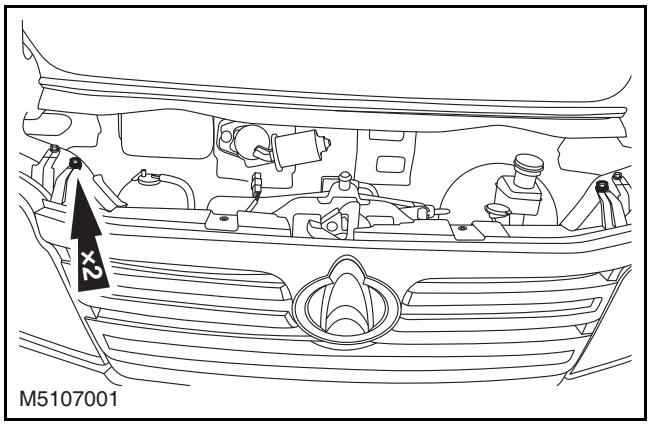
1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the front bumper upper grill.

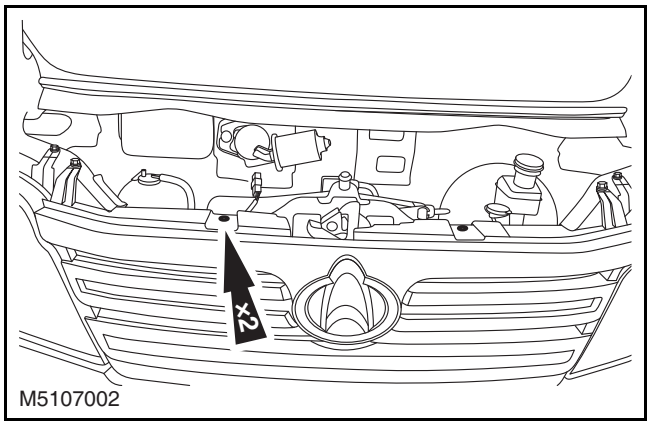
   1 Remove the retaining bolts from the left and right sides of bumper upper grill.

   Torque: 9 Nm



M5107001

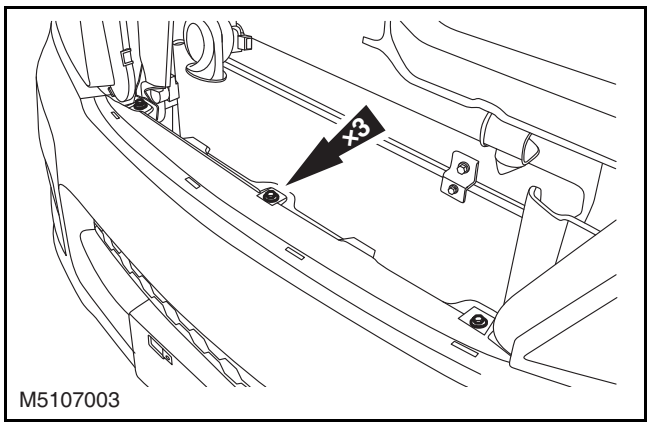
   2 Remove the clips from the center of bumper upper grill, and then pull up the bumper upper grill and remove it.



M5107002

3. Remove 3 retaining bolts between front bumper upper part and bumper crossmember.

   Torque: 9 Nm

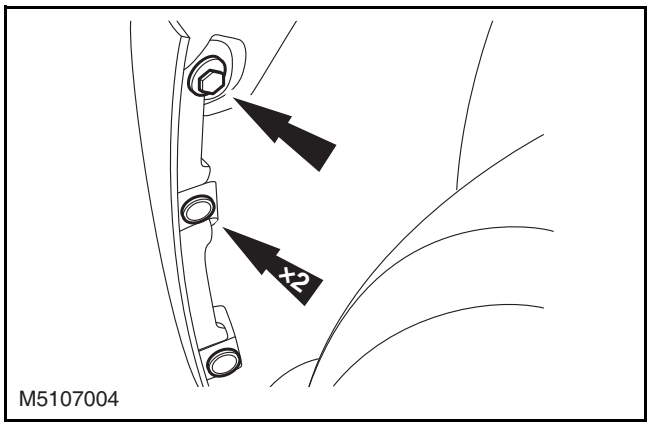


M5107003

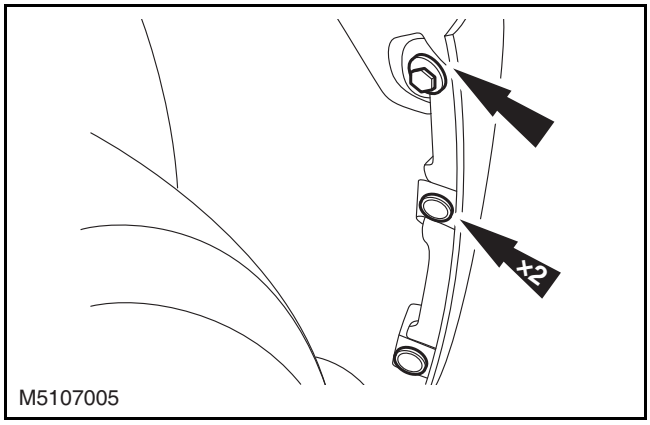
https://truckmanualshub.com/



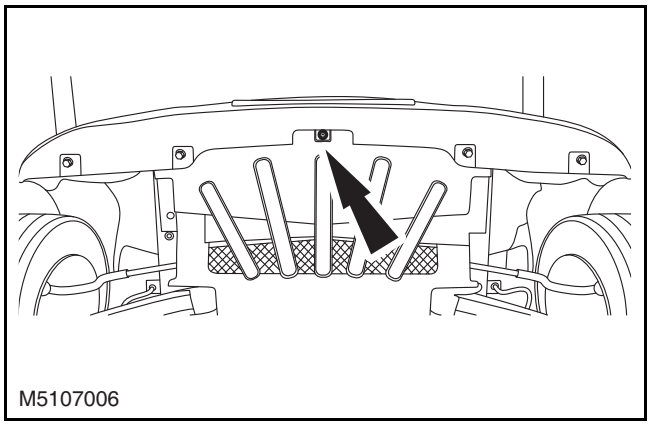
**4.** Remove 2 clips and retaining bolt between front fender lining and left side of front bumper.




**5.** Remove 2 clips and retaining bolt between front fender lining and right side of front bumper.

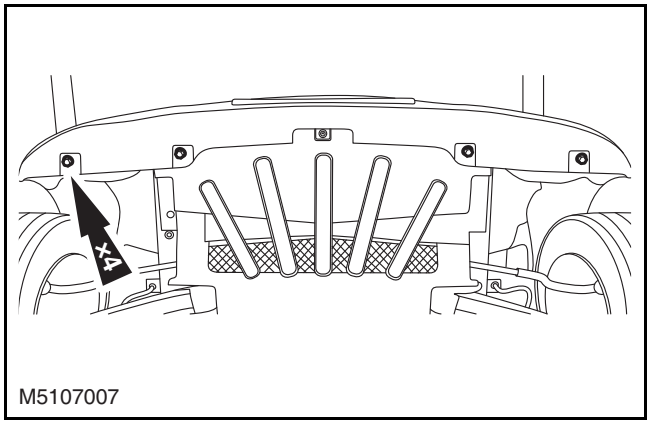



**6.** Remove the retaining screw from the lower part of front bumper.




**7.** Remove 4 retaining bolts from the lower part of front bumper.

Torque: 9 Nm



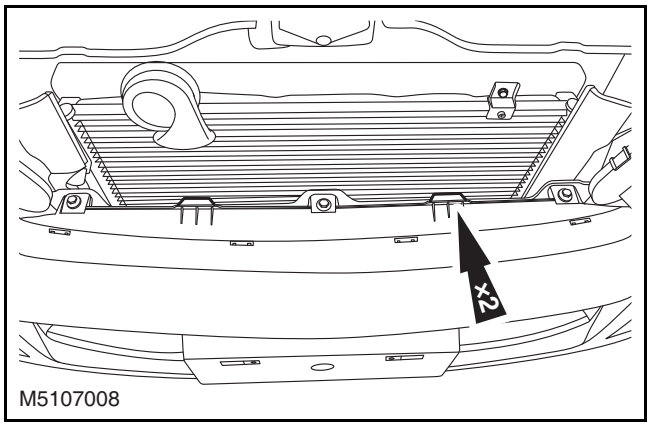
https://truckmanualshub.com/



**8.** Disengage the front bumper from the bumper mounting crossmember.

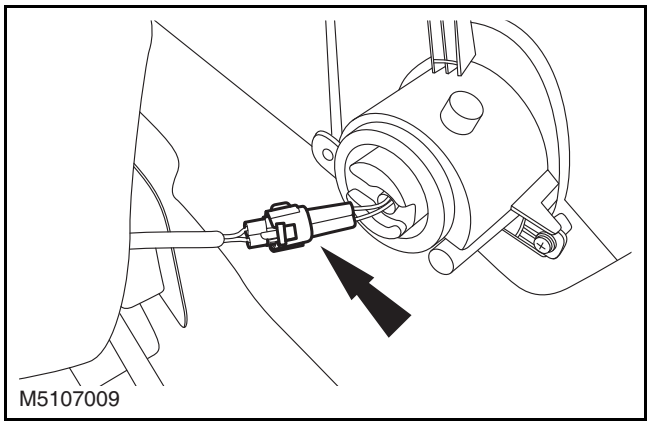
1 Using a screwdriver wrapped with protective tape, pry out 6 claws on the left and right sides of front bumper.

2 Disengage the hooks and pull out the front bumper.



M5107008

**9.** Disconnect the front fog lamp wiring harness connector.


M5107009

## Installation

**1.** Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Engine hood lock retaining bolt | 10 | - | 89 |
| Outside handle retaining bolt | 10 | - | 89 |

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## Description and Operation

# System Overview

The front hood lock, front and rear door locks are traditional pin-fier design. The front door lock are usually controlled by the control rod system, which is connected with outside handle, and door lock remote control system while the front door lock latch is connected with door lock core. The remote door lock device has a handle lever to lock and unlock from the inside of vehicle. The front hood lock is controlled by control cable and release grip.

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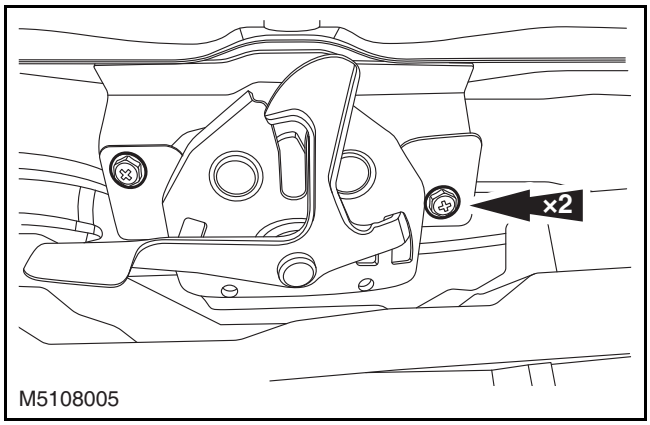
## Removal and Installation

# Front Hood Lock

### Removal

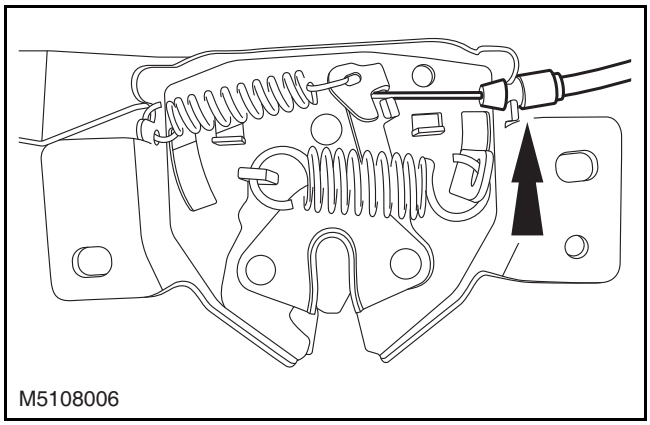
1. Open the front hood.
2. Remove 2 retaining bolts from the front hood lock.

   Torque: 10 Nm



M5108005

3. Remove the engine hood lock releasing cable.


M5108006

### Installation

1. Installation is in the reverse order of removal.

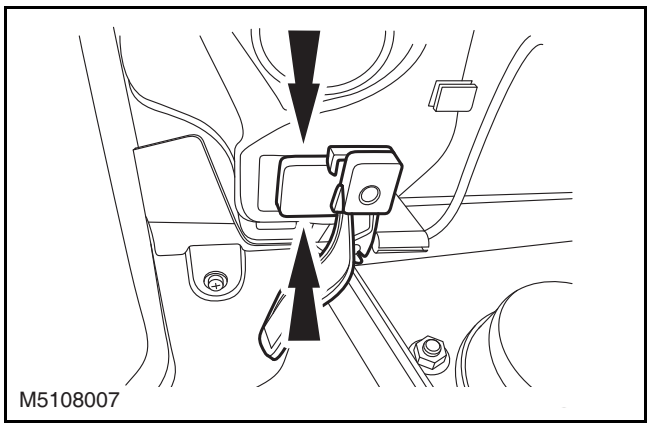
https://truckmanualshub.com/



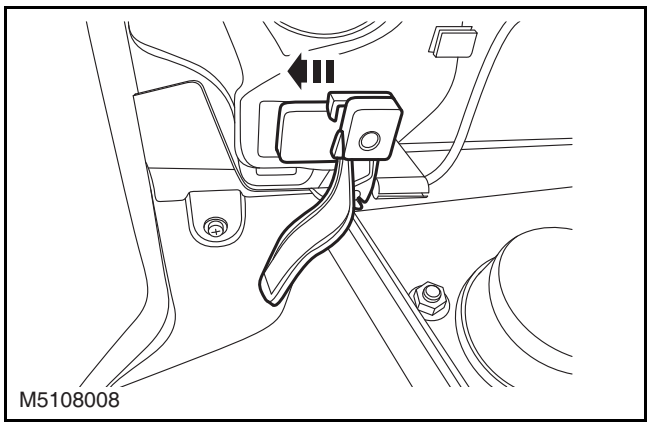
# Front Hood Lock Release Grip

## Removal

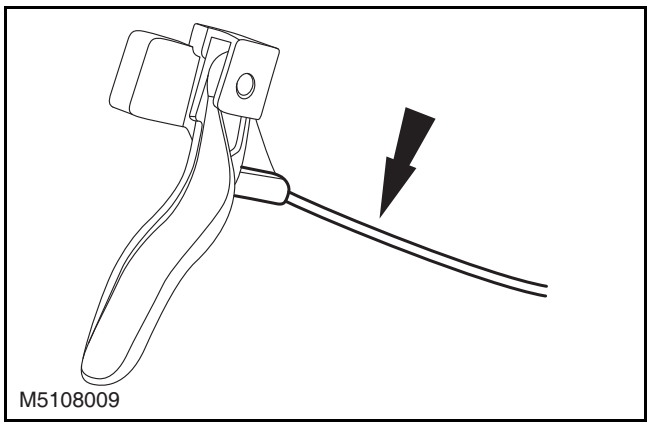
1. Using a screwdriver wrapped with protective tape to pry the engine hood lock release grip from inside of the instrument panel in the direction indicated by arrow.




2. Remove the release grip.




3. Loosen the front hood lock releasing cable.




## Installation

1. Installation is in the reverse order of removal.

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# Steering Lock Assembly

## Removal

1. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

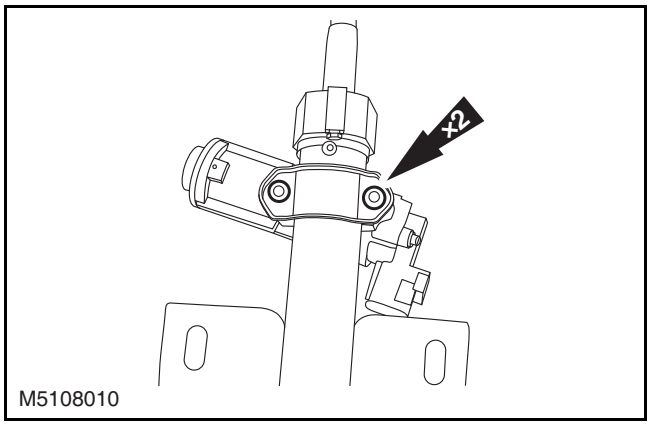
2. Remove the steering wheel combination switch.

   **Refer to: Lighting Combination Switch (4.2.6 Lighting System, Removal and Installation).**
   **Wiper Combination Switch (4.2.7 Wiper and Washer, Removal and Installation).**

3. Remove the ignition switch.

   **Refer to: Ignition Switch (3.1.8 Ignition System, Remove and Installation).**

4. Remove and discard the retaining anti-theft bolts from the steering lock assembly.




## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Anti-theft steering lock assembly retaining bolt is disposable component and replaced with new ones after removal.**

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# Front Door Lock Core

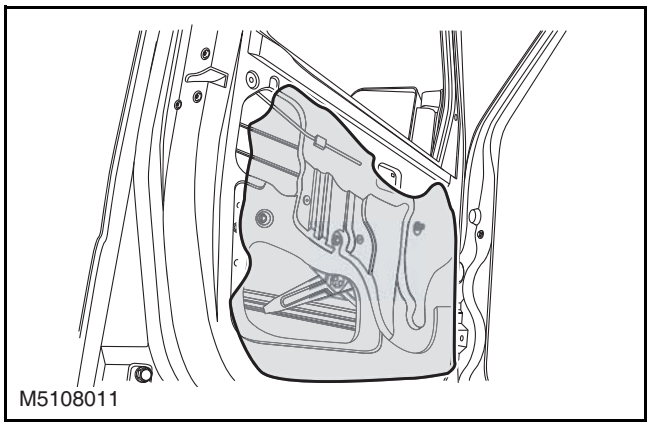
## Removal

1. Remove the front door interior trim panel.

   **Refer to: Front Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**

2. Uncover the water-proof film.

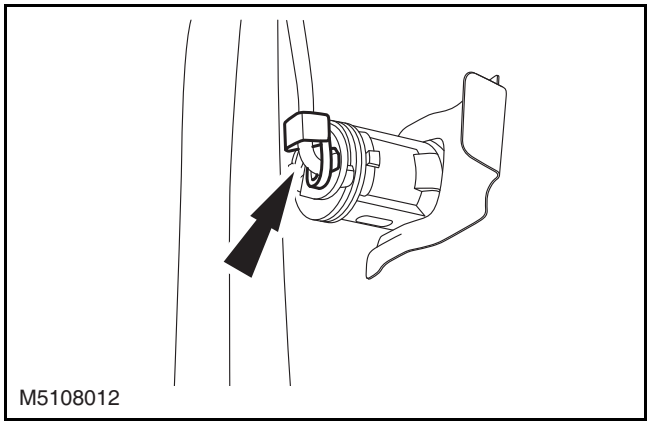
**CAUTION: Do not touch the adhesive surface to avoid reduction in adhesion effect during reassembly.**


M5108011

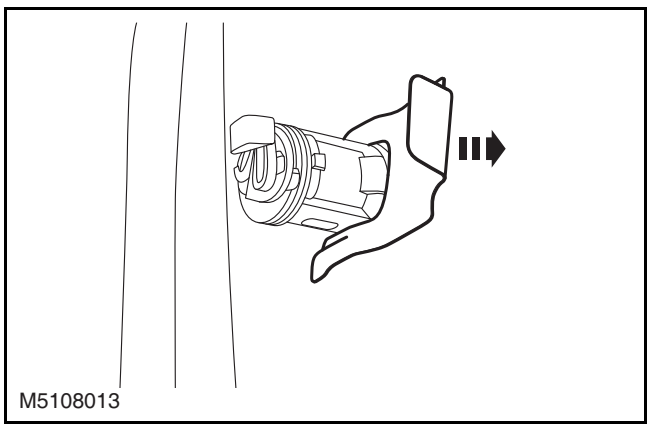
3. Remove the front door rear slot.

   **Refer to: Front Door Rear Slot (5.1.2 Door, Removal and Installation).**

4. Disconnect the control lever from the front door lock core.


M5108012

5. Remove the retaining plate from the front door lock core.


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6. Take out the door lock core from the outside of door.

## Installation

1. Installation is in the reverse order of removal.

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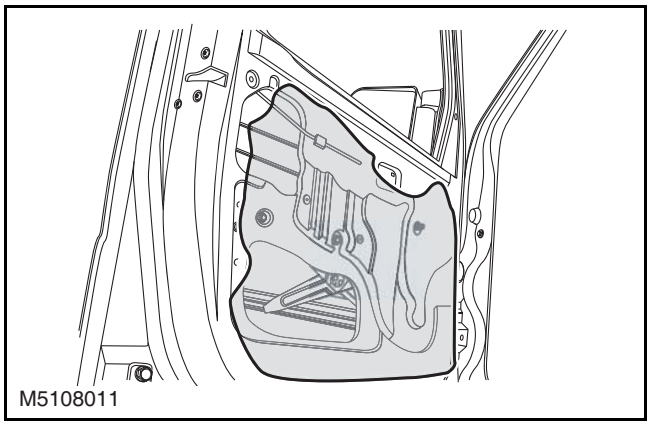
# Front Door Outside Handle

## Removal

1. Disconnect the negative battery cable.
2. Remove the front door interior trim panel.

   **Refer to: Front Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**
3. Uncover the water-proof film.

**CAUTION: Do not touch the adhesive surface to avoid reduction in adhesion effect during reassembly.**

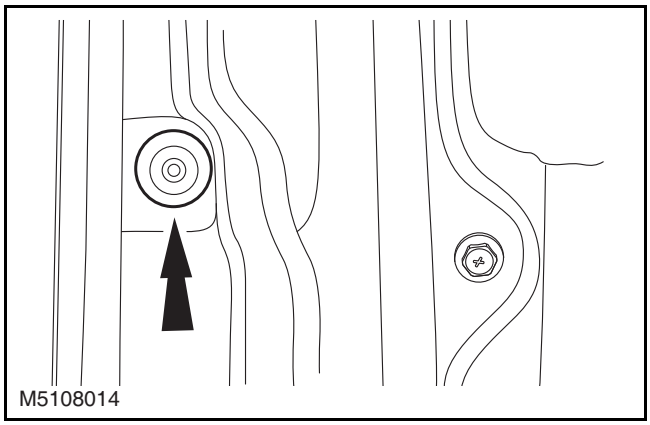

M5108011

4. Remove the front door rear slot.

   **Refer to: Front Door Rear Slot (5.1.2 Door, Removal and Installation).**
5. Remove the front door lock latch and fastener.

   **Refer to: Front Door Lock Latch (5.1.8 Handles, Locks and Latches, Removal and Installation).**
6. Remove the front door outside handle.

   1 Remove the left retaining bolt plug.

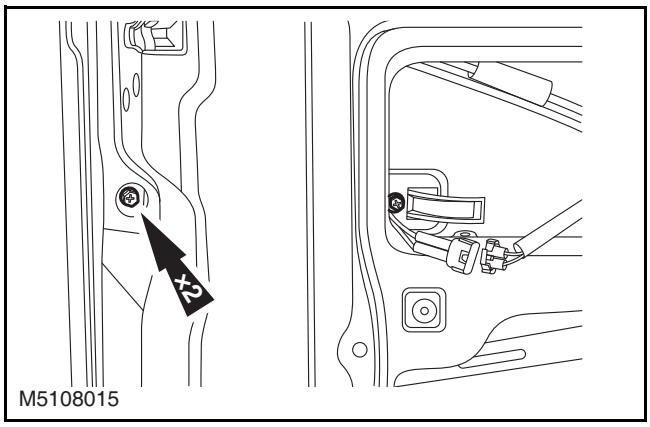

M5108014

https://truckmanualshub.com/

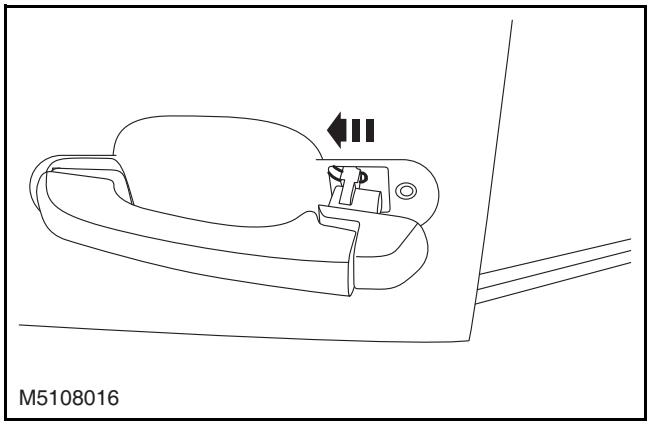


2 Remove 2 retaining bolts.

Torque: 9 Nm




7. Disconnect the control lever from the front door outside handle.




8. Take off the front door outside handle.

### Installation

1. Installation is in the reverse order of removal.

## Rear Door Outside Handle

**Note: Removal and installation procedure of the rear door outside handle is the same with that of the front door outside handle.**

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# Front Door Inside Handle

## Removal

1. Disconnect the negative battery cable.

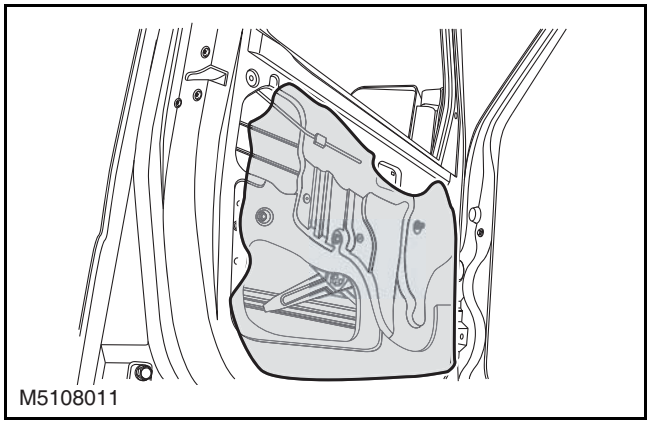
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove the front door interior trim panel.

   **Refer to: Front Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**

3. Uncover the water-proof film.

**CAUTION: Do not touch the adhesive surface to avoid reduction in adhesion effect during reassembly.**

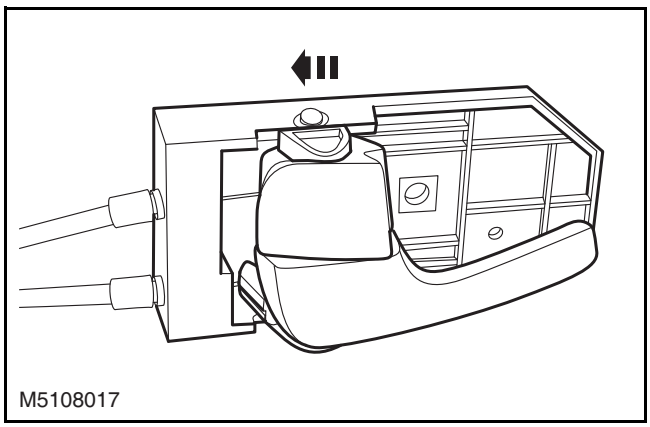

M5108011

4. Remove the inside handle.

   1 Slide along the arrow direction and remove the inside handle assembly.

   2 Disconnect the inside handle cable and locking button cable.

   3 Release 2 cable clips and remove the inside handle.


M5108017

## Installation

1. Installation is in the reverse order of removal.

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# Rear Door Inside Handle

**Refer to: Removal and installation procedure of the rear door inside handle is the same with that of the front door inside handle.**

# Front Door Lock Latch

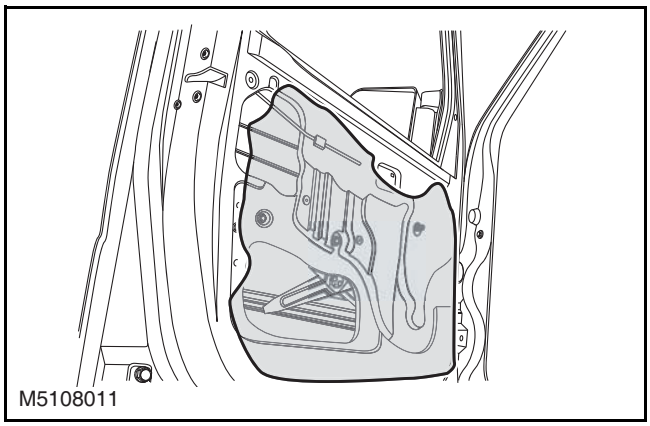
## Removal

1. Remove the front door interior trim panel.

   **Refer to: Front Door Interior Trim Panel (5.1.2 Door, Removal and Installation).**

2. Uncover the water-proof film.

**CAUTION: Do not touch the adhesive surface to avoid reduction in adhesion effect during reassembly.**


M5108011

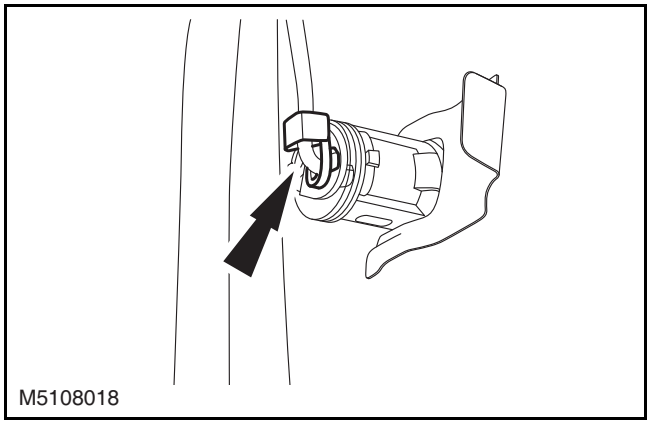
3. Remove the front door inside handle.

   **Refer to: Front Door Inside Handle (5.1.8 Handles, Locks and Latches, Removal and Installation).**

4. Remove the front door rear slot.

   **Refer to: Front Door Rear Slot (5.1.2 Door, Removal and Installation).**

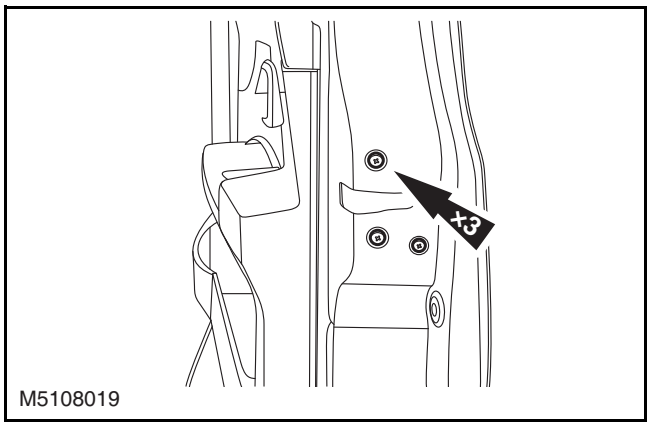
5. Disconnect the control lever from the front door lock core.


M5108018

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6. Remove 3 retaining screws from the front door lock latch.




7. Disconnect the front door outside handle control lever and take off the front door lock latch.

**Refer to: Front Door Outside Handle (5.1.8 Handles, Locks and Latches, Removal and Installation).**

### Installation

1. Installation is in the reverse order of removal.

## Rear Door Lock Latch

**Refer to: Removal and installation procedure of the rear door lock latch is the same with that of the front door lock latch.**

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## Removal and Installation

# A Pillar Trim Panel

**Special Tool**

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

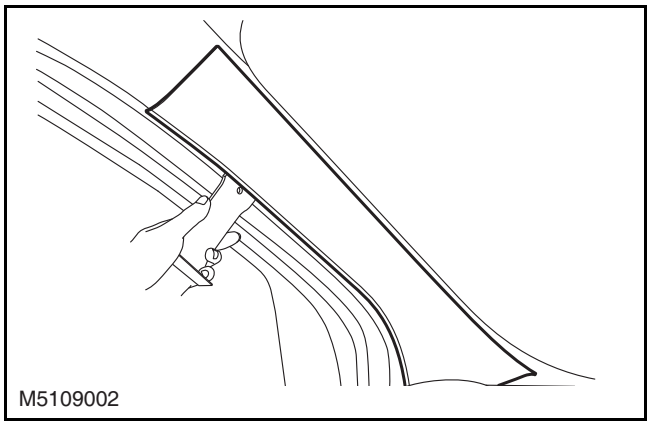
## Removal

**1.** Partly remove the front door frame weatherstrip.


M5109001

**2.** Use the special tool to remove the A pillar trim panel.

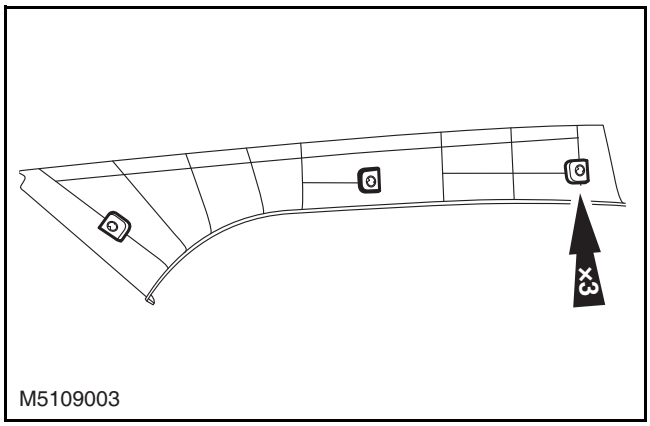
Special tool: CA501-002


M5109002

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3. The A pillar trim panel clip position is as shown in the figure.



M5109003

## Installation

1. Installation is in the reverse order of removal.

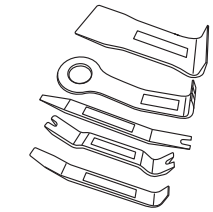
**CAUTION: Make sure to use new clip for A pillar trim panel during installation.**

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# Front Seat Belt Retractor Cover

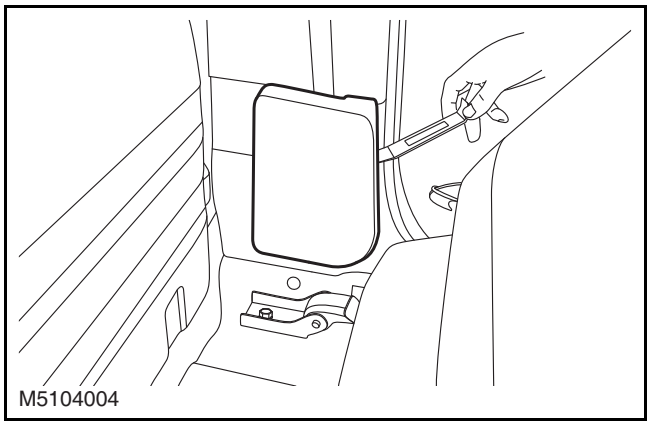
### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

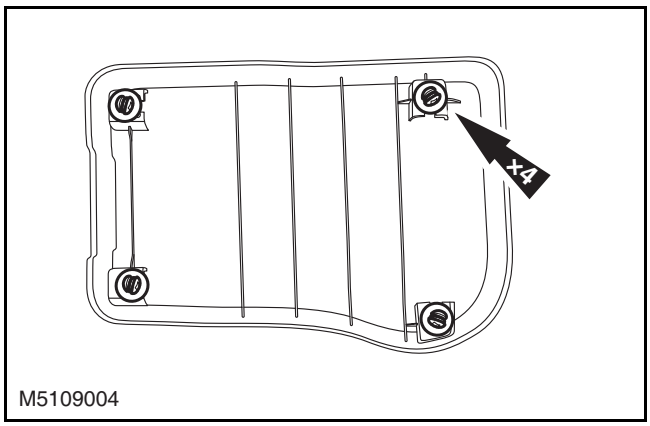
## Removal

1. Use the special tool to remove the front seat belt retractor cover.

   Special tool: CA501-002


M5104004

2. The front seat belt retractor cover clip position is as shown in the figure.



M5109004

## Installation

1. Installation is in the reverse order of removal.

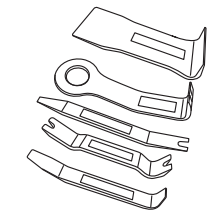
**CAUTION: Make sure to use new clip for front seat belt retractor cover during installation.**

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# Front Doorsill Ornamentation

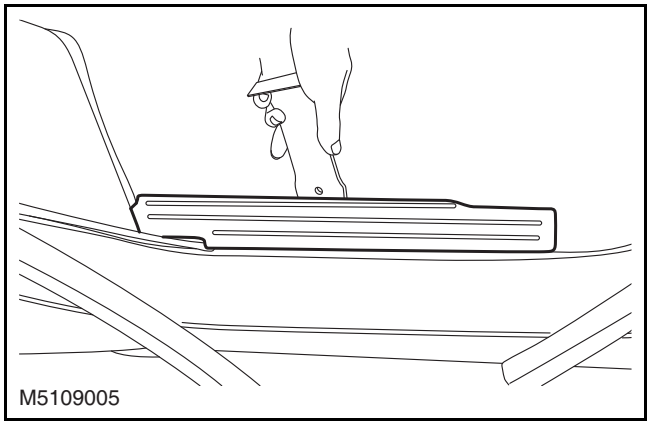
### Special Tool

| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

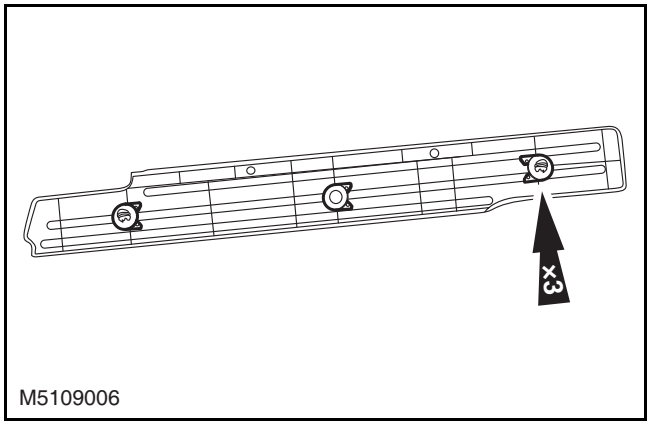
## Removal

1. Partly remove the front door frame weatherstrip.
2. Use the special tool to remove the front doorsill ornamentation.

   Special tool: CA501-002


M5109005

3. The front doorsill ornamentation clip position is as shown in the figure.



M5109006

## Installation

1. Installation is in the reverse order of removal.

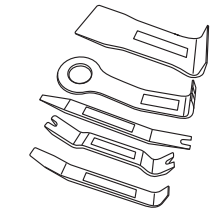
**CAUTION: Make sure to use new clip for the front doorsill ornamentation during installation.**

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# Roof Panel Lining

### Special Tool

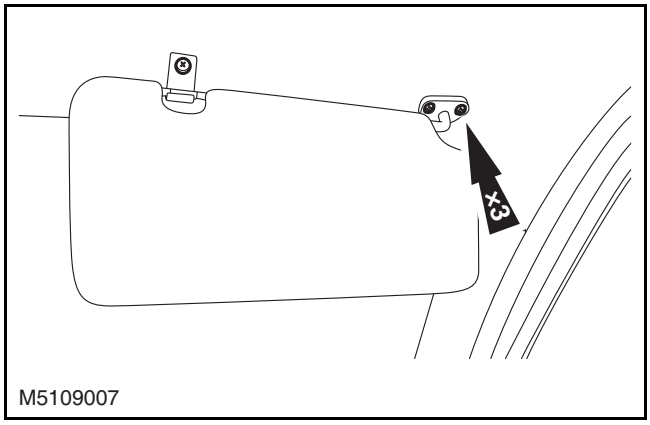
| | |
|---|---|
|  CA501-002 | Interior and Exterior Trim Panel Remover CA501-002 |

## Removal

1. Disconnect the negative battery cable.

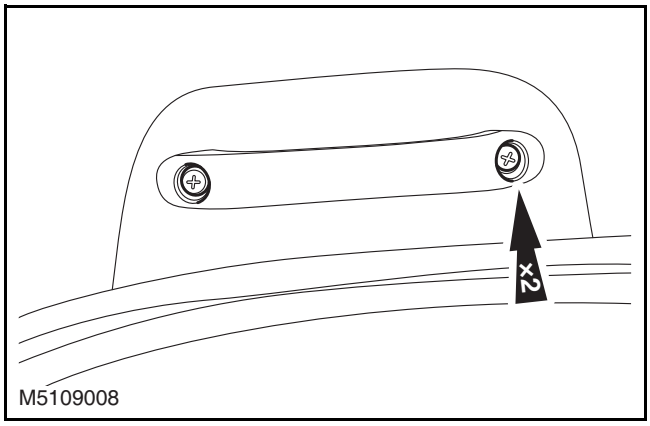
   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**

2. Remove 3 retaining screws from the sun visor and take off the sun visor.



M5109007

3. Remove 2 retaining screws from the assistant grip, and take off the assistant grip.



M5109008

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4. Remove the reading lamp.

   **Refer to: Reading Lamp (4.2.6 Lighting System, Removal and Installation).**

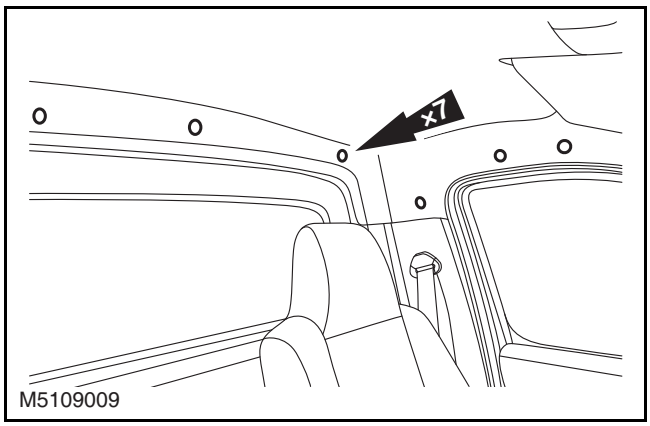
5. Remove the A pillar trim panel.

   **Refer to: A Pillar Trim Panel (5.1.9 Interior Trim Panel and Ornamentation, Removal and Installation).**

For Model MD201

6. Use the special tool to remove 7 retaining clips from the roof panel lining.

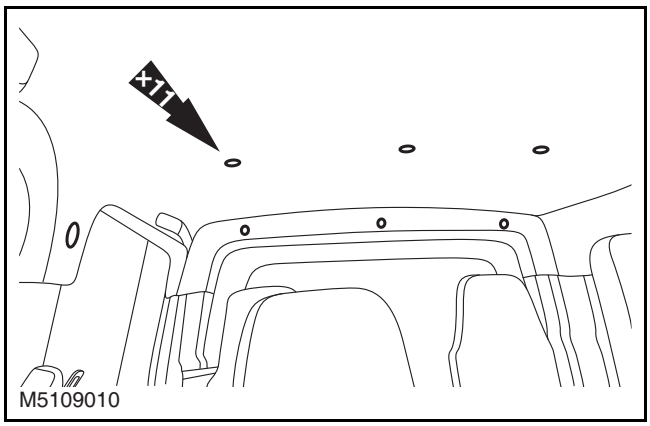
   Special tool: CA501-002




For Model MS201

6. Use the special tool to remove 11 retaining clips from the roof panel lining.

   Special tool: CA501-002




7. Remove the roof panel lining.

## Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure to use new clip for the roof lining during installation.**

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## Removal and Installation

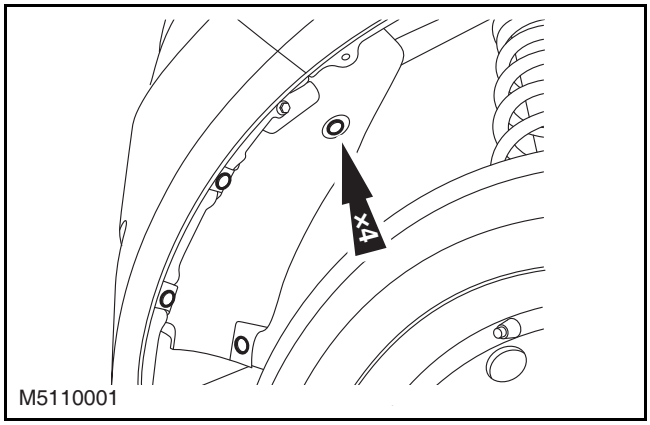
# Front Fender Lining Plate

### Removal

1. Remove the front fender lining plate clip.

   1 Remove 2 clips between front fender lining plate and front bumper.

   2 Remove 2 clips between front fender lining plate and fender flanging.




2. Take out the front fender lining plate.

### Installation

1. Installation is in the reverse order of removal.

**CAUTION: Make sure to use new clip for front fender lining plate during installation.**

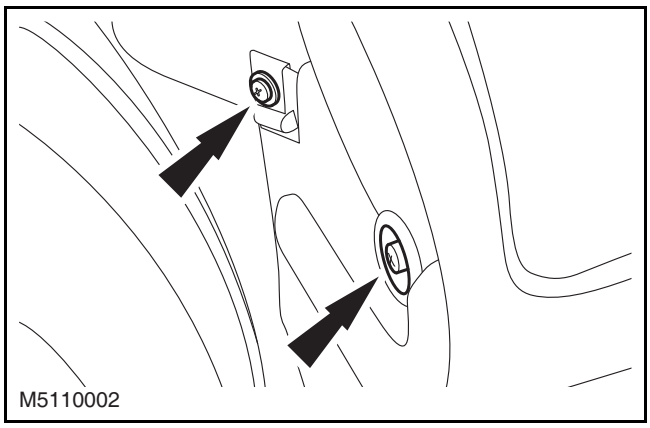
https://truckmanualshub.com/



# Front Mud Guard

## Removal

1. Remove 2 retaining screws from the front mud guard.




2. Remove the front mud guard.

## Installation

1. Installation is in the reverse order of removal.

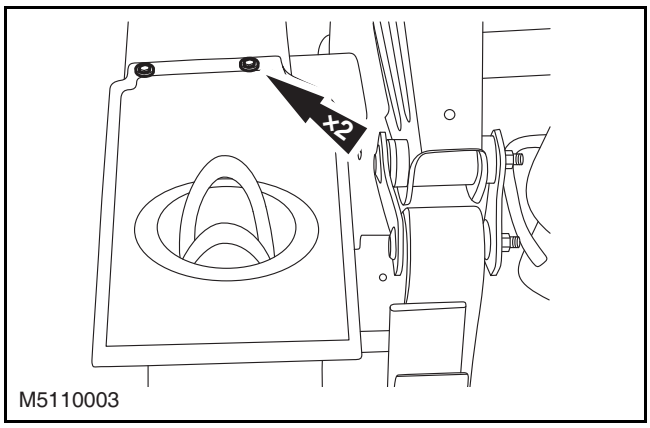
https://truckmanualshub.com/



# Rear Mud Guard

## Removal

1. Remove 2 retaining bolts from the rear mud guard.




2. Remove the rear mud guard.

## Installation

1. Installation is in the reverse order of removal.

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# Front Wind Guiding Cover

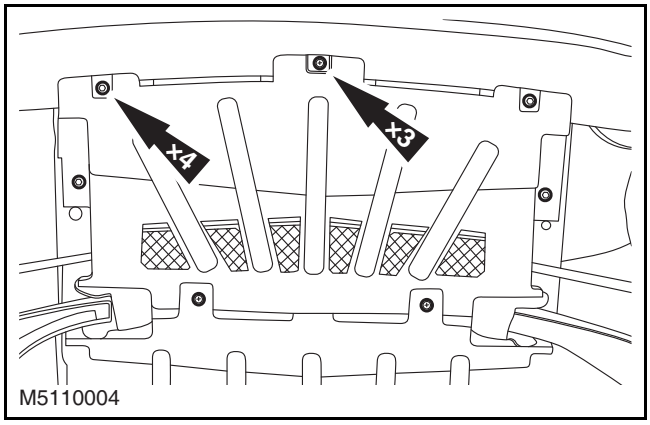
## Removal

1. Lift the vehicle.

   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Remove 4 retaining bolts and 3 retaining screws from the front wind guiding cover.

   Torque: 10 Nm




3. Remove the front wind guiding cover.

## Installation

1. Installation is in the reverse order of removal.

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# Rear Wind Guiding Cover

## Removal

1. Lift the vehicle.

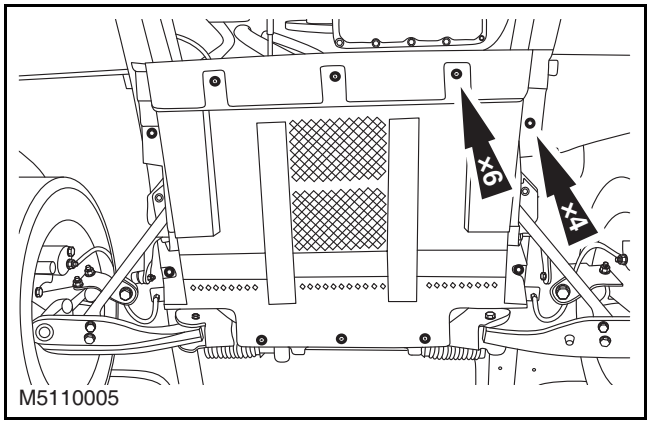
   **Refer to: Lifting (1.1.3 Traction and Lifting, Description and Operation).**

2. Remove the front wind guiding cover.

   **Refer to: Front Wind Guiding Cover (5.1.10 Exterior Trim, Removal and Installation).**

3. Remove 4 retaining bolts and 6 retaining screws from the rear wind guiding cover.

   Torque: 10 Nm




4. Remove the rear wind guiding cover.

## Installation

1. Installation is in the reverse order of removal.

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## Specifications

# Torque Specifications

| Item | Nm | lb-ft | lb-in |
|---|---|---|---|
| Vehicle baseplate retaining bolt | 45 ± 3 | - | - |
| Portal frame welding assembly retaining bolt | 28 ± 3 | - | - |

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## Removal and Installation

# Cargo Box

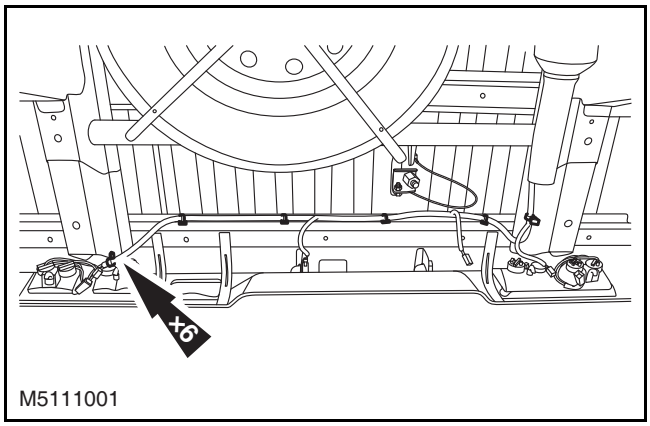
### Removal

1. Park the vehicle on flat ground and apply the hand brake.
2. Disconnect the negative battery cable.

   **Refer to: Battery (3.1.10 Charging System, Removal and Installation).**
3. Remove the license plate lamp.

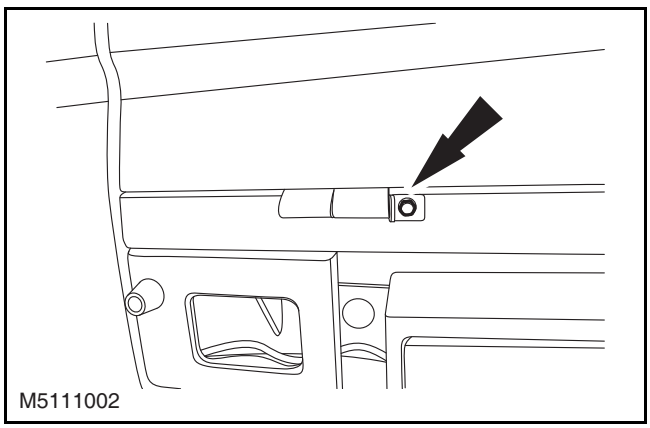
   **Refer to: License Plate Lamp (4.2.6 Lighting System, Removal and Installation).**
4. Remove the rear combination lamp.

   **Refer to: Rear Combination Lamp (4.2.6 Lighting System, Removal and Installation).**
5. Disconnect the retaining clips between rear wiring harness and baseplate.



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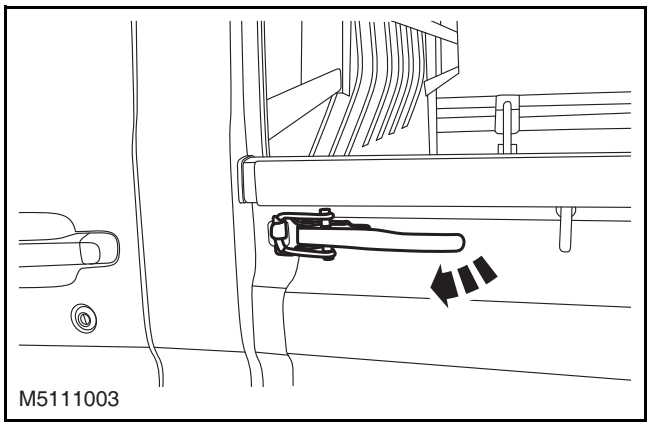
6. Remove the retaining bolt from left side panel stopper.


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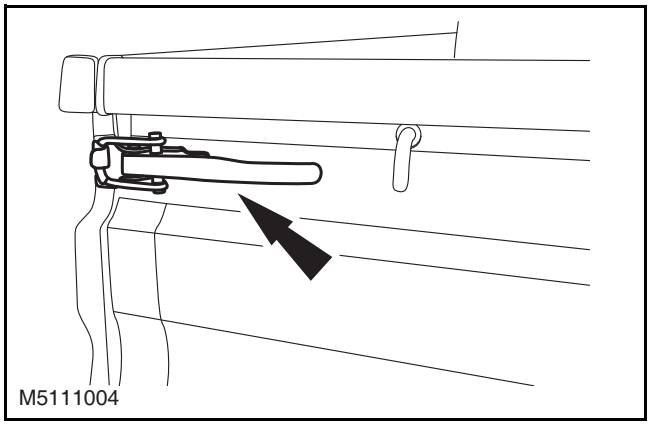
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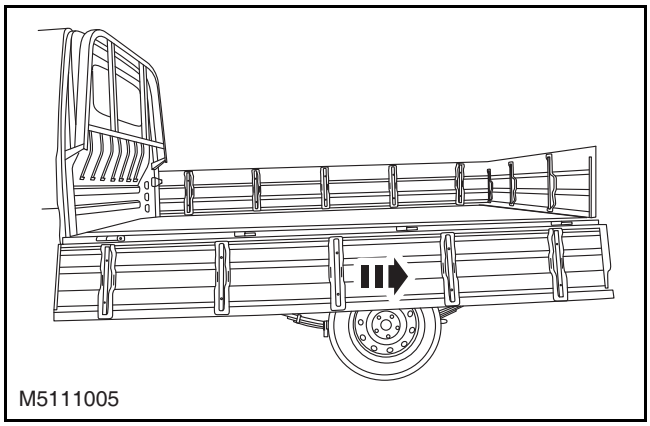
7. Unlock the left side panel lock.




8. Unlock the rear left side panel lock.




9. Push backward slightly to remove the left side panel as shown in the figure.



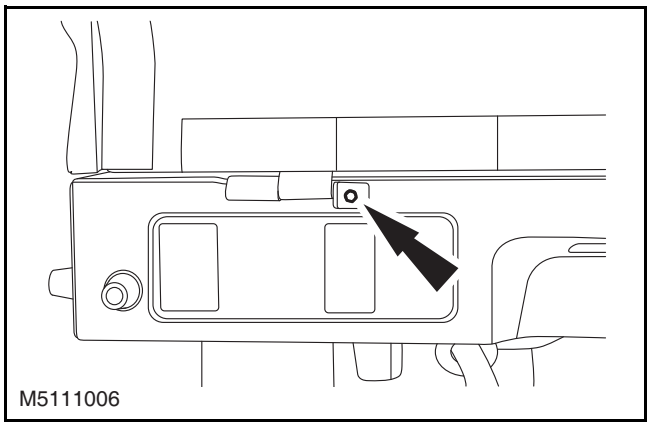

10. Remove the right side panel.

**HINT: Use the same removal procedure for the left side and right side panels.**

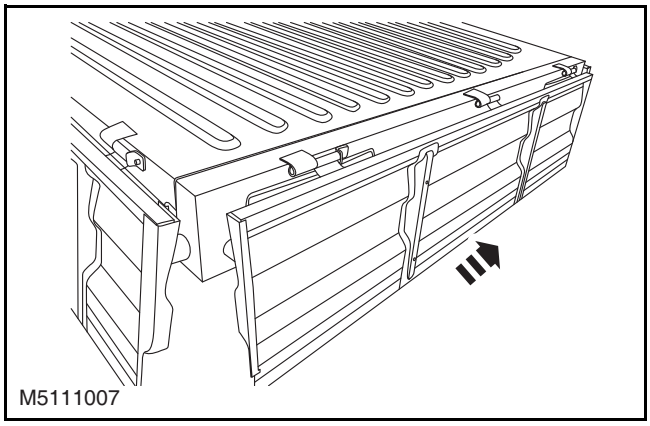
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**11.** Remove the retaining bolt from rear panel stopper.

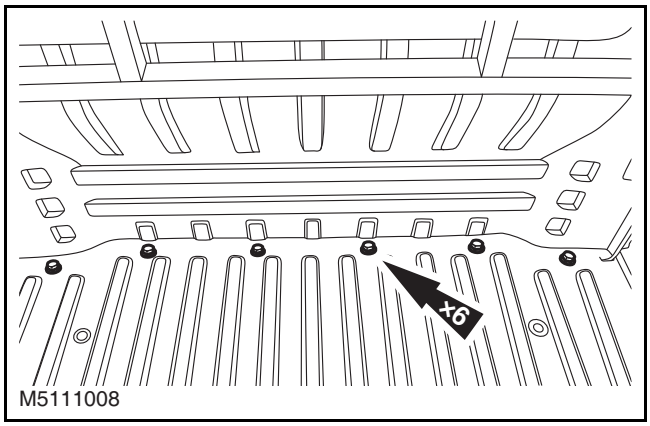

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**12.** Push in the direction of arrow slightly as shown in the figure to remove the rear panel.


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**13.** Remove 6 retaining bolts from the upper part of vehicle baseplate.

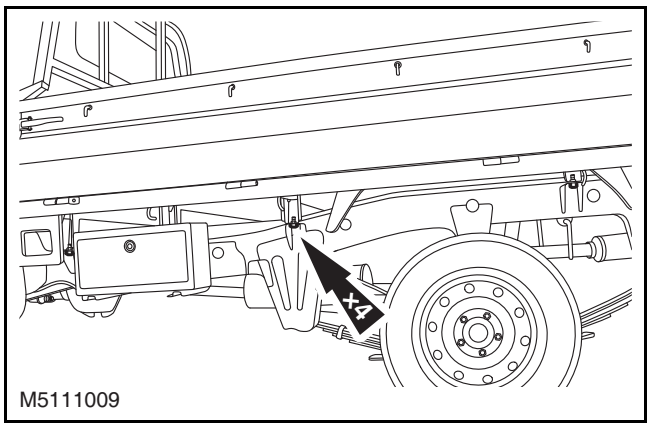
Torque: 45 ± 3 Nm



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**14.** Remove 4 retaining bolts from the lower left part of vehicle baseplate.

Torque: 45 ± 3 Nm



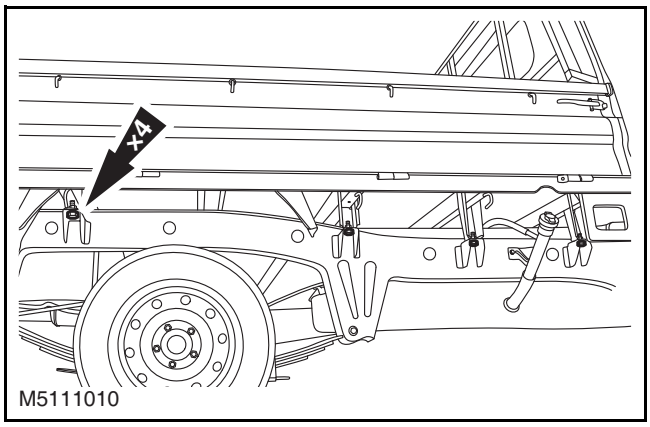
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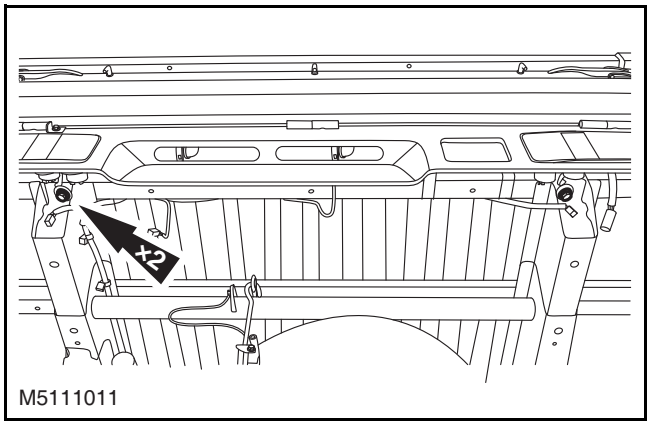
**15.** Remove 4 retaining bolts from the lower right part of vehicle baseplate.

Torque: 45 ± 3 Nm




**16.** Remove 2 retaining bolts from the lower backside part of vehicle baseplate.

Torque: 45 ± 3 Nm




**17.** Remove the cargo box baseplate.

## Installation

**1.** Installation is in the reverse order of removal.

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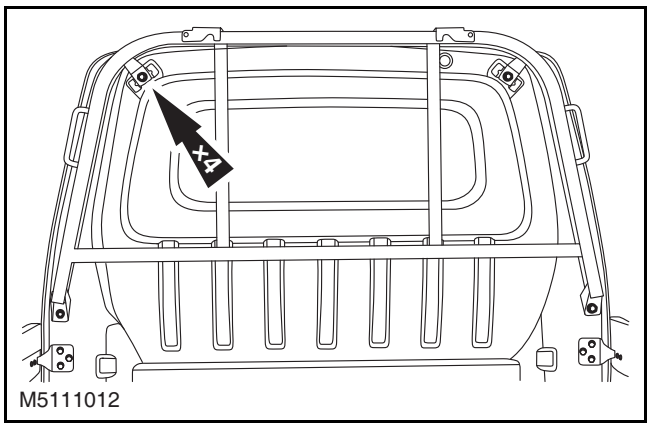


# Portal Frame Welding Assembly

## Removal

1. Remove 4 retaining bolts from portal frame welding assembly, and remove the portal frame welding assembly.

   Torque: 28 ± 3 Nm




## Installation

1. Installation is in the reverse order of removal.

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# 5.2 Body Repairs

## 2014 MD/MS201

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## Description and Operation

# Noise, Vibration and Harshness

### Meaning of NVH 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

According to the sound intensity, the noise in the automotive engineering can be classified as following: slight noise, moderate noise and strong noise. Slight noise mostly comes from engine and road surface, especially from rough road surface. Strong noise is commonly generated by airflow or accessories (such as alternator, power steering pump and drive belt). Chatter sound can be heard when vehicle runs on uneven road. The unstable noise is usually caused by shock absorber, chassis components or loose components inside the vehicle.

### Requirements of NVH for Vehicle Body

The vehicle body is one of the most important part involving NVH. The vehicle body not only causes air noise, but also causes solid noise. The main components of NVH in the vehicle body are roof steel plate, quarter and floor. The vibration or noise shall be increased greatly due to the structure, just as an amplifier. NVH engineering raises higher requirements for vehicle body:

- The vehicle body must absorb vibration from all components, and try to ensure that the vibration is not transmitted to the interior of vehicle body.
- The structure can ensure the body rigidity and provide excellent buffering performance in crash.
- Spacious interior
- Corrosion resistance
- Light weight
- Excellent aerodynamic appearance

### Methods of Sound Transmission

The sound can be transmitted via air or substances. The sound travel speed in liquid or solid (such as vehicle body) depends on the material features of substance. Generally, the speed of sound in liquid or solid is 5 times that in air. The noise can be transmitted in the vehicle via air and substance.

### Vibration

The vibration is a form of physical movement commonly found in the nature. Vibration waves with a frequency lower than 20 Hz (low frequency) or higher than 20000 Hz (20 kHz, high frequency) cannot be heard by human ears. Generally, the low frequency vibration is visible. The high-frequency vibration is audible and palpable through floor and steering wheel. For example, engine with flexible installation can relieve the vibration when vehicle runs on the uneven road surface. However, when flexible installation of engine is in trouble, vibration will be transmitted from engine to vehicle body and even cab.

### Resonance

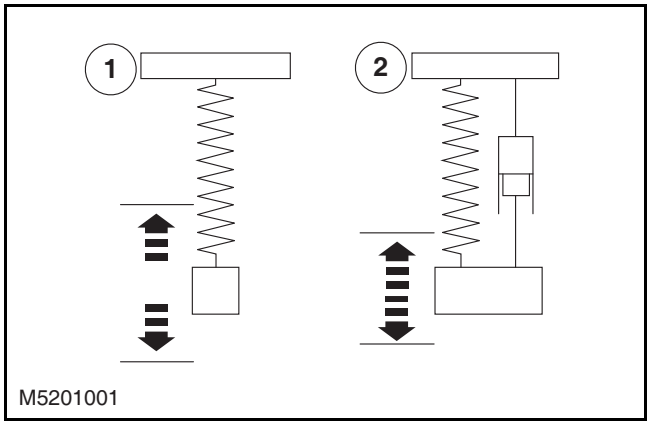
Each object has its inherent vibration frequency. If a certain system vibrates with its inherent vibration frequency, it will cause resonance. For example, when engine reaches resonance frequency, it will become unstable (engine critical speed). Once the engine speed exceeds the critical point, the engine will run stably immediately.

### Damping Vibration

Damping has influence on the resonance of the objects or systems. Object vibration can be reduced if a damper is connected with spring in parallel. The vehicle shock absorber is made based on the principle to reduce the body vibration through damping.

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

## Sound Insulation and Noise Reduction

The sound insulation and noise reduction technology is adopted in automotive engineering to minimize the noise. For example, engine is installed on elastic supporting seat, so that the vibration is transmitted into the vehicle body as little as possible.

# Plastic Components Type

It is important to know the material characteristics for plastic components when repairing. The plastic components can be generally divided into two basic categories according to the materials: thermoplastic plastic and thermosetting plastic.

Thermoplastic Plastic Components

The thermoplastic plastic components turn soft when heated and harden when cooled. The process is reversible and can be proceeded repeatedly. Therefore, thermplastic plastic components can be formed and solidified repeatedly by heating. The thermoplastic plastic component scraps can be recycled. Most of the interior and exterior trim closures are made of thermoplastic plastics.

Thermosetting Plastic Components

The thermosetting plastic components will turn soft when first heated, but to a certain temperature, it will solidify due to chemical reaction. This process is irreversible. Hereafter, it cannot turn soft when heated again. The thermosetting plastic components are formed with this feature. Using the plastifying flow in the first heating, the material fills the cavity full to solidify the components with the preset shape and dimension under the pressure. The thermosetting plastic components are harder and more fragile than the thermoplastic components, and the state does not change when heating. If continued heating, thermosetting plastic components may be damaged when temperature is higher than the critical point. The thermosetting plastic components are widely used as structure components in electrical and safety components with the purpose of heat isolation, anti-wear, insulation and high voltage resistance.

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## Component State

The surface must be flat with caulking and polished with sand paper before the vehicle or component is delivered to the workshop for painting after repair. The metaler should be responsible to prepare this process. The body and floor are formed by cold stamping with steel sheet. Therefore, the damaged part should be recovered using the same method after the accident. If the damaged component cannot be recovered as the original shape, remove and replace the damaged component as its integrity after calibrating the adjacent part. Never cut the component unit; otherwise, the vehicle rigidity, driving safety and repair feasibility may be influenced.

## Welding Type

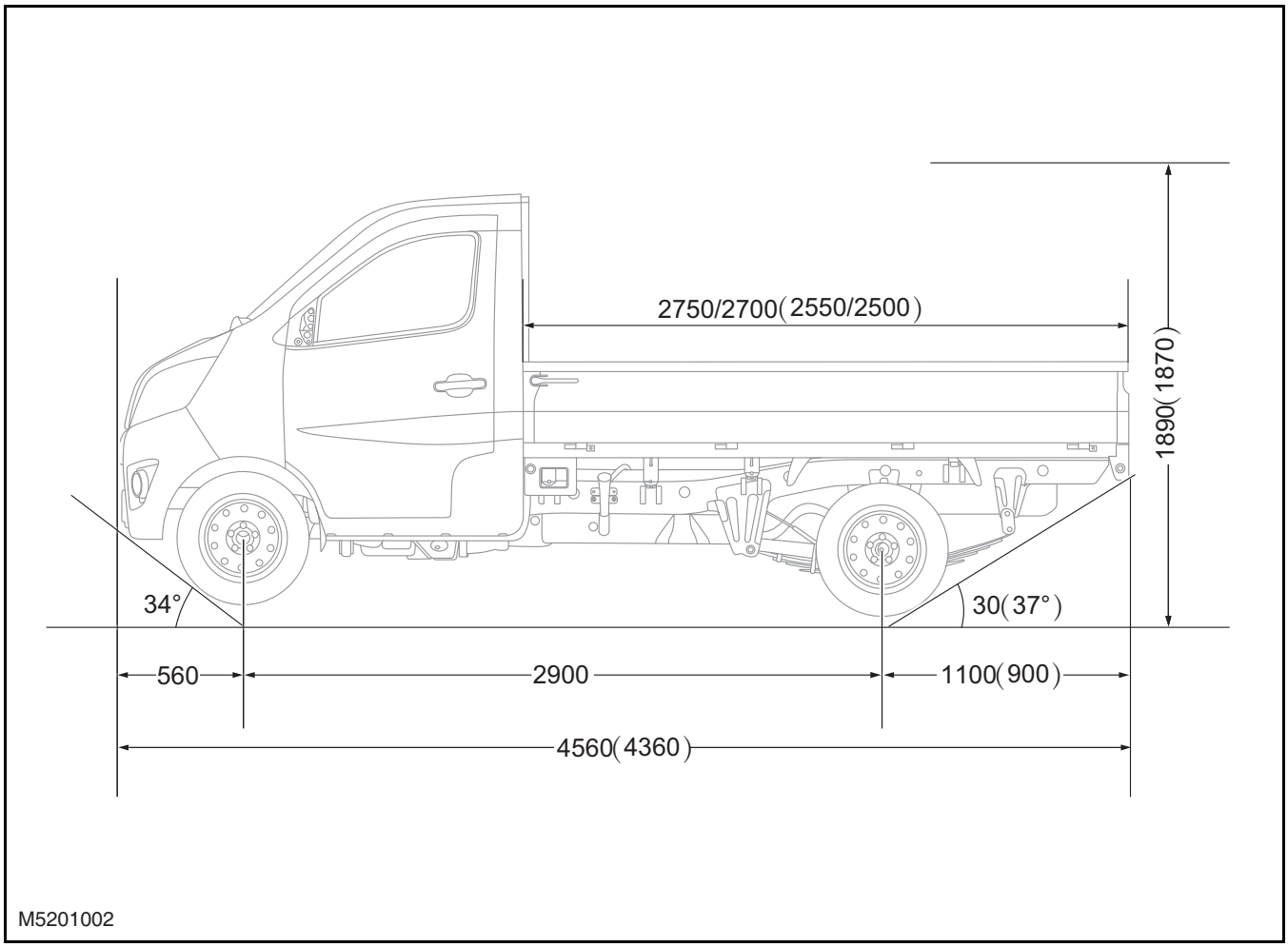
The general welding includes spot welding, gas shielded welding and braze welding. It is not allowed to reduce the spot quantity during spot welding. If the spot welding device is unavailable, apply gas shielded welding to plug after drilling. When applying spot welding, the spot must be on the original one if only external plate is replaced for the three-layer plate. Single welding line, double welding lines and double offset welding lines can be formed in spot welding. Related welding line, continuous welding line and imtermittent welding line can be formed in gas shielded welding. Braze welding is generally to weld and repair the area with weak tension strength and low thickness.

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# Body Size

## For Model MD201

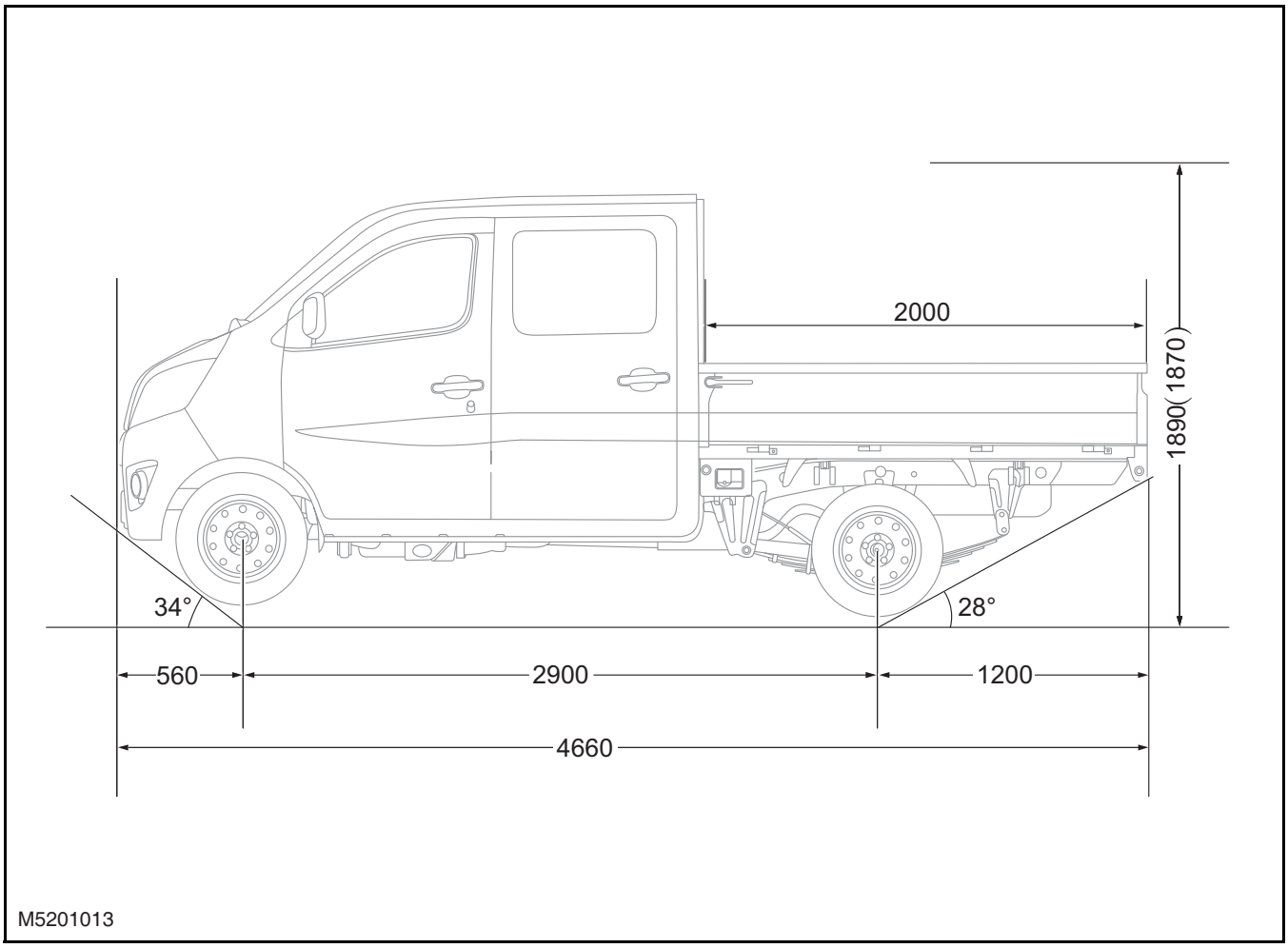



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## For Model MS201



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## Symptom Diagnosis and Testing

# Diagnosis of Vehicle in Accident

The professional technicians should use beam calibrator, electrical measuring system, spot welder and other grinding tools when repairing the body to recover its geometrical dimension and performance to the original state. However, sometimes the symptoms of driving system and suspension that can lead to serious fault may not be found in repairing the vehicle in an accident. Special attention must be paid to the following components besides the geometrical dimension inspection of the body:

- Ensure that the steering gear and the steering column can work normally within the steering wheel turning range. Visually inspect components for any bending and crack.
- Inspect all the components (for example: Y-tube/trailing arm, suspension arm, steering knuckle, stabilizer bar, frame and mountings) in the driving system for bending, twist and crack.
- Inspect the wheel and tire for any damage, concentric rotating and out of balance. Inspect the tire thread and wall for cutting/Inspect the tire pressure.
- Inspect the engine/transmission/exhaust system for damage.

Carry out the road test after repairing the body and ensure the driving performance. Finally, hand the vehicle over to the user.

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## Removal and Installation

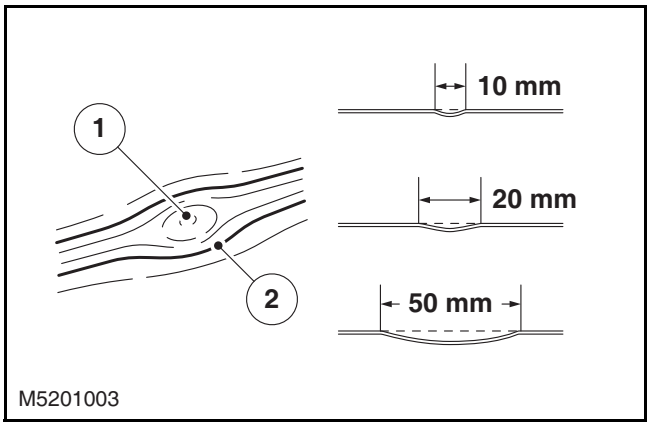
# Pit Repair Without Painting

### Damage Assessment

Slight pit can be repaired with no impact on the painting. The pit can be eliminated from inside with special lever tool (pressure tool). The repair requires that technicians must have rich experience of using special tool and good material knowledge, and have ability of confirming the fault and taking the proper repair method. The pit should meet the following requirements:

- Only for the body with access from both sides; this technology is uncommon for the dual-coating structure or closed section.
- Only shallow and small pit can be repaired perfectly. This method is applicable for the damage caused by hail, parking or shipment.
- The pit diameter should be less than 50 mm and the damage can be judged by the pit size.

**CAUTION: The material of pit center cannot exceed the deformation limit.**



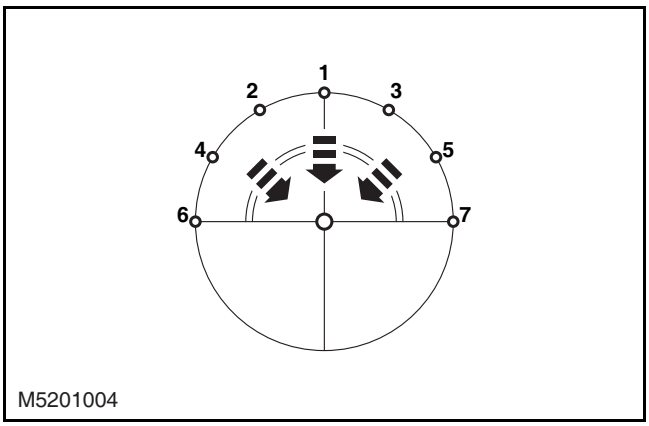
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| Item | Description |
|---|---|
| 1 | Pit center |
| 2 | Pit edge |

### Working Principle of Pressure Correction

- In order to restore the surface shape, all the treatment must be completed for the semicircle of pit.
- The operation collectively forms a semicircular shape. Operate in the specified order.
- The untreated semicircle of pit is automatically restored through the stress generated in the pressing process.

**CAUTION: Do not correct the shape from the center of pit. If so, the edge shall rise and retain the protruding state (the material is drawn to be longer). Once a bulging edge is formed, it requires a long time to repair it.**



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### Repair Procedures

1. Verify the repair method.
2. The labeling of pit is helpful for identification.

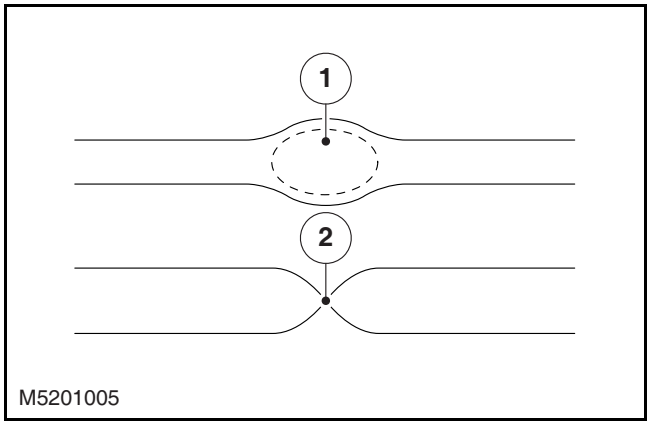
**CAUTION: Do not use pens with dissolvability that can damage the paint).**

3. Prepare the repair area.
   - It is unnecessary to open a hole for repair if the inner side of pit can be touched.
   - Clean the damaged area of vehicle body. The careful inspection is important for successful repair.
   - Polishing the repair surface if it is rough. The decision can be made only when the reflected light is strong enough.

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4. Install and adjust the illumination lamp.
   - Arrange and adjust the illumination lamp, so that the pit (oval) can be seen clearly in the reflected light of paint surface.
   - If the elliptical shape is changed in cross lines when pressing the pit, the crossing point is the working point for the pressure tool.



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| Item | Description |
|---|---|
| 1 | No pressure is exerted on the pit |
| 2 | Pressure is exerted on the pit |

5. Pressure tool position
   - Place the peak of pressure tool on the edge of the pit.
   - Slightly press the pit with the peak of pressure tool, move the pressure tool back and forth, and the reflected light can show the pressure tool position.
6. Restore the anti-corrosion protection.

# Crash Repair

## Precautions for Crash Repair

Pay attention to the following when repairing the body metal sheet:

- Wear protective clothes, goggles, gloves and shoes when welding, cutting and grinding the body.
- Good ventilation is required for the welding area.
- Disconnect the battery and cover the terminal before welding.
- Remove the battery if spark may appear when working near the battery.
- Fix the vehicle on the lift before removing the components to keep the gravity center stable to ensure the operation safety.
- Directly connect the grounding wire of welder to the components to be welded. No conductive component is allowed between the grounding point and welding point when operation.
- The grounding wire or welding electrode is not allowed to contact the electrical control unit and wire.
- The vehicle without any protection should not be parked in the repair area. The splashed spark will cause fire and damage the painting and glass.
- Be careful when grinding and welding the fuel tank or other components filled with fuel. Remove all the suspicious components that may influence the safety.
- Do not weld, hard or soft braze weld any component of the A/C system with refrigerant, as well as other components that may increase the temperature of A/C system. It may cause explosion of the A/C system. The refrigerant must be recycled if welding is required near the refrigerant hose. The refrigerant will deteriorate due to the invisible ultraviolet ray generated in welding.
- Disconnect the negative battery cable when repairing the airbag or calibrating the body; the ambient temperature of airbag shall not exceed 100°C.

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**CAUTION: Calibrate the body with the general body calibrator to determine the damaged component before replacing the key components of body.**

**CAUTION: Precise component alignment is required before welding; then, measure to confirm the body dimension before welding.**

**CAUTION: Measure frequently to ensure the correct assembling in welding.**

**CAUTION: Learn the welding assembling relationship of body metal sheet before removal. It is not recommended to cut the component unit; otherwise, the vehicle rigidity, driving safety and repair feasibility may be influenced.**

### Removal Procedures

1. Remove all the sheets and components related to the components to be replaced.
2. Clear the sealant and anti-corrosion material as necessary.
3. Align, mark and drill all the welding spots of the components to be replaced.
4. Remove the damaged components.
5. Eliminate the remaining material.

### Installation Procedures

1. Pretreat the matching surface as necessary.
2. Choose a correct welding method according to the original state of vehicle. Apply protective welding in the area where resistance welding is unavailable. Drill holes on new components for welding line if choosing plug welding. The diameter and interval of holes should be determined by the original welding spot.
3. Put new component on the vehicle temporarily.
4. Assemble and fix the new components with calibrate retainer (correct alignment repair plate).
5. Measure the new components positions to ensure the correct assembling dimension.
6. Perform the corresponding welding.
7. Clear all the welding surface.
8. Paint the coating.
9. Apply some sealant and anti-corrosion coating as necessary.
10. Install all the related components.

## Anticorrosion Measures

### Precautions for Anti-corrosion Treatment:

- Protective measures must be taken when painting sound isolation or anti-corrosion materials to avoid the painted component opening (such as lock, window slot, regulator and seat belt retractor) and any moving and rotating component, especially the parking brake cable. All the relief holes of body must be open after painting.
- The foam sound isolation material of repaired component must be removed when repairing the body with open fire. Do not breathe in the harmful dust when reinstalling the sound isolation material.
- Wear special goggles and gloves to avoid injury during operation.
- The body metal sheet is treated by electrophoresis and coating when exfactory. All the exposed metal surfaces must be coated with anti-rust painting after repairing and/or replacing the components.
- If the original cladding or anticorrosion material is burnt during welding or heating, clear the surface and carry out corrosion resistance treatment.
- The metal may be exposed in crash repair. Paint the surface with special anti-corrosion material.

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## Anti-corrosion Treatment Principle

- The standard anti-corrosion coating must be formed with approved material after repair.
- The coating must be painted inside and outside the welding line before sealing.
- Apply sealant on the coated metal sheet.
- Seal the joint metal sheet, edge, even joint welding line and welding seam with sealant.
- Apply long-term protective solute at the bottom of body.
- Repair the cavity with the protective material in the repair area after painting.
- Clean the drain port after the protective material becomes dry.

## Anti-corrosion Protection for New Components

Inspect all the new components for any scraps or bruises caused in transport.

The following operations are required according to the damage.

New components without damage:

Do not burnish the negative electrophoretic coating. Completely clean the new components with silicone cleaning agent and dry them.

New components with slightly damage:

1. Scrape off the scratching.
2. Slightly wipe the outer surface.
3. Use the cleaning agent silicone to completely clear and dry.
4. Carry out the anti-corrosion pretreatment for exposed areas.

Damaged components (damaged through collision and pressing):

1. Level the bruised area and grind exposed metal.
2. Scrape polyester putty (only for the exposed metal).
3. Scrape the putty (further fill).
4. Slightly grind the whole component.
5. Use the cleaning agent silicone to completely clear and dry.
6. Carry out anti-corrosion pretreatment for exposed areas.

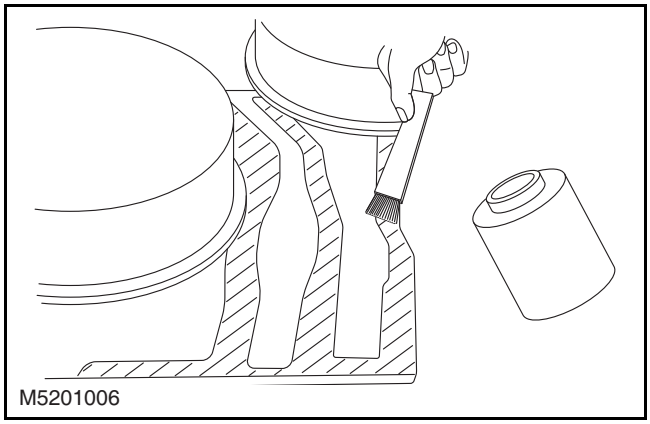
## Anti-corrosion Treatment for Welding Component

1. Clear the dip coat in the welding inner and outer areas with a rotary steel wire brush, and be careful not to damage the zinc coat.

**CAUTION: The grounding area should be as small as possible, and the anti-corrosion protection (negative coating) of product should be preserved as much as possible.**

2. Thoroughly clear the repairing area (with silicone).
3. Use the welding primer component for all the welding seams (new or old components).

**CAUTION: The welding primer should be thoroughly stirred before being used.**

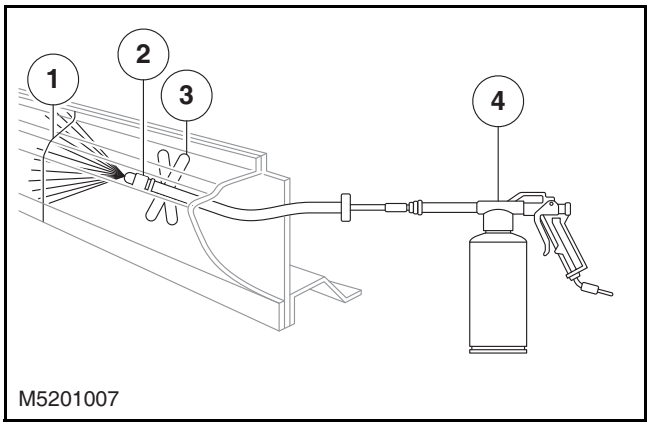

M5201006

4. The welding operation cannot be performed until the welding primering is dried.
5. Remove the welding slag after the welding is completed, and be careful not to destroy the strength of the material.
6. All the scallops in welding seams are treated with lead containing material filling method.
7. Clear and fill the sealed inner areas.
8. Seal all welding areas and joints for full protection.

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### Cavity Protection (Perform Cavity Protection for Doorsill After Local Repair)



M5201007

| Item | Description |
|---|---|
| 1 | Welding seam |
| 2 | Nozzle |
| 3 | Distant positioning |
| 4 | Spray gun |

Drill a hole at a proper position when injecting cavity protecting wax for areas that cannot reach, and the hole diameter is defined according to the available hole sealing plug. It is important to remove the scrap iron from the cavity, because any residual scrap iron may cause rust. The edge of hole should be treated with hole sealing wax, and finally, the bottom is sealed with a plug or sealant.

## Plastic Components Repair

### Precautions for Plastic Component Repair

- Apply protective cream on the naked skin to avoid irritation.
- Wear rubber gloves.
- Wear goggles when using compressed air and sanding.
- Immediately eliminate any mixture on the skin since it becomes solid rapidly.
- Wear dust-proof mask and goggles when grinding or sanding.
- Wash the skin with cold water to relieve the slight irritating caused by resin dust.
- Keep the repair materials away from the clothes.
- Use the repair materials in place with good ventilation, because the materials may produce toxic dust and pollution.
- Close all the repair material containers after using. The dust and moisture may cause pollution to the materials and impact on the repair.

### Plastic Components Repair

This chapter introduces the repair method for the plastic components only.

### Thermoplastic Plastic Component Rectification (Slight Deformation)

The bumper is usually deformed at the elastic part, such as pit and bending. Most of the deformation can be recovered by the hot air pressure gun. The damaged component can be heated up to about 200°C with the pressure gun. Heat the component from both sides if possible. In addition, the wooden hammer and plastic wedge can be used for the rectification.

### Thermoplastic Plastic Component Welding

Plastic welding is the best way to repair thermoplastic plastic component, for example: section with edge and corner, square section and small round section in the reinforced area.

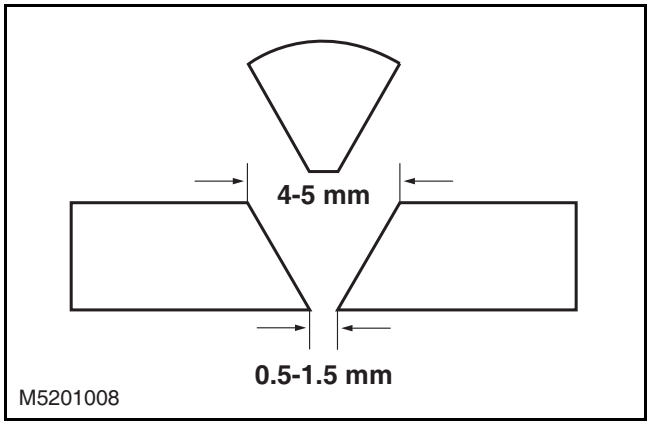
Take the bumper crack as an example:

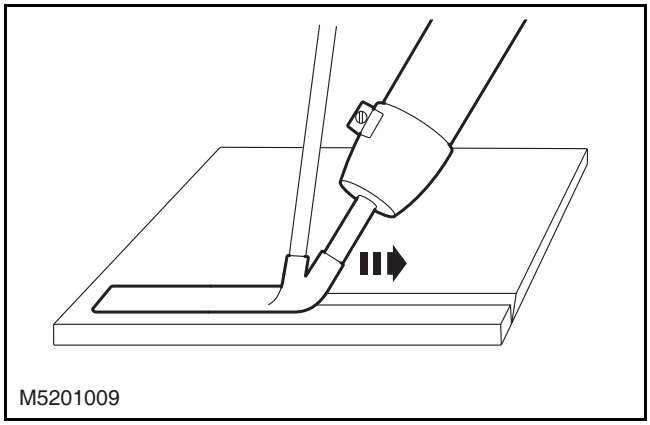
**1.** Cut the crack into V section for welding.

- Use a scraper to cut the V welding seam with opening of 60° ~ 70°.
- Use 3 mm driller to drill holes at the end of crack to prevent extension. Repair the crack beginning with caliper before welding if the seam edge is tough. Then, drill holes at the end of the crack.

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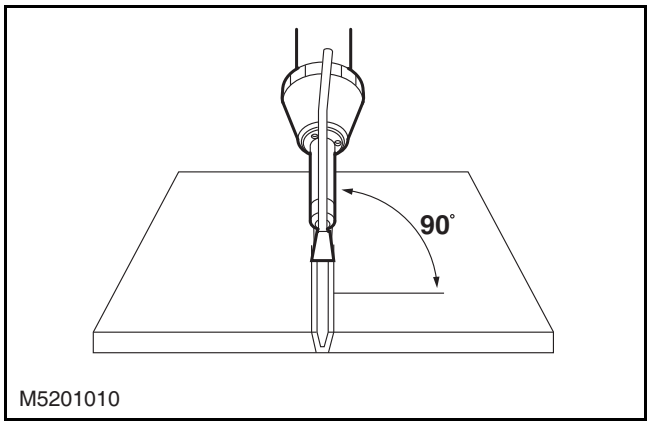




**2.** Set the welding temperature according to the manufacturer specification (200°C ~ 700°C). The welding temperature is determined by the thickness of plastic material and welding rod.

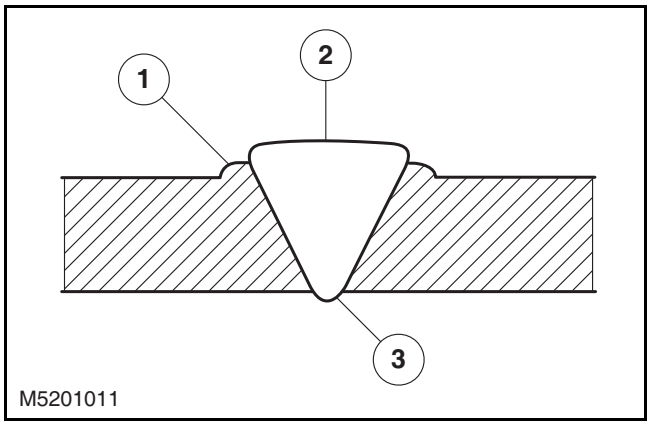
- Preheat the welder for 3 ~ 4 mins to reach the preset welding temperature.
- Cut the welding front end incline and fill the welding seam from the beginning.

**3.** Welding

- Push the welding rod with incline front end into heated quick welding nozzle cavity until the rod appears at bottom. When the welding rods and components to be welded are in the plastic state, start welding. Stable welding speed and pressure are required when welding plastic components. Pressure is only exerted to the welding rods when welding.
- The lower end of the quick welding nozzle shall move in parallel with the repairing surface. Parallel moving along the longer length direction is achieved through suitable incline of the welding device.
- When moving the plastic welding gun, keep the welding rods vertical with the welding seams.




**4.** Inspect the welding joint head.




| Item | Description |
|---|---|
| 1 | Edge bulge of welding seam |
| 2 | Welding seam remaining height |
| 3 | Welding seam root |

The welding is good if only small or smooth bulge is formed when welding the seam edge. It is important for welding of the bevel seam. Inspect

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the seam from back for the following defects. Reweld it as necessary.

| Item | Description |
|---|---|
| Distortion | Repaired position is excessively hot |
| | Material is stretched when welding is performed |
| | Plastic material is excessively thin |
| Poor welding joint | Welding temperature is excessively low |
| | Welding speed is excessively fast |
| | Different materials are welded together |
| Welding seam plastic filled surface is excessively low | Welding seam is excessively wide |
| | Welding temperature is excessively high |

**5.** Reprocess the welding seam

- After cooling, use the angle grinding machine to burnish the bulging part of the welding seam. Sand paper type: P80 ROUGH SAND PAPER. Then, use the track grinding machine to burnish the surface. Sand paper type: P120 ~ P220 FINE SAND PAPER.
- Use the plastic cleaning brush to clean and repair the surface.
- Spray the plastic primer on the repaired surface.

## Plastic Adhesive Bonding

It is applicable for the thermoplastic and thermosetting plastic components. All thermoplastic plastic components must adopt the binder containing polyurethane. The reinforced belts can be used for the welding seam and broken seam to ensure the initial extensibility.

**1.** Wash the part to be repaired

- Before repairing, use the high pressure water cleaner to clean both sides of the plastic components, and then perform drying.
- Use the plastic cleaner to clean the surface of components to be repaired.

**2.** Pretreatment

Pretreatment of scratches:

- Use the track grinding machine and P80 ~ P120 sand paper to thoroughly burnish the scratches into flatness.
- Use the track grinding machine and P120 sand paper to perform fine burnish.
- Use the plastic cleaner or tissue to thoroughly clean the surface to be repaired.
- Evenly spray the plastic primer on the surface to be repaired.

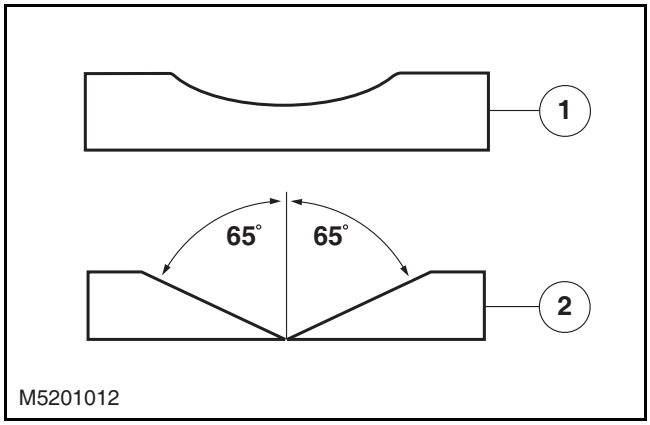
Pretreatment of crack:

- Use the angle grinding machine or belt type grinding machine to burnish the front side of crack. The width of grinding surface is 40 ~ 60 mm.
- Use the track grinding machine to burnish again.

  Sand paper type: P120.
- Use 3 mm driller to drill holes at the end of crack to prevent extension.
- Burnish along the inner side of crack.
- Use the plastic cleaner or tissue to clean the position to be repaired.
- Paint the plastic primer at the position to be repaired.

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| Item | Description |
|---|---|
| 1 | Scratching preparation |
| 2 | Crack preparation |

**3.** Adhesive bonding

Scratch bonding:

- Use the binder to fill the crack after the crack is cleaned and the primer is painted.
- Use a flexible plastic clearance gauge to lay open and flatten the binder.
- Use the infrared heater or dryer to perform drying.

Adhesive bonding and repairing crack:

Reinforce the position to be repaired to improve the anti-twisting intensity for large area of crack or breaking. Therefore, suitable reinforcing material (such as metal strip and reinforced fiber) is attached at the back of components.

- Use the PE flake or adhesive tape to cover the front side of the crack.
- Use the plastic binder to stuff the welding seam from inner side.
- Simultaneously, a wider reinforced fiber and binder are stuffed into welding crack.
- Reinforce the end of crack by adding the metal strips embedded in the plastic components.
- Repair the upper surface of reinforcing material to have the same height as the whole surface to be repaired.
- Use the infrared heater or dryer to perform drying.
- Use the PE flake to prevent the binder from spilling out of the front side of crack.
- Take off the PE flake after the binder is dried.
- Apply the binder at the front side of position to be repaired.
- Use the infrared heater or the dryer to perform drying.
- Cool the binder to be at the room temperature to prevent the binder from falling off and prevent the sand paper from being excessively heated in the burnishing progress.

**4.** Grinding

- Use the track grinding machine to grind off the bulging part of binder.

Sand paper type: P120 ~ P220 ROUGH SAND PAPER.

- Manually repair the sunken and bent areas.
- Use the grinding pads to rub the paint surface.
- Thoroughly clean the plastic components.
- Paint the plastic primer after it is thoroughly dried.

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