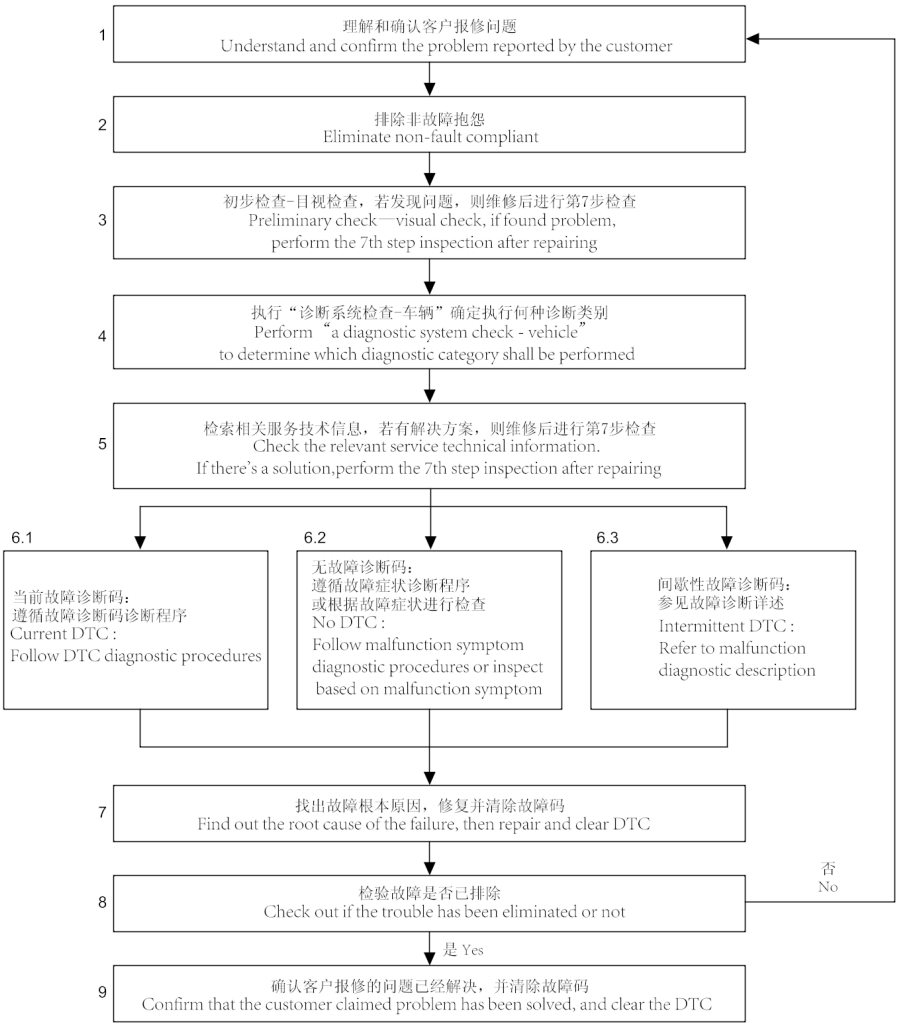
MG4 EV

Guided Fault Finding - General

Contents

Strategy Based Diagnostics

Description on Diagnostic Procedure



1. Understand and confirm the problem reported by the customer: The first step of this procedure is to know as much as possible about the customer. Working conditions while the failure occurs, frequency of the failure and service history shall be inquired. The technician shall have a good knowledge of the normal working condition of the system prior to confirming any customer claimed problem. For details, please refer to User Manual or Service Manual.
2. The driving condition meets the design requirement: this condition exists during normal driving. The condition described by the customer may be a normal condition. Under the same condition as described by the customer, compare with the similar vehicles which are in normal operation. Explain the check results and system operation conditions to the customer.
3. Preliminary Check: Perform an overall visual check. Review the service history. Check for any abnormal noise or smell. Collect the DTC information so as to make effective repair.
4. Perform a diagnostic system check - vehicle, confirm if the system works normally. This can help the technician to take systematic diagnostic actions and determine which diagnostic category shall be performed. Refer to "Diagnostic System Check - Vehicle".
5. Check and refer to the relevant service technical information.
6. Diagnostic category:
   a. Current DTC: Diagnose according to the designated DTC so as to make an effective repair. Refer to "DTC Troubleshooting" .
   b. Symptom - No DTC is detected: Select a proper symptom diagnosis procedure. Refer to "Phenomena-based Diagnosis".
   c. Intermittent DTC: Intermittent failure is a failure that does not occur consecutively, is difficult to reappear and only occurs when the relevant conditions are met. Normally, intermittent failures are caused by electrical connector and harness failure, component

failure, electromagnetic/radio frequency interference, driving condition or aftermarket add-on equipments.

7. Find out the root cause of the failure, then make repair and verify the result: after finding out the root cause of the failure, repair it and verify if the problem is solved in a proper way. Confirm that the DTC or symptom has been solved, it may be required to perform a road test on the vehicle.
8. Recheck the problem reported by the customer: If the technician fails to find out the cause of the problem, recheck as necessary. Reconfirm the problem claimed by the customer. The problem could be an intermittent failure, or a normal condition.
9. Confirm that the customer claimed problem has been solved, and clear the relevant DTC.

Diagnostic System Check - Vehicle

Perform the diagnostic procedure in this manual on condition that all functions below conform to the design conventions

- 12 V battery is fully charged and the cable is clean and secure.
- The fuse is not blown.
- The ground circuit in the area where the customer claims repair is clean, firm and in proper position.
- All the connections/connectors of the faulty section are in place.
- No after-sale add-on equipments affect the system operation.
- The scan tool is powered on.

Diagnostic System Check

1. Confirm customer claimed problems - understand and confirm customer claimed problems. Check the visible system parts for apparent damage or failure which has caused the problem.
2. Check the service technical information - read the relevant maintenance manual, maintenance bulletin information.
3. Mechanical system malfunction - Confirm if this symptom is not caused by malfunction of the mechanical system only.
4. Vehicle electricity check - Place the start switch in "ON" position, and confirm if the vehicle is powered on.
5. Control module - use the scan tool, and confirm that at least one control module can communicate with the scan tool; confirm that the control module communication DTC is not set; confirm whether the vehicle has control module that cannot communicate.
6. Control module internal performance failure - Confirm that DTCs for the control module internal hardware performance failure have not been set.
7. Power mode failure - Confirm that no DTCs for control module power mode have been set at the moment.
8. Engine startup and run verification - Confirm engine startup and run.
9. Check for other DTCs - Confirm that no other DTCs are set.
10. Emission related check/maintenance failure - If the vehicle has recently been checked and maintained, confirm that customer claimed problem is irrelevant to the check/maintenance.

Basic Methods of Circuit Inspection

The basic methods of circuit inspection include the following basic inspection information. This information is used with the diagnostic procedures to identify the causes for electrical failures.

- Measurement of Voltage
- Measurement of Voltage Drop
- Measurement of Frequency
- Inspection of Ground and Low Level Reference Voltage Circuits
- Inspection of Conductivity
- Inspection for Short to Ground
- Inspection for Short to Battery
- Inspection for Intermittent Failure or Poor Contact

Measurement of Voltage

The following procedure is used to measure the voltage at selected points in the circuit.

1. If necessary, disconnect the electrical harness connector in the circuit under test.
2. Enable the circuit and/or system under test. The method is as follows:
   a. With the engine off, place the start switch in "ON" position.
   b. Start the engine.
   c. Connect the circuit and/or system with the "Forced Output" function of a scan tool.
   d. Turn on the switch of the circuit and/or system under test.
3. Select V (AC) or V (DC) position on a digital multimeter.
4. Connect the positive lead of the digital multimeter to the point to be measured in the circuit.
5. Connect the negative lead of the digital multimeter to a good ground.
6. The digital multimeter will display the voltage measured at this point.

Measurement of Voltage Drop

The following procedure is used to determine the voltage drop between two points.

1. Set the digital multimeter at V (DC) position.
2. Connect the positive lead of the digital multimeter to a point to be measured in the circuit.
3. Connect the negative lead of the digital multimeter to another point to be measured in the circuit.
4. Apply power to the circuit.
5. The digital multimeter will display the voltage drop between the two points.

Measurement of Frequency

Use an oscilloscope or other special frequency meters to measure the frequency. Only the measurement method using a digital multimeter will be described below.

The following procedure can be used to determine the signal frequency.

1. Apply power to the circuit.
2. Set the digital multimeter at V (AC) position.
3. Connect the positive lead of the digital multimeter to the circuit to be measured.
4. Connect the negative lead of the digital multimeter to a good ground.
5. Set the digital multimeter to Hz.
6. The digital multimeter will display the measured frequency.

Inspection of Ground and Low Level Reference Voltage Circuits

When using a digital multimeter, many vehicle conditions may affect the conductivity test of ground and low level reference voltage circuits. If these conditions are not met, the test of ground or low level reference voltage circuit in a good circuit may fail. This may cause longer diagnostic time and incorrect component replacement.

During the test, any current flowing through the ground or low level reference voltage circuit will cause the digital multimeter to have conductivity reading deviation or display a higher reading than that when no current flows. When the conductivity test is performed for ground or low level reference voltage circuit, it is most likely to fail to test a good ground or low level reference circuit at the negative terminal of the vehicle battery compared to any other ground reference points. The best ground test points should be the control module housing (when the control module housing is metal and grounded), door pillar striker (when connected with metal), below the metal frame of instrument panel, engine cylinder block or body ground stud (other positions than the connection of negative battery cable).

The typical conductivity reading of the digital multimeter for ground or low level reference circuit should be displayed as 100Ω when the start switch is in "ON" position, and drops to 15 - 25Ω when the start switch is in "OFF" position. The reading will drop below 10Ω after 30 - 40s, and below 5Ω after 60s. Once the vehicle fully enters the sleep state (usually 3 - 10min), the reading will drop below 0.3Ω.

The following conditions may need to be met to ensure that the conductivity reading for ground or low level reference voltage circuit is valid.

- The start switch is in "OFF" position
- The key is removed from the start switch (Without remote door lock and remote start)

- The accessory power is OFF (Open and close the driver door after the start switch is turned off)
- The charging rate of the battery charger is set to 2A or lower
- The scan tool does not communicate with any vehicle control modules (Sometimes it needs to be disconnected from the scan tool interface DLC)
- All doors are closed
- The headlamps are off (Auto headlamp disabled)
- Any delay lamp goes off
- HVAC system is turned off
- Any accessory that works when the start switch is OFF
- Wait for 60s (After all the above conditions are met)

Inspection of Conductivity

The following procedure may be used to check that the circuit has good conductivity.

Use a digital multimeter

1. Set the digital multimeter in Ω position.
2. Disconnect the connectors at both ends of the suspected circuit.
3. Connect a lead of the digital multimeter to one end of the circuit to be tested.
4. Connect the other lead of the digital multimeter to the other end of the circuit to be tested.
5. If the digital multimeter displays little or no resistance, the circuit has good conductivity.

Inspection for Short to Ground

The following procedure is used to test if the circuit is short to ground.

Take the digital multimeter as an example:

1. Disconnect the connectors at both ends of the suspected circuit.
2. Set the digital multimeter in Ω position.
3. Connect a lead of the digital multimeter to one end of the circuit to be tested.
4. Connect the other lead of the digital multimeter to a good ground.
5. If the resistance displayed on the digital multimeter is not infinite, the circuit is short to ground.

When a fuse supplies power to multiple loads:

1. Consult the system schematic diagram and find the blown fuse.
2. Disconnect all connectors or switches between the fuse and each load.
3. Connect the digital multimeter with both terminals of the fuse (ensure the fuse is energized).

   If the digital multimeter shows a voltage when the first connector or switch is connected, the circuit to the first connector or switch is short-circuited.
4. Close the connectors or switches one by one until the digital multimeter shows a voltage to find out the short circuit.

Inspection for Short to Battery

The following procedure is used to test if the circuit is short to battery.

1. Disconnect the connectors at both ends of the suspected circuit.
2. Set the digital multimeter at V (DC) position.
3. Connect the positive pole of the digital multimeter to one end of the circuit to be tested.
4. Connect the negative pole of the digital multimeter to a good ground.
5. Place the start switch in "ON" position, and have all accessories operating.
6. If the measured voltage is higher than 1V, the circuit is short to battery.

Inspection for Intermittent Failure and Poor Contact

Conditions Causing Intermittent Failure

Many intermittent open circuit and short circuit failures are caused by harness/connector movement due to vibration, engine torque, or bumps/uneven roads. If the failure arises from vibration, harness operations may be required to reproduce the failure reported by the customer. Circuit operation may include various operations, such as:

- Shake the harness.
- Disconnect and reconnect the connector.
- Squeeze the mechanical connection of the connector.
- Pull the harness or wire to judge if the wire inside the insulating layer is disconnected/broken.
- Reroute the harness or wire.

All these operations must be performed in a targeted manner. For example, when a scan tool is connected, shaking the wire may be used to find failure in the input signals of the control module. The data information of the corresponding components can be observed through "real-time display".

Another method is: connect, shut off and shift related connector and harness with "Force Output" component of the scan tool and observe component operations. With the engine running, move the related connector and harness while monitoring the engine operation. If the movement of harness or connector affects the displayed data, the component/system operation or the engine operation, check the harness or connector and repair it if necessary.

It may be necessary to load the vehicle to reproduce the failure. This may require heavy objects, floor jack, jack stand, lift, etc. The suspension or frame can be operated with the above method to reproduce the failure. This method can be used to effectively find those too short harnesses, which may cause the connectors on the harnesses to be pulled apart, thereby resulting in poor contact.

Of course, good effect can also be achieved by sight, smell, and hearing when operating circuits.

Sometimes operating circuits only may not reach the goal to reproduce the failure. In this case, the suspected circuit should be exposed to other conditions while operating the harness. This kind of conditions include high humidity condition and extreme high or low temperature condition.

The following describes how to expose circuits to such conditions.

- High Temperature Condition

  If the failure reported by the customer is related to overheat, a heat gun can be used to heat the suspected area or component to simulate the failure condition.

  Operate the harness in high temperature condition while monitoring the scan tool or digital multimeter to find the failure.

  High temperature condition can also be easily obtained by road testing the vehicle at normal operating temperature, but this method is inconvenient to perform corresponding operations for components such as harnesses at the same time.

- Low Temperature Condition

  The desired effect can be achieved by placing a fan in the front of the vehicle according to the failure nature and parking the vehicle in the shade.

  When the vehicle, component or harness is fully cooled, operate the harness or component to reproduce the failure. Reproduce the failure condition:

  1. If previous tests are not successful, try to reproduce and/or capture the failure condition.
  2. "Freeze Frame" data includes conditions occurred when a DTC is set (if applicable).

Inspection for Intermittent Failure and Poor Contact

If a failure does not occur currently, but the DTC history indicates that the failure has occurred, it may be an intermittent failure. Intermittent failure may also be the cause for repair reported by the customer, but its symptom cannot be reproduced.

Most intermittent failures are caused by electrical connection or wiring failure. Check the following:

- Wires inside insulating layer are broken or not.
- Positive and negative terminals of the connector are in poor contact or not.
- Poor terminal-to-wire contact - This kind of failure includes poor crimping, poor welding, crimping onto wire insulating layer rather than wire itself, corrosion in contact area of wire and terminal, etc.
- Pierced or damaged insulating layer may cause moisture to enter the circuit, resulting in corrosion. Conductor in insulating layer may corrode, but it can hardly be found visually. Look for expanded or hardened wires in the suspected circuit.
- Pinched wires, cuts, or damaged insulating layer may cause intermittent open or short circuit (because the exposed part contacts other harnesses or parts in the vehicle).
- Wires may contact hot or exhaust components.
- Reproduce the failure to verify the failure reported by the customer.
- Understand the test procedures for intermittent open circuit, excessive resistance, short to ground, and short to battery.

1. Check for fretting wear of terminals

   Some intermittent failures may be caused by contact wear of wire terminals. Contact wear is formed by oxidized wear debris of insulating aggregates when a small movement occurs between electrical connectors. The resistance at the connector increases when the oxidized wear debris builds up to a certain extent at the electrical connector. A minor movement from 10 to 100 micron on contact surface will result in contact wear. Imagine a piece of paper with a thickness of about 100 micron, the contact wear movement is so small that it is hard to see. Vibration and thermal expansion are the main causes for contact wear movement. Vehicle vibration and significant temperature fluctuation are also sources of contact wear movement. Surfaces of tin, copper, nickel and iron are prone to contact wear. Contact wear is hard to see, but appears as a small black stain on the terminal contact surface. In order to improve wear, disconnect the suspected connector and add lubricant (insulating grease) to both sides of the connector terminals. Then reconnect the connector and wipe off excessive lubricant. This will improve the additional resistance of terminal contact caused by terminal contact wear.

2. Check if the terminals are in good contact

   Before replacing a suspected component, test the contact condition of terminals on component connector and in-line connector. Mating terminals must be inspected to ensure good terminal contact. The female and male terminals of the connector may be poorly connected

due to contamination or deformation. Improper connection of connectors may cause contamination. Missed or damaged connector seal, damaged connector or exposure of terminals in moisture or dust may also cause contamination. Connectors under the bonnet or body are most easily be contaminated, which may cause terminal corrosion and in turn cause open circuit or intermittent open circuit. Other causes for terminal deformation are improper connection or repeated removal and installation of connectors. Deformation (usually on the contact tab of female connector) may cause poor terminal contact, resulting in open circuit or intermittent open circuit.

3. Test if the bus electrical centre terminals are in good contact

   Test connector contact according to the following procedure:

   • Disconnect the connector.

   • Visually check the connector for contamination. Contamination may cause white or green rust to build up inside the connector case or between the terminals, which may cause excessive terminal resistance, intermittent poor contact, or open circuit. Connectors under the bonnet or body must be replaced as a whole if they show signs of contamination: terminals, seals and connector body.

   • Change the suspected connector with a known good connector, and if it works well, replace the suspected connector.

   Test terminal contact according to the following procedures:

   • Remove the suspected component.

   • Visually check both sides of the connector for signs of contamination. Avoid touching any side of the connector, as skin oil may also contaminate the connector.

   • Visually check the connector support surface on the wire side for separation, cracks, or other defects that may cause poor terminal contact. Visually check the connector on the component side to ensure that all terminals are consistent without damage or deformation.

   • Insert the appropriate adapter into the harness connector to test the suspected circuit.

4. Control Module/Component Voltage and Ground

   Poor contact of power supply or ground may result in many different symptoms.

   • Test the power circuits of all control modules. Many vehicles have multiple circuits to supply power to a control module. Other components in the system may have separate supply voltage circuits that should also be tested. Check the connectors, fuse connections, and any intermediate connections between the power supply and the module/component. Test lamp or digital multimeter can display the presence of voltage, but cannot be used to test if the circuit can transmit sufficient current. Operate components to test the capacity of a circuit to transmit sufficient current.

   • Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds, which may also need to be tested. Check that all grounding points are clean and connected securely. If possible, check connections on component and star connectors. Operate components to test the capacity of a circuit to transmit sufficient current.

5. Temperature Sensitivity

   Once the component/connection reaches normal working temperature, intermittent failure may occur. The failure may occur only when the component/connection is cold or hot.

   The presence of corresponding "Freeze Frame", "DTC" or other vehicle data recorder data will help determine this type of intermittent failure.

   If the intermittent failure is heat-related, check if data is related to the following situations:

   • Extreme high ambient temperature.

   • Heat generated under the bonnet/by the engine.

   • Heat generated due to poor contact or excessive electrical load.

   • Overloaded vehicle, such as towing vehicle, etc.

   If the intermittent failure occurs in cold state, check if data is related to the following situations:

   • Extreme low ambient temperature - Under extreme low temperature, the connection or component may freeze. Check for water entry.

   • This failure occurs only during cold start.

   • The failure disappears when the vehicle is warmed up.

   Information provided by the customer is helpful for determining if the failure is temperature-related.

   If it is suspected that temperature may be the condition for causing the intermittent failure, try to reproduce the failure condition.

6. Electromagnetic Interference and Electrical Noise

   Some electrical components/circuits are sensitive to electromagnetic interference and other types of electrical noises. Check if the following situations exist:

   • Improper harness wiring, too close to high voltage/high current devices (e.g. secondary ignition component,

motor, alternator, etc.) - such components will induce electrical noise in the circuit and interfere its normal operation.

- Electrical system interference caused by the failure of relay, solenoid valve driven by control module or switch - all these may result in strong surge. Generally, the failure occurs when the faulty component operates.
- Incorrect refit of non-genuine aftersales accessories (e.g. car lamp, interphone, amplifier, motor, remote starter, warning system, onboard telephone, etc.) - these accessories may generate interference during the operation, but no failure occurs when they are not in use.
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may be equipped with a clamping diode.
- Alternator may bring AC noise in the electrical system.

7. Incorrect Control Module

- Control modules needs to be reprogrammed only under the following situations: A new control module is fitted during repair; the control module from another vehicle is fitted; the upgrade software/calibration file is issued for this vehicle.
- Check that the control module is installed with the correct calibration or configuration file. If programming is found to be incorrect, the control module should be reprogrammed with the latest software/calibration file.

Diagnosis Repair Verification

1. Fit all components or connectors removed or replaced during diagnosis.
2. Perform any adjustment, programming, or setup procedures that are required when a component or module is removed or replaced.
3. Clear the DTC.
4. Place the start switch in "OFF" position and turn off all vehicle systems for 2min.
5. In case the repair is related with the DTC, reproduce the operation conditions for running the DTC and apply "Frozen Failure State/Failure Record" (if applied) in order to confirm not to set the DTC. If the DTC is reset, or another DTC is present, refer to the "DTC Troubleshooting" and perform the appropriate diagnostic procedure.
6. In case the repair is related with the symptom, reproduce the occurrence conditions of failure claimed by customer to verify repair effects. In case problems claimed by customer reoccur or another symptom occurs, return to "Phenomena-based Diagnosis" and perform related symptom diagnosis procedure.

Vibration

Vibration Analysis

Noise and Vibration from Vehicle

Mechanical vibration is usually accompanied by noise and roughness. They occur simultaneously and dependently.

Vehicle vibration sources mainly include: engine, transmission, drive system, rough roads, etc. Sound is generated by object vibration, thus noise and vibration will not occur individually in most occasions. Vehicle is a system composed by excitation source (the source generating noise and vibration, e.g. engine, transmission, etc.), vibration transmitter (consisting of suspension system and connector) and noise emitters (body).

Vehicle noise sources mainly include: engine, exhaust system, wind noise, tyre noise and any other moving parts possibly making noise.

Symptom Table

According to the most important features felt or heard when the customer's vibration concern occurs, refer to the "Vibration Analysis" table in the following symptom tables.

Vibration Symptoms that are Felt

Type	Description	Typical Frequency Range	Occurrence Conditions	Key Parts
Shudder	Can sometimes be seen or felt in the steering wheel, seat or console. Related terminologies: shimmy, wobble, waddle, shudder, hop	5 ~ 20Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Tyres and Wheels
			Vehicle Speed Sensitive Affected by torque/load or steering input	Propeller Shaft or Suspension
			Engine Speed Sensitive	Engine
Roughness	Similar to the feeling of holding a jigsaw	20 ~ 50Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Tyres and Wheels
			Vehicle Speed Sensitive Affected by torque/load or steering input	Propeller Shaft or Suspension
			Engine Speed Sensitive	Engine
Surge	Similar to the feeling of holding an electric razor. May be felt in the hands through the steering wheel, in the feet through the floor, or in the seat of the pants	50 ~ 100Hz	Vehicle Speed Sensitive Affected by torque/load or steering input	Propeller Shaft or Suspension
			Engine Speed Sensitive	Engine
Tingling	May produce a "pins and needles" sensation or may put hands or feet "to sleep" Highest vibration frequency range that can be felt	Higher than 100Hz	Vehicle Speed Sensitive Affected by torque/load or steering input	Propeller Shaft or Suspension
			Engine Speed Sensitive	Engine

Vibration Symptoms that are Heard

Type	Description	Typical Frequency Range	Occurrence Conditions	Key Parts
Boom	Usually heard as an interior noise similar to the noise of a bowling ball rolling down an alley, deep thunder, or a bass drum • Related terminologies - droning, growling, moaning, roaring, rumbling, humming • May not be accompanied by a perceptible vibration or roughness	20 ~ 60Hz	Vehicle Speed Sensitive Still occurs during coast down in NEUTRAL	Tyres and Wheels
			Vehicle Speed Sensitive Affected by torque/load or steering input	Propeller Shaft or Suspension
Moaning or Droning	Similar to the sound of bumblebee or blowing into the bottle neck • Related terminologies - humming, droning and resonance • May be accompanied by perceptible vibration, e.g. surge	60 ~ 120Hz	Vehicle Speed Sensitive Affected by torque/load or steering input	Propeller Shaft or Suspension
			Engine Speed Sensitive	Engine
Howl	Similar to the sound of the wind howling	120 ~ 300Hz	Vehicle Speed Sensitive Affected by torque/load or steering input	Propeller Shaft or Suspension
			Engine Speed Sensitive	Engine
Whine	Similar to the sound of mosquitoes, turbine engines, or vacuum cleaners	300 ~ 500Hz	Vehicle Speed Sensitive Affected by torque/load	Transmission

Diagnostic Aid for Vibration

Vibration reproduced intermittently or cannot be reproduced

If the vibration problem cannot be reproduced or can only be reproduced intermittently, see the information below.

Most vibration problems cannot be reproduced since a specific condition does not occur during reproduction, or the procedure designed to reproduce vibration is not executed correctly in the specified sequence.

Specific conditions affecting vibration problem

Consider the following conditions that may not occur when reproducing the vibration problem. Try to get more related information from the customer to understand the exact conditions that occur when the customer encounter the vibration problem reported for repair. Try to reproduce the vibration problem by recreating the necessary exact conditions (except those that cause safety problems or are outside the normal driving range, such as vehicle overloaded, etc.).

Most vibration problems are reproduced after the vehicle is driven to the repair shop, and the vehicle may even have been placed there for a period of time during reproduction; however, the vehicle may still be too hot to detect the vibration problem during reproduction. In contrast, if the vehicle has been placed in a cold environment for a period of time, it may also be too cold to reproduce the vibration problem since it cannot fully reach the operating temperature during reproduction.

Temperature, fit clearance out of tolerance, accessory load

Flat spot on tire

Flat spot may develop after tires have been stopped and cooled for a period of time.

Irregular wear of tire tread

Tires become harder when they are stopped and cooled for a period of time, and irregular wear is more obvious than that when they are hot or softened.

Expansion of exhaust system

Fit clearance out of tolerance may occur in the exhaust system in cold state, and disappear in hot state. The opposite situation may also occur, i.e. the exhaust system is in good condition when cold, but fit clearance out of tolerance occurs when the system reaches the operating temperature.

Noise of accessories driven by the engine

Stethoscope with probe can be used as an additional method to help identify those accessories that may cause or result in vibration problems.

- Belt flapping - Flapping occurs once the performance of the engine accessory drive belt is degraded and impurities accumulate at the underside of the belt.
- Loose mounting bracket or component fit clearance out of tolerance - Noise occurs in the accessories (such as alternator, A/C compressor, etc.) driven by the engine once the mounting bracket is loose or the fit clearance of the related component in the accessory system is out of tolerance during an operation of the system.
- Cold or hot state - Noise may occur in these accessories in cold state, and disappear when the system is fully warmed up, or vice versa.
- Load on accessory component - Noise may occur in an accessory under heavy load, which may be combined with the cold state or fully warmed-up condition.
- Bent or misaligned pulley - Noise or vibration may occur once one or more pulleys in the accessory system driven by the engine are bent or misaligned.
- Fluid level in the accessory system - Noise may occur in the accessories once the fluid level in the system to which they belong is abnormal.

  For example:

  – Incorrect A/C refrigerant level or excessive refrigerant may cause noise or vibration in the A/C system.

  – Incorrect fluid type in the accessory system - Noise may occur in the accessories once the fluid type in the system to which they belong is incorrect.

Vehicle payload

Vibration problem may occur only when the vehicle is heavily loaded or tows a trailer. The vehicle may be unloaded during reproduction.

Heavy load

The vehicle may be unloaded when reproducing the vibration problem, but the customer may encounter the vibration problem when it is heavily loaded.

Trailer towing

The vibration problem encountered by the customer may occur only when towing a trailer.

Road selection

The road used to reproduce vibration may be selected near the repair shop, and it is impossible to provide a road similar to that the customer usually travels on.

The customer may encounter vibration only on a certain road. The road may be raised excessively or very bumpy or rough.

Vibration reproduced, but the faulty component cannot be identified

After-sales accessories

If after-sales accessories are fitted incorrectly, they may transmit and amplify the inherent rotational frequency of rotating parts.

Vibration isolation methods should be used when fitting accessories to prevent them becoming a path to transmit vibration to other parts of the vehicle. For example, if a set of pedals is not fitted correctly and they are sensitive to a certain frequency of a rotating part, they will respond to the frequency once its amplitude is sufficient (maybe at higher vehicle speed), thereby causing disturbance.

If the pedals in the same set are fitted correctly - isolated properly, the transmission path will be eliminated and disturbance no longer occurs.

Vibration reproduced, but difficult to isolate vibration/balance components

If the vibration problem has been reproduced, but it is difficult to balance related components or isolate the component, see the information below.

Most vibration problems are corrected or eliminated in the following ways: correct excessive runout of components, correct balance of components, or isolate components in abnormal contact with other objects/components.

Components that generate much energy and have excessive runout, unbalance or fit clearance out of tolerance may vibrate with high amplitude, and such vibration may be transmitted to the components most relavent to them. Such situations are usually related and sensitive to torque load. They are most likely to occur in the drivetrain.

Vibration reproduced, which seems to be a potential operating characteristic

If the following two conditions exist, the service bulletin should be consulted for identification of related failures. If the failure condition has been identified before this vehicle, and it is determined that the condition is not an operating characteristic of the vehicle or may not be the design intent of the vehicle, it is likely that the adjustment or corrective measures have been established to address the failure condition.

- The vibration analysis table has been consulted, the steps have been performed by strictly following the instructions, and the vibration problem has been reproduced.
- After compared with known good vehicles of the same model, year and configuration, it is concluded that the problem reported for repair by the customer seems to be a potential operating characteristic of the vehicle.

Noise

Air/Wind Noise

To analyze a reported wind noise condition, test the driving vehicle to determine the origin of the noise.

Drive on normal flat straight road along four directions respectively: north, south, east and west. This area must be of low traffic flow or low environmental noise to eliminate outside interference to test.

Drive the vehicle at the speed that the noise is most noticeable, or until the noise is heard. Maintain safe and legal speeds.

Many of the water leak diagnosis tests are also used for the wind noise diagnosis.

Most wind noise is caused either by leaking seals or by misaligned body surfaces.

You can diagnose the following types of wind noise with the aid of proper Chassis Ear or Leak Detector.

- Wind whistle
- Wind roar
- Wind rush

When moving at highway speeds, air pressure inside the vehicle becomes greater than the air pressure outside. When a leak occurs, the escaping air causes a hiss or a wind whistle.

Wind roar occurs when air passes over or through a gap between the 2 body surfaces. To correct the condition, adjust the alignment to the body panel.

Wind rush occurs when air presses over the vehicle's body, and is related to the aerodynamics of the vehicle. Wind whistle and wind roar are eliminable. Eliminate wind whistle and wind roar before concluding that the wind noise is due to wind rush.

Use the following inspections in order to aid in diagnosing wind whistle or wind roar:

1. Note the details for wind noise:
   - The perceived location of noise
   - The location where the noise is the loudest
   - The time when noise occurs
   - Vehicle Speed
   - The interior fan speed
   - The position of the windows
   - What the noise sounds like
2. Inspect the vehicle for the possible cause of the wind noise.
3. Test drive the vehicle and determine if the wind noise is external or internal.
4. Perform a visual inspection of the following components:
   - Loose fasteners
   - Cracked weatherstrips
   - Broken welding points
   - Neglected sealant and/or adhesive

Squeak and Click

Use proper chassis ear or leak detector for auxiliary diagnosis.

- Attach the component that squeaks or clicks securely.
- Separate the components that squeak or click to prevent contact.
- Insulate the components that squeak or click.
- Insulate uniform friction surfaces to eliminate stick-slip movement.

Soap Suds or Bubble Test

1. Mask off the pressure relief valve.
2. Close all the windows and the doors.
3. Turn the vehicles ventilation fan to the on position, with the selection switch in high-speed and defrost mode.
4. Unlock and close the door.
5. Apply the soap solution to the potential leak areas.
6. Look for bubbles.

Air Pressure Test

1. Mask off both the pressure relief valves.
2. Close all the windows.
3. Turn the vehicles ventilation fan to the on position, with the selection switch in high-speed and defrost mode.
4. Unlock and close the door.
5. Listen for escaping air along the door and the window weatherstrips with a stethoscope.

Tracing Powder or Chalk Test

Clean the weatherstrips and the contact surfaces with cleaning agent.

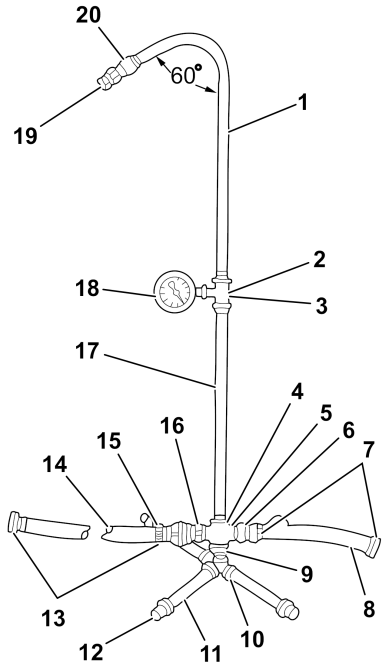
1. Apply powder or chalk in an unbroken line to the contact surface of the weatherstrip surrounding the perimeter of the suspected areas.
2. Close the panel completely without slamming the panel. Closing the panel completely can press the weatherstrip firmly against the mating surface.
3. Inspect the applied line on the weatherstrip. The applied line shall be marred where contact is good. A corresponding imprint is on the mating surface.
4. Gaps or irregularities in the powder or the chalk line on the mating surface indicate the area with a poor seal.

Waterleaks

Water Leak Test Preparation

- This vehicle is designed to operate under normal environmental conditions.
- The design criteria for sealing materials and components takes into consideration the sealing forces required to withstand the natural elements. These specifications cannot take into consideration all artificial conditions, e.g. , high pressure car washes.
- The water leak test procedure has been correlated to the natural elements and will determine the ability of a vehicle to perform under normal operating conditions.
- The first step of water leak test is to determine leakage conditions. If the general leak area can be found, the exact entry point can be isolated using a water hose or an air hose. Some trim panels or components may need to be removed in order to repair the leak.
- If leaks are found around the door, window, trunk lid or liftgate area, this does not necessarily indicate a poor weatherstrip. An adjustment to these areas may resolve the condition.

Water Spray Test Stand Assembly



S0030048

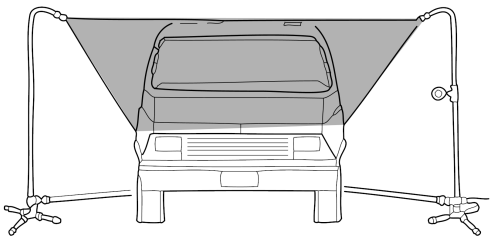
Icon

1. Pipe
2. Reducer Tee Fitting, Right Stand Only
3. Pipe Fitting, Left Stand Only
4. Tee Fitting, Left Stand Only
5. Cross Fitting, Right Stand Only
6. Pipe to Hose Nipple, Right Stand Only
7. Female Hose Coupling
8. Input Hose, Right Stand Only
9. Close Nipple
10. Cross with Weld-On Cap
11. Nipple
12. cover
13. Female Hose Coupling
14. Cross Hose
15. Hose Quick Connect
16. Pipe to Hose Nipple
17. Pipe
18. Water Pressure Gage, Right Stand Only
19. Full Jet Spray Nozzle
20. Pipe Fitting

Preparation Procedure

1. Assemble water spray stands as shown in the figure.
2. Position the stands as shown in the figure.

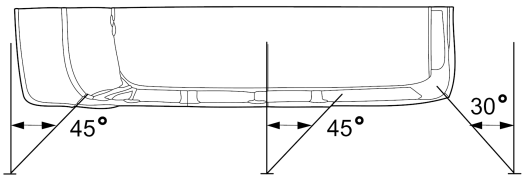
   The water spray from the stands should overlap the vehicle as shown.



S0030049

3. Have an assistant inside of the vehicle during the test in order to locate any leaks.
4. The water pressure at the nozzle should maintain a 155 kPa for at least 4 minutes.
5. In order to check the windscreen, aim the water spray 30 degrees down and 45 degrees toward the rear.

   Aim the water towards the corner of the windshield.



S0030050

6. In order to check the side windows for leaks, position the water spray test stand towards the centre of the rear quarter, aiming the water spray 30 degrees down and 45 degrees toward the rear.
7. In order to check the rear window, aim the water spray 30 degrees down and 30 degrees toward the front.

Dust Leaks

Dust may leak into the vehicle where water will not. This happens particularly in the lower portion of the interior.

Forward motion of the vehicle can create a slight vacuum which pulls air and dust into the vehicle.

In order to determine the location of dust leaks, perform the following steps:

1. Remove the carpet from the floor.
2. Remove the carpet from the running board.
3. Remove the vibration isolator from the floor.
4. Remove the vibration isolator from the running board.
5. Drive the vehicle on a dusty road.
6. Examine the interior.

Dust in the shape of a small cone or slit will usually be found at the point of leakage.

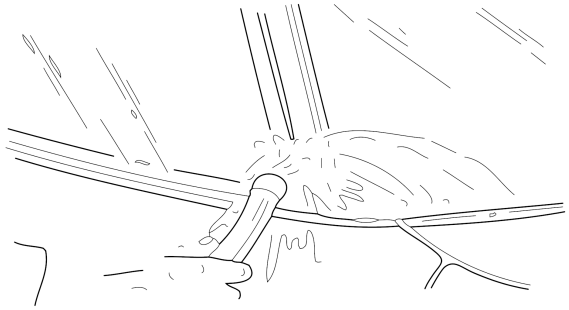
7. Mark the points of leakage.
8. Illuminate the lamps on the underside of the floor and the cowl panel.
9. Have an assistant mark any points inside of the vehicle for any points where the light shines through.

- Inspect the weld joints.
- Inspect the body mounts.

10. Seal any leaks with an air-drying, body-sealing compound.

Water Hose Test

1. Have an assistant inside of the vehicle in order to locate the leak.
2. Begin testing at the base of the window or the windshield.
3. Slowly move the hose upward and across the top of the vehicle.

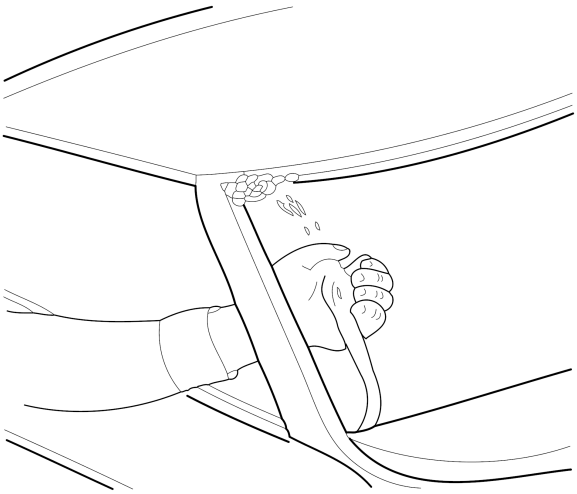


S0030051

Air Hose Test

1. Using a liquid detergent, diluted with water in a spray bottle, spray the window at the edges. Begin at the bottom and gradually move up and across the top.
2. Have an assistant inside of the vehicle with an air hose.
3. Have the assistant aim the compressed air at the suspected areas.

Bubbles will form in the soap solution at the location of the leak.



S0030052

Information on Precautions

General Precautions

Dangerous Substances

Modern vehicles contain many materials or liquids which if not handled with care can be hazardous to both personal health and the environment.

Synthetic Rubber

Many O rings, seals, hoses, flexible pipes and other similar items which appear to be natural rubber, are in fact, made of synthetic materials called Fluoroelastomers. Under normal operating conditions this material is safe and does not present a health hazard. However, if the material is damaged by fire or excessive heating, it can break down and produce highly corrosive Hydrofluoric acid.

Contact with Hydrofluoric acid can cause serious burns on contact with skin. If skin contact does occur:

- Remove any contaminated clothing immediately.
- Irrigate affected area of skin with a copious amount of cold water or limewater for 15 to 60 minutes.
- Obtain medical assistance immediately.

Should any material be in a burnt or overheated condition, handle with extreme caution and wear protective clothing (seamless industrial gloves, protective apron etc.).

Decontaminate and dispose of gloves immediately after use.

Lubricating Fluids

Avoid excessive skin contact with used lubricating oils and always adhere to the health protection precautions.

Health Protection Precautions

The following precautions should be observed at all times:

- Wear protective clothing, including impervious gloves when practicable.
- Avoid prolonged and repeated contact with oils, particularly used engine oils.
- Do not put oily rags in pockets.
- Avoid contaminating clothes (particularly those next to the skin) with oil.
- Overalls must be cleaned regularly. Discard heavily soiled clothing and oil impregnated footwear.
- First aid treatment should be obtained immediately for open cuts and wounds.
- Apply barrier creams before each work period to help prevent lubricating oil from contaminating the skin.
- Wash with soap and water to ensure all oil is removed (proprietary skin cleansers and nail brushes will help).
- Use moisturisers after cleaning; preparations containing lanolin help replace the skin's natural oils which have been removed.
- Do not use petrol/gasoline, kerosene, diesel fuel, oil, thinners or solvents for cleaning skin.
- Where practicable, degrease components prior to handling.
- If skin disorders develop, obtain medical advice without delay.
- Wear eye protection (e.g. goggles or face shield) if there is a risk of eye contamination. Eye wash facilities should be provided in close vicinity to the work area.

Safety Instructions

Jacking

Always use the recommended jacking points.

Always ensure that any lifting apparatus has sufficient load capacity for the weight to be lifted.

Ensure the vehicle is standing on level ground prior to lifting or jacking.

Apply the parking brake and chock the wheels.

Do not leave tools, lifting equipment, spilt oil, etc. around or on the work bench area. Always keep a clean and tidy work area.

Brake Shoes and Pads

Use the correct gear and brake pads. When renewing brake pads and brake shoes, always replace as complete axle sets.

Brake Hydraulic System

Observe the following recommendations when working on the brake system:

- Apply two spanners to loosen or tighten brake pipes or pipe fittings.
- Ensure that hoses run in a natural curve and are not twisted or deformed.
- Fix brake pipes securely with retaining clips and ensure that the pipe cannot contact a potential chafing point.
- Containers used for brake fluid must be kept absolutely clean.
- Do not store brake fluid in an unsealed container, it will absorb water and in this condition would be dangerous to use due to a lowering of its boiling point.
- Do not allow brake fluid to be contaminated with mineral oil, or put new brake fluid in a container which has previously contained mineral oil.
- Do not re-use the brake fluid removed from the system.
- Always use clean brake fluid or a recommended alternative to clean hydraulic components.
- After disconnection of brake pipes and hoses, immediately fit suitable blanking caps or plugs to prevent the ingress of dirt.
- Only use the correct brake fittings with compatible threads.
- Observe absolute cleanliness when working with hydraulic components.

Cooling System Caps and Plugs

Remove expansion tank caps and coolant drain pipe or bleed screws with great care when the engine is hot, especially if it is overheated. To avoid the possibility of scalding, allow the engine to cool before attempting removal.

Environmental Precautions

Overview

This section provides general information which can help to reduce the environmental impacts from the activities carried out in workshops.

Emissions to Air

Many of the activities that are carried out in workshops emit gases and fumes which contribute to global warming, depletion of the ozone layer and/or the formation of photochemical smog at ground level. By considering how the workshop activities are carried out, these gases and fumes can be minimised, thus reducing the impact on the environment.

Exhaust Fumes

Running car engines is an essential part of workshop activities and shall be carried out in a well ventilated environment. However, the amount of time engines are running and the position of the vehicle should be carefully considered at all times, to reduce the release of poisonous gases and minimise the inconvenience to people living nearby.

Solvents

Some of the cleaning agents used are solvent based and will evaporate to atmosphere if used improperly, or if cans are left unsealed. All solvent containers should be firmly closed when not needed and solvent should be used sparingly. Suitable alternative materials may be available to replace some of the commonly used solvents. Similarly, many paints are solvent based and the spray should be minimised to reduce solvent emissions.

Refrigerant

Discharge and replacement of refrigerant from air conditioning units should only be carried out by using the correct equipment.

Engine

Always adhere to the following:

- Don't leave engines running unnecessarily.
- Minimise testing times and check where the exhaust fumes being blown.

Thinners:

- Keep lids on containers of solvents.
- Only use the minimum quantity.
- Consider alternative materials.
- Minimise over-spray when painting.

Gases:

- Use the correct equipment for collecting refrigerants.
- Don't burn rubbish on site.

Discharges to Water

Oil, petrol, solvent, acids, hydraulic oil, antifreeze and other such substances should never be poured down the drain and every precaution must be taken to prevent spillage reaching the drains.

Handling of such materials must take place well away from the drains and preferably in an area with a kerb or wall around it, to prevent discharge into the drain. If a spillage occurs, it should be soaked up immediately. Having a spill kit available will make this easier.

Checklist

Always adhere to the following disposal and spillage prevention instructions.

- Never pour anything down a drain without first checking that it is environmentally safe to do so, and that it does not contravene any local regulations.
- Store liquids in a walled area.
- Make sure that taps on liquid containers are secure and cannot be accidentally turned on.
- Protect bulk storage tanks from vandalism by locking the valves.
- Transfer liquids from one container to another in an area away from open drains.
- Ensure lids are replaced securely on containers.
- Have spill kits available near to points of storage and handling of liquids.

Spill Kits

Special materials are available to absorb a number of different substances. They can be in granular form, ready to use and bought in convenient containers for storage.

Land Contamination

Oils, fuels, solvents, etc. can contaminate any soil that they are allowed to contact. Such materials should never be disposed of by pouring onto soil and every precaution must be taken to prevent spillage reaching soil. Waste materials stored on open ground could also leak, or have polluting substances washed off them that would contaminate the land. Always store these materials in suitable robust containers.

Checklist

Always adhere to the following:

- Don't pour or spill anything onto the soil or bare ground.
- Don't store waste materials on bare ground.

Local Issues

A number of environmental issues will be of particular concern to residents and other neighbors close to the site. The sensitivity of these issues will depend on the proximity of the site and the layout and amount of activity carried on at the site.

Car alarm testing, panel beating, hammering and other such noisy activities should, whenever possible, be carried out indoors with doors and windows shut or as far away from residential area as possible.

Be sensitive to the time of day when these activities are carried out and minimise the time of the noisy operation, particularly in the early morning and late evening.

Another local concern will be the smell from the various materials used. Using less solvent, paint and petrol could help prevent this annoyance.

Local residents and other business users will also be concerned about traffic congestion, noise and exhaust fumes, be sensitive to these concerns and try to minimise inconvenience from deliveries, customers and servicing operations.

Checklist

Always adhere to the following:

- Identify where the neighbors who are likely to be affected are situated.
- Minimise noise, smells and traffic nuisance.
- Prevent waste pollution by disposing of waste in the correct container.
- Have waste containers emptied regularly.

Waste Management

One of the major ways that pollution can be reduced is by the careful handling, storage and disposal of all waste materials that occur on sites. This means that it is necessary to not only know what the waste materials are, but also to have the necessary documentation and to know local regulations that apply.

Handling and Storage of Waste

They should be stored in such a way as to prevent the escape of the material to land, water or air.

They must also be segregated into different types of waste e.g. oil, metals, batteries, used vehicle components. This will prevent any reaction between different materials and assist in disposal.

Disposal of Waste

Disposal of waste materials must only be to waste carriers who are authorized to carry those particular waste materials and have all the necessary documentation. The waste carrier is responsible for ensuring that the waste is taken to the correct disposal sites.

Dispose of waste in accordance with the following guidelines:

- Fuel, hydraulic fluid, anti-freeze and oil: keep separate and dispose of to specialist contractor.
- Refrigerant: collect in specialist equipment and reuse.
- Detergents: safe to pour down the foul drain if diluted.
- Paint, thinners: keep separate and dispose of to specialist contractor.
- Components: send back to supplier for refurbishment, or disassemble and reuse any suitable parts. Dispose of the remainder in ordinary waste.
- Small parts: reuse any suitable parts, dispose of the remainder in ordinary waste.
- Metals: can be sold if kept separate from general waste.
- Tyres: keep separate and dispose of to specialist contractor.
- Packaging: compact as much as possible and dispose of in ordinary waste.
- Asbestos material: keep separate and dispose of to specialist contractor.
- Oily and fuel wastes (e.g. rags, used spill kit material): keep separate and dispose of to specialist contractor.
- Air filters: keep separate and dispose of to specialist contractor.
- Rubber/plastics: dispose of in ordinary waste.
- Water pipes: dispose of in ordinary waste.
- Batteries: keep separate and dispose of to specialist contractor.
- Airbags - explosives: keep separate and dispose of to specialist contractor.
- Electrical components: send back to supplier for refurbishment, or disassemble and reuse any suitable parts. Dispose of the remainder in ordinary waste.
- Catalysts: can be sold if kept separate from general waste.
- Used spill-absorbing material: keep separate and dispose of to specialist contractor.

Fuel Handling Precautions

Overview

Fuel vapour is highly flammable and in confined spaces is also explosive and toxic. The vapour is heavier than air and will always fall to the lowest level. The vapour can be easily distributed throughout a workshop by air currents; consequently, even a small spillage of fuel is potentially very dangerous.

The following information provides basic precautions which must be observed if fuel is to be handled safely. It also outlines other areas of risk which must not be ignored. This information is issued for basic guidance only, if in doubt consult your local Fire Officer.

Always have a fire extinguisher containing FOAM, CO2, GAS or POWDER close at hand when handling or draining fuel or when removing fuel systems. Fire extinguishers should also be located in areas where fuel containers are stored.

Always disconnect the vehicle battery before carrying out removing or draining work on a fuel system.

Whenever fuel is being handled, drained or stored, or when fuel systems are being removed, all forms of ignition must be extinguished or removed; any work lamps must be flameproof and kept clear of spillage.

Fuel Tank Draining

Fuel tank draining should be carried out in accordance with the procedure outlined in the FUEL DELIVERY section of this manual and observing the following precautions.

The capacity of containers must be more than adequate for the amount of fuel to be extracted or drained. The container should be clearly marked with its contents and placed in a safe storage area which meets the requirements of local authority regulations.

Fuel Tank Remove

When the fuel pipe is secured to the fuel tank outlet by a spring steel clip, the clip must be released before the fuel pipe is disconnected or the fuel tank is removed. This procedure will avoid the possibility of fumes in the fuel tank being ignited when the clip is released.

As an added precaution, fuel tanks should have a 'FUEL VAPOUR' warning label attached to them as soon as they are removed from the vehicle.

Fuel Tank Repairs

No attempt should be made to repair a plastic fuel tank. If the structure of the tank is damaged, a new tank must be fitted.

Body Repairs

Plastic fuel pipes are particularly susceptible to heat, even at relatively low temperature, and can be melted by heat conducted from some distance away.

When body repairs involve the use of heat, all fuel pipes which run in the vicinity of the repair area must be removed, and the tank outlet plugged.

Electrical Precautions

Overview

The following guidelines are intended to ensure the safety of the operator while preventing damage to the electrical and electronic components fitted to the vehicle. Where necessary, specific precautions are detailed in the individual procedures of this manual.

Equipment

Prior to commencing any test procedure on the vehicle ensure that the relevant test equipment is working correctly and any harness or connectors are normal. It is particularly important to check the condition of the lead and plugs of mains operated equipment.

Polarity

Never reverse connect the vehicle battery and always ensure the correct polarity when connecting test equipment.

High Voltage Circuits

Whenever disconnecting live HT circuits always use insulated pliers and never allow the open end of the HT lead to contact any components, especially the ECU. Measure voltage of the ignition coil terminal when the engine is running. Special care shall be taken since the terminal may generate high voltage.

Connectors and Harnesses

The engine compartment of a vehicle is a particularly hostile environment for electrical components and connectors:

- Always ensure electrically related items are dry and oil free before disconnecting and connecting test equipment.
- Ensure disconnected multiplugs and sensors are protected from being contaminated with oil, coolant or other solutions. Contamination could impair performance or result in catastrophic failure.
- Never force connectors apart using tools to prise apart or by pulling on the wiring harness.
- Always ensure locking mechanism is disengaged before disconnection, and match orientation to enable correct reconnection.
- Ensure that any protection (covers, insulation etc.) is normal and replaced if damaged.

Having confirmed a component to be faulty:

- Turn off the start switch, and disconnect the negative battery cable.
- Remove the component and support the disconnected harness.
- When replacing the component keep oily hands away from electrical connection areas and push connectors home until any locking tabs fully engage.

Battery Disconnection

Before disconnecting the battery, disable the alarm system and switch off all electrical equipment.

Battery Charging

Always ensure any battery charging area is well ventilated and that every precaution is taken to avoid naked flames and sparks.

Disciplines

Turn off the ignition system prior to making any connection or disconnection in the system to prevent electrical surges caused by disconnecting 'live' connections damaging electronic components.

Ensure hands and work surfaces are clean and free of grease, swarf, etc. Grease collects dirt which can cause electric leakage (shortcircuits) or open circuit.

Connectors should never be subjected to forced removal or installation, especially internal connectors. Damaged circuits can cause short-circuit and open-circuit fault conditions.

Prior to commencing test, and periodically during a test, touch a good vehicle body to discharge static electricity. Some electronic components are vulnerable to the static electricity that may be generated by the operator.

When handling printed circuit boards, treat with care and hold by the edges only; note that some electronic components are susceptible to body static.

Electrical Connectors Lubrication

In order to prevent corrosion, some connectors under bonnet and vehicle body is wiped special lubricant in factory. If these are destroyed in maintaining, repair and replacing process, special lubricant should be newly wiped.

Supplementary Restraint System Precautions

General Precautions

The SRS system contains components which could be potentially hazardous to the service engineer if not serviced and handled correctly. The following guidelines are intended to alert the service engineer to potential sources of danger and emphasise the importance of ensuring the integrity of SRS components fitted to the vehicle.

It should be noted that these precautions are not restricted to operations performed when servicing the SRS system, the same care must be exercised when working on ancillary systems and components located in the vicinity of the SRS components;

Making the System Safe

Before working on, or in the vicinity of SRS components, ensure the system is rendered safe by performing the following procedures:

- Remove the key from the start switch.
- Disconnect the negative battery terminal first, and then the positive.
- Wait 10 minutes for SRS ECU back-up power circuit to discharge.

The SRS system uses energy reserve capacitors to keep the system active in the event of electrical supply failure under crash conditions. It is necessary to allow the capacitor sufficient time to discharge (at least 10 minutes) in order to avoid the risk of accidental deployment.

Refit

In order to ensure system integrity, it is essential that the SRS system is regularly checked and maintained so that it is ready for effective operation in the event of a collision. Carefully inspect SRS components before installation. Do not fit a part that shows signs of being dropped or improperly handled, such as dents, cracks or deformation.

Ensure the following precautions are always adhered to:

- Never fit used SRS components from another vehicle or attempt to repair an SRS component.
- Never use the SRS components without a clear identification label.
- Never use an airbag or SRS ECU that has been dropped.
- When repairing an SRS system only use genuine new parts.
- Never apply electrical power to an SRS component unless instructed to do so as part of an approved test procedure.
- Ensure the screws are tightened to the correct torque. Always use new fasteners when replacing SRS components.
- Ensure the SRS ECU is always fitted correctly. There must not be any gap between the SRS ECU and the bracket to which it is mounted. An incorrectly mounted SRS ECU could cause the system to malfunction.
- Do not supply power to the SRS ECU before all SRS components are connected.

SRS Component Test Precautions

The SRS components are triggered using relatively low operating currents, always adhere to the following precautions:

Handling and Storage

Always comply with the following handling precautions:

SRS Harnesses and Connectors

Always observe the following precautions with regards to SRS system harnesses:

- Never attempt to modify, splice or repair SRS harnesses.
- Never fit extra electronic equipment (such as a mobile telephone, two-way radio or in-car entertainment system) in such a way that it could generate electromagnetic interference in the airbag circuit. Seek specialist advice when fitting such equipment.

Precautions for Vehicle Owners

For the airbag to work effectively and protect vehicle owners, follow the precautions listed below.

Driver and passengers must use seat belts correctly. Correctly using the seat belts can protect the body and reduce injuries in the event of an accident.

Never fit any accessory that obstructs or impairs the operation of the seat belt pre-tensioners or airbags.

Do not place any object on the steering wheel or instrument panel that could penetrate an inflating airbag or be a thrown item likely to cause injury.

Never fit cover on seat which fitting side airbag.

Children under 12 years old should not sit in the front seat.

Only genuine accessory parts are allowed to be fitted.

Only authorised people can remove airbag modules, SRS ECU, SRS system harnesses and connectors.

If the airbag and seat belt pre-tensioner are deployed during an accident, SRS ECU must be replaced and discarded.

Every SRS system on every car has been paired and identified, illegally adding or modifying the SRS system and the wiring harness could injure people.

Modifying the vehicle structure or SRS system is strictly not allowed and may cause wrong airbag deployment or failure to deploy when required.

Rotary Coupler Precautions

Observe the following precautions:

- Do not unlock and rotate the rotary coupler when it is removed from the vehicle.
- Do not turn the wheels when the rotary coupler is removed from the vehicle.
- Always ensure the rotary coupler is removed and fitted in its centre position and with the front wheels in the straight ahead position - refer to the SRS repair section for the correct removal and installation procedure.
- If a new rotary coupler is being fitted, ensure the locking tab holding the coupler's rotational position is not broken; units with a broken locking tab should not be used.

Roadside Assistance

Traction - SRS Component Non-deployment

Normal towing procedures are unlikely to cause an airbag to deploy. However, as preventive measures, the start switch shall be turned off and the positive and negative poles of the battery shall be disconnected. Disconnect the negative '-' lead first.

Traction - SRS Component Deployment

Once the driver's airbag has been deployed, the vehicle must have a suspended tow. However, as preventive measures, the start switch shall be turned off and the positive and negative poles of the battery shall be disconnected. Disconnect the negative '-' lead first.

SRS Components Deployed

If a vehicle is to be scrapped and contains an undeployed airbag module, the module must be manually deployed.

Always observe the following precautions:

Air Conditioning System Precautions

Overview

The air conditioning system contains fluids and components which could be potentially hazardous to the service engineer or the environment if not serviced and handled correctly. The following guidelines are intended to alert the service engineer to potential sources of danger and emphasise the importance of ensuring the integrity of the air conditioning operating conditions and components fitted to the vehicle.

Where necessary, additional specific precautions are detailed in the relevant sections of this Manual which should be referred to prior to commencing repair operations.

The refrigerant used in the air conditioning system is HFC-134a (Hydrofluorocarbon) R134a.

Remedial Actions

If an accident involving R134a should occur, conduct the following remedial actions:

- If liquid R134a enters the eye, do not rub it. Gently run large quantities of eye wash over affected eye to raise the temperature. If an eye wash is not available, cool clean water may be used to flush the eye. After rinsing, cover the eye with a clean pad and seek immediate medical attention.
- If liquid R134a is splashed onto the skin, run large quantities of water over the affected area to raise the temperature. Implement the same action if the skin comes in contact with discharging cylinders. Wrap the contaminated body parts in blankets (or similar materials) and seek immediate medical attention.
- If the debilitating effects of inhalation of R134a vapour is suspected, seek fresh air. If the affected person is unconscious, move them away from the contaminated area to fresh air and apply artificial respiration and/or oxygen and seek immediate medical attention.

Service Precautions

Observe the following precautions when handling components used in the air conditioning system:

- Air conditioning units must not be lifted by their hoses, pipes or capillary lines.
- Hoses and lines must not be subjected to any twist or stress; the efficiency of the system will be impaired by kinks or restrictions. Ensure that hoses are correctly positioned before tightening couplings, and ensure that all clips and supports are utilised.
- Flexible hoses should not be positioned close to the exhaust manifold (no less than 100 mm) unless protected by heat shielding.
- Completed assemblies must be checked for refrigeration lines touching metal panels. Any direct contact of components and panels may transmit noise and so must be eliminated.
- The appropriate torque wrench must be used when tightening refrigerant connections to the stipulated value. An additional spanner must be used to hold the union to prevent twisting of the pipe when tightening connections.
- Before connecting any hose or pipe, ensure that refrigerant oil is applied to the seat of the new O-rings, BUT NOT to the threads of the connection.
- All air conditioning system components must be stored under seal until immediately prior to connection.
- Ensure components are at room temperature before uncapping, to prevent condensation of moisture from the air that enters it.
- Components must not remain uncapped for longer than 15 minutes. In the event of a delay, the sealing component must be fitted.
- When disconnecting, immediately cap all air conditioning pipes to prevent ingress of dirt and moisture into the system.
- The receiver/drier contains desiccant which absorbs moisture. It must be positively sealed at all times. A receiver/drier that has been left uncapped must not be used, and fit a new unit.
- The receiver/drier should be the last component connected to the system to ensure optimum dehydration and maximum moisture protection of the system.
- Whenever the refrigerant system is opened, the desiccant must be renewed immediately before refilling the refrigerant.
- Use alcohol and a clean lint-free cloth to clean dirty connections.
- Ensure that all new parts fitted are marked for use with R134a.

Refrigerant Oil

Refrigerant oil easily absorbs water and must not be stored for long periods. Do not pour unused refrigerant oil back into the container. Always use an approved refrigerant oil.

When replacing components in the A/C system, drain the refrigerant oil from the component being replaced into a graduated container. On assembly, add the quantity of lubricating oil drained to the new component.

Compressor

A new compressor is sealed and pressurized with Nitrogen gas. When fitting a new compressor, slowly release the sealing cap; gas pressure should be heard to vent as the seal is broken.

Rapid Refrigerant Discharge

If the air conditioning system is involved in accident damage and the system is punctured, the refrigerant will discharge

rapidly. The rapid discharge of refrigerant will also result in the loss of most of the oil from the system. While removing the compressor, drain the remaining oil, and service as instructed in the air conditioning section of this manual.

Precautions for Refrigerant Recovery, Recycling and Recharging

When the air conditioning system is recharged, any existing refrigerant is first recovered from the system and recycled. The system is then charged with the required weight of refrigerant and volume of refrigerant oil.

Precautions for High Voltage

Basic Requirements

Attention: Do not operate or unplug MSD unless necessary. If there is a working condition, please first turn off the high-voltage power of the entire vehicle, and then disconnect the 12V low-voltage battery and the negative cable of the 12V low-voltage redundant battery. The vehicle should be left standing for more than 3 minutes before disconnecting the MSD. If you need to perform the MSD recovery action, you must wait for more than 1 minute. Do not quickly and frequently plug and unplug MSD, otherwise it may cause the high-voltage battery pack to malfunction.

Basic requirements for related precautions for high voltage in vehicle are as follows:

- Non-related personnel are forbidden to come into contact with the vehicle during vehicle repair.
- Do not touch the components with the high-voltage warning sign at will.
- If it is necessary to dismantle the relevant high voltage components, the dismantling personnel need to undergo high voltage safety training.
- When operating high voltage components, the operator must wear protective equipment as well as insulating gloves.
- When operating exposed high voltage system components, the operator must use a multimeter to measure if there is high voltage, and don't do anything before making sure that there is no high voltage.
- When the driving is over, turn off the start switch. If there is a need to disassemble the high voltage system, wait for 5 minutes before proceeding.
- When disassembling or assembling electrical components, the 12V power supply and the MSD on the high-voltage battery pack must be disconnected.
- After removing the high voltage components, it is necessary to check the assembling and connection of all high voltage components and ensure their reliability before reconnecting the high voltage power supply.
- All high voltage components should be grounded well.

Warning : Make sure the maintenance personnel of the high-voltage system have the special operation permit of electrician produced by the safety supervision bureau.

Warning : It is forbidden for maintenance personnel who have not participated in the knowledge training of high voltage system of this model to dismantle the high voltage system (including high-voltage battery pack, drive motor, PEB, high voltage harness, electric A/C compressor, on-board charger, charging port and AC charging cable).

Warning : Prior to opening any high voltage circuits the systems MUST be checked using a suitable multi meter to ensure they carry no high voltage current. Where there is need to work with the high voltage system is essential that the correct 'make safe' procedure is followed - see Manual Service Disconnect procedure in the Service Repair manual. After disconnecting the Manual Service Disconnect (MSD), always wait 5 minutes prior to commencing any checks for residual voltage etc.

Caution : In the process of installation and dismantling, brake fluid, washer fluid, coolant and other liquids shall be prevented from entering or splashing onto high voltage components.

Insulation protective equipment

Insulation protective equipment must comply with national standards.

- Electric insulating shoes must meet the national standard GB12011-2009 General technology Conditions for Electric Insulating Shoes.
- Electric insulating gloves must meet the national standard GB17622-2008 General technology conditions of insulating gloves for live working.

High voltage discharge

- When the power system can be shut down normally, the high-voltage output can be disconnected by first shutting down the power system, then disconnecting the 12V low-voltage battery and the negative cable of the 12V low-voltage redundant battery, and then disconnecting the manual maintenance switch.
- In an emergency, the high-voltage output can be disconnected by disconnecting the negative cable of the 12V low-voltage battery and the 12V low-voltage redundant battery, and then disconnecting the manual maintenance switch.