Manuales Tecnicos Automotrices

CHERY arauca 1.3L

REPARACIÓN Y SERVICIO

en Inglés

Motor - Caja de Velocidad - Frenos
Suspensión Dirección - Aire Acondicionado, Etc.
Contiene Diagramas Eléctricos


JARAGUA2012
INVERTIR EN CONOCIMIENTOS PRODUCE
SIEMPRE LOS MEJORES BENEFICIOS

Maintenance Manual of Chery A113

(Body Accessories & Dimensions)

Chery Automobile Sales Co., Ltd

CONTENT

Chapter I Front Hood & Trunk

I. Removal and Installation of Front Hood

1. Preparations

Tools: Flat head/cross head screwdriver, socket wrench, snipe nose pliers

2. Notes

2.1. During removal and installation, be particularly careful to apply proper strength and no abrupt or violent operation is allowed.

2.2. During removal and installation of the trims, be particularly careful to avoid surface scratch of them.

3. Removal and Installation of Front Hood Accessories

3.1. Removal Steps

3.1.1. Pull off the detergent hose.

3.1.2. Press down the water nozzle clip from under the front hood, and then push it up while removing the noozle outward.

3.2. Installation Steps

The installation steps are reverse to those for removal.

4. Removal & Adjustment of of Front Hood Assembly

Preparation of Tools: 13# sleeve, wheel wrench and extension bar
4.1. Turn and remove the four adjusting bolts off the front hood, and then the front hood can be taken down. And the positing of the front hood can be adjusted in all directions by loosening the four adjusting bolts.

4.2. Installation of Front Hood Assembly:
The installation steps are reverse to those for removal.
Installation torque is 29±3Nm

5. Removal and Installation of Air Inlet Grid Assembly

5.1. Removal Steps

5.1.1. Use the wrench to remove the four fastening screws on the Air Inlet Grid assembly as shown in the picture.

5.1.2. Remove the Air Inlet Grid.

5.2. Installation Steps

The installation steps are reverse to those for removal.
Installation torque is 5±0.5Nm

6. Removal of Front Hood Lock

6.1. Removal Steps

6.1.1. Turn and remove two screws off the front hood to take down its lock.

6.1.2. Remove the front hood lock cable off the front hood lock assembly.

6.2. Installation Steps

The installation steps are reverse to those for removal.

7. Removal & Adjustment of of Hood Cable

7.1. Removal & Adjustment of Steps

7.1.1. Remove the plastic nut behind the front hood handle in driver's cab.And you can also regulate the cable by adjusting this nut.

7.1.2. Use snipe nose pliers to remove the front hood cable off the pull cover.

7.1.3. Drag out the cable.

7.2. Installation Steps

The installation steps are reverse to those for removal.

II. Removal of Rear Trunk Cover

1. Preparations

Tools: flat head screwdriver, 13# sleeve, wrench and cross head screwdriver
Material(s): Clip

2. Removal of Rear Decoration Plate

2.1. Pry up the rear decoration plate with a flat head screwdriver before you take it apart.

2.2. Installation of Rear Decoration Plate
The installation steps are reverse to those for removal.

3. Removal and Installation of Trunk Lock

3.1. Removal Steps

3.1.1. Remove the pull rod off the upper lock.

3.1.2. Pull off the connector on top of the upper lock.

3.1.3. Use a cross head screwdriver to remove the three screws on the upper lock.

3.1.4. Remove the trunk lock.

3.2. Installation Steps

The installation steps are reverse to those for removal.
Installation notes: Is the lock column deformed? Is the riveting adequate? Is the lock jacket on the trunk in good condition? Or can the lock tongue open and shut freely?

4. Removal of Trunk Lock Cylinder

4.1. Removal Steps

4.1.1. Disengage the hitch bar from the lock core.

4.1.2. Pry open the clip on the lock core with a flat head screwdriver.

4.1.3. Push up the lock core to take it out.
Note: Do not throw away the washer of the lock core.

4.2. Installation Steps

The installation steps are reverse to those for removal.
Pay attention to assemble it to its correct position and joint to door plate work.

5. Removal of Rear Wiper Nozzle

5.1. Removal Steps

5.1.1. Pry open the shield of the high mount ceiling light with a flat head screwdriver.

5.1.2. Pull off the connector, and then use a cross head screwdriver to remove the two screws on the high mount ceiling light and take it down.

5.1.3. Remove the two nuts on the spoiler with 10# sleeve.

5.1.4. Remove the spoiler.

5.1.5. Pull off the rear water nozzle (You can pry with a flat head screwdriver, but try to avoid any paint scratch), and then pull off the water nozzle hose.

5.2. Installation Steps

The installation steps are reverse to those for removal.
Note: Water injection opening should be opposite to wiper motor steering shaft.

6. Removal of Rear Wiper Motor

6.1. Removal Steps

6.1.1. Remove the rear wiper shield by hand.

6.1.2. Use a 10# sleeve wrench to loosen off the nut above the motor, and remove the rear wiper blade.
Installation torque is 12±2Nm

6.1.3. Remove the three fixing bolts on the rear wiper motor.
Installation torque is 12±2Nm

6.1.4. Remove the motor.

6.2. Installation Steps

The installation steps are reverse to those for removal.

Chapter II Removal of Trims

I. Removal and Installation of Seat belts

1. Preparations

Tools: flat head screwdriver, wrench, sleeve wrench
Spare parts: disposable clip

2. Notes

Keep the seat belts clean and free of oil, and check them for any damage.

3. Removal Steps (Take Driver's Seat belt as an Example)

3.1. Carefully pry up the front sill plate with a flat head screwdriver.

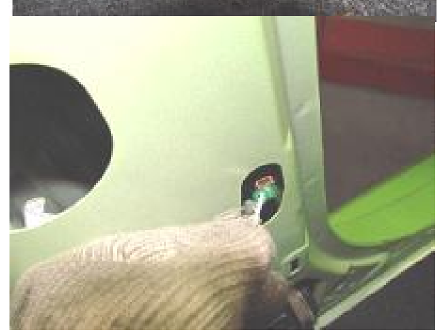
3.2. Remove the front door weather strip by hand.

3.3. Remove the B-pillar plate with a flat head screwdriver.

3.4. Remove the decorative covers at the upper and lower ends of the seat belt with a flat head screwdriver.

3.5. Use a 17# wrench to loosen the upper and lower fastening nuts before you remove the seat belt.
Installation Torque: 50±5Nm

3.6. Pull off the seat belt warning light connector by hand.



3.7. Use a cross head screwdriver to remove the pre-tension belt assembly.

4. Installation Steps

The installation steps are reverse to those for removal.
Note:
4.1. Keep the seat belt clean and free of oil, and check it for any damage.
4.2. The pillar shield should fit securely with the vehicle body without any looseness, and it should also fit well with the vehicle ceiling and weather strip s.
4.3. The seat belt adjusting slide baffle of the upper B-pillar shield should be able to move freely and won't affect the adjustment of the seat belt, and its fitting clearance with the lower shield should be consistent and less than 1mm;
4.4. The fitting clearance between the lower B-pillar shield and the front/rear sill plate should be consistent and less than 1mm;

II. Removal and Installation of Seats

Preparation of Tools: sleeve wrench

1. Removal of Front Seats

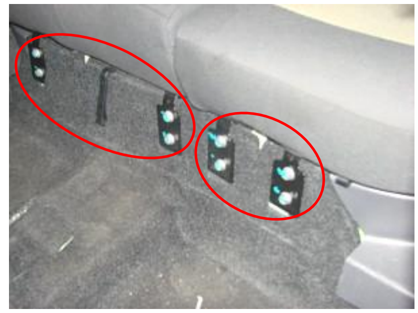
1.1. Move the seat by pulling at the movable handle below it, and when the fixing bolts are shown, use a 13# socket wrench to remove the bolts in the seat.
Torque: 25±3Nm

1.2. Pull off the seat connector and raise the seat.

2. Removal of Rear Seats

2.1. Use a 13# socket wrench to remove the fixing bolts in the rear seat cushion.
Torque: 25±3Nm

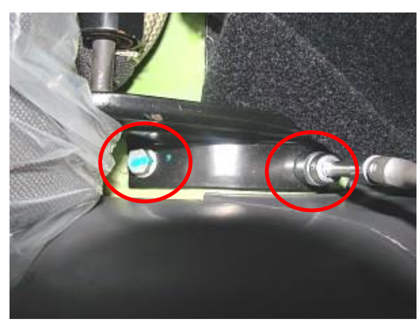
2.2. There are two rear seat cushions, a left one and a right one, secured by four bolts respectively.
Torque: 25±3Nm



2.3. The cushion can be dismounted when the four fixing bolts are removed.

2.4. Pull up the pull button in the rear seat and the seat back can be released forward (Take the left-rear seat as an example).

2.5. Use a 13# socket wrench to loosen off the two fixing bolts below the seat back (Take the left-rear seat as an example).
Torque: 25±3Nm



2.6. Open the trunk and take out the trunk vehicle carpet.

2.7. Loosen off the fixing seat of the spare tire and take it out.

2.8. Use a 13# socket wrench to loosen off the fixing bolts in the rear seat back, and then the rear seat back can be removed.
Torque: 25±3Nm

3. Installation Steps

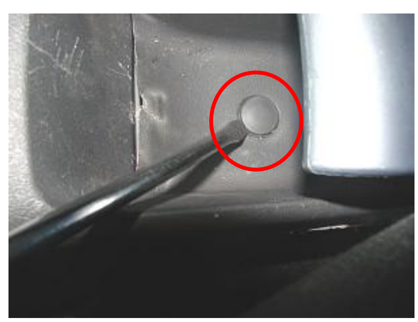
The installation steps are reverse to those for removal.

III. Removal and Installation of auxiliary Instrument Panel

Preparation of Tools: cross head screwdriver, flat head screwdriver

1. Removal Steps

1.1. Use a flat head screwdriver to pry open the shield at the hand brake and gears.



2.6. Open the trunk and take out the trunk vehiclepet.

2.7. Loosen off the fixing seat of the spare tire and take it out.

2.8. Use a 13# socket wrench to loosen off the fixing bolts in the rear seat back, and then the rear seat back can be removed.
Torque: 25±3Nm

3. Installation Steps

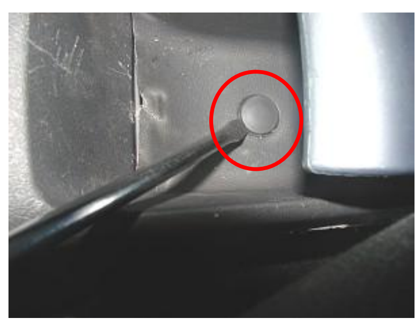
The installation steps are reverse to those for removal.

III. Removal of auxiliary Instrument Panel

Preparation of Tools: cross head screwdriver, flat head screwdriver

1. Removal Steps

1.1. Use a flat head screwdriver to pry open the shield at the hand brake and gears.



1.2. Use a cross head screwdriver to loosen off the fixing screws of the shield

1.3. Use a flat head screwdriver to pry open the shield at the hand brake and gears.
Note: Please pry carefully.

1.4. Use a cross head screwdriver to remove the two fixing screws below the shield.

1.5. Take out the gear selector shield upward by hand (The shield and the auxiliary Instrument Panel are fixed with clips and no fixing screws are used).

1.6. Use a cross head screwdriver to remove the front fixing screws of the auxiliary Instrument Panel (One on the left and the other one the right).

1.7. Use a cross head screwdriver to remove the rear fixing screws of the auxiliary Instrument Panel (One on the left and the other one the right), and then the suxiliary Instrument Panel can be dismounted.

2. Installation Steps

The installation steps are reverse to those for removal.

IV. Removal and Installation of Vehicle Carpet

Tools: flat head screwdriver, cross head screwdriver; sleeve wrench

1. Removal Steps

1.1. Dismount the seats. (See Removal of Seat)
1.2. Disassemble the auxiliary Instrument Panel (See Removal of auxiliary Instrument Panel)
1.3. Remove the seat belt shield. (See Removal of Seat belt)
1.4. Remove the front/rear sill plates, B pillar and the lower shield.

1.5. Use a flat head screwdriver to pry up the top cover of footrest plate.

1.6. Use a 10# wrench to remove the footrest plate covers
Installation Torque: 7±1N.m

1.7. Remove the rear seat cushion (See Removal of Seats)
Use a cross head screwdriver to remove the left shield of the rear seat cushion.

1.8. Take down the vehicle vehicle carpet by hand.

2. Installation Steps

2.1. Put the vehicle vehicle carpet inside the vehicle, and take out the harness connected with the seats, and then press the vehicle vehicle carpet besideds the middle passage tightly.

2.2. Keep the seat holes visible.

2.3. Spread the vehicle vehicle carpet till it gets to the footrest plate and press it tightly.

2.4. Spread the left-rear part of the vehicle vehicle carpet according to the shape of the vehicle floor, keep the installation holes of the left-rear seats visible, and spread and press the rear part of the vehicle vehicle carpet according to the shape of the vehicle floor.

V. Removal of Damping Mat

1. Removal Steps

1.1. Remove the vehicle vehicle carpet (See Removal of Vehicle Vehicle carpet).

1.2. Take down each damping mat.

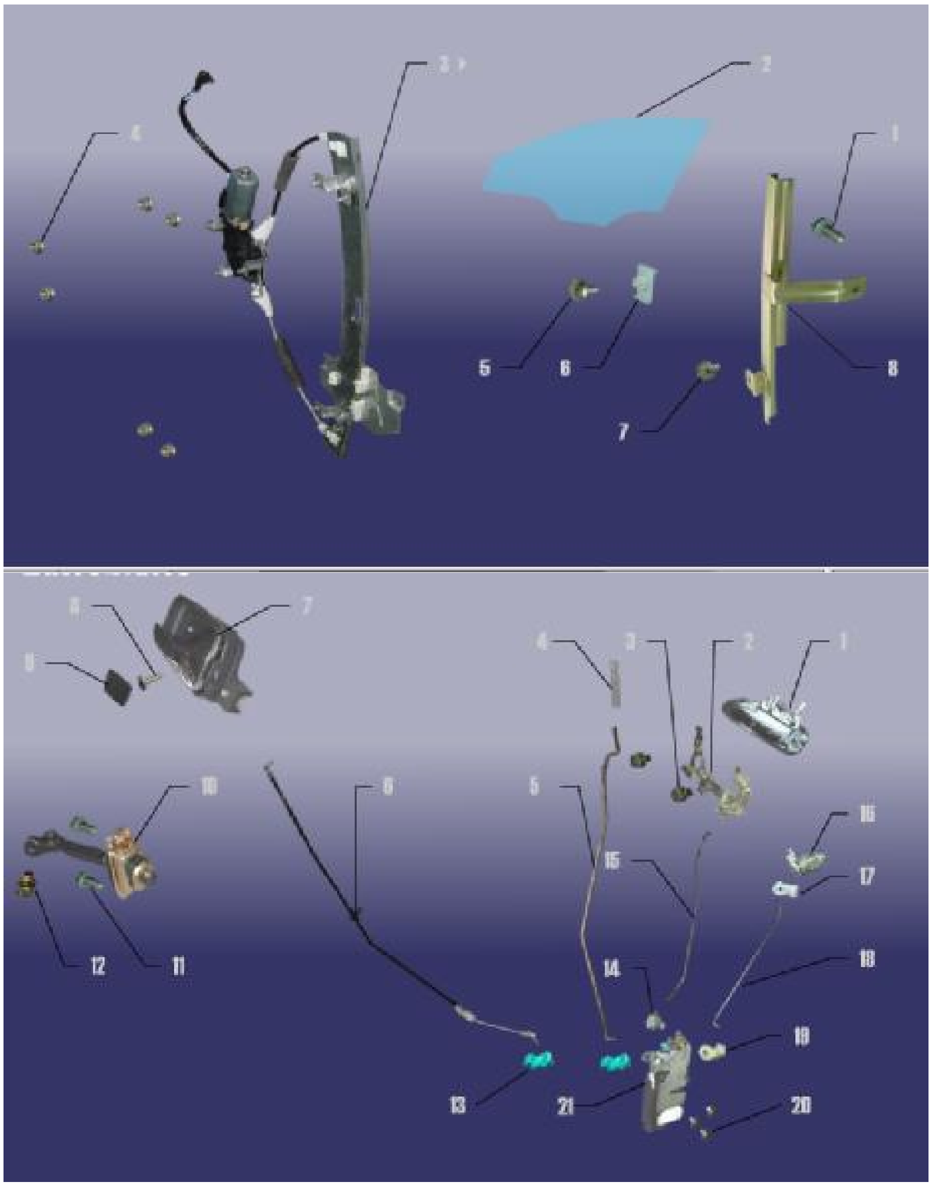
2. Installation Steps

2.1. The installation steps are reverse to those for removal.
2.2. Notes: When installing, sort out the harness, and at the same time the damping mat should fit well with the vehicle body plate work.

Chapter III Removal & Maintenance of Vehicle Doors

I. Removal, Installation & Maintenance of Front Doors

1. System Constitution Diagram



2. Preparations

Tools: flat head screwdriver, cross head screwdriver, 10#, 13# sleeve, wrench and pliers.

3. Notes

3.1. Please wear necessary labour protection supplies to avoid any accident.
3.2. Disconnect the battery to avoid damaging the eletrical equipment.
3.3 Use the correct method to disassemble and assemble the glass to avoid damage.

4. Removal Steps

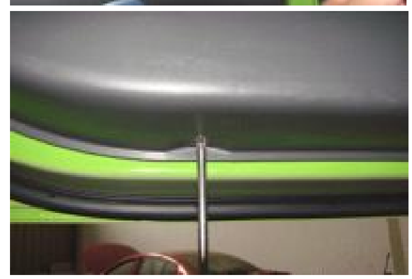
4.1. Remove the left-front vehicle door weather strip. The fixing clip of the vehicle door weather strip are “-” shaped, and when disassembling it, press the weather strip downward, and then push the weather strip to one side till you can see part of the clip. And go on to push it to the opposite direction to show another part of it. Don’t pull the weather strip vertically so as not to damage the weather strip.

4.2. Use a flat head screwdriver to pry up the plastic decorative block fixing the rearview mirror outside the vehicle door.

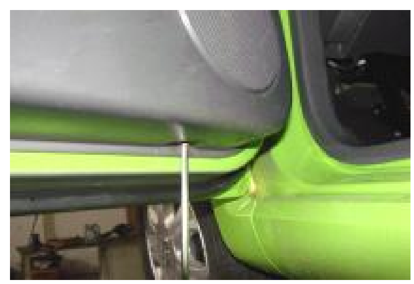
4.3. Use a 10# sleeve wrench to loosen off the two screws fixing the outside rearview mirror.

4.4. Pull off the electrically-adjustable outside rearview mirror harness connector and take off the outside rearview mirror assembly.

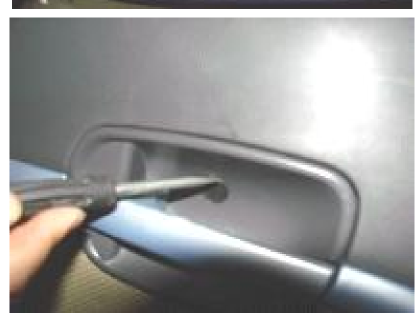
4.5. Use a cross head screwdriver to loosen off the four screws that fix the shield inside the door.



4.6. Use a cross head screwdriver to loosen off the screw that fixes the handle inside the vehicle door.



4.7. Use a flat head screwdriver to pry off the plastic cover of the screw hole for the handle inside the vehicle door, and then remove the fixing screw with a cross head screwdriver so as to disassemble the lock assembly inside the door.



4.8. Pull of the vehicle alarm connector.

4.9. Remove the shield inside the door.

4.10. Pull off the power window up-down switch connector.

4.11. Use a cross head screwdriver to loosen off the two screws of the front door handle fixing mount.

4.11. Tear off the anti-water plastic sheeting on the left-front door.

4.12. Connect the battery and plug in the window up-down switch plug, lower the window glass to a proper position and loosen off the two screws that fix the glass.

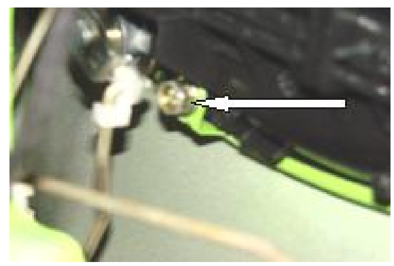
4.13. Take out the glass carefully.

4.14. Use a 10# sleeve to loosen off the five screws that fix the window glass up-down regulator.

4.15. Loosen off the screws, and then pull off the window glass up-down motor connector to take out the window glass up-down regulator assembly.

4.16. Use a 10# sleeve wrench to loosen off the two fixing screws and remove the lock outside the door.

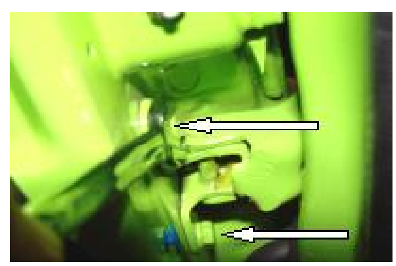
4.17. Use a cross head screwdriver to loosen off the three screws fixing the lock core and remove it.

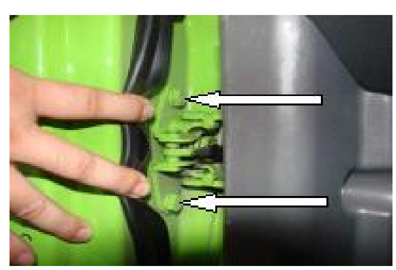


4.18. Use a 13# sleeve wrench to loosen off the four fixing screws at the hinge that fixes the vehicle door, and then the vehicle door can be disassembled.

5. Installation Steps

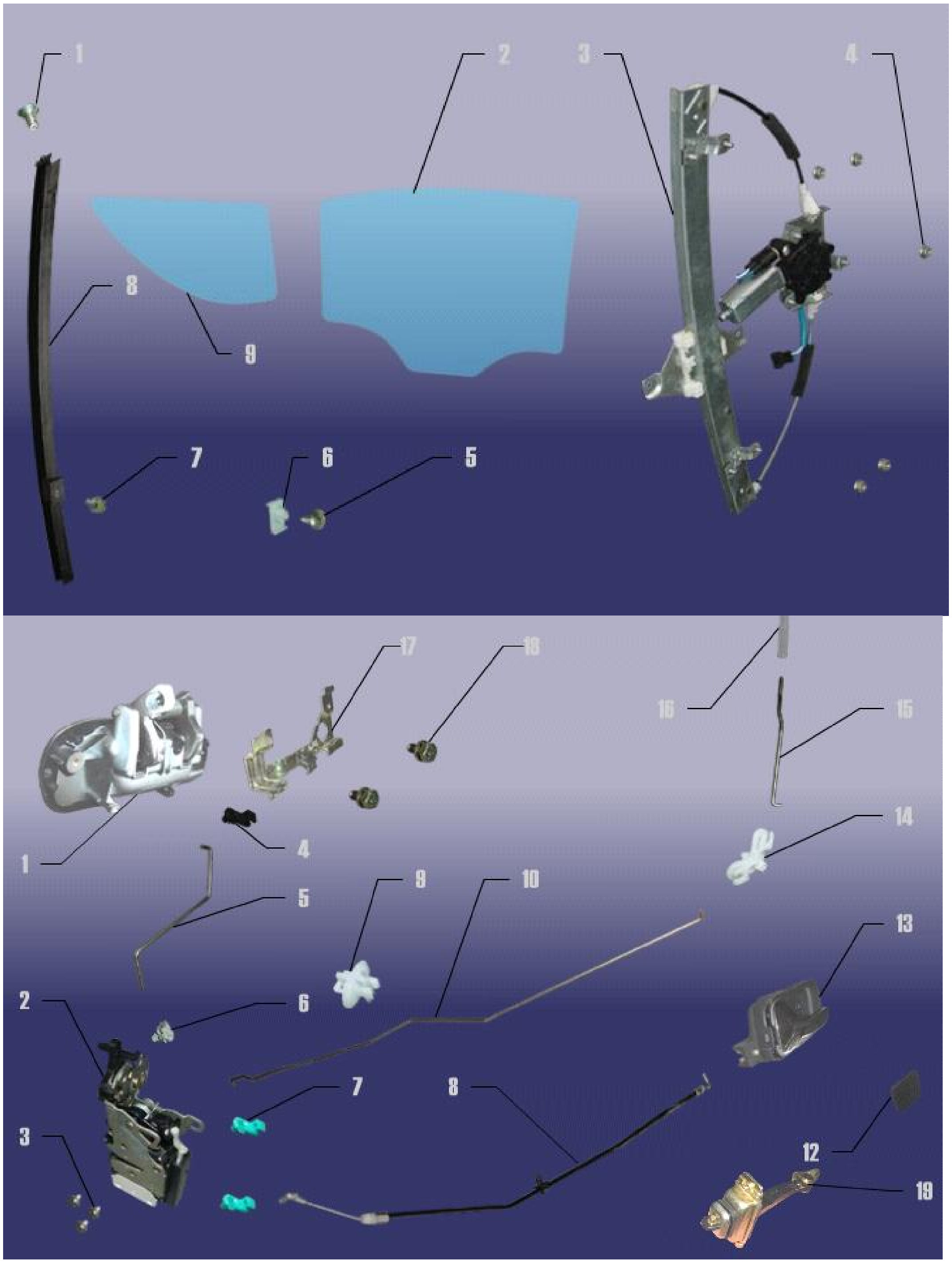
The installation steps are reverse to those for removal.
Note: The removal steps for the right-front door are the same as those for the left-front door.





II. Removal & Installation of Rear Doors

1. System Constitution Diagram



2. Preparations

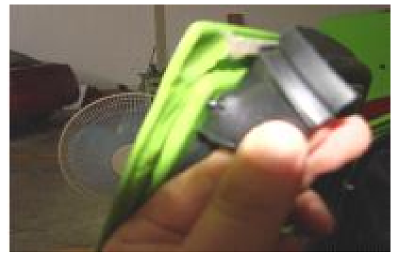
Tools: flat head screwdriver, cross head screwdriver, and 10# / 13# sleeve, wrench.

3. Notes

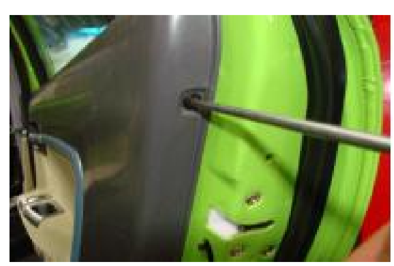
3.1. Please wear necessary labor protection supplies to avoid accidents.
3.2. Disconnect the battery so as to avoid damaging the eletrical equipment.
3.3. Take correct steps during removal and installation of glass to avoid any damage.

4. Removal Steps

4.1. Disassemble the right-rear door weather strip. The fixing clip of the vehicle door weather strip are “-” shaped, and when disassembling it, press the weather strip downward, and then push the weather strip to one side till you can see part of the clip. And go on to push it to the opposite direction till another corner of it is exposed. Don’t pull the weather strip vertically so as not to damage the weather strip.



4.2. Use a cross head screwdriver to loosen off the four screws that fix the shield inside the door.

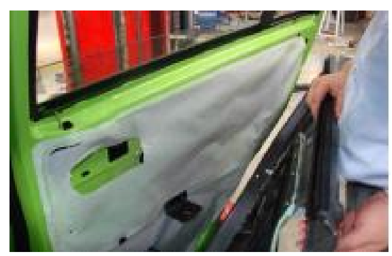


4.3. Use a flat head screwdriver to pry off the plastic cover of the screws that fix the handle inside the vehicle door.

4.4. Use a cross head screwdriver to loosen off the screws that secure the handle inside the door, and then disassemble it.

4.5. Use a cross head screwdriver to loosen off the screws that secure the handle inside the vehicle door, and then disassemble the handle inside the door.

4.6. Disassemble the shield inside the door by hand.



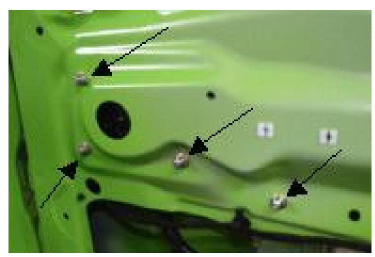
4.7. Pull off the power window up-down switch connector.

4.8. Use a cross head screwdriver to remove the two fixing screws in the mount that fixes the rear door handle cover.

4.9. Tear off the anti-water plastic sheeting on the rear door.

4.10. Connect the battery, lower the window glass to a proper position and loosen off the two screws that fix the glass, and then carefully diassemble the glass.

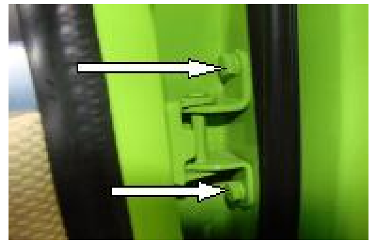
4.11. Use a 10# wrench to loosen off the five screws that fix the window up-down regulator and remove it.

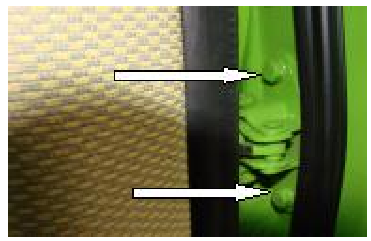


4.12. Use a 10# sleeve wrench to loosen off the screw that fix the handle outside the rear door and then remove it.

4.13. Use a cross head screwdriver to loosen off the three screws that fix the rear door lock core and then remove it.

4.14. Use a 13# sleeve wrench to loosen off the four screws (at the hinge) that fix the right-rear vehicle door and then remove it.





5. Installation Steps

The installation steps are reverse to those for removal.
Note: Removal of the left-rear door is similar to that of the right-rear door.

Chapter IV Removal, Installation & Maintenance of Front/Rear Bumper

I. Removal, Installation & Maintenance of Front Bumper

1. Preparations

Tools: 8# wrench, 8#sleeve, cross head screwdriver, flat head screwdriver
Spare parts: disposable clips

2. Notes

2.1. Please wear necessary labor protection supplies to avoid accidents.
2.2. Try to avoid scratching the painted surface of the bumper during the removal operation.
2.3. For removal in colder environment, operate gently to avoid damaging the bumper.

3. Removal Steps

(Take the left side as an example)
3.1 Open the Front Hood.
3.2 Remove the headlights. (See Removal and Installation of Headlights)
3.3 Use a cross head screwdriver to loosen off the four screws on the grid fence.

3.4. Use a 8# sleeve wrench to loosen off the two bolts on the bumper and the left wing sheet.
Torque: 11N • m

3.5. Use a cross head screwdriver to loosen off the 7 screws on the bumper and the front compartment member.

3.6. Use a 8# sleeve wrench and a cross head screwdriver to loosen off the screws and fixing screws below the mud fender and the bumper.
Installation Torque: 2±0.5 Nm

3.7 Raise the vehicle with a hoister.
3.8. Use a cross head screwdriver and 8#sleeve to loosen off the fixing bolts and the screws below the mud fenderand the bumper.
Installation Torque: 2±0.5N.m

3.9. Pull off the fog lights connector.

3.10. Remove the bumper.

4. Installation Steps

The installation steps are reverse to those for removal.

II. Removal, Installation & Maintenance of Rear Bumper

1. Preparations

Tools: cross head screwdriver, flat head screwdriver, No.8 sleeve.
Spare parts: disposable clips.

2. Notes

2.1. Please wear necessary labor protection supplies to avoid accidents.
2.2. Try to avoid scratching the painted surface of the bumper when removing it.
2.3. When removing the bumper in colder environment, operate gently to avoid damaging it.

3. Removal Steps

3.1 Disassemble the tail lights. (See Removal and Installation of Tail Lights)
3.2. Open the trunk cover, and use a cross head screwdriver to loosen off the four fixing clips on the rear bumper.

3.3. Use a cross head screwdriver to loosen off the three clips fixing the rear bumper bottom and the vehicle body.
Note: Raise the vehicle with a hoister.

3.4 Use an 8# torque wrench to loosen the screws connecting the wing sheet and the bumper.
Note: Two fixing screws on either side.

3.5 Pull off the connector of the rear license plate lights.

3.6 Disassemble the connector of the reverse radar and remove the rear bumper assembly.

3.7 Unplug the reverse radar.

3.8 Use a cross head screwdriver to loosen the clip seat of the reverse radar.

4. Installation Steps

The installation steps are reverse to those for removal.

Chapter V Removal and Installation of Headlights, Fog Lights & Tail Lights

1. Preparations

Tools: 10# open-ended wrench, cross head screwdriver.

2. Notes

2.1. Please wear necessary labour protection supplies to avoid any accidents.
2.2. Try to avoid scratching the painted surface of the bumper when removing it.
2.3. When removing the bumper in colder environment, operate gently to avoid cracking it.
2.4. When disassembling the headlights, violent operation may damage their clips on the bumper, so operate properly.
2.5 Pay attention not to scratch the headlight surface when disassembling and placing it.

3. Removal Steps of Headlights

3.1. First open the front hood.

3.2. Use a 10# open-ended wrench to loosen off the three fixing screws of the right headlights on the front compartment member.

3.3. Hold the headlight with both hands and apply a forward force to loosen off the right headlights.

3.4. Unplug the right headlights harness to take out the right headlights assembly.

3.5. Turn open the the high beam headlight holder shield by hand.

3.6. Press down the bulb fixing clip by hand and turn the clip over to take out the bulb.

3.7. Unplug the right-front position light harness to take out the bump.

3.8. Turn open the low beam light holder shield by hand.

3.9. Unplug the low beam light harness.

3.10. Press down the bulb fixing clip by hand and turn the clip over to take out the bulb.

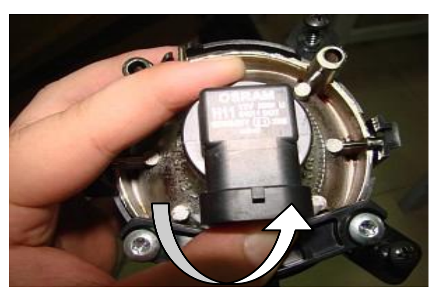
3.11. Turn the right-front turning light shield counterclockwise to disassemble the bulb.
(See the above steps for removal of the left headlight)

4. Removal of Front Fog Lights

4.1. Diassemble the bumper assembly. (Refer to removal of bumper)
4.2. Unplug the right-front fog lights harness connector.

4.3. Use a cross head screwdriver to loosen off the three screws that fix the front fog light, and then disassemble the right-front fog light assembly

4.4. Turn the right-front fog light holder and remove the bulb.
(See the above steps for removal of left-front fog lights)



5. Removal of Tail Lights

5.1. Open the rear door.
5.2. Use a cross head screwdriver to loosen off the screws fixing the left tail light.

5.3. Remove the left tail light, unplug the left tail light harness connector, and then disassemble the left tail light assembly.

5.4. Use a cross head screwdriver to loosen off the four screws that fix the tail light holder and open it.

5.5. Turn the bulb counterclockwise by hand and then the bulb can be removed.

6. Removal of License Plate Lights

6.1. Use a flat head screwdriver to pry off the license plate light.

6.2. Unplug the harness plug to disassemble the license plate light.

7. Installation & Adjustment of Headlights

7.1. Installation Steps for the Headlights

The installation steps of headlights are reverse to those for removal.

7.2. Functions of Headlights

7.2.1. Front view

See right figure:

1 High beam light
2 Position light
3 Low beam light
4 Turn light

7.2.2. Back view

1 High beam light holder
2 High beam adjusting nut
3 Low beam light holder
4 Low beam adjusting nut
5 High beam, low beam, position and turning light plugs
6 Turning light holder

8.3. Adjustment of Headlights

8.3.1 Pay attention to law and regulations and verify the following items before adjustment:

1). The tire air pressure should comply with the related standard;

2). Vehicle is unloaded (except for spare tire and equiping tools, and include driver’s weight for sedan);

3). The vehicle should be parked on level and smooth road or field;

4). The matched mirror surface of the headlight should be fresh of dirt;

5). The power supply should work normally and the bulb should be properly installed.

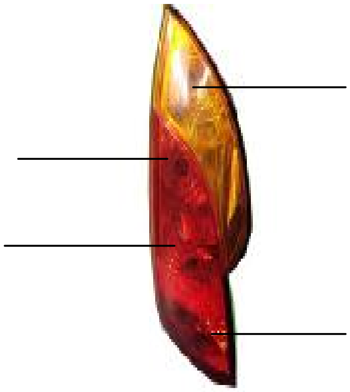
8.3.2. Insert a cross head screwdriver into related adjusting hole to adjust the light.

8. Installation & Adjustment of Front Fog Lights

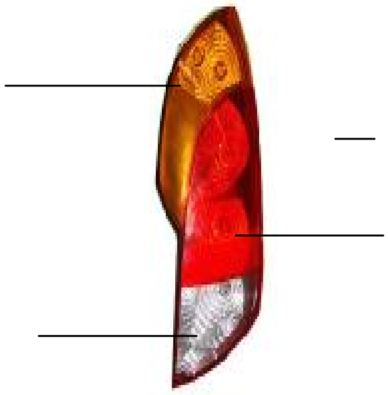
8.1. The installation of front light
The installation steps of front fog light are reverse to those for removal.
8.2. The adjustment of the front fog lights
The front fog lights can be adjusted by turning the device with your hand or a cross head screwdriver.

9. Installation of Tail Lights

9.1. Installation steps of the tail lights
The installation steps of tail lights are reverse to those for removal.
9.2. The functions of the tail lights
9.2.1. Front view
See right figure:
1). Left-rear turning light (21w)
2). Brake light (21w)
3). Position light (5-21w)
4). Rear Fog Light (21w)



See right figure:
1). Right-rear turning light (21w)
2). Brake light (21w)
3). Position light (5-21w)
4). Reverse indicator (21w)



Chapter VI Removal and Installtion of Vehicle Ceiling

1. Preparations

Tools: sleeve wrench, cross head screwdriver, flat head screwdriver

2. Notes

2.1. During the removal and installtion, make sure to apply proper force and no violent operation is allowed.

2.2. During removal and installation of the inner decoration parts, make sure to protect the decoration parts from being scratched.

3. Removal and Installation of Sun Visor

3.1. Removal Steps

3.1.1. Use a cross head screwdriver to loosen off the screws in the sun visor on the left of the driver's cab, and disassemble the sun visor.
As shown in the figure:
Torque: 3±1Nm

3.1.2. The removal steps for the right sun visor are reverse to those for removal of the left one.

3.2. Installation Steps

The installation steps are reverse to those for removal.

4. Removal and Installation of Vehicle-top Armrest

4.1. Removal Steps

4.1.1. Open the ceiling armrest screw cover over the co-driver's seat by hand, and then use a cross head screwdriver to loosen off the left and right fixing screws.
As shown in the figure:
Torque: 9±3Nm

4.1.2. Remove the ceiling armrest.

4.1.3. The removal of other ceiling armrests can follow the above steps.

4.2. Installation Steps

The installation steps are reverse to those for removal.

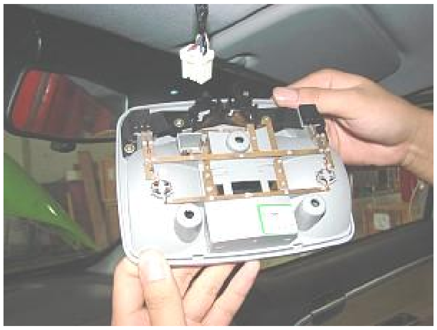
5. Removal and Installation of Front Ceiling light

5.1. Removal Steps

5.1.1. Align a flat head screwdriver with the groove along the ceiling light edge to pry it open, as shown in the figure:
Note: Do not scratch part surface.

5.1.2. Remove the three fixing screws of the the front ceiling light.
Torque: 1.5±0.5Nm

5.1.3. Unplug the harness and disassemble the front ceiling light assembly.



5.2. Installation Steps

The installation steps are reverse to those for removal.

6. Removal and Installation of Reverse Radar Display

6.1. Removal Steps

6.1.1. Use a cross head screwdriver to loosen off the screws of the reverse radar display.

6.1.2. Unplug the harness and remove the reverse radar display.

6.2. Installation Steps

The installation steps are reverse to those for removal.

7. Removal and Installation of A-pillar Shield

7.1. Removal Steps

7.1.1. Use a flat head screwdriver to pry open the weather strip of the left A-pillar shield, and then take out the left A-pillar shield by hand.

7.1.2. Take out the left A-pillar shield.

7.1.3. Follow the the removal steps of the right A-pillar shield for that of the left one.

7.2. Installation Steps

The installation steps are reverse to those for removal.

8. Removal and Installation of B-pillar Shield

8.1. Removal Steps

8.1.1. Disassemble the shield below the left B-pillar (See Removal and Installation of Seat belt).

8.1.2. Use a flat head screwdriver to pry open the B-pillar shield. Note: protect the trim part surface from scratching.

8.1.3. Follow the removal steps of the left B-pillar shield for removal of the right B-pillar shield.

8.2. Installation Steps

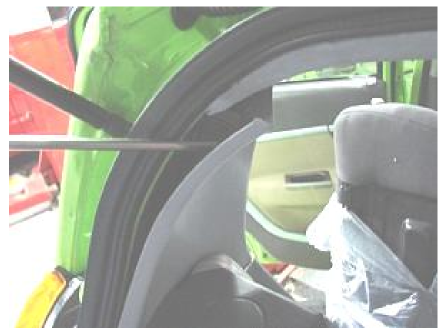
The installation steps are reverse to those for removal.

9. Removal and Installation of C-pillar Shield

9.1. Removal Steps

9.1.1. Use a sleeve wrench to loosen off the seat belt bolts (See Removal and Installation of Rear Seats & Seat belts).

9.1.2. Use a flat head screwdriver to pry open the C-pillar upper shield.



9.1.3. Remove the C-pillar upper shield.

9.1.4. Please follow the removal steps of left C-pillar upper shield for that of the right C-pillar upper shield.

9.2. Installation Steps

The installation steps are reverse to those for removal.

10. Removal and Installation of Vehicle Ceiling

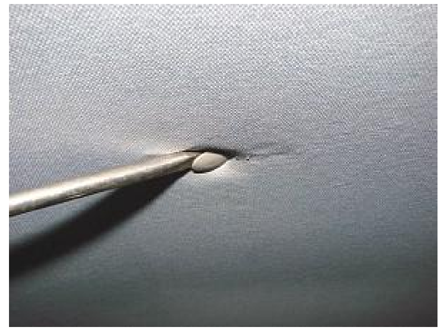
10.1. Removal Steps

10.1.1. Disassembling the left/right front sun visors. (See Removal and Installation of Sun Visor)

10.1.2. Disaasembling the front ceiling light. (Refer to removal and installation of front ceiling light)

10.1.3. Disassembling all interior ceiling armrests. (See removal and installation of ceiling armrest)

10.1.4. Disassembling A/B/C-pillar shield. (See removal and installation of A/B/C-Pillar Shield)



10.1.5. Use a flat head screwdriver to loosen off the vehicle ceiling clip (4 in all).

10.1.6. Disassemble the four doors' weather strip by hand.

10.1.7. Open the trunk and disassemble the vehicle ceiling.

10.2. Installation Steps

The installation steps are reverse to those for removal.

Chapter VII Removal and Installation of Instrument Panel & Instrument Panel Crossbeam

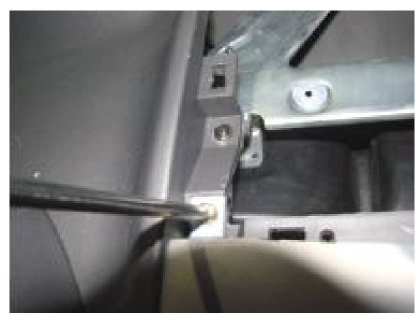
I. Removal of Instrument Panel

Tools: 8 #sleeve, extension bar, 飞扳[MS1], cross head screwdriver, flat head screwdriver, etc.

1. Removal Steps

1.1. Open the storage box over the console, and use a cross head screwdriver to loosen off the two screws. Then use a flat head screwdriver to pry open the storage box. See the right figure:

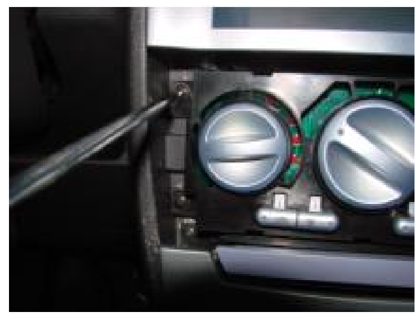
1.2. Use a cross head screwdriver to loosen off the two screws than connect the emergency switch with the Instrument Panel, as shown in the figure:



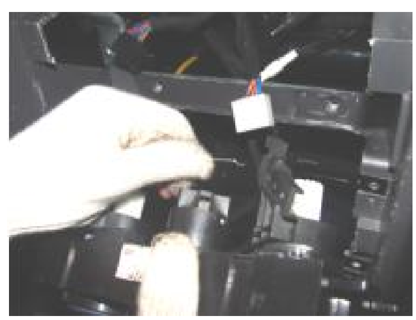
1.3. Pull out the top part by hand, and then use a flat head screwdriver to pry open the lower part. Unplug the harness when removing it, as shown in the figure:

1.4. Use a flat head screwdriver to pry open the control panel of the airconditioner switch and take it out.

1.5. Use a cross head screwdriver to loosen off the four screws that connect the airconditioner switch and the Instrument Panel.



1.6. When taking the airconditioner switch, unplug the two harness plugs behind it and disassemble the two cables behind the switch.



1.7. Use a 8# sleeve wrench to loosen off the four fixing bolts that connect the audio system with the Instrument Panel.

1.8. When taking out the audio system, unplug the antenna and harness.

1.9. Use a cross head screwdriver to loosen off the two screws that connect the cup-holder and the Instrument Panel, and then take out the cup-holder.

1.10. Disassemble the auxiliary Instrument Panel (See Chapter I Removal, Installation & Adjustment of of the Brake System).

1.11. Use a cross head screwdriver to pry open the decoration sheet on the ash tray and take it out.

1.12. Use a cross head screwdriver to loosen off the four screws that connect the cigarette lighter with the Instrument Panel, and unplug the harness when removing the lighter.

1.13. Use a cross head screwdriver to loosen off the three screws that connects the ashtray with the Instrument Panel and take out the ashtray.

Note: When disassembling the console, the operations should be carried out from top to bottom, and you should disassemble the air-conditioner switch before disassembling the audio system.

1.14. Disassemble the steering wheel, combination switches and ignition switch.

1.15. Use a cross head screwdriver to loosen off the two screws on the instrument panel shield and the Instrument Panel, and then pull it out with both hands.

1.16. Use a cross head screwdriver to loosen off the four screws on the instrument panel and the Instrument Panel.

1.17. Use a flat head screwdriver to pry up the red clip and the instrument panel harness plug can be taken out before the instrument panel is taken out.

1.18. Push out the two harness plugs from behind the fog light switch.

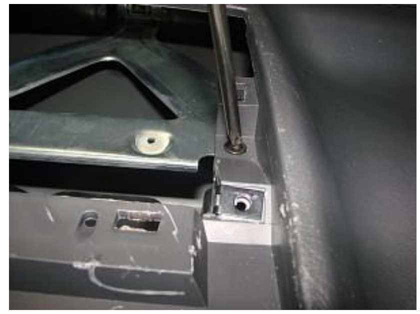
1.19. Disassemble the left-front and the right-front door seal strip.

1.20. Disassemble the decorative shields of the left and righte A-pillars (See Removal of Vehicle Ceiling for details).

1.21. Open the storage box to the lower right of the Instrument Panel, use a cross head screwdriver to loosen off the four screws on the storage box and disassemble the storage box.

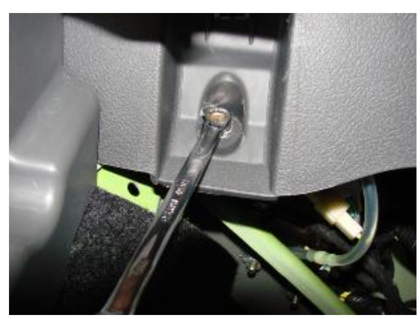
1.22. Disassemble the front hood cord switch (See Removal of Front Hood & Trunk).

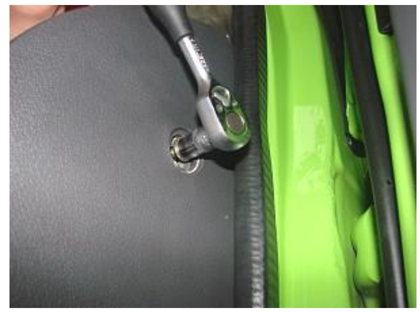
1.23. Use a cross head screwdriver to loosen off the two screws on the console.



1.24. Pull off the central switch box shield to the left Instrument Panel.

1.25. Use a 8# wrench to disassemble the bolts to the left and right of the Instrument Panel (with 3 bolts for the top/middle/bottom part respectively, i.e. 9 in total).





1.26. Use a 8# sleeve wrench to loosen off the four bolts that connect the console and the instrument beam and another bolt behind the instrument panel.

1.27. Unplug the harness plugs of the left and right loudspeakers.

1.28. Take out the Instrument Panel.

Notes: 1. Disconnect the battery negative before disassembling the electrical equipment.

2. Don’t wait until all the Instrument Panel bolts are disassembled before you disassemble the ones on the other side, or the Instrument Panel are likely to get deformed.

2. Installation Steps

2.1. The installation steps are reverse to those for removal.

2.2. Notes

①. Double-wind channels should agree with the air-conditioner outlet connector and be installed properly without any air leak, and the Instrument Panel air channel should not conflict with the Instrument Panel crossbeam, the evaporator and other parts, or the Instrument Panel and its accessories will not be installed properly.

②. The Instrument Panel should not interfer with the front windscreen or affect its installation and an even clearance should exist between the Instrument Panel and the windscreen.

③. The clearances between the Instrument Panel and either sides of the vehicle body should be consistant and meet the requirements for assembling the door weather strips.

3. Methods for Clearing Instrument Maintenance Indicator

1. Clearing with diagnosis equipment:

①. Using the X431 diagnosis equipment: Select the OBD-Ⅱ diagnosis connector and connect it with the diagnosis interface below the instrument panel; turn on the ignition switch and start the diagnosis equipment; choose the latest edition and select the instrument panel system; select "ATECH Instrument System", and then "Action Testing"; select "Maintenance and service requirements", and then click “confirm” to clear the instrument maintenance indicator, and then exit the diagnosis equipment;

②. Using K81/K61 diagnosis equipment: Select the MITSUBISHI diagnosis connector and connect it with the diagnosis interface below the instrument panel; turn on the ignition switch and start the diagnosis equipment; choose the latest edition and select the instrument panel system; select "Instrument System (ATECH)", and then "Action Testing"; select "To clear maintenance requirement indicator", and then press “enter” to clear the instrument maintenance indicator, and then exit the diagnosis equipment;

2. Clearing by the adjusting knob as follows:

①. Insert the key into the ignition switch and get it to the position “Ⅰ”;

②. Press the mode adjusting knob by hand and let it stay there when you turn the key to “Ⅱ” position;

③. Push down the mode adjusting knob and keep it there for about 20 seconds before you release the knob, and then the maintenance indicator will be cleared.

II. Removal of Instrument Panel crossbeam

1. Removal Steps

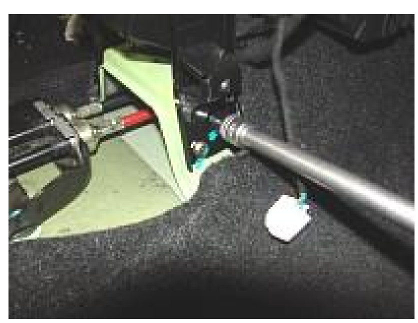
1.1. Disassemble the Instrument Panel assembly (See Removal of Instrument Panel)

1.2. Use a 13# sleeve, combined wrench to loosen off the two nuts and four bolts that connect the Instrument Panel crossbeam with the left/right A-pillars.

1.3. Use a 13# wrench to loosen off the bolts at the place as shown in the figure.

1.4. Use a 10# wrench to loosen off the four bolts at the places as shown in the figure.

1.5. Use a 10# wrench to loosen off the four bolts at the places as shown in the figure.



1.6. Use a 10# wrench to disassemble the two bolts of the ground wire earth at the places as shown in the figure.

1.7. Loosen off the single bolt and four nuts on the side pillars (See Chassis Maintenance Manual: side pillars), and then relase the side pillar.

1.8. Disassemble all harness plugs that are connected with the Instrument Panel crossbeam. For example, the harness plug of the brake light switch.

1.9. Take out the Instrument Panel crossbeam.

2. Installation Steps

The installation steps are reverse to those for removal.

Chapter VIII Air Conditioning System

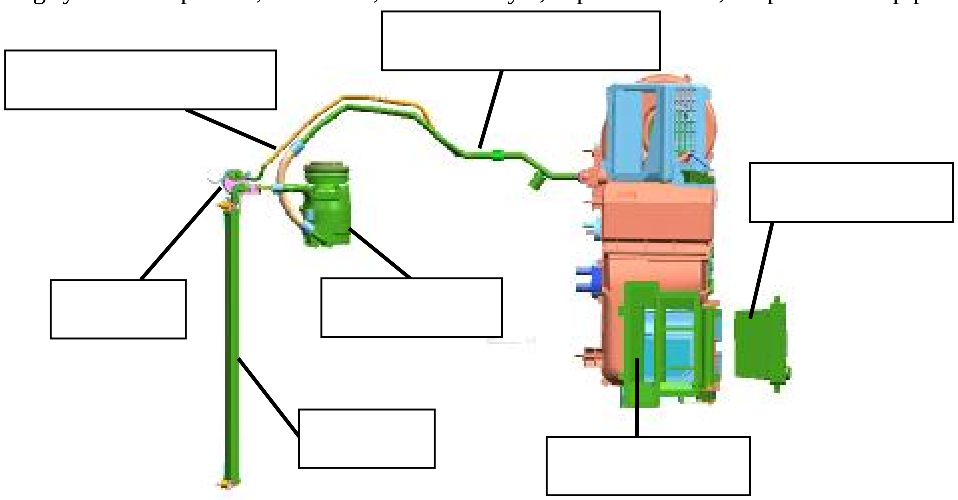
I. System Constitution

Air adjustment and distributing system: HVAC air mixing and distributor part, inside/outside circulation air inlet, air outlet, outside circulation air filter.

Control system: control panel assembly, micro motor, blower, speed regulating mode, high/low voltage switch, AC thermostat.

Heating system: heating water tank, hot water pipe, and engine cooling water system.

Cooling system: compressor, condenser, reservoir dryer, expansion valve, evaporator and pipe.



II. Removal of Evaporator Assembly

1. Preparations

Tools: cross head screwdriver, vehiclep pliers, socket spanner
Auxiliary material: refrigerant, antifreeze, sponge rubber strip

2. Removal Steps

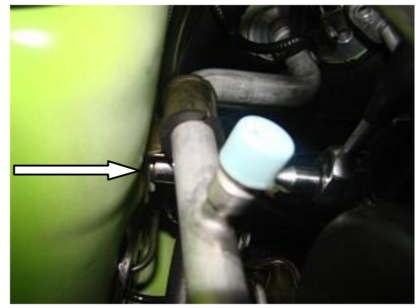
2.1. Use coolant recycling machine to recycle the coolant.
Note:

(1) Don’t deal with the coolant in any closed place or near flame.

(2) Do not splash the refrigerant into eyes and skin.

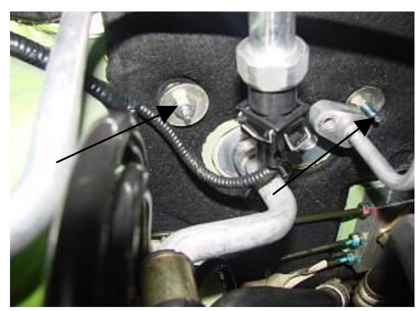
2.2. Disassemble the Instrument Panel assembly and the front crossbeam, and unplug the related electrical equipment connector. (See Removal and Installation of Instrument Panel)

2.3. Use a sleeve wrench to loosen off the fixing bolts of the high/low pressure pipes.



2.4. Loosen the fastening nuts of the high/low pressure pipes, and then pull them out.

2.5. Loosen off the three nuts fixed on the plate work.



2.6. Use pliers to remove the inlet/outlet water pipes of the evaporator and pull out the pipes.
Note: Coolant will flow out from the water pipe, pay attention to recycle the coolant.

2.7. Loosen off the 8 fixing nuts that fix the evaporator assembly on the plate work from the front compartment (See the following figures for detailed positions).

2.8. Take the evaporator assembly from the driver’s cab..

3. Installation of Evaporator Assembly

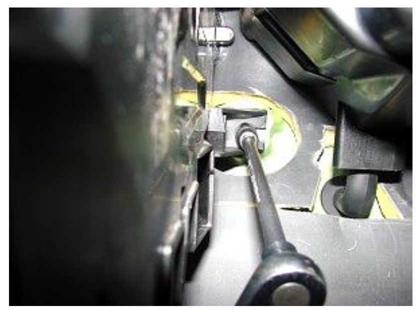
The installation steps are reverse to those for removal.

4. Removal and Installation of Evaporator Interior

Preparation of Tools: cross head screwdriver, sleeve wrench.

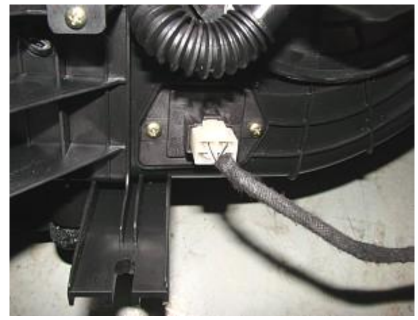
1. Replacement of Blower

1.1. Removal Steps
1.1.1. Disassemble the blower motor, relay and motor speed regulation module plug.

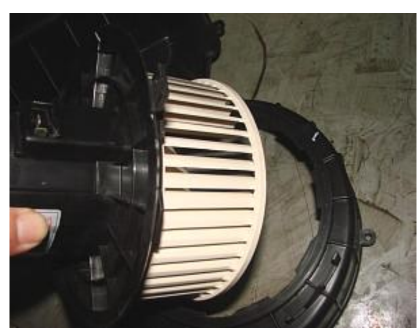


1.1.2. Remove the blower cooling jacket.

1.1.3. Push down the clip and drag out the blower clockwise.



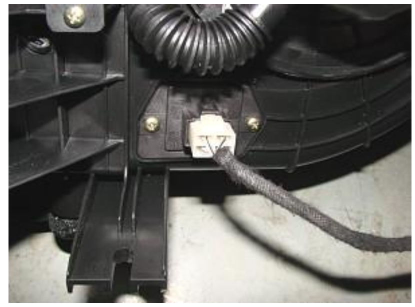
1.2. Installation Steps
The installation steps are reverse to those for removal.



2. Removal and Installation of Blower Speed Regulation Module

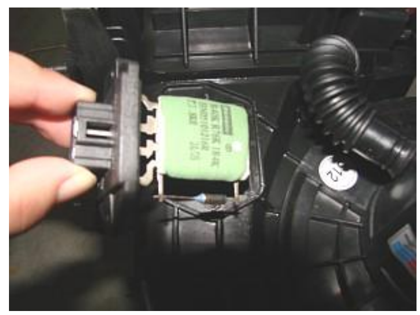
2.1. Removal Steps

2.1.1. Pull out the speed regulation module plug.



2.1.2. Use a cross head screwdriver to loosen off the 2 fixing screws on Speed Regulation Module.

2.1.3. Pull out the speed regulation module.



2.2. Installation Steps

The installation steps are reverse to those for removal.

3. Removal and Installation of Heater Exchanger

3.1. Removal Steps

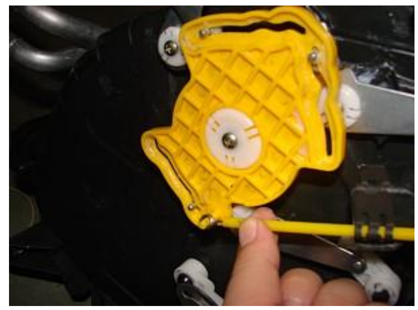
3.1.1. Disassemble the evaporator assembly. (See Removal of Evaporator Assembly)

3.1.2. Disassemble the air-conditioner harness. (See Removal of Air-conditioner Harness)

3.1.3. Loosen off the two fixing screws and remove the heater exchanger shield.

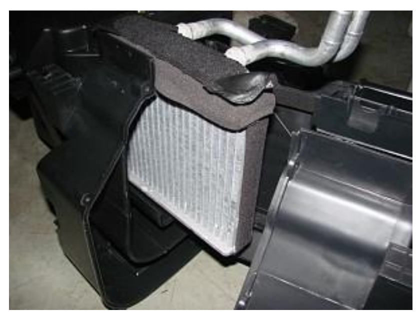
3.1.4. Unplug the plug of the evaporator thermostat.

3.1.5. Disassemble the mode throttle hitch bar.



3.1.6. Remove the temperature control throttle bar.

3.1.7. Loosen off the 8 screws on the heater shiled, and disassemble the evaporator shield.
Notes: The sponge weather strips around the shield are for single use only.



3.1.8. Use a flat head screwdriver to pry off the clips that fix the air conditioner cover plate assembly.

3.1.9. Remove the air conditioner cover plate assembly.

3.1.10. Tear open the sponge around the inlet/outlet water pipes and remove the fixing clips.

3.1.11. Remove the heater exchanger.

3.2. Installation Steps

The installation steps are reverse to those for removal.

After the installation, the system should be evacuated, proper pressure should be maintained and anti-freeze agent should be filled to check for any leakage. Check if the radiator is blocked and pressure air can be used to get it through if it is.

4. Removal and Installation of Mode Throttle Related Mechanism

4.1. Removal of Steps

4.1.1. Remove the mode throttle hitch bar, use a cross head screwdriver to lossen off the fixing screws on the control panel to disassemble.

4.1.2. Loosen off the three screws and washers behind the control panel that control defroster, blowing head, blowing foot and control arm.

4.2. Installation Steps
The installation steps are reverse to those for removal.

5. Removal and Installation of Blend Throttle Related Mechanism

5.1. Removal Steps
5.1.1. Remove the blend throttle bar, and use a cross head screwdriver to loosen off the screws on the control panel.

5.1.2. Use a flat head screwdriver to pry off the control arm.

5.1.3. Remove the blend throttle.

5.2. Installation Steps
The installation steps are reverse to those for removal.

6. Removal and Installation of Int./Ext. Throttle Motor & Related Mechanism

6.1. Removal Steps

6.1.1. Unplug the motor plug.

6.1.2. Loosen off the 4 fixing screws to remove the shield.

6.1.3 Loosen 3 screws of inside/outside circulation ventilator motor, and disassemble the motor.

6.1.4. Use a flat head screwdriver to pry off the plastic parts that fix the inside/outside circulation ventilator.

6.1.5 Remove the inside/outside circulation ventilator.
6.2. Installation Steps
The installation steps are reverse to those for removal.

7. Removal and Installation of Evaporator

7.1. Removal Steps
7.1.1. Disassemble the evaporator assembly (See removal of Eevaporator assembly)

7.1.2. Remove the air-conditioner harness (See removal of air-conditioner harness)

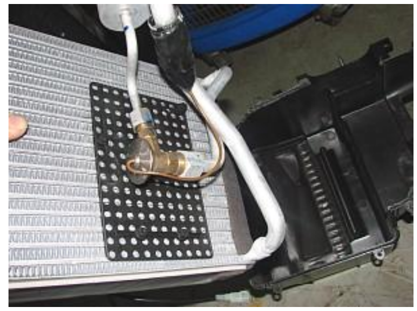
7.1.3 Disassemble evaporator water thermostat (Refer to removal of evaporator water thermostat)

7.1.4 Disassemble mode ventilator connection rod (Refer to removal of mode ventilator motor)

7.1.5. Remove the temperature control throttle bar

7.1.6. Loosen off the 9 screws on the evaporator shield, and use a flat head screwdriver to pry off the two clips to disassemble the evaporator shield.
Note: The sponge seal around housing is for single use only

7.1.7 Remove the evaporator assembly.

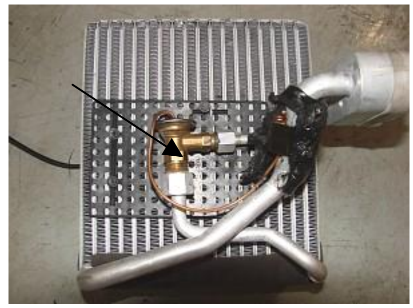


7.1.8. Use a wrench to disassemble the expansion valve.

7.2. Installation of the Evaporator Assembly

The installation steps are reverse to those for removal.

After the installation, the system should be evacuated, proper pressure should be maintained and anti-freeze agent should be filled to check for any leakage. Check if the radiator is blocked and pressure air can be used to get it through if it is.



III. Trouble Shooting

Types of pressure deviation	Possible causes	Method for troubleshooting
1. The pressure at the high pressure side remains unchanged or just slightly rises (compared with the value when the engine stalls); the pressure at the low pressure side is within or under the range as shown; the air conditioner is under refrigeration. 2. The pressure at the high pressure side is normal; the pressure at the low pressure side is within the range as shown; the air conditioner is under refrigeration.	Lack of refrigerant or the expansion valve fails	Evacuate the refrigerant ●If the volume of the refrigerant is normal 1. Replace the expansion valve 2. Refill the refrigerant to the system 3. Test the pressure again ●If the volume of the refrigerant is short 1. Check if there is leaking, if there is fix it 2. Refill the refrigerant to the system 3. Test the pressure again
The pressure at the high pressure side is higher than the specified value; the pressure at the low pressure side falls rapidly to within or under the range as shown; the air conditioner is under refrigeration.	The blockage or throttling occur somewhere in the refrigerant pipelines The expansion valve fails	Touch the pipelines to feel the temperature change ●If there exists temperature differences on several parts of a certain component 1. Dredge the pipe with compressed air and nitrogen and replace the expansion valve. 2. Replace the blocked parts. ●If no trouble found: 1. Dredge the pipelines with compressed air and nitrogen 2. Test the pressure again.
Initially, the pressures at the high and low pressure sides are normal, but after a period of time, the pressure at the high pressure side is higher than the specified value and the pressure at the low pressure side is within or under the range as shown; the air conditioner is under refrigeration.	The expansion valve fails There exists vapor in the refrigerant pipelines	Check for dirt or rust in the expansion valve and replace it when necessary ●Dredge the pipelines with compressed air and nitrogen

The pressure at the high pressure side is higher than the specified value or is too high; the pressure at the low pressure side is too high; the air conditioner is under refrigeration; the compressor makes exceptional sounds (especially when just starts the engine).	The refrigerant in the refrigerant pipelines is excessive The expansion valve fails or the compressor is disabled	Evacuate the refrigerant ●If the volume of the refrigerant is normal 1. Replace the expansion valve 2. Refill the refrigerant to the system 3. Test the pressure again ●If the refrigerant is obviously excessive 1. Refill the refrigerant to the system 2. Test the pressure again. Note: If the system is still off normal after retesting the pressure, install the expansion valve, have it replaced and dredge the pipelines with compressed air and nitrogen, and then further replace the compressor and the fluid reservoir and drying chamber.
When turning off the engine, the pressure at the high pressure side slightly rises while the pressure at the low pressure side slightly falls; the air conditioner is under refrigeration.	The compressor is disabled	Dredge the pipelines with compressed air and nitrogen Replace the compressor and the fluid reservoir and drying chamber
High pressure side is correct, low pressure side is too low, AC refrigerating correct, sometimes the evaporator has ice (even the refrigerant quantity is correct)	The expansion valve fails or the compressor is disabled	Replace the expansion valve Refill the refrigerant to the system Test the pressure again Note: If the system is still off normal after retesting the pressure, install the expansion valve, have it replaced and dredge the pipelines with compressed air and nitrogen, and then further replace the compressor and the fluid reservoir and drying chamber.
1. High/low pressure sides are correct, AC refrigerating deficiency. 2. High/low pressure sides are correct, compressor is abnormal (especially when the engine is started), AC refrigerating good	The transmission oil in the air conditioner pipelines is excessive	Evacuate the refrigerant ●Dredge the pipelines with compressed air and nitrogen Note: Adjust the volume of the lubricant when replacing such component of the air conditioner system as the compressor
The reservoir can not be used	• Puncture • The sealed part is damaged • Thread of fasten part is damaged, outside air entering to system	Replace

CHAPTER IX Body Dimension

I. Basic Instructions on BIW Maintenance

Vehicle body maintenance should be carried out by professionals according to the requirements of the manufacturer, and only in this way will the promises of “rust free” and “paint defect free” be effective.

1. Only adopt the materials specified by the manufacturer;
2. When welding the outside metal of the vehicle body, make sure protective coating is applied to the inner side;
3. When spot-welding, make sure zinc coating is used;
4. Before air-tight sealing the welded parts, apply a layer of filling coating to the inner side and outer side;
5. Before protecting the chassis with paint, apply protective coating to protect the chassis from rock bumping;
6. When the coating is sprayed, all opening parts at this position should be secured with fasteners;

In some cases, the vehicle must be placed on a hoister platform, for removal of spare parts may affect the distribution of various parts in the vehicle body.

Before spot-welding, make sure the battery connector is unplugged, and check if the ventilation is good enough before welding.

In maintaining the vehicle body in a certain area, take care to protect other vehicles in this area.

Be particularly careful when spraying sand or welding near the oil tank or fuel system, and disassemble them if the safety can not be assured.

When maintaining or spray-painting the vehicle body, take all possible measures of preventing accidents.

When welding galvanized steel sheets, the spot-welding current should be raised by 30%, and the electrodes should be pointed, and the clamping force of the electrodes should be increaded; and when doing gas shielded welding, the welding current should be further intensified.

Do not weld the air-conditioning parts or try to weld the parts on the vehicle whose temperature are easily raised. When spray-painting the vehicle frame, the temperature either in the drying oven or the pre-heating oven should not go beyond 80˚C.

Take the following measures during welding operation to prevent shaking the electronically welded equipment:

1. Connect the grouding of the electronic welding equipment directly to the welded parts. And check to make sure no other parts or insulative parts exists between the ground wiring connector and the spot-welded parts;
2. First disassemble the ECU, and prevent the electronic device or circuit from contacting the ground wiring connector or welding wire.

Corrections:

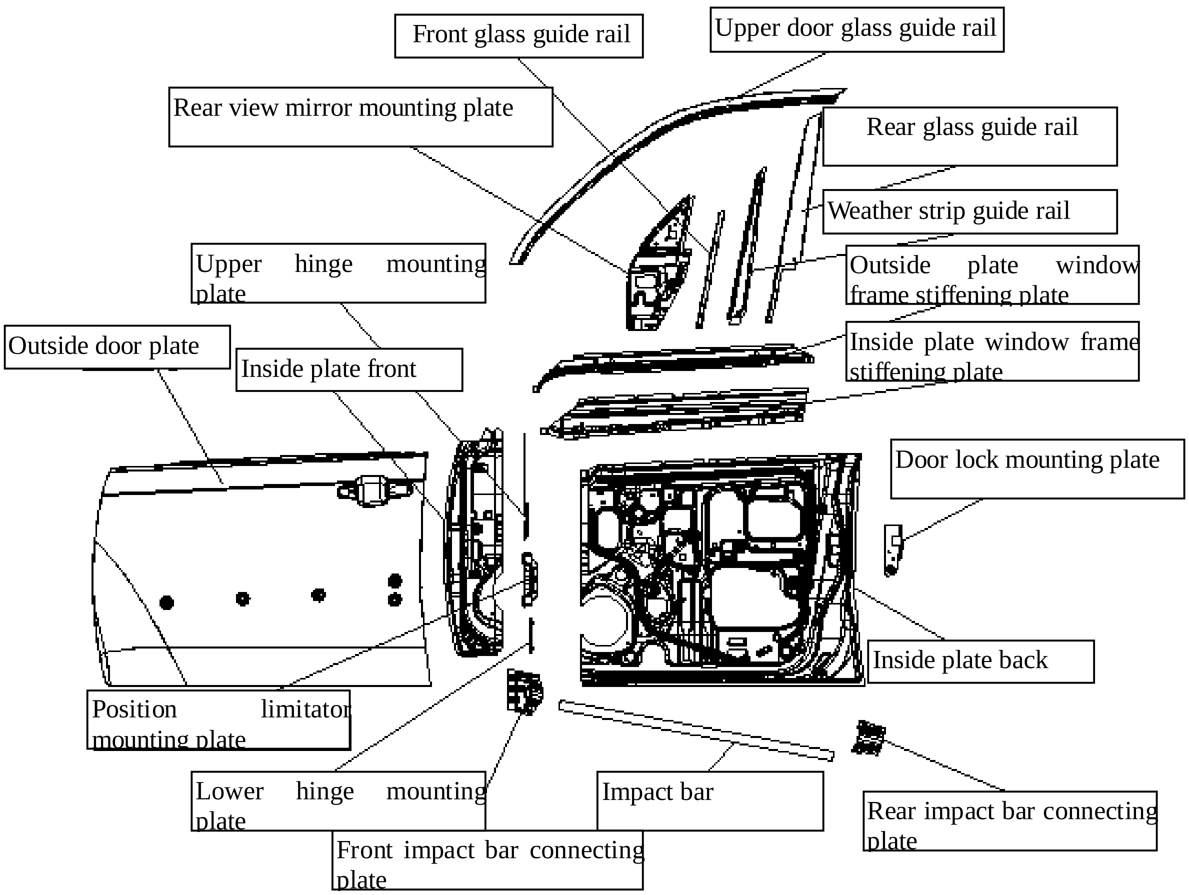
The vehicle body and the chassis are manufactured off the production-line by low-temperature tempering and cold die casting. Therefore, when the metal parts are damage in any accident, the same processes must be used to restore them, and no heating is allowed. If they are damaged very seriously and can not be restored, the damaged parts must be removed after the connecting surface is corrected.

The car bodies are made up of various members, pressing panels and other parts, of which the doors are the most complexly processed parts of the vehicle body. They involve processes like part stamping and welding, assembly of spare parts and assemblies, for which the dimensional fits and technical requirements are quite strict, so the car doors are difficult to maintain and the quality requirements are fairly high, and only the service personnel understand the structure of the car doors thoroughly and are qualified for the maintaining operations.

1. Vehicle Door Structure

Generally speaking, the vehicle doors consist of outside plates, inside plates, window frames, glass guide rails, hinges, locks and window accessories and so on. The inside door plates are equiped with accessories including glass lifter, locks and so on. To secure the assembly, some parts of the inside door plates need to be fortrified. To increase safety level, the inner parts of the outside plates are usually equipped with impact bars. The outside plates and inside plates are connected by flanging, adhesion, seam welding and so on. Depending on different bearing capabilities, the outside plates should be light and the inside plates should have higher rigidity and be able to stand stronger impact.

The BIW vehicle door assemblies have relatively fewer components, and usually consist of inside plates, outside plates, glass guide rails, window frame reinforcing plates, lock mounting plates, hinges reinforcing plates, impact bar assemblies and so on; The figure below is a typical structure drawing of a vehicle door.



2. Door panel Maintenance Process

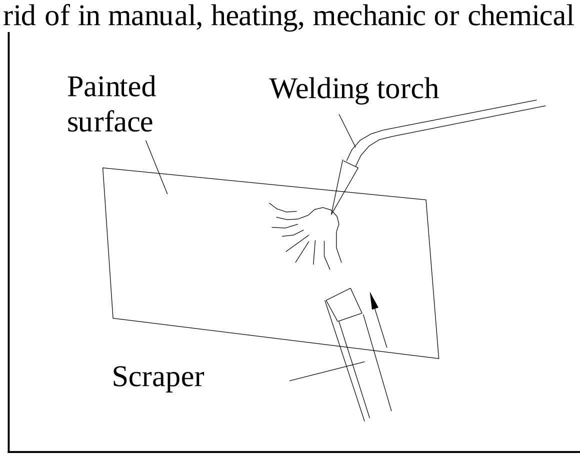
Generally speaking, the basic maintenance methods for car doors and hoods are the same as those for ordinary plate work, and the following steps apply to both of them:

(1) Primary tests. The positions of the door panels as related to other assemblies of the vehicle body as well as the dimensions of their tolerance clearances should be tested;

（2） Clean the vehicle doors. Use fresh water or detergent to clean the dirt and greasy spots on the door panels, and let them thoroughly dry for tests.

（3） Maintenance appraisal. Appraise the scope and degree of damage to the door panels by testing and decide the maintenance methods.

（4） Clear the old paint. Before cleaning or maintenance, get rid of the old paint according to the actual situation, especially when there exists obvious rust, cracks or dents; The paint can be got rid of in manual, heating, mechanic or chemical metchod(s).



（5） Tests after the removal, including the measurements of the geometric dimensions between various plate work pieces, tests of specific damage spots of various plate work pieces, recognition of damage types, analyses of damage causes and choices of maintenance schemes.

3. Main Contents of Door Panel Maintenance

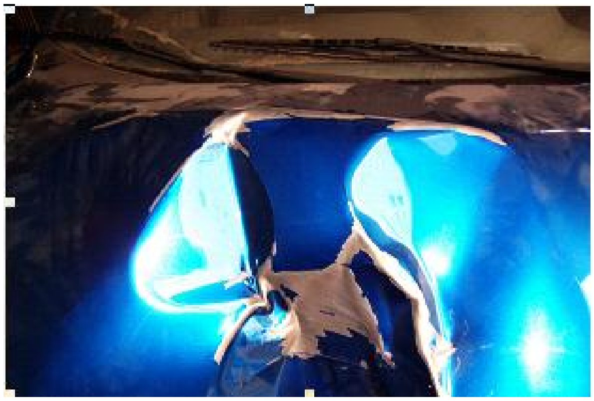
Generally speaking, the causes of door panel damages are related to the following 4 aspects: structure design defects, manufacturing defects, chemical erosion, and physical damage. And the most common damage causes can be classified as the following types:

1. Abrasion: The surfaces of plate work pieces may contact each other and relative movements will take place and cause surface friction, which will lead to abrasion. For example, the long time friction between the hinge hole and the shaft of the vehicle door hinge will increase their tolerance clearance and cause to vehicle doors to drop.

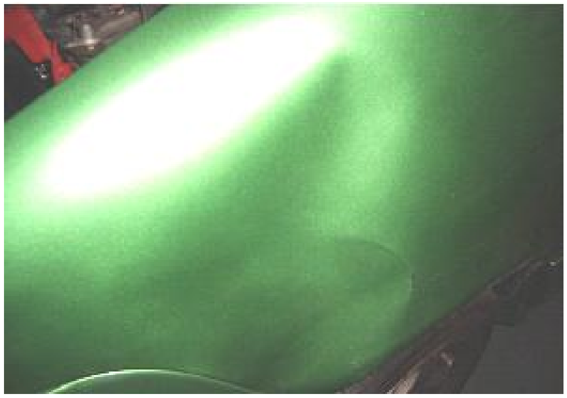
2. Erosion: This is generally due to the oxidation caused by the mud deposit and dirt; or the rust caused by lack of anti-erosion processing after welding; or erosion caused by chemicals. This type of damage usually occurs between the plate work pieces, in overlapped parts of spot-welded pieces, and at other similar places.

3. Cracks or breaks: The metal plates may develop fatigue under repeated inner/outer stress where the stress concentrates and the structure is the weakest, causing cracks and even breaks.

4. Dents or wrinkles: Dents develop because the door panel is subjected to bumping or pressing, leading to elastic or plastic deformations.



5. Bends or twists: They are mainly caused by too much load the door panel receives in use or the plastic deformation due to bumps.



4. Basic Methods for Door Panel Maintenance

The basic maintenance methods for the above door panel damage types include dent reconditioning, flame correction, welding, repairing and mending, wrinkle spreading and so on.

4.1. Reconditioning of Dents

For convex-concave damages in the outside door panels, if they are indirectly caused by structural pieces or reinforcers, the structural pieces should be corrected first, and then the outside panel breaks or dents are to be corrected. If the backs of the metal panels are accessible, hand hammers and underlay irons or spoon-shaped irons, tommy bars, flat punches and so on can be used for primary repairs. For enclosed metal panels or parts that are difficult to access from the backs, other tools can be used for repairing, such as slide hammers and pointed hammers.

Here are some common ways of dent reconditioning:

(1) Repair the dents with underlay irons and hand hammers: the commonest practice is to beat the damaged metal panels with underlay irons and hand hammers. Both sides of the metal panel to be repaired must be accessible to the hand-held underlay iron and there are two ways of using the underlay iron as the supporting piece for the hand hammer:

① Beat with a hammer from above the underlay rion. This approach is suitable for correcting smaller and shallower dent or breaks.

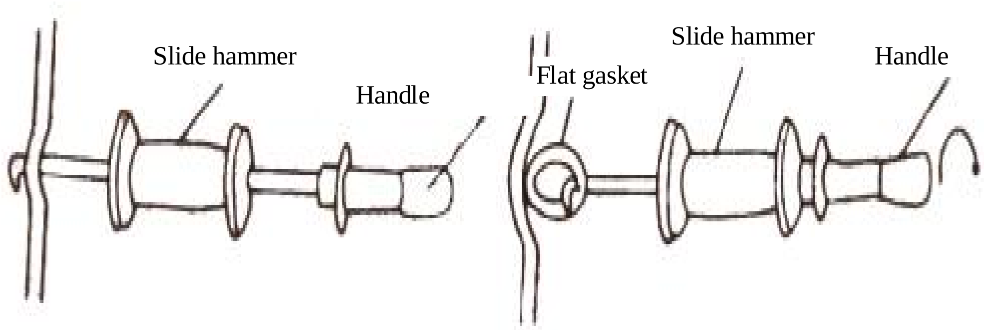
When beating with a hammer from above the underlay rion, the hand-held underlay iron should be placed against the back of the metal panels, and then beat the convex part. The beating of hand hammer can make the metal panel contract and finally smooth the metal panel.

② Beat with a hand hammer from other parts than from directly above the underlay iron. The underlay iron is placed against the lowest part of the dent, and then the higher parts near the dent are beaten with a hand hammer.

Generally, when trying to repair the dent with a hand hammer and an underlay iron, the convex side is beaten with the hand hammer and the concave side is pressed against the underlay iron. First do brief correction by beating the damaged part with a wooden hammer, and then do finer repairing with an iron hammer. For a larger area of dent, the underlay iron should be placed against the place where the dent is shallower, and the hand hammer should beat the higher parts. Besides, the wooden hammer and the iron one should be used alternatively according to the actual situation.

(2) Repair the dent with a shaping spoon or tommy bar. Shaping spoons and tommy bars are commonly used tools for door panel maintenance, and they are customized according the characteristics of the vehicle body. They can reach the limited space between door panels to push up the dent. This method is suitable for the narrow room between the door panels where it is inaccessible for the underlay iron or the hammer, and the shaping spoon can act as a underlay iron to distribute the impact of the hammer over a larger area.

(3) Restore the dent with a dent smoother. The dent smoother is applied to the inner side of the metal panel and it is used for the dents that are hardly accessible to other tools and it is usually operated in the following two ways:



Puncturing: Drill a small hole in the dent with a hand power drill, and then insert a pull-rod with threaded head or hook-shaped head into the hole. Slide the slide hammer on the metal pull-rod and impact the handle repeatedly so as to pull up the dent gradually. Make more than one holes when necessary, and fill the hole(s) by soldering and polish the spot(s) when the dent(s) is/are smoothed.

Electrode welding: Weld a peg or a flat gasket onto the dent with a special spot-welder, and then use a dent smoother to pull at the peg or flat gasket till the dent is smoothed. More than one peg or flat gaskets can be welded when necessary so that the whole dented area can be dragged out. Finally, break the peg or flat gasket, and polish the welded scar with a sand mill. This method can avoid drilling the metal panels and prevent potential erosion, so it is widely used.

4.2. Restoration of Stretched Parts

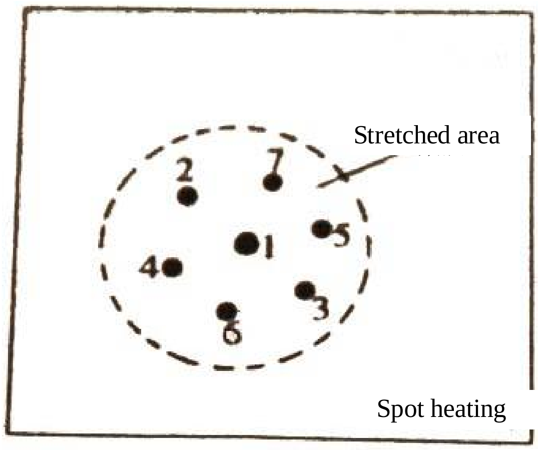
When the metal panel is impacted, the dented area would be stretched. At times even proper operations can not restore it, the heating-contracting method is sometimes used to achieve the desired repairing effect.

(2) Heated position and flame intensity: The effect of flame correction depends on the heated position and the flame intensity. Different heated spots bring about different effects, and the heated position should be where the material is deformed the most and the metal panel is stretch the most, or the furthest part outward that is bent and deformed. Different flame intensities also lead to different correcting effects. The intenser the flame is, the faster the metal panel is heated and the more concentrated the heat is, and then the stronger the contracting capability is. The low-carbon steel panel, for example, should be heated till it gets cherry red (600℃ - 800℃).

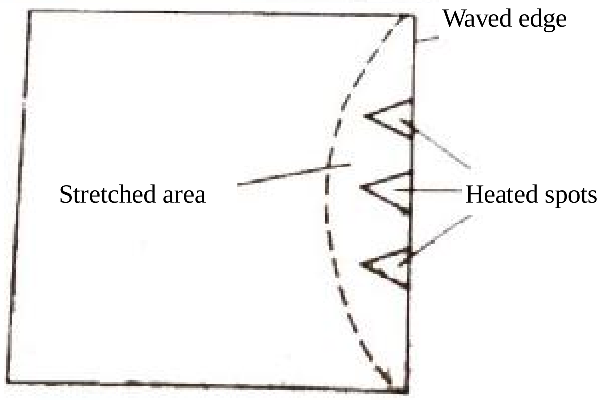
(2) Heating ways normally adopted for flame correction in the vehicle body maintenance are:

① Spot heating: The heated area is a round spot of a certain diameter, which is usually 15 - 30mm. One or more spots can be heated according to the actual deformity situation. When more than one spot is heated, the spots are arranged in a plum pattern. And this way is often used for contracting the convex area in the middle of the panel.

② Triangle heating: The heated area resembles a triangle, and this way is often used for correcting strip-shaped materials and deformed panel edges.



Spot heating



Triangle heating

（3）Cooling-contracting way: When the flame is taken away, proper cooling ways should be chosen according to the stretched degrees of the metal panels. Different cooling ways bring about different contracting effects.

① Natural cooling-contracting, or cooling in the air naturally, which is suitable for smaller areas of deformities.

② Water cooling, or covering the heated area with wet cotton cloth to make it cool suddenly. The contraction of metal plate cooled in this way is larger than that of the naturally cooled one, but it may make the steel panel fragile.

③ Natural cooling and hammering, usually operated with a hand hammer and a underlay iron. During the operation, beat around the heated area quickly to increase the compressing stress and the contraction till that area is smoothed. The wooden hammer is preferred and do not use too strong a force, or the metal panel may get re-stretched.

4.3. Restoration of Cutting & Patching

When any part of the metal door panel is eroded or damaged beyond repair, it should be removed and replaced with a new piece by welding. The repairing methods include patching repair and cutting.

Steps for cutting repair are as follows:

（1） Check the damaged part and determine the repairing area.

（2） Make a paper model according to the determined area.

（3） Draw lines on the metal plates and cut material according to the paper model, and leave proper processing allowance.

（4） Select proper processing and shaping methods so that the patch matches well with the part to be removed.

（5） Apply the patch to the intended position and press it tightly, draw a line along the edge of the part to be removed and cut it out, using methods like gas cutting or excising according to the actual situation, and then align the patch with the excised area.

（6） Weld the seam by gas welding or carbon oxide protection welding. Spot-weld it at a pace of 30-50mm to fix it and then weld it again in a certain order after beating it smooth. For seams requiring welding of higher strength, doulble-sided welding is prefered.

（7） Smooth the welded seam by beating it with flat hammer, release the welding pressures, and then shape it and polish the seam with a grinding machine.

4.4. Restoration of Wrinkled Parts

Depending on the damage extent of the plate work pieces, the wrinkles are divided into “live wrinkles” and “dead wrinkles”. The “live wrinkles” are slight ones and can be directly removed by beating the convex part with a hammer. The “dead wrinkles” refere to seriously damaged parts. Since the wrinkles are folded and pressed against each other, so if you hammer the most convex part, the wrinkles would get even more seriously and harder to release, hence the name “dead wrinkles”. The principle of correcting the wrinkles is to spread “dead wrinkles” first so that they become “live wrinkles”, and then “live wrinkles” are converted into convex-concave shape, and finally restore the damaged parts just as you deal with convex-concave damages. The repairing steps are as follows:

（1） First use support-draw method to apply a correcting force in the direction opposite to that of the impact at the wrinkled part of the plate work, and then spread and ease the wrinkles.

（2） Remove the wrinkled plate work and lay it on a platform and then, beginning with the inner side of the wrinkled area, pry up the wrinkles with a proper prying tool and heat the “dead wrinkles” one by one with a welding torch at the same time. Finally all “dead wrinkles” are pried up and eased and converted into“live wrinkle”.

（3） Beat and smooth the “live wrinkles” from the inner side outward. The hammered spots should be near the most convex part of the “live wrinkles”. At the same time make sure the platform can support every beaten spot. When the wrinkles in one side of the plate are almost smoothed, turn it over to beat the other side till all wrinkles are completely spread out.

（4） Measure with a templet, and at the same time heat and beat the convex-concave part to restore it to its original shape.

（5） When the vehicle body is assembled, test with a templet again and make finer correction to achieve the final requirements.

（6） The seriously damaged wrinkles that can not be restored can be excised and repaired.

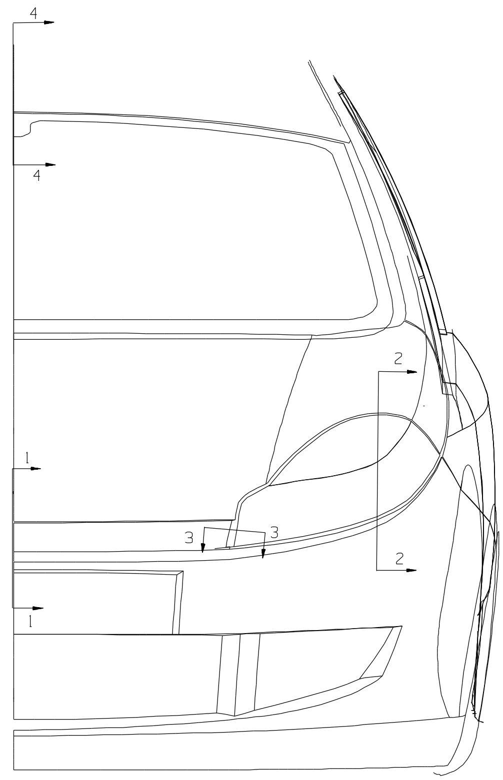
4.5. Welding of Four Doors and Two Covers

When welding the door panel, choose proper welding methods: gas welding (oxygen and acetylene welding), CO_2 shielded welding, manual arc welding, resistance spot welding, braze welding and so on. Besides, in order not to reduce the original strength and durability of the vehicle body, try to adopt the welding methods used in manufacturing the door panels, and the dimensions and types of all weld joints should be similar to those used by the original manufacturer.

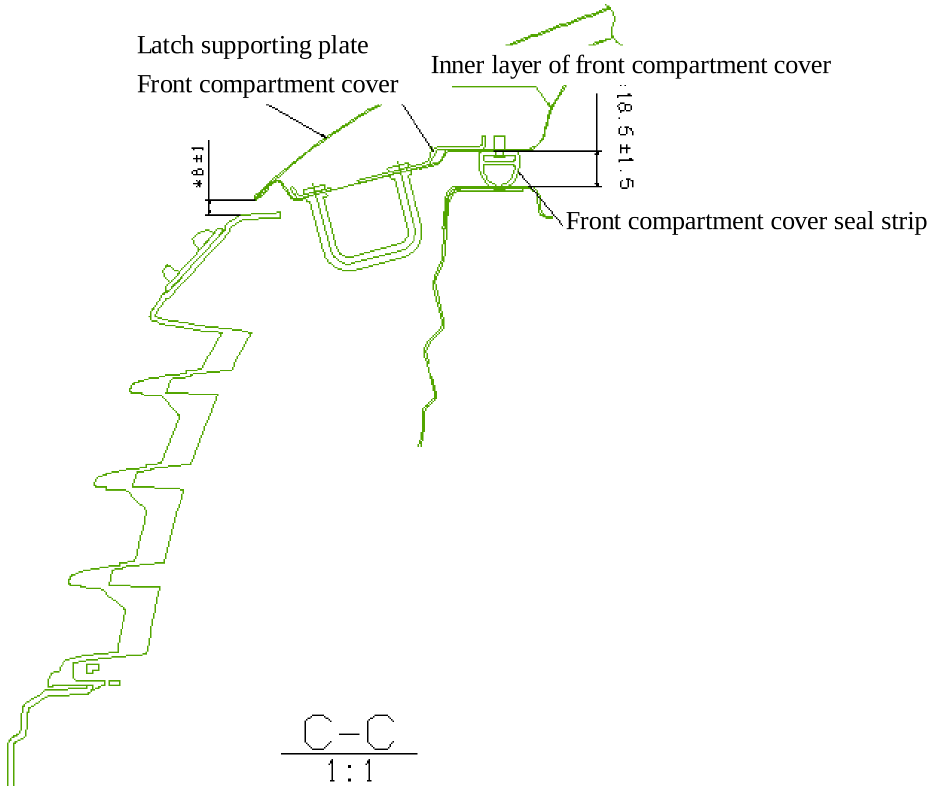
As for appearance and quality, no burnt-through spots, half points, cracks, a lot of burrs or other defects should exist at the welded parts. The welded surface should be smooth and nice-looking, no obvious twist or deformation is allowed, and the indentation depth should be less than 1/5 of the plate thickness. Flat spade and iron hammer can be used to carry out non-destructive tests of the welded spots’ strength. Insert the flat spade between two welded spots to see if they are easy to separate, and then beat the welded part with an iron hammer to restore it. No welding spatter is allowed at the welded seam, and the overlapped seam should be nice-looking with no defects like air holes or cracks. Defects like undercut, welding beading and burning through are also not allowed.

II. Vehicle Body Assembly Dimensions

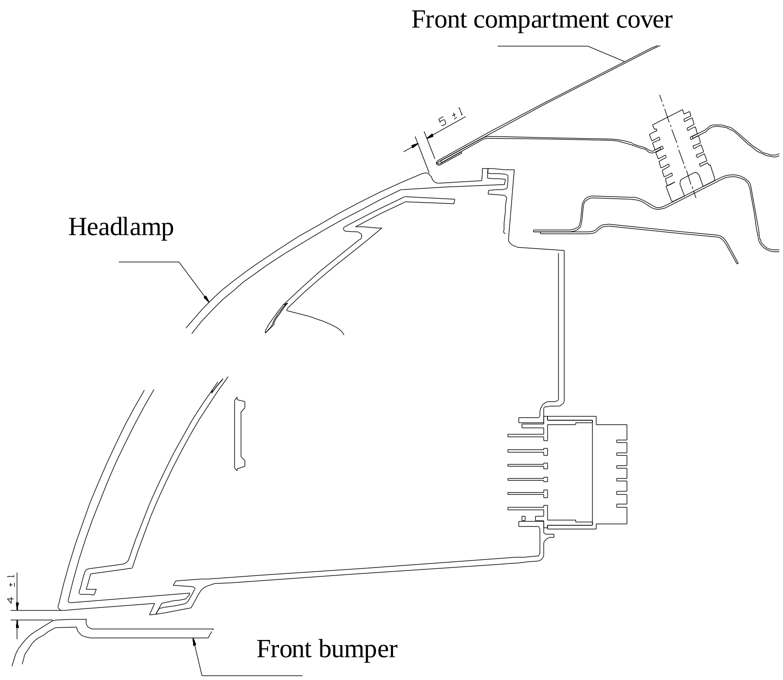
1. Front View



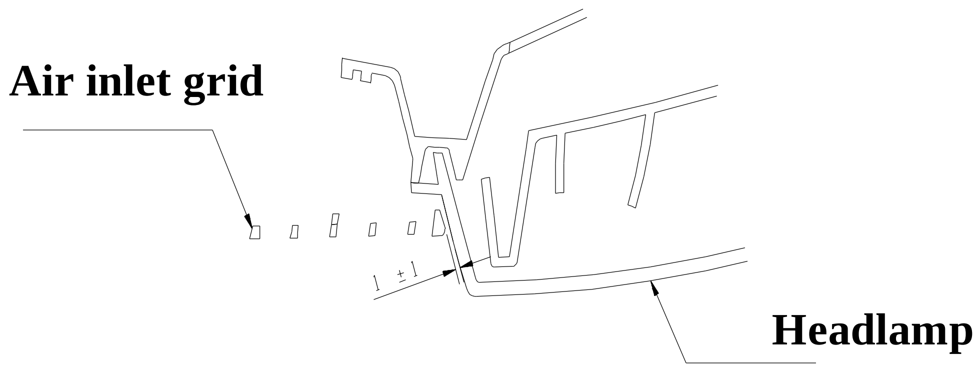
1.1. Clearance between front hood and air inlet grid at C-C: 8±1



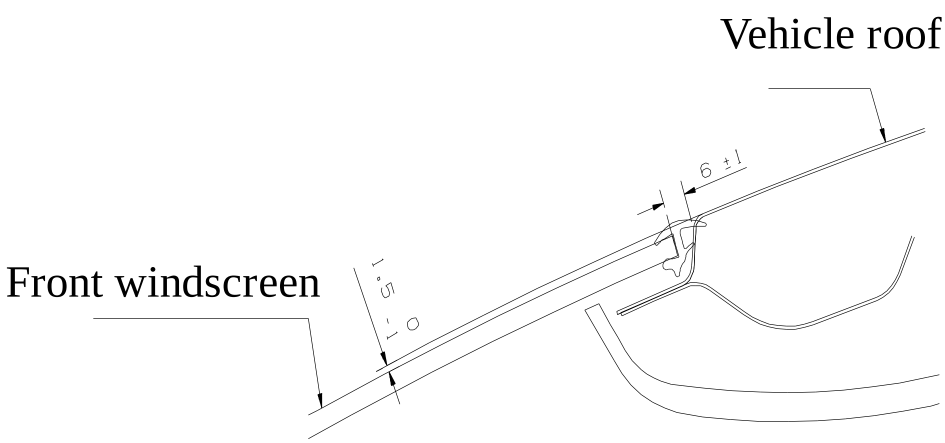
1.2. Clearance between front hood and headlamp at 2-2: 5±1mm



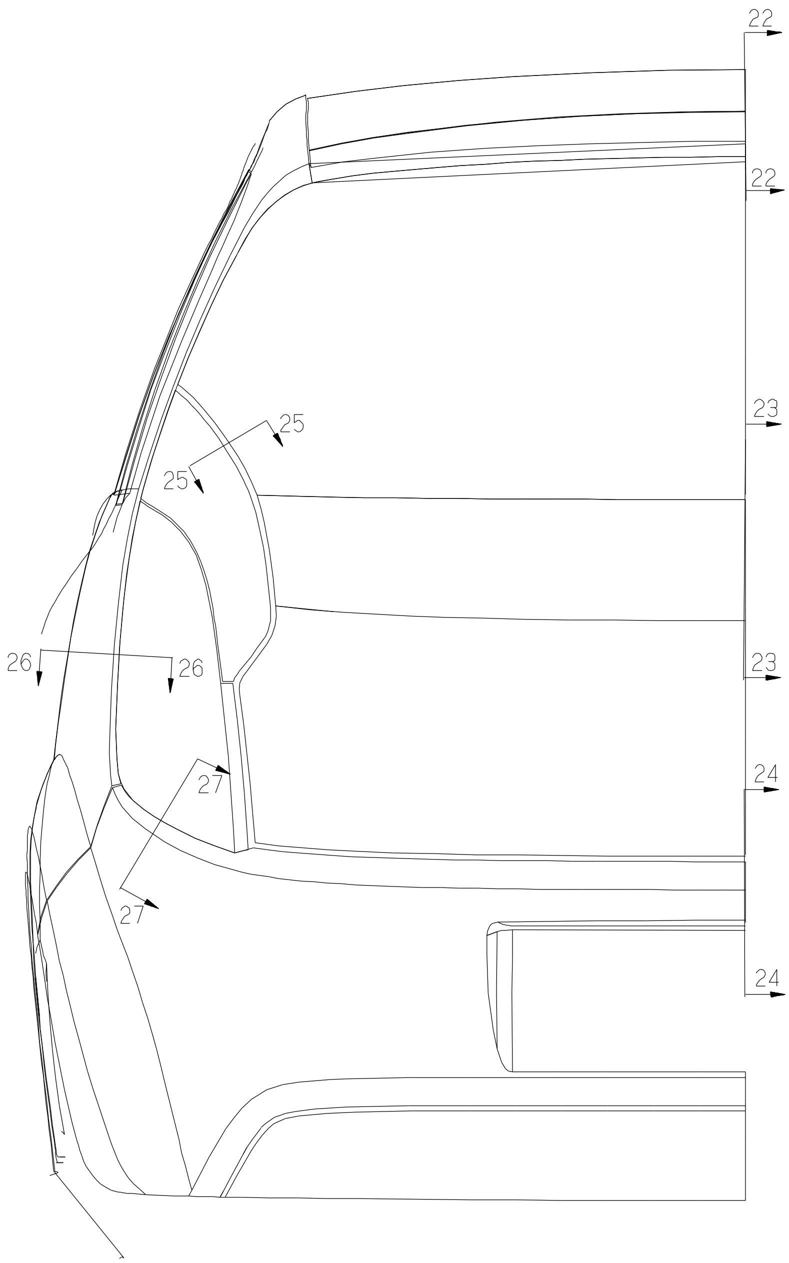
1.3. Clearance between headlamp and air inlet grid at 3-3: 1±1mm



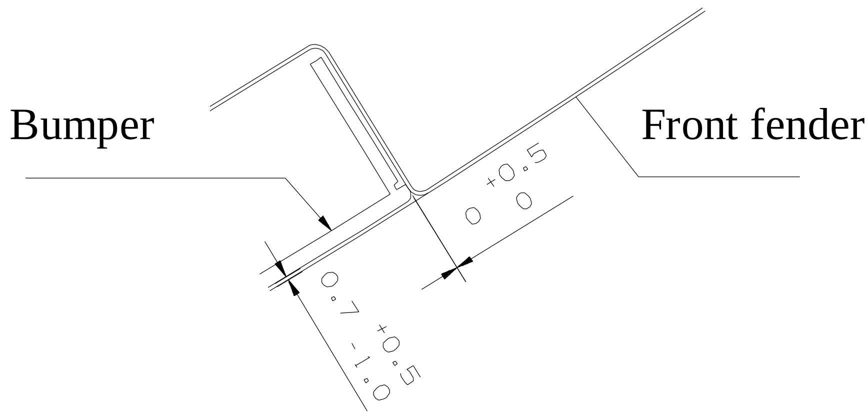
1.4. Clearance between the front windscreen and the vehicle roof at 4-4: 6±1mm



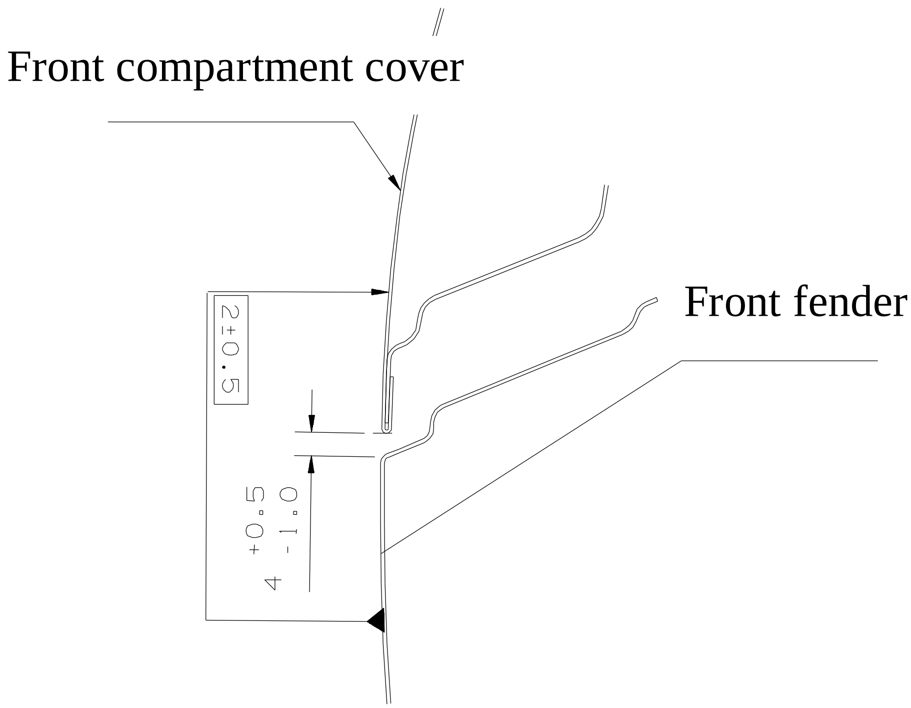
2. Left-front View



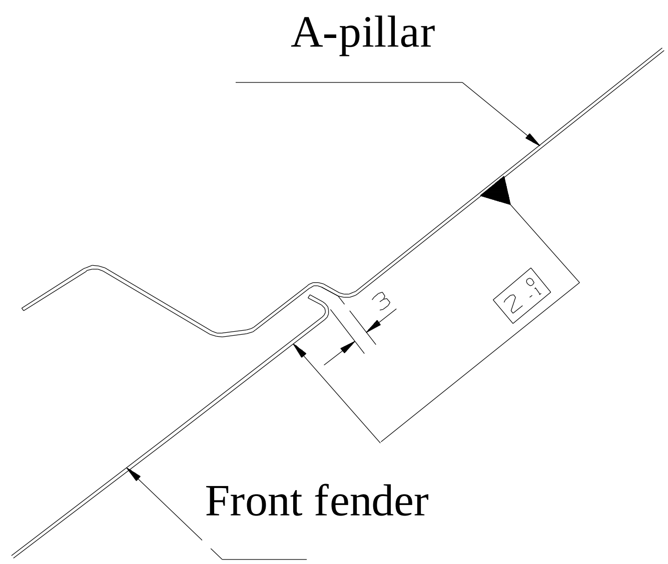
2.1. Clearance between front bumper and front fender at 5-5: $0_{0}^{+0.5}$ mm



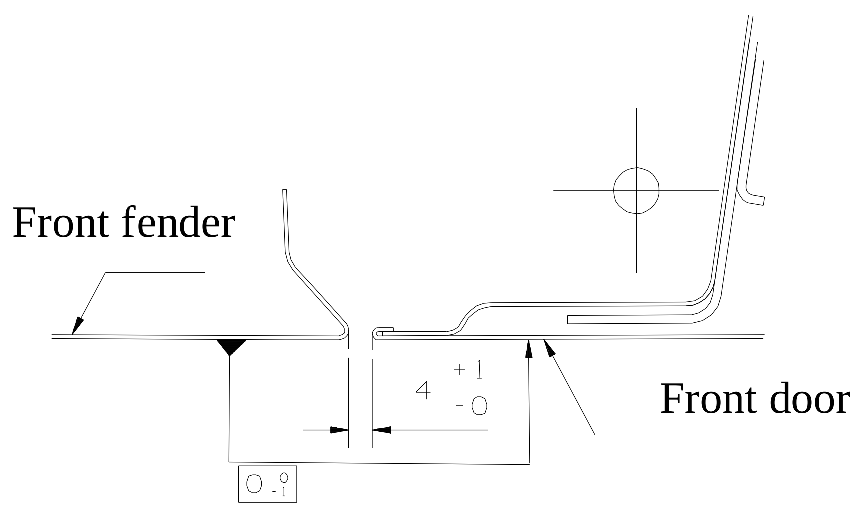
2.2. Clearance between front hood and front fender at 6-6: 4mm



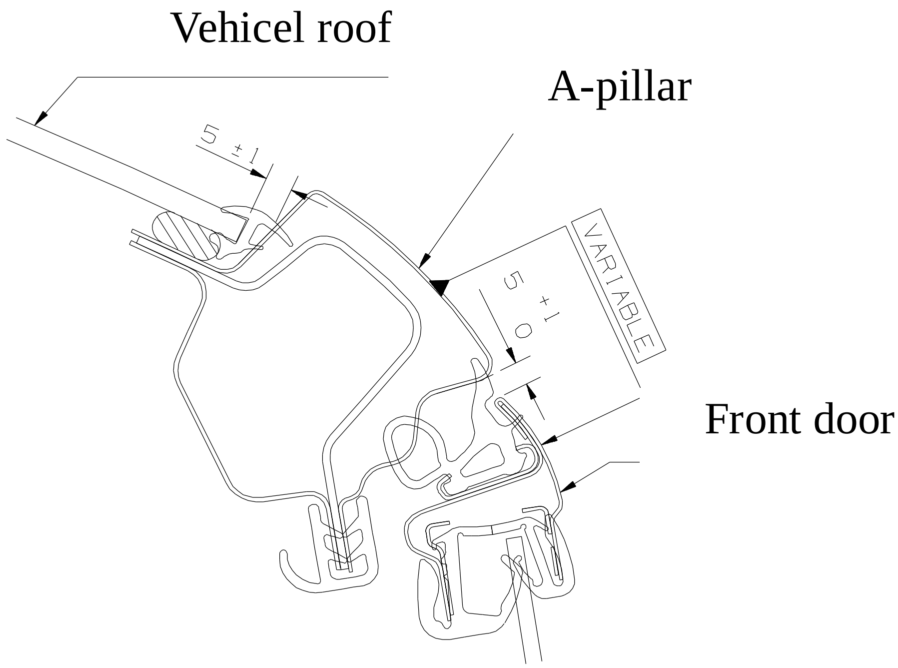
2.3. Clearance between front fender and A-pillar (side wall) at 7-7: 3mm



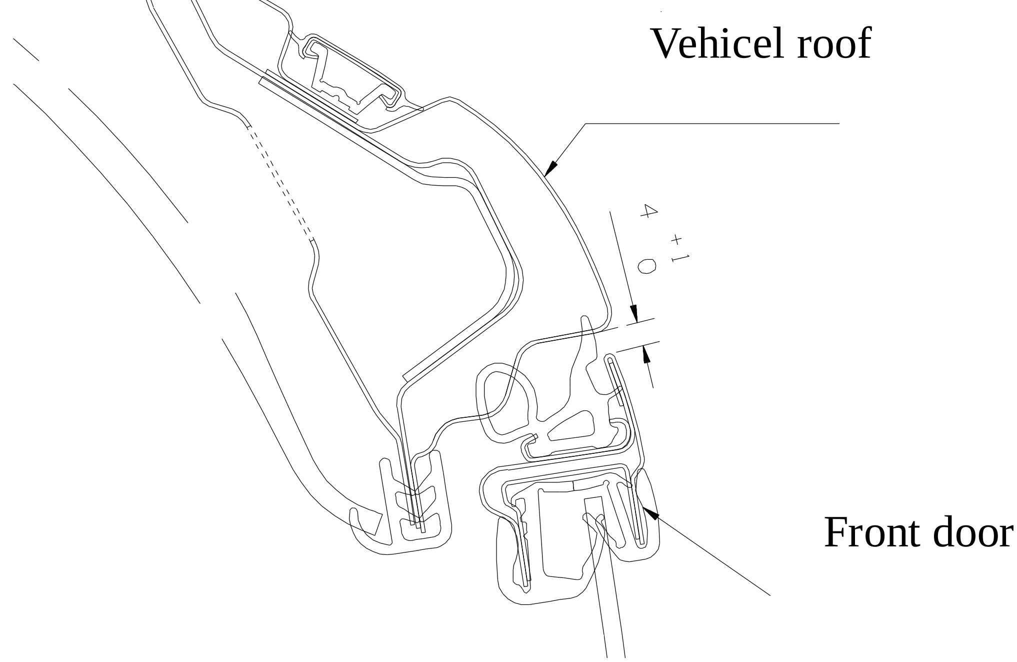
2.4. Clearance between front fender and front vehicle doors at 8-8: 4^{+1}_{0} mm



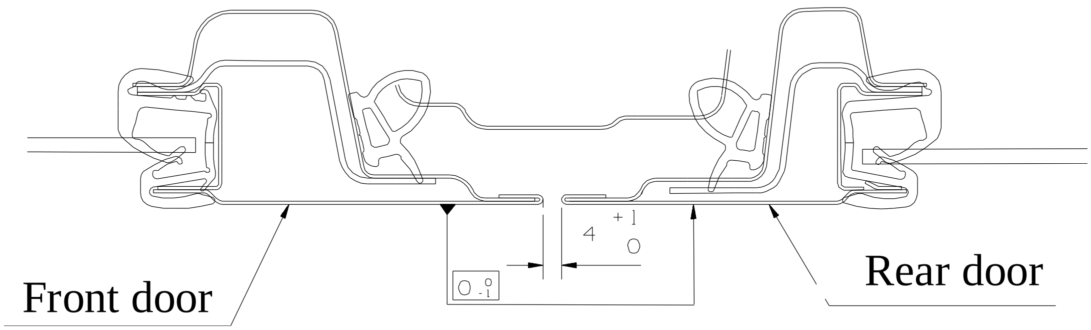
2.5. Clearance between front door and A-pillar (Side wall) at 9-9: 5±1mm



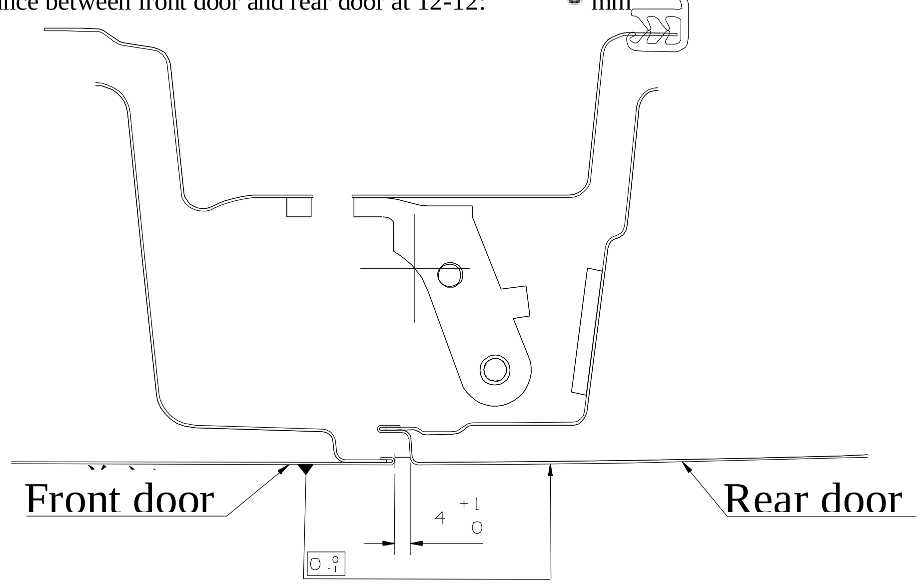
2.6. Clearance between front vehicle doors and vehicle roof 10-10: 4_{0}^{+1} mm



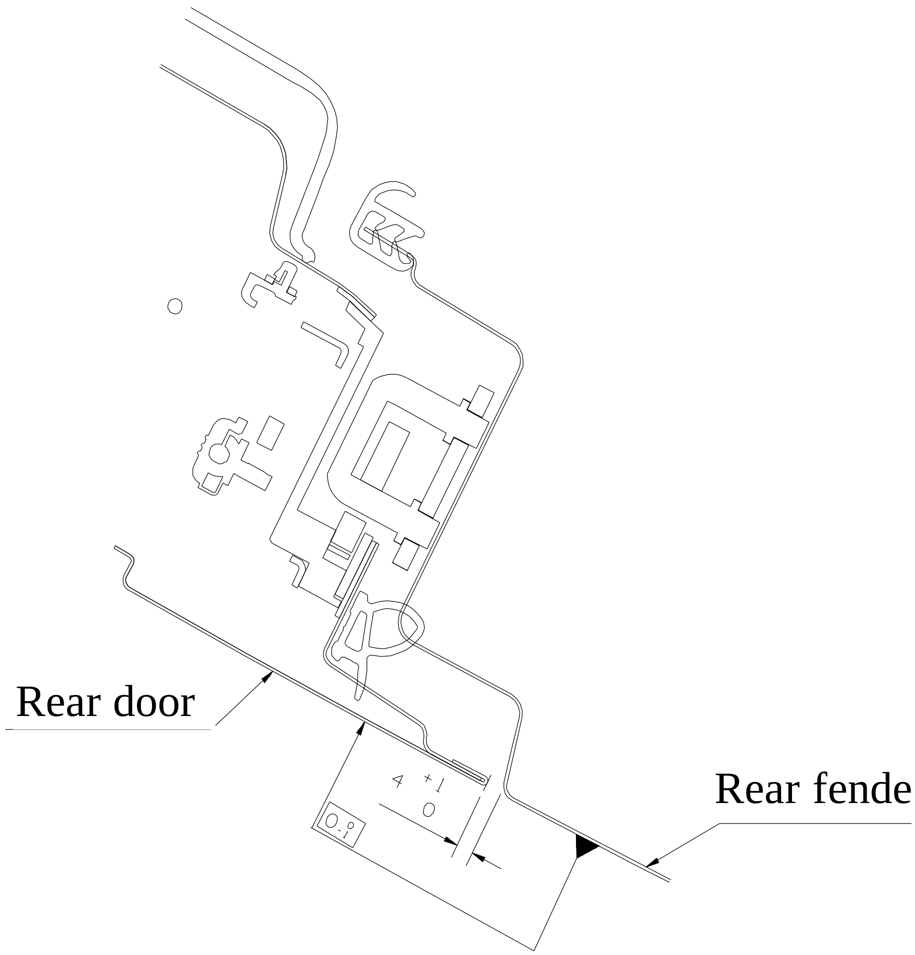
2.7. Clearance between front door and rear door at 11-11: 4^{+1}_{0} mm



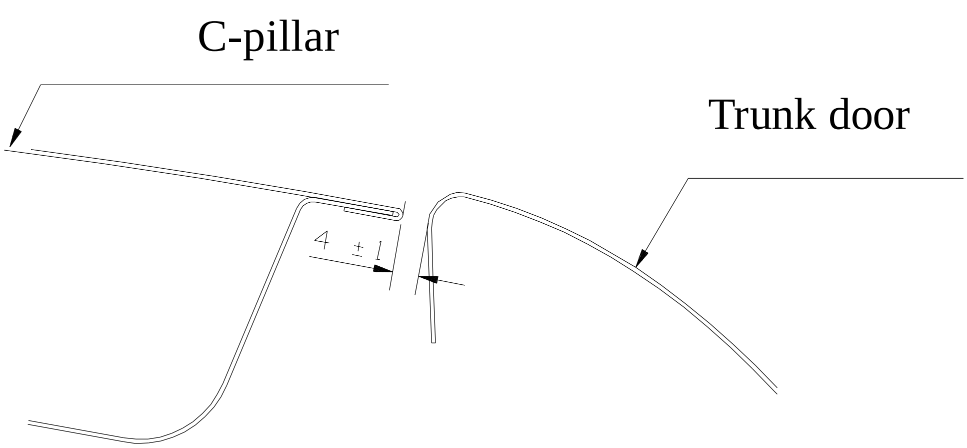
2.8. Clearance between front door and rear door at 12-12: 4^{+1}_{0} mm



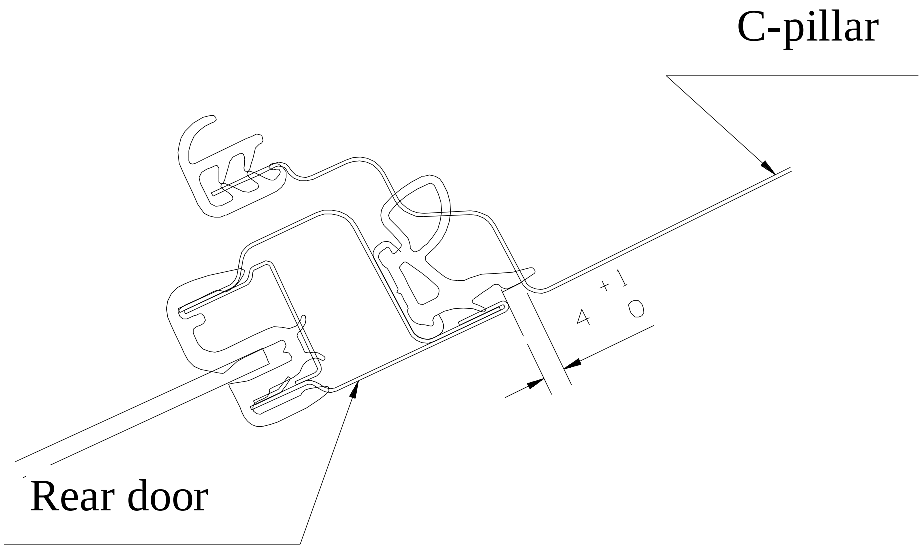
2.9. Clearance between rear door and rear fender (side wall) at 13-13: 4^{+1}_{0} mm



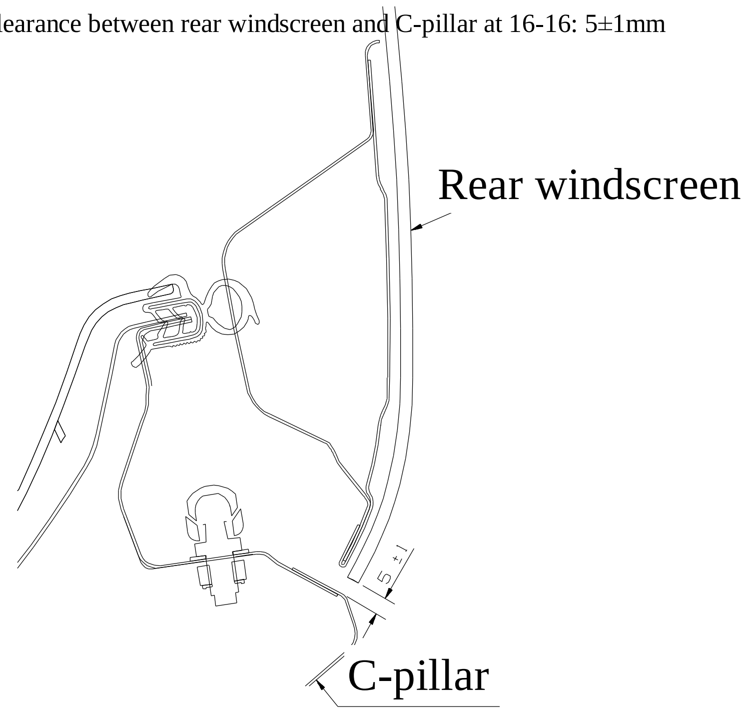
2.10. Clearance between rear door and rear fender (side wall) at 14-14: 4^{+1}_{0} mm



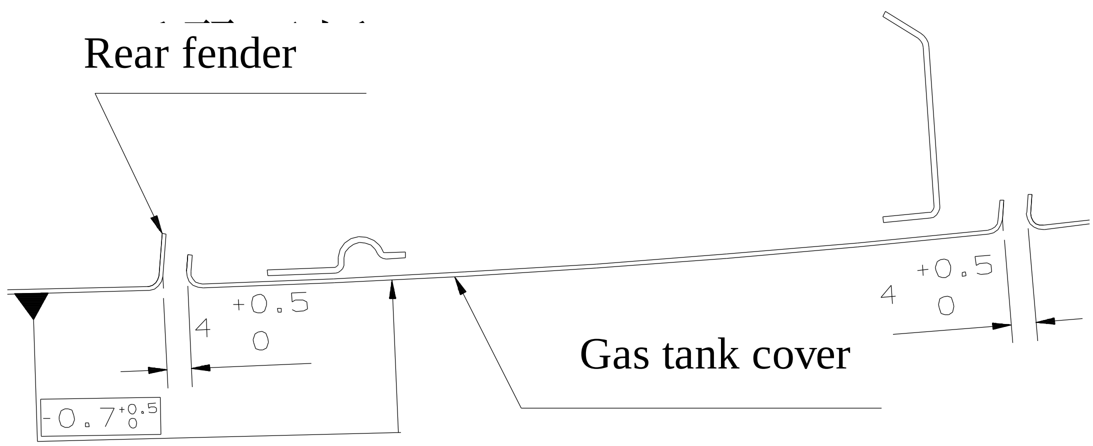
2.11. Clearance between rear door and C-pillar at 15-15: 4^{+1}_{0} mm



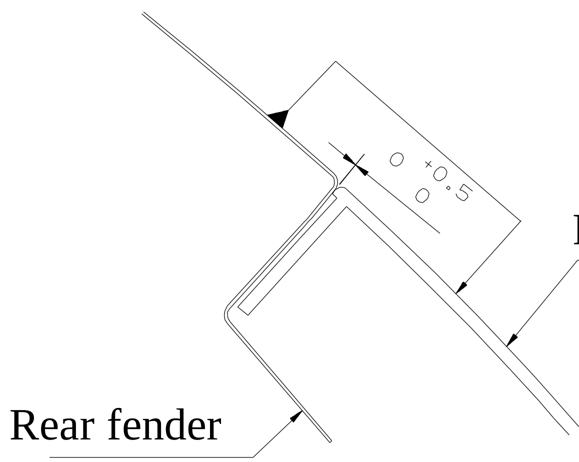
2.12. Clearance between rear windscreen and C-pillar at 16-16: 5±1mm



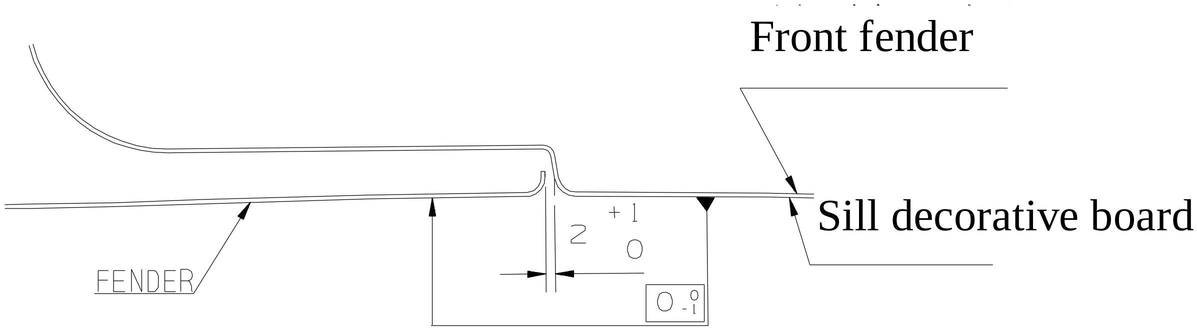
2.13. Clearance between gas tank cover and rear fender (side wall) at 17-17 and 18-18: $4_{0}^{+0.5}$ mm



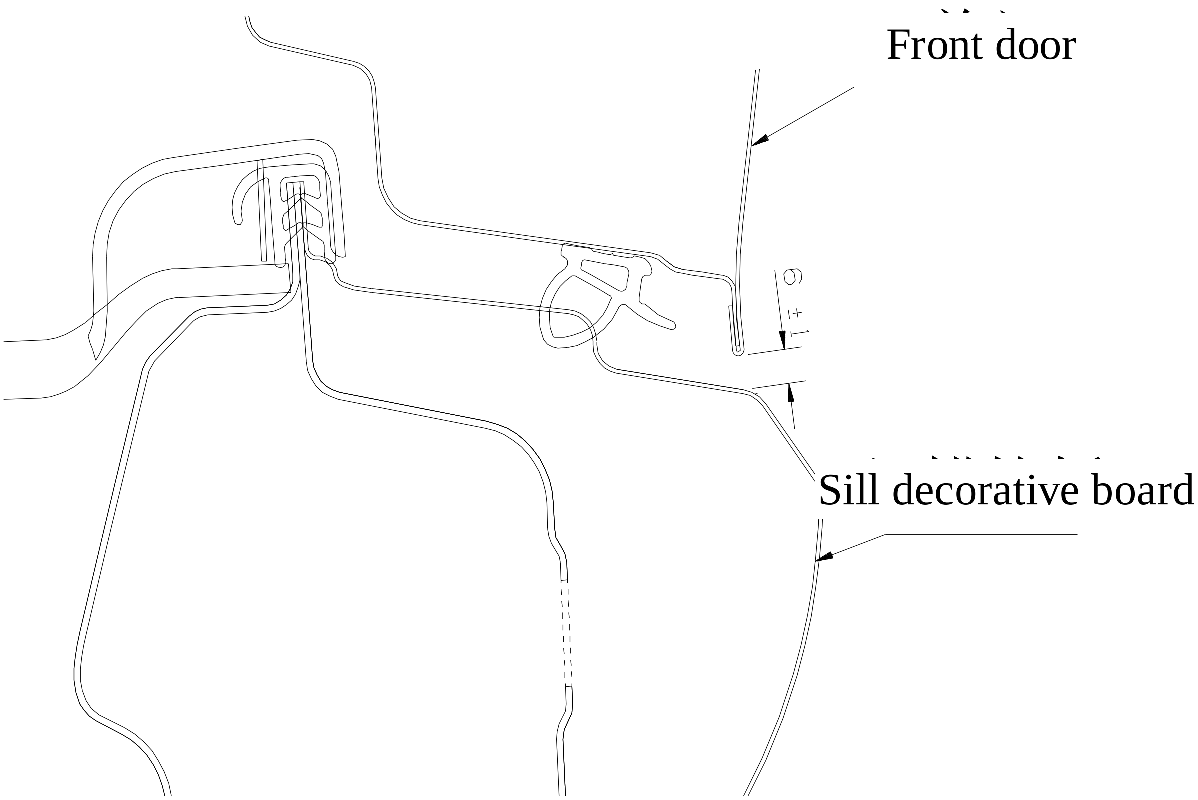
2.14. Clearance between rear bumper and rear fender at 19-19: $0_{0}^{+0.5}$ mm



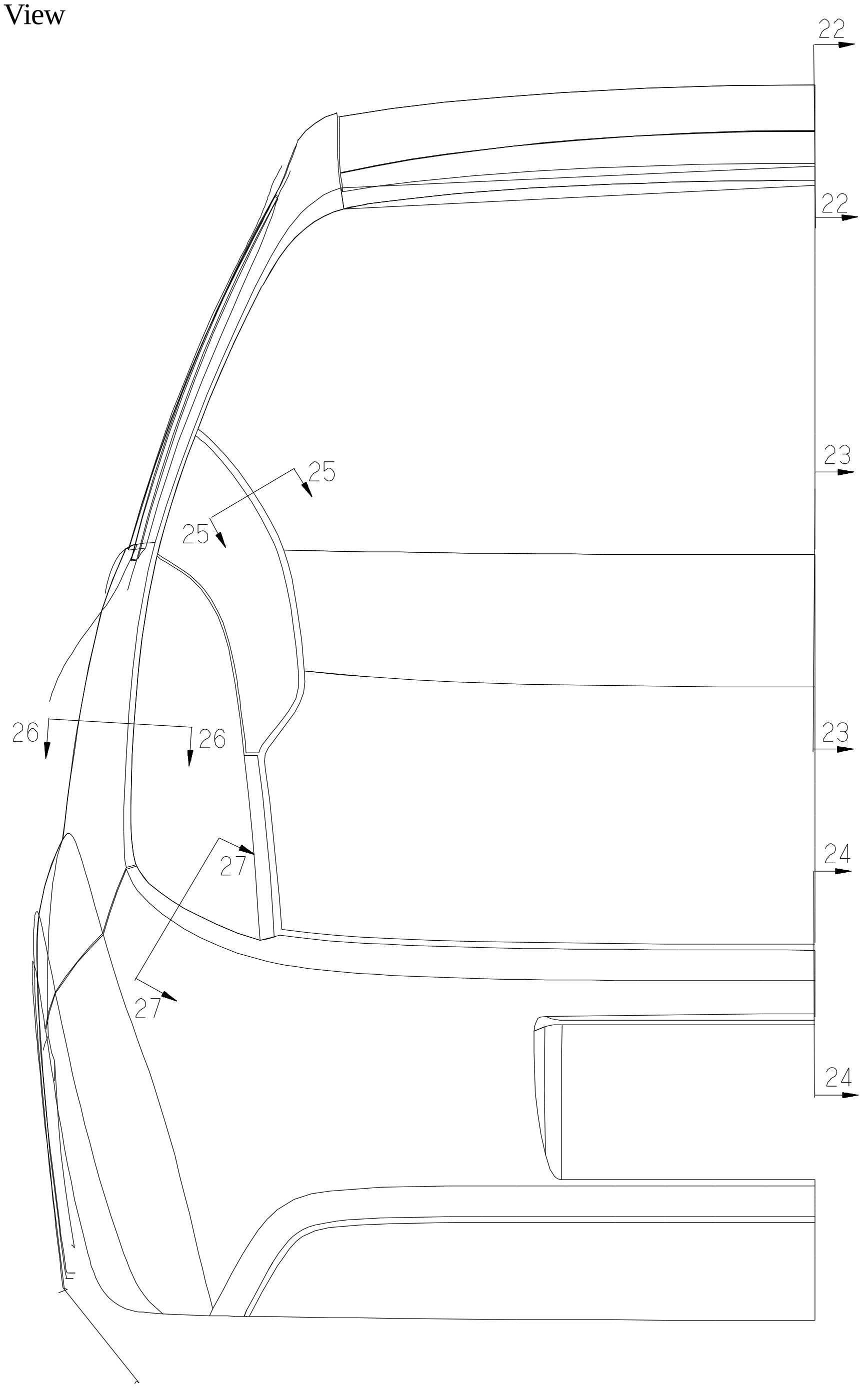
2.15. Clearance between front fender and sill decorative board (side wall) at 20-20: 2_{0}^{+1} mm



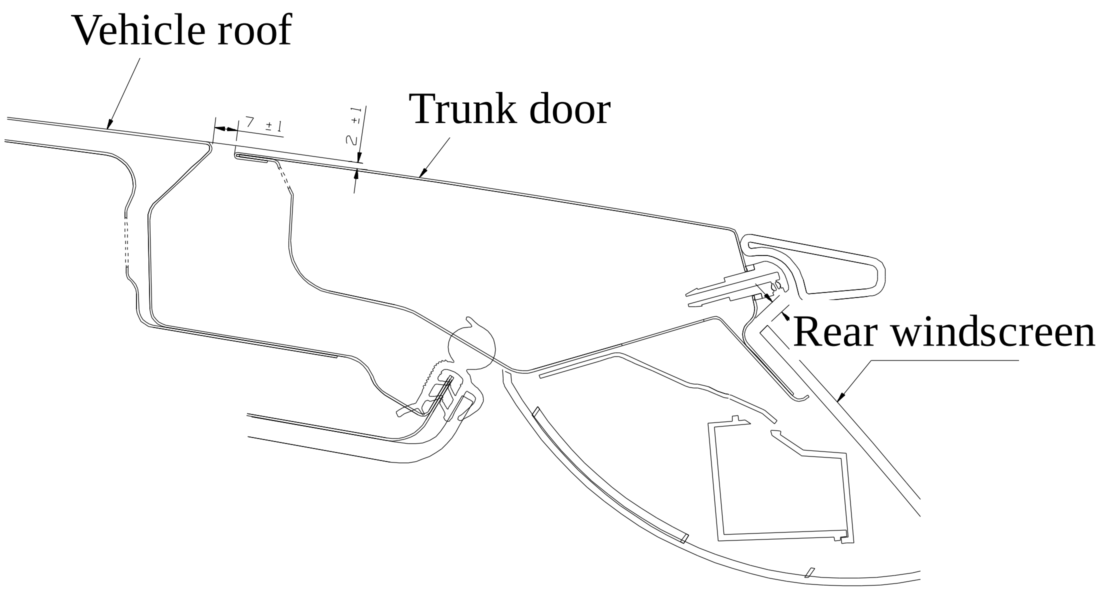
2.16. Clearance between front door and sill decorative board (side wall) at 21-21: 6±1mm



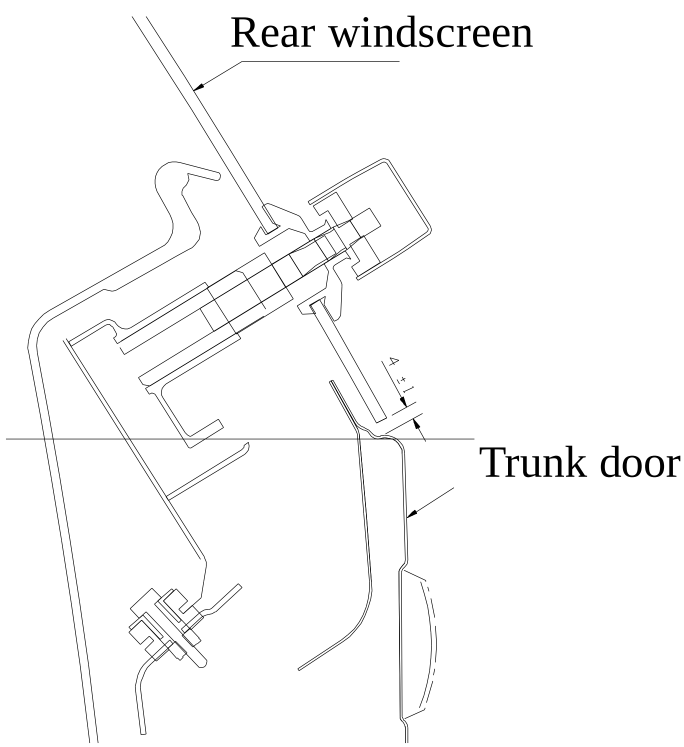
3. Back View



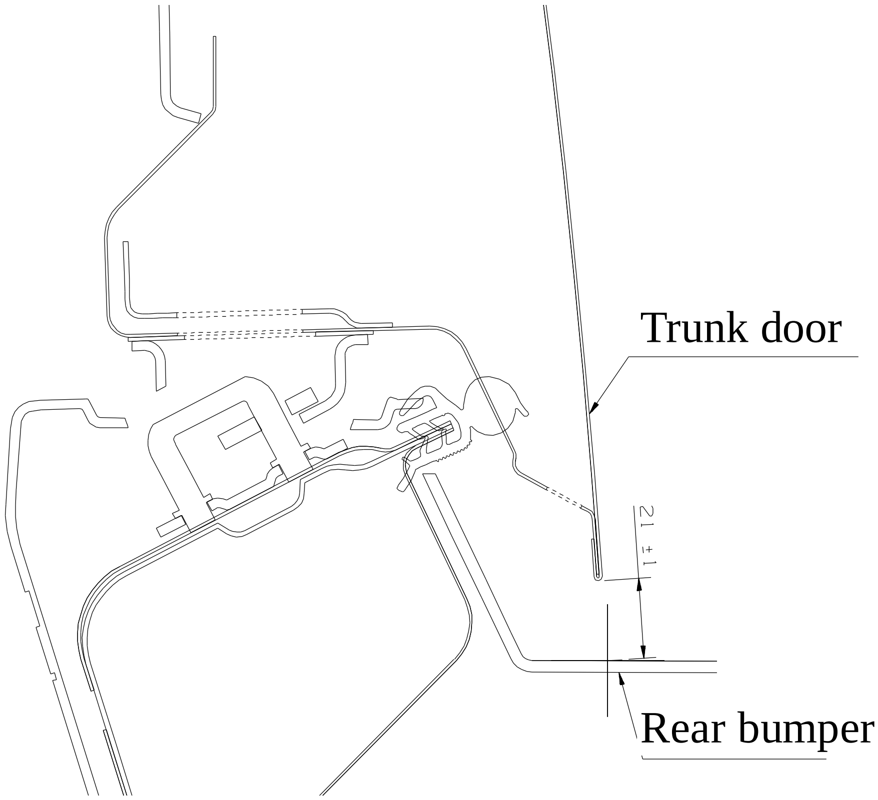
3.1. Clearance between vehicle roof and trunk door at 22-22: 7±1mm



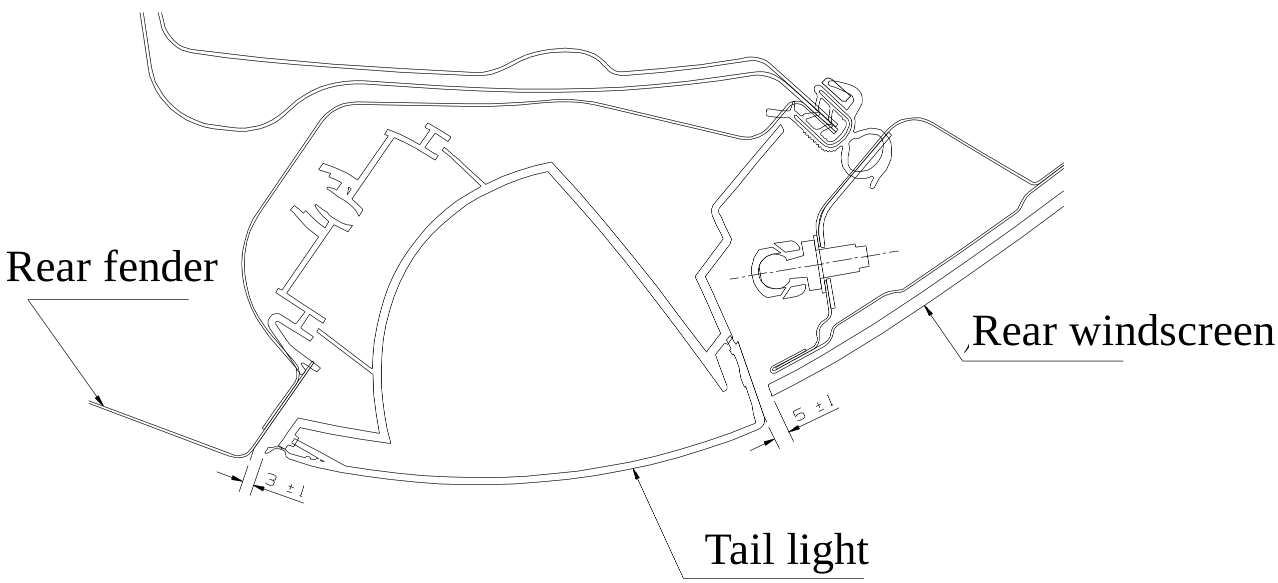
3.2. Clearance between rear windscreen and trunk door at 23-23: 4±1mm



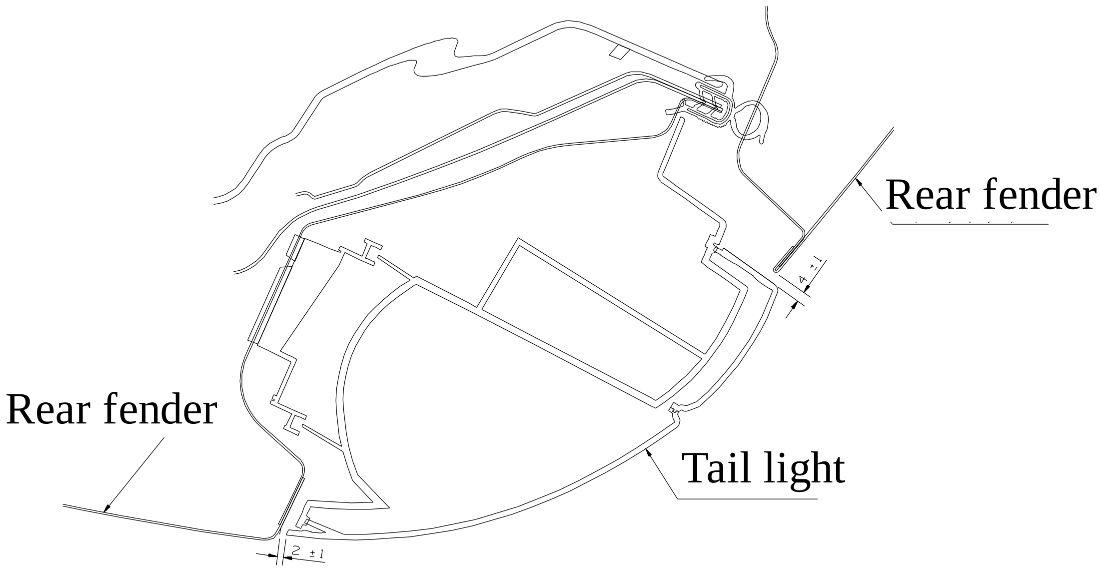
3.3. Clearance between trunk door and rearbumper at 24-24: 21±1mm



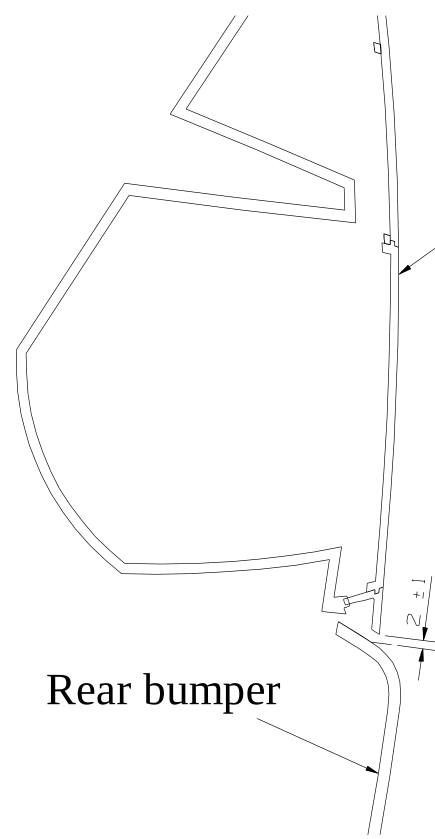
3.3. Clearance between rear windscreen and tail light at 25-25: 5±1mm



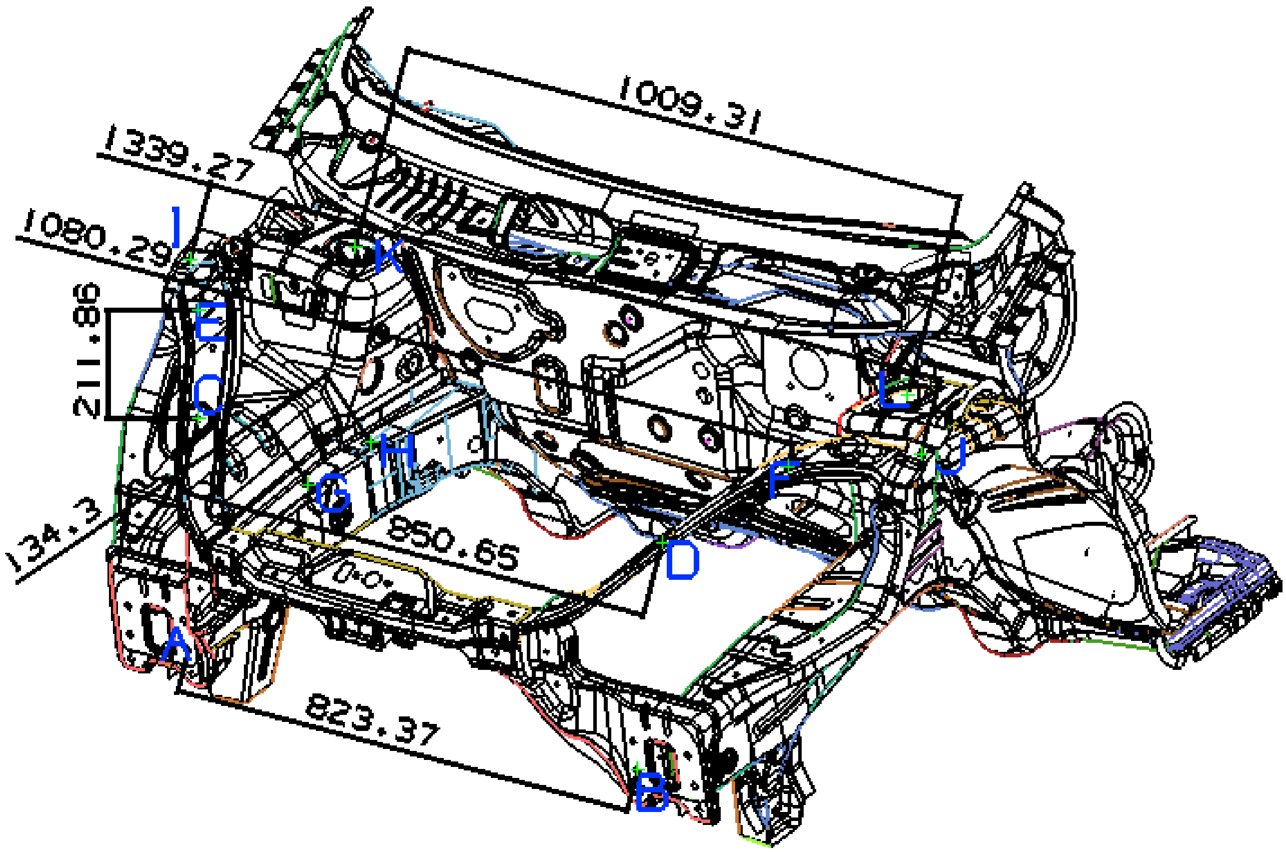
3.4. Clearance between tail lights and rear fender (side wall) at 26-26: 4±1mm



3.5. Clearance between tail light and rear bumper at 27-27: 2±1mm

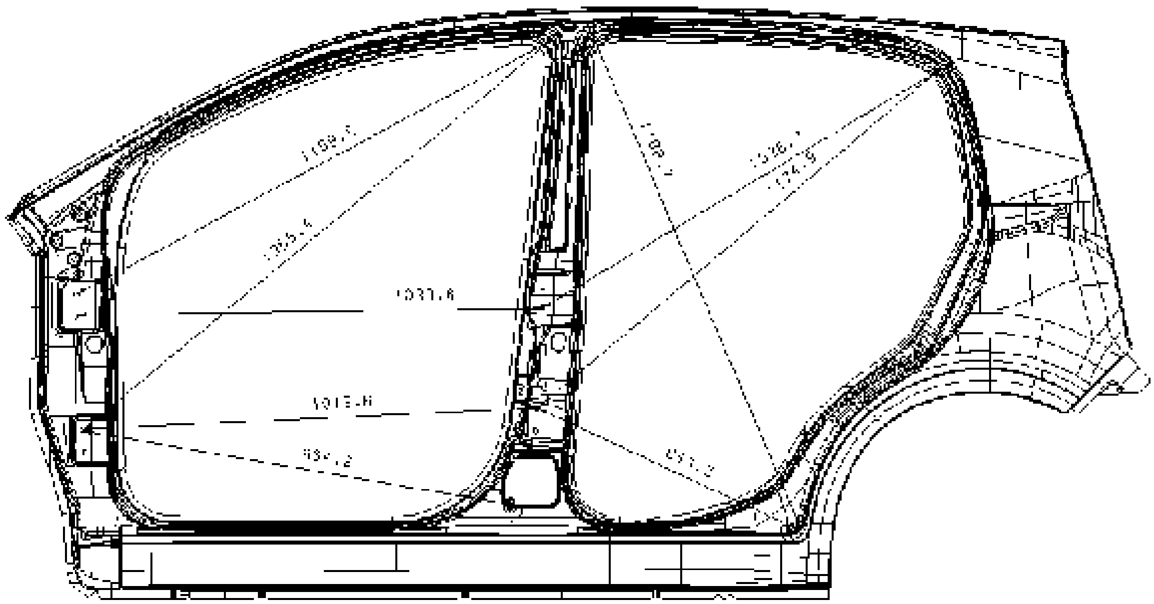


III. Engine Compartment Dimensions

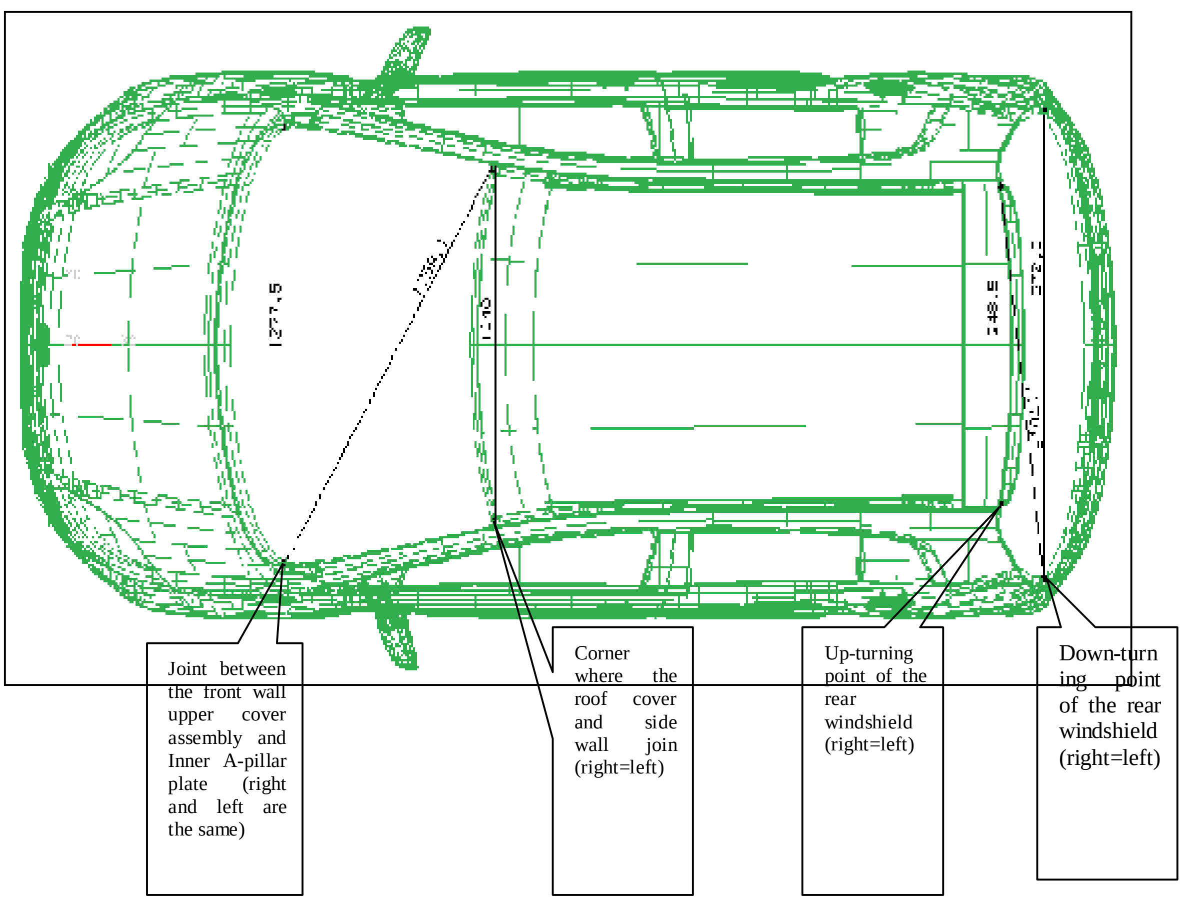


No	Name	Diameter
A/B	Front bumper crossbeam mounting hole	Φ11
C/D/E/F	Headlight mounting hole	Φ7
G/H	Engine right suspension bracket mounting hole	Φ13
I/J	Installation of fender	Φ8
K/L	Shock absorber mounting hole	Φ76

IV. Various Opening Dimensions



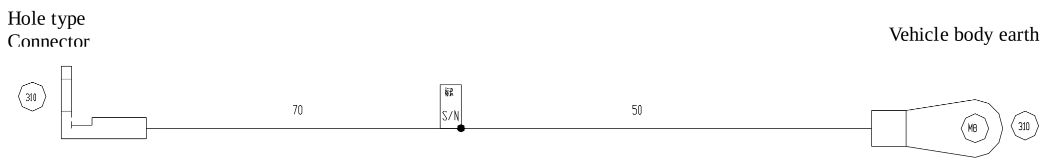
V. Windshield Dimensions



Chapter X Harness

Section I Battery Negative Harness

I. Harness Sketch



II. Instructions on Main Connectors

No	Connector Name	Pins	Connection	Remark
1	Hole type joint	1	Battery Negative	
2	Vehicle body ground	1	Vehicle body	Below left-front fender

III. Removal and Installation of Battery Harness

Part number: S12-3703010AC

(I). Preparations

Tools: 10#. 13# wrench

(II). Notes

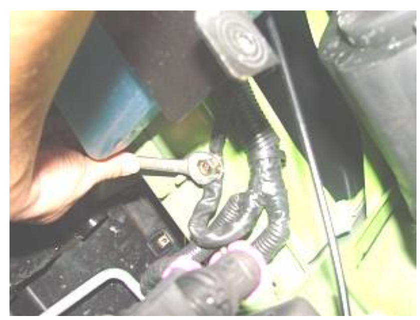
Make sure to disconnect the power supply when disassembling the electrical components and harnesses.
Ignition switch must be OFF.

(III). Removal Steps

1. Removal
1.1. Use a 10# wrench to remove the battery positive.

1.2. Use a 10# wrench to loosen off the battery negative.

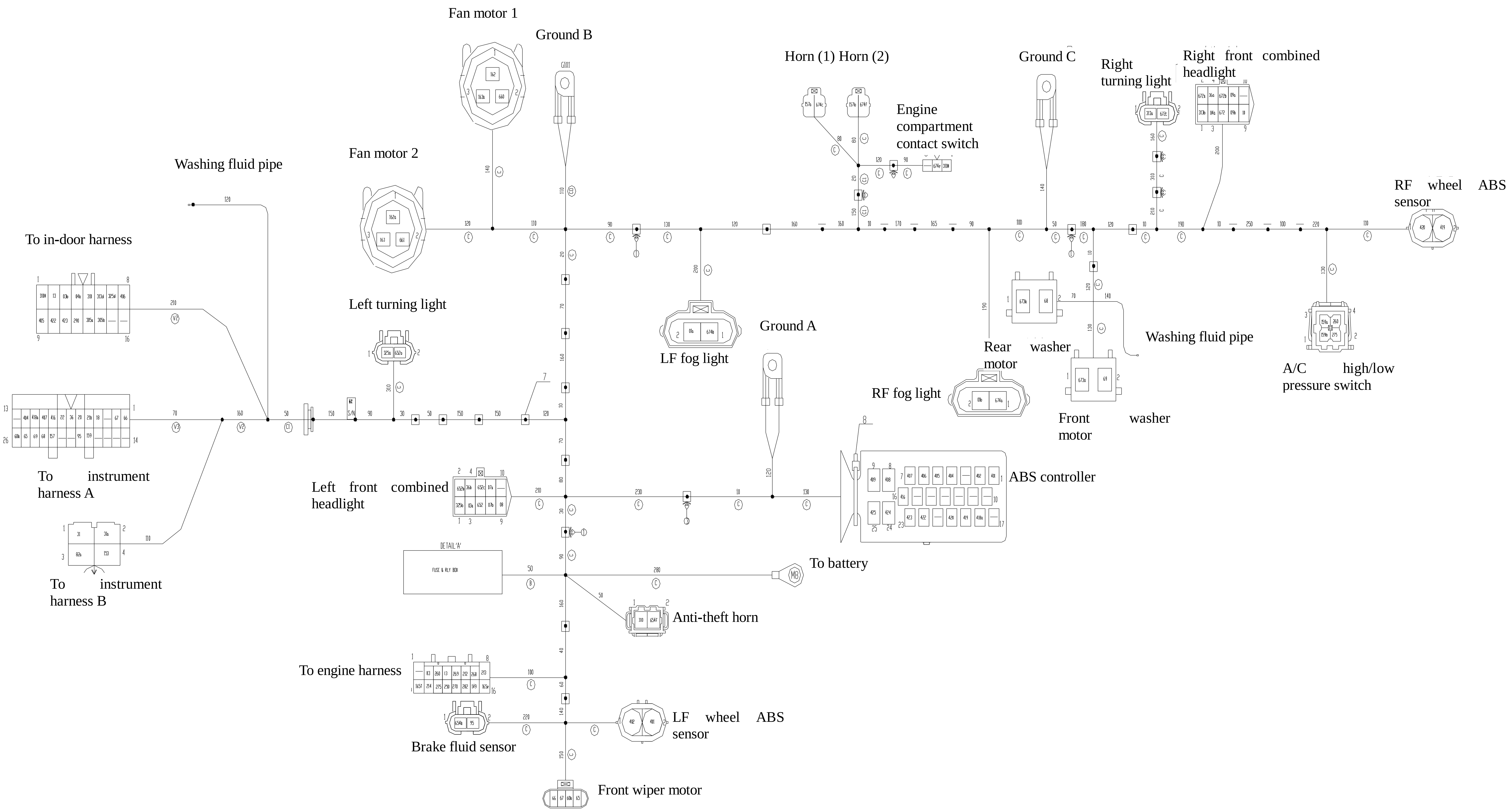
1.3. Use a 13# wrench to loosen off the battery negative harness Remove the battery negative harness at the vehicle body ground wire.



2. Installation
The installation steps are reverse to those for removal.

Section II Front Compartment Harness

I. Harness Sketch



II. Instructions on Main Connectors

No	Connector Name	Pins	Connection	Remark
1	In-door harness connector	16	In-door harness	
2	Instrument harness A connector	26	Instrument harness A	
3	Instrument harness B connector	4	Instrument harness B	
4	Washing fluid piping			
5	ABS connector	25	ABS	
6	Ground A		Vehicle body	ABS on the left-front side member
7	Left-front combination headlights connector	10	Left-front combination headlights	
8	Fuse box		Fuse box	
9	Anti-theft speakerconnector	2	Anti-theft speaker	
10	Connect the battery		Battery	
11	Engine harness connector	16	Engine harness	
12	Brake fluid level sensor connector	2	Brake fluid level sensor	
13	Front wiper motor connector	4	Front wiper motor	
14	Left-front wheel ABS sensor connector	2	Left-front wheel ABS sensor	
15	Left turning light connector	2	Left turning light	
16	Fan motor 1 connector	3	Fan motor 1	
17	Fan motor 2 connector	3	Fan motor 2	
18	Ground B		Vehicle body	Fan on the left-front side member
19	Left-front fog lights connector	2	Left-front fog lights	
20	Speaker 1 connector	2	Speaker 1	
21	Speaker 2 connector	2	Speaker 2	
22	Front compartment contact switch connector	3	Front compartment contact switch	
23	Ground C		Vehicle body	Washer solution tank on the right-front side member
24	Right-front fog light connector	2	Left-front fog light	
25	Front washing motor connector	2	Front washing motor	
26	Rear washing motor connector	2	Rear washing motor	
27	Washing fluid pipe			
28	Right turning light connector	2	Left turning light	
29	Right-front combination headlight connector	10	Right-front combination headlight	
30	Right-front wheel ABS sensor connector	2	Right-front wheel ABS sensor	
31	Air-conditioner high/low voltage switch connector	4	Air-conditioner high/low voltage switch	

III. Removal and Installation of Front Compartment Harness

Part number: S12-3724010

(I). Preparations

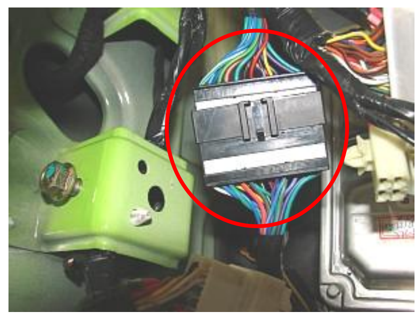
Tools: sleeve wrench, cross head screwdriver, flat head screwdriver

(II). Notes

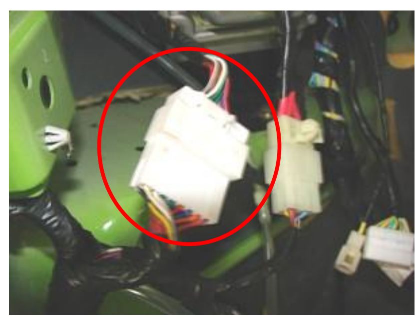
Make sure to disconnect the power supply when disassembling the electrical components and harnesses.
The ignition switch must be OFF.

(III). Removal Steps

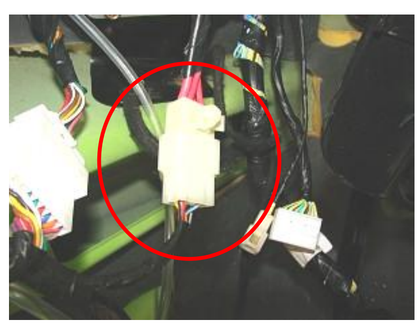
1. Removal
1.1.1. Remove the left-down shield of the Instrument Panel. (See Removal and Installation of Instrument Panel)
1.1.2. Unplug the in-door harness connector.



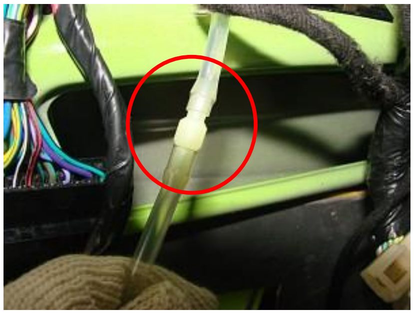
1.1.3. Unplug the connector of instrument harness A.



1.1.4. Unplug the connector of instrument harness B.

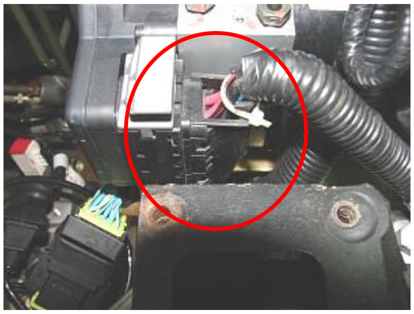


1.1.5. Unplug the washing fluid piping connector.

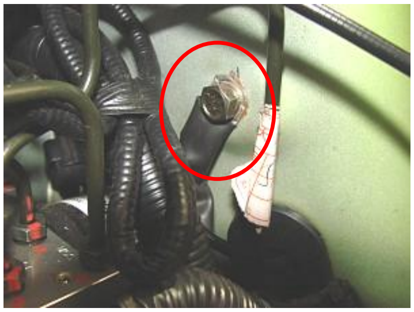


1.1.5. Disassemble the battery. (See Removal and Installtion of Battery).

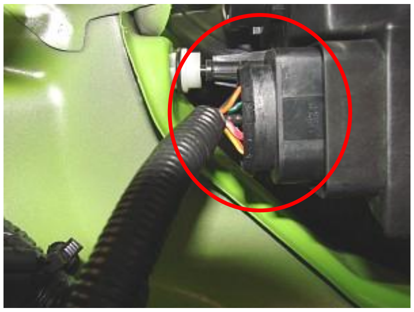
1.1.6. Unplug the ABS plug.



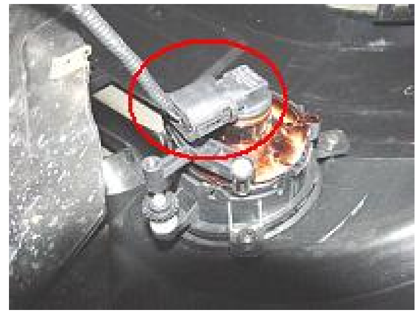
1.1.7. Remove the ground wire. (ABS on left-front side member)



1.1.8. Unplug the connector to left headlight.

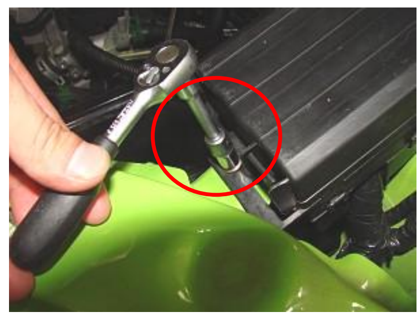


1.1.9. Unplug the connector of left-front fog light.

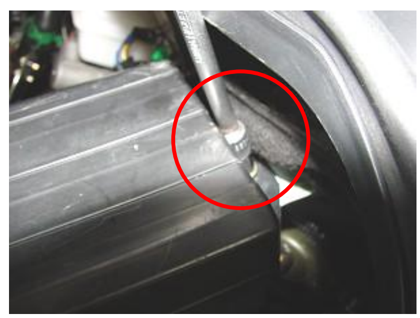


1.1.10. Unplug the engine harness connector.

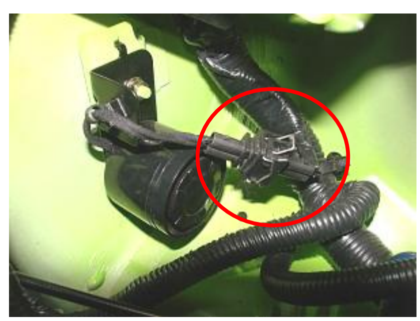
1.1.11. Use a sleeve wrench to loosen off the lower fixing screws of the fuse box.



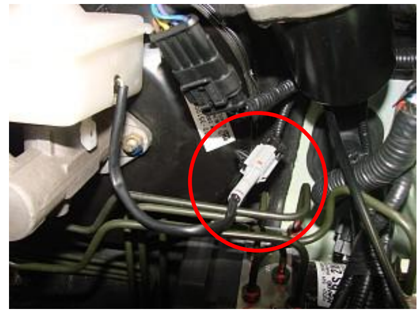
1.1.12. Use a sleeve wrench to loosen off the upper fixing screws of the fuse box.



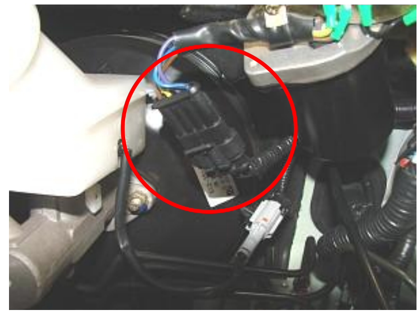
1.1.13. Unplug the connector to the anti-theft speaker.



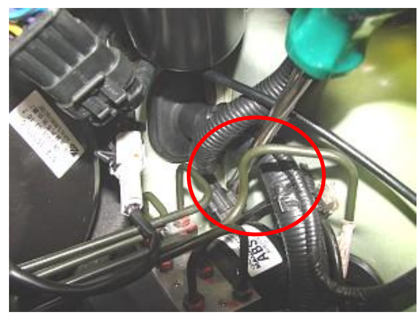
1.1.14. Unplug the connector to the brake fluid level sensor.



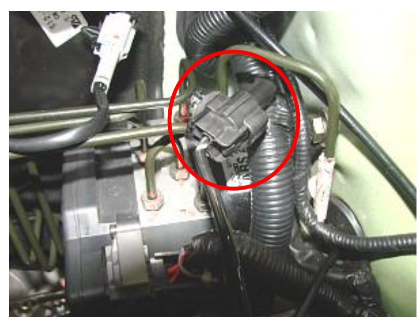
1.1.15. Unplug the connector to the wiper motor



1.1.16. Use a flat head screwdriver to pry out the left-front wheel ABS sensor plug fixed on the vehicle body. (Near ABS)



1.1.17. Unplug the left-front wheel ABS sensor plug.

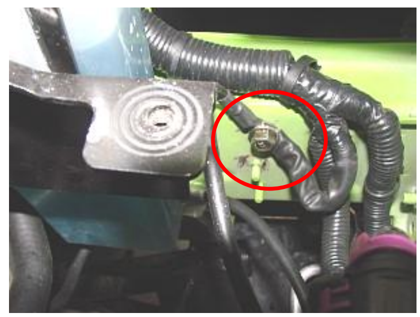


1.1.18. Use a flat head screwdriver to pry open the left-front turning light.

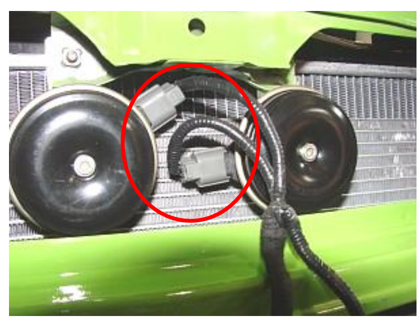
1.1.19. Unplug the plug of the left-front turning light.

1.1.20. Unplug the two connectors of the fan motor.

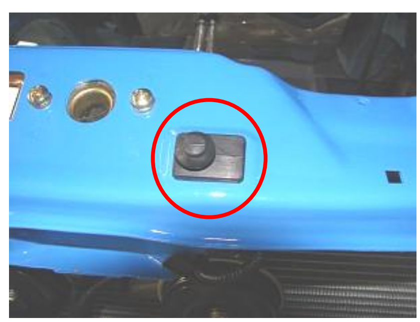
1.1.21. Loosen off the ground wire on the side member. (Fan)



1.1.22. Unplug the two connectors to the speaker.

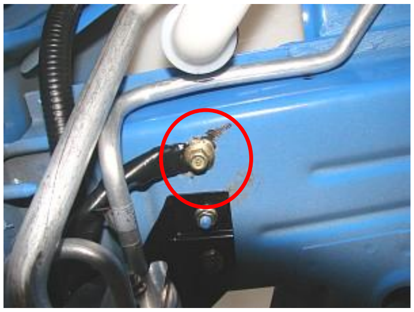


1.1.23. Disassemble the front compartment contact switch.



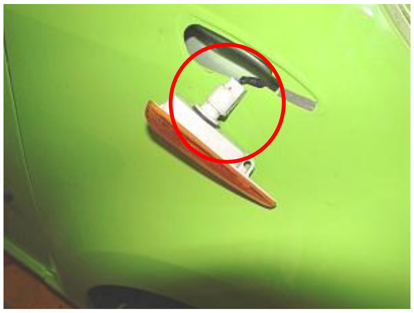
1.1.24. Unplug the connectors of the front/rear washing motors.

1.1.25. Disassemble the ground wire. (Washing fluid tank on the right-front side member)

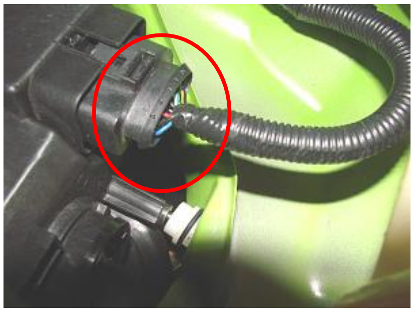


1.1.26. Use a flat head screwdriver to pry open right-front turning light.

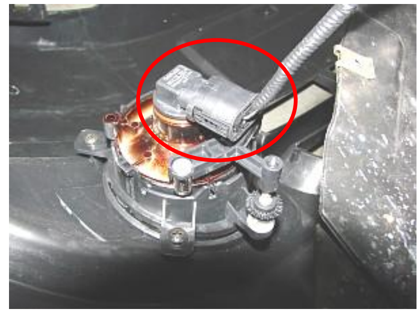
1.1.27. Unplug the plug of the right-front turning light.



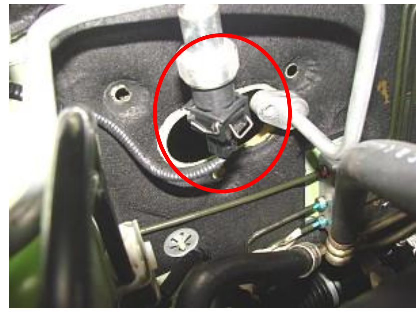
1.1.28. Unplug the right headlight connector.



1.1.29. Unplug the right-front fog light connector.



1.1.30. Unplug the high/low voltage switch plug of the air-conditioner.

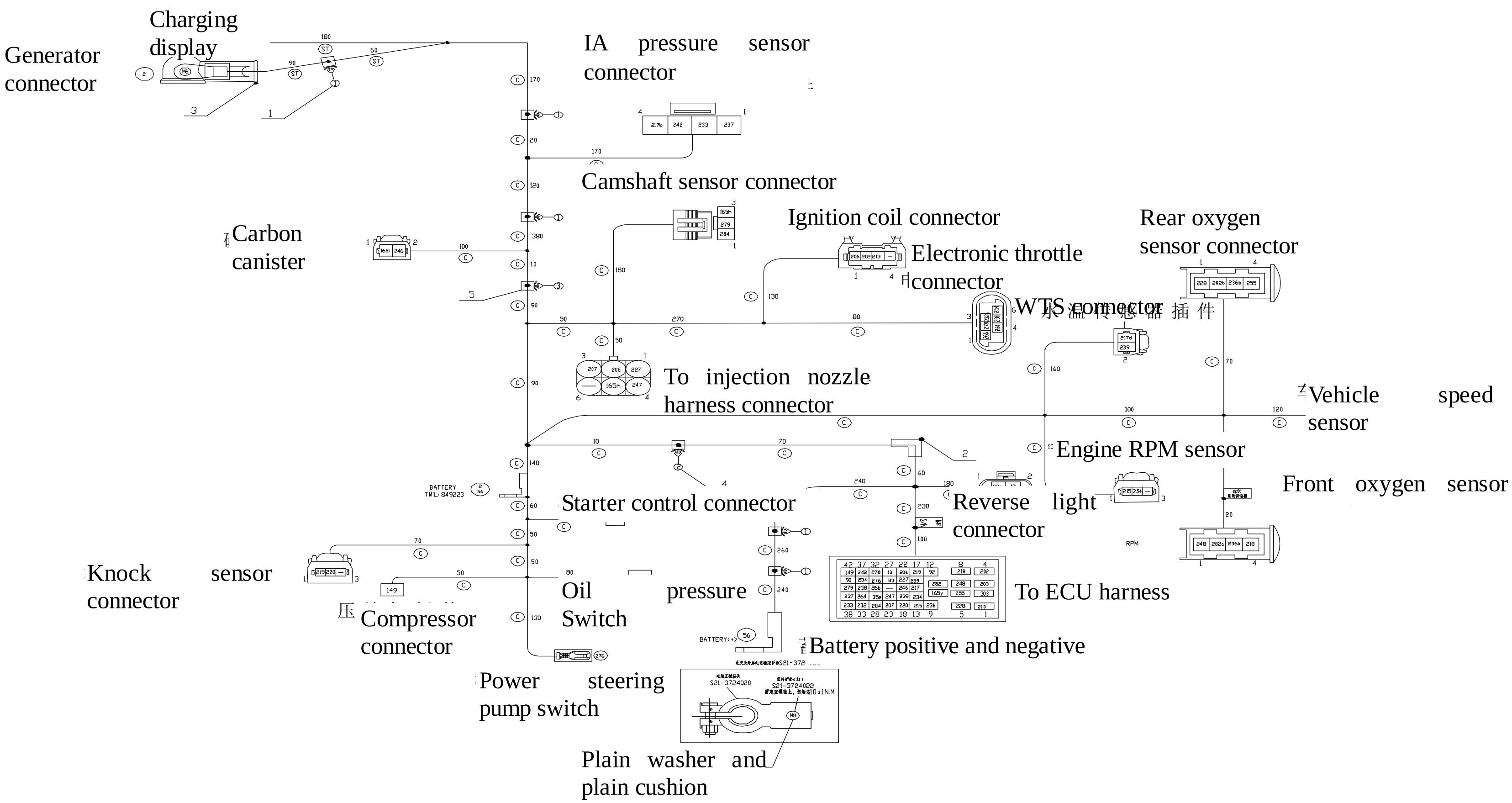


1.1.31. Unplug the right-front wheel ABS sensor plug.

2. Installation
The installation steps are reverse to those for removal.

Section III Removal and Installation of Electronic Fuel Injection Harness

I. Harness Sketch



II. Instructions on Harness Connectors

No	Connector Name	Pins	Connection
1	Recharging display connector	1	Ground
		2	To ECU harness connector
2	Motor connector	1	——
3	Intake pressure sensor	1	To ECU harness connector
		2	To ECU harness connector
		3	To ECU harness connector
		4	Ground
4	Carbon canister solenoid valve connector	1	Ground
		2	To ECU harness connector
5	Camshaft sensor connector	1	To ECU harness connector
		2	To ECU harness connector
		3	Ground
6	Oil nozzle harness connector	1	To ECU harness connector
		2	To ECU harness connector
		3	To ECU harness connector
		4	To ECU harness connector
		5	Ground
		6	——
7	Ignition coil connector	1	To ECU harness connector
		2	To ECU harness connector
		3	To ECU harness connector
		4	——
8	Electronic throttle connector	1	To ECU harness connector
		2	To ECU harness connector
		3	Ground
		4	To ECU harness connector
		5	To ECU harness connector
		6	To ECU harness connector

9	Water thermostat connector	1	Ground
		2	To ECU harness connector
10	Engine rotation speed sensor connector	1	To ECU harness connector
		2	To ECU harness connector
		3	——
11	Rear oxygen sensor connector	1	To ECU harness connector
		2	Ground
		3	Ground
		4	To ECU harness connector
12	Front oxygen sensor connector	1	To ECU harness connector
		2	Ground
		3	Ground
		4	To ECU harness connector
13	Vehicle speed sensor connector	1	To ECU harness connector
		2	To ECU harness connector
		3	To ECU harness connector
14	Starter controller connector	1	To ECU harness connector
15	Knock sensor connector	1	To ECU harness connector
		2	To ECU harness connector
		3	——
16	Oil pressure switch connector	1	To ECU harness connector
17	Compressor connector	1	To ECU harness connector
18	Power steering pump switch connector	1	To ECU harness connector
19	Reverse light switch connector	1	Ground
		2	To ECU harness connector

III. Removal and Installation of Harness

Part number: S12-3724180
Tools: flat head screwdriver, cross head screwdriver, sleeve wrench
Notes:
(1) The ignition switch must be OFF.
(2) When disassembling the electrical components and harnesses, disconnect the power supply.
(3) When disassembling common plugs (connectors), first press down the locking device, and then separate the plug and socket by force. Be careful not to pull at the wires so as not to damage the wires and connectors.

1. Removal Steps

1.1. Removal of battery and air filter.

1.1.1. Disconnect the battery negative.

1.1.2. Loosen off the battery positive and remove the battery assembly.

1.1.3. Use a sleeve wrench to loosen off the air filter fastening nuts.

1.1.4. Use a sleeve wrench to loosen off the inlet air filter fastening nuts.

1.1.5. Pull out the hose that connects the air filter and engine inlet manifold by hand.

1.1.6. Remove the air filter.

1.1.7. Disassemble the battery fixed mounting.

1.2. The installation steps are reverse to those for removal..

2. Removal of harness

2.1. Disassemble the joints of all connectors of the engine harness.

2.1.1. Disassemble the connector that connects the electronic fuel injection harness with the ECU wiring harnes.
The removal can be carried out by pulling out the clip as shown in the figure, and then the connector can be removed.

2.1.2. Disassemble the electronic throttle connector.

2.1.3.The ignition coil connector can be diassembled by pressing at the place shown in the right figure.

2.1.4. Disassemble the camshaft sensor connector.

2.1.5. Disassemble the carbon canister solenoid valve connector.

2.1.6. Disassemble the inlet pressure sensor connector.

2.1.7. Disassemble the recharging display connector.

2.1.8. Disassemble the generator connector.

2.1.9. Disassemble the starter connector.

2.1.10. Unplug the air-conditioning compressor connector.

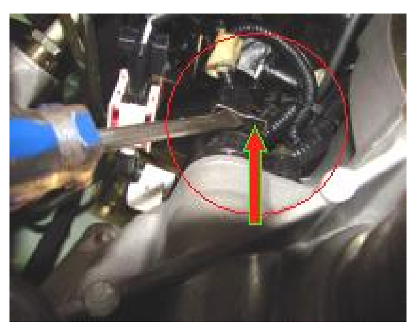
2.1.11. Disassemble the power steering pump connector.

2.1.12. Disassemble the knock sensor connector.

2.1.13. Disassemble the reverse light switch connector.

2.1.14. Disassemble the water thermostat connector.

2.1.15. Disassemble the front/rear oxygen sensor connector. Simply pull out the red lid on the connector as shown in the figure.



2.1.17. Disassemble the vehicle speed sensor connector.
Use a flat head screwdriver to pry open the clips on the connector and then pull it out.

2.1.18. Disassemble the engine rotation speed sensor connector.

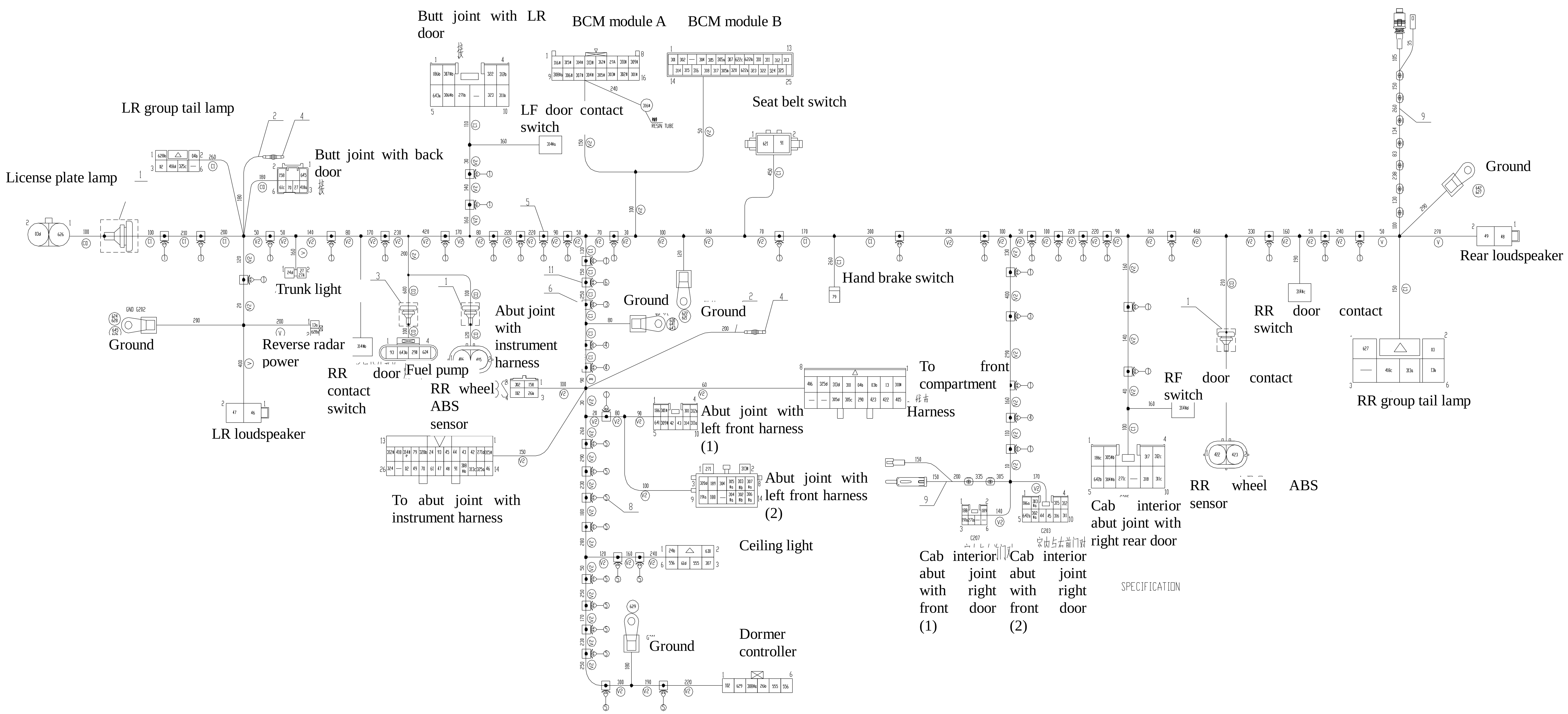
2.1.19. Take out the electronic fuel injection harness assembly.

2. Installation of harness

The installation steps are reverse to those for removal..

Section IV In-door Harness:

I. Harness Sketch



III. Instructions on Main Connectors

No	Connector Name	Pins	Connection	Remark
1	License plate lights connector	2	License plate lights harness	
2	Left-rear combination tail light connector	10	Left-rear combination tail light harness	
3	Trunk light connector	2	Trunk light harness	
4	Left-rear speaker connector	2	Left-rear speaker harness	
5	Fuel pump connector	4	Fuel pump harness	
6	Right-rear speaker connector	2	Right-rear speaker harness	
7	Right-rear combination tail tights connector	6	Right-rear combination tail lights harness	
8	BCM Module A connector BCM Module B connector	16 25	BCM Module A harness BCM Module B harness	
9	Hand brake switch connector	1	Hand brake switch harness	
10	Ceiling light connector	6	Ceiling light harness	
11	Seat belt switch connector	2	Seat belt switch harness	
12	Connect the instrument harness butt joint	26	Butt jointed with instrument harness	
13	Butt jointed with instrument harness	4	Butt jointed with instrument harness	
14	To front compartment harness connector	16	To front compartment harness	
15	Left-rear wheel ABS sensor connector	2	Left-rear wheel ABS sensor harness	
16	Right-rear wheel ABS sensor connector	2	Right-rear wheel ABS sensor harness	
17	Reverse radar power connector	2	Reverse radar power harness	
18	Butt jointed with tail door harness	6	Butt jointed with tail door harness	
19	Ground	1	Connected with ground wire	Inside the left C-pillar inner shield
20	Left-rear door contact switch connector	1	Left-rear door contact switch harness	
21	Right-rear door contact switch connector	1	Right-rear door contact switch harness	
22	Ground	1	Connected with ground wire	Inside the right C-pillar inner shield
23	Connector to front door harness butt joint 1	10	Front door harness butt joint 1	
24	Connector to front door harness butt joint 2	14	Front door harness butt joint 2	
25	Connector to interior and right-front door butt joint 1	6	Interior and right-front door butt joint 1	
26	Connector to interior and right-front door butt joint 2	10	Interior and right-front door butt joint 2	
27	Right-front door contact switch connector	1	Right-front door contact switch harness	
28	Left-front door contact switch connector	1	Left-front door contact switch harness	
29	Forming butt-joint with left-rear door harness	10	Forming butt-joint with left-rear door harness	
30	Interior forming butt-joint with right-rear door	10	Interior forming butt-joint with right-rear door	
31	Ground	1	Connected with ground wire	In the carpet under below left A-pillar
32	Ground	1	Connected with ground wire	On the left of BCM module box
33	Ground	1	Connected with ground wire	In the left ceiling handle
34	Dormer controllerconnector	6	Sunroof controller harness	

III. Removal and Installation of In-door harness

Part number: S12-3724050

(I). Preparations

Tools: sleeve wrench, cross head screwdriver, flat head screwdriver

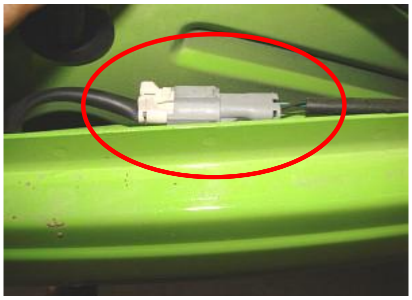
(II). Notes

When disassembling the electrical components and harness, make sure to disconnect the power supply.
The ignition switch must be OFF.

(III). Removal Steps

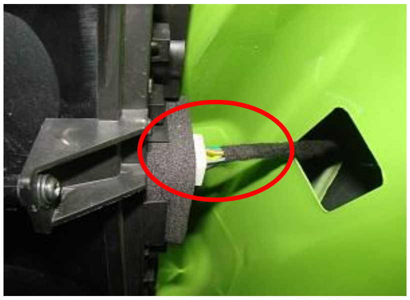
1. Removal of license plate light harness.

1.1. Disassemble the rear bumper assembly. (See Removal and Installation of Rear Bumper)
1.2. Unplug the plug of the license plate light harness.



2. Removal of left-rear group tail Llights harness

2.1. Disassemble the left-rear group tail lights assembly. (See Removal and Installation of Left-rear Combination Tail Lights)
2.2. Unplug the plug of the left-rear combination tail lights harness.



3. Use a flat head screwdriver to pry off the luggage light, and unplug the luggage light harness.

4. Unplug the plug of the left-rear speaker harness.

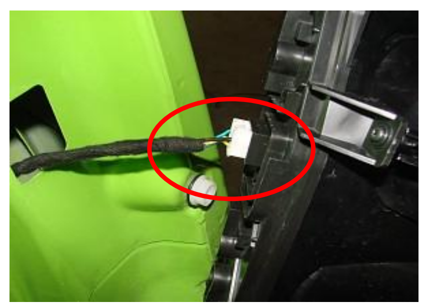
5. Removal of fuel pump harness.

5.1. Pull off the right-rear seat, and take down the plastic cover on the fuel pump.
5.2. Unplug the fuel pump harness plug.

6. Unplug right-rear speaker harness plug.

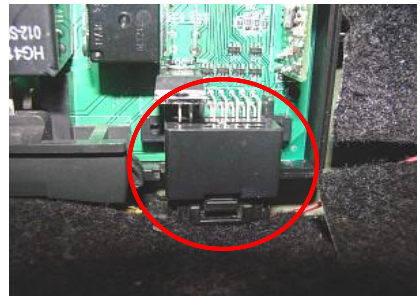
7. Disassemble the right-rear combination tail light harness.

7.1. Disassemble right-rear combination tail lights assembly. (See Removal and Installation of Right-rear Combination Tail Lights)
7.2. Unplug the right-rear combination tail lights harness plug.

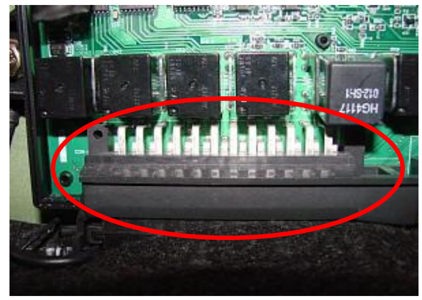


8. Removal of BCM MODULE.

8 . 1 . Open BCM module box.
8 . 2 . Unplug the BCM module A plug.



8 . 3 . Unplug the BCM Module B plug.

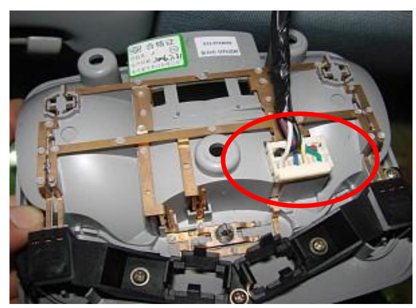


9 . Removal of hand brake harness

9 . 1 . Disassemble the auxiliary Instrument Panel assembly. (See Removal and Instalaltion of Auxiliary Instrument Panel)
9 . 2 . Unplug the hand brake harness plug.

10. Removal of ceiling light harness.

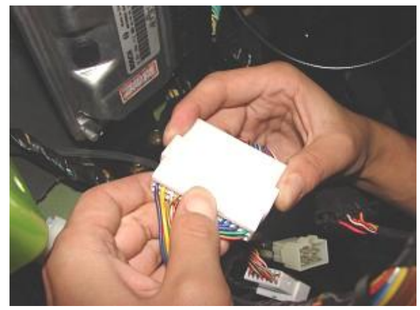
10. 1 . Disassemble the ceiling light. (See Removal and Installation of Ceiling Light)
10. 2 . Unplug the ceiling light harness plug.



11. Unplug the seat belt switch harness plug.

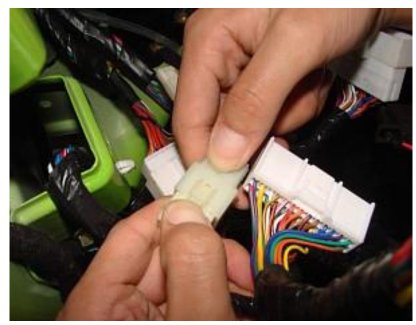
12. Removal of instrument harness butt joint

12. １ . Disassemble the Instrument Panel. (See Removal and Installation of Instrument Panel)
12. ２ . Unplug the instrument harness butt joint.



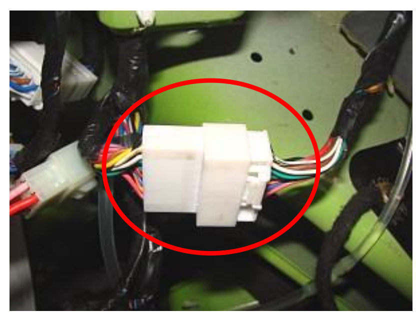
13. Removal of instrument harness butt joint

13. １ . Disassemble the Instrument Panel. (See Removal and Installation of Instrument Panel)
13. ２ . Unplug the instrument harness butt joint.

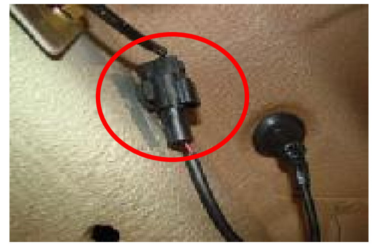


14. Removal of front compartment harness connector.

14. １ . Disassemble the Instrument Panel. (See Removal and Installation of Instrument Panel)
14. ２ . Unplug the front compartment harness plug.



15. Removal of left-rear wheel ABS sensor harness



15.1. Raise the vehicle by hoister. (Take care of your safety)
15.2. Unplug the left-rear wheel ABS sensor connector.

16. Removal of right-rear wheel ABS sensor harness.

16.1. Raise the vehicle by hoister. (Take care of your safety)
16.2. Unplug the right-rear wheel ABS sensor connector.

17. Removal of reverse radar power harness

17.1. Use a cross head screwdriver to remove the left C-pillar inner shield.

17.2. Unplug the reverse radar power plug.

18. Removal of the tail door harness' butt jointed harness.

18.1. Disassemble the left C-pillar inner shield.

18.2. Unplug the tail door harness' butt jointed harness.

19. Disassemble the ground.

20. Removal of right-rear door contact switch harness

20.1. Open the right-rear door and disassemble the crews that fix the contact switch with a cross head screwdriver, and then take off the right-rear door contact switch.

20.2. Unplug the right-rear door contact switch plug.

21. Removal and removal of left-rear door contact switch harness

21.1. Open the left-rear door and disassemble the crews that fix the contact switch with a cross head screwdriver, and then remove left-rear door contact switch.

21.2. Unplug the left-rear door contact switch plug.

22. Disassemble the rigth C-pillar inner shield and then disassemble the ground wire.

23. Removal of left-front door harness butt joint 1.

23.1. Disassemble the left A-pillar inner shield, and push down the plastic lock that fixed the connector of the left-front door harness butt joint 1. (See Removal of A-pillar inner shield)
23.2. Unplug the plug of the left-front door harness butt joint 1.

24. Removal of the left-front door harness butt joint 2.

24.1. Disassemble the left A-pillar inner shield, push down the plastic lock that fixes the connector of left-front door harness butt joint 2. (See Removal of A-pillar Inner Shield)

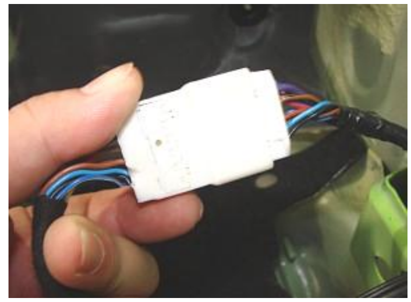
24.2. Unplug the plug of left-front door harness butt joint 2.

25. Removal of interior and right-front door butt joint 1.

25.1. Disassemble the right A-pillar inner shield, and push down the plastic lock that fixes the right-front door harness butt joint 2. (See Removal of A-pillar Inner Shield)
25.2. Unplug the plug of right-front Door harness butt joint 1.

26. Removal of interior and right-front door butt joint 2.

26.1. Disassemble the right A-pillar inner shield, push down the connector plastic lock that fixes the right-front door harness butt joint 2. (See Removal of A-pillar Inner Shield).
26.2. Unplug the plug of Right-front Door harness butt joint 1.



27. Removal of right-front door contact switch harness.

27.1. Use a cross head screwdriver to loosen off the screws that fix the right-front door contact switch, and then remove the right-front door contact switch.

27.2. Unplug the right-front door contact switch plug.

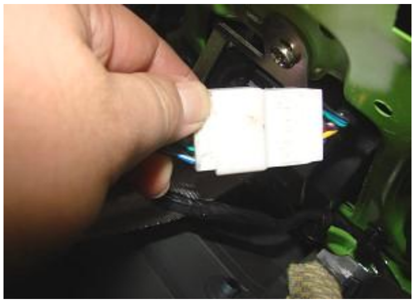
28. Removal of left-front door contact switch harness.

28.1. Use a cross head screwdriver to loosen off the screws that fixes the left-front door contact switch, and then remove the left-front door contact switch.

28.2. Unplug the left-front door contact switch plug.

29. Removal of the harness butt jointed with the left-rear door harness.

29.1. Disassemble the left B-pillar inner shield. (See Removal and Installation of B-pillar Inner Shield)
29.2. Push down the plastic clips that fixes the harness connector butt jointed left-rear door harness, and then unplug the harness plug that butt joints the left-rear door harness.



30. Removal of the Interior and right-rear door butt jointed harness

30.1. Disassemble the right B-pillar inner shield. (See Removal and Installation of B-pillar Inner Shield)
30.2. Unplug the harness plug butt jointed with the interior and right-rear door.

31. Disassemble the ground wire.

32. Disassemble the screws that fix the BCM module, and then disassemble the ground wire.

33. Use a cross head screwdriver to remove the left vehicle ceiling handle, and then disassemble the ground wire.

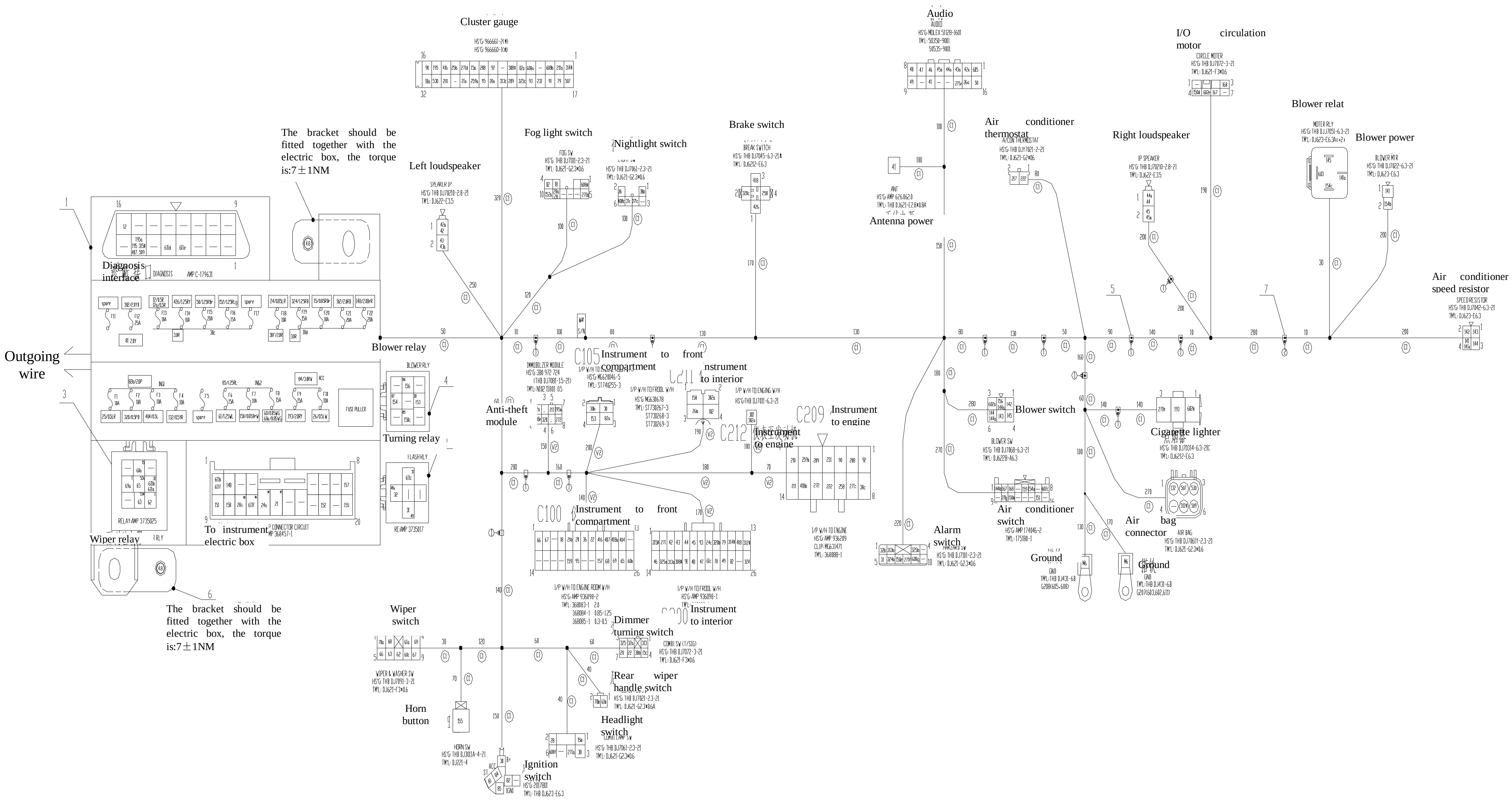
34. Removal of sunroof controller harness.

34.1. Disassemble the left vehicle ceiling. (See Removal and Installation of Vehicle Ceiling)
34.2. Remove the sunroof controller harness plug.
(Note: Optional for some vehicle types and the sunroof controller connectors are reserved for this vehicle type.)

35. Installation of In-door harness. (The steps are reverse to those for removal)

Section V Removal and Installation of Instrument Panel Harness

I. Harness sketch



II. Instructions on Main Connectors

No	Connector Name	Pins	Connection
1	Combination instrument connector	1	Instrument to interior
		2	Anti-sheft module →instrument to engine
		3	Ground
		4	——
		5	Ground
		6	Fog lights →c200 (instrument to interior)
		7	C200 (instrument to interior)
		8	——
		9	C209 (instrument to engine)
		10	C209 (instrument to engine)
		11	Instrument electric box
		12	Instrument to interior (c200)
		13	Ignition switch (IGN1)
		14	C100 (instrument to front compartment)
		15	Trouble diagnosis socket
		16	C209 (instrument to engine)
		17	Air bag
		18	C209 (instrument to engine)
		19	C200 (instrument to interior)
		20	C209（instrument to engine）
		21	C200 （instrument to interior ）
		22	Headlight switch
		23	C209 (instrument to engine)
		24	Headlight switch
		25	C100（instrument to front compartment ）
		26	C100（instrument to front compartment
		27	C209（instrument to engine）
		28	Instrument electric box
		29	——
		30	C209（instrument to engine）
		31	Air bag
		32	Fog lights switch →instrument to front compartment
2	Left loudspeaker connector	1	Audio system C200 (instrument to interior)
			C200(instrument to interior) Audio system
3	Fog light switch connector	1	Ground
		2	——
		3	C100 （instrument to front compartment）
		4	C200(instrument to interior)
		5	C200 (instrument to interior)
		6	——
		7	——
		8	——
		9	Headlight switch Instrument electric box

		10	Instrument electric box connector → instrument electric box
4	Nightlight switch connector	1	Headlight switch
		2	C100 （instrument to front compartment ）
		3	——
		4	C200 (instrument to interior)
		5	Instrument electric box
		6	Ground
5	Brake light switch connector	1	Instrument electric box
		2	Ignition switch (IGN1)
		3	C200 (instrument to interior)
		4	C209（instrument to engine）
6	Audio system connector	1	Ground
		2	C200 instrument to interior
		3	Speaker
		4	Speaker
		5	Speaker
		6	Speaker
		7	C200 (instrument to interior)
		8	C200 (instrument to interior)
		9	C200 (instrument to interior)
		10	——
		11	ANT
		13	——
		14	——
		15	C200 (instrument to interior)
		16	C200 (instrument to interior)
7	Antenna power connector	1	ANT
8	Air-conditioner thermostat connector	1	C209 （instrument to engine）
		2	C209 （instrument to engine）
9	Right loudspeaker connector	1	Audio system C200 (instrument to interior)
		2	C200 (instrument to interior) Audio system

10	Inside/outside motor connector	1	——
		2	——
		3	A/C switch
		4	Ignition switch (IGN2)
		5	Ground
		6	A/c switch
		7	——
11	Blower relay connector	1	Ground
		2	Blower switch
		3	Speaker resistor
		4	Ground
12	Blower power supply connector	1	Air-conditioner reconditionang
		2	Blower relay
13	Air-conditioner reconditionang connector	1	Blower switch
		2	Blower switch
		3	Blower switch
		4	Blower power supply Blower relay connector
14	C105 instrument to front compartment connector	1	Ignition switch
		2	Ignition switch
		3	Ignition switch
		4	Blower relay
15	C100 instrument to front compartment connector	1	Windshield washing switch
		2	Windshield washing switch
		3	——
		4	Fog light switch
		5	To Instrument electric box connector
		6	Headlight switch
		7	Nightlight switch
		8	Headlight switch
		9	Instrument panel plug
		10	Trouble diagnosis socket
		11	Brake light switch
		12	Ignition switch(IGN1)
		13	——
		14	——
		15	——
		16	——
		17	——
		18	A\C switch
		19	——Instrument panel connector
		20	——
		21	——

		22	To instrument electric box connector
		23	Wiper switch
		24	Wiper switch
		25	Wiper switch
		26	Ignition switch(IGN1)
16	C211 instrument to interior connector	1	To instrument electric box connector
		2	C212 instrument to engine
		3	Ignition switch(acc)
		4	Instrument electric box
17	C200 instrument to front compartment connector	1	Trouble diagnosis socket
		2	Ground
		3	Left loud speaker
		4	Left loud speaker
		5	Right loud speaker
		6	Right loud speaker
		7	Instrument panel plug
		8	Instrument panel electric box
		9	Ignition switch(IGN1)
		10	Instrument panel plug
		11	Instrument panel plug
		12	Brake light switch
		13	Air bag
		14	Audio system
		15	Light group switch
		16	Light group switch
		17	Instrument panel plug
		18	Instrument panel plug
		19	Audio system
		20	Audio system
		21	Ignition switch(IGN2)
		22	Wiper switch
		23	Audio system
		24	Fog light switch
		25	——
		26	Alarm switch

18	C212 instrument to engine connector	1	Instrument electric device box C211
19	C209 instrument to engine connector	1	Instrument panel to plug
		2	Instrument panel to plug
		3	Instrument panel to plug
		4	Instrument panel to plug
		5	Instrument panel to plug
		6	Instrument panel to plug
		7	Instrument panel to plug
		8	Headlight switch
		9	Nightlight switch
		10	Brake light switch
		11	Air-conditioner thermostat
		12	Air-conditioner thermostat
		13	Brake light switch
		14	Anti-sheft module
20	Anti-sheft module connector	1	Instrument electric device box
		2	Ground
		3	——
		4	Ignition switch(IGN1)
		5	C209〔instrument to engine〕
		6	——
		7	Failure diagnosis socket → instrument panel plug
		8	C20〔instrument to engine〕
21	Wiper switch connector	1	C200 (instrument to interior)
		2	C100 (instrument to front compartment)
		3	Ignition switch(IGN2)
		4	C100 (instrument to front compartment)
		5	C100(instrument to front compartment)
		6	Wiper relay
		7	Wiper relay
		8	Ignition switch(IGN2)
		9	C100 instrument to front compartment

22	Speaker button	1	Instrument electric box
23	Ignition switch connector	1	C100 (instrument to front compartment)
		2	Instrument electric box
		3	Ground
		4	(ACC) auxiliary electrical equipment bus
		5	Ignition switch(IGN2)
24	Headlights switch connector	1	Instrument electric box
		2	Fog light switch
		3	Ground
		4	C200 (instrument to interior)
		5	——
		6	Ground
25	Rear wiper handle switch connector	1	Ignition switch(IGN2)
		2	C200 (instrument to interior)
26	Dimmer steering switch connector	1	Ground
		2	Steering relay
		3	Ground
		4	Instrument electric box
		5	Ground
		6	C100 (instrument to front compartment)
		7	C100(instrument to front compartment)
27	Alarm switch connector	1	Steering relay
		2	Dimmer steering switch connector
		3	Dimmer steering switch connector
		4	——
		5	Steering relay
		6	Instrument electric box
		7	Ignition switch(IGN2)
		8	C200 (instrument to interior)
		9	Ground
		10	——
28	Blower switch connector	1	Air-conditioner reconditionang
		2	Blower relay
		3	Ground
		4	Blower relay
		5	Air-conditioner reconditionang
		6	Air-conditioner reconditionang

29	Air-conditioner switch connector	1	Blower switch → air-conditioner reconditionang
		2	Inside/outside circulation motor
		3	Inside/outside circulation motor
		4	——
		5	C100(instrument to front compartment)
		6	Blower relay
		7	——
		8	Ground
		9	——
		10	C200 (instrument to interior)
		11	Ignition switch(IGN2)
		12	——
		13	——
		14	——
		15	To instrument electric box
		16	——
30	Cigar lighter	1	Ground wire
		2	Ignition switch(ACC)
		3	C200 (instrument to interior)
31	Air bag connector	1	Ignition switch(IGN1)
		2	Instrument panel plug
		3	Instrument panel plug
		4	——
		5	C200(instrument to interior)
		6	Trouble diagnosis socket
32	Trouble diagnosis socket	1	——
		2	——
		3	——
		4	Ground
		5	Ground
		6	——
		7	Anti-sheft module connector Instrument panel plug C200(instrument to interior) C100(instrument to front compartment) Air bag
		8	——
		9	——
		10	——
		11	——
		12	——
		13	——

		14	——
		15	——
		16	Instrument electric box
33	Wiper relay	1	——
		2	
		3	——
		4	
		5	
		6	
		7	——
		8	
		9	
34	To instrument electric box connector	1	Wiper relay
		2	Instrument electric box
		3	——
		4	——
		5	——
		6	——
		7	——
		8	C100 (instrument to front compartment)
		9	Air-conditioner temperature switch connector
		10	C211 (instrument to interior)
		11	Fog lights switch connector Ignition switch (IGN2)
		12	——
		13	Instrument electric box C105(instrument to front compartment)
		14	Ground
		15	——
		16	——
		17	——
		18	Instrument electric box
		19	——
		20	Speaker button

35	Blower relay	1	——
		2	Blower switch
		3	——
		4	Ground
		5	——
		6	C105 (instrument to front compartment)
		7	——
		8	Ignition switch(IGN2)
		9	——
36	Steering relay	1	Ground Alarm switch
		2	Ground
		3	——
		4	——
		5	Alarm switch Audio system→C200 (instrument to interior)

III. Removal and Installation of Instrument Panel Harness

(I). Preparation of Tools

Tools: 10＃/13＃sleeve wrench, cross head screwdriver, flat head screwdriver

(II). Notes

(1) When disassembling the electrical components and harness, the power supply should be disconnected.
(2) Make sure the ignition switch is OFF.
(3) When disassembling common connectors, push down the latch device on the connector, and then separate the plug from the socket by force, but do not pull at the wires so as not to damage the wires and connectors.

(III). Removal and installation of instrument panel harness

1.1. Removal of Instrument harness
1.1.1. Disassemle the auxiliary instrument panel, and when disassembling the instrument panel, the cigarette lighter connector, blower switch connector, air-conditioner switch connector, air-conditioner thermostat connector, audio system connector, antenna power supply plug, alarm switch connector and safety airbag socket will also be disassembled.. The safety airbag socket is a reserved function, and there are 2 grounds under the console, which can be disaasembled with a 10# sleeve. See Removal of Instrument Panel for detailed removal methods.

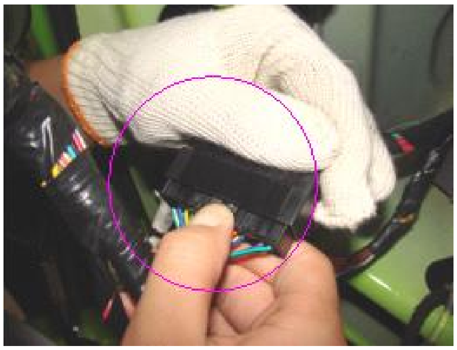
1.1.2. Removal of the steering wheel will also involve removal of speaker button connector, wiper switch connector, dimmer steering switch connector, rear wiper switch connector, headlight switch connector, ignition switch connector, nightlight switch connector and fog light switch connector. See Removal of Instrument Panel for detailed removal methods.

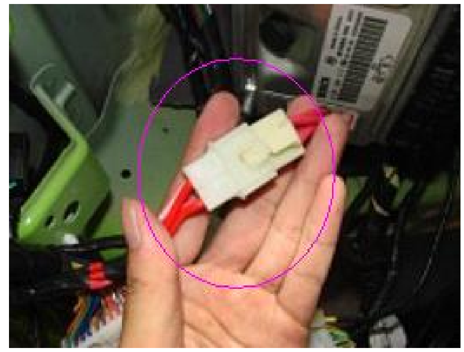
1.1.3. When disassembling the combination instrument, please disassemble the harness plug connectede with the combination instrument. See Removal of Instrument Panel for detailed removal methods.

1.1.4. Unplug the left-right loudspeaker and the brake switch connector.

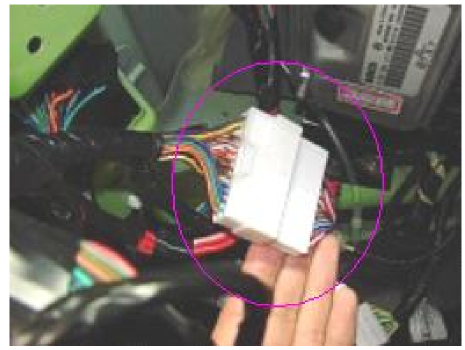
1.1.5. When disassembling the instrument panel crossbeam, please disassemble the inside/outside circulation motor connector of the air-conditioner evaporator, blower power supply connector, blower relay connector, air-conditioner reconditionang connector and anti-theft module connector. See Removal of Evaporator for detailed removal methods.

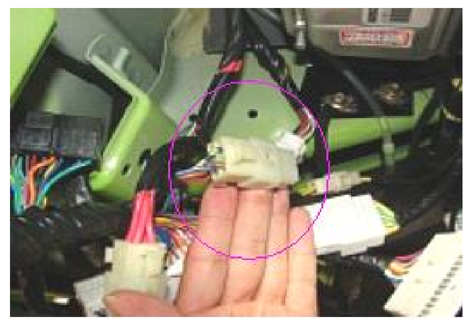
1.1.6. Disassemble the two connectors of the instrument harness and the front compartment harness, as shown in the right figures:



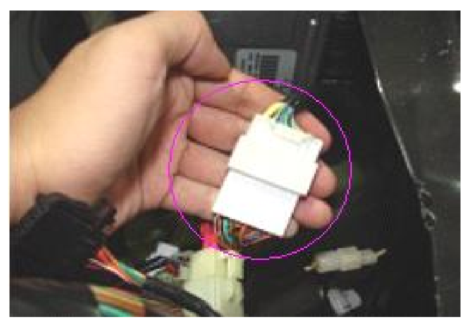


1.1.7. Disassemble the two connectors of the instrument harness and the interior floor harness, as shown in the right figures:

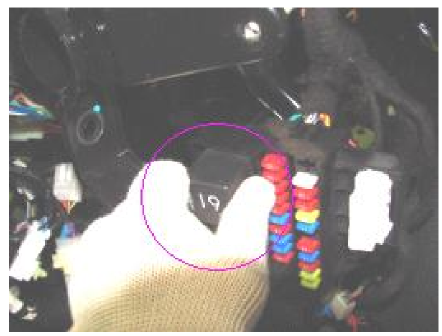




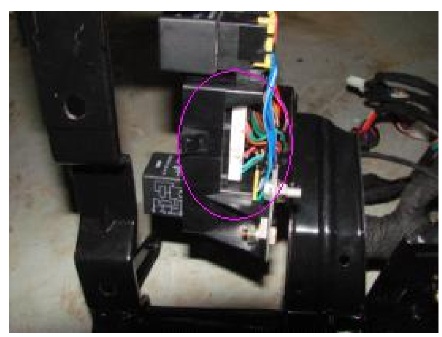
1.1.8. Disassemble the two connectors of the instrument harness and the engine wiring harnes, as shown in the right figures:



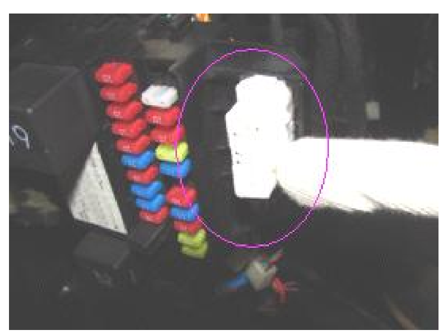
1.1.9. Unplug the blower relay, steering relay, and wiper relay, as shown in the right figures:



1.1.10. Unplug the instrument electric box connector as shown in the right figures:



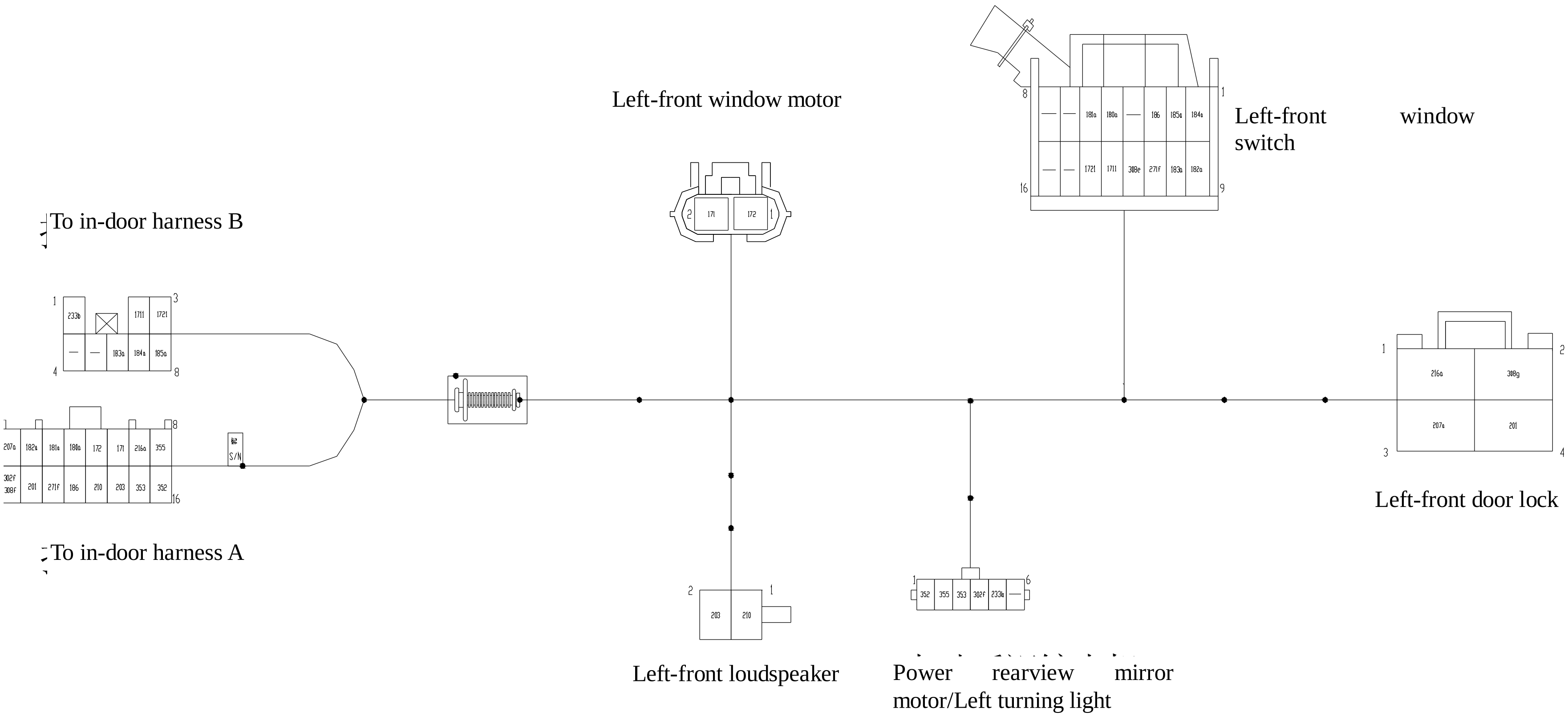
1.1.11. Here is the failure diagnosis socket.



2. Installation of instrument panel harness
The installation steps are reverse to those for removal

Section VI Left-front Door Harness

I. Harness Sketch



II. Instructions on Main Connectors

No	Connector Name	Pins	Connection	Remark
1	To in-door harness B connector	10	In-door harness B	
2	Left-front window motor connector	2	Left-front window motor	
3	Left-front window switch connector	16	Left-front window switch	
4	To in-door harness A connector	14	In-door harnessA	
5	Left-front speaker connector	2	Left/front speaker	
6	Power rearview mirror /left turning light connector	3	Power rearview mirror /left turning light	
7	Left-front door lock connector	4	Left-front door lock	
8	Left-front door remote control connector	2	Left-front door lock	

III. Removal and Installation of Left-front door in-door harness

Part number: S21-3724070

(I). Preparations

Tools: sleeve wrench, cross head screwdriver, flat head screwdriver

(II). Notes

When disassembling the electrical components and harness, please disconnect the power supply.
The ignition switch must be OFF.

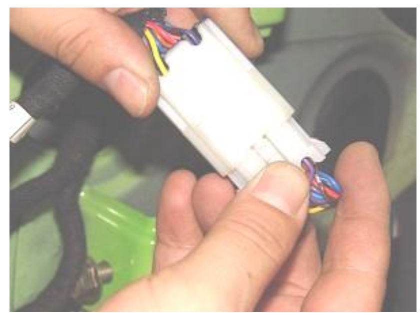
(III). Removal Steps

1. Removal
1.1. Disassemble inside door shield. (See Removal of Inside Door Shield)
1.2. Remove the inside door protecting film.
1.3 Unplug the left-front door remote control connector.

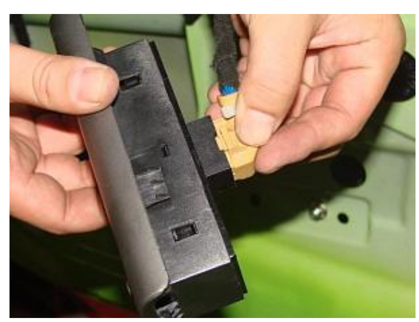
1.4. Unplug the door lock connector. (See Removal of Door Lock)
1.5. Unplug the outside left-front door rearview mirror harness connector.

1.6. Unplug the left-front door speaker connector.

1.7. Unplug the two connectors that connect the left-front door in-door harness and interior floor harness. (See Removal of In-door harness)



1.8. Unplug the left-front window switch connector.



19. Unplug the left-front door lock connector.

2.0. Unplug the elevating motor connector.

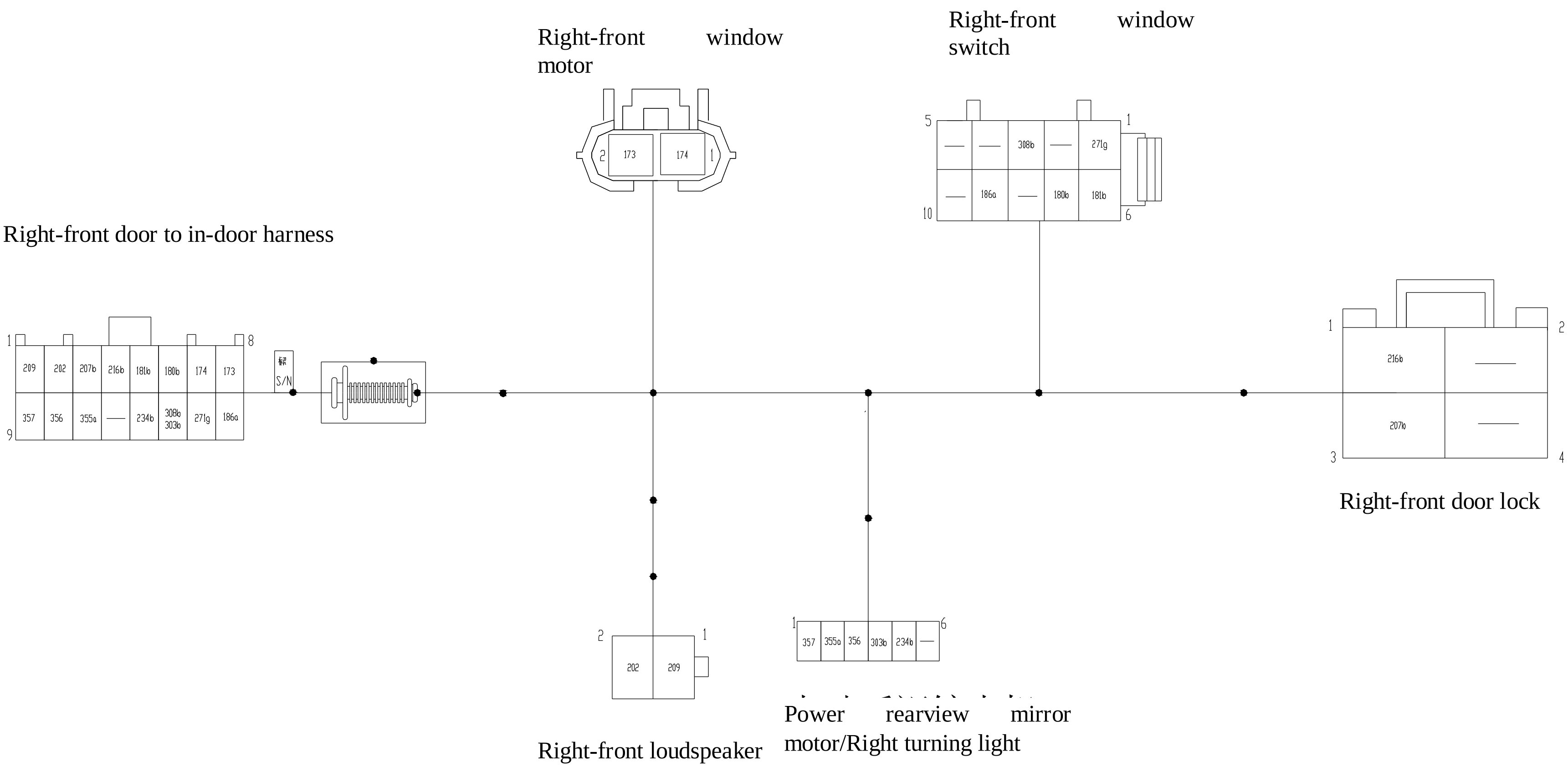
21. Unplug the inside door harness shield, and then remove the harness.

2. Installation.

The installation steps are reverse to those for removal..

Section VII Right-front Door Harness

I. Harness Sketch



II. Instructions on Main Connectors

No	Connector Name	Pins	Connection	Remark
1	Right-front door in-door harness connector	16	In-door harness	
2	Right-front window motor connector	2	Right-front window motor	
3	Right-front window switch connector	10	Right front window switch	
4	Right-front door lock connector	4	Right-front door lock	
5	Right-front speaker connector	2	Right-front speaker	
6	Power rearview mirror motor / right turning light connector	6	Power rearview mirror motor / right turning light	

III. Removal and Installation of Right-front Door In-door Harness

Part number: S21-3724080

1. Removal

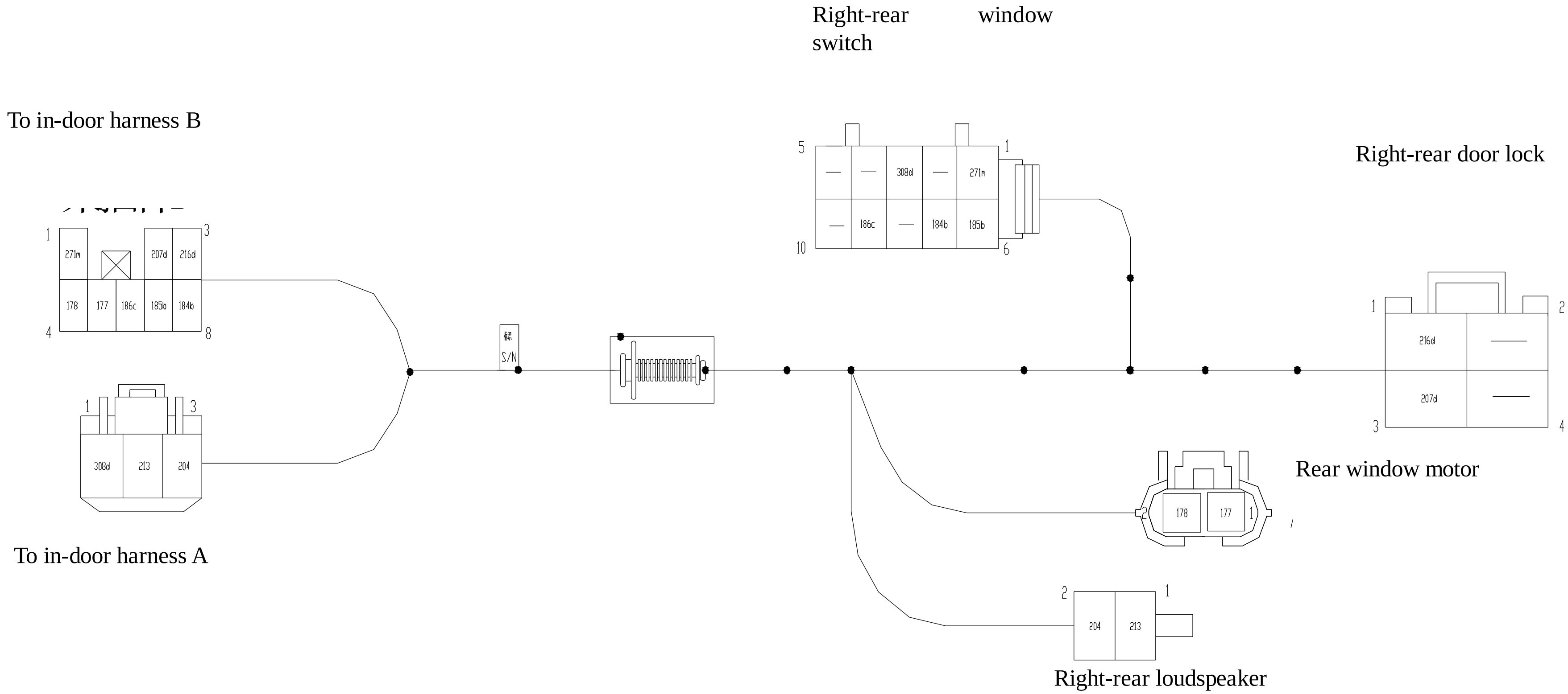
See Removal of Left-front Door In-door harness.

2. Installation

The installation steps are reverse to those for removal.

Section VIII Rear Door Harness

I. Harness Sketch



II. Instructions on Main Connectors

No	Connector Name	Pins	Connection	Remark
1	Right-rear window switch connector	10	Right-rear window switch	
2	Right-rear door lock connector	4	Right-rear door lock	
3	To in-door harness connector A	10	In-door harness A	
4	Rear window motor connector	2	Rear window motor	

III. Removal and Installation of Right-rear Door In-door Harness

Part number: S21-3724180

(I). Preparations

Tools: sleeve wrench, cross head screwdriver, flat head screwdriver

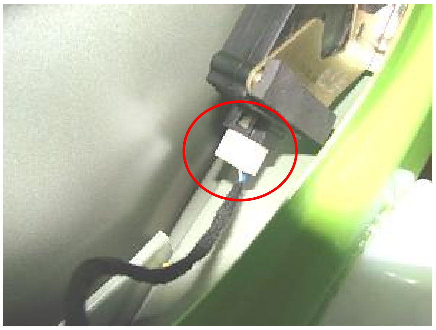
(II). Notes

When disassembling the electrical components and harness, please disconnect the power supply.
The ignition switch must be OFF.

(III). Removal Steps

1. Removal
1.1. Disassemble the rear inside door shield. (See Removal of Inside Door Shield)
1.2. And then remove the inside left-rear door protecting film.
1.3. Unplug right-rear window connector.

1.4. Unplug the door lock harness connector.



1.5. Unplug the elevating motor connector.

1.5. Disassemble the lower-right B-pillar shield. (See Removal and Installation of Door Shield)
1.6. Unplug the connector that connects the inside door harness and in-door harness.

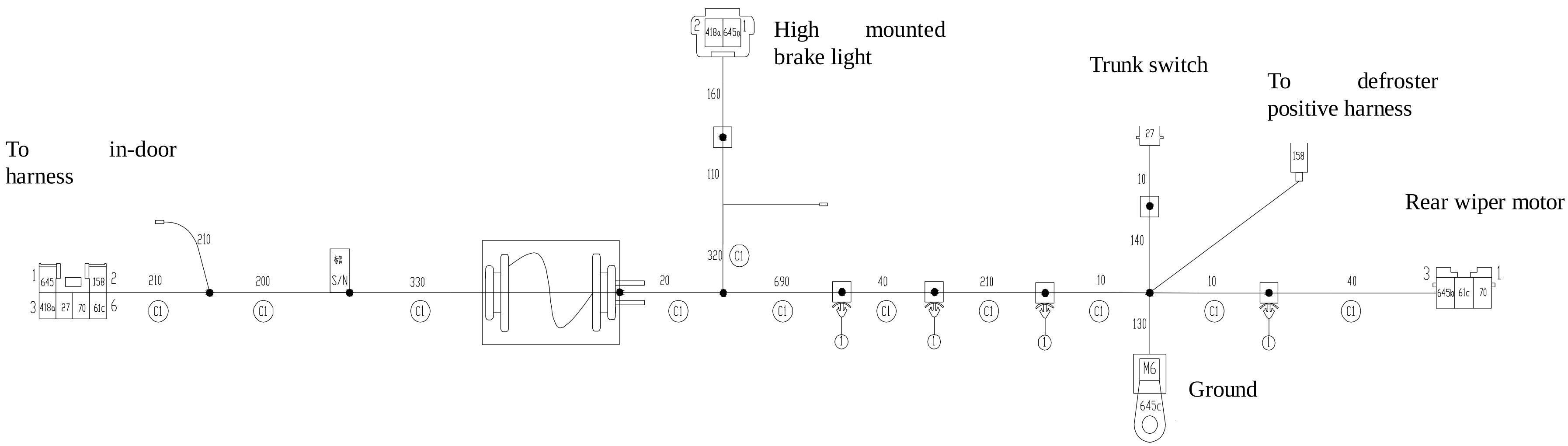
1.7. Unplug door contact switch connector.

1.8. Pull out the inside door harness protective rubber jacket, and take out the harness assembly from inside the door.

2. Installation
The installation steps are reverse to those for removal.
Note: See Removal of Right-rear Door Harness for details about the inside left-rear door harness.

Section IX Tail Door Harness

I. Harness Sketch



II. Instructions on Main Connectors

No	Connector Name	Pins	Connection	Remark
1	To in-door harness connector	6	In-door harness	
2	High mount brake light connector	2	High mount brake light	
3	Trunk switch connector	2	Trunk switch	
4	To defroster positive harness connector	2	Defroster positive harness	
5	Rear wiper motor connector	3	Rear wiper motor	
6	Ground	1	Vehicle body plate work	On the tail door plate work

III. Removal and Installation of Tail Door In-door harness

Part number: S12-3724160

(I). Preparations

Tools: sleeve wrench, cross head screwdriver, flat head screwdriver

(II). Notes

1. Do not use too much force when getting the harness through the hole in the vehicle body plate work, or the harness may get damaged and result in short circuit.
2. When disassembling the electrical components and harness, please disconnect the power supply.
3. The ignition switch must be OFF.

(III). Removal and Installation Steps

1. Removal

1.1.1. Use a cross head screwdriver to remove the left C-pillar inner shield.
(See Removal of Vehicle Body Accessories)

1.1.2. Unplug the harness plug forming abutt-joint with the in-door harness.

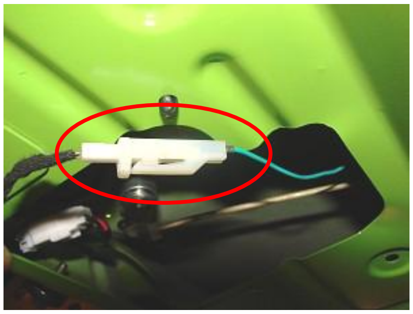
1.1.3. Disassemble the high mount brake light shield by hand.

1.1.4. Unplug the harness plug connecting the high mount brake light.

1.1.5. Use a flat head screwdriver to disassemble the tail door shield.

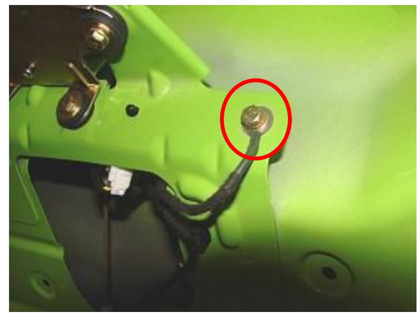
1.1.6. Unplug the rear defroster positive harness plug.

1.1.7. Unplug the trunk switch plug.



1.1.8. Unplug the rear wiper motor plug.

1.1.9. Disassemble the vehicle body ground wire. (On the tail door)



1.1.10. Removal of tail door in-door harness

2. Installation

The installation steps are reverse to those for removal, and special auxiliary tools (thin steel wire) can be used to accomplish it.

Section X Defroster Harness

I. Harness Sketch

Harness to tail door

Rear defroster negative

Rear defroster negative

Ground

II. Instructions on Main Connectors

No	Connector Name	Pins	Connection	Remark
1	Defroster positive connector	1	Defroster positive	
2	Defroster negative connector	1	Defroster negative	
3	Tail door harness connector	1	Tail door harness	
4	Vehicle body ground wire	1	Vehicle body	On the tail door

III. Removal and Installation of Rear Defroster Harness

Defroster harness positive part number: S12-3724530
Defroster harness negative part number: S12-3724540

(I). Preparations

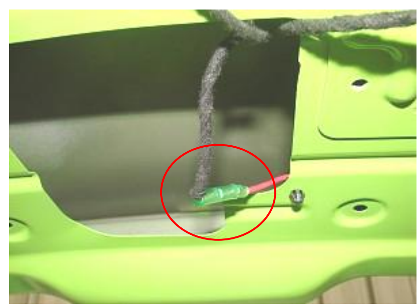
Tools: sleeve wrench, cross head screwdriver, flat head screwdriver

(II). Notes

When disassembling the electrical components and harness, disconnect the power supply.
The ignition switch must be OFF.

(III). Removal Steps

1. Unplug the defroster harness connector.



2. Unplug the left-rear defroster connector.

3 Unplug the right-rear defroster connector.

(IV) Installation Steps

The installation steps are reverse to those for removal.

Maintenance Manual of Chery A113

(Chassis)

Chery Automobile Co., Ltd

CONTENT

Chapter 1 Brake System

I. System Checking Parameters

1. Check brake disc:

The friction surface of brake disc should be flat and has no apparent grooves; otherwise, brake disc should be replaced.

2. Thickness checking

The standard thickness of front disc (ventilation disc) is 17 mm with its operating limit of 15 mm; when exceeding the operating limit, the front disc should be replaced.

3. Checking of brake friction lining thickness

Standard thickness of front brake lining shall be 10 mm, application limit shall be 1 mm, and the remaining thickness of limit brake pad thickness shall be not less than 1mm.

Standard thickness of rear brake lining shall be 5 mm, application limit shall be 1 mm, and the remaining thickness of limit brake pad thickness shall be not less than 1 mm.

4. Checking of brake disc run-out

Use dial gauge to check the face runout of brake disk, the application limit of front disk shall be 0.03mm, the application limit of rear disk shall be 0.03mm, otherwise replace it.

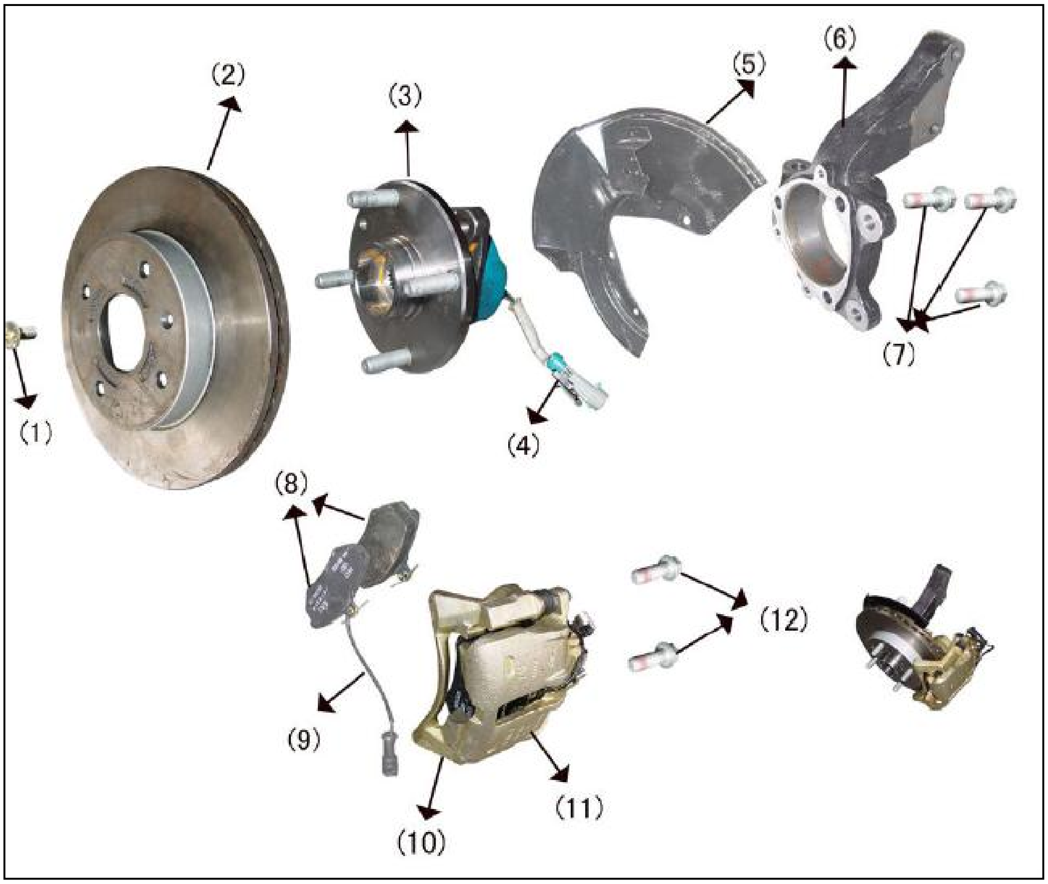
Important notice:

After completion of replacing friction lining or brake disk, apply the brake for several times to enable breaking-in between brake lining and brake disk. Always ensure safety!

After replacing brake lining, check brake fluid level to ensure it is between MIN and MAX.

II. Removal/Installation and Overhaul of Front Brake and Brake Calliper

1. System Structural Diagram



Structural Diagram of Front Brake Assembly

(1) Brake disc positioning bolt	(2) Brake disc
(3) Wheel hub bearing unit;	(4) ABS speed sensor plug
(5) Dust cover	(6) Steering joint
(7) Fixing bolt	(8) Friction lining
(9) Friction lining thickness sensor plug	(10) Brake bracket
(11) Brake calliper assembly	(12) Fixing bolt

2. Preparations

Tools: Ratchet wheel, ratchet lever, 13#, 14#, 16#, 18#, 19#, 8#,
30# socket, 10#, 13#, 14#, 16# ring wrench, vice,
torque wrench, measure ruler..
Accessories: brake fluid

3. Notices

3.1 Please wear necessary labor protection supplies to avoid accidents.
3.2 The brake liquid is one toxic liquid. In event of contact with the skin or eyes due to carelessness, flush with a great amount of water and if necessary call for medical treatment timely.
3.3 The scrapped brake liquid should be accommodated in the container. It’s prohibited to drain it into the sewage system or stack with other household garbage.
3.4 Do not depress the brake pedal nor move the vehicle during the removal/installation operation.
3.5 Do not make the friction lining or brake disc come contact with the oil substances, which will impair the braking effects.

4. Removal and Overhaul

4.1 Remove the protective cover from the tire rim with slotted screwdriver.

4.2 Remove the tire fixing nuts with 19# torque wrench or vehicle attached tool and remove the tire.
Torque: 110±10 Nm.

4.3 Lift the vehicle with elevator.
4.4 Remove the 2 nuts (upper and lower) from
the brake calliper and steering joint with 18# wrench.

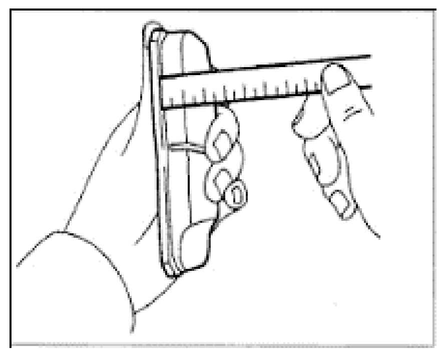
4.5 Remove the nuts from brake hose with 13# wrench.

Notice: The brake liquid is one toxic liquid. Do not splash the brake liquid to the clothes or skin during the removal of the brake hose.

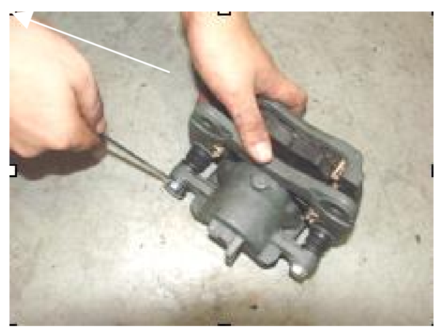
Torque: 16±3 Nm.

4.6 Pull out the brake disc with hand.

4.7 Measure the thickness of friction lining. If below 3mm, replace timely in pairs.

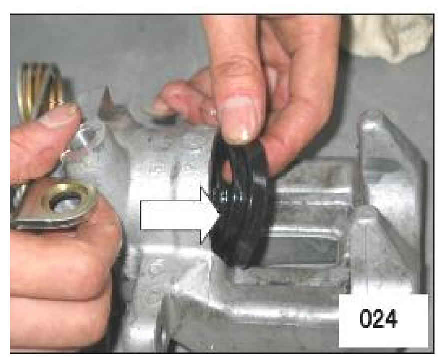


4.8 Remove the brake calliper and brake pump with 14# wrench.

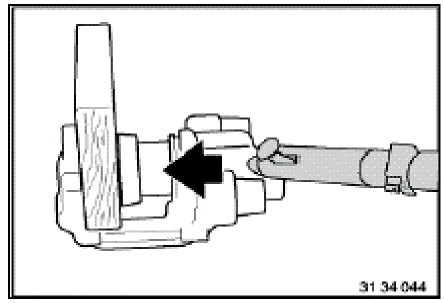


4.9 Remove the dustproof seal and check for the damage of the dustproof seal. If necessary, renew the dustproof seal. Clean the contact surface of the brake piston and apply with one film of silencing grease.

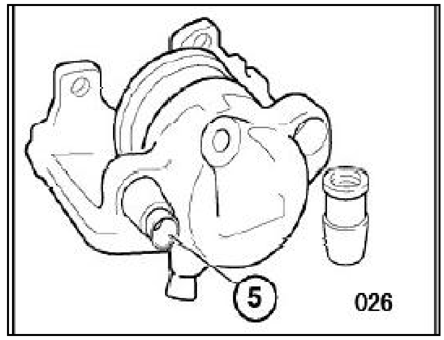
Notice: It's prohibited to make the dustproof seal come contact with the silencing grease, which will cause the swelling of the dustproof seal.



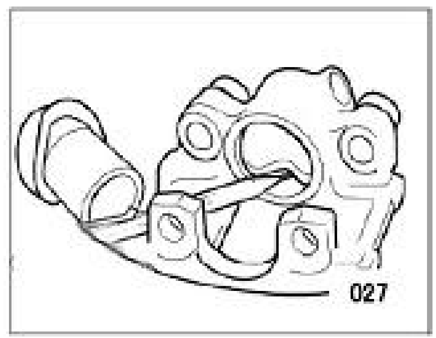
4.10 Remove the piston. Prepare one wood board to hold the piston and place the wood board between the piston and the wall of the brake calliper. Press out the piston with the compressed air carefully through the connecting bore. Place the guard plate (such as hard wood) at the notch of the brake calliper to protect the piston.
Notice: Do not hold the piston with fingers – danger of clamping! The brake calliper piston is prohibited from removal at will and should be removed/installed only by professionals or under the guidance of the professionals.



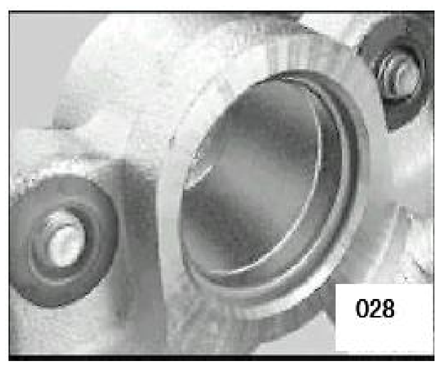
4.11 Check the guide sleeve. The guide sleeve should move smoothly and freely when pushed with hand. Replace the guide sleeve in event of jamming or stiffness. Notice: Apply the lubricating grease onto the guide sleeve during assembling.



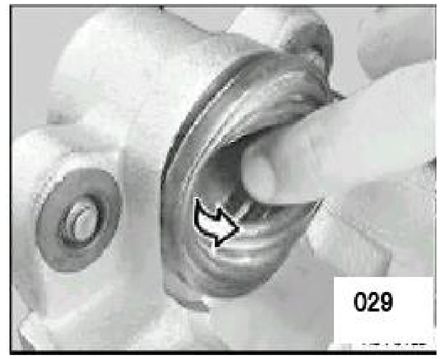
4.12 Remove the seal ring carefully with the plastic needle, clean the brake cylinder and components with alcohol and blow dry with compressed air. Carefully check the surfaces of brake cylinder, piston, and flange. It's prohibited to conduct the machining process on the brake cylinder and piston.



4.3 Installation of brake branch pump: Apply one film of brake cylinder cream onto the cylinder body, plunger, and seal sleeve. Attach the seal ring onto the circular groove at the rear of the brake cylinder. Attach the dustproof seal ring onto the front circular groove and press it in completely.



4.14 The area between the dustproof seal ring and the brake clamp housing must be kept dry. It should be kept away from the brake cylinder cream or the brake liquid, in order to ensure the correct position of dustproof seal ring.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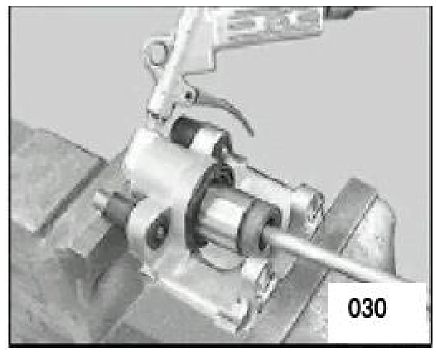
4.15 Secure the brake piston with the reinforcement parts available in market and press it onto the dustproof seal ring slightly. Blow the dustproof seal ring with compressed air (up to 3.0bar) to attach the piston ring onto the piston.

Notice: Dip the dustproof seal ring and piston with brake liquid to facilitate the passing of the seal ring.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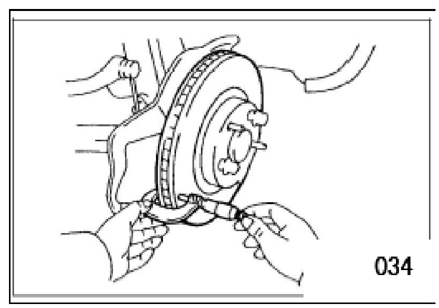
4.16 (Checking of brake disc) Check the thickness of brake disc. Replace the brake disc if the thickness is less than the min thickness.

Notice: The two brake discs at the same axle should be replaced at a time. The friction linings must be replaced following the replacement of the brake discs.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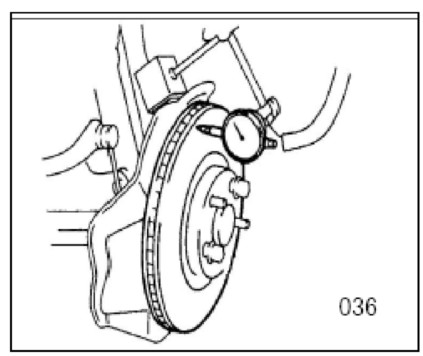
4.17 Check the max run-out of the end surface of brake disc with dial gage. If above 0.03mm, replace it. (Provided that the brake disc thickness is guaranteed, it may conduct the proper machining to meet with the max run-out.)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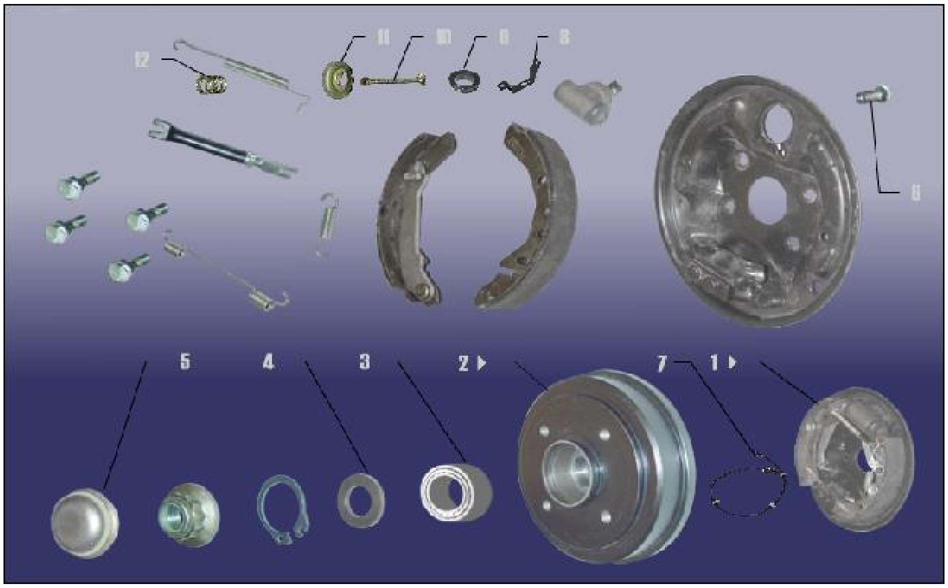
4.18 Installation of other portions with reference to the Removal Procedure.

III. Removal/Installation and Overhaul of Rear Brake

1. System Structural Diagram



1. Rear brake assembly	2. Brake drum
3. Rear wheel hub bearing assembly	4. Oil seal
5. End cap	6. Bolt
7. Rear wheel sensor	8. Rear brake hose retaining clip
9. Dual-port pipe clip	10. Tie rod
11. Rear shoe pressure spring plate	12. Rear shoe pressure spring

2. Preparations

Tools:

Ratchet wheel, ratchet lever, 10#, 19#, 32# socket, 10# ring wrench, vice, torque wrench, slotted screwdriver.

Accessories: brake fluid

3. Notices

3.1 Please wear necessary labor protection supplies to avoid accidents.

3.2 The brake liquid is one toxic liquid. In event of contact with the skin or eyes due to carelessness, flush with a great amount of water and if necessary call for medical treatment timely.

3.3 The scrapped brake liquid should be accommodated in the container. It’s prohibited to drain it into the sewage system or stack with other household garbage.

3.4 Do not depress the brake pedal nor move the vehicle during the removal/installation operation.

3.5 Do not make the friction lining or brake disc come contact with the oil substances, which will impair the braking effects.

4. Removal Procedure

4.1 Remove the rear wheels (see the removal procedure of front wheels).
4.2 Remove two position bolts from the brake drum with the cross screwdriver.

4.3 Remove the bearing dust cap with slotted screwdriver.

4.4 Vibrate the brake drum to remove it.

4.5 Observe the rear braking structure.

4.6 If it’s necessary to check the brake drum bearing, remove the lock nuts shown in the figure with 30# socket and torque wrench and remove the brake drum bearing.
Torque: 250±10 Nm

4.7 Remove the handbrake cable with calliper.

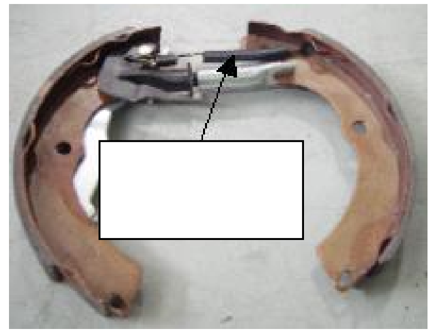
4.8 Remove the upper return tension spring with calliper.

4.9 Remove the lower return tension spring with calliper.

4.10 Depress the spring strip of the brake shoe positioning tie rod with calliper and then rotate clockwise or counter clockwise for 90° to remove two brake shoe position tie rods.

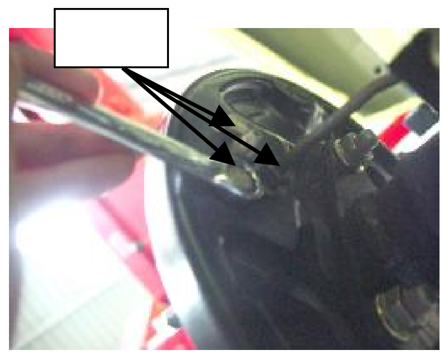
4.11 Pull out two brake shoes.

4.12 Remove the tension spring to separate the brake shoe.



4.13 In the event of detection of over-tight rear brake, it may adjust the length of the push rod: Rotate clockwise to eliminate the friction.

4.14 Remove the three bolts shown in the figure with 10# ring wrench.



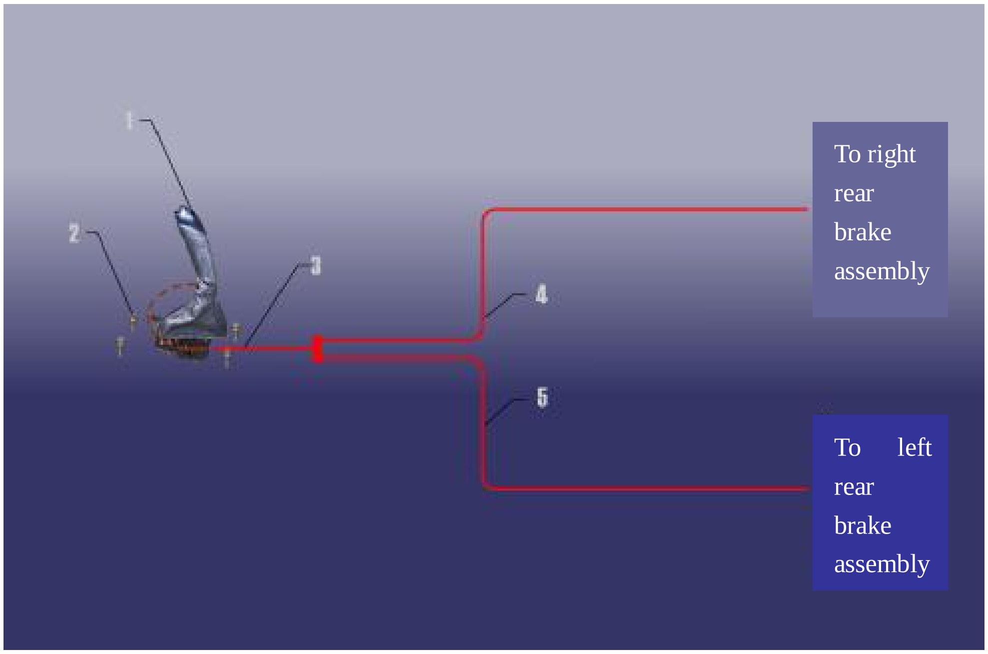
4.15 Remove the branch pump and break it down for checking of intactness.

4. Installation Procedure

Refer to removal procedures.

IV. Adjustment and Replacement of Handbrake

1. System Composition Illustration



1. Handle 2. Fixing bolts 3. Cable 4, 5. Left/Right rear wheel cable

2. Preparations

Tools: Ratchet wheel, ratchet lever, 10#, 13#, 14#, 16# socket, 10#
13#, 14# ring wrench, vice, torque wrench, slotted screwdriver.

3. Notices

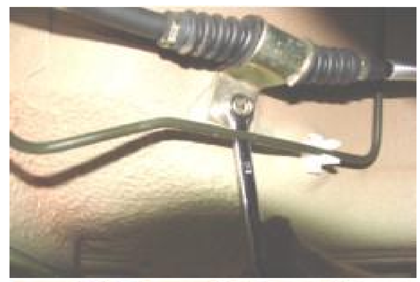
3.1 Please wear necessary labor protection supplies to avoid accidents.
3.2 During the removal/installation of the spring parts, enough cautions should be taken to prevent the ejection of such parts from causing body injuries.
3.3 The removal/installation at the vicinity of the exhaust pipe must be conducted only after the temperature of the exhaust pipe is lowered to normal temperature so as to prevent scald.

4. Removal/Installation Procedure

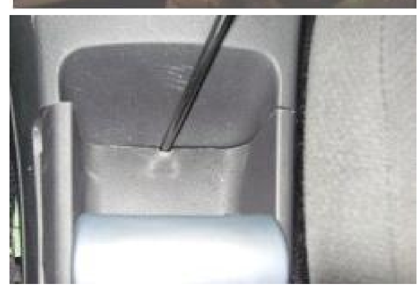
4.1 With reference to the removal/installation of the rear brake, loosen the handbrake cable of the rear wheels.

4.2 Remove the handbrake clip with priers.
Notice: It’s under the rear wheels.

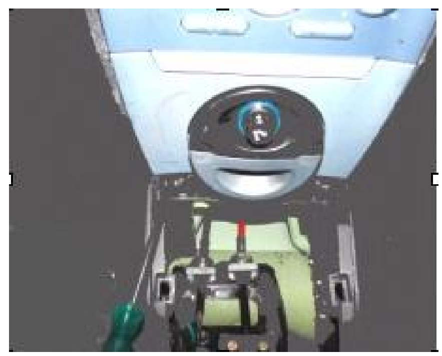
4.3 Remove the fixing bracket bolts of the handbrake cable shown below with 8# ring wrench.
Torque: 9~12 Nm



4.5 Pry out the protective cover at the handbrake and gear position with slotted screwdriver.



4.6 Remove all fixing screws from the secondary instrument panel assembly with ring screwdriver to remove the secondary instrument panel assembly.



4.7 Remove the handbrake adjustment nuts with 10# wrench.

4.5 Loosen the two handbrake cables with hand.

4.9 Pull out the handbrake cable from the underside of the vehicle body.

Notice: Remove the handbrake cable at another side in accordance with the same method.

4.10 **(Handbrake adjustment)** The length of the handbrake cable equipped on this model is designed to be the fixed length. To adjust the handbrake effects, refer to the part “removal of rear brake”. The adjustment of the ejector rod length (clockwise for looseness and counter clockwise for tightness) can achieve the handbrake adjustment.

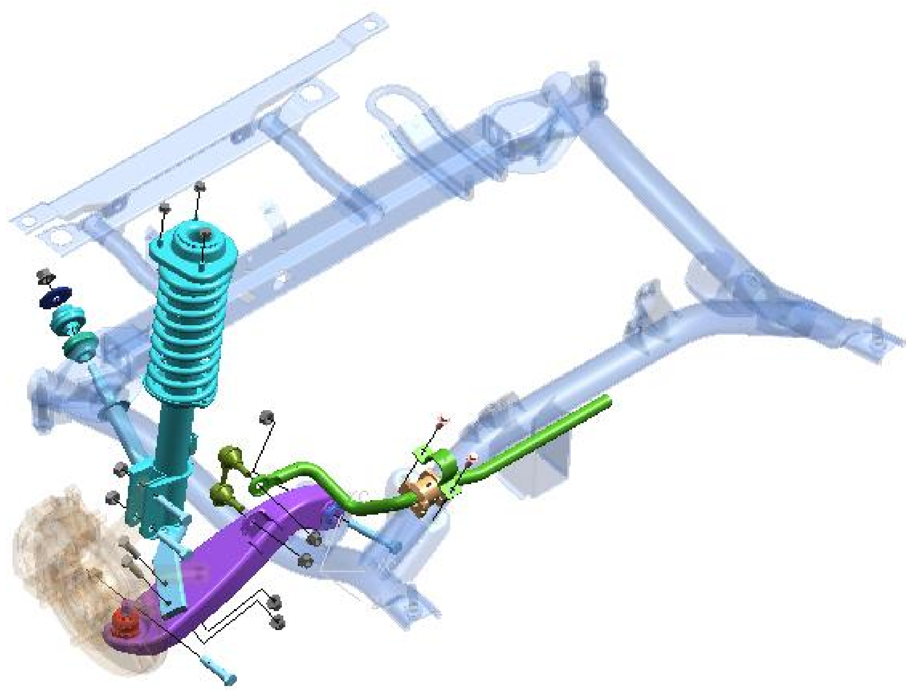
4.11 The installation procedure should be conducted with reference to the removal procedure.

Chapter 2 Adjustment of Suspension System and Four-Wheel Alignment

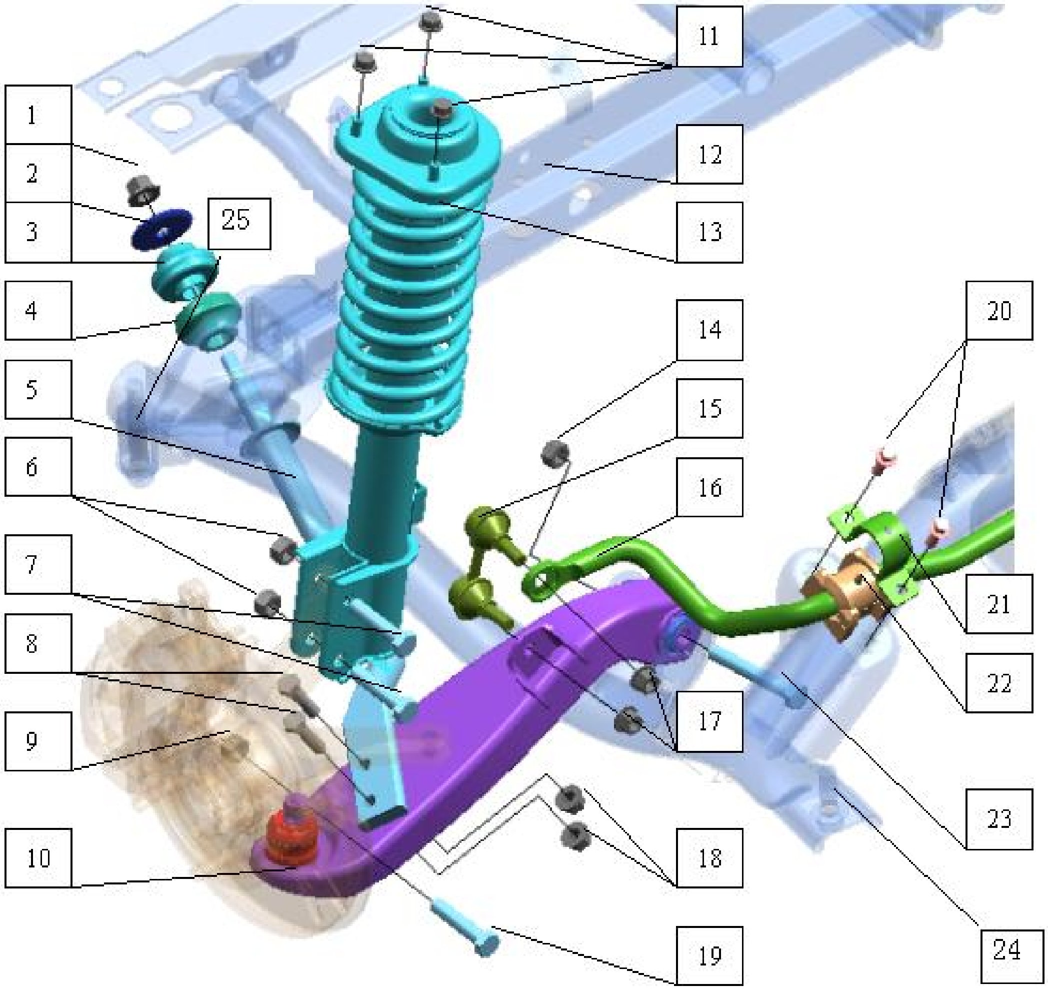
I. Removal/Installation and Overhaul of Front Axle and Suspension

1. System Structural Diagram

The front axle of Chery S21 model adopts the split steering drive axle, with MacPherson independent suspension. The upper end of the suspension is connected with the vehicle body as the lower end is connected with the secondary vehicle frame. The front Macpherson suspension undertakes the dual functions of driving and steering. Subframe connects with vehicle body via elastic element, which improves diving stability and ride comfort.



Structural diagram of Front Axle and Suspension System



1	Nut	9	Nut	17	Nut
2	Gasket	10	Left control arm	18	Nut
3	Rubber gasket I	10	Right control arm	19	Bolt
4	Rubber gasket II	11	Nut	20	Bolt
5	Left propelling rod weldment assembly	12	Secondary vehicle frame	21	Clamp
5	Right propelling rod weldment assembly	13	Front strut assy.	22	Rubber bush
6	Nut	14	Nut	23	Bolt
7	Bolt	15	Front connecting rod assy.	24	Bolt
8	Bolt	16	Front stabilizer bar	25	Bolt

Composition List for Front Axle and Suspension System

2. Preparations

Tools: 8#, 15#, 18#, 19# socket; 10#, 13#, 15# wrench.

3. Notices

2.1 Please wear necessary labor protection supplies to avoid accidents.
2.2 When carry out maintenance and repair to chassis, please note that whether the safety lock of lifting machine is locked.
2.3 When carry out removal/installation to shock absorber spring, prevent spring ejection from being injured.
2.4 It’s prohibited to conduct the welding and correction on the bearing components of the wheel suspension and the guiding components of the wheels.
2.5 During the removal of the chassis component, renew the self-lock nuts and rusted nuts so as to guarantee the safety.

4. Removal/Installation Procedure

4.1 Removal of shock absorber assembly

4.1.1 Remove the tire fixing nuts with 19# socket or vehicle attached wrench to remove the tire (take left side for instance).
Torque: 110±10 Nm

4.1.2 Remove the ABS pipeline from the fixing seat with hand.

4.1.3 Remove the fixing bolts of steering joint and shock absorber with 18# socket.
Torque: 110±10 Nm

4.1.4 Remove the three fixing bolts of shock absorber assembly from the vehicle frame with 13# socket.
Torque: 60±5 Nm

4.1.5 Remove the shock absorber assembly.

4.2 Removal of Control Arm Assembly

4.2.1 Remove the fixing bolts of front connecting rod assembly from the control arm with 15# socket.

Torque: 100±10 Nm

4.2.2 Remove the connecting bolts of front propelling rod and control arm with 15# wrench.
Torque: 75±5 Nm

4.2.3 Remove the ball joint fixing bolts from control arm and steering universal joint with 18# socket and 18# ring wrench.

Torque: 100±10 Nm

4.2.4 Remove the connection bolts of control arm and front axle with 18# socket to remove the control arm assembly.

Torque: 150±10 Nm

4.3 Removal of Front Axle Assembly

4.3.1 Remove the fixing bolts from the chassis mud guard to remove the mud guard assembly.

Torque: 3±0.5 Nm

4.3.2 Remove the front bracket bolts of the transmission from the secondary vehicle frame with 19# socket.
Torque: 110±10 Nm

4.3.3 Remove the rear bracket bolts of the transmission from the secondary vehicle frame with 19# socket.
Torque: 110±10 Nm

4.3.4 Remove the two connecting bolts of front exhaust pipe with 15# socket.
Torque: 50±5 Nm

4.3.54 Remove the two connecting bolts of front exhaust pipe and rear muffler with 15# socket.

Torque: 50±5 Nm

4.3.6 Remove the fixing bolts at the right side of the booster steering gear with 13# wrench.
Torque: 75±5 Nm

4.3.7 Remove the fixing bolts at the left side of the booster steering gear with 15# wrench.
Torque: 75±5 Nm

4.3.8 Remove the fixing bolts of propelling rod and secondary vehicle frame with 19# socket.
Torque: 105±10 Nm

4.3.9 Remove the fixing bracket of the A/C pipeline from the secondary vehicle frame with 10# wrench.
Torque: 25±2.5 Nm

4.3.10 Remove the fixing bracket of the condenser from the secondary vehicle frame with 13# wrench.
Torque: 45±5 Nm

4.3.11 Remove the four connecting nuts of secondary vehicle frame and vehicle body with 18# socket to remove the front axle assembly.

Torque: 150±10 Nm

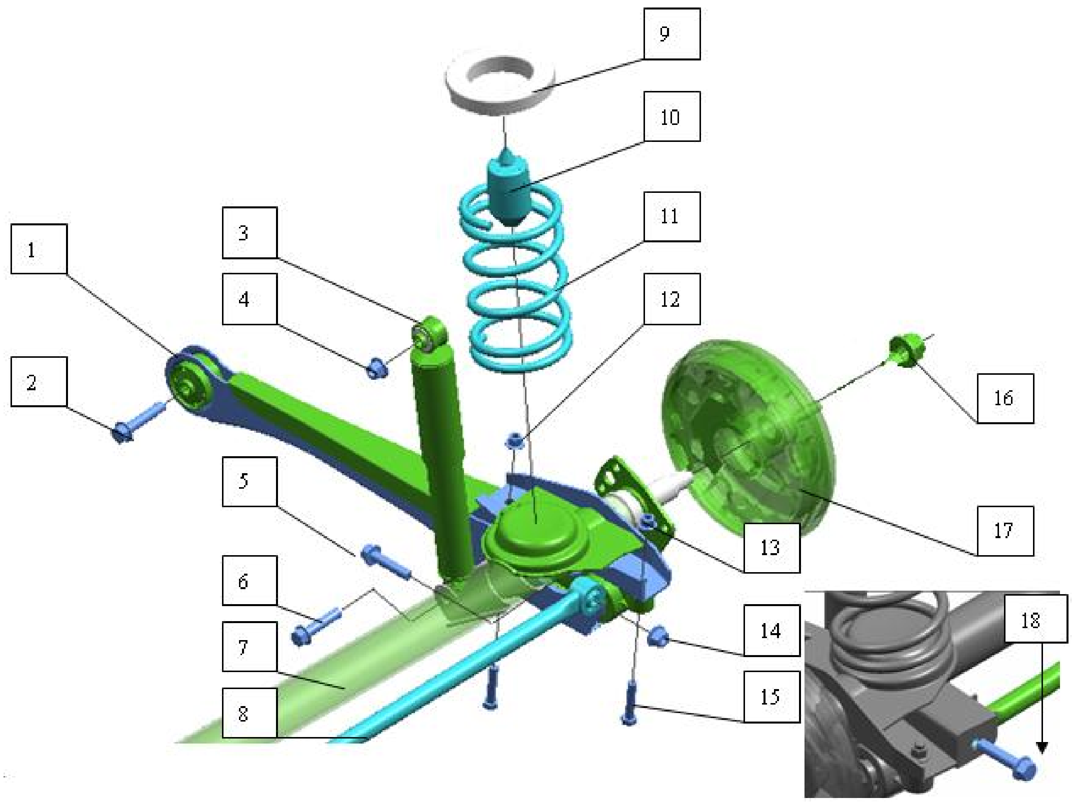
4.3.12 Remove the fixing bolts and nuts from the rubber sleeve of the stabilizer rod with 10# wrench.
Torque: 50±5 Nm

5. Installation Procedure

Refer to the removal procedures of front axle and front suspension.

II. Removal/Installation and Overhaul of Rear Axle and Suspension

1. System Structural Diagram



1	Rear trailing arm assembly	7	Rear shaft welding assembly	13	Nut
2	Bolt	8	Cross stay assembly	14	Nut
3	Rear shock absorber assembly	9	Rear spring cushion	15	Bolt
4	Nut	10	Rear bumper block	16	Lock nut
5	Bolt	11	Rear coil spring	17	Rear brake band drum assembly
6	Bolt	12	Nut	18	Bolt

Structural diagram of Rear Axle and Suspension System

2. Preparations

Tools: 11#, 13#, 15#, 16#, 16#, 19#, 30# socket, Slotted screwdriver, priers.

3. Notices

3.1 Please wear necessary labor protection supplies to avoid accidents.

3.2 Notice to lock the safety lock of the elevator during the repair of the chassis.

3.3 When carry out removal/installation to shock absorber spring, prevent spring ejection from being injured.

4. Removal/Installation Procedure

4.1 Removal of Shock Absorber Assembly and Shock Absorber Spring.

4.1.1 Remove the tire fixing nuts with 19# torque wrench or vehicle attached wrench to remove the tire (take left side for instance).

Torque: 110±10 Nm

4.1.2 Remove the connecting bolts of shock absorber assembly and rear axle with 18# socket.

Torque: 100±10 Nm

4.1.3 Remove the connecting bolts of shock absorber assembly and vehicle body with 18# socket to remove the shock absorber assembly.

Torque: 100±10 Nm

4.1.4 Pry out the rear coil spring with screwdriver.

4.1.5 Vibrate from side to side with force with hand to remove the rear bumper block.

4.2 Cross Stay Assembly

4.2.1 Remove the connecting bolts of cross stay and left side of vehicle body with 16# socket.
Torque: 100±10 Nm

4.2.2 Remove the connecting bolts of cross stay and right side of vehicle body with 15# socket to remove the cross stay assembly.
Torque: 100±10 Nm

4.3 Rear Trailing Arm Assembly

4.3.1 Remove the connecting bolts from the rear side of rear axle and trailing arm assembly with 13# socket.
Torque: 100±10 Nm

4.3.2 Remove the connecting bolts from the middle side of rear axle and trailing arm assembly with 13# socket.
Torque: 100±10 Nm

4.3.3 Remove the connecting bolts of trailing arm and vehicle body with 15# wrench to remove the rear trailing arm assembly.
Torque: 100±10 Nm

4.4. Removal of Rear Axle Assembly

4.4.1 Remove the connecting bolts of brake pipeline and rear axle with 11# socket. Notice the storage of brake liquid.
Torque: 16±3 Nm

4.4.2 Remove the rear brake band drum assembly.

4.4.3 Remove the handbrake cable with priers.

4.4.4 Remove the lock nuts from the rear brake band drum assembly with 30# socket to remove the rear brake band drum assembly.
Torque: 180±10 Nm

4.4.5 Remove the rear axle assembly.

5. Installation Procedure

The installation procedure is reverse to that of removal.

III. Adjustment of Four-Wheel Alignment

Please conduct the measurement and adjustment of parameters on the four-wheel alignment instrument recommended by Chery Auto.

1. Adjustment of Front Wheel Toe-In

The toe-in can be adjusted by means of the optical testing instrument or mechanical toe-in adjustment instrument.

1.1 Depending on the requirements of the testing instrument, conduct the pre-adjustment preparations for the wheel alignment;

1.2 Loosen the lock nuts of right steering track rod and the spring clips of protective sleeve. Based on the demands, rotate the toe-in adjustment rod to adjust the length, till reach the specified value.

Toe-in value: 6′±6′

1.3 Tighten the lock nuts and install the spring clips of the protective sleeve. Check if the lock nuts are properly tightened and the protective sleeve is in right position;

Torque: 35±3 Nm

1.4 At the finish of toe-in adjustment of front wheels, check the steering wheel for levelness. Otherwise, loosen the lock nuts of the steering wheel, adjust the steering wheel to level position, and then tighten the lock nuts of the steering wheel to the specified torque.

2. Adjustment of Front Wheel Camber Angle

2.1 Under normal conditions, it’s unnecessary to adjust the camber angle after the assembling of independent suspension and wheel steering joint. In case the wheel camber angle is out of the tolerance scope due to other reasons, it may be calibrated by means of the connecting bolts of independent suspension and steering joint.
Front wheel camber angle: 0.87°±50′

2.2 Before the calibration, check (visual observation) the driving system components for damage and replace the damaged parts.

2.3 In case the front wheel camber angle is out of tolerance, loosen the connecting bolts of front shock absorber and steering joint and move the wheels for correction.

3. Adjustment of Caster Angle and Kingpin Inclination

The caster angle and the kingpin inclination are guaranteed by the designed structure and are free of adjustment during use.

Caster angle: 3.4°±30′

Kingpin inclination: 12.7°If the parameters are out of the specified range, replace the steering joint.

4. Adjustment of Rear-Wheel Alignment Parameters

All of the rear wheel positional parameters shall be guaranteed through design process.

4.1 Rear wheel camber angle: 0°±30′

4.2 Rear wheel toe-in: 0°±10′

4.3 If the deformation of rear shaft arising from the great impact force causes the change of rear wheel alignment parameters that out of the specified range, correct the rear axle or replace the rear axle.

IV. Tire Installation and Air Pressure Adjustment

1. Installation of Air Valve

Prior to installing tire valve, firstly check the valve port to ensure whether it is smooth and free from burr, and then apply glycerol on the rubber body surface, or soak the tire valve into glycerol. Pull or press (200 - 400N) using special tools to make the locating ring of the valve can go through the wheel holes, to this point, the assembly is completed (soap water is allowed to substitute glycerol).

2. Tire Assembling

Before fit the tire, apply glycerol or soap water along the cycle of tire bead, meanwhile, note that:

2.1 When there is colored dot on the wheel rim, align the uniformity testing mark of tire to the colored dot mark of wheel rim.

2.2 When without colored dot on the wheel rim, align the dynamic balance testing mark of tire to valve position.

2.3 When without colored dot on the wheel rim, additionally, there is no dynamic balance testing mark, however, static balance testing mark is available, at this point, align the tire valve to the static balance testing mark.

2.4 The description concerning the uniformity, dynamic balance and static balance testing marks for tires will be additionally provided in writing by the product division of Chery Company or suppliers. In addition, this kind of descriptions will clearly be indicated on process sheet.

2.5 Carry out tire inflation strictly in accordance with specified pressure. During inflating process, air pressure shall not exceed 10% of rated pressure. When performing separate packaging to spare wheel assembly, the rated inflation pressure shall be 3.0bar, and the spare wheel assembly shall be stored separately from four wheels. Before the four-wheel alignment, check the air pressure of all wheels and adjust the air pressure: 2.3bar for front wheels and 2.1bar for rear wheels.

3. Tire Inflation

After completion of tire inflation, screw up the protective cap of valve, and then carry out dynamic balancing test. Fit appropriate balance weight at the internal and external fringe of wheel rim as required. It is required that the unbalancedness of the final assembly shall be less than 100g • cm, which is approximately equivalent to a 5g balance weight at the internal and external fringe of wheel rim. Note: each wheel and each side can use only one balance weight. Additionally, its maximum mass shall not be more than 70g. During assembling process, never hit the balance weight too heavy. Otherwise, replace balance weight in time. In addition, never use the replaced balance weight again.

4. Installation of Wheel and Tire Assembly.

When fixing wheel and tire assembly, first, manually screw up the wheel bolt onto the hub for pretension, after that use special tools for tightening in accordance with diagonal process. Tightening torque shall be 110±10N.m. It is prohibited to use impact wrench to prevent from wheel damage, over loose or over tight. It is not allowed to apply grease on wheel bolt (For new installed wheel and tire assembly, the wheel bolts should be tightened at first running of 100km to guarantee the tightening torque. The tightening torque checking of wheel bolts is one of the items of regular maintenance)

5. Tightening Method of Wheel Nuts

Tighten the fixing nut in a decussate way, the tightening force shall be approximately equal, then wheel shall be able to turn freely. When carry out final tightening, the wheel shall be on the ground.

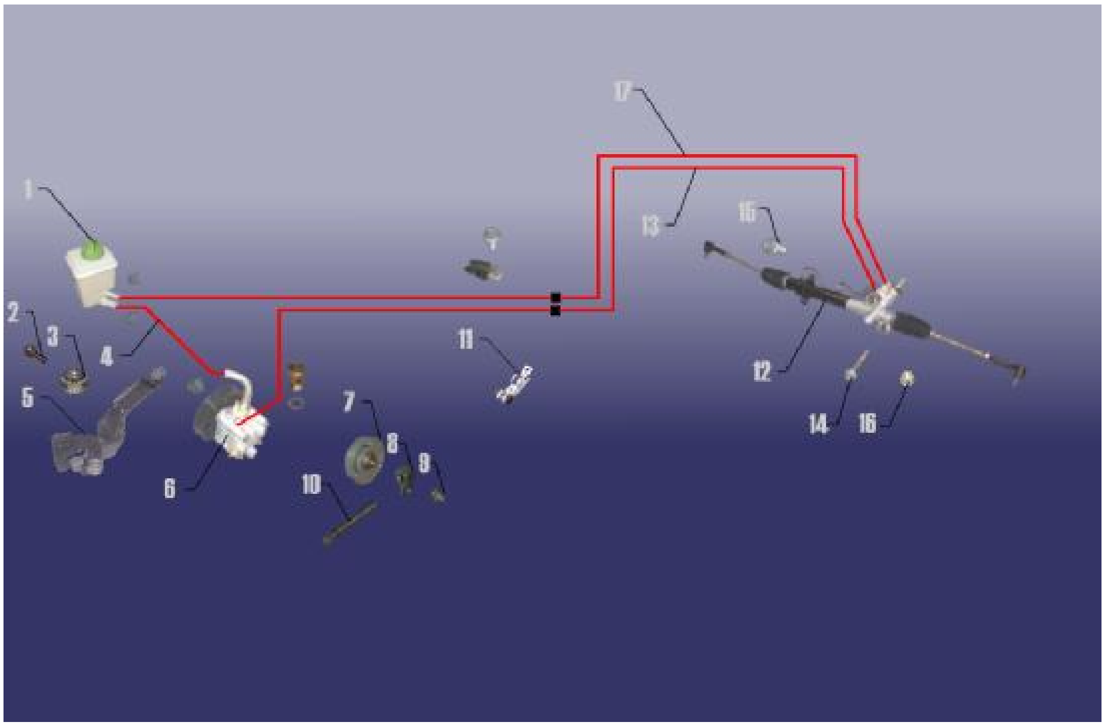
6. Installation of Decorative Cover

Mount trim cover or place trim cover as required. When fitting clip-type trim cover, place knock in position by hand or via rubber tools.

Chapter 3 Removal/Installation and Overhaul of Steering System

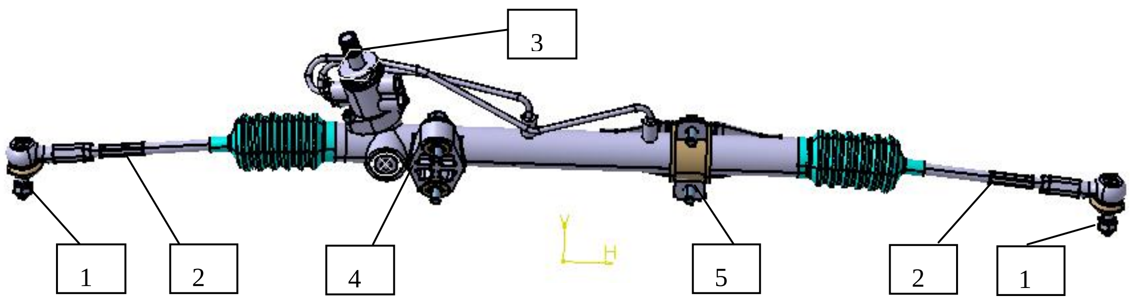
I. Removal/Installation of Steering Gear

1. System Composition Illustration



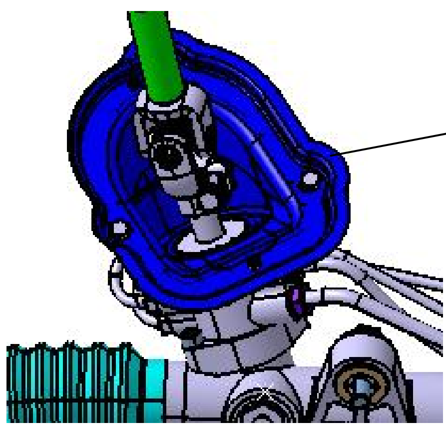
1. Booster steering liquid reservoir
2. Bracket fixing bolt
3. Bracket fixing nut
4. Outlet pipeline
5. Reservoir fixing bracket
6. Steering pump
7. Tensioner
8. Lock nut
9. Adjustment nut
10. Adjustment tie rod
11. Pipe clamp
12. Steering gear
13. Outlet pipeline
14. 15. Fixing bolt
16. Fixing nut
17. Return pipeline

The breakdown illustration of steering gear is shown below:



1 – Lock nuts 2 – Track rod 3 – Input shaft 4 – Left installation bracket 5 – Right installation bracket

The illustration of steering universal joint and protective sleeve is shown below:



S21-3404060
(Steering universal knuckle protective sleeve assembly)

2. Preparations

Tools: 13#, 19# socket wrench, 12#, 13#, 17# non-adjustable wrench.
Accessories: power steering fluid

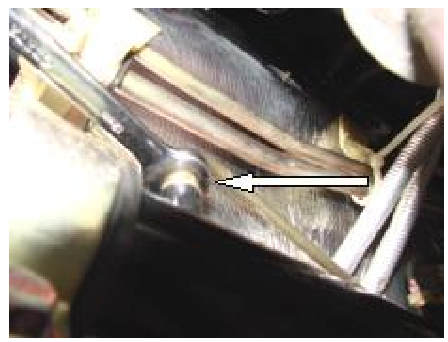
3. Notices

3.1. Please wear necessary labor insurance products in order to avoid the accidents.
3.2 Avoid steering fluid to contact with skin or eyes when disassembling steering system.

4. Removal/Installation Procedure

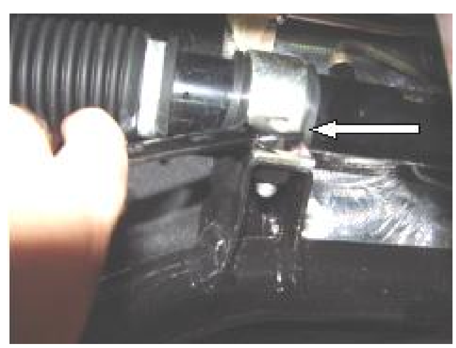
4.1 Remove the fixing nuts at the both sides of steering ball joint with 19# socket.
Torque: 40±5 Nm

4.2 Loosen the fixing nuts under the booster steering hose with 17# non-adjustable wrench.
Torque: 25±5 Nm



4.3 Loosen the fixing nuts above the booster steering hose with 12# non-adjustable wrench.
Torque: 25±5 Nm

4.4 Remove the fixing screws above the right bracket of power steering gear with 13# socket.
Torque: 100±10 Nm



4.5 Remove the fixing screws under the right bracket of power steering gear with 13# socket.
Torque: 100±10 Nm

4.6 Remove the fixing screws above the left bracket of power steering gear with 13# socket.
Torque: 100±10 Nm

4.7 Remove the fixing screws under the left bracket of power steering gear with 13# socket.
Torque: 100±10 Nm

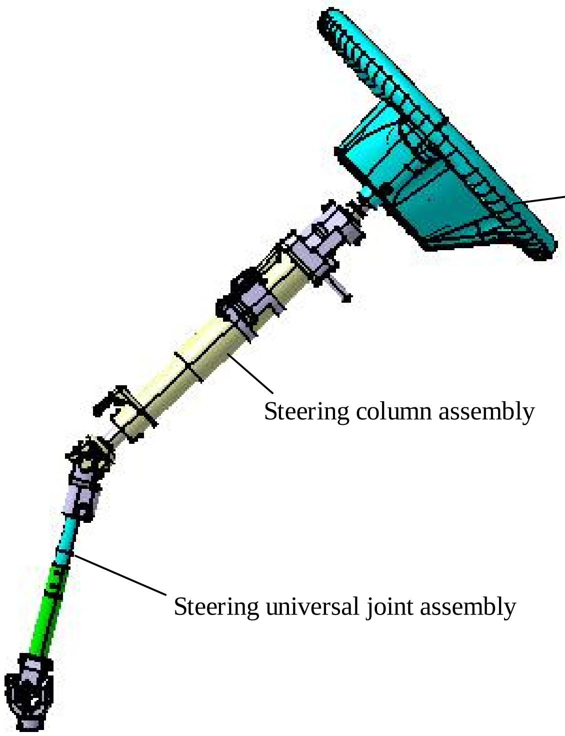
4.8 Remove the fixing bolts of the steering universal joint with 10# socket wrench to remove the steering gear assembly.

5. Installation Procedure

Refer to removal procedures.

II. Removal/Installation of Steering Column

1. System Composition Illustration



1 – Steering wheel 2 – Steering column assembly 3 – Steering universal joint assembly

2. Preparations

Tools: Cross screwdriver, 5#, 6# inner hex wrench, 10#, 13#, 22# socket wrench.

3. Notices

3.1 Please wear necessary labor protection supplies to avoid accidents.

3.2 Avoid steering fluid to contact with skin or eyes when disassembling steering system.

3.3 Before disassembling steering wheel, disconnect negative of battery cell to avoid airbag ejection.

4. Removal Procedure

4.1 Loosen the two screws under the steering wheel with 5# inner hex wrench.

4.2 Remove the horn cover from the steering wheel.

4.3 Remove the fixing nuts of the steering wheel with 22# socket wrench.

4.4 Remove the steering wheel after screw off the nuts.

4.5 Screw off the two screws from the front surface of combined switch guard plate with cross screwdriver.

4.6 After screw off the screws, open upward to remove the upper protective cover.

4.7 Screw off the three screws from the lower side of combined switch guard plate with cross screwdriver.

4.8 Remove the lower protective cover after screw off the screws.

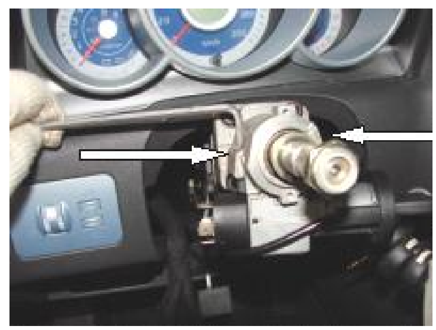
4.9 Remove the two fixing screws from the combined switch with cross screwdriver.

4.10 Pull out all plugs from the combined switch. (Total 5 plugs)

4.11 Remove the combined switch.

4.12 Pull out the plug of ignition switch.

4.13 Screw off the fixing screws from ignition lock with 5# inner hex wrench and remove the ignition lock assembly.



4.14 Screw off the 4 fixing screws from the upper end cap with 6# inner hex wrench.

4.15 Remove the outer caliper with the outer caliper pliers.

4.16 Remove the retainer and spring with hand.

4.17 Remove the upper end cap with hand.

4.18 Remove the two upper fixing nuts from the steering column with 13# socket.
Torque: 25±3 Nm

4.19 Remove the two lower fixing nuts from the steering column with 13# socket.
Torque: 25±3 Nm

4.20 Remove the connecting nuts of steering column and steering universal joint with 10# socket to remove the steering column assembly.

Torque: 25±3 Nm

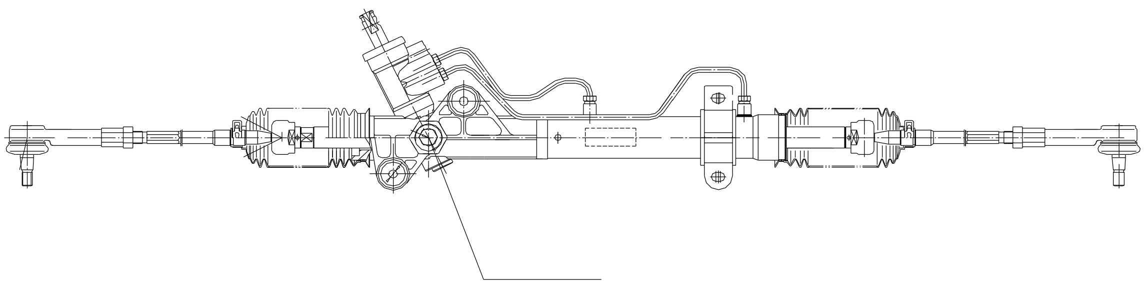
4.21 Remove the connecting bolts of steering universal joint and steering gear with hand.
Take out steering universal joint assembly.

5. Installation Procedure

Refer to removal procedures.

III. Adjustment of Steering Gear Clearance

1. Place the wheels at linear driving position;
2. Rotate the steering wheel towards both sides;
3. If heard noise of steering gear, adjust the screw as shown in the diagram until no impinge noise is heard when turning steering wheel;
4. Tighten the screws for further 1/8 turn (approximate 45°);
5. Carry out the road test;
6. If the steering mechanism can not return to the central position by itself, then loosen the bolt for 15° ;
7. Carry out the road test.



IV. Adjustment of Power Steering System

1. Correctly connect power steering oil pipe—where the tightening torque for the connector between oil return pipe, high-pressure oil pipe and steering gear shall be 35±3N.m, the tightening torque of hollow bolt connecting high-pressure oil pipe and power steering pump shall be 45±3N.m. When filling power steering oil, it is recommended to use special purpose vacuum pumping oil. The specifications for filling power steering hydraulic fluid and exhaustion are described as below:

Fill power steering hydraulic fluid into steering reservoir assembly to the maximum level, start engine at low speed (idle speed) to drive the steering pump, the steering system will be quickly full of hydraulic fluid. In the oil filling process, only let engine run at idle speed to drive vane pump. Meanwhile, continuously add hydraulic fluid to prevent vane from sucking air due to oil level drops.

2. When hydraulic fluid in the oil tank presents emulsification state, or the pump emits excessive noise (under normal condition, max. noise shall be 80 db), it must carry out exhaustion process. The exhaustion procedure is described as below:

Jack the front part of the vehicle till two front wheels are hung up, start the engine, turn the steering wheel to right and left till reach limit position (caution: after come to the limit position, try not to stop, even if stop, never maintain over 2 seconds). Repeat above action for several times, until the air in the system is gradually exhausted from the oil reservoir. In this process, with the drop of oil level, continuously supplement hydraulic fluid until the oil comes to specified level.

3. Regularly check and adjust the tension of power steering belt: vertically apply a 100N force at the middle of the belt, the max. deflection of belt shall be less than 5 mm, otherwise adjust the belt tension until meet the above requirement via adjusting tension bolt.

4. When in service, it is prohibited to turn the steering wheel to limit position, even if it has to do so, never maintain at this position over 10 seconds. It is strictly prohibited to use power steering pump without oil. If the driver suddenly feels the steering heavy in service, immediately stop the vehicle, dismantle and repair accordingly.

Mando MGH-25 Anti-Lock Brake System
User's Manual

CONTENT

Common Abbreviations and Acronyms in This Manual

FL——*Front Left*

FR——*Front Right*

RL——*Rear Left*

RR——*Rear Right*

ABS——*Anti-lock Brake System*

EBD——*Electronic Brake Distribution*

ECU——*Electronic Control Unit*

HU、**HCU**——*Hydraulic (Control) Unit*

HECU——*ECU+HCU*

LPA——*Low Pressure Accumulator*

MCP——*Master Cylinder Primary, one of two outlet of master cylinder. P refers to primary.*

MCS——*Master Cylinder Secondary, one of two outlet of master cylinder. S refers to secondary*

SDL——*Serial Data Link*

I. Product Instruction

1. ABS Overview

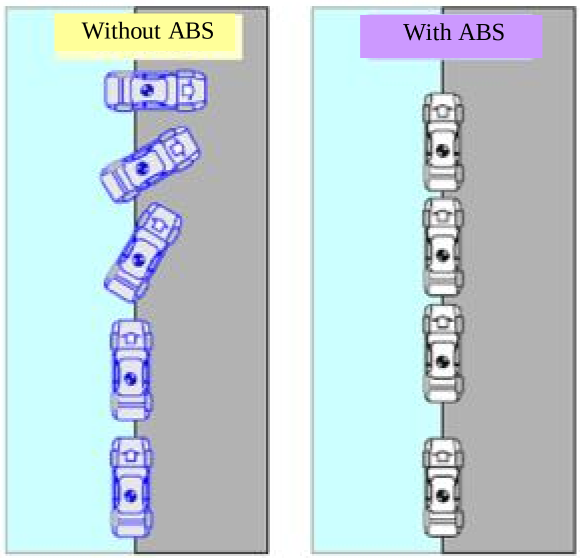
1.1 System Function

① Promotion of vehicle stability;

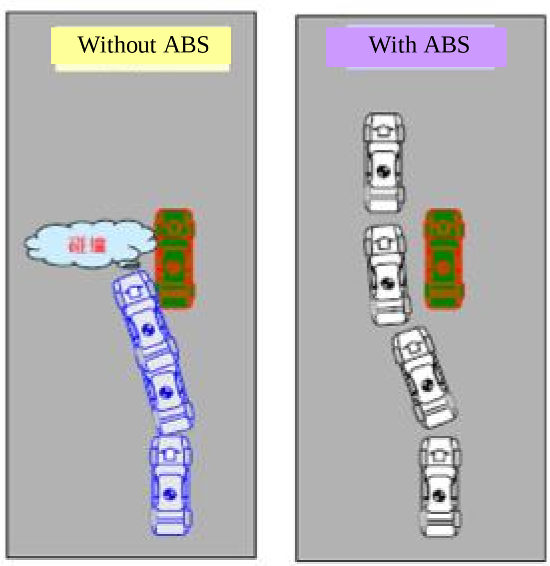
② Guarantee of vehicle steering ability;

③ Guarantee of shortest brake distance.

1.2 Comparison between with and without ABS braking effects

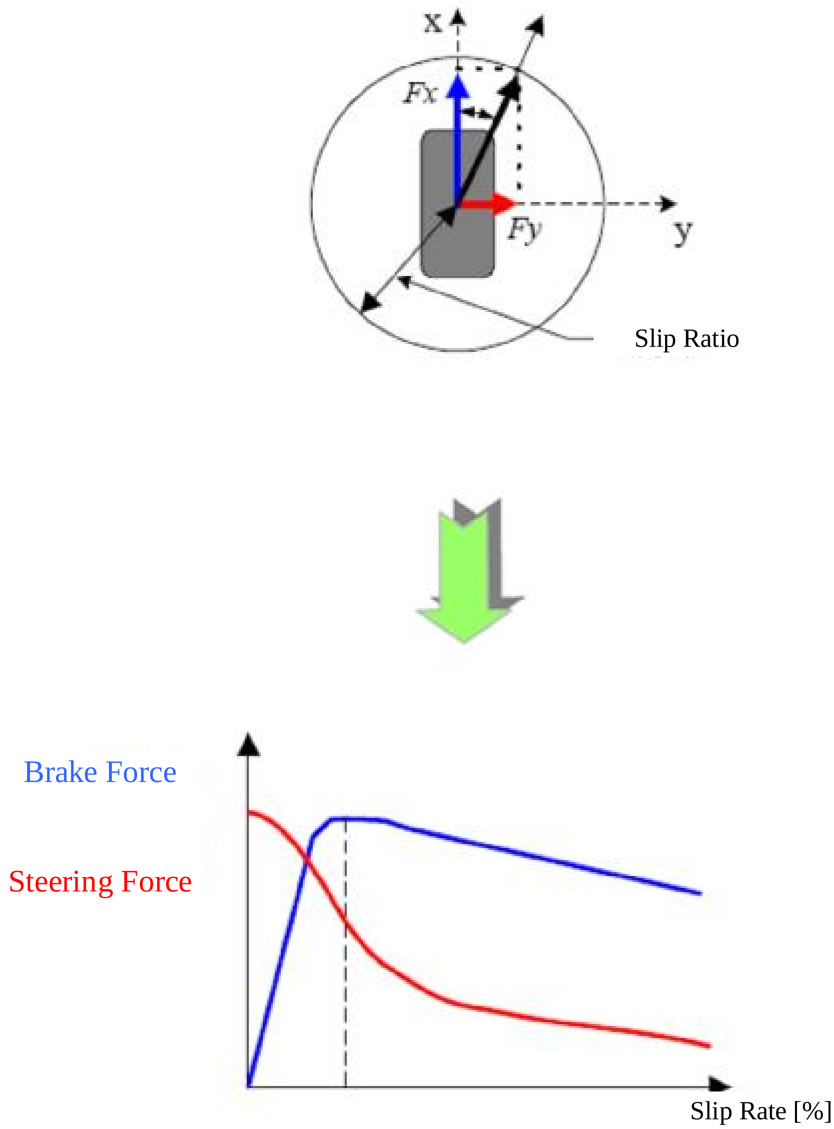


Braking on Bisectional Roads (Split)

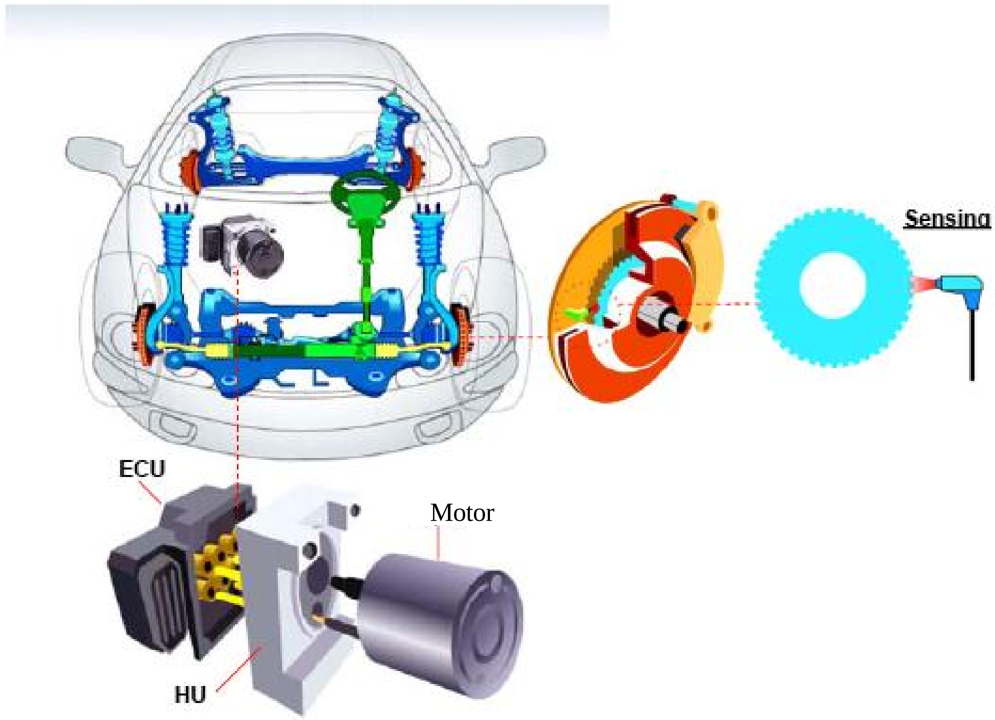


Evading the obstacles during braking

1.3 Tire Dynamic Characteristics



2. System Structure

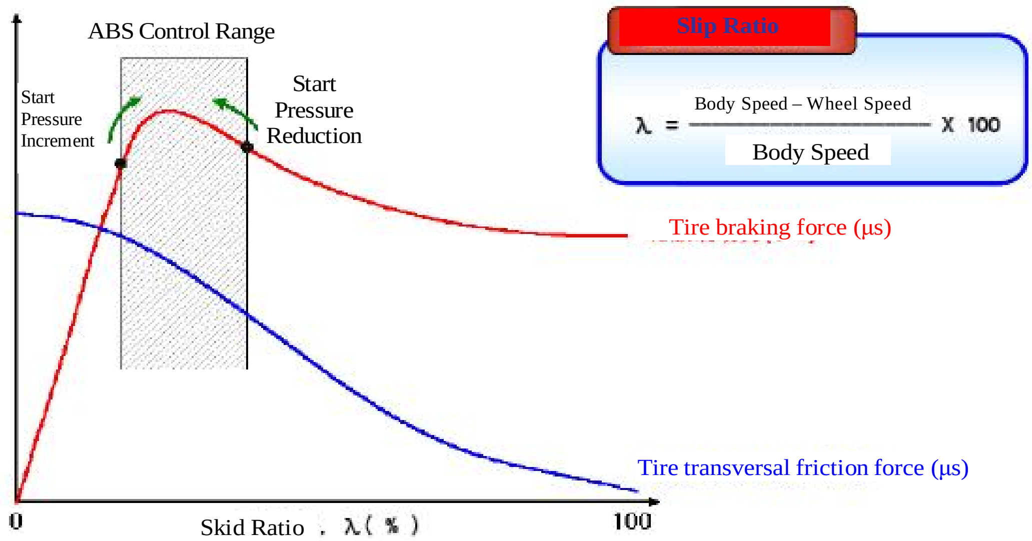


Including:

Electronic Control Unit	The sensor will calculate the speed and acceleration/deceleration of four wheels and judge the skid status of the wheels and therefore drive the electromagnetic valve and motor, control the pressure increment and pressure reduction, maintain the status, and etc.
Hydraulic Unit	The basic hydraulic circuit is comprised of the 1st circuit and the 2nd circuit that is active only when the ABS is functioning and is the integral part that controls the hydraulic parts transmitted to various wheels. Depending on the transmitted signal output of the sensor, the ECU performs the calculation and judges the skid status to determine if it's necessary to run the ABS. Therefore, depending on the control procedure of the ECU, the electromagnetic valve and the motor will be started to control the pressure increment and pressure reduction, maintain the status, and etc.
Sensor	In order to make the ECU to calculate the speed and acceleration/ deceleration of the four wheels, it always transmits the revolution measurement of the gear ring to the ECU.
Motor	When the ABS is functioning, the motor will rotate following the ECU signal and convert the rotation movement into linear reciprocated movement via the bearing to circulate the brake oil.

3. System Functioning Theory

3.1 ABS Control Theory



λ= 0%: The status that the brake is not functioning

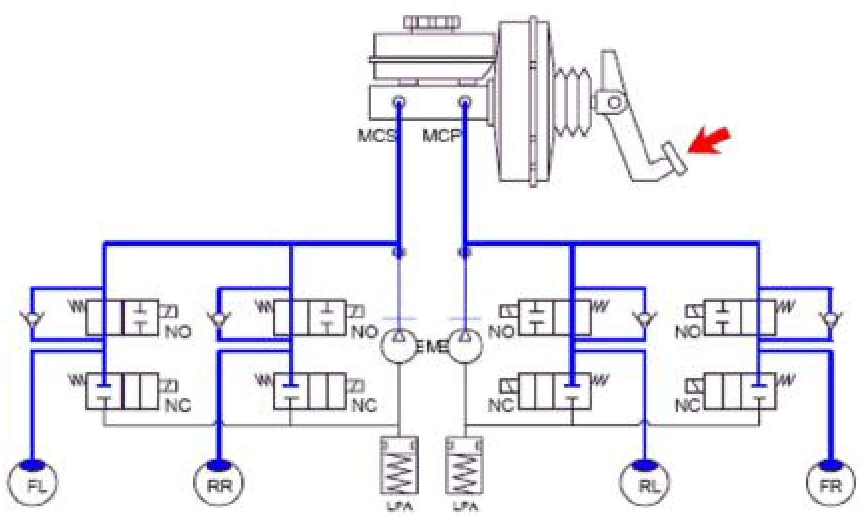
λ= 100%: The status that the wheels are locked

3.2 ABS Control Mode

① Functioning Status of General Brake

For the vehicles equipped with ABS, if the braking pressure applied onto the wheels is not enough to lock the wheels, the pressure generated by the general pump will transmit to the wheel branch pump via the normal open valve to obtain the braking effects. When it's unnecessary for further braking, the driver will reduce the pressure on the brake pedal and then the brake liquid of various wheels will return to the general pump to reduce the braking pressure.

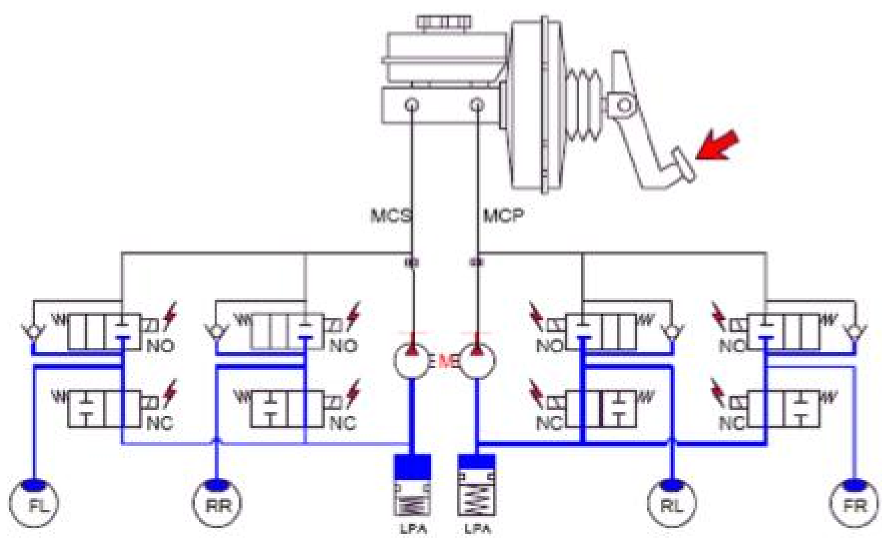
Solenoid Valve	Power Status	Solenoid Valve Status
Normal Open Valve (NO Valve)	OFF	Open
Normal Close Valve (NC Valve)	OFF	Close



② ABS Functioning (Pressure Reduction) Status

For the vehicles equipped with ABS, if the applied braking pressure is too big, the wheels will have rapider deceleration than that of vehicle body, which will be ready to result the lock of the wheels. Under such case, the ECU will transmit the code for wheel pressure reduction to the HCU, namely turn off the normal open valve and turn on the normal close valve to reduce the pressure of wheel branch pump. In such case, the brake oil released by the wheel branch pump is temporarily stored in the low pressure accumulator (LPA). The brake oil stored in the LPA will be sucked back to the general pump by the oil pump started following the rotation of the motor. The brake liquid will return to the high pressure accumulator (HPA) in the pipeline and reduce the high pressure pulse generated by the running of the oil pump by means of the orifice hydraulic resistance.

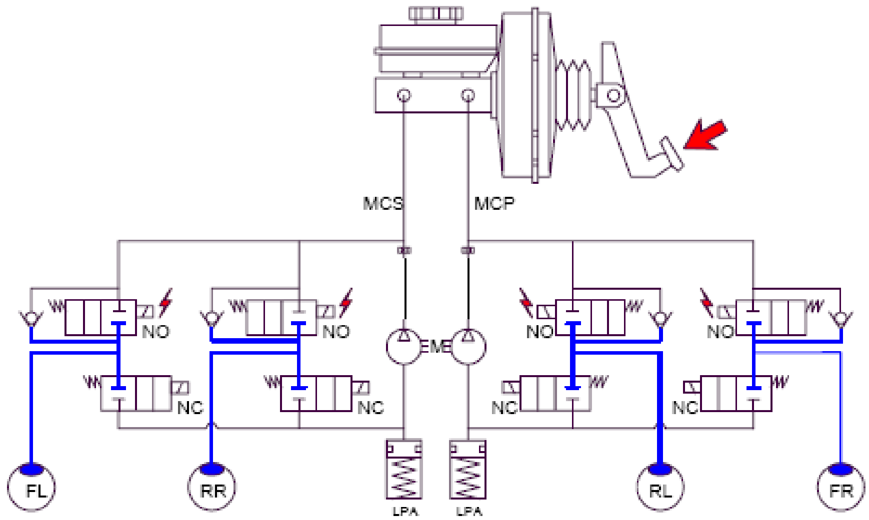
Solenoid Valve	Power Status	Solenoid Valve Status
Normal Open Valve (NO Valve)	ON	Close
Normal Close Valve (NC Valve)	ON	Open



③ ABS Functioning (Maintaining) Status

When the branch pumps of the wheels are applied with proper pressure via the pressure reduction or pressure increment, the normal open valve and the normal close valve will be turned off to maintain the pressure of the wheel branch pumps. For the operations mentioned in above ② ~ ④, depending on that wheels are locked or not, the ABS will function till the vehicle is fully stopped and therefore the safety and steering capability of the vehicle are guaranteed.

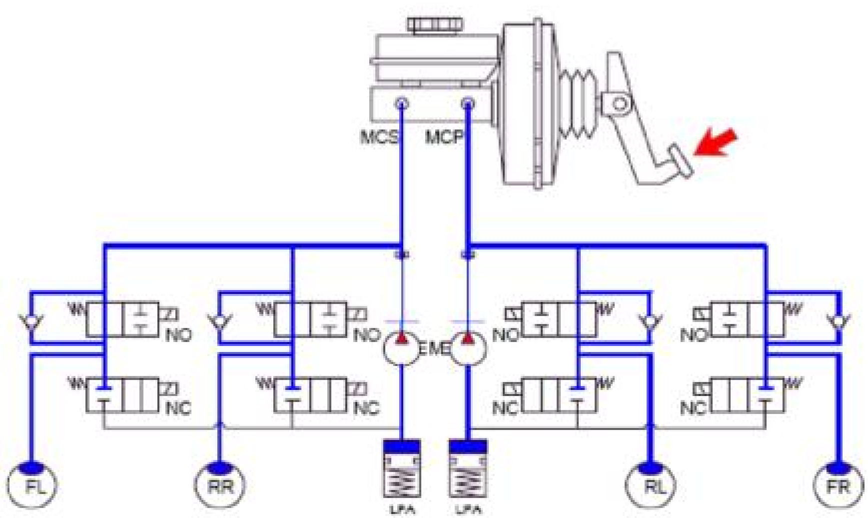
Solenoid Valve	Power Status	Solenoid Valve Status
Normal Open Valve (NO Valve)	ON	Close
Normal Close Valve (NC Valve)	OFF	Close



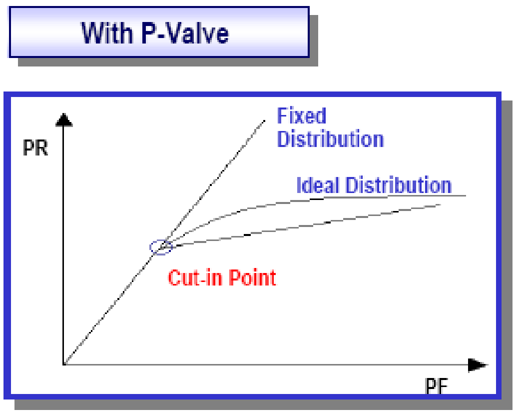
④ ABS Functioning (Pressure Increment) Status

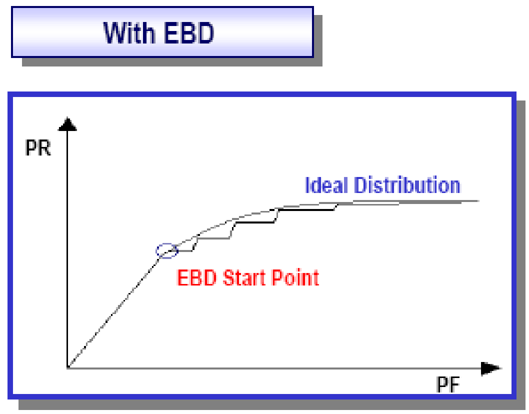
During the implementation of the pressure reduction, if the excessive brake liquid is drained or the friction coefficient between the wheels and the road is increased, it's necessary to increase the pressure of various wheels. Under such case, the ECU will transmit the code for wheel pressure increment to the HCU, namely turn on the normal open valve and turn off the normal close valve to increase the pressure of wheel branch pump. During the implementation of the pressure reduction, the brake liquid stored in the low pressure accumulator (LPA) will continue to rotate the motor to drain the brake liquid under the pressure increment status. In such case, the brake liquid is supplied to branch pump of various wheels via the general pump and normal open valve. The brake liquid will return to the high pressure accumulator (HPA) in the pipeline and reduce the high pressure pulse generated by the running of the oil pump by means of the orifice hydraulic resistance.

Solenoid Valve	Power Status	Solenoid Valve Status
Normal Open Valve (NO Valve)	OFF	Open
Normal Close Valve (NC Valve)	OFF	Close



3.3 EBD Control Mode





In order to guarantee the operation stability, the EBD function is designed in such manner that front wheels are stopped ahead of the rear wheels. As the front brakes undertake more works than that of the rear brakes, it will cause that the rear wheels will be stopped firstly when apply with same braking pressure. In order to preventing the occurrence of above thing, a device to reduce the braking pressure applied on the rear wheels under certain pressure is required, of which this function is fulfilled by the pressure reducing valve (P-Valve). The special pressure reducing valve is not required for the vehicles equipped with ABS as the procedure supplemented to the ABS will fulfill the control function on the braking pressure of the rear wheels so as to effect the improvement of vehicle operation stability.

II. Removal and Installation

1. Spare Part Supply Status

① Differentiation between Dry Type HECU and Wet Type HECU

The biggest differentiation between the dry type HECU and wet type HECU is that the no air discharge is conducted in the 2nd circuit (namely the circuit from the normal close valve to the general pump) of the dry type HECU. Therefore, when the spare part is of wet type HECU, it's only necessary to conduct the air discharge and oil refill in accordance with the regular brake system after the replacement. When the spare part is of dry type HECU, besides that the air discharge and oil refill are required in accordance with the regular brake system after the replacement, it's necessary to conduct the air discharge and oil refill to the 2nd circuit of the HECU. In addition, for the appearance, the wet type HECU has the bolts for sealing purpose and the dry type HECU has the protection film. The product label located on the motor is marked with the part number of the products, through which the dry type HECU and wet type HECU can be differentiated.

Take the S21 model for instance, the dry type Mando product number is BH601-086-00 and the wet type Mando product number is BH602-386-00.

Dry Type

Wet Type

② Notices

If the bolts on the wet type HECU are fallen off (such as during the transportation), besides that the air discharge and oil refill must be conducted for 1st circuit, maybe it's necessary to conduct the air discharge and oil refill to the 2nd circuit.

2. Notices for Removal and Installation

① Notices for HECU Assembling

During the assembling of brake pipeline:

† Remove the protection film attached onto the HECU before the operation.

† Confirm the pipeline of general pump and wheel branch pump before the operation.

(General pump: MCP, MCS Wheel branch pump: FR, FL, RR, RL)

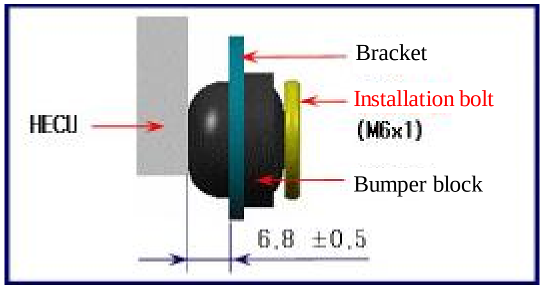
† Confirm if the brake hose is tightened to 120~160 kgf·cm with special tool or torque wrench.

† Notice to keep away the impurity ingress into the HECU hole and brake hose during operation.

② Notices for HECU Bracket Assembling

During the assembling of HECU bracket:

† During the tightening of the bolt (3 pcs), it may cause the incorrect assembling due to the friction resistance of the cushion pad. It's preferable to use the lubricating oil with the physical properties that will not impair the cushion pad.



† Insert the bolts (3 pcs) onto the cushion pad installed onto the bracket before install to the HECU, which will help the operation.

† Confirm if the bolts (3 pcs) are tightened to 80~100 kgf·cm with special tool or torque wrench.

③ Notices for Installation of HECU and Bracket Assembly

During the installation to vehicle body:

† Attach the components of brake hose and bracket to the HECU and install to the vehicle body with the body fixing bolts.

† Confirm if the body fixing bolts are tightened to 190~260 kgf·cm with special tool or torque wrench.

† Again confirm if the pipeline installation of general pump and wheel branch pump is correct.

(General pump: MCP, MCS; Wheel branch pump: FR, FL, RR, RL)

† Tighten the brake hose not fully tightened to the specified torque (120 ~ 160 kgf·cm) with special tool or torque wrench.

④ Other Notices

† Find out the trouble cause with diagnosis instrument before repair.

† The package of the spare parts should be unwrapped only before the installation.

† Only use the parts supplied by the original manufacturer.

† Notice the cleanliness during removal and only use the non-fuzz cloth for cleaning.

† Use the detergent not containing the mineral oil to clean the appearance before removal.

† Do not use the compressed air or move the vehicle when the system is opened.

† After the removal of the ABS assembly, plug various hydraulic outlets with plugs as soon as possible.

† Remove other components interfering the operation.

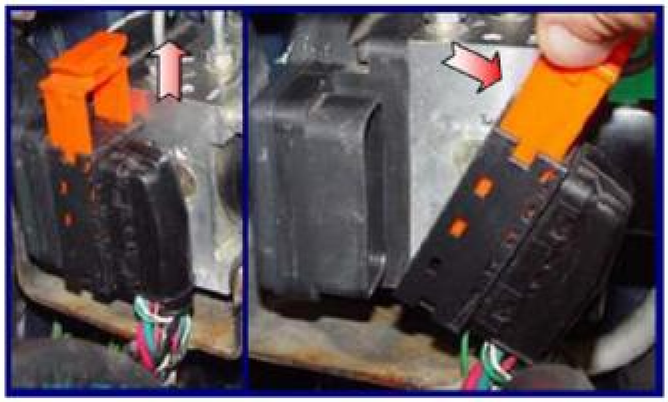
† Use DOT#3 brake liquid.

† Immerse the seals with brake liquid, instead of engine oil or braking ointment.

† Check all hydraulic connectors for leakage.

3. HECU Replacement

① When the vehicle is stopped, remove the 25-pin connector and harness wiring of the HECU located within the engine compartment.



25-Pin Connector Used in MGH-25 ABS

(P/No：AMP 368482-1)

② Screw off in counter clockwise direction the 6 bolts (M10x1.0) connected to the HECU brake hose with 11mm tool (wrench) (rotate in clockwise direction during refit). The tightening torque for the brake hose is 120 ~ 160 kgf·cm.

③ Screw off in counter clockwise direction the 3 bolts or nuts connected to the bracket with 12mm tool (wrench) (rotate in clockwise direction during refit). The tightening torque for the fixing bolts or nuts of the bracket is 190 ~ 260 kgf·cm.

④ After the removal of the product, screw off in counter clockwise direction the 3 embedded bolts (M6x1.0) attached to the HECU with 5mm tool (hex wrench) (see the figure in next page).

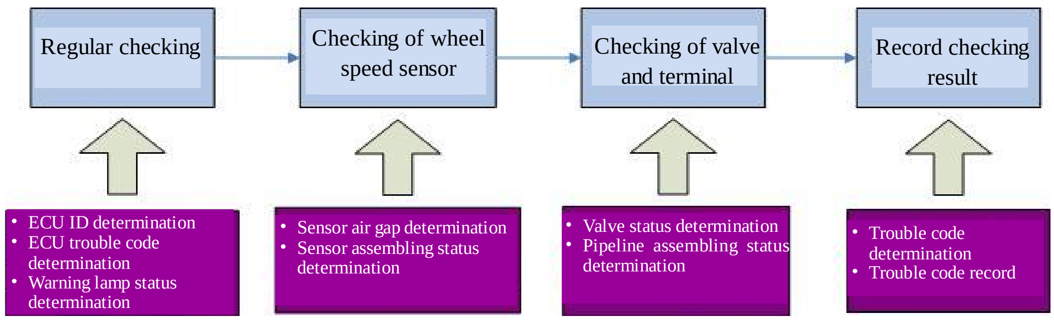
⑤ Screw off in counter clockwise direction the 6 bolts from the after-service HECU with 6mm tool (hex wrench).

⑥ Screw on in clockwise direction 3 embedded bolts to assemble the after-service HECU and the bracket with 5mm tool (hex wrench). The tightening torque for the embedded bolts is 80 ~ 100 kgf·cm.

⑦ With reference to above item ①~ ③, install the replacement after-service HECU to the vehicle in reverse order.

III. Trouble Diagnosis and Troubleshooting

1. Checking Sequence



2. Trouble Diagnosis and Troubleshooting of MGH-25 ABS

2.1 Checking of ABS and EBD Warning Lamp

Check if the ABS and EBD warning lamps are illuminated in accordance with following:

① Rotate the vehicle key to turn on the power. The ABS warning lamp will illuminate and then go off in 3s.

② It indicates the trouble if the status mentioned in ① is not present and it's necessary to check the trouble code with reference to the trouble code checklist.

③ If the warning lamps are completely not illuminated, please refer to the trouble checklist without trouble code.

2.2 Table for Common Troubles

Position	Cause	Structure	Warning lamp	
			ABS	**EBD**
Vehicle harness	Incorrect assembling of brake hose	Locked wheels and brake off-tracking	Off	Off
	Brake oil leakage	Poor start of ABS and EBD		
	Incorrect wiring installation	Brake failure		
	Air discharge trouble	Deteriorated ABS performance		
Motor	Motor trouble	ABS start failure	On	Off
ECU	Trouble of ECU power line	Start failure of ABS and EBD	On	On
	Trouble of valve power line	Start failure of ABS and EBD		
	Poor grounding of ECU	Start failure of ABS and EBD		
	ECU trouble	Start failure of ABS and EBD		
	Trouble of motor wire line	ABS start failure	On	Off
Speed sensor	Sensor open-circuit/short-circuit	In event of whichever trouble: ABS start failure	On	Off
		In event of both troubles: Start failure of ABS/EBD	On	On
	Gear ring trouble, sensor interference trouble, air gap trouble	In event of whichever trouble: Incorrect start of ABS	On	Off
		In event of both troubles: Start failure of ABS/EBD	On	On

2.3 Trouble Code Readout and Deletion without Trouble Diagnosis Instrument

① Purpose and condition of trouble code readout without trouble diagnosis instrument

If without the trouble diagnosis instrument, it may display the trouble status of the ABS via the ABS warning lamp and read out the trouble code to facilitate the trouble determination and troubleshooting. In such case, the trouble code will be displayed in 2-digit number. Please refer to the numbers in parentheses in the trouble checklist of trouble code in succeeding section 2.4.

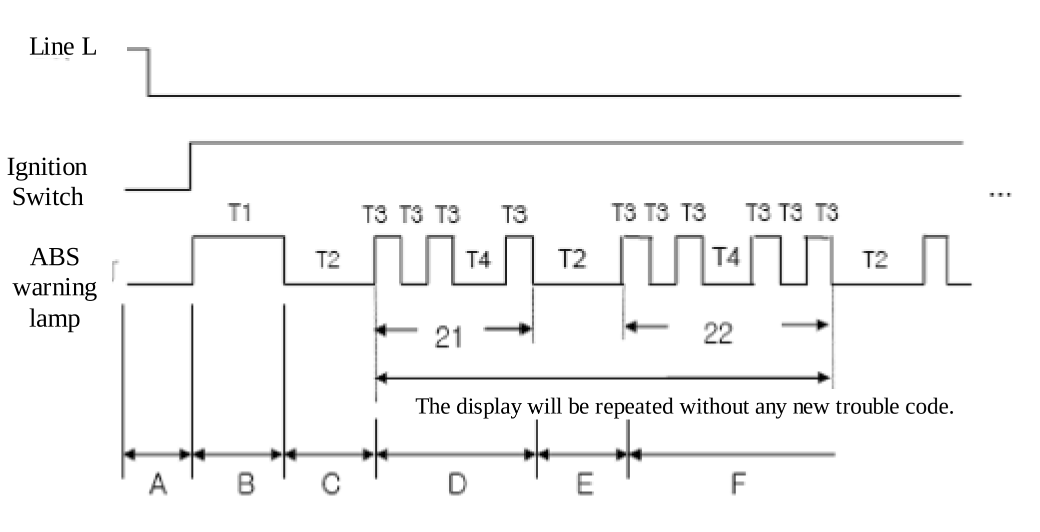
The service conditions are as follows:

† Vehicle speed below 2km/h;
† Without connection of trouble diagnosis instrument;
† The line L (namely the pin 7 of interior diagnosis socket) should be always grounded during the diagnosis process.

In addition, at finish of the trouble code readout, restore the ECU status of the ABS to the normal mode (previously, it's the diagnosis status), of which the method is as follows: At finish of the diagnosis operation, disconnect the grounding status of the line L, rotate the key to power off status, and then re-connect.

② Readout method of trouble code without trouble diagnosis instrument

Read out the trouble code in accordance with following procedure when the service conditions for trouble code readout without trouble diagnosis instrument are met:



The steps in above figure are respectively:

A. Rotate the vehicle key to power on position after the line L is grounded;

B. When the ABS warning lamp illuminates and lasts for 3s, it indicates the start of diagnosis;

C. When the ABS warning lamp is off for 3s, it indicates that it enters into the trouble code display phase;

D. Trouble code display and readout;

E. When the ABS warning lamp is off for 3s, it indicates that it enters into next trouble display phase or circulated display phase;

F. The display and readout of new trouble code and the circulated display of last trouble code.

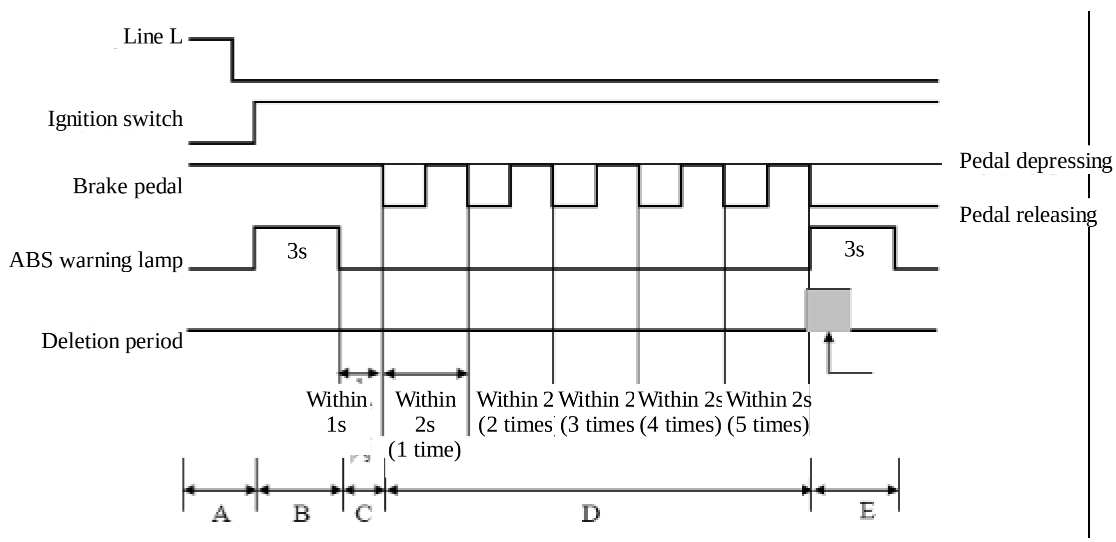
The meaning of symbols in the figure is as follows:

Code	Symbol Description	Duration
T1	The symbol for diagnosis start. The warning lamp starts flashing	3.0s
T2	For differentiation of the duration of various trouble codes during the display of multi trouble codes	3.0s
T3	Flashing interval of warning lamp at the presence of trouble code	0.5s
T4	For differentiation of the interval of various digits of trouble code during the display of certain trouble code (for this interval, the first digit is for tens digit and the second digit is for ones digit)	1.5s

Take the process shown in above figure for instance. Within the display span of the first trouble code, before the presence of T4 (namely, 1.5s before the off of the warning lamp), since the warning lamp flashes twice (the duration for each on and off is both T3, namely 0.5s), the first digit of the 2-digit trouble code (tens digit) is at 2; after the presence of T4 (namely 1.5s after the off of the warning lamp), since the warning lamp flashes once, the second digit of the 2-digit trouble code (ones digit) is at 1. After that, the warning lamp will be off for 3s (namely T2 duration). Therefore, the display of first trouble code is completed with the trouble code of 21. The detailed description of the trouble is shown in the trouble code checklist in section 2.4. Also, the second trouble code of 22 can be obtained.

③ Deletion of trouble code without trouble diagnosis instrument

After the trouble code readout and troubleshooting based on the trouble code checklist, it’s necessary to delete the previous trouble code before the re-checking of the trouble code. The condition for trouble code deletion is same with that of the trouble code readout. The detailed operation method is as follows:

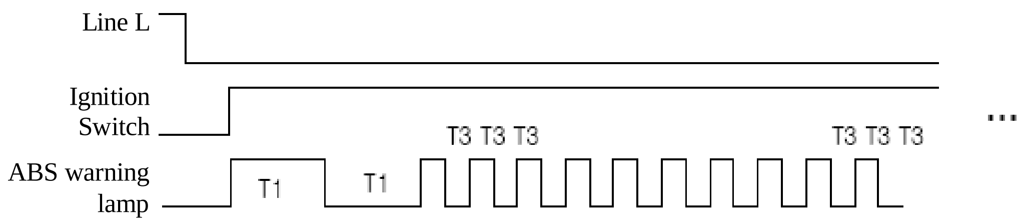


The steps in the above figure are respectively as follows:

A. After the brake pedal is depressed, ground the line L and rotate the vehicle key to the power on position;
B. The ABS warning lamp illumination and go off in 3s;
C. Start to release the pedal within 1s after the ABS warning lamp goes off;
D. After the pedal is released for approximate 1s, re-depress the pedal for approximate 1s. Repeat the above operation for 5 times. During this operation, the warning lamp will not be illuminated;
E. The ABS warning lamp illuminates and lasts for 3s. During this period, the trouble code within this process will be deleted.

At the finish of the trouble code deletion, restore the ECU status of the ABS to the normal mode, of which the operation method is same with that of the trouble code diagnosis.

In addition, when the ECU of the ABS has no trouble code, ground the line L and rotate the key to the power on position. The flashing of the ABS warning lamp is conducted in accordance with the type in following figure, of which the symbol meaning is same with the foregoing section.



2.4 Trouble Checklist of Trouble Code

① Contents of Trouble Code

Trouble code	Contents	Trouble code	Contents
C1 200 (11)	Open-circuit/short-circuit of left front sensor	C1 206 (31)	Open-circuit/short-circuit of left rear sensor
C1 201 (12)	Interference of left front sensor or gear ring	C1 207 (32)	Interference of left rear sensor or gear ring
C1 202 (13)	Air gap error of left front sensor	C1 208 (33)	Air gap error of left rear sensor
C1 203 (21)	Open-circuit/short-circuit of right front sensor	C1 209 (41)	Open-circuit/short-circuit of right rear sensor
C1 204 (22)	Interference of right front sensor or gear ring	C1 210 (42)	Interference of right rear sensor or gear ring
C1 205 (23)	Air gap error of right front sensor	C1 211 (43)	Air gap error of right rear sensor
C1 101 (51)	Battery voltage too high (above 17V)	C2 112 (54)	Trouble of electromagnetic valve fuse or electromagnetic relay
C1 102 (52)	Battery voltage too low (below 9.4V)	C2 402 (55)	Trouble of motor fuse or motor
C1 604 (53)	Trouble of ECU internal circuit or electromagnetic valve coil		

② Trouble checklist of trouble code

Table 1

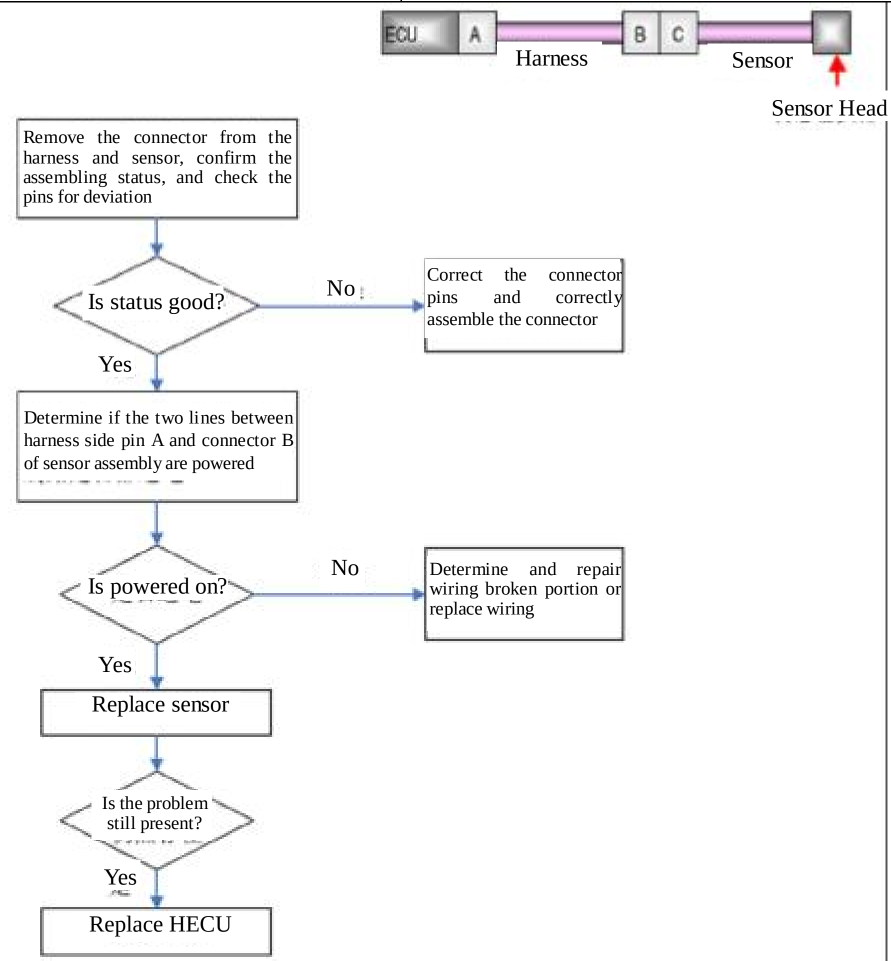
<table>
<tr><td>Trouble Code</td><td>C1 200(11) C1 203(21)
C1 206(31) C1 209(41)</td><td rowspan="2">Note: If the malfunctions corresponding to more than 2 trouble codes can be determined, after the trouble codes are deleted (erasable trouble codes), drive the vehicle to above 40km/h to determine the malfunctions to that the trouble codes correspond and check in accordance with the registered trouble codes (determine the same one trouble code).</td></tr>
<tr><td>Possible Case</td><td>Open-circuit/short-circuit of sensor: At short-circuit or open-circuit of battery anode or cathode of sensor.</td></tr>
<tr><td>Troubleshooting Flow</td><td colspan="2">
</td></tr>
</table>

Table 2

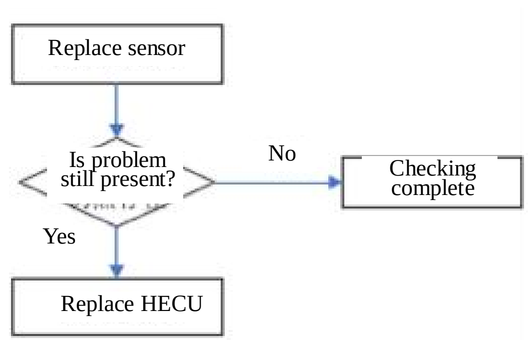
<table>
<tr><td>Trouble Code</td><td>C1 202(13)　C1 205(23)
C1 208(33)　C1 211(43)</td><td rowspan="2">Note: ①The air gap refers to the gap between the gear ring and the sensor;
② If the malfunctions corresponding to more than 2 trouble codes can be determined, after the trouble codes are deleted (erasable trouble codes), drive the vehicle to above 40km/h to determine the malfunctions to that the trouble codes correspond and check in accordance with the registered trouble codes (determine the same one trouble code).</td></tr>
<tr><td>Possible Case</td><td>Air gap error:
Air gap too big or self short-circuit of sensor (resistance value at 0) that results no signal or the gear ring not properly installed.</td></tr>
<tr><td>Troubleshooting Flow</td><td colspan="2">
</td></tr>
</table>

Table 3

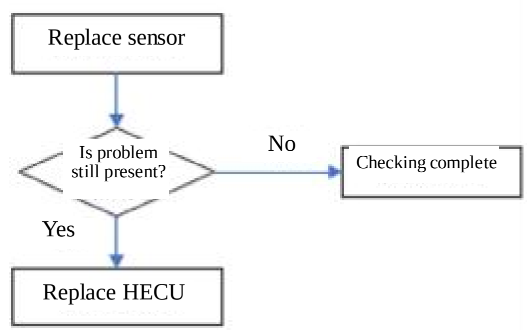
Trouble Code	C1 201(12) C1 204(22) C1 207(32) C1 210(42)	Note: ① The sensor signal is not uniform when the gears are adhered with engine oil and the impurities such as slag; ② The air gap refers to the air gap between the gear ring and the sensor; ③ If the malfunctions corresponding to more than 2 trouble codes can be determined, after the trouble codes are deleted (erasable trouble codes), drive the vehicle to above 40km/h to determine the malfunctions to that the trouble codes correspond and check in accordance with the registered trouble codes (determine the same one trouble code).
Possible Cause	Interference of gear ring or sensor: Occurred when installed with non-standard specification gear rings.	
Troubleshooting Flow		

Table 4

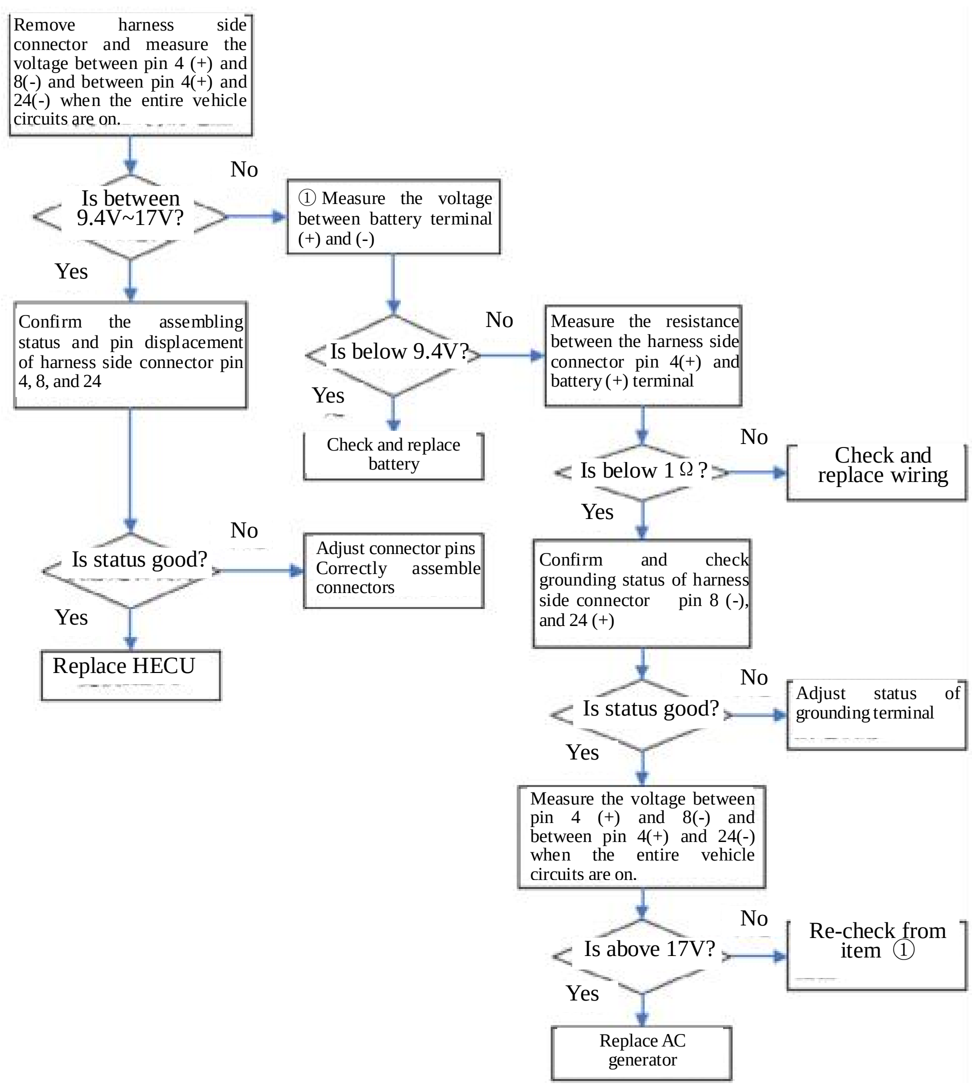
Trouble Code	C1 101(51) C1 102(52)	Note: If the malfunctions corresponding to more than 2 trouble codes can be determined, after the trouble codes are deleted (erasable trouble codes), drive the vehicle to above 40km/h to determine the malfunctions to that the trouble codes correspond and check in accordance with the registered trouble codes (determine the same one trouble code).
Possible Cause	Abnormal battery voltage: Occurred when the voltage is too high or too low	
Troubleshooting Flow		

Table 5

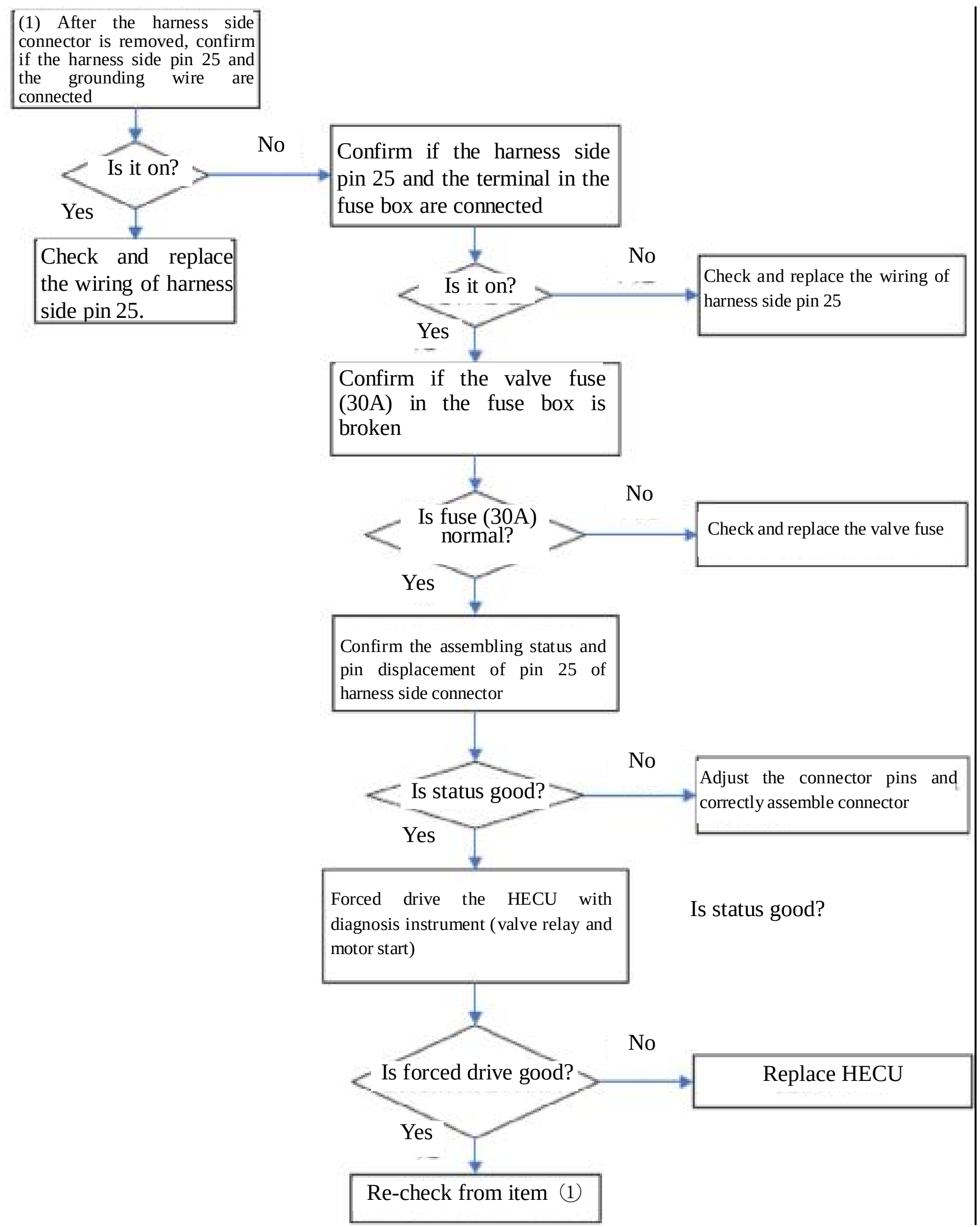
Trouble Code	C2 402(55)	Note: If the malfunctions corresponding to more than 2 trouble codes can be determined, after the trouble codes are deleted (erasable trouble codes), drive the vehicle to above 40km/h to determine the malfunctions to that the trouble codes correspond and check in accordance with the registered trouble codes (determine the same one trouble code).
Possible Cause	Malfunction of motor fuse/motor	
Troubleshooting Flow		

Table 6

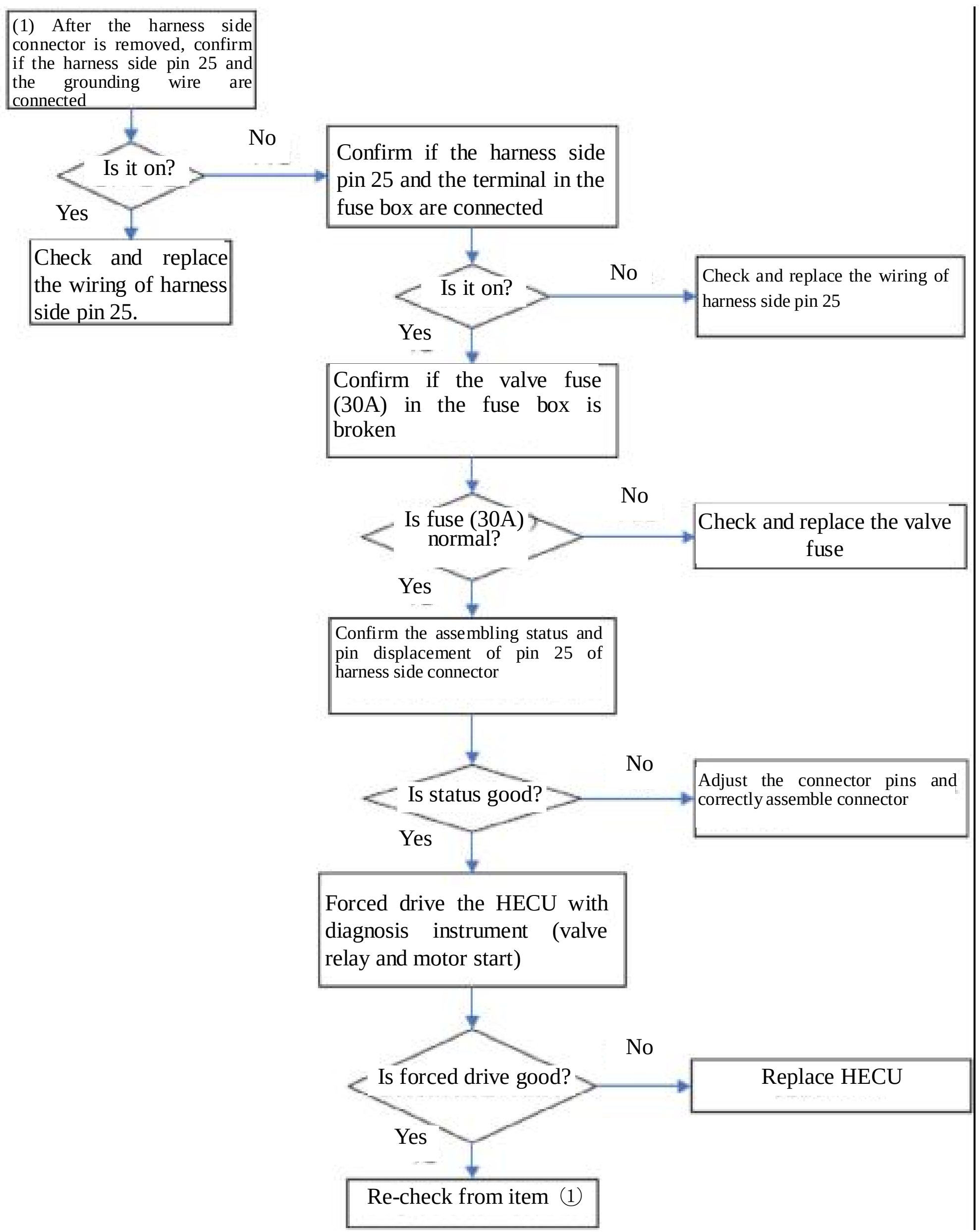
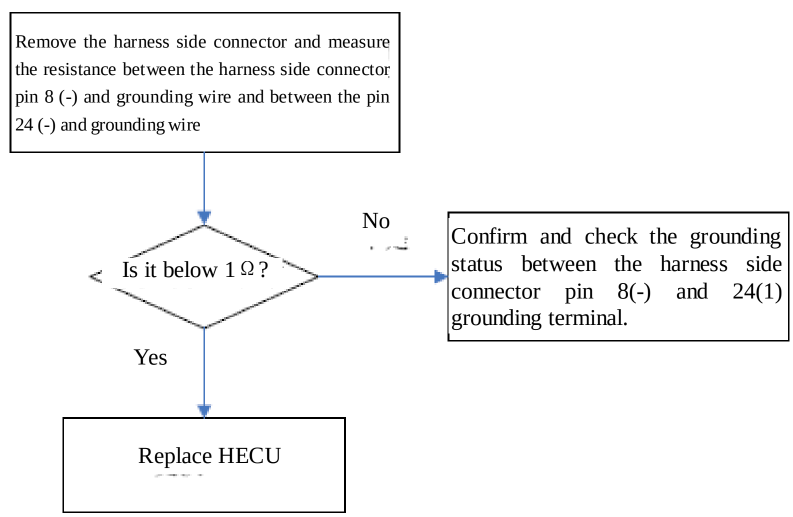
Trouble Code	C2 112(54)	Note: If the malfunctions corresponding to more than 2 trouble codes can be determined, after the trouble codes are deleted (erasable trouble codes), drive the vehicle to above 40km/h to determine the malfunctions to that the trouble codes correspond and check in accordance with the registered trouble codes (determine the same one trouble code).
Possible Cause	Malfunction of valve fuse and relay: a) Broken of primary relay or fuse b) Short-circuit of primary relay	
Troubleshooting Flow		

Table 7

<table>
<tr><td>Trouble Code</td><td>C1 604(53)</td><td rowspan="2">Note: If the malfunctions corresponding to more than 2 trouble codes can be determined, after the trouble codes are deleted (erasable trouble codes), drive the vehicle to above 40km/h to determine the malfunctions to that the trouble codes correspond and check in accordance with the registered trouble codes (determine the same one trouble code).</td></tr>
<tr><td>Possible Cause</td><td>Malfunction of ECU internal circuit and valve coil</td></tr>
<tr><td>Troubleshooting Flow</td><td colspan="2">
</td></tr>
</table>

2.5 Trouble Checklist without Trouble Code

Table 1

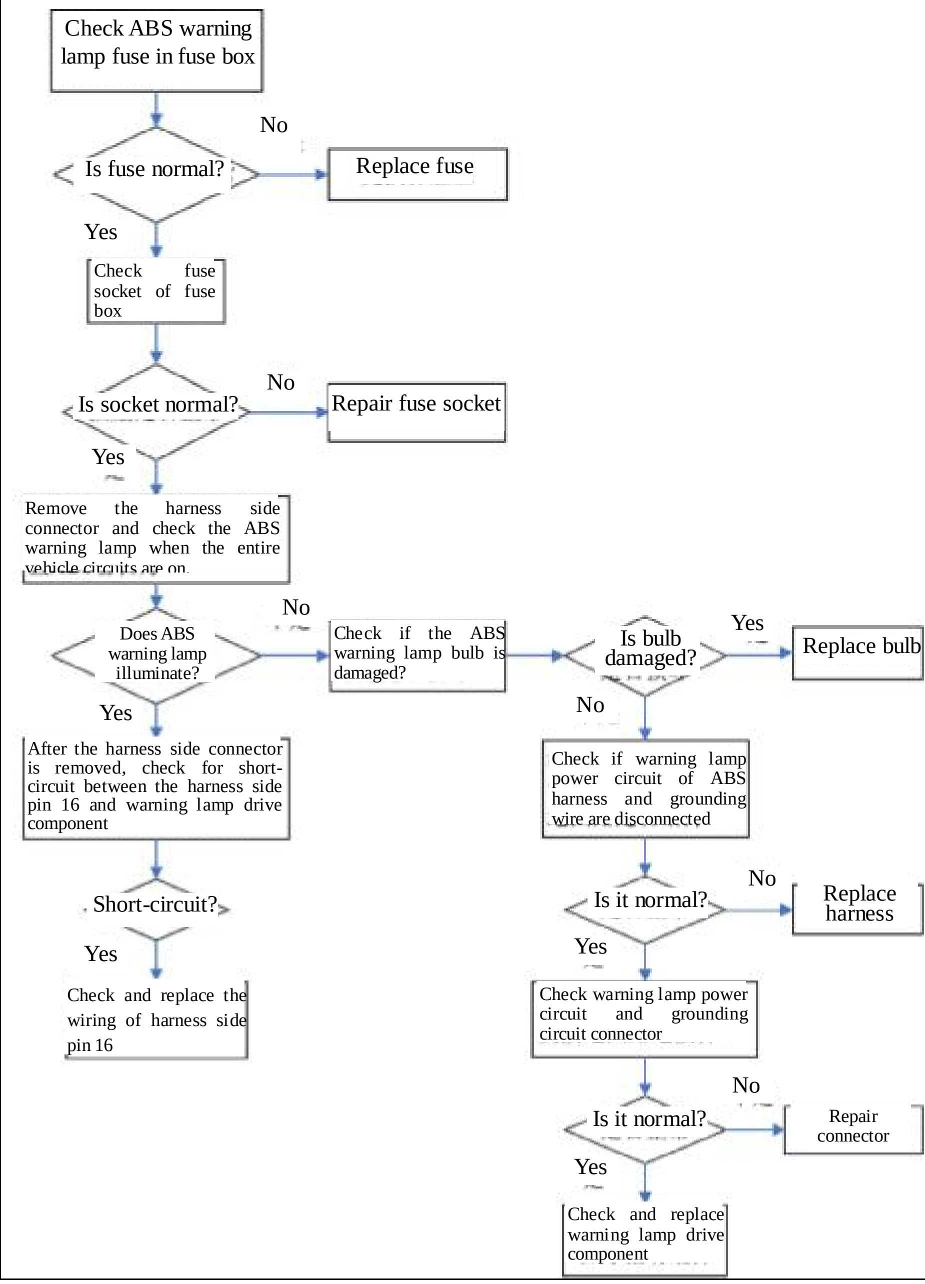
Trouble Evidence	The ABS warning lamp doesn't illuminate when the engine is started	
Possible Cause	● Burn of fuse ● Open-circuit of power line	● Burn of ABS warning lamp bulb ● Damage of ABS warning lamp control
Troubleshooting Flow		

Table 2

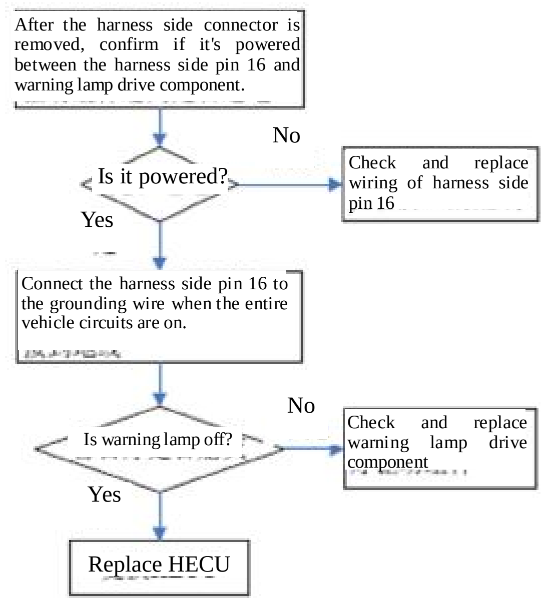
Trouble Evidence	The ABS warning lamp constantly illuminates after the vehicle start
Possible Cause	● Damage of ABS warning lamp control ● Open-circuit of ABS warning lamp control circuit ● ECU damage of ABS
Troubleshooting Flow	

Table 3

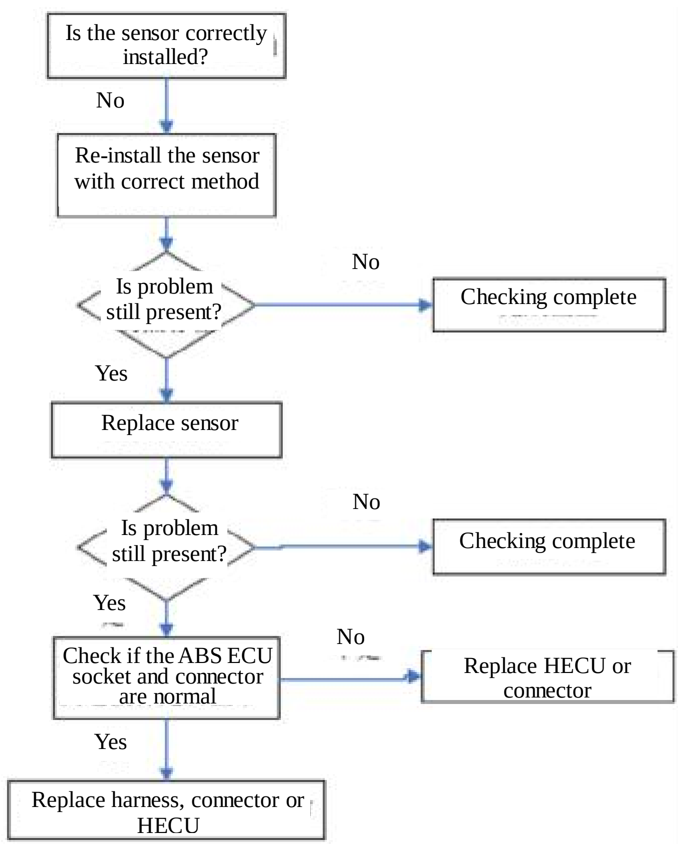
Trouble Evidence	Abnormal functioning of ABS
Possible Cause	● Damage of sensor ● Improper installation of sensor ● Problem of sensor harness ● Impurity adherence on sensor ● Damage of gear ring ● Damage of wheel bearing ● HCU damage of ABS ● ECU damage of ABS
Troubleshooting Flow	

Table 4

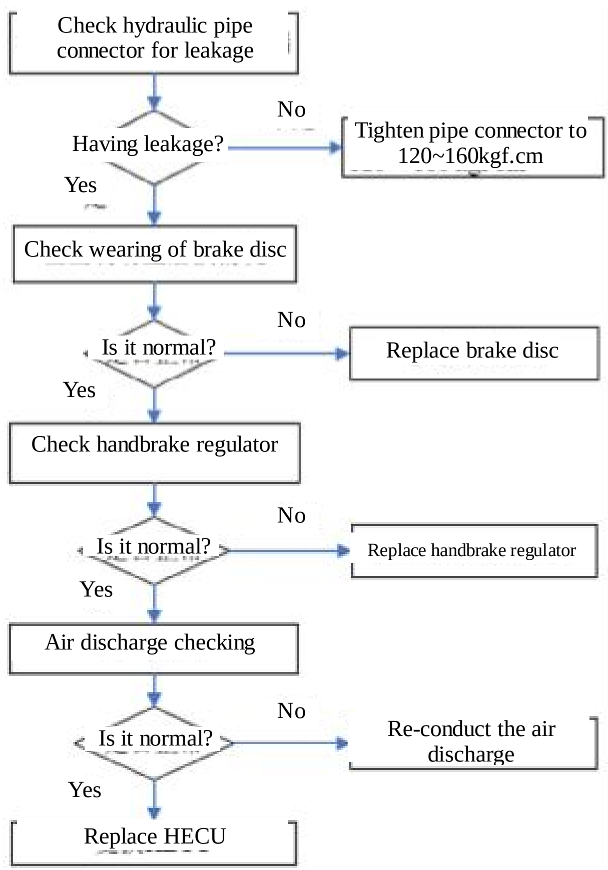
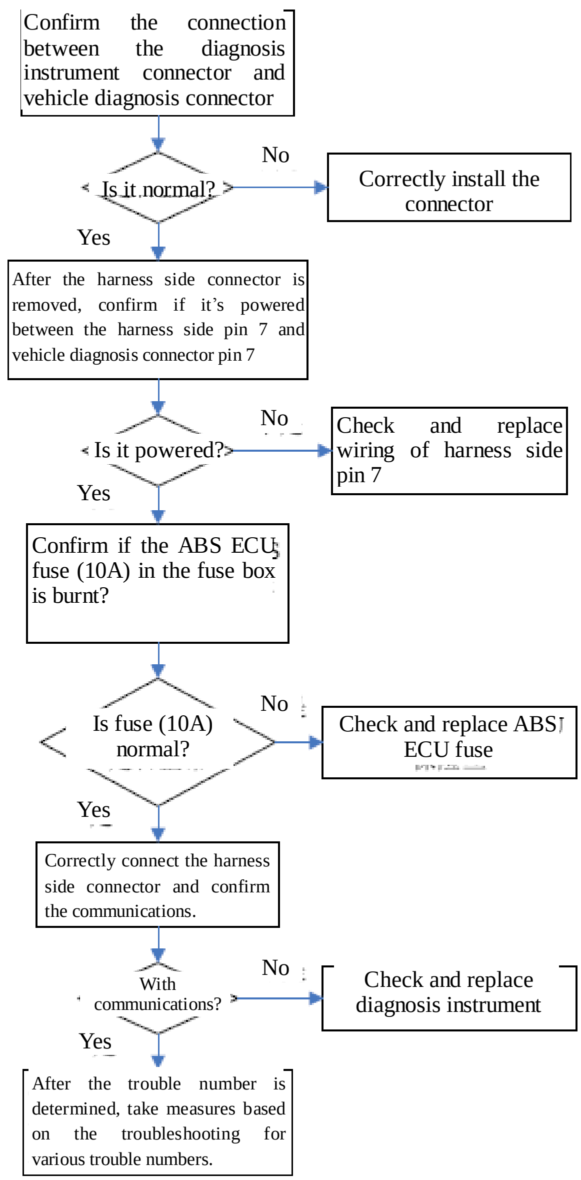
Trouble Evidence	Brake pedal travel too long
Possible Cause	● Improper adjustment of handbrake ● Leakage of brake liquid ● Severe wearing of brake friction disc ● Leakage of normal close valve ● Air in the system
Troubleshooting Flow	

Table 5

<table>
<tr><td>Trouble Evidence</td><td>Without diagnosis code output (communication failure with trouble diagnosis instrument)</td></tr>
<tr><td>Possible Cause</td><td>● Problem of diagnosis instrument
● Burn of fuse
● Broken of diagnosis line or loosening of connector
● ECU damage of ABS</td></tr>
<tr><td>Troubleshooting Flow</td><td>
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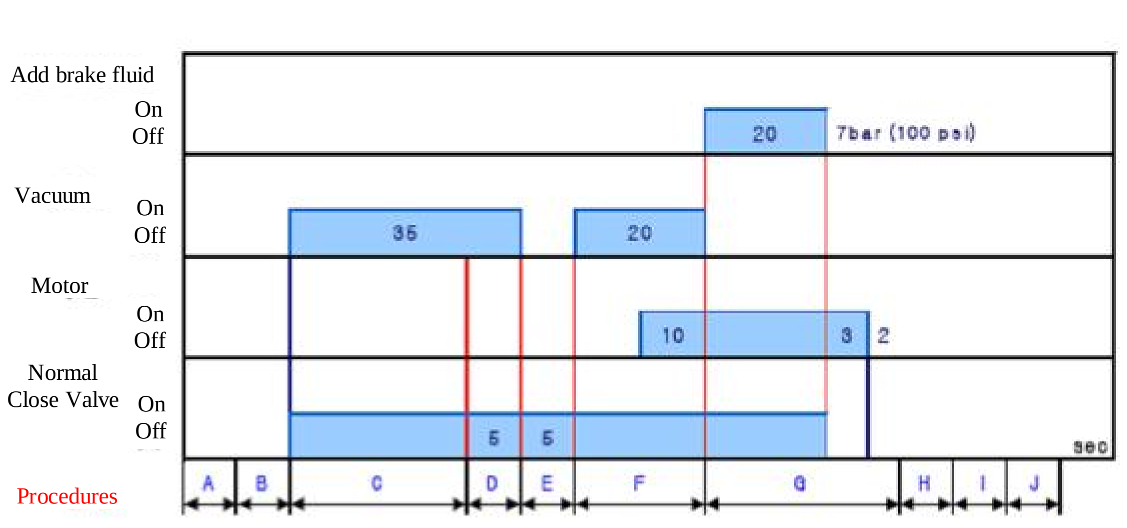
IV. Air Discharge and Oil Refill

1. Regular Operation Procedure



The regular operation procedure of air discharge and oil refill is shown in the figure, of which:

A : Move the vacuum device and brake oil refill device;
B : Start after connected with vacuum and brake oil refill device and SDL;
C : Drive normal close electromagnetic valve and apply the 1st vacuum;
D : Excessive leakage test;
E : Minor leakage test after the 1st vacuum cut-off;
F : Applicable for 2nd vacuum and drive motor;
G : After the oil refill and maintaining of pressurization on the brake oil, relieve the brake oil pressure, stop the normal close electromagnetic valve and motor, and adjust the brake oil level;
H : Disconnect the vacuum device and brake liquid refiller;
I : Screw on the oil reservoir lid/disconnect the SDL;
J : Transfer to next step.

2. Checking Device

① The vacuum supplied to the oil reservoir should be as lower as possible, provided that the oil gun must supply at least below 1mm Hg vacuum.

② Confirm if the air discharge screw portion of the rear wheel hydraulic device (drum brake or brake caliper) forms the vacuum within the specified period. (It should be below 5~10mm Hg after connected with vacuum for 20~25s).

③ Confirm if the working voltage supplied to the HECU is at specified 10~12V.

④ Confirm the circulation time (C/T). Confirm the working time setting of the electromagnetic valve meets with the specified value.

- † C/T< 90: Run the electromagnetic valve continually;
- † 90⩽C/T⩾180: Start the electromagnetic valve for 2s and stop the electromagnetic valve for 2s. continually repeat above cycles;
- † C/T>180: The total running period setting of the electromagnetic valve is below 90s.

3. Notices for Air Discharge and Oil Refill

① During the refilling of brake oil, if the refilling pressure is not maintained for certain period or above, the oil level within the oil reservoir will lower at the finish of the refilling. Therefore, it's required to refill more brake oil or maintain the refilling pressure for certain period.

② The time period marked in the regular operations refers to the general circulation period.

③ The inside of after-service HECU is at moisture status, therefore, it may not conduct the air discharge mode operation (see succeeding item 5⑥ for the definition of air discharge mode) but directly conduct the air discharge operation on all wheels (However, in order to meet with the performance and pedal comfort, it's preferable to conduct the air discharge mode operation).

④ During the air discharge mode operation, the voltage supplied to HECU is preferably at 10~12V. However, during the use of checking devices, it will be OK to use the vehicle amounted battery. (The repeated air discharge mode operation with high voltage may damage the coil of ECU components).

4. Determination Method for Vehicles with Air Discharge Trouble

Differentiation / Category	ECU functioning or not	Leakage test		Note
		Excessive leakage	Minor leakage	
Case 1	Normal functioning	O.K	O.K	Normal functioning, no separate repetition required
Case 2	Normal functioning	O.K	N.G	Abnormal functioning, separate repetition required
Case 3	Normal functioning	N.G	N.G	Abnormal functioning, separate repetition required
Case 4	Not functioning	O.K	O.K	Abnormal functioning, separate repetition required
Case 5	Not functioning	O.K	N.G	Abnormal functioning, separate repetition required
Case 6	Not functioning	N.G	N.G	Abnormal functioning, separate repetition required

† Case 1 : The status at finish of normal functioning.

† Case 2 : The status that the connection of brake (HECU hole portion/brake pipe/brake hose) is poor and therefore needs rework.

† Case 3 : The status same with Case 2, but it may cause the status incapable of repetition when the leakage is really severe.

† Case 4 : Internal circuit air discharge trouble of HECU. It's the status necessary for repetition as the ABS may cause the sponge phenomenon after functioning for one time.

† Case 5 : The comprehensive trouble of Case 2 and Case 4. The status necessary for repetition.

† Case 6: The status similar to Case 5, but it may cause the status incapable of repetition when the leakage is really severe.

5. Measures in Event of Troubles during Air Discharge and Oil Refill (for internal dry status of brake system)

① Implementation of trouble determination. It's required to determine the connection portions of all components from the general pump to the wheel branch pump: HECU hole portion, connection portion of brake pipe, connection portion of brake hose, brake caliper and the air discharge screw portion of brake, and etc.

② After the determination of the trouble, re-assemble in accordance with the provisions in order to avoid the further occurrence of leakage.

③ Connect the repetition device to the 25-pin connector of the ECU or connect the checking device to the line K (pin 7). Use the specific wiring to connect to the connectors. During the connection to line K (pin 7), make the vehicle at power on or start status. The oil reservoir of the general pump is connected with the device for continual supply of brake oil or it's required that the oil reservoir should have enough oil during the supply of brake oil.

④. Check the HECU with repetition device or checking device and determine the existence of trouble code. If with trouble code, firstly conduct the operation for deletion of the trouble code (if the trouble in above item ① is not determined, it's necessary to determine the existence of trouble code). When the trouble code can't be deleted, operate with reference to the Trouble Checklist of Trouble Code in section 2.4 (In case of trouble of HU, motor and ECU, the air discharge and oil refill can't be conducted at the inside of the HECU).

⑤ After the brake pedal is depressed, open the air discharge screw attached onto the wheel brake caliper or drum brake to discharge the air. Conduct this operation on all wheels, till that the brake oil discharged from the air discharge screw is free of air and the brake pedal is properly rigid. Refer to the operation in item ⑩ in using the repetition device capable of vacuum formation and refilling of brake liquid.

⑥ Conduct the air discharge mode by means of the repetition device or the checking device. If there has no reaction force when the brake pedal is depressed, then repeat the operation of pedal depressing and pedal releasing, till the air discharge mode is completed (air discharge mode: repeat the start in 2s interval, stop the normal close valve of HECU for 1min, and continually drive the motor. The repeated operation of pedal depressing and pedal releasing is conducted within the period of normal close electromagnetic valve and motor drive).

⑦ The operation in item ⑤ (air discharge) should be repeated for all wheels.

⑧ Measure the brake pedal travel. If not meet with the provisions, repeat the operations in item ⑥ (air discharge mode) and item ⑤ (air discharge). If the brake pedal travel doesn't meet with the provisions after the air discharge mode and air discharge are repeated for above 10 times, replace with after-service HECU (wet type) and then repeat the operations from the beginning.

⑨ Connect the repetition device and checking device to the HECU and again determine the existence of trouble code. If with trouble code, delete the trouble code and then disconnect the repetition device or checking device.

⑩ During the use of other repetition devices (the equipment capable of vacuum formation and liquid refilling), the implementation method is as follows:

- † Conduct in accordance with the contents in above item ①～④;
- † When the vacuum pump is sufficiently driving for approximate 60s, the inside of brake system will form the vacuum status.
  - **C** Start the operation of air discharge mode in above item ⑥ 10s before the vacuum cut-off.
  - **C** Without the repeated operations of pedal depressing and pedal releasing.
- † Conduct the brake liquid refilling operation (above 7bar/100Psi) for above 20s at the same time of vacuum cut-off.
- † Complete the brake liquid refill and air discharge mode.
- † Conduct the operation based on the contents in above item ⑧～⑨.

6. Measures in Event of Trouble during Checking and ABS Functioning Test (for internal wet status of brake system)

① Connect the repetition device or checking device. The following conditions must be guaranteed:

- † Use the specific wiring while connecting to the 25-pin connector of ECU.
- † The vehicle should be at power on status or start status while connecting to line K (pin 7).
- † The oil reservoir of the general pump is connected with the device for continual supply of brake oil or it's required that the oil reservoir should have enough oil during the supply of brake liquid.

② Check the HECU with repetition device or checking device and determine if it has trouble code.

- † If with trouble code, firstly conduct the operation to delete the trouble code.
- † If the trouble code can't be deleted, implement with reference to section 2.4 "trouble checklist of trouble code" (If the HU, motor or ECU has trouble, the inside of HECU can't conduct the air discharge and oil refill).

③ After the brake pedal is depressed, open the air discharge screw attached on the wheel brake caliper or drum brake to discharge the internal air. It's required to conduct this operation on all wheels, till that the brake oil discharged from the air discharge screw is free of air and the brake pedal is properly rigid.

④ Conduct the air discharge mode by means of the repetition device or the checking device. If there has no reaction force when the brake pedal is depressed, then repeat the operation of pedal depressing and pedal releasing, till the air discharge mode is completed

⑤ The operation in item ③ (air discharge) should be repeated for all wheels.

⑥ Measure the brake pedal travel. If not meet with the provisions, repeat the operations in item ④ (air discharge mode) and item ③ (air discharge). If the brake pedal travel doesn't meet with the provisions after the air discharge mode and air discharge are repeated for above 10 times, replace with after-service HECU (wet type) and then repeat the operations from the beginning.

⑦ Connect the repetition device and checking device to the HECU and again determine the existence of trouble code. If with trouble code, delete the trouble code and then disconnect the repetition device or checking device.

Annex I Malfunction Cases and Incorrect Repair Cases

1. HECU Incorrect Repair Cases

① HECU replacement relating to ABS functioning noise

The HECU replacement case that deemed the noise of electromagnetic valve and motor as the malfunction during the functioning of the ABS.

† During the functioning of ABS, the noise generated during the relieving or enhancing of the braking pressure on various wheels is of normal functioning status. The noise level will vary depending on the braking pressure applied on various wheels, other than the product malfunction. Therefore, we should persuade the customers to understand that.

† When the vehicle reaches 10km/h speed at the first time after vehicle start, the sensitive customers may hear the noise at the time when the ECU diagnoses the motor drive, which is also the normal functioning of the ABS.

② HECU replacement relating to EBD functioning noise

The HECU replacement case that deemed the clattering noise of rear wheels that other than the ABS functioning noise during the braking as the malfunction.

† The ABS is also equipped with EBD function, which will effect the relieving of braking pressure on the rear wheels when the rear wheels are locked ahead of the front wheels. The noise generated during the above mentioned process is of normal functioning status.

③ HECU replacement relating to braking off-tracking

HECU replacement case due to the vehicle braking off-tracking towards one side during the braking.

† ABS is the braking assisted device that functioning in such manner that the ECU will calculate the speed of various wheels in order to maintain the best braking force and control stability during the braking. In the event of malfunction of the HECU, the ECU will illuminate the warning lamp by means of the diagnosis. Therefore, in the event of braking off-tracking without the illumination of ABS warning lamp, it's necessary to check other braking hydraulic devices.

† In the event of incorrect assembling of the braking hose, the braking off-tracking may occur during the functioning of the ABS.

④ Replacement case that the ABS is functioning during barking at low speed (below 40km/h)

HECU and sensor replacement case that the ABS is always functioning during the braking at low speed.

† During the braking at low speed, the ABS may also function depending on the road conditions and braking pressure. If the ABS is always functioning at each time, it's necessary to check if the sensor air gap of various wheels is too large, if it has interference with the gear ring, and if the tooth shape of the gear ring is damaged.

† Air gap adjustment method. For the improper air gap, after the determination of the parts related to the problem, replace or grind the installation surface (junction portion) of the sensor to the specified air gap; in the event of interference, place the thin gasket onto the sensor installation surface so as to adjust to the specified air gap.

2. Incorrect Repair Cases for Wheel Speed Sensor

① Open-circuit and short-circuit related to sensor

The sensor replacement case without product checking when the ABS warning lamp is illuminated and the trouble code of the vehicle is determined.

† The ABS trouble code is prepared based on the ABS products. Therefore, during the open-circuit or short-circuit of the sensor, it's necessary to conduct the problem checking, such as confirm the connection status from the ECU to the wiring and connectors of the sensor, measure the sensor resistance, and etc. During the malfunction checking of sensor, it's preferable to use the tetrastyle jack, which will facilitate the confirmation of short-circuit problems such as the pinned wiring.

- † The union status of the sensor must be checked before the removal of the connectors of connecting wiring (such as incomplete union, pin displacement, with impurity, and etc.)After confirm that the sensor resistance and head are free of abnormalities, centrally check the wiring and connectors.

② Notices for sensor checking

Case of sensor head line break arisen from over-pulling of sensor cable.

- † When the connectors are removed during the checking of sensor, the instantaneous pulling of cable under the condition that the sensor head is fixed will cause the falloff of the internal cable of the sensor head to cause line break problem. Therefore, during the checking of sensor, do not pull the cable with the force above the specified one.
- † Sensor head cable: It may be damaged when applied with above 12kgf tension force; Cable at connectors: it may be damaged when applied with above 4.5kgf tension force.

Annex II ABS Basics

Will the braking distance be shortened when equipped with ABS?

† The testing data show that the braking distance will be shortened on most road conditions (approximately 5%~20%). However, under some special road conditions (such as snowy road, non-asphalt road and rough road), the braking distance will be lengthened. However, the steering stability can be guaranteed.

What's the main objective of ABS?

† The main objective of ABS is to prevent the wheels to be locked, which has following effects:

① Maintain the vehicle stability on roads during the braking

② Capable of controlling the vehicle driving direction during braking in order to avoid the occurrence of the collision.

③ Maintain the best braking pressure, disregarding the driving skills of the driver.

Why is the ABS warming lamp illuminated?

† After the driver starts the vehicle, the warning lamp will be off when the automatic diagnosis of ABS ECU shows no trouble. If the warning lamp is illuminated during driving or the warning lamp is always on, it indicates the trouble of ABS. Please drive your vehicle to the designated service station for checking of ABS as soon as possible. However, when the warning lamp is illuminated that indicates the ABS trouble, the brake system still has the basic braking capability.

Will there be free of accident when equipped with ABS?

† ABS is the one device capable of increasing the driving safety, rather than the device used to avoid the accidents arising from the driving mistake or variation of traffic conditions. Therefore, insist on the safe driving all along rather than the excessive reliance on the ABS.

The vehicle will lean to one side during braking on the one-side-slippery road, is this phenomenon caused by ABS?

† This phenomenon is resulted from the different friction coefficients between the left and right wheels on the roads. Under such condition, the ABS will exert the special effects on the stability of the vehicle body. However, even under such condition, make sure to operate the steering wheel with car in order to avoid the occurrence of accidents.

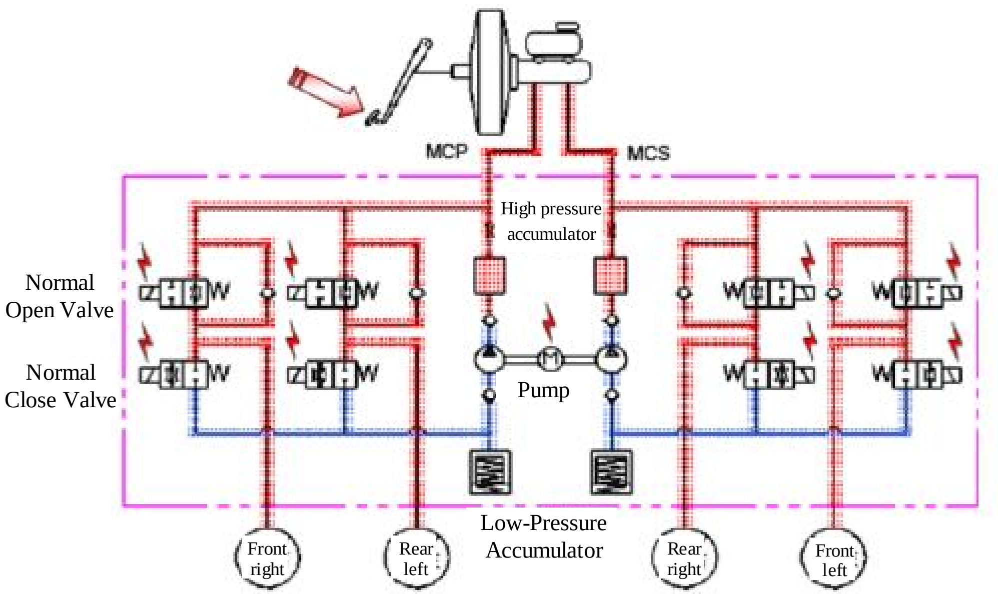
The vehicle will present the slippery phenomenon before braking during the turning on the slippery road, will the ABS function effectively when the brake pedal is depressed at that time?

† The ABS will function effectively to provide certain help depending on the vehicle speed. However, under most conditions, the outward cornering force is really big due to the vehicle inertia and therefore the body correction will have limit even the ABS is functioning.

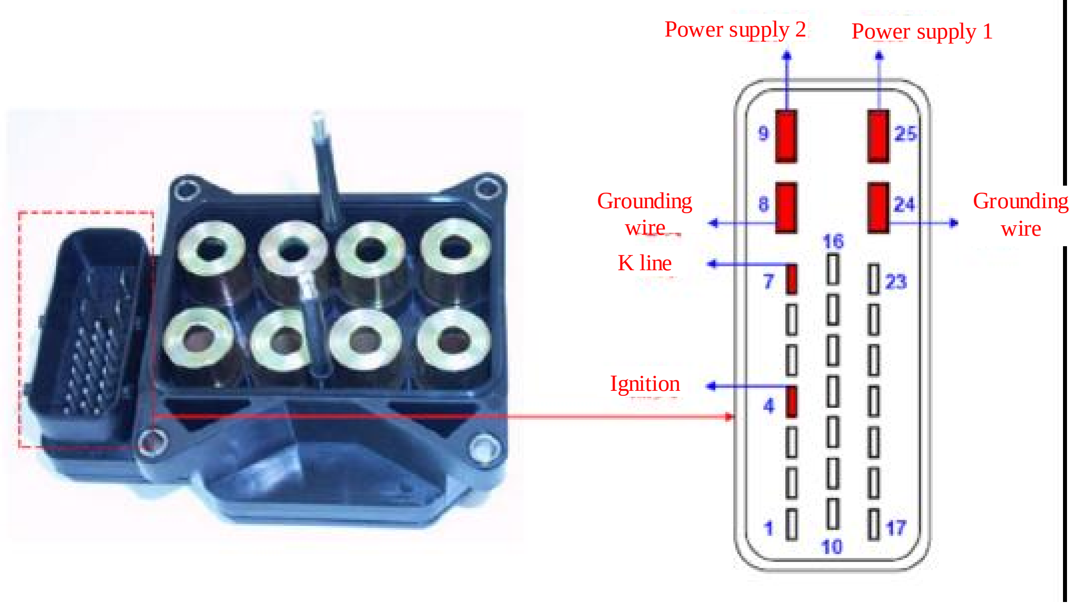
† Generally, the tires will be applied with two kinds of forces during cornering: One is the force required by driving and braking; another is the force required for vehicle steering and stability maintaining. In fact, the driving, braking and steering of the vehicle are completed though the coordination of above two forces and the two forces are in reverse ratio. Therefore, during the braking at cornering, the braking force will be increased and the force required for steering and stability maintaining will be reduced. The vehicles equipped with ABS will best coordinate these two forces. For the vehicles without the ABS, the steering performance and the stability are really weak as these two forces are not in good coordination.

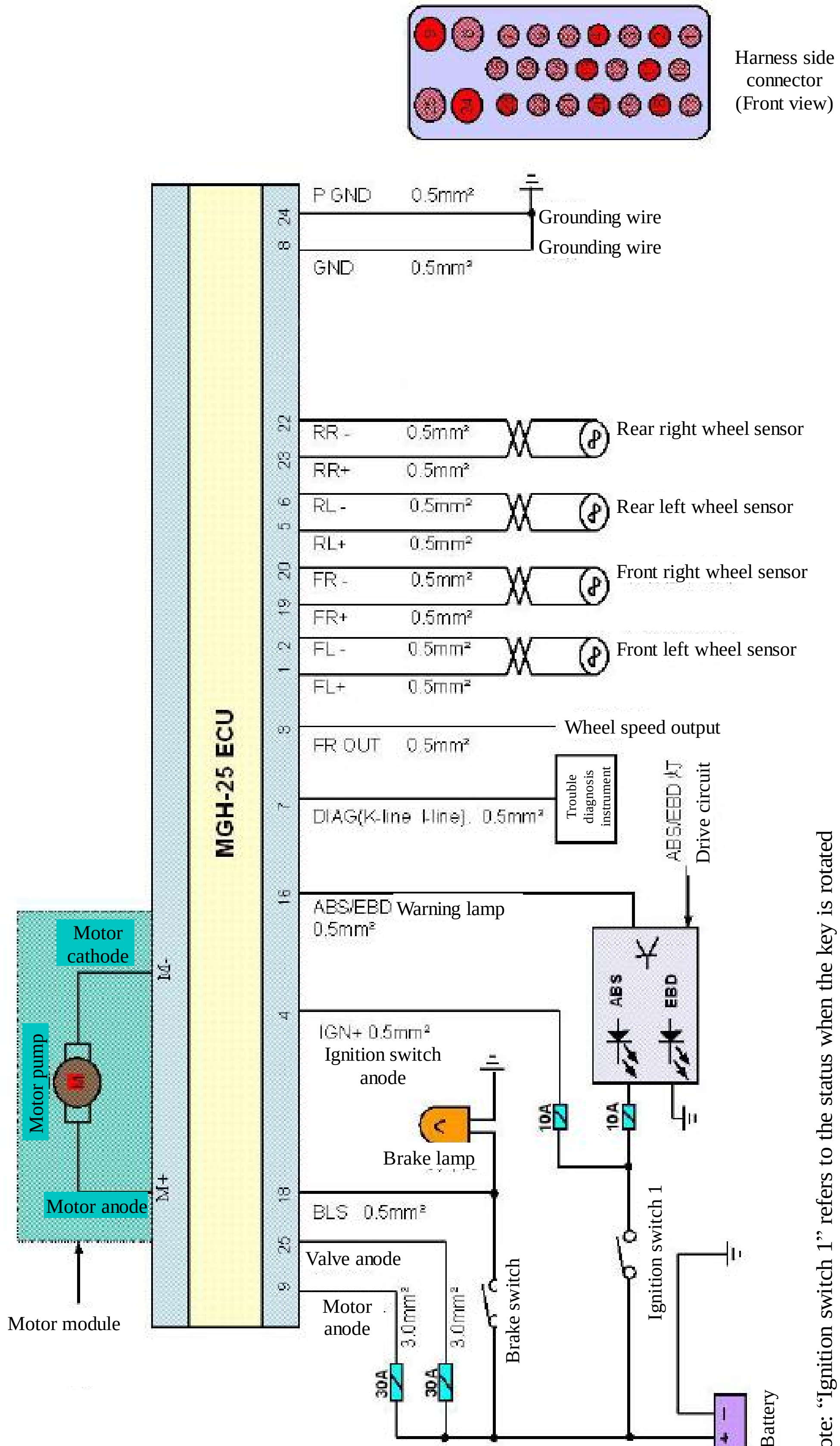
† However, under the condition that the above two forces are really small (such as: off-tracking due to excessive speed during the vehicle skid), the force for body correction is really small. Therefore, the ABS will not exert the effects. In conclusion, deceleration in advance and safe cornering is the best method.

Annex III ABS Internal hydraulic Flow Diagram



Annex IV Connector Pin Layout of MGH-25 ABS ECU





Note: "Ignition switch 1" refers to the status when the key is rotated to power on the vehicle but not to start the engine.

Maintenance Manual for Chery A113

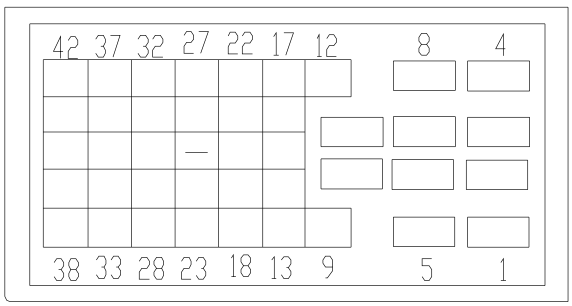
(Circuit Diagram)

Content

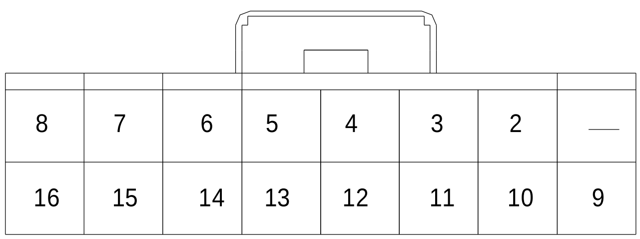
Chapter 1 Illustration Instruction

I. Definition of Main Harness Inserters

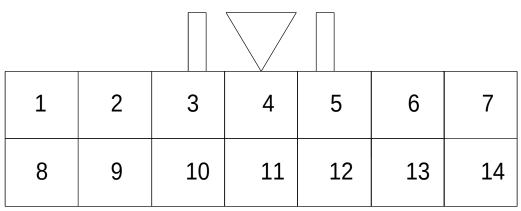
Engine/ECU (inserter of engine harness and ECU harness)



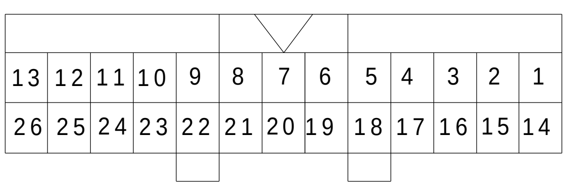
ECU/front (plug of ECU and front compartment harness)



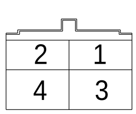
ECU/instrument (plug of ECU and instrument harness)



Interior/instrument A (plug A of interior harness and instrument harness)



Interior/instrumentB（plug B of inte
harness and instrument harness）



Interior/front (plug of interior harness and front compartment harness)

8	7	6	5	4	3	2	1
16	15	14	13	12	11	10	9

Instrument/engine A (plug A of instrument harness and engine)

7	6	5	4	3	2	1
14	13	12	11	10	9	8

Instrument/engine B (plug B of instrument harness and engine)

1

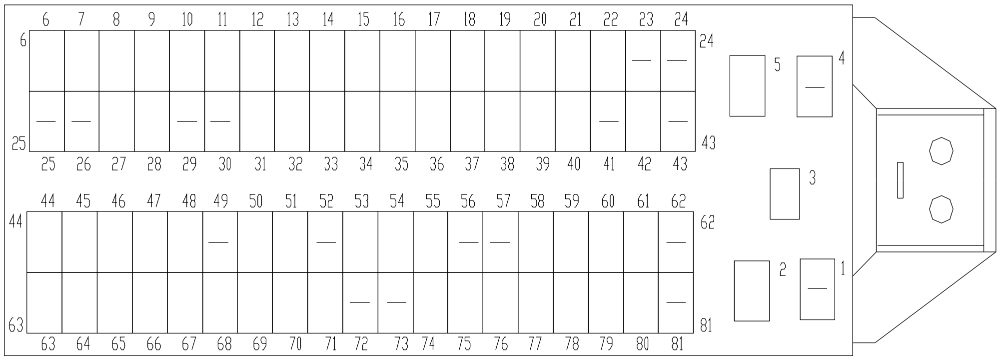
Instrument/front A (plug A of instrument harness and front compartment harness)

1	2	—	4	5	6	7	8	9	10	11	12	—
—	—	—	—	18	19	—	—	22	23	24	25	26

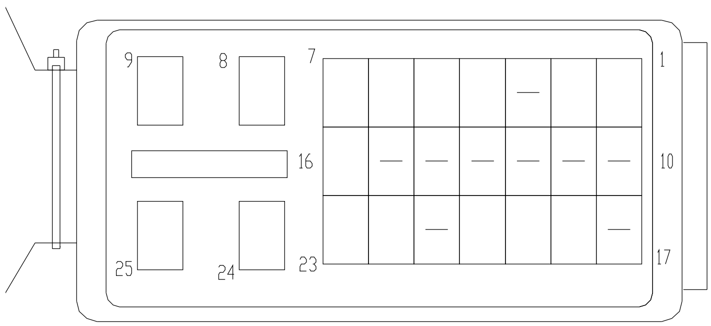
Instrument/front B (plug B of instrument harness and front compartment harness)

2	1
4	3

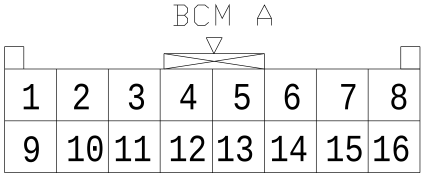
ECU pin definition



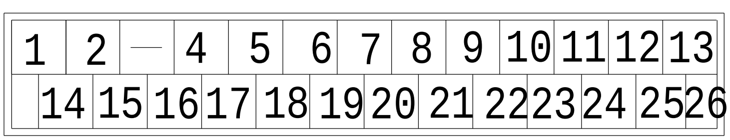
ABS pin definition



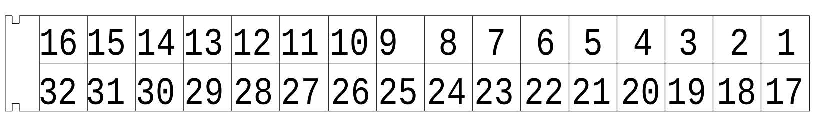
BCM A



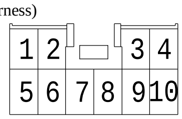
BCM B



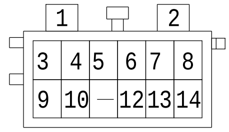
COMBINED INSTRUMENTS



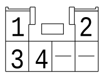
Interior/left front A (plug A of interior harness and left front door harness)



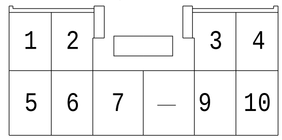
Interior/left front B (plug B of interior harness and left front door harness)



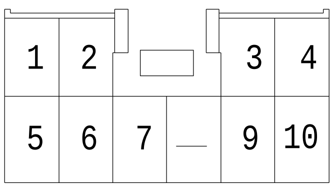
Interior/right front A（plug A of i harness and right front door harne



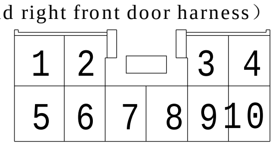
Interior/left rear（plug of interior harness and left rear door harness）



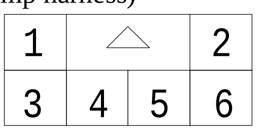
Interior/right rear（plug of interior harness and right rear door harness）



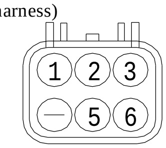
Interior/right front B（plug B of interic and right front door harness）



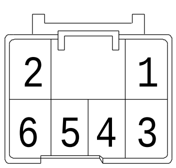
Interior/ceiling lamp (plug interior harness and ceiling lamp harness)



Interior/airbag (plug of interior harness and airb harness)



Interior/rear bumper (plug of inter harness and rear bumper harness)

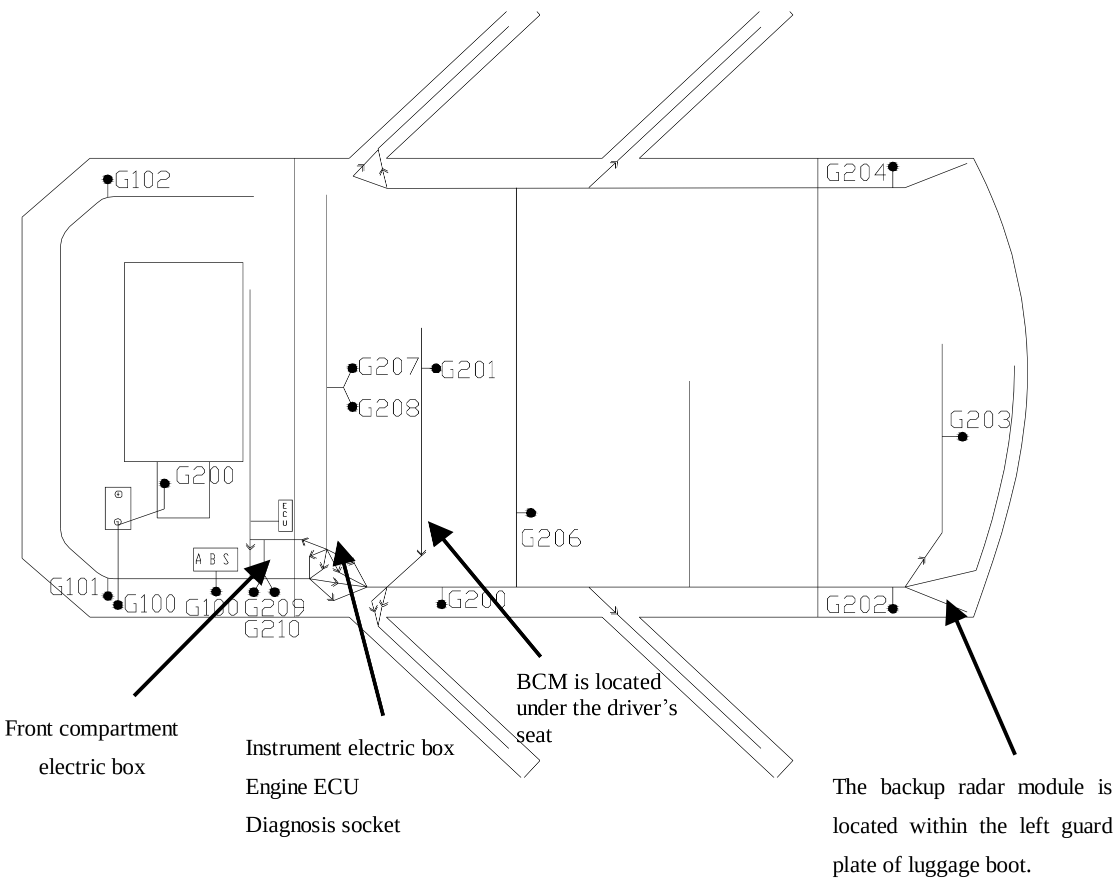


II. Definition of Body Earth Points

1. Earth Definition

G100: Body earth, ABS earth
G101: Left front compartment earth (radiator fan, low beam, high beam, position lamp, turn signal lamp, front fog lamp, wiper, brake liquid level, anti-deterrent horn)
G102: Right front compartment earth (high beam, low beam, position lamp, turn signal lamp, side turn signal lamp, front fog lamp, horn)
G200: Power train, fuel position sensor, left front door, left rear door, front ceiling lamp
G201: Electric sunroof
G202: Tail lamp, backup radar, oil pump, rear wiper motor
G203: Luggage boot door (rear wiper, high mount brake lamp)
G204: Tail lamp earth
G206: BCM, seat belt switch
G207: Cigarette lighter, fan, instrument electric box
G208: Audio equipment, combined instrument, various control switches, diagnosis socket
G209: Engine ECU earth
G210: Engine ECU earth

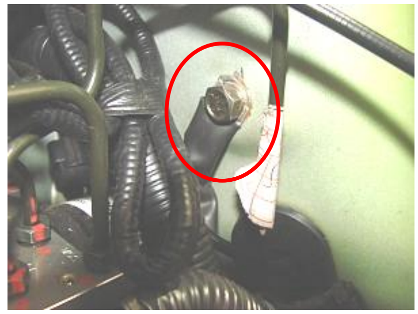
2. Distribution of Various Earth Points and Main Modules



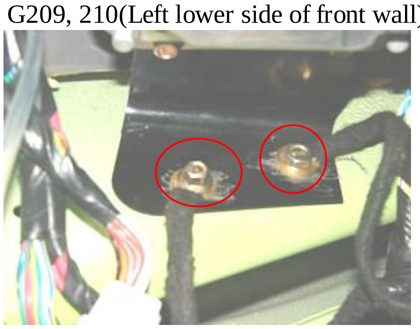
3. Photos of Earth Points

G100(Below battery)

G100



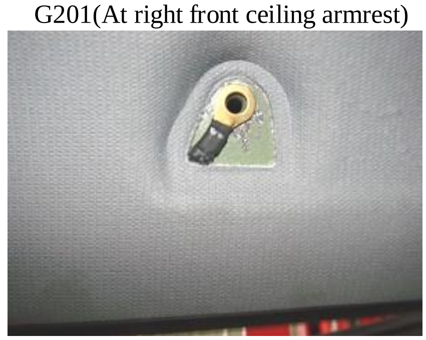
G209, 210(Left lower side of front wall)



G101 (at left front longitudinal beam)

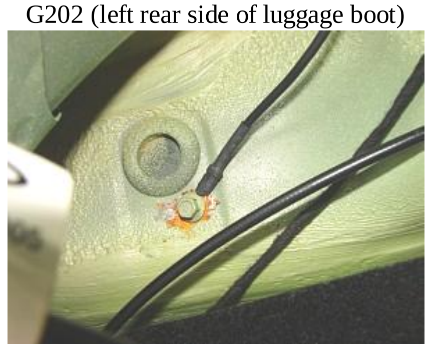
G102 (at right front longitudinal beam)

G201(At right front ceiling armrest)



G207, 208(at secondary instrument panel)

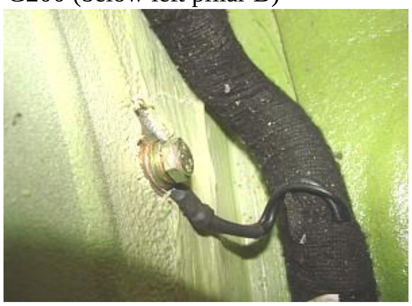
G202 (left rear side of luggage boot)



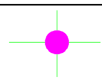
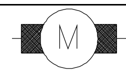
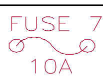
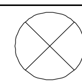
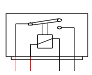
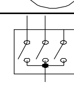
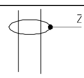
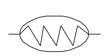
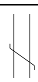
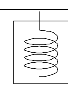
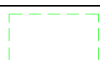
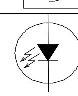
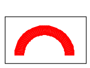
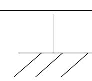
G204 (below right pillar C)

G206 (near BCM)

G200 (below left pillar B)



III. Instruction of Main Circuit Symbols

Symbol	Meaning	Symbol	Meaning
	Wiring joint		Motor
	Fuse position and specification		Bulb
	Relay		Switch control
	Shield wire		Resistance unit
	Shield wire		Electromagnetic coil
	This part is not covered within this system		LBD
	Connector		Earth

Note: Please validate specifically the real articles with the circuits for other symbols.

IV. Auxiliary Instruction of Circuit Diagram

1. Instruction of Power Supply and Earth Wire

30: Primary live wire from the battery
30a: Primary live wire from the battery
15: From the ignition switch (IGN1)
15a: From the ignition switch (IGN2)
Ka: From ignition switch (ACC, disconnect at start)
58b(RHEO): power supply for noctilucence illumination
30–(GROUND): Earth wire, from cathode terminal of the battery

2. Wire Size and Color

R Red; O Orange; W White; B Black; Y Yellow; V Purple;

G Green; L Blue; Br Brown; Gr Grey; P Pink; Lg Light green;

0.5 R Y
Secondary color
Primary color
Lead wire size(mm)

3. Definition of Main Controls

This circuit control theory diagram uses “instrument plug/” to indicate the integrated relay plug of the instrument electric box.
This circuit control theory diagram uses “ECU” to indicate the engine control unit.
This circuit control theory diagram uses “BCM” to indicate the body control module.

4. Pin Definition Explanation

The pin definition explanation of the circuit theory diagram:
For instance as follows:
4.1.

Instrument/interior/A/6

Indication of pin number

indicate the differentiation of plugs with same name

Indicate the name of the harness to be connected

Indicate the name of the connecting harness

“Instrument/interior/A/6” indicates the #6 pin of plug A of instrument harness and interior harness connectors;

4.2. “To anti-deterrent module A5” indicates “to #5 pin of plug A of anti-deterrent module”;

4.3. “To ECU25” indicates “to #25 pin of ECU";

V. Fuse Definition

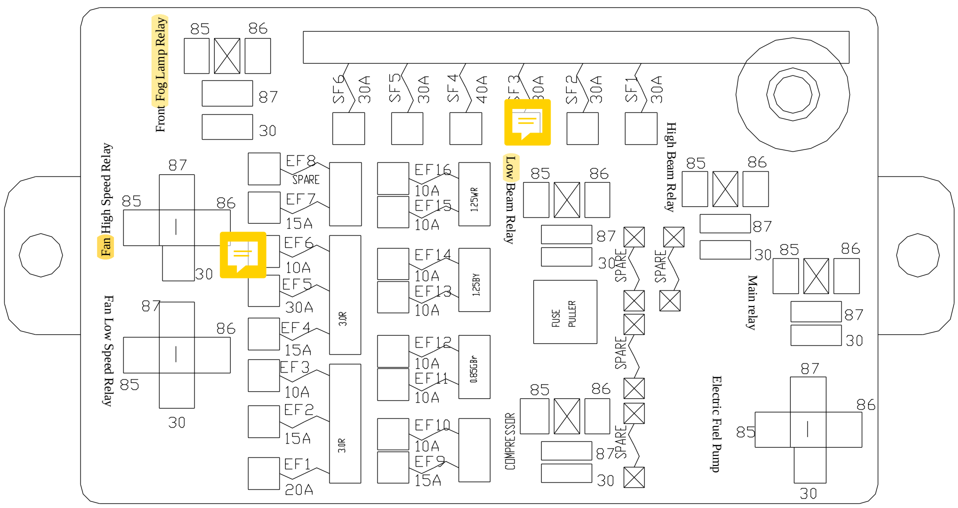
1. Fuse Number

The fuse number within the front compartment relay box is expressed by “EF+number” and “SF+number”.

The fuse number within the instrument relay box is expressed by “F+number”.

2. Fuse Position and Function Instruction

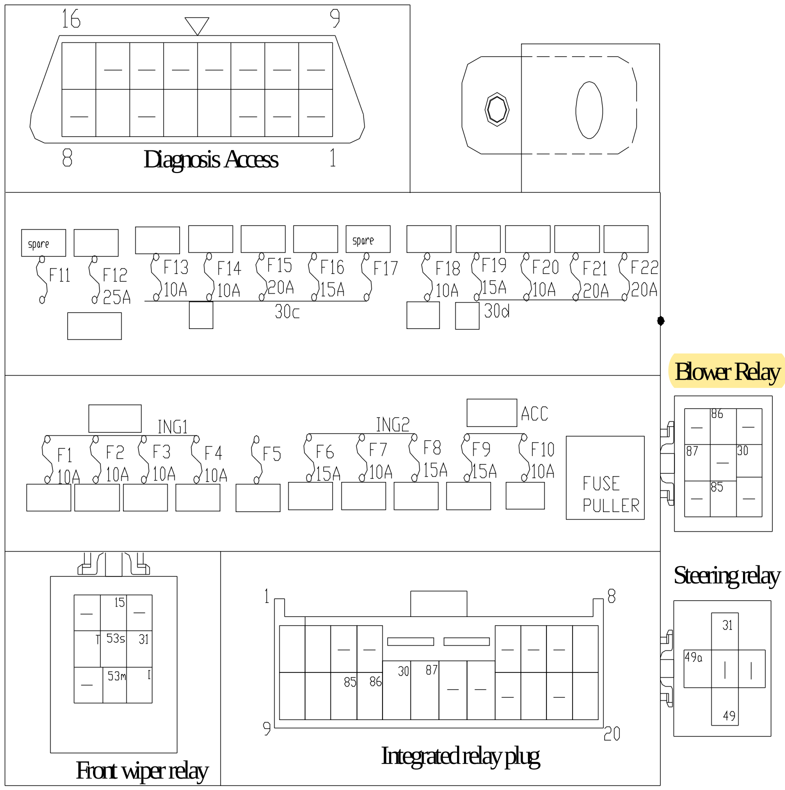
2.1. Front Compartment Relay Box Fuse



The front compartment relay box is located near the front compartment battery, with the detailed function instructions of the fuses are as follows:

Fuse No.	Capacity	Function	Fuse No.	Capacity	Function
SF1	30A	Fan, high speed	EF6	10A	Compressor
SF2	30A	BCM	EF7	15A	Oxygen sensor
SF3	30A	A/C	EF8	Vacant	Vacant
SF4	40A	Instrument electric box	EF9	15A	Ignition coil
SF5	30A	ABS	EF10	10A	Backup lamp
SF6	30A	ABS	EF11	10A	Right position lamp
EF1	20A	Fan, low speed	EF12	10A	Left position lamp
EF2	15A	Front fog lamp	EF13	10A	Right high beam
EF3	10A	ECU	EF14	10A	Left high beam
EF4	15A	Fuel pump	EF15	10A	Right low beam
EF5	30A	Primary relay	EF16	10A	Left low beam

2.2. Instrument Relay Box Fuse

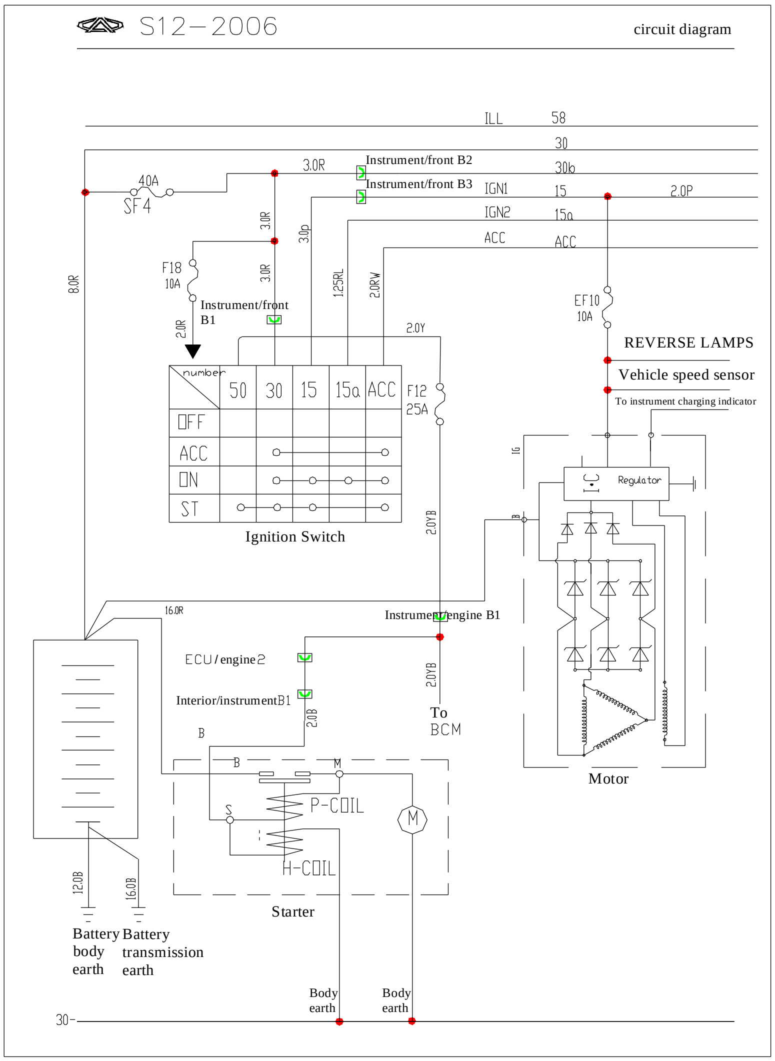


The instrument relay box is located within the left cover plate of the dashboard, with the detailed function instructions of the fuses are as follows:

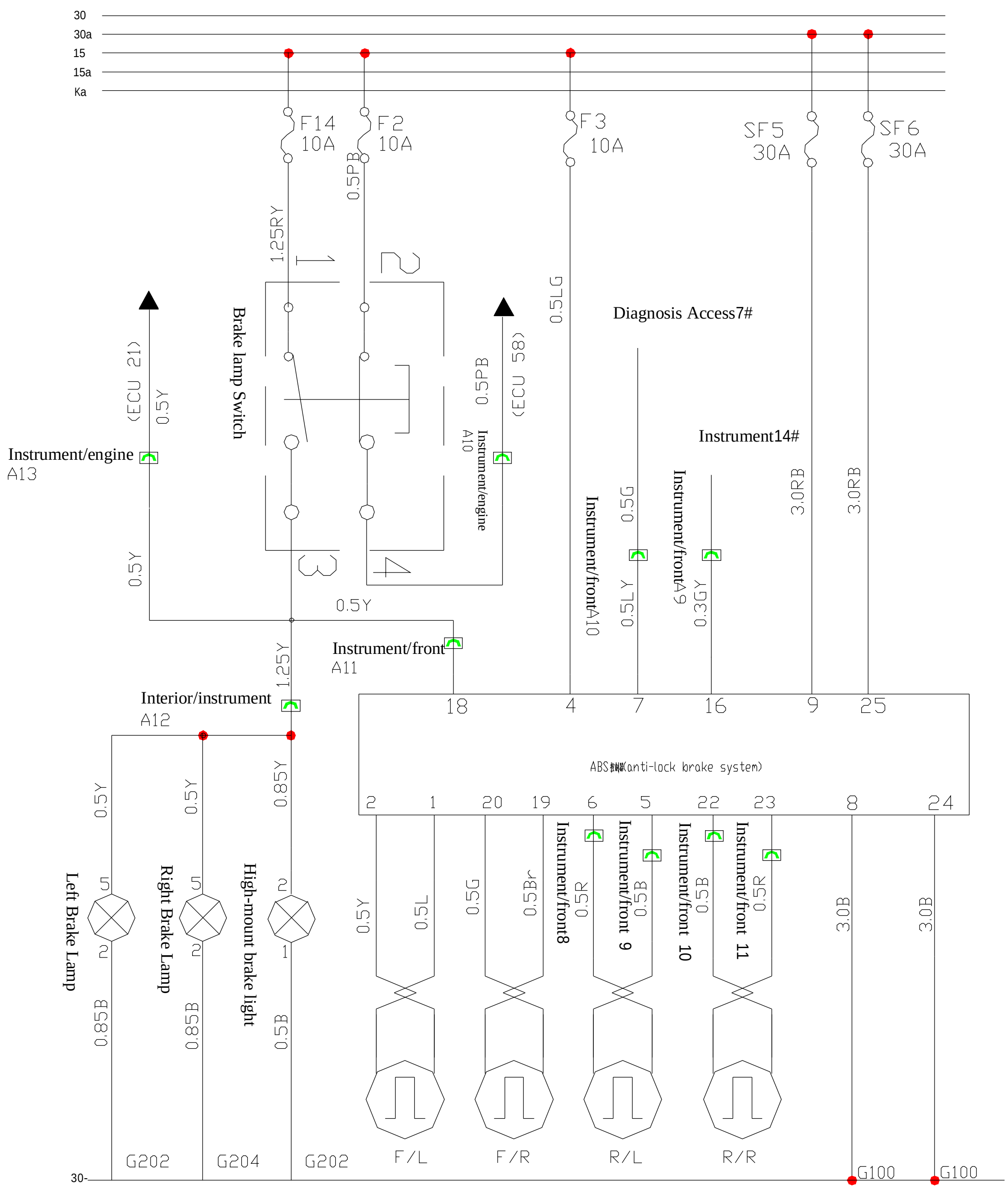
No	Specification	Functions	No	Specification	Functions
F22	20A	Rear defroster	F11		Vacant
F21	20A	Sunroof power supply	F10	10A	Radio/player control
F20	10A	Lamp switch, instrument	F9	15A	Cigar Lighter
F19	15A	Alarm switch	F8	15A	Front wiper
F18	10A	Clearance lamp, ceiling lamp	F7	10A	Steering power supply, A/C relay coil
F17		Vacant	F6	15A	Washer, rear wiper power supply, sunroof control
F16	15A	Horn, fog lamp	F5		Vacant
F15	20A	Audio device	F4	10A	Air Bag
F14	10A	Braking Lamp	F3	10A	ABS control
F13	10A	Diagnosis Access	F2	10A	Rear view mirror, brake switch, BCM
F12	25A	Start	F1	10A	COMBINED INSTRUMENTS

Chapter 2　Circuit Control Theory Diagram

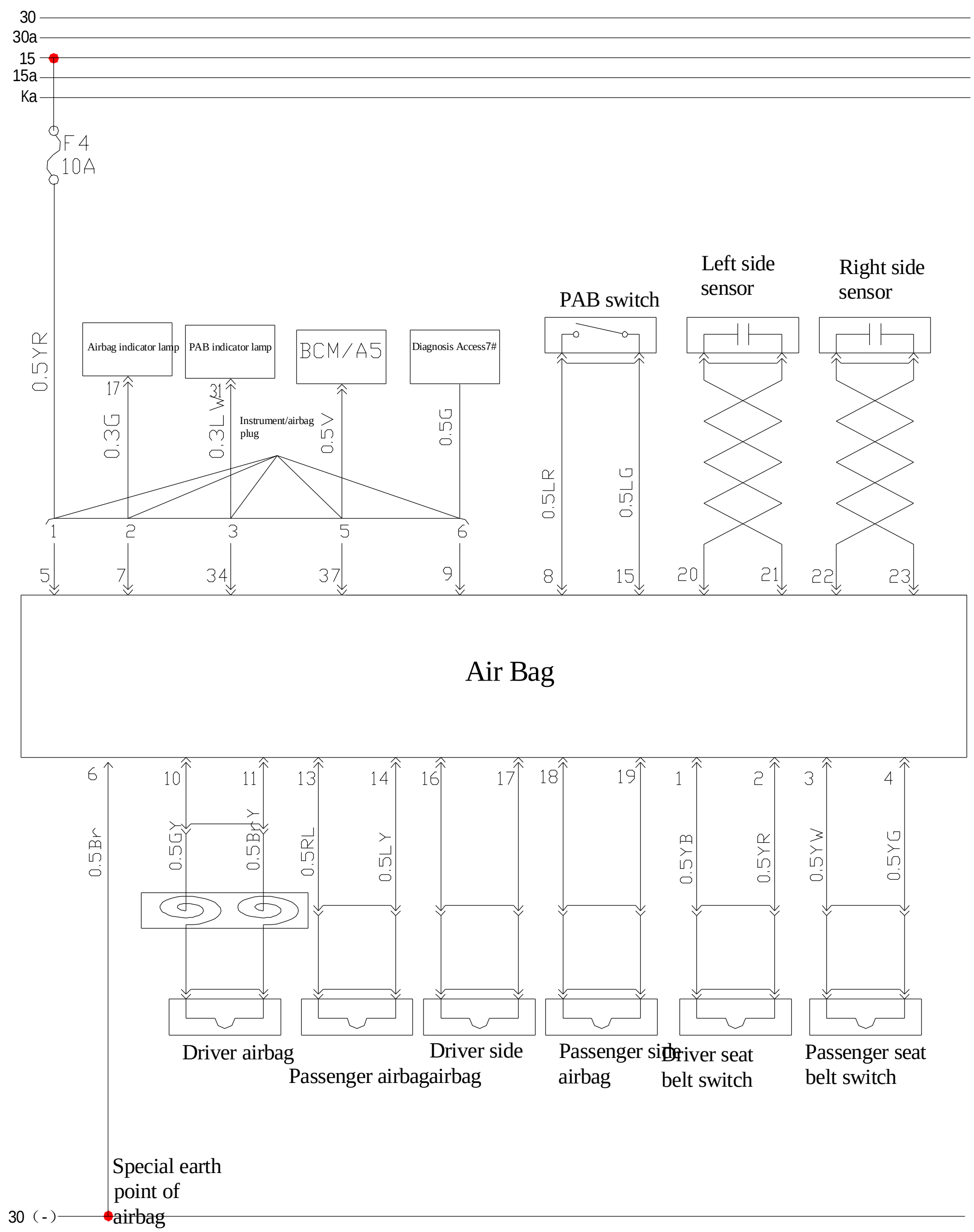
I. Starter Charging System



II. ABS Control System

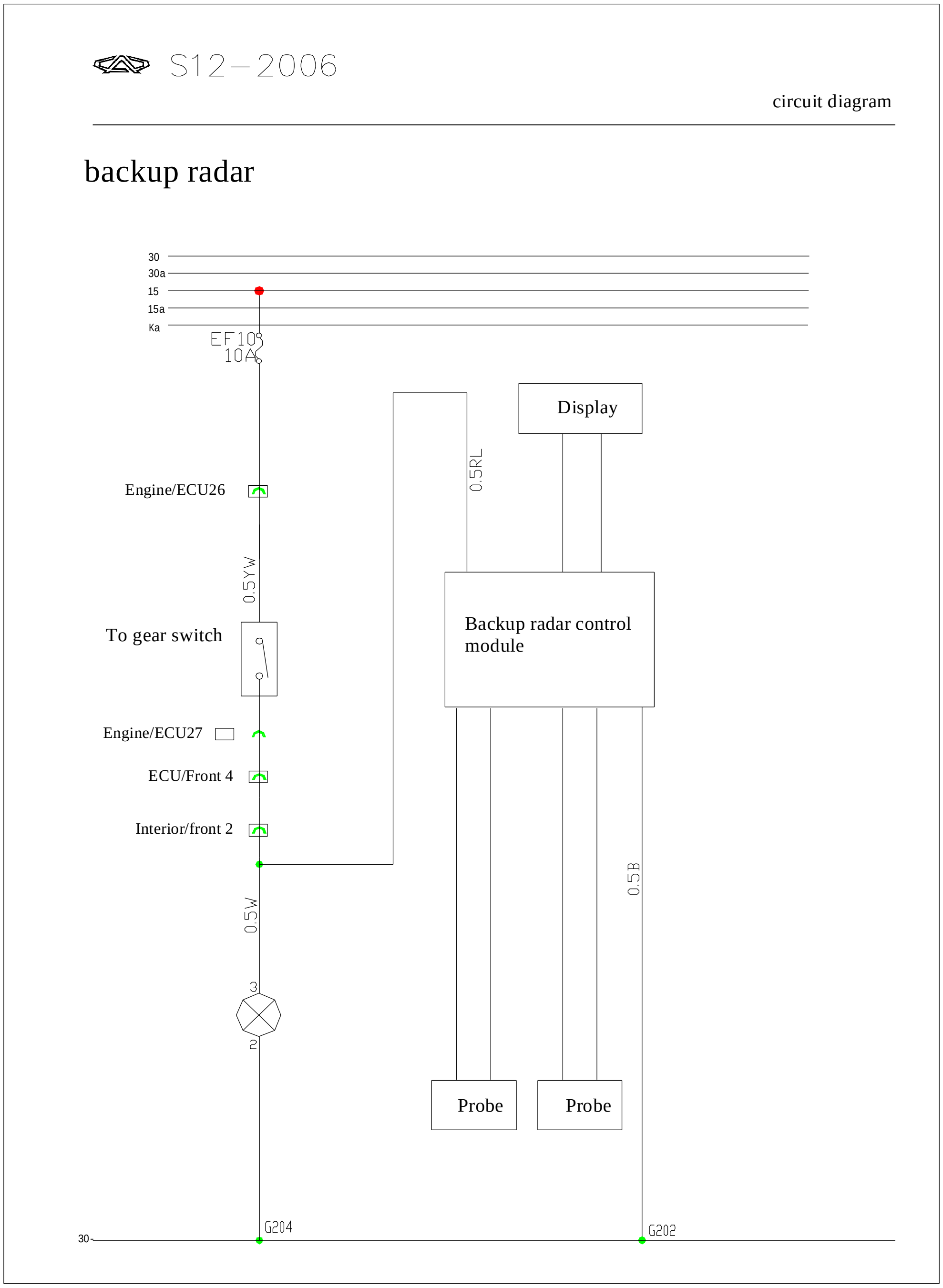


III. Airbag

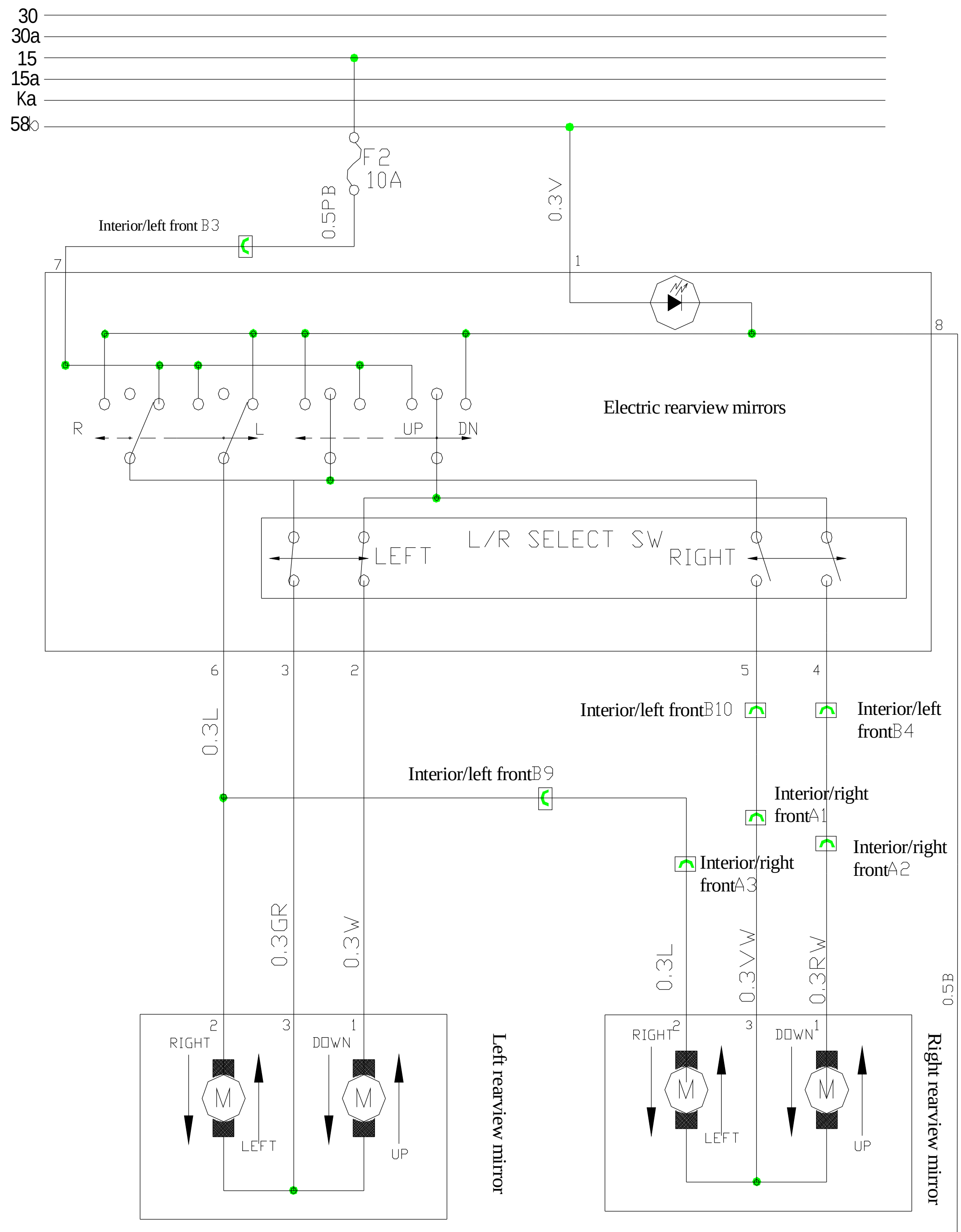


30
30a
15
15a
Ka
F4
10A
0.5YR
Airbag indicator lamp
PAB indicator lamp
BCM/A5
Diagnosis Access7#
Instrument/airbag plug
0.3G
0.3LW
0.5V
0.5G
PAB switch
Left side sensor
Right side sensor
0.5LR
0.5LG
Air Bag
0.5Br
0.5GY
0.5BrY
0.5RL
0.5LY
0.5YB
0.5YR
0.5YW
0.5YG
Driver airbag
Passenger airbagairbag
Driver side
Passenger side airbag
Driver seat belt switch
Passenger seat belt switch
Special earth point of airbag
30（-）

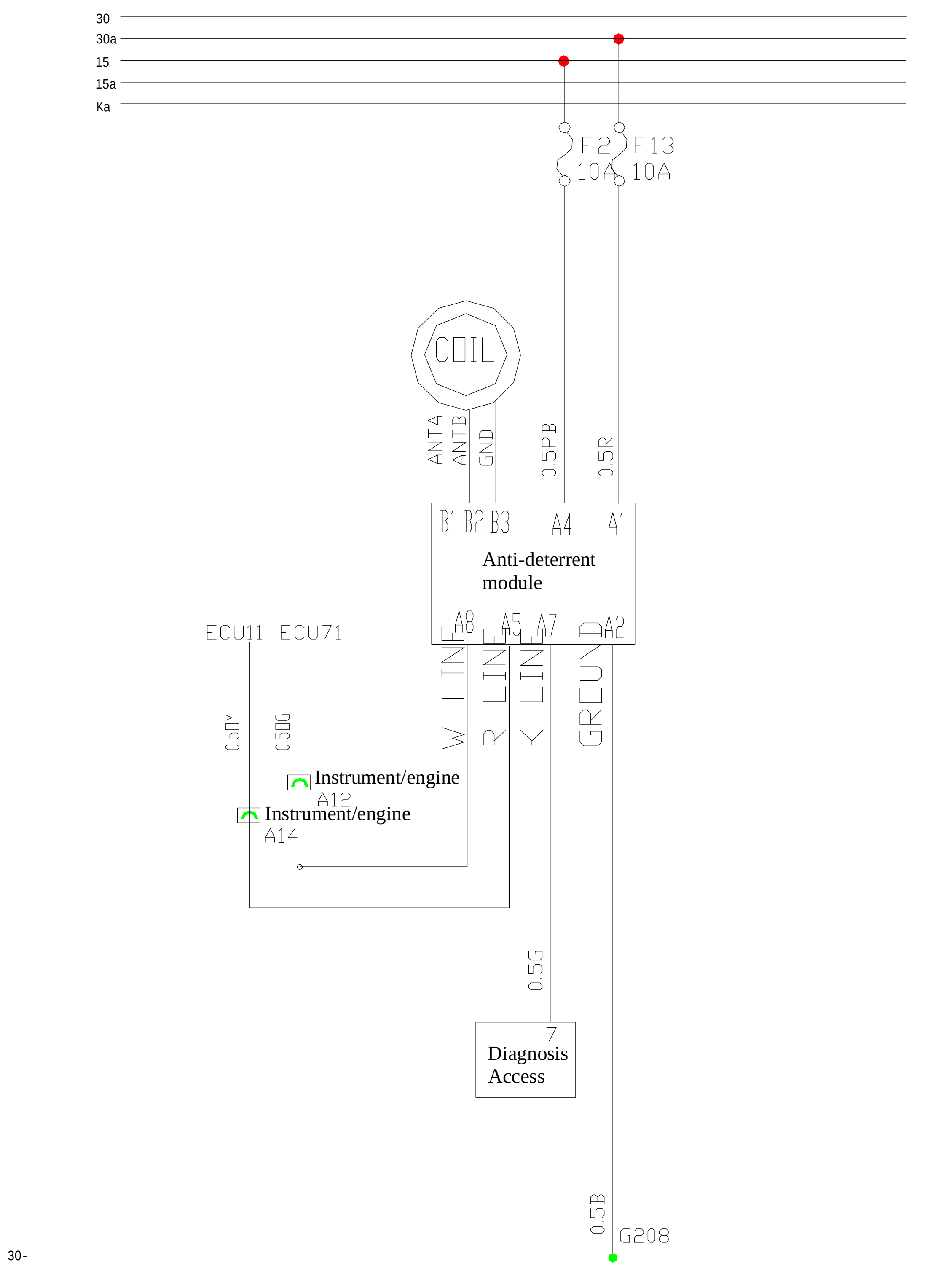
IV. Backup Radar



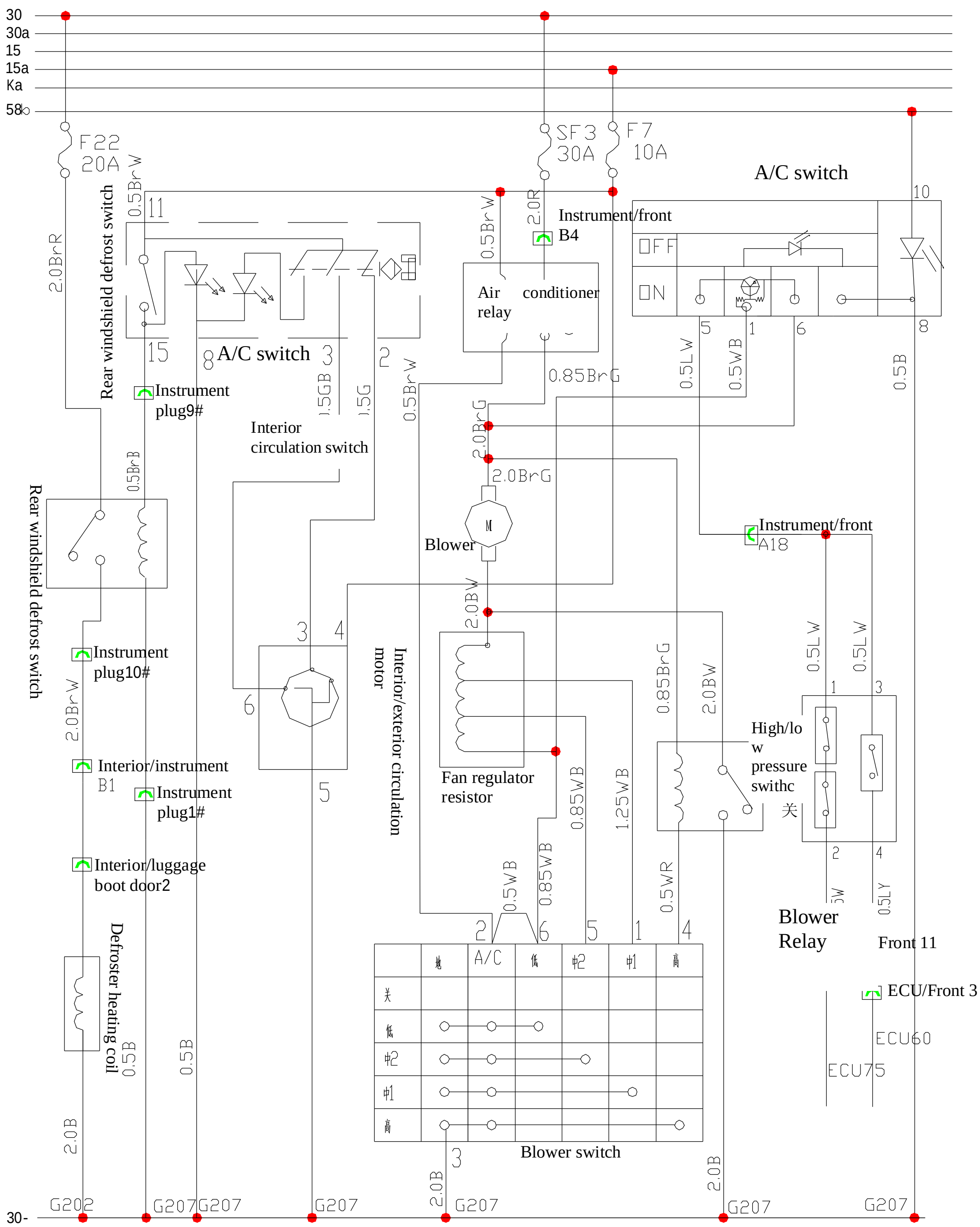
V. Electric Rear View Mirror



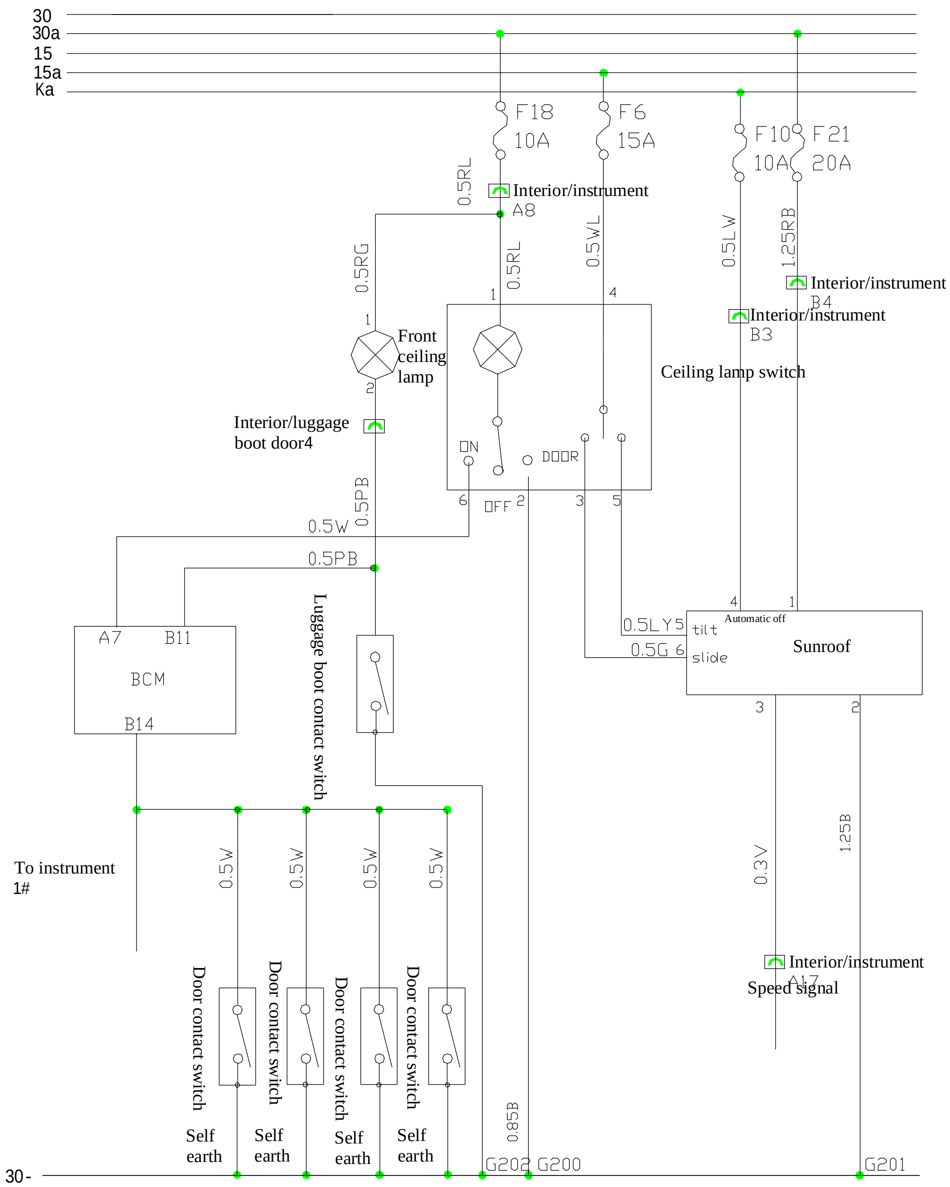
VI. Engine Anti-Deterrent



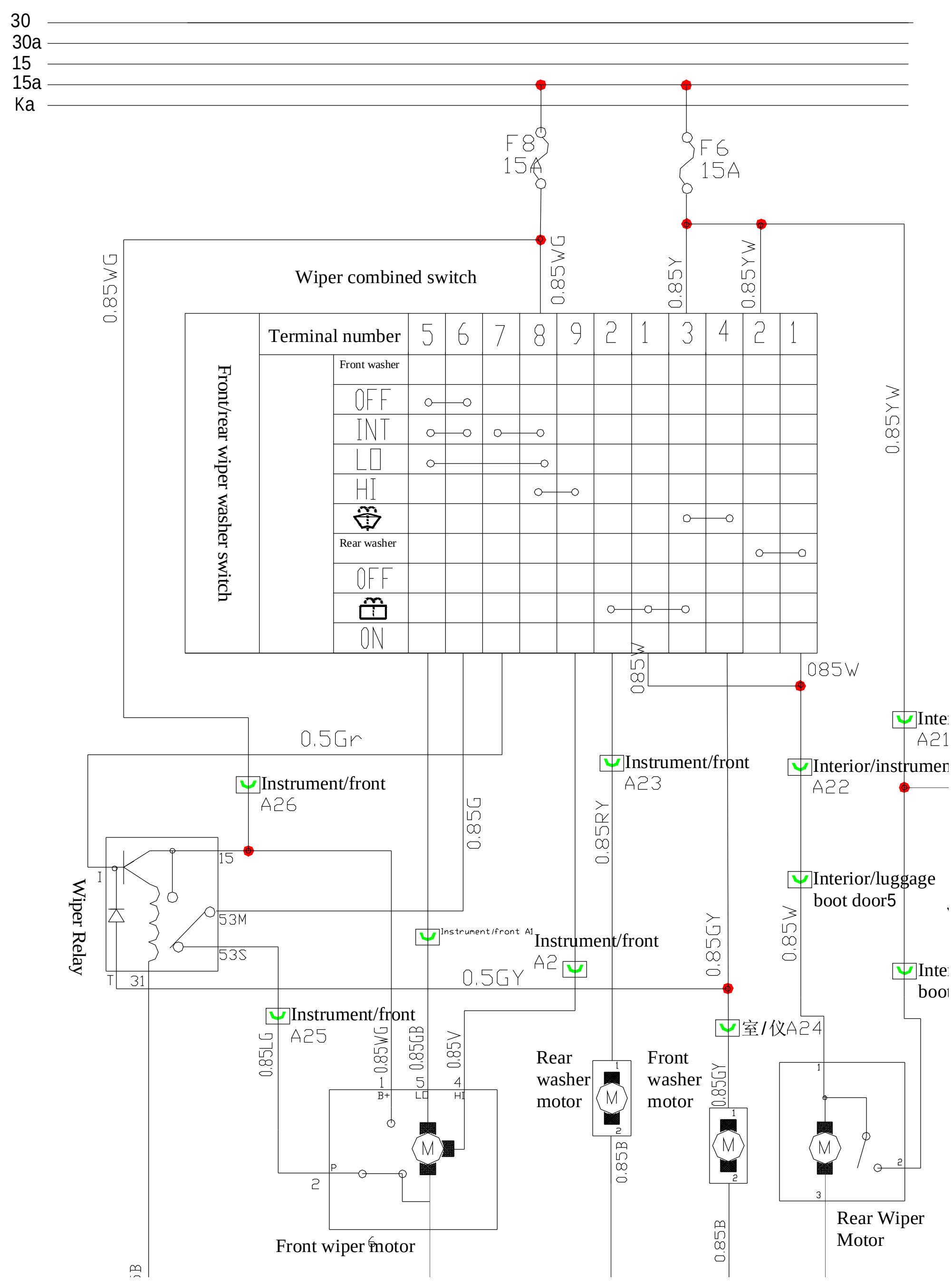
VII. A/C, Defroster System



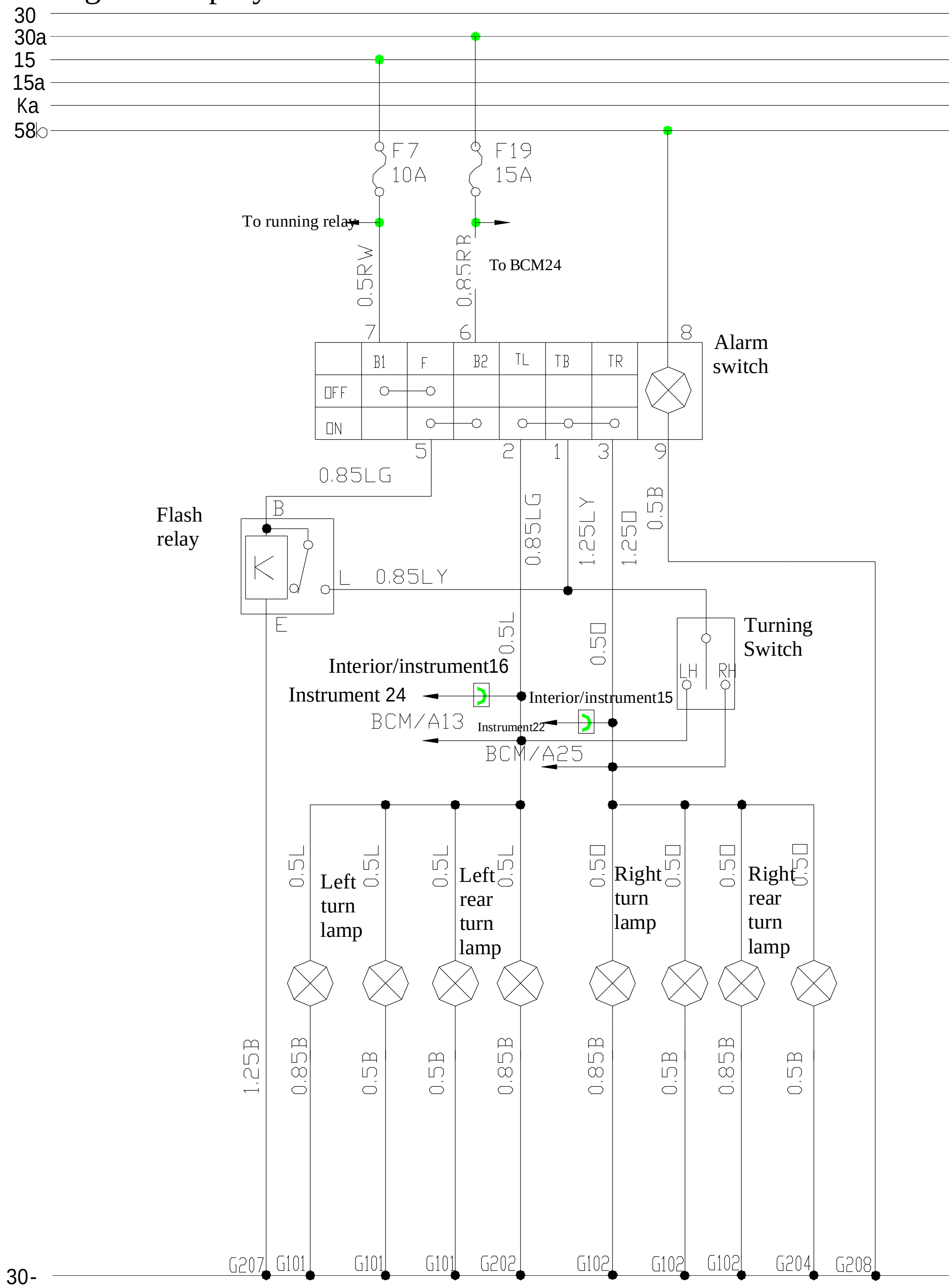
VIII. Ceiling Lamp, Luggage Boot Lamp, and Sunroof System



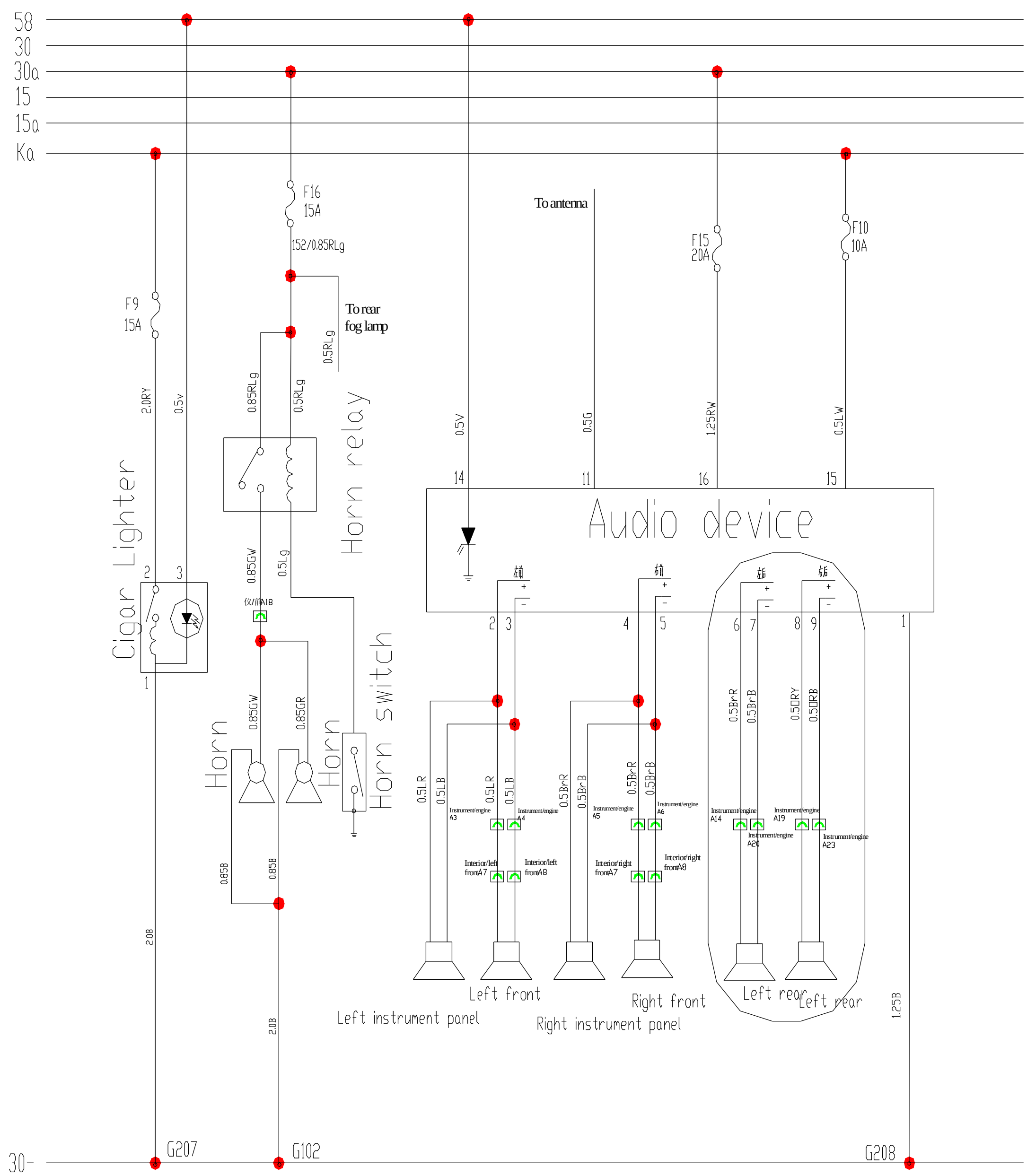
IX. Front/Rear Wiper System



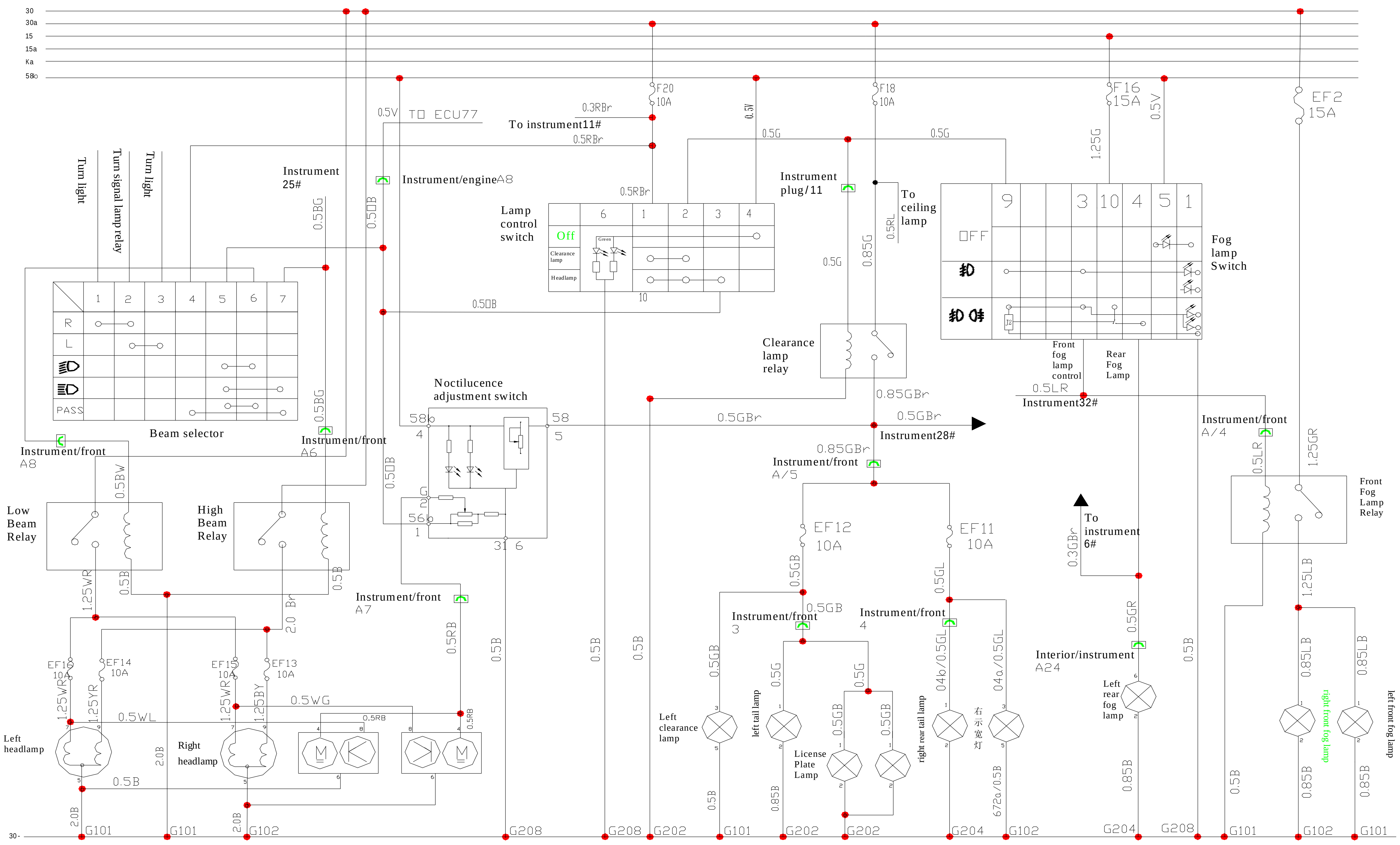
X. Turn Signal Lamp System



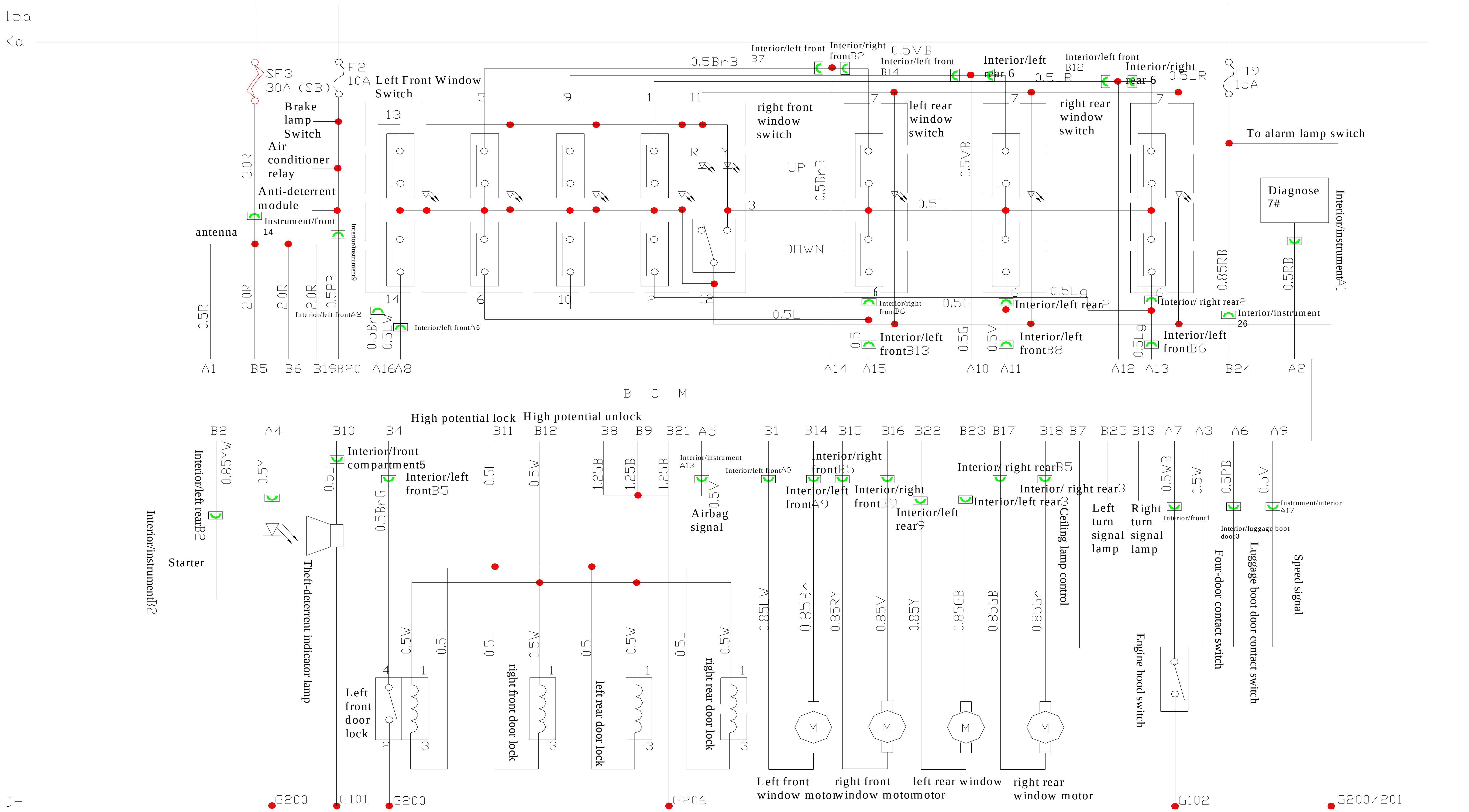
XI. Radio/Player, Horn, Cigarette Lighter



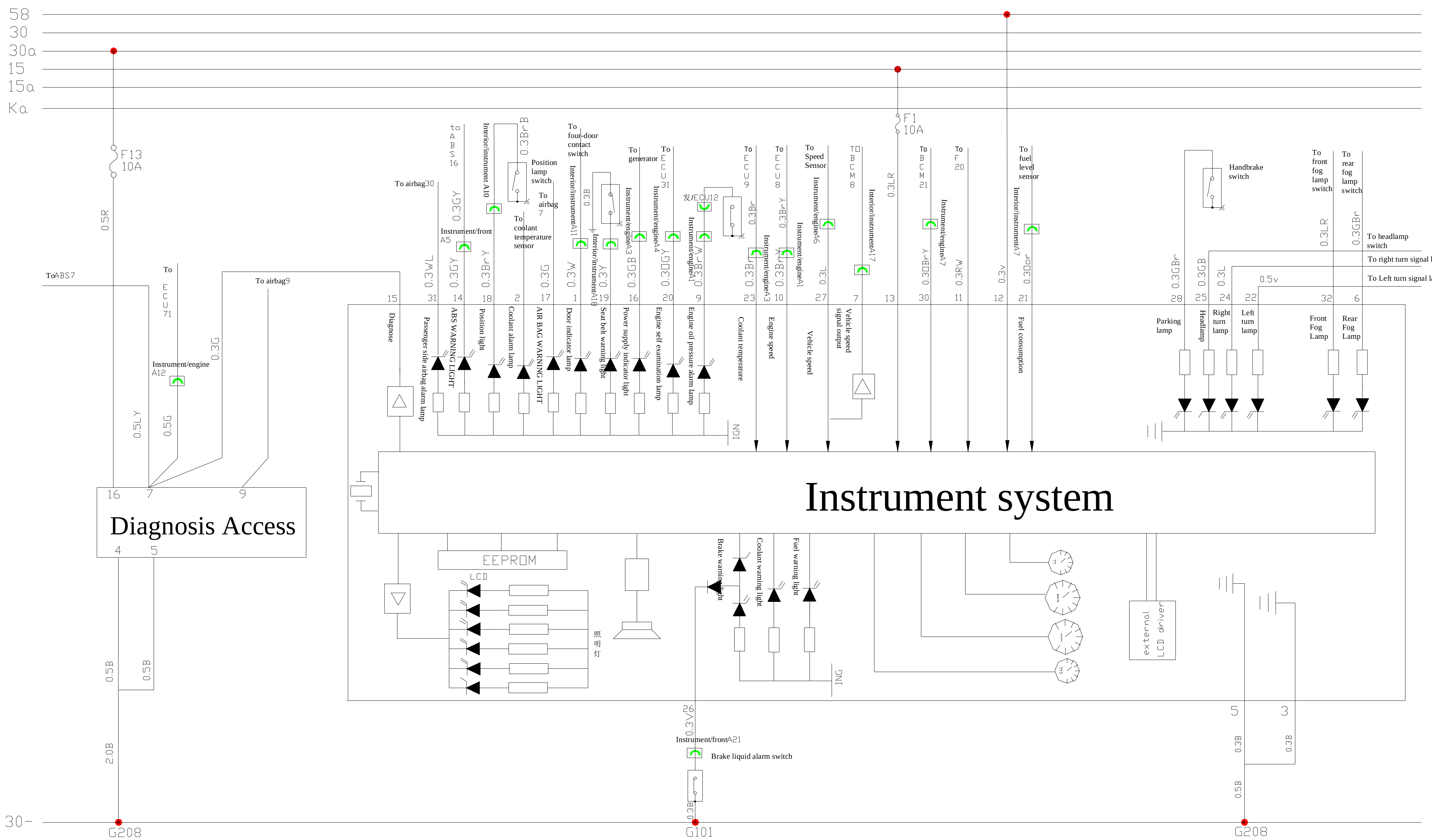
XII. Headlamp, Fog Lamp System



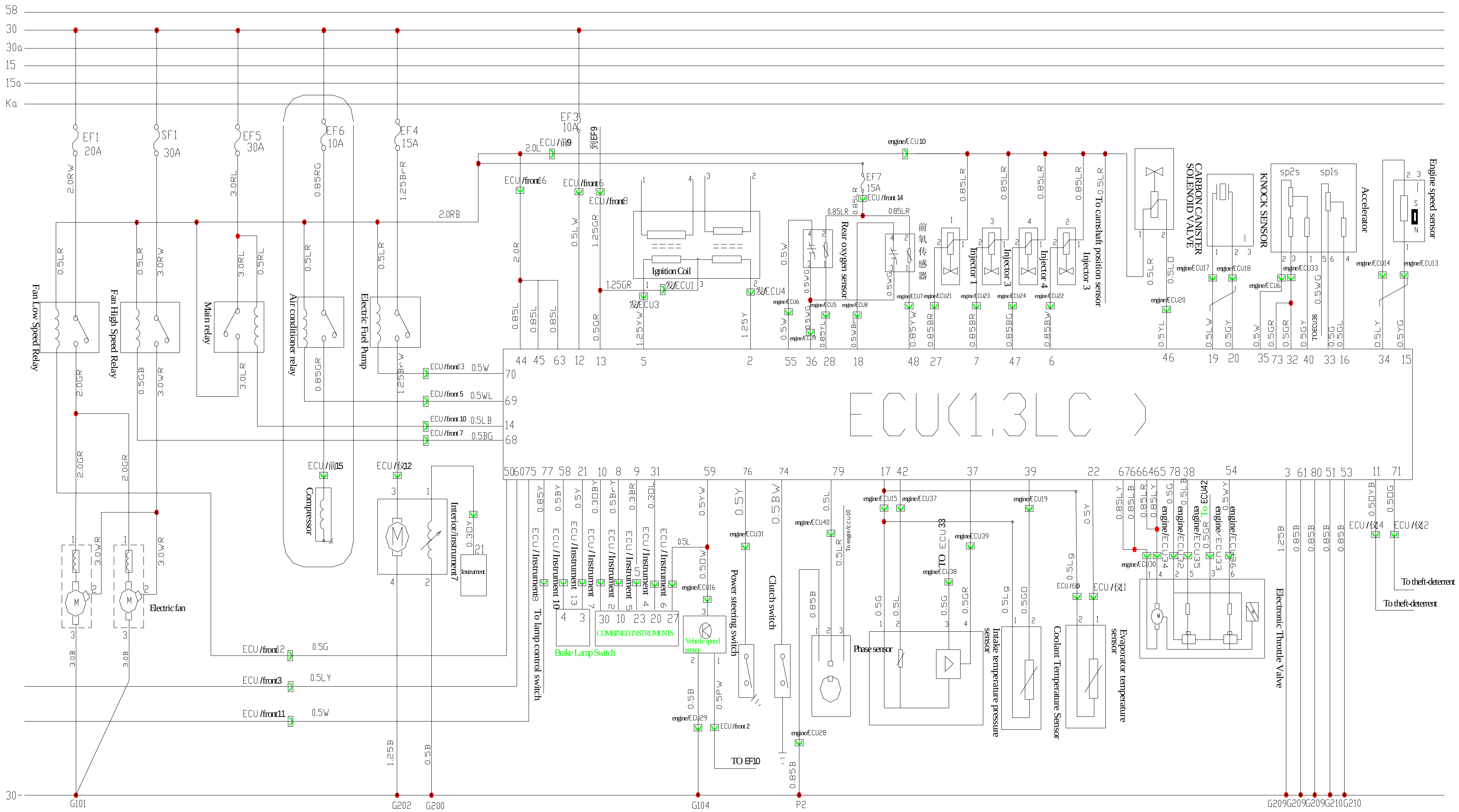
XIII. BCM System



XIV. Instrument System



XV. 473 Engine and Liandian Electric Injection System



Service Manual for Chery

(QR513 Transmission Case)

After Sales Service Department of Chery
Automobile Sales Co., Ltd

CONTENTS

Foreword

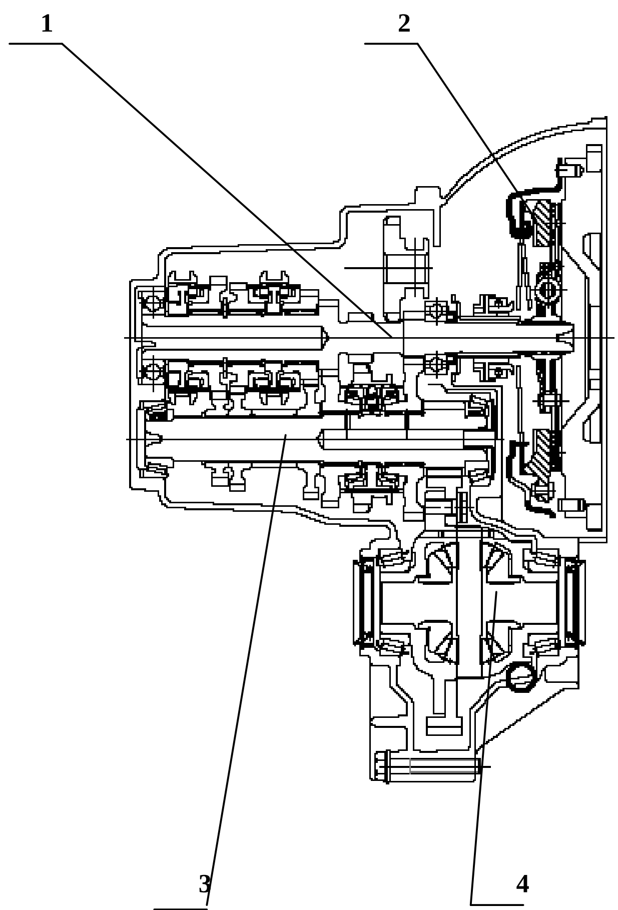
1. This service manual applies to use and maintenance of QR513 transmission manufactured by Chery Automobile Co., Ltd.

2. ***Service Manual for QR513 Transmission*** describes relations among various parts and assemblies of this transmission, which provide the maintenance personnel with a reference when maintaining and repairing QR513 transmission.

3. Due to restrictions of the compiler's level and other conditions, errors and imperfections may exist in this service manual. During maintenance and use, please inform us of any problem in and improvement idea on QR513 transmission and this service manual, so that we can correct and perfect this service manual, for which we express our thanks herein.

Chapter One Introduction of QR513 Transmission

I. Assembly Drawing of QR513 Transmission



1. Input shaft 2. Clutch 3. Output shaft 4. Differential

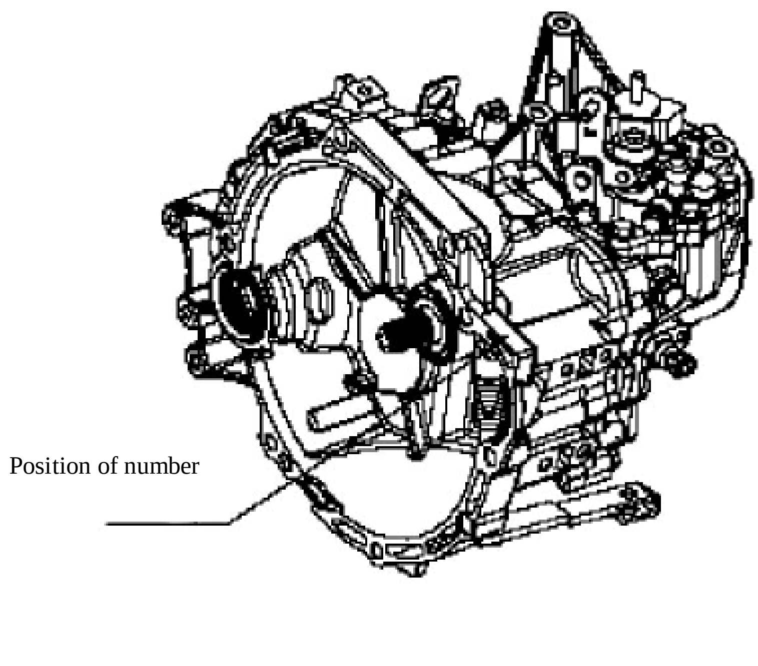
II. Driving Characteristics of QR513 Transmission

This transmission achieves five forward gears and one reverse gear through three groups of synchronizers and two shafts-input shaft and output shaft; all forward gears adopt conventional engagement system while reverse gear adopts a gliding idler device. The synchronizers of the first and second gears are installed on output shaft while the synchronizers of the third, fourth and fifth gears are installed on input shaft. When the transmission is shifted to various gears, these synchronizers will engage with corresponding gear hub to enable transmission of power, and then the driving gear of main decelerator will drive the driven gear of main decelerator and differential assembly to rotate, which will drive the drive shaft to drive the wheels to rotate.

III. SN of QR513 Transmission

1. Print position of SN of QR513 transmission

The print position of SN of QR513 series transmission is as shown in the figure:



2. Composition and connotation of SN of QR513 transmission

SN of QR513 series transmission is consisted of model and leaving factory number of the transmission case.

1) Model of the transmission case

Model of the transmission case is composed of code QR, number of shift gears of the transmission, maximum transmission torque, characteristic code and structure specification number.

A complete transmission case model is as follows:

□ □ ○ ○○ □ □ □

Structure specification number

Characteristic code

Maximum transmission torque (kg·m)

Number of shift gears of the transmission case

Code QR

Among which, ○ indicates an Arabic numeral while □ indicates a letter.

2) Leaving factory number

Leaving factory number is composed of endnote of assembly part number (for that without endnote, us AA), character code of the year of production, character code of the month of production, sequence number of this transmission case among the transmission cases manufactured in that month and start stop sign "*". See Table 1 and Table 2 for check list of character codes of the year and of the month.

Complete form of leaving factory number of a transmission case is as follows:

* □ □ ○ □ ○○○○○ *

Sequence number among the product of the same model manufactured in that month

Character code of the month

Character code of the year

Endnote of assembly part number

Among which, ○ indicates an Arabic numeral, □ indicates a letter and indicates an Arabic numeral or a letter. The endnote locates at tail end of the part code, for a fundamental model, no endnote. The endnote should be modified when modification is made to structure, dimension, material, heat treatment requirements and surface treatment etc. of the part or assembly on the basis of original product. The English letter in the code should be upper case letter (use in sequence with "A" as the first), in order to avoid confusion, do not use "I", "O" and "X". When the modification does not affect interchangeability, use "A" as the first; when the modification affects interchangeability, skip "A", use "B" as the first.

Table 1 Character Codes Indicating the Years

Year	Code	Year	Code
1999	X	2015	F
2000	Y	2016	G
2001	1	2017	H
2002	2	2018	J
2003	3	2019	K

2004	4	2020	L
2005	5	2021	M
2006	6	2022	N
2007	7	2023	P
2008	8	2024	R
2009	9	2025	S
2010	A	2026	T
2011	B	2027	V
2012	C	2028	W
2013	D	2029	X
2014	E	2030	Y

Table 2 Character Codes Indicating the Months

Month	Code	Month	Code
January	A	July	G
February	B	August	H
March	C	September	J
April	D	October	K
May	E	November	L
June	F	December	M

3) Illustration

For example: QR513MHA MH5H00001 indicates the first transmission case with the model as QR513MHA manufactured in August, 2005.

IV. Specification of QR513 Transmission

	QR513 Series Transmission			
Type	Machine Gear Mesh			
Model	QR513MHA		QR513MHB	
Gear shift	Velocity Ratio	Teeth Ratio	Velocity Ratio	Teeth Ratio
First Gear	3.545	39/11	3.167	38/12
Second Gear	2.05	41/20	2.05	41/20
Third Gear	1.423	37/26	1.423	37/26
Fourth Gear	1.065	33/31	1.065	33/31
Fifth Gear	0.865	32/37	0.865	32/37
Reverse Gear	3.364	37/11	3.364	37/11
Main reduction ratio	4.056	73/18	75	16

Speedometer	0.806	29/36	0.806	29/36
Largest input torque	130 Nm			
Lubricant oil type	GL-4 75W-90			
Volume of lubricant	1.8L			

V. Maintenance Instruction

- In order to ensure maintenance quality of the transmission, when operating, please be careful and ensure cleanness of each part of the transmission.
- Use appropriate tools or special tools.
- Strictly follow the specification to assembly or adjustment to maintain so as to ensure that the transmission can accomplish a favorable working position.

Chapter Two Decomposition of QR513 Transmission

I. Decomposition Process for QR513 Transmission

1. Bleeding lubricant in transmission

First, drive the vehicle onto a maintenance platform or hoist the vehicle and keep it on a horizontal plane, screw off the bleeding plug as shown by the arrowhead, and then use a clean container to accommodate lubricant of the transmission to completely bleed the lubricant in the transmission.

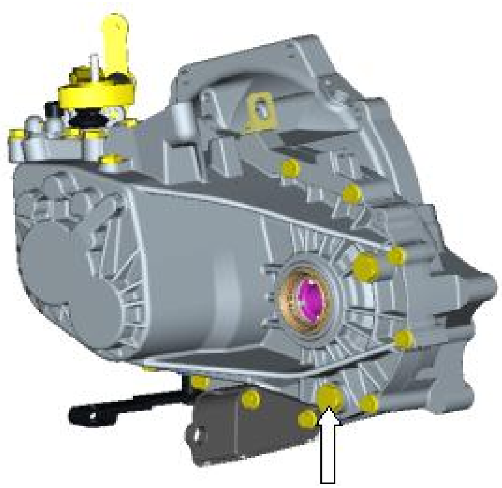


Figure 1

2. Disassembly of external parts of transmission

Switch the transmission to NEUTRAL position; use an appropriate tool to remove the locating seat of the fork shaft as shown in Figure 2; Connecting bolts for gearshift housing and transmission housing and the screws for backup lamp switch and idler shaft.

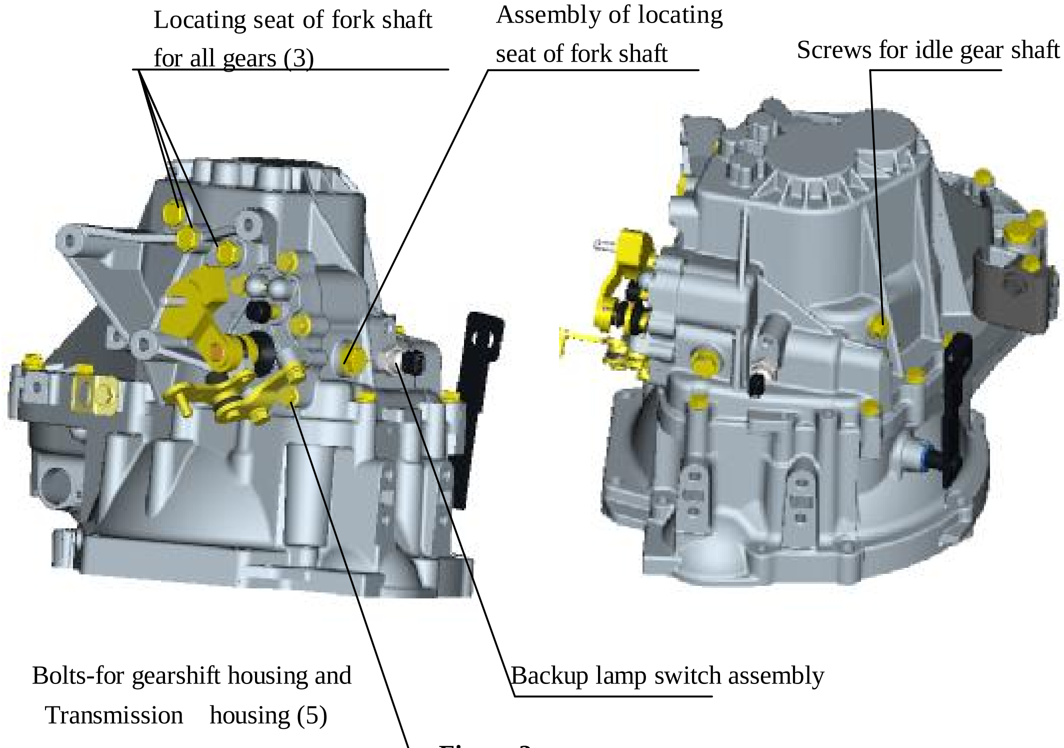


Figure 2

3. Separation of gear shift mechanism and transmission

Remove the gearshift mechanism assembly from the place as shown in Figure 3; as a result of sealant, the disassembly process may be difficult, so, use such tools as a hand hammer etc. to knock on the bulge at flank of housing of the gearshift mechanism, and then take out the whole gearshift mechanism assembly until the two housings completely separate; remember to be slow when taking out the gearshift mechanism assembly, so as to prevent the return spring as shown in the figure from dropping out inside the transmission; during disassembly, be careful not to damage the junction planes of the two housings, so as to avoid oil leak after re-assembly.

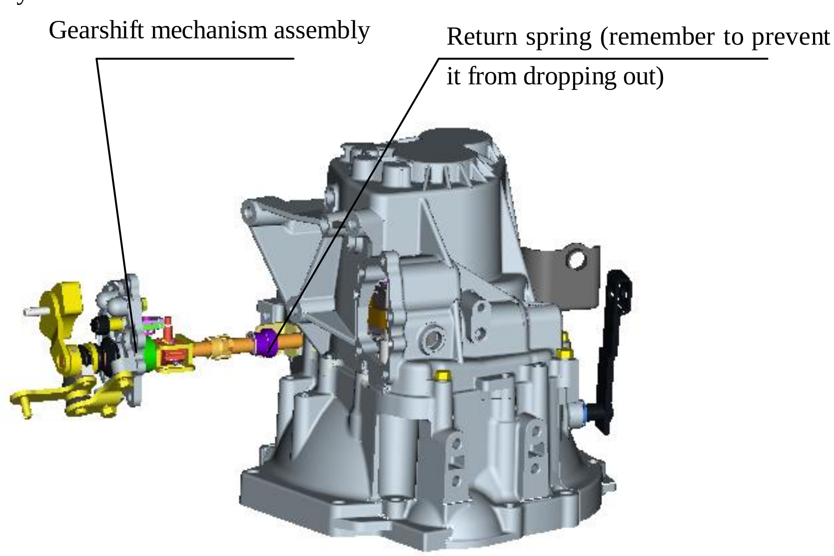


Figure 3

4. Disassembly of the connecting bolts for clutch and transmission housings

Use a tool to remove the connecting bolts for transmission and clutch housings as shown in Figure 4. Remember to remove the bolts both inside and outside the clutch housing when disassembling, and a sleeve with long connecting rod is required when removing the bolts inside the clutch.

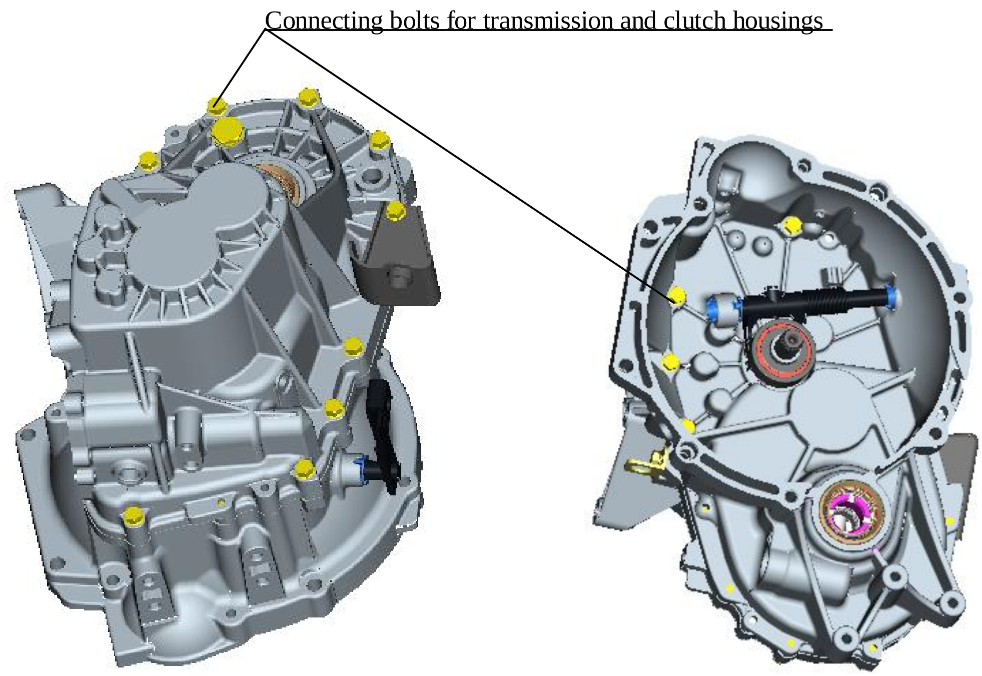


Figure 4

5. Separation of transmission and clutch housings

After the bolts for transmission and clutch housings are removed, separate clutch housing and transmission housing (Figure 5). as a result of sealant, the separation process may be difficult, so, use such tools as a hand hammer etc. to knock on the bulge at flank of housing of the transmission, and then take out the whole transmission housing until the two housings completely separate; during disassembly, be careful not to damage the junction planes of the two housings, so as to avoid oil leak of the transmission after re-assembly.

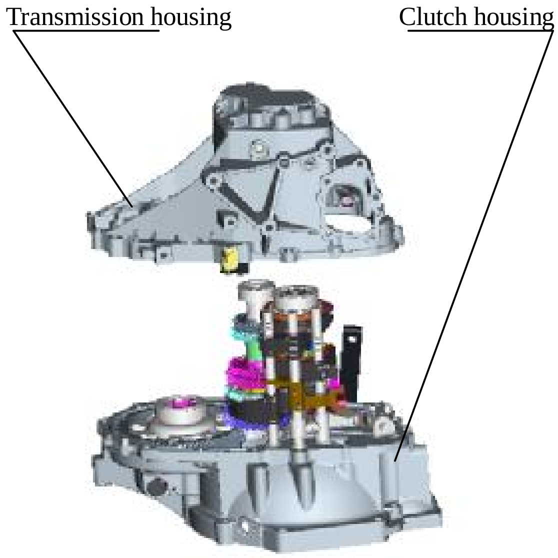


Figure 5

6. Separation of interior transmission parts and fork module from the housing

After transmission housing and clutch housing are separated, keep the clutch housing flat at the place as shown in Figure 6, remove the bolts for bracket of reverse gear rocker arm, take out the reverse gear rocker arm assembly and the pin on idler drive, and then take out input shaft, output shaft and fork mechanism together (when taking out, gently shake, meanwhile, press the driven gear of main decelerator along the direction of arrowhead as shown in the figure to take out the assembly of input shaft, output shaft and idler as well as fork mechanism); when taking out, remember to avoid interference between bearing retainer of output shaft and big gear ring of differential and prevent the bearing retainer from damage.

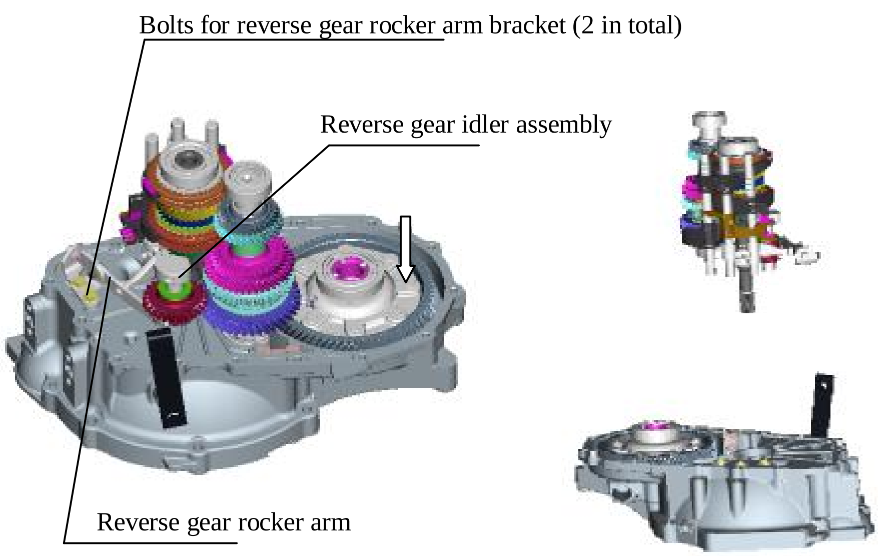


Figure 6

7. Separation of differential assembly and clutch housing

Separate differential assembly and clutch housing, and then simply take out the differential assembly as shown in Figure 7.

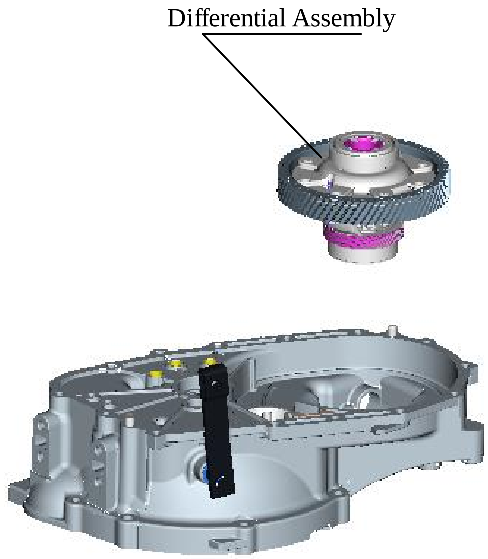


Figure 7

8. Disassembly of gearshift fork mechanism

Use a hammer and a special tool to knock off all spring pins and then use a snap ring pliers or other special tool to take the split washer off the fork shaft (when taking off the split washer, prevent it from deformation), and then disassemble each part of the gearshift mechanism.

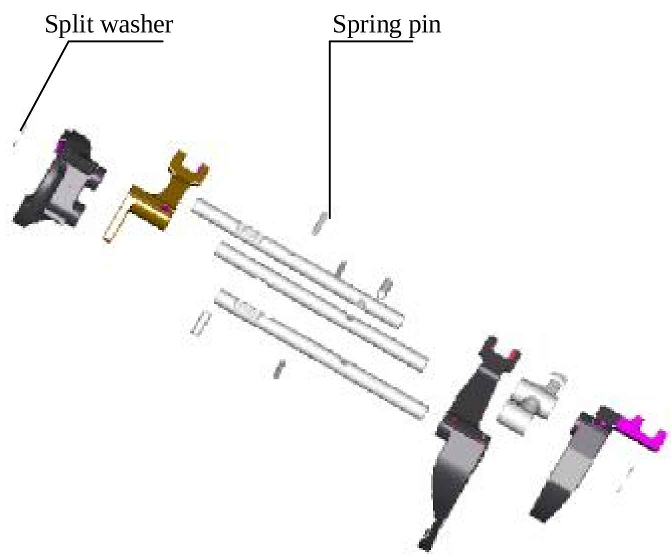


Figure 8

9. Disassembly of gearshift mechanism

As shown in Figure 9, remove the gearshift arm bracket bolts and reverse gear lockup mechanism bolts first, use a hammer and a special tool to knock off all spring pins, use a special tool to remove the split washer, and then disassemble each part of the gearshift mechanism.

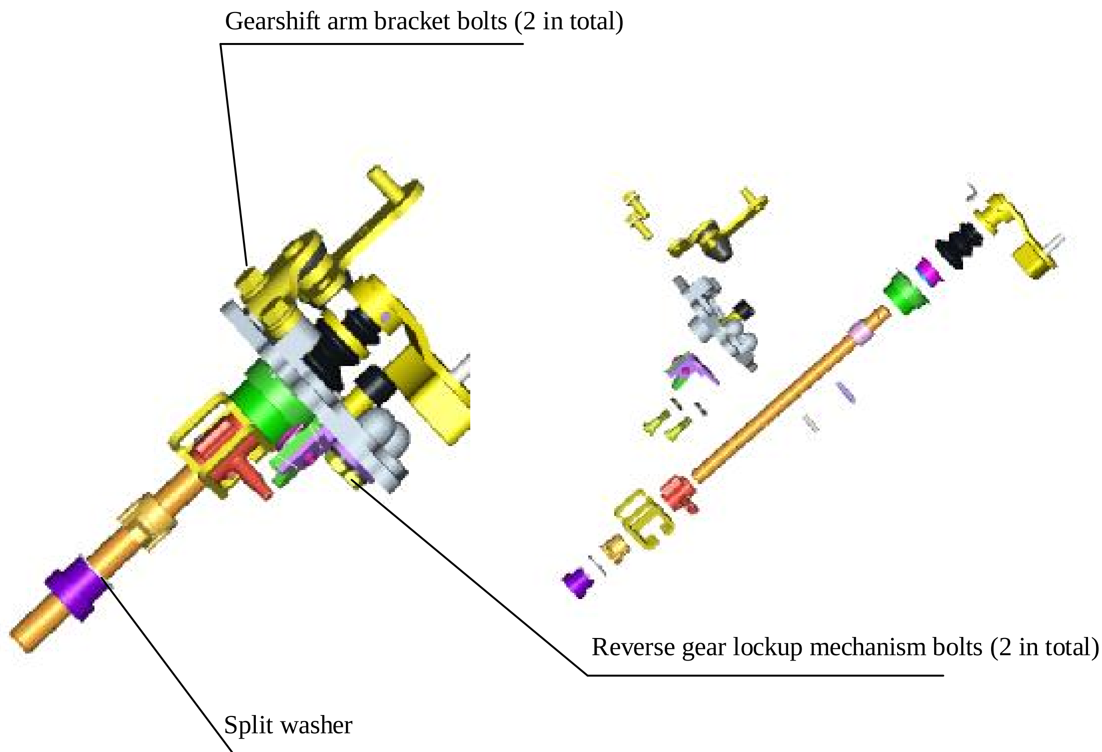


Figure 9

10. Disassembly of input shaft

As shown in Figure 10, Use a special tool (such as bearing remover etc.) to remove the two bearings on the input shaft first, use a special tool to remove the rear snap ring, and then take off the fifth gear synchronizer assembly.

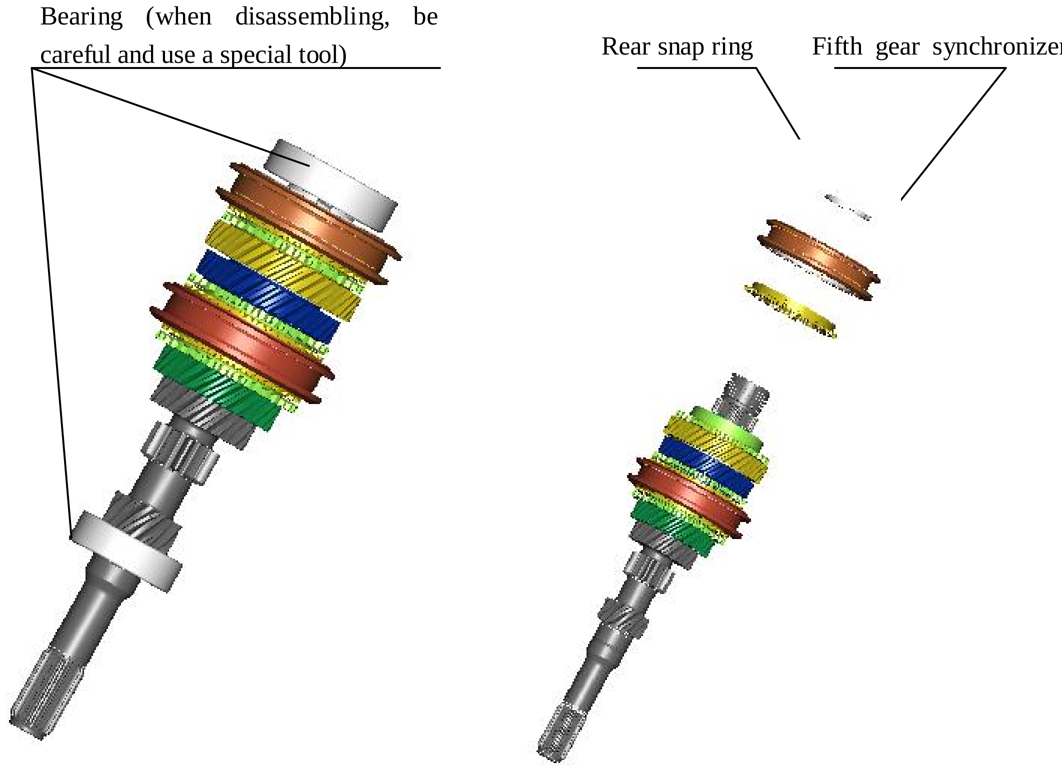


Figure 10

After the fifth gear synchronizer assembly is removed, remove the remaining parts such as shift gears, needle bearings and synchronizers in turn as shown in Figure 11; when disassembling, be sure to keep the synchronizer of each gear concurrent with its corresponding synchronizer ring.

Figure 11

11. Disassembly of output shaft

The method and process for disassembly of output shaft are basically the same as those for input shaft and the output shaft can be disassembled to the status as shown in Figure 12.

Figure 12

12. Disassembly of differential

As shown in Figure 13, use a special tool to take off the two bearings first, remove the bolts for driven gear and differential housing, remove the driven gear, knock off the fixing pin of the planetary gear, and then take out every part inside the differential (Figure 14).

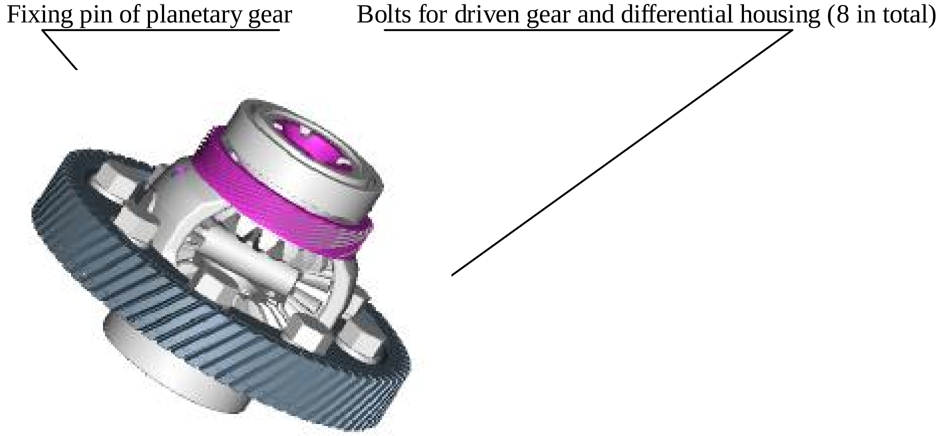


Figure 13

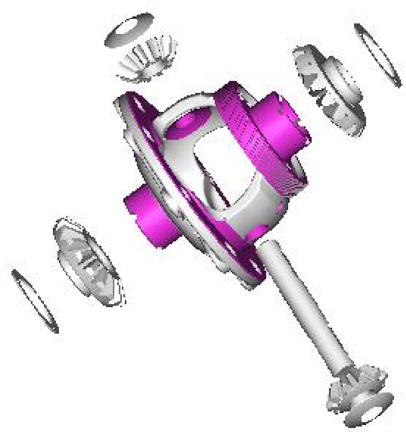


Figure 14

13. Disassembly of release mechanism of clutch

As shown in Figure 15, take off release bearing of the clutch first, remove the bolts for release fork, and then draw the release shaft assembly off the clutch housing (during the drawing off process, be sure to prevent the release return spring from ejection); also, remove the bush and dismount release mechanism of the clutch from the clutch housing.

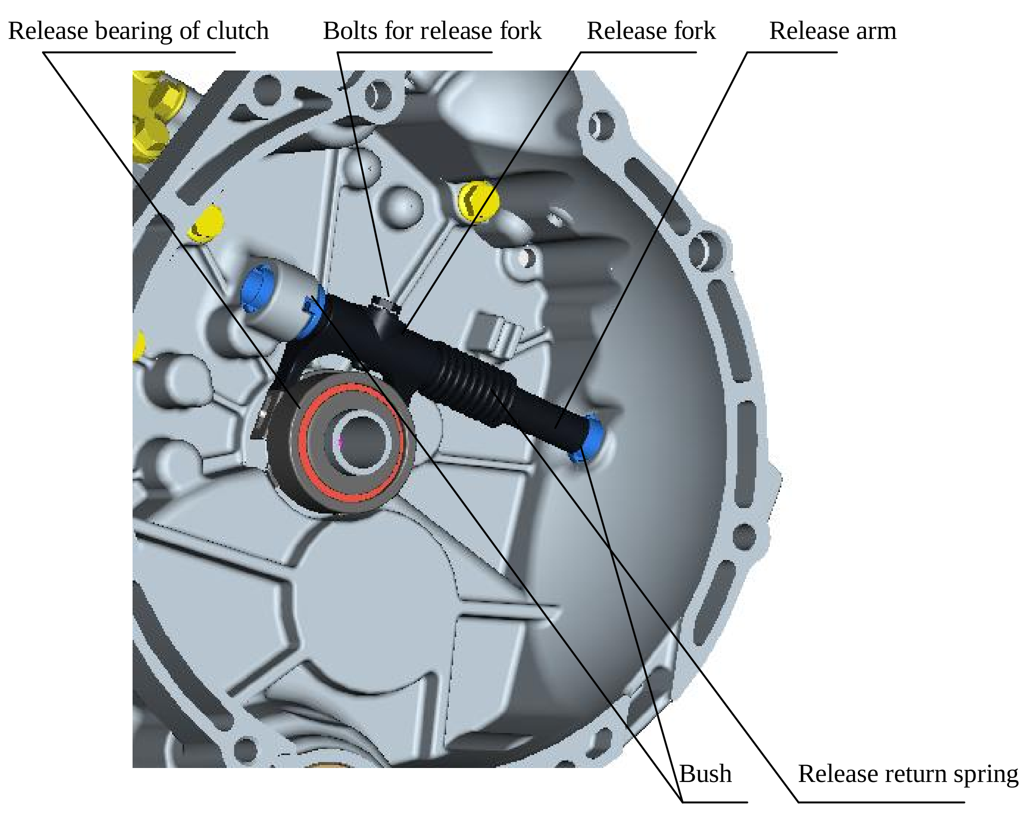


Figure 15

Be sure to use special tool and be careful to remove the oil seal on the clutch housing, because excessive deformation or damage of the oil seal may result in oil leak of the transmission. Use a special tool to remove the two oil seals on the clutch housing, and then remove the remaining bushes, oil ducts and outer rings of bearings as shown in Figure 16. Replacing with new oil seals after the former ones are removed is recommended.

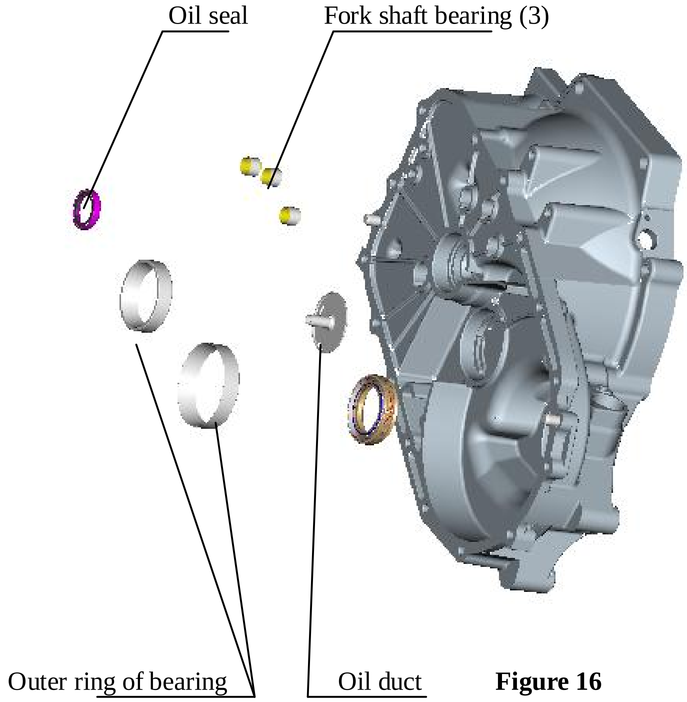


Figure 16

14. Disassembly of transmission housing

As shown in Figure 17, use a special tool to remove the oil seal of transmission housing, and then remove oil drain channel, fork shaft bush and linear bearing.

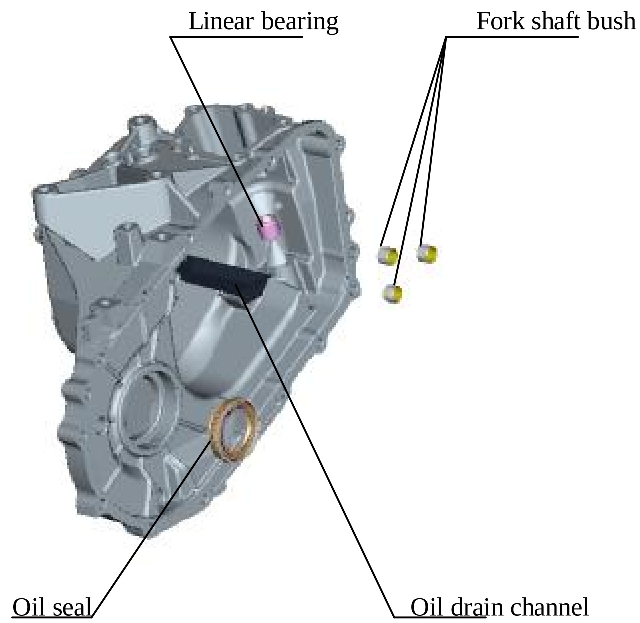


Figure 17

Chapter Three Assembly and Regulation of QR513 Transmission

I. Assembly of QR513 Transmission

After disassembly, visually inspect parts for any abnormal condition such as deformation etc, and make records; Replace the damaged parts, clean and wash all parts, then reassemble.

1. Assembly of differential assembly

Fit adjustment gaskets respectively at backsides of the two half axle gears, and then install the two half axle gears together with their gaskets into the differential. When fitting adjustment gaskets for the half axle gears, select the gasket with thickness as 1.2mm first. Fit spherical washers for the planetary gear, and then simultaneously engage the two planetary gears with the two half axle gears (fit them to correct positions while turning the gears). Insert the planetary gear shaft; note that the fixing pin hole on the shaft should align correctly with that on the differential housing both in the position and along the direction. Measure the clearance between the half axle gear and the planetary gear, and the normalized value should be **0.025~0.150mm**; if the clearance does not conform to the normalized value, replace the adjustment gaskets for the half axle gear, and then re-measure the clearance until it conforms to the standard with uniform clearance at both sides. Drive down the fixing pin of planetary gear shaft from the fixing pin hole at the side of differential housing with flange with the pin with end surface of the pin hole. Install driven gear of main decelerator and ensure that the installation end surface of the gear fits well with the end surface of the differential housing, and then fix the driven gear of main decelerator with bolts (apply sealant to full thread of the bolt before installation); screw the bolts home with the torque as **130±5Nm** cornerwise and alternately; respectively press in an inner ring of front and rear bearings from each of both ends of the differential housing and check if it has been pressed to the designated position. Note that the lubricant applied onto adjustment gaskets for half axle gears, planetary gear gaskets, junction surface of planetary gear and planetary gear shaft, junction surface of half axle gear and differential housing should be the same as that used inside the transmission. Refer to Figure 18.

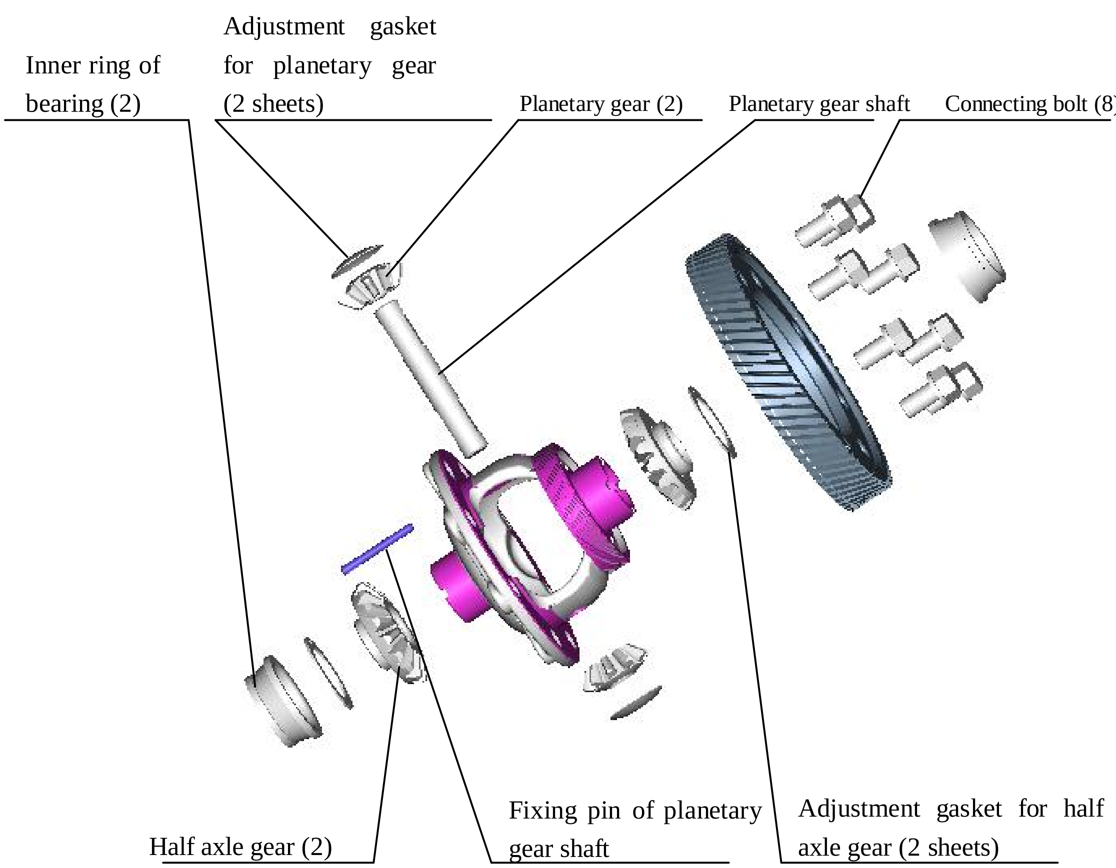


Figure 18

2. Assembly of clutch housing

Use a hammer and a special tool to fit oil seal of input shaft with spring side of the oil seal up and grease applied to lip of the oil seal. Use a special tool and a hamper to fit right side oil seal of differential with end surface of the oil seal flush with the housing surface, and then apply grease to lip of the oil seal. See Figure 19.

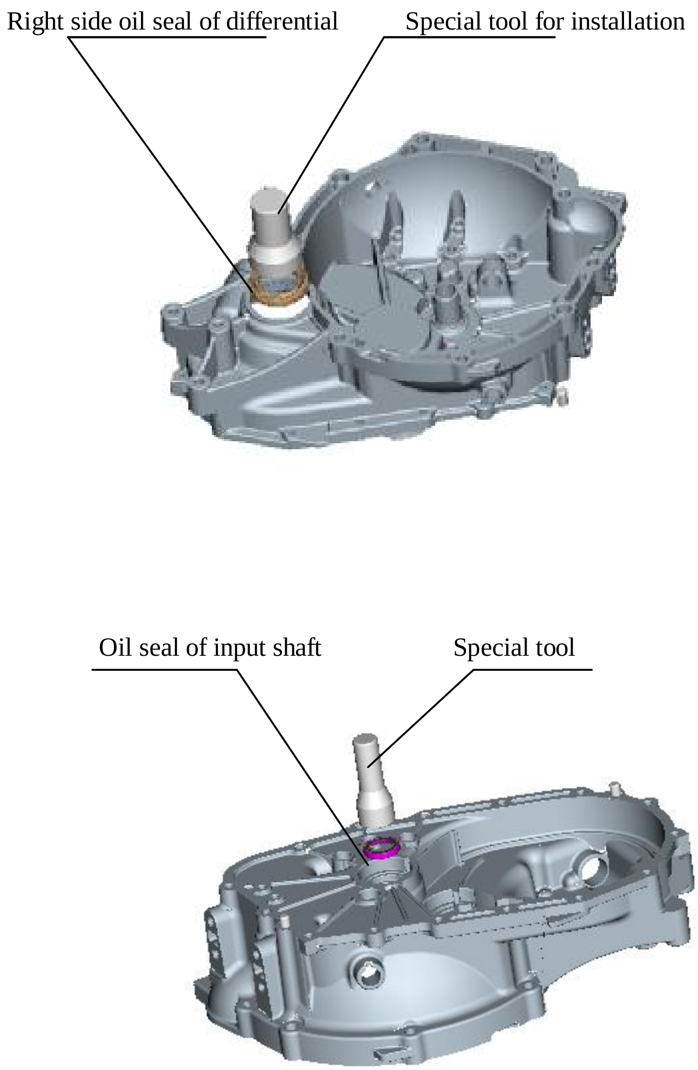


Figure 19

First, install the oil duct of output shaft to its designated position as shown in Figure 20 (note that the oil inlet and outlet of the oil duct should align with those on the housing), and then use a special tool to respectively install the outer rings of the front bearing of output shaft and the differential bearing.

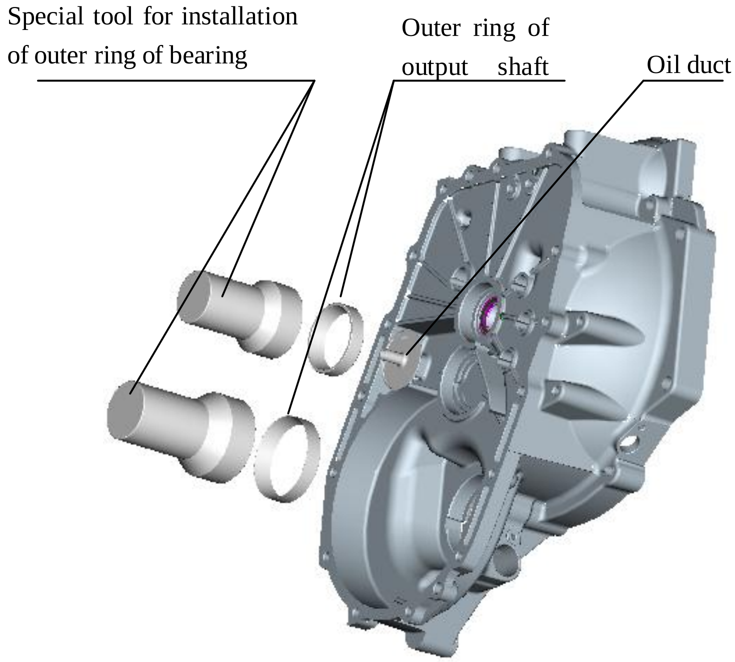


Figure 20

The tool for installation of oil seal can be used to install the three bushes. When installing the bushes, stagger the gap on the bush and that on the clutch housing (the two gaps can not coincide), as shown in Figure 21.

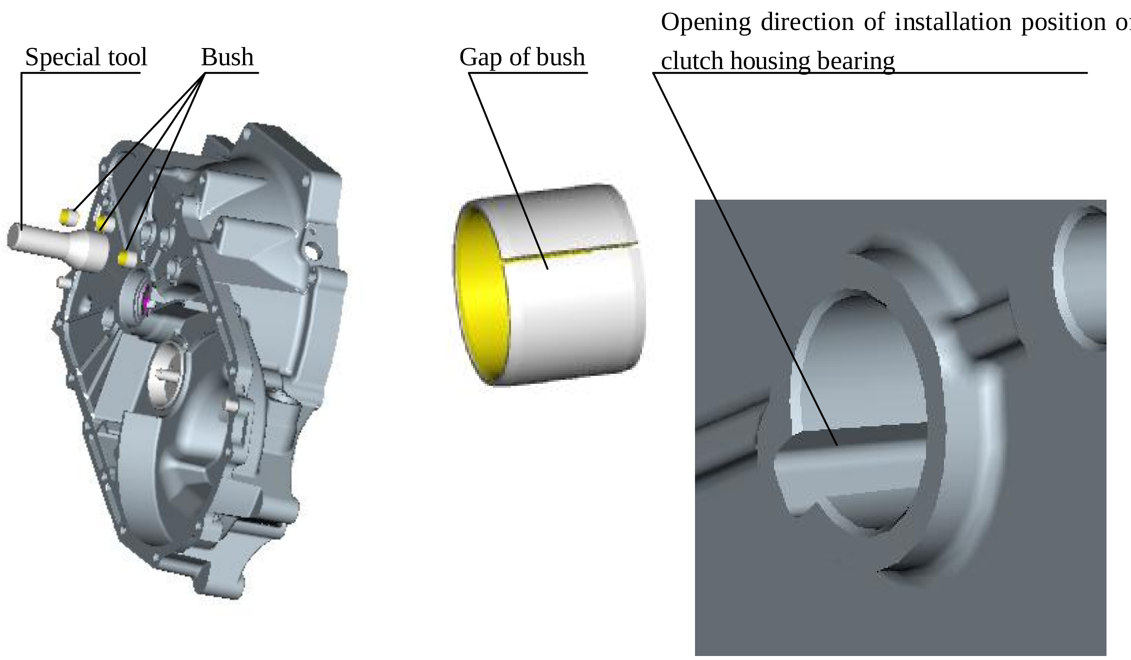
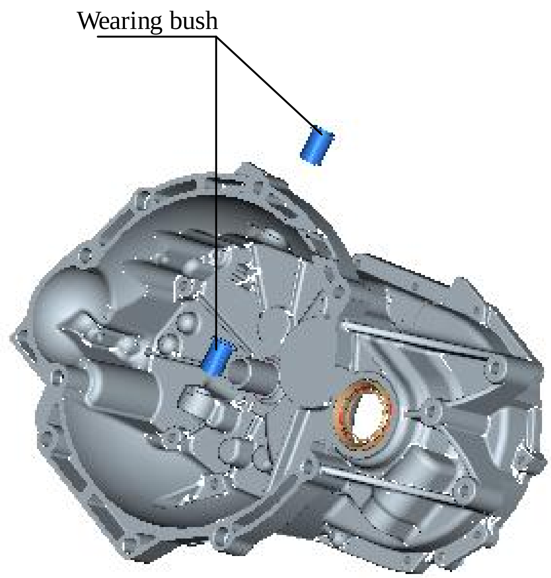


Figure 21



Now start to install release bearing assembly and release bearing as shown in Figure 22. First, install the two wearing bushes to their designated positions, and then put the release bearing through bush, release return torsion spring, release fork (release fork and release bearing should be assembled properly in advance, and then set the release bearing onto the housing) and bush in turn up to its designated position, finally, tighten the release arm bolts (with torque as **20±2Nm**). See Figure 23.

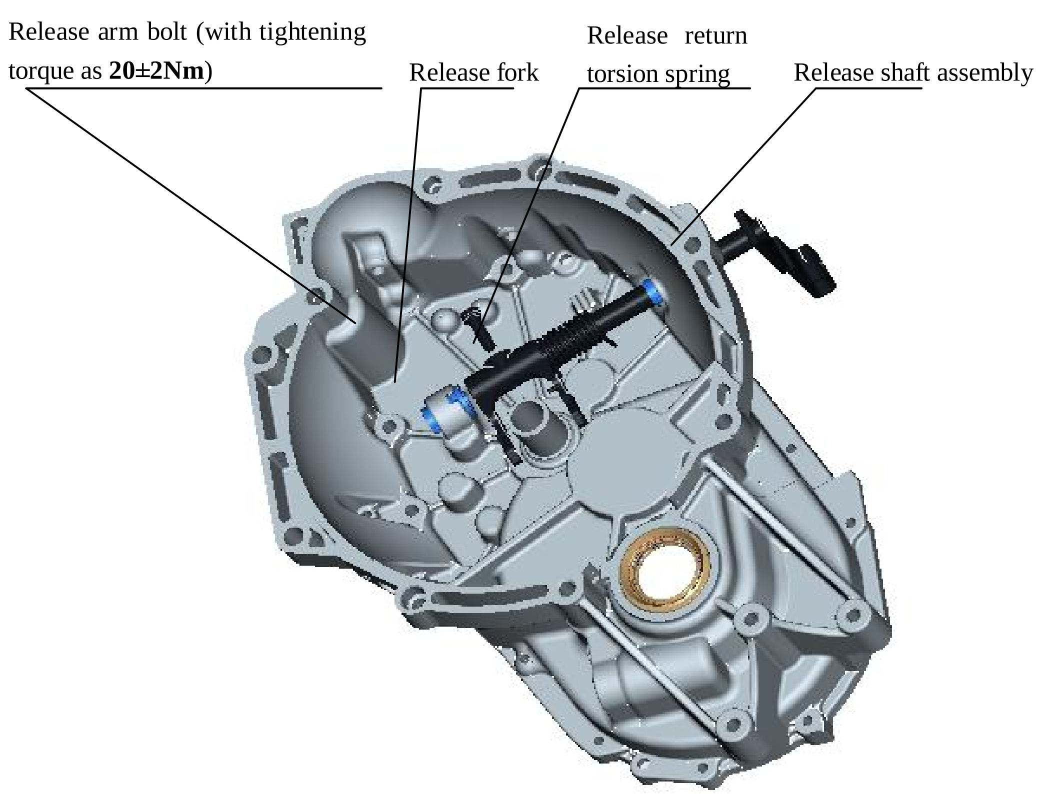


Figure 23

3. Assembly of transmission housing

First, use a special tool to fit oil seal of the differential to its designated position (when fitting the oil seal, care should be taken to prevent oil leak in the future, and replacement with new oil seal is recommended), and then respectively install oil drain channel, bush (**note:** the installation process for this bush is the same as that for the bush of clutch housing above), linear bearing etc. to their designated positions. See Figure 24.

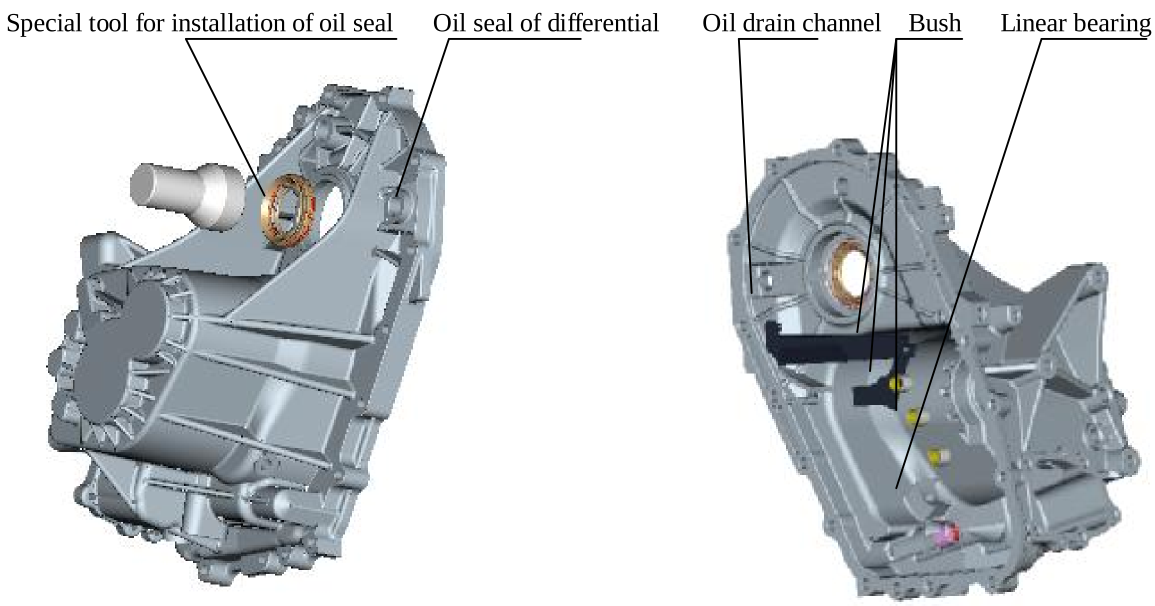


Figure 24

4. Assembly of gearshift mechanism assembly

Assembly of gearshift mechanism assembly is comparatively simple, which can refer to the disassembly process of the gearshift mechanism assembly. Remember to check the amount of parts to prevent neglected installation. Please refer to Figure 25 for tightening torque of the bolt.

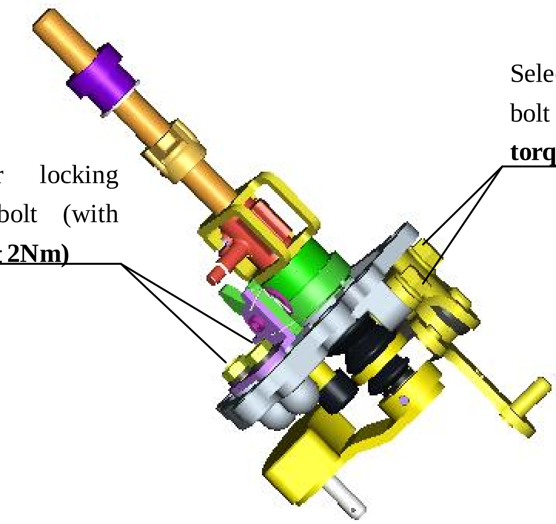


Figure 25

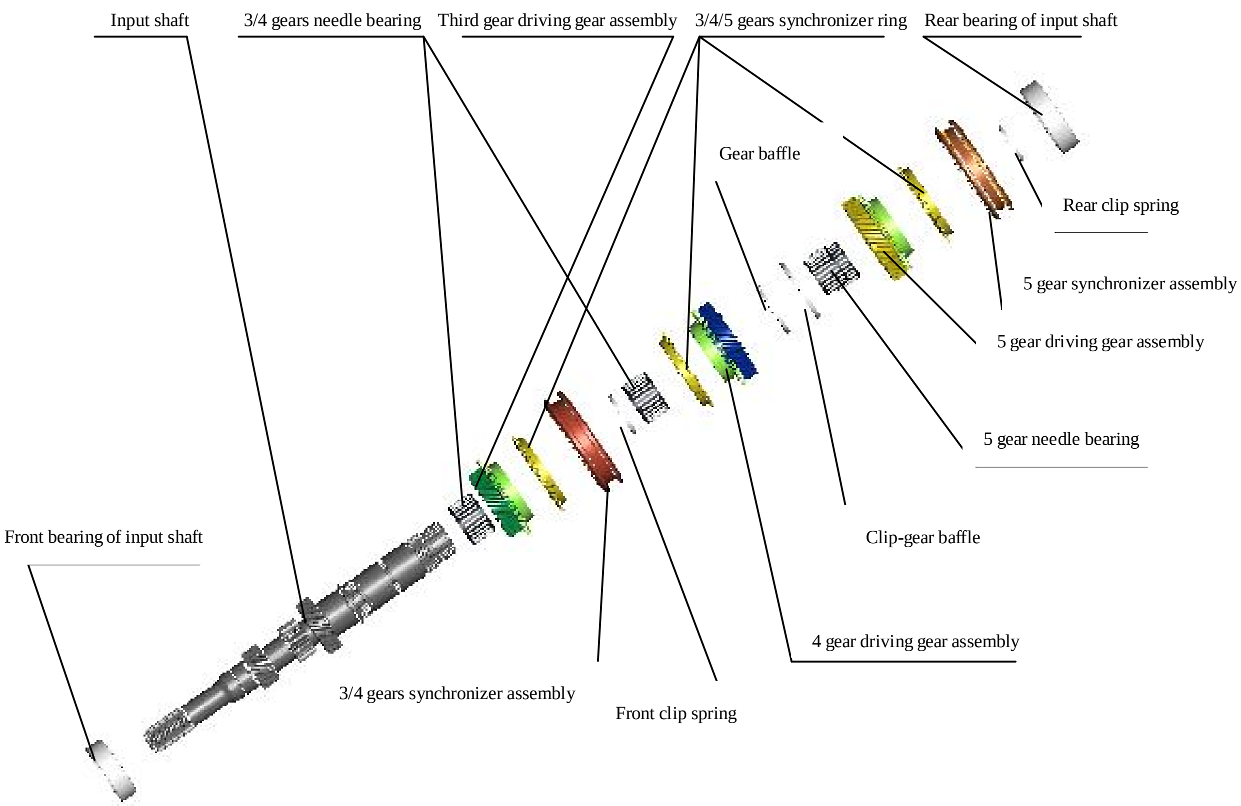
5. Assembly of gearshift fork assembly

Assembly of gearshift fork assembly is comparatively simple, which can be assembled with reference to the disassembly drawing.

6. Regulation and assembly of input shaft assembly

Place the input shaft with its end with clutch spline down, and then set the third gear needle bearing applied with the gear oil of the same designation as that used inside the transmission assembly onto the input shaft. Set the third gear driving gear assembly in from upside of input shaft with the end with synchronizer cone of the gear assembly up, and then check and make sure that the gear assembly can rotate freely. Set a 3/4/5 gears synchronizer ring in from upside of input shaft with conical surface of the synchronizer ring applied with the gear oil of the same designation as that used inside the transmission assembly, and then check and make sure that the synchronizer ring should envelop loosely on synchronizer cone of the third gear driving gear assembly and can rotate relative to the synchronizer cone. Press 3/4 gears synchronizer assembly onto the input shaft with the end surface of gear hub with two oil grooves down, turn the synchronizer ring to make its guide block completely enter the groove corresponding to the gear hub, and then make sure that the synchronizer ring is not locked. Fit front snap ring of input shaft; when fitting, try to use the thicker snap ring, if really unsuitable, select the snap ring of next thinner level, and then check if the snap ring has really enter the groove with the clearance between the snap ring and the groove not exceeding 0.05mm. Set a 3/4 gears needle bearing applied with the gear oil of the same designation as that used inside the transmission assembly onto the input shaft from upside of the input shaft. Set a 3/4/5 gears synchronizer ring applied with the gear oil of the same designation as that used inside the transmission assembly in from upside of the input shaft. Set the fourth gear driving gear assembly in from upside of input shaft with the end with synchronizer cone of the gear assembly down (the guide block of 3/4 gears synchronizer ring should completely enter the groove corresponding to the gear hub), and then make sure that the gear assembly can rotate freely. Set friction ball of gear, fender and clamp in from upside of input shaft, and then perform axial orientation for the fourth gear driving gear. Set fifth gear needle bearing applied with the gear oil of the same designation as that used inside the transmission assembly onto the input shaft from upside of the input shaft. Set fifth gear driving gear assembly in from upside of input shaft with the end with synchronizer cone of the gear assembly up, and then make sure that the gear assembly can rotate freely. Set a 3/4/5 gears synchronizer ring in from upside of input shaft with conical surface of the synchronizer ring applied with the gear oil of the same designation as that used inside the transmission assembly, and then check and make sure that the synchronizer ring should envelop loosely on synchronizer cone of the fifth gear driving gear assembly and can rotate relative to the synchronizer cone. Press fifth gear synchronizer assembly onto the input shaft with the end surface of gear hub with oil groove down, turn the synchronizer ring to make its guide block completely enter the groove corresponding to the gear hub, and then make sure that the synchronizer ring is not locked. Fit rear snap ring of input shaft; when fitting, try to use the thicker snap ring, if really unsuitable, select the snap ring of next thinner level, and then check if the snap ring has really enter the groove with the clearance between the snap ring and the groove not exceeding 0.07mm. Simultaneously press front and rear bearings of input shaft onto the input shaft with the side of front bearing of input shaft having word down and the side of rear bearing of input shaft having word up, and then check and make sure that the outer rings of the bearings can rotate freely. Refer to Figure 26.

Note: There are two friction balls between the bearing baffles (2 sheets). Be careful to install them in full.



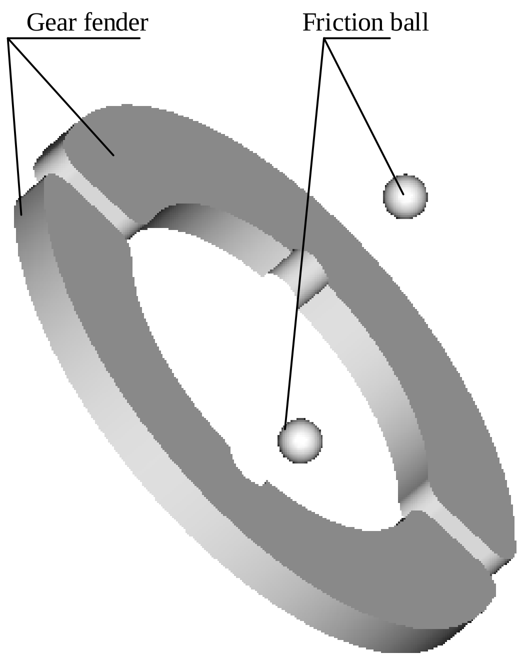


Figure26

7. Regulation and assembly of output shaft assembly

With the end of output shaft with driving gear of main decelerator down, set first gear needle bearing in onto output shaft from upside of the output shaft; before installation of the needle bearing, apply the gear oil of the same designation as that used inside the transmission assembly on it. Set first gear driven gear assembly in from upside of output shaft with the end with synchronizer cone of the gear assembly up, and then check if the gear assembly can rotate freely. Set a 1/2 gears synchronizer ring assembly in from upside of output shaft and the three finger jaws of balking ring of the synchronizer ring should completely enter the three corresponding grooves on the first gear driven gear assembly; before installation of the synchronizer ring assembly, apply the gear oil of the same designation as that used inside t Clamp-gear fender ıbly on three conical surfaces of the sync 3/4 gears synchronizer assembly that the synchronizer ring assembly envelops loosely on the synchronizer cone of the first gear driving and driven gears assembly and can turn a certain angle relative to the synchronizer cone. Press 1/2 gears synchronizer assembly onto the input shaft with the end of external gear of 1/2 gears hub sleeve wit the synchronizer ring to make its guide block completely enter the groove corresponc Front snap ring , and then make sure that the synchronizer ring is not locked. Fit front snap ring of output shaft; when fitting, try to use the thicker snap ring, if really unsuitable, select the snap ring of next thinner level, and then check if the snap ring has really enter the groove with the clearance between the snap ring and the groove not exceeding 0.05mm. Set a 1/2 gears synchronizer ring assembly in from upside of output shaft; before installation of the synchronizer ring assembly, apply the gear oil of the same designation as that used inside the transmission assembly on three conical surfaces of the synchronizer ring. Set a second gear needle bearing onto output shaft from upside of the output shaft; before installation of the needle bearing, apply the gear oil of the same designation as that used inside the transmission assembly on it. Set second gear driven gear assembly in from upside of output shaft with the end with synchronizer cone of the gear assembly down (the three grooves on the gear assembly should completely envelop the three corresponding finger jaws on 1/2 gears synchronizer cone), and then check and make sure that the gear assembly can rotate freely. Set the third gear driven gear in from upside of output shaft with the end with boss of the gear up, and then check and make sure that the 1/2 gears synchronizer ring assembly is not locked. Set 3/4 gears driven gear bush and then fourth gear driven gear in from upside of output shaft, with the end with boss of the gear down. Set fifth gear driven gear in from upside of output shaft with the end with boss of the gear up. When fitting, try to use the thicker snap ring, if really unsuitable, select the snap ring of next thinner level, and then check if the snap ring has really enter the groove with the clearance between the snap ring and the groove not exceeding 0.05mm. Simultaneously press inner rings of front and rear bearings of output onto the output shaft. See Figure 27.

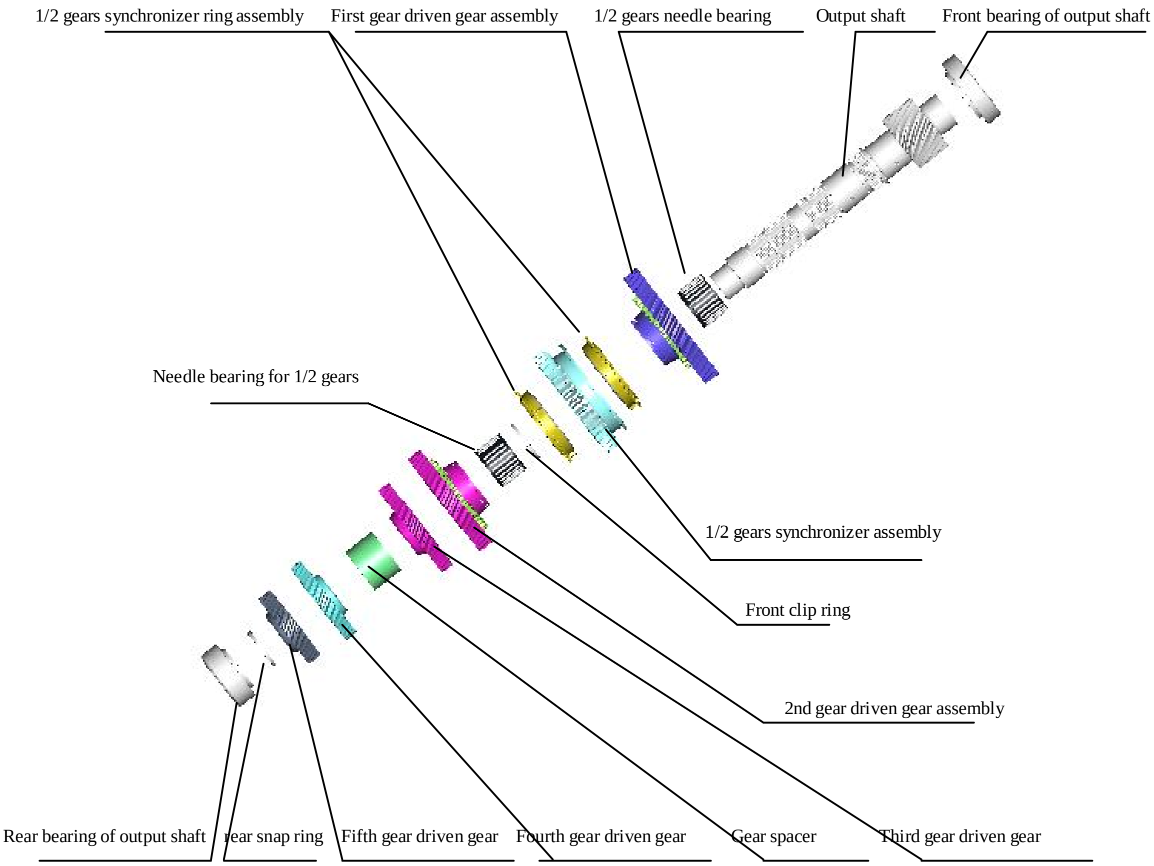


Figure 27

8. Assembly and regulation of transmission assembly

Place the clutch as shown in Figure 28 first, and then assemble the differential assembly to its designated position.

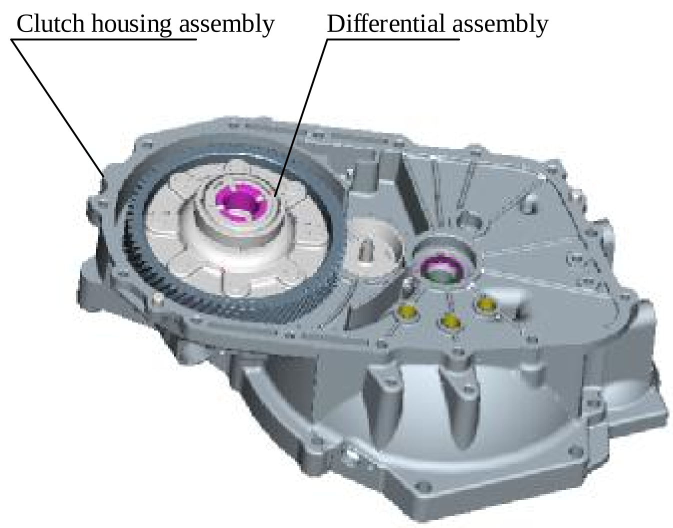


Figure 28

Assemble gearshift fork assembly, input shaft assembly and output shaft assembly together as shown in Figure 29, and then install them together onto clutch housing assembly. When assembling, wrap front end spline of input shaft with polyvinyl chloride adhesive tape to prevent damage to oil seal. After installation, turn each gear to ensure favorable engagement.

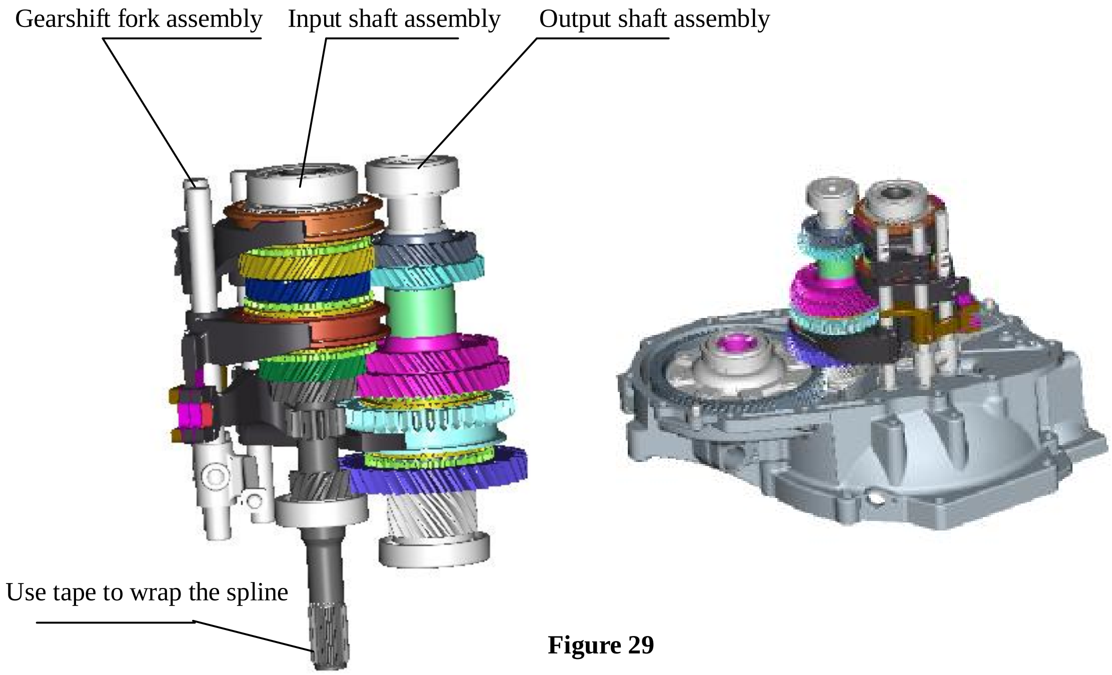
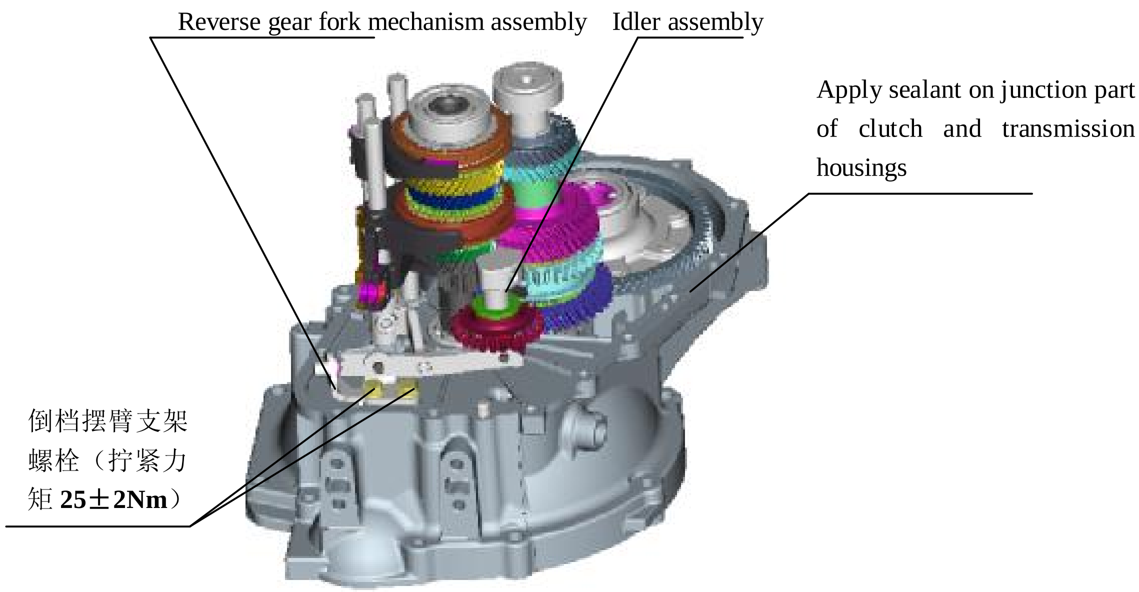


Figure 29

Install the assembled idler assembly (assembly of idler assembly is comparatively simple, please refer to its disassembly process) onto clutch housing, and then install reverse gear fork mechanism assembly with tightening torque of the two reverse gear rocker arm bracket bolts as **25±2Nm**. Clean the junction part of clutch and transmission housings and apply sealant (oil resistance silicone sealant, HZ1213Q/320222 YAP02-92) on it, and then install the magnet. See Figure 30.



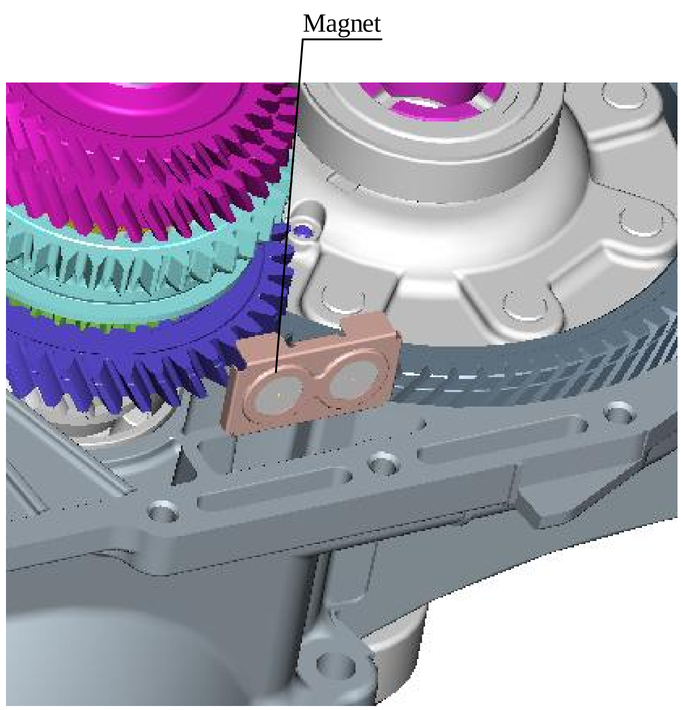


Figure 30

Assemble transmission housing and clutch housing together and then fasten them with connecting bolts. Before fastening, apply **thread locking glue (262 type anaerobic adhesive)** on the bolts properly. Tighten the diagonal bolts first as possible to ensure favorable fastening and sealing effects, and the tightening torque for the bolts are **25±2Nm**. **Note: the two connecting bolts at oil drain hole are a little longer than other connecting bolts, and the bracket should be installed first.** See Figure 31.

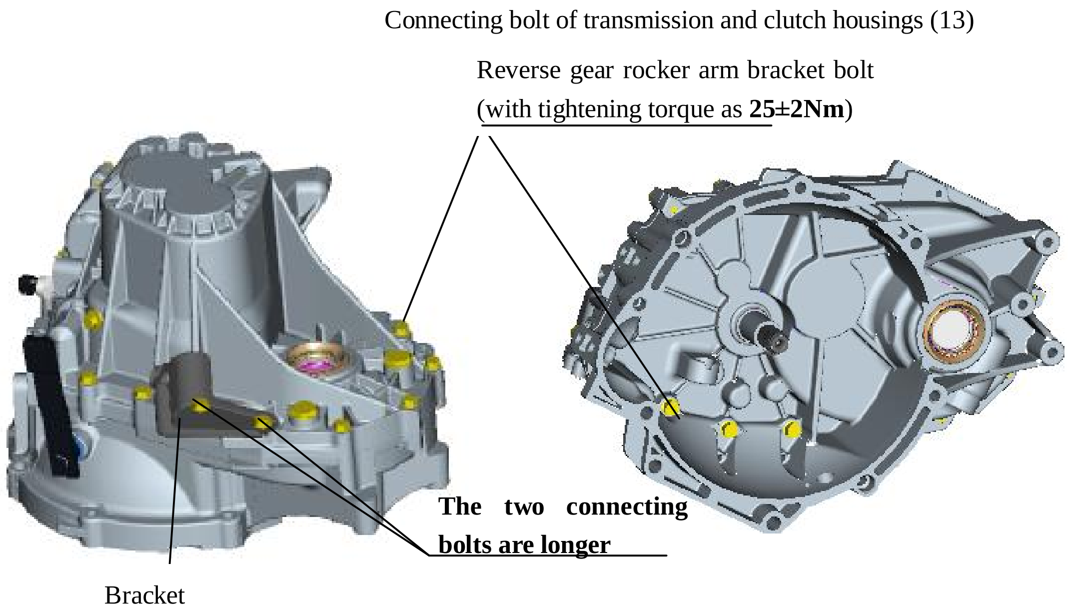


Figure 31

To install the assembled gearshift mechanism assembly onto the transmission, clean the junction part of gearshift housing and transmission housing and apply sealant on it (oil resistance silicone sealant, HZ1213Q/320222 YAP02-92), align one end of gearshift shaft with the linear bearing inside the transmission and align the locating hole on gearshift housing with the locating pin on transmission housing, and then tighten the connecting bolts of gearshift housing and transmission housing with the tightening torque as **25±2Nm**. See Figure 32.

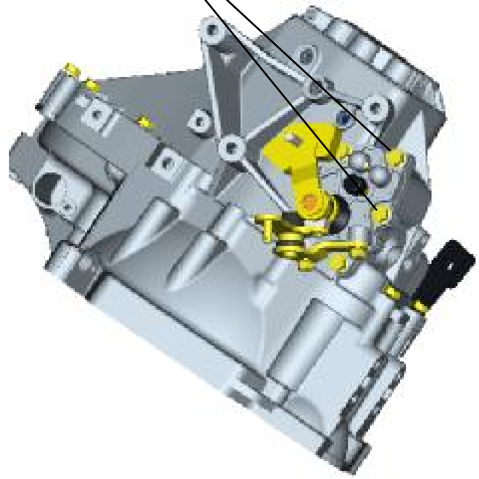


Figure 32

9. Disassembly of external accessories of transmission

Respectively install locating seats of 1/2 gears fork shaft and 3/4/5 gears fork shaft. Before installation, apply **thread fastening glue (262 type anaerobic adhesive)** on the thread, and the tightening torque for the bolts are **20±2Nm**. **Note: the locating seat of 1/2 gears fork shaft is longer than that of 3/4/5 gears fork shaft.** Then install locating seat of gearshift shaft, before installation, apply **thread fastening glue (262 type anaerobic adhesive)** on the thread, and the tightening torque for the bolts are **32±2.5Nm**; and install backup lamp switch assembly, before installation, apply **thread fastening glue (262 type anaerobic adhesive)** on the thread, and the tightening torque for the bolts are **20±2Nm.** See Figure 33**.**

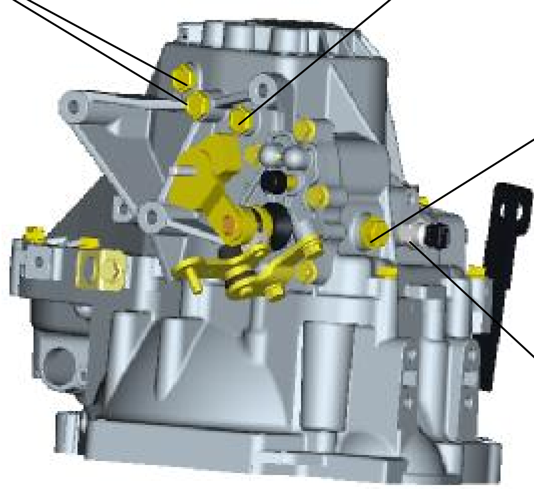


Figure 33

Follow by installation of screw of reverse gear idler shaft. Align the screw of reverse gear idler shaft with the threaded hole on the idler shaft, and then tighten it with the tightening torque as **38±2.5Nm**; after that, tighten bleeding plug with tightening torque as **44±3Nm**; finally, install oil limit plug onto the transmission, but do not tighten it then. See Figure 34.

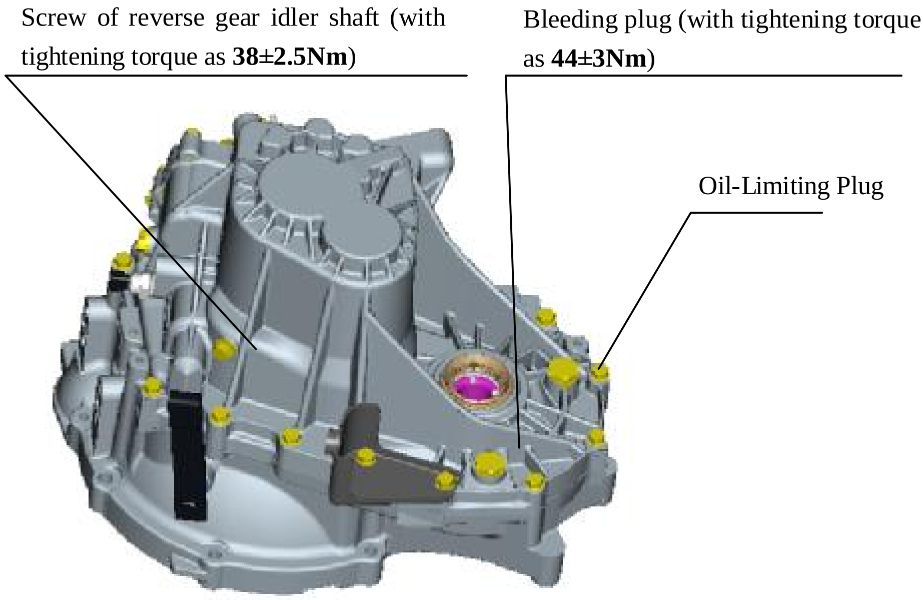


Figure 34

10. Refilling and volume regulation of transmission lubricant

After the transmission is installed onto the vehicle, park the vehicle on a flat road surface, then use the tool for refilling to refill transmission lubricant. The lubricant refilled should at least conform to API GL-4 SAE 75W-90 specification. Refill through installation hole of speed sensor as shown in Figure 35 with the refilling volume as 1.8L. after refilling, open the oil limit plug to regulate the lubricant to specified volume, and then tighten the oil limit plug with the tightening torque as **44±3Nm**.

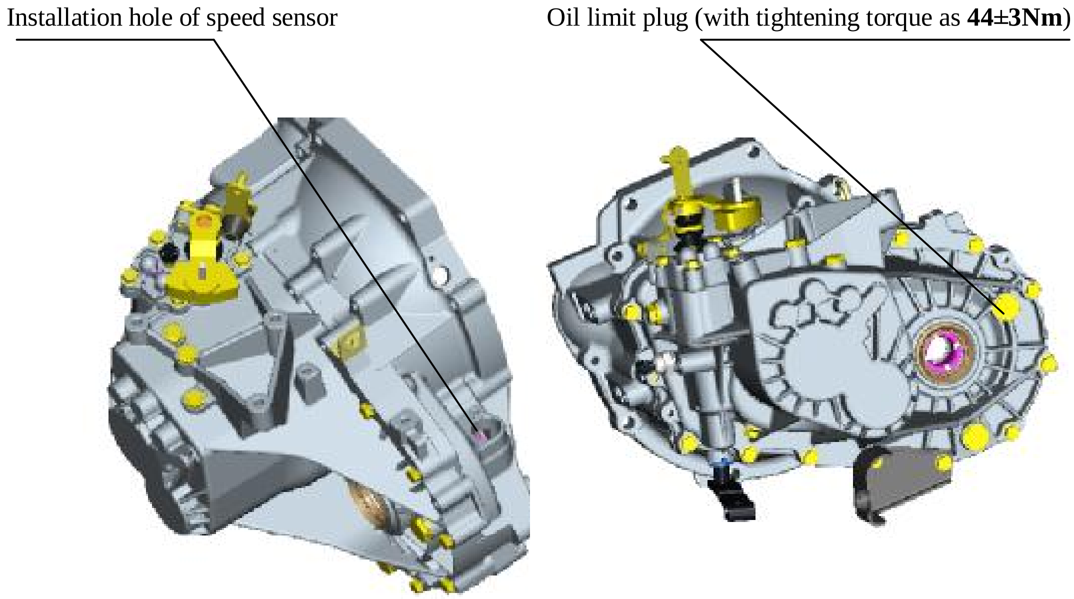


Figure 35

After the above steps, assembly and regulation to the transmission assembly are accomplished.

II. Tightening Torque Table for Fasteners

Position	Tightening torque (N.m)
Reverse gear rocker arm bracket bolt	25±2
Connecting bolts for clutch and transmission housings	25±2
Reverse gear idler shaft screw	38±2.5
Connecting bolts for gearshift and transmission housings	25±2
Gearshift shaft locating seat assembly	32±2.5
Reverse switch assembly	20±2
Fork shaft locating seats of gears	20±2
Bleeding\oil limit plug	44±3
Clutch release fork bolt	20±2
Clutch release arm bolt\nut	20±2
Selector Lever Bracket Bolt	25±2
Main decelerator driven gear bolt	130±5
Reverse gear lockup mechanism bolt	18±2

Chapter Four General Failures and Troubleshooting

Failure status	Possible reason	Troubleshooting
Excessive or abnormal noise	Damaged input or/and output shaft bearing(s)	Replace the bearing
	Gear tooth faces damaged due to knocking, burr or pit corrosion existing, or poor contact between them.	Repair or replace the gear
	Incorrect gear shaft position and clearance	Check and adjust
	Low oil level, insufficient lubrication	Fill oil to the specified level
	Foreign matter(s) existing in the assembly	Check and remove
Oil leakage	Excessively worn or damaged oil seal(s)	Replace
	Uneven sealant smearing or damaged seal gasket(s)	Replace the seal gasket(s) or sealant
	Failure to timely recondition junction surface(s) damage due to knocking	Check and repair
	Damaged differential bearing	Replace
Difficult to implement gear shift	Improper clutch adjustment and incomplete release.	Adjustment
	Improper gearshift transmission system adjustment or movement obstruction occurring	Check and adjust
	Synchronizer ring(s) fails to work	Replace
Gear jump	Worn synchronizer gear sleeve(s) or tooth cone surface(s) of gear junction	Replace related components
	Improper gearshift transmission system adjustment	Check and adjust
No gear	Loose gearshift transmission system	Overhauling
	Loose gearshift arm of transmission	Repair
Abnormally damaged bearing(s)	Metal impurities contained in transmission oil	Replace
	Insufficient lubrication or unqualified transmission oil	Replace
	Using of unqualified bearing(s)	Replace

Service Manual for Chery

(UMC EFI for 473F Engine)

After Sales Service Department of Chery
Automobile Sales Co., Ltd.

CONTENTS

Chapter One Disassembly and Installation of Electronic Fuel Injection System

I. Disassembly and Installation of Components of Electronic Fuel Injection System

1. Disassembly and installation of engine control unit (ECU).

2. Position and disassembly of intake air pressure sensor.

3. Position and disassembly of camshaft position sensor.

4. Remove fixing hoop of intake hose.

5. Remove the four fixing bolts of electronic throttle body.
Pull out the connector and take out the electronic throttle body.

6. Use a screwdriver to press down the fixed clip of the injection nozzle connector and then pull out the connector.

7. Use a screwdriver to press down the fixed clip of the knock sensor connector and then pull out the connector.

8. The water temperature sensor is behind the thermostat seat.

9. Pull out the connector of the ignition primary coil by hand.

10. Pull out the connector of the engine tachogenerator by hand.

Chapter Two Principle of Electronic Fuel Injection System

I. Overhaul of System Components

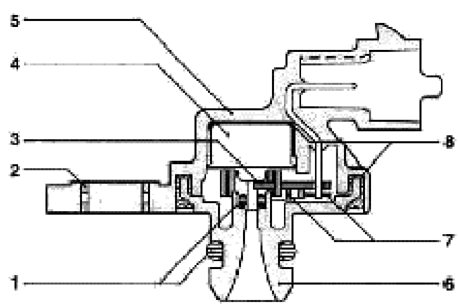
1. Intake Air Temperature Pressure Sensor

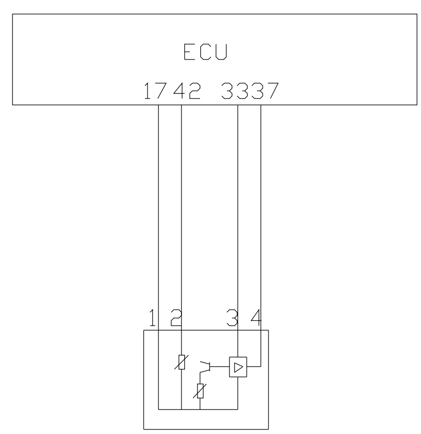
1.1 Function of the sensor:

Detect air intake pressure and temperature in air intake manifold, which will be provided to ECU as main load signal of engine; ECU will calculate injection pulse-width based on this signal.

1.2 Principle of the sensor:

Intake air temperature pressure sensor is a sensor that integrates an intake air pressure sensor and an intake air temperature sensor. Absolute pressure sensor element of intake manifold is composed of a silicon chip. A pressure diaphragm is etched on the silicon chip. On the pressure diaphragm, there are 4 piezo-resistances, which serve as strain sensors and constitute a Wheatstone bridge. In addition to this pressure diaphragm, a signal processing circuit is also integrated on the silicon chip. The silicon chip and a metal housing constitute a closed reference, where the absolute pressure of the gas inside approaches to zero. Thus, a micro-electronic mechanical system is formed. The active face of the silicon chip stands a pressure close to zero, while its back face stands the pending measuring intake manifold absolute pressure introduced by a connecting pipe. The thickness of the silicon chip is merely several μm, so the absolute pressure change in intake manifold will bring mechanical deformation to the silicon chip. The 4 piezo-resistances will accordingly deform and their resistances also change. The voltage signal in linear relation to the pressure is formed after process by the signal processing circuit on the silicon chip. The intake temperature sensor element is a negative temperature coefficient (NTC) resistance, which will change with the intake temperature. This sensor sends out a voltage indicating the intake temperature change to the controller.





Intake air temperature pressure sensor

Cross-section view for sensor of air absolute pressure and temperature in intake manifold

1 Gasket 2 Stainless Steel Sleeve 3 PCB Board 4 Sensing Element 5 Housing 6 Pressure Bracket 7 Soldering 8 Bonded With Bonding Agent

1.3 Parameters of technical features

This sensor is designed to be mounted on the plane of auto engine intake manifold. The pressure connecting pipe together with the temperature sensor protrudes inside the intake manifold and an O gasket is used to enable atmosphere-proof.

If it is mounted on an auto through an appropriate method (picks up pressure from the intake manifold and the pressure connecting pipe tilts down etc.), it can be ensured that no condensed water will be formed on the pressure-sensitive element.

Drilling and fixing on the intake manifold must be carried out according to the supply drawing so as to ensure a long seal and a good tolerance to fretting by agent.

The reliable contact of electric connection of a joint will mainly be affected by the joints of components and parts, and it is also in relation to the material quality and dimensional precision of the joint fitted with it on the harness.

1.4 Failure effects and judgment method

- Failure effects: spark extinction and poor idling etc.
- General Failure Reason:

  1. Abnormal high voltage or inverse strong current occur during working;

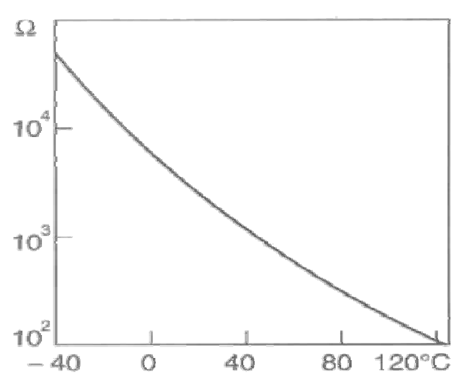
  2. The vacuum element is damaged during maintenance.
- Maintenance precautions: during maintenance, impinge using high pressure gas toward the vacuum element is prohibited; when replacing the sensor after a failure is found, remember to check if output voltage and current of the generator is normal.
- Simple measurement method:

1.4.1 Temperature sensor:

With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to 1# and 2# pins of the sensor; At 20℃, the rated resistance should be 2.5 kΩ±5%, and the other corresponding resistances can be measured out from the characteristic curve in above chart. Analogue method can also be used when measuring, i.e., use an electric drier to blow the sensor (be careful not to be too close to the sensor), and then observe the change of the sensor resistance. At this point, the sensor resistance should fall.

1.4.2 Pressure sensor:

With the joint connected, turn the digital multimeter to DC Voltage shift, and then connect the black pen to ground while the red pen respectively to 3# and 4# pins. Under idle speed state, 3# pin should have a 5V reference voltage while the voltage on 4# pin should be around 1.3V (the actual value depends on the model); Under no load state, when opening the throttle slowly, the voltage on 4# pin may change little; when opening the throttle rapidly, the voltage on 4# pin may reach around 4V instantly (the actual value depends on the model) and then fall to around 1.5V (the actual value depends on the model).



2. Tachogenerator of Engine

2.1 Function of the sensor:

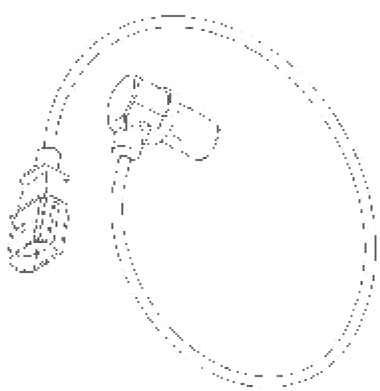
As one of the uppermost sensors of engine, the tachogenerator of engine provides ECU with rev signal, acceleration signal and crank angle signal etc. of engine. ECU will calculate injection pulse-width, injection time and ignition timing through these signals and provide the instruments with rev signal of engine.

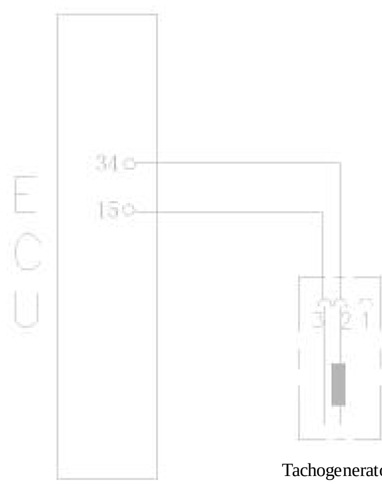
2.2 Principle of the sensor:

The inductive tachogenerator work together with pulse disc, it is used in ignition system without distributor providing engine speed and crank shaft top dead center information.

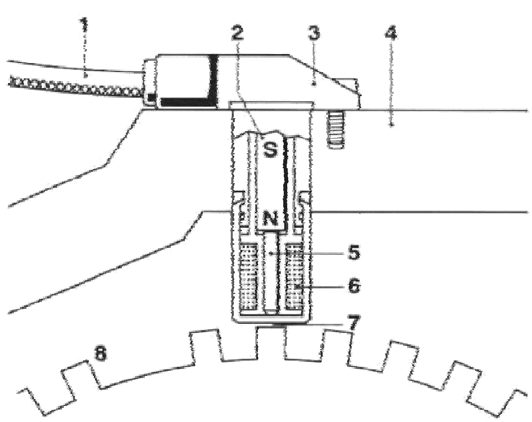
Inductive tachogenerator is made up of a permanent magnet and coil outside of magnet.

Pulse disc is a tooth disc with 60 teeth originally but there are two teeth opening. Pulse disc is assembled on crank shaft and rotate with crankshaft. When the tooth tip passes through closely the end of the inductive engine tachogenerator, the pulse disc made of the ferromagnetic material will cut the line of magnetic force of the permanent magnet in the inductive engine tachogenerator to generate inductive voltage in the coil as engine speed signal output.





Tachogenerator



1. Shielded wire	2. Permanent magnet
3. Housing of sensor	4. Installation bracket
5. Soft magnet core	6. Coil
7. Air gap	8. 60-2 gear ring

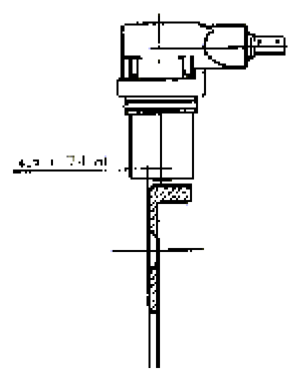
2.3 Parameters of technical features

Item	Value			Unit
	Min.	Typical	Max.	
Resistance under a room temperature of 20 ℃	774	860	946	**W**
Inductance	310	370	430	mH
Output voltage at a crankshaft revolution of 416rpm	>1650			mV

2.4 Installation attentions:

- For the inductive tachogenerator, it is permitted to take out from its pack before it is assembled to the auto or testing device right away.
- Inductive tachogenerator is assembled by press in method but not hammer tapping.
- Partly micro-encapsulated bolt M6´12 for fixing of the inductive engine tachogenerator is recommended.
- The tightening torque is 8±2Nm.
- Gas clearance between inductive tachogenerator and pulse disc tip is **0.8-1.2mm**.

Dimension d (see the figure below): 4.7mm.



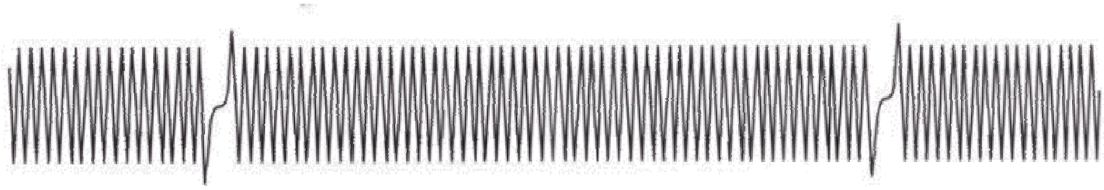
Installation of the tachogenerator

2.5 Failure effects and judgment method:

- Failure effects: start failure etc.
- General cause of the failure: man induced failure.
- Maintenance precautions: during maintenance, the tachogenerator should be installed by using press-in method instead of hammering method.
- Simple measurement method:

1. With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to 2# and 3# pins; At 20℃, the rated resistance should be 860Ω±10%.

2. With the joint connected, turn the digital multimeter to AC Voltage shift, and then connect the two meter pens respectively to 2# and 3# pins of the sensor; start the engine and voltage output should be present at this point. (Inspection with vehicle oscilloscope is recommended).



Oscillogram in Test

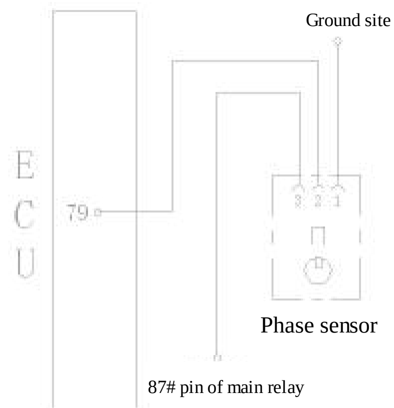
3. Phase Sensor

3.1 Function of the sensor:

Provide ECU with phase signal, i.e. help crankshaft position sensor of engine to judge it is then at compressing top dead center or air exhaust top dead center.

3.2 Principle of the sensor:

The phase sensor is consisted of the Hall generator installed on the valve cover and the signal wheel machined on the intake camshaft. When the camshaft rotates, the signal wheel will make the magnetic flux passing the Hall generator change, thus generating a variable Hall signal.



3.3 Effects and judgment method:

- Failure effects: over proof emission and fuel consumption rise etc.
- General cause of the failure: man induced failure.
- Simple measurement method:

(connect the joint) switch on ignition switch but do not start the engine; put digital multimeter on DC volt shift, connect two meter pen to No. 1 and No. 3 sensor connectors and make sure there is 12V reference voltage. Start the engine, check if it is in good conditions of No.2 pin by oscillograph on vehicle.

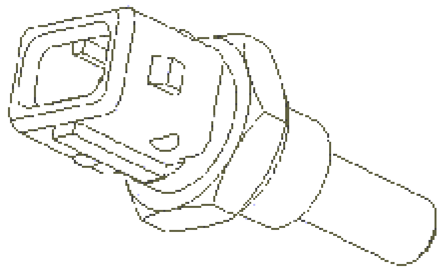
4. Water Temperature Sensor

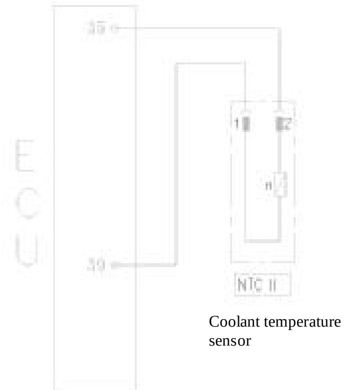
4.1 Function of the sensor:

The water temperature sensor simultaneously provides ECU and instruments with water temperature signal. ECU will calculate and regulate injection pulse-width and ignition advance angle through water temperature signal. In addition, through water temperature signal, ECU also can control turn-on and turn-off of cooling fan to prevent engine from damage caused by overheat.

4.2 Principle of the sensor:

The water temperature sensor is a minus temperature coefficient type electric resistance model sensor; the higher the temperature is, the less the resistance will be. But, temperature rise and resistance fall are not in linear relation.





4.3 Parameters of technical features

(1) Data limit

Item	Value	Unit
Rated voltage	Can only be run by ECU	
Rated resistance at 20℃	2.5±5%	kΩ
Range of running temperature	-30 to +130	℃
Max. measuring current passing the sensor	1	mA
Permissible vibration acceleration	600	m/s^2

4.4 Installation attentions

Coolant temperature sensor is installed on the cylinder body and the copper heat conducted socket is inserted into coolant. There are thread on the socket, and screw in coolant temperature sensor onto the threaded hole on cylinder block by the hexagon head of the socket. The maximum permissible tightening torque is 15Nm.

4.5 Failure effects and judgment method

- Failure effects: starting difficulties etc.
- General cause of the failure: man induced failure.
- Simple measurement method:

With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to 1# and 2# pins of the sensor; At 20℃, the rated resistance should be 2.5kΩ±5% and the others can be measured out from the characteristic curve in above chart. Analogue method can also be used when measuring, i.e., dip the working area of the sensor in boiled water (dip for adequate time), observe the resistance change of the sensor, at this point, the resistance should fall to 300Ω-400Ω(the actual value depends on the temperature of the boiled water).

5. Knock Sensor

5.1 Function of the sensor:

The knock sensor provides ECU with knock signal. When the engine generates knock, ECU will control to gradually reduce ignition advance angle to eliminate the knock; when no knock occurs during certain strokes, ECU will gradually increase ignition advance angle to enable the engine to obtain max. torque.

5.2 Principle of the sensor:

Knock sensor is a kind of vibrating acceleration sensor and is assembled on cylinder block. Either single or multiple can be installed. The sense organ of the sensor is a piezoelectric element. The vibration of cylinder block is transferred to piezoelectric crystal by mass block inside of sensor. The piezoelectricity crystalloid gets pressure from mass block vibration, producing voltage on two polar and transferring vibration signals to voltage signal and output it. See the following frequency response characteristic curve. Because the frequency of knock vibration signal is much higher than the normal engine vibration signal, the ECU can separate the signal into knock signal and non-knock signal.

5.3 Attentions

Knock sensor has a hole in the middle, through which it is fastened on the cylinder by a M8 bolt. For the aluminum alloy block, using long bolt with 30 mm; for the casting iron, using 25mm bolt. The tightening torque is 20±5Nm. The installation position should ensure that the sensor is liable to receive vibration signals from all cylinders. Decide the optimal installation position of knock sensor through modal analysis to the engine body. Generally, for a 4-cylinder engine, the knock sensor is installed between 2# cylinder and 3# cylinder; for a 3-cylinder engine, it is installed at the center of 2# cylinder. Do not let liquid such as engine oil, coolant, brake fluid and water etc. contact the sensor long. Use of gasket of any type is not allowed in installation. The sensor must cling to the cylinder tightly through its metal surface. During wiring of sensor signal cables, do not make the signal cables resonate; otherwise, they may break. Be sure to prevent turning on of high voltage between 1# and 2# pins of the sensor; otherwise, damage to the piezoelectric element may occur.

5.4 Effects and judgment method

Failure effects: poor acceleration etc.

- Reasons for general failures: long time contact of liquid such as engine oil, coolant, brake fluid and water etc. with the sensor, which may corrode the sensor.
- Maintenance precautions: (see installation attentions)
- Simple measurement method: (remove the joint) put digital multimeter at ohm shift, and contact the No. 1, No. 2 and No. 3 pin with its two meter pens. The resistance value should be more than 1MΩ¸ under normal temperature. Leave the digital multimeter at millivolt shift, and tap around the sensor using little hammer, there should be voltage signal output.

6. Electric Throttle Body

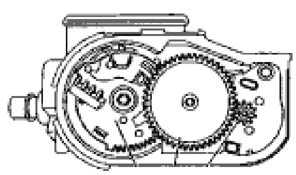
6.1 Function:

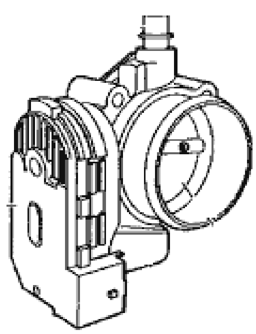
The electronic throttle body can automatically open or close the throttle according to the driver’s will to apply the accelerator pedal to let the engine work under the corresponding operating mode. The electronic throttle has cancelled the conventional throttle guy and the opening of throttle is controlled by ECU based on the signal from accelerator pedal and other signals (such as A/C, power assisted steering, back and gearshift etc.) through an electronic step motor inside the electronic throttle body. In addition to cancel of conventional idle speed by-pass and idle speed step motor, there are also throttle position sensors on the electronic throttle body to feed back the opening of the throttle. This suite of throttle position sensor is different from the common one; totally two suites of throttle position sensors are installed inside the electronic throttle body to monitor rationality of the signals from the latter; when any problem occurs in a certain signal, ECU can still use the other suite of signals to work on.

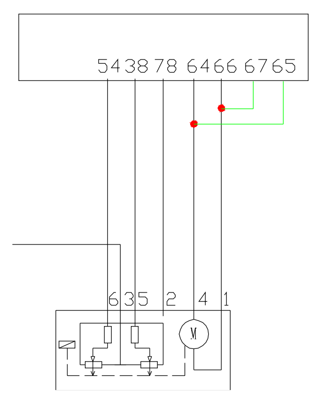
6.2 Working principle:

The throttle driving motor is a micro motor, which is composed of multi steel stators in a circle and a rotor, with one coil on each steel stator. The rotor is a permanent magnet with a nut at its center. All stators coils are constantly power on. As long as the direction of current of one coil is changed, the rotor will turn a certain angle. When the directions of current of all stator coils is changed in a proper order, a rotating magnetic field is formed, which will drive the rotor made from permanent magnet rotate along a certain direction. Its principle is just that of a micro direct current motor.

This motor drives a suite of special gear reducing mechanism and a bidirectional spring; when the system is under power off condition, this mechanism can ensure that the opening of throttle valve plate maintains at a safe position where is bigger than that for idle speed but not too high, so that the vehicle can continue to run; if engine ECU has entered this failure mode, when applying the accelerator pedal, the valve plate of the electronic throttle body will no longer act.







Electronic throttle

6.3 Failure diagnosis:

ECU can monitor short-circuit and break of coil of the throttle driving motor, and light the engine failure light in case of such failure to let the engine enter failure mode, when the engine fails to accelerate, has very poor driving performance and needs maintenance immediately.

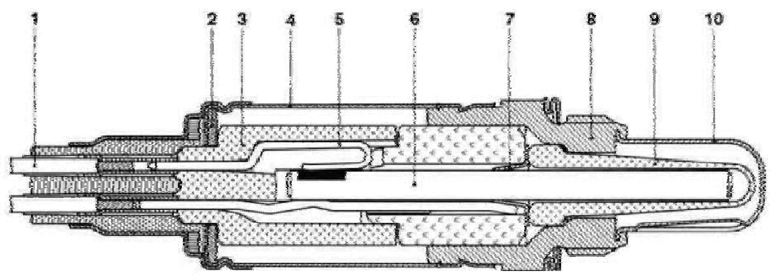
7. Oxygen Sensor

7.1 Function of the sensor:

Oxygen sensor is one of the principal sensors on modern autos; it can feed back the mixture strength by detecting oxygen content in exhaust gas. ECU will correct the mixed gas based on the signals fed back by the oxygen sensor, i.e. control injection pulse-width to let the mixed gas always maintain an approximately ideal air-fuel ratio (14.7:1).

7.2 Principle of the sensor:

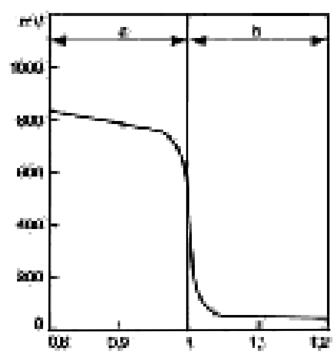
Sensing element of oxygen sensor is a kind of ceramic tube with holes, and outside of tube walls are surrounded by engine exhaust gas and inside is air. Ceramic sensor element is a kind of solid state electrolyte with electrical heating tube inside (as shown in the figure).



Cross-section view of oxygen sensor

1. Cable   2. Dish washer   3. Insulation bush   4. Protective bush
5. Clamp fitting of heating element   6. Heating rod   7. Contact pad
8. Sensor seat   9. Ceramic probe   10. Protection sleeve

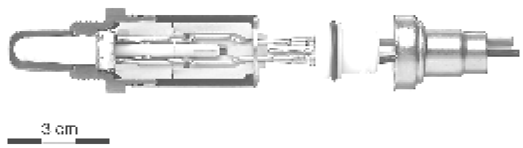
Output voltage V

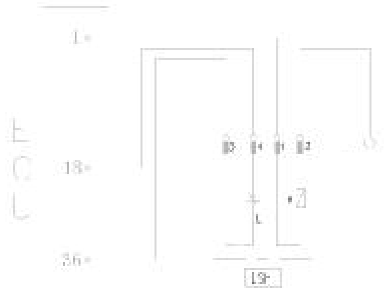


Excessive air-fuel ratio λ

Characteristic Curve of oxygen sensor at 600 ℃

The operation of the oxygen sensor is achieved by converting the concentration difference of oxygen ion between inside and outside of the ceramic sensor element to the voltage signal output. It bears the characteristic of solid electrolyte once the temperature of the ceramic sensor element reaches 350℃. Because of the particularity of its materials, the oxygen ion can pass the ceramic sensor element freely. Taking advantage of this characteristic, the concentration difference will be converted to electric potential difference to form electric signal output. If the mixed gas is comparatively thick, the oxygen ion thickness difference between inside and outside of the ceramic tube will be higher and the potential difference will also be higher, then a mass of oxygen ion will move from inside to outside, so, the output voltage is comparatively high (close to 800mV-1000mV); If the mixed gas is comparatively thin, the oxygen ion thickness difference between inside and outside of the ceramic tube will be smaller and the potential difference will also be smaller, then just a few of oxygen ion will move from inside to outside, so, the output voltage is comparatively low (close to 100mV). The signal voltage will mutate near theoretical equivalent air-fuel ratio ($\lambda=1$), see the figure above.





Every oxygen sensor bears a cable and the other end of the cable is the wire connector. The wire connector of oxygen sensor produced by our company has four pins:

No.1 connects to the positive pole of heater power supply (white);
No.2 connects to the negative pole of heater power supply (white);
No.3 connects to signal negative pole (gray);
No.4 connects to signal positive (black).

7.3 Parameters of technical features

- The requirement to exhaust pipe: the segment of exhaust pipe in the area before the oxygen sensor must be heated up rapidly. If possible, the exhaust pipe should be designed to be tilting down to avoid accumulation of condensed water in front of the oxygen sensor.
- Do not inappropriately heat up the metal snap ring of the cable at oxygen sensor side, especially after the engine is shut down.
- Do not apply purge fluid, oiliness fluid or volatile solid on connector of the oxygen sensor.
- The screw thread of the oxygen sensor is M18 ´1.5.
- The size of the hexagonal head wrench for the oxygen sensor is 22-0.33.

The tightening torque for the oxygen sensor is 40-60Nm.

7.4 Failure effects and judgment method

- Failure effects: poor idling, poor acceleration, over proof tail gas and excessive fuel consumption etc.
- General causes of the failure:

1. Moisture entering inside of sensor, and when the temperature is changed, the pin will be broken;

2. The oxygen sensor “intoxicates”. (Pb, S, Br, Si)

Maintenance precautions: application of cleaning fluid, oiliness fluid or volatile solid on the oxygen sensor during maintenance is prohibited.

- Simple measurement method:

1. Remove joint, put digital multimeter to ohm shift, connect meter pen to No.1 (white) and No.2 (white) pins of the sensor. The resistance value is 1~6W at constant temperature.

2. With the joint connected, under idle speed state, when the working temperature of the oxygen sensor reaches 350℃, turn the digital multimeter to DC Voltage shift and connect the two meter pens respectively to 3# (gray) and 4# (black) pins; at this point, the voltage should fluctuate rapidly between 0.1-0.9V.

8. Fuel Pump Assembly

8.1 Function of fuel pump:

Fuel pump is used to deliver the fuel in the fuel tank to inside the engine at a certain pressure for combustion. It also needs to regulate the fuel pressure duly as required by system pressure (non fuel return type). Generally, the system fuel pressure provided by fuel pump is around 3.5-4bar.

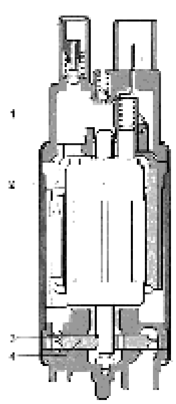
8.2 Operating principle of fuel pump:

The electrical fuel pump is comprised of the DC motor, vane pump and end cover (integrates check valve, relief valve and anti-electromagnetic interference element) as shown in following figure.

The pump and the motor are installed on the same shaft within same closed housing. The pump and electromotor are full of gasoline for coolant and greasing inside of the casing. The accumulator provide power to electric fuel pump via fuel pump relay, and the relay switches on electric fuel pump only when engine starting and running. When the engine stops for some reason, the pump will stop to run by itself.

The max pressure at the outlet of the electrical fuel pump shall be between 450 and 650 kPa, depending on the relief valve. Because the system is a non fuel return system, the pressure of the whole fuel system will be controlled by the fuel pressure regulator. The value is 400KPa in general.

The electric fuel pump has different flow to the engine's request. In order to facilitate the production, the electromotor revolutions of EKP13 series electric fuel pumps of the same structure are adjusted by changing the coil's number of turns, and thus the flow is adjusted. Therefore, do not apply an electric fuel pump for one model to another at will.



Cross-section view of electric fuel pump

8.3 Parameters of technical features

Under certain fuel supply pressure, the flow of the electric fuel pump is in direct proportion to voltage. The fuel pumps used by complete vehicle manufacturers are different.

8.4 Installation attentions

EKP13 series electric fuel pump can only be used inside fuel tank. When installing the fuel pump, the filter net at fuel inlet with mesh size not bigger than 60**m**or arranged with the customer must be installed. Be careful not to let the fuel jet from air vent spray on the filter net at fuel inlet, fuel pump bracket or fuel tank wall. Be careful when carrying the fuel pump. First, be sure to protect the filter net at fuel inlet from load and impact. The fuel pump should be taken out of the plastic wrapping material with care only when installing. The viser can be taken off only when the fuel pump is to be installed. Takeoff of the filter net at fuel inlet is absolutely not allowed. The foreign material that enters the fuel inlet of the fuel pump or the filter net may lead to damage of the fuel pump.

8.5 Failure effects and judgment method

- Failure effect: strong running noise, poor acceleration, failure to start (starting difficulties) etc.
- Reasons for general failures: use of inferior fuel leads to:

  1. Accumulated colloid became insulation layer;
  2. Fuel pump bushing and armature blocked;
  3. Components of fuel level sensor eroded.
- Maintenance precautions:

1. The electric fuel pump has different flow according to the requirement of engine. The pump with same shape and possible to assemble perhaps is not available. For service, the part number of replaced fuel pump must be in conformity with the original ones;

2. Do not run the pump at dry status to prevent the pump from accident;

3. Please pay attention to take cleaning measures for fuel tank and pipeline and replace fuel filter in case replace fuel pump.

Simple measurement method:

1. With the joint removed, swift the digital multimeter on ohm shift, connect the two meter pens to two pins of pump respectively to measure the inner resistance, it is indicated that is not at zero or infinite (that is non short circuit, open circuit status).

2. With the joint connected, connect the fuel pressure gauge onto the sucker, start the engine and then observe if the fuel pump works; if the fuel pump does not run, check if mains voltage is present at “+” pin; if the fuel pump works, under idling mode, check if the fuel pressure is about 400kPa.

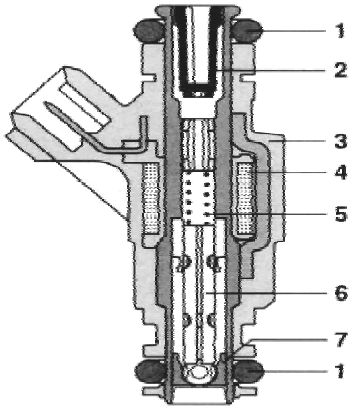
9. Injector

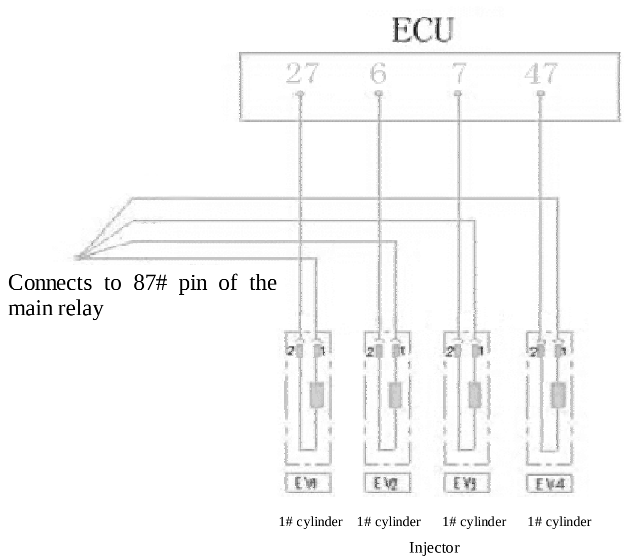
9.1 Function of injector:

ECU controls the coil of the injector through pulse to make the injector open or close, so that, appropriate fuel will be injected into air intake pipe in due time to mix with air.

9.2 Working principle:

ECU sends electrical impulse to injector coil to form magnetic field force. When magnetic field force increase to resultant force that enough to conquer return spring pressure, needle valve gravity and friction force, the needle valve begin to rise up and start the injection process. The pressure of return spring makes needle valve close again when the injection impulse is stopped.





Circuit diagram of electromagnetic injector

9.3 Parameters of technical features

Item	Value			Unit
	Min.	Typical	Max.	
Operating pressure (pressure difference)		350		KPa
Injector electric resistance at 20℃	11		16	**W**

Allowable fuel:

The injector can only use the fuel in compliance with the provisions in GB 17930-1999 (for vehicle unleaded gasoline) and GWKB 1-1999 (harmful substance control standard for vehicle gasoline), and detergent is required to be added into gasoline. It should be specially pointed out that too long storage of gasoline may make it deteriorate. Especially, the taxi with a (LPG and gasoline) dual-fuel engine uses LPG as fuel long and gasoline is only used for startup, so, daily consumption of gasoline is little. However, because the fuel pump runs long, so the temperature of fuel tank is quite high. If gasoline is stored in the fuel tank of such auto, it may quite liable to oxidation and deterioration, which may lead to choke even damage of injector.

9.4 Installation attentions

- Use specific connector for certain injector and no mixed use will be allowable.
- For installation convenience, it is recommended to daub silica-free clean engine oil on the

surface of the O-ring at the upside of the injector where it connects with the fuel distributing pipe. Be careful not to let engine oil contaminate inside of the injector and the nozzle.

- Place the injector in its bracket vertically along injector bracket, then fix it to the bracket with retaining clips. Note:

① By location mode, the remaining clips for injector fall into axial location remaining clip and axial and radial location remaining clip; misuse should be avoided.

② For installation of an axially located injector, make sure that the bayonet at middle of the remaining clip is completely locked into the groove of the injector and the grooves at both sides of the remaining clip are completely locked into the outskirt flanging of the injector seat.

③ When installing an injector that both axial and radial locations are required, use an axial and radial location remaining clip and place the locating piece of the injector and the locating pin of the injector seat respectively into the corresponding grooves on the location remaining clip.

④ If the injector has two grooves, be careful not to place by mistake, refer to the installation site of the original.

- Installation of injector should be done by hand and knocking the injector with such tools as hammer etc. is prohibited.
- When disassemble/reassemble the fuel injector, the O ring must be replaced. And pay attention to not damage the sealing surface of the injector.
- Do not pull the support gasket of O-ring out of the injector. When installing, avoid damage to fuel inlet end, support ring, nozzle plate and electric connector of the injector. If damaged, use is prohibited.
- After installation of injector, perform leakproofness detection for fuel distributing pipe assembly. It is acceptable only when no leakage exists.
- The failure part must be disassembled by hand. Remove remaining clip of the injector first, and then pull out the injector from the injector seat. After disassembly, ensure cleanliness of the injector seat and avoid contamination.

9.5 Failure effects and judgment method

- Failure effects: Poor idling, poor acceleration, failure to start (starting difficulties) etc.
- Reasons for general failures: failure caused by colloid accumulation inside the injector due to lack of maintenance.
- Maintenance precautions: (see installation attentions)
- Simple measure method:

(remove the joint) swift the digital multimeter on ohm shift, connect the meter pens to the two pins of injector. The rated resistance should be 11 - 16Ω¸ when it is 20℃.

Suggestion: regularly wash and analyze the injector using a special washer analyzer for injector.

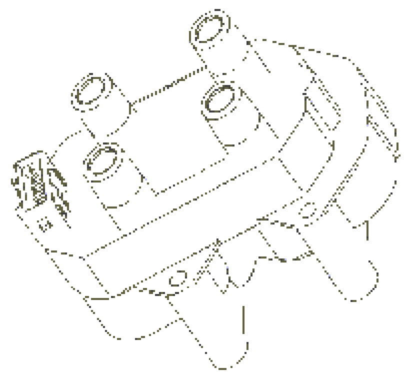
10. Ignition Coil

10.1 Function of ignition coil:

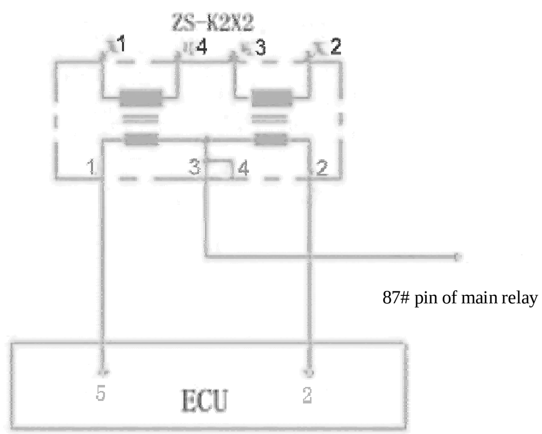
Primary and secondary circuits are integrated inside the ignition coil; when ECU controls on-off of current in the primary coil, a high voltage as high as thousands volts will be generated in the secondary coil, which will then generate spark through ignition cable and spark plug to ignite the mixed air in the cylinder.

10.2 Working principle

Ignition coil ZS - K2 ´2 consists of two primary windings, two secondary windings, mandrel, and casing. When one of the primary windings grounding channel is connected, the primary winding is in charging. Once the primary winding circuit is cut off by ECU, the charging will be stopped. At the same time, the high voltage is sensed in the secondary winding and making the spark plug discharging. There is a different with the distributor ignition coil: for the ignition coil ZS - K2 ´2, there is one spark plug on both side of the secondary winding, so the both spark plugs can ignite at the same time. These two primary windings power on/off alternatively, correspondently, these two secondary windings discharge alternatively.



Double spark ignition coil



10.3 Technical characteristic

Item		Value			Unit
		Min.	Typical	Max.	
Nominal voltage			14		V
Resistance (20 to 25℃)	Primary winding	0.42	0.5	0.58	**W**
	Secondary winding	11.2	13.0	14.8	k**W**
Inductance (20 to 25℃)	Primary winding	3.4	4.1	4.8	mH
	Secondary winding	26.5	32.0	37.5	H
Voltage produced	50pF load	30			kV
	50pF//1M**W** load	23			kV

10.4 Failure effects and judgment method

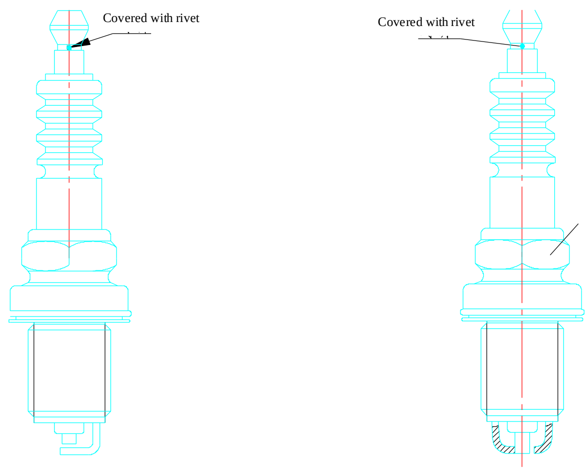
- Failure effects: start failure etc.
- Reasons for the failures: burn out due to too strong current, damage by external force etc.
- Maintenance precautions: use of “test ignition by short circuit” to test the ignition function is prohibited during maintenance to avoid damage to the electronic controller.
- Simple measurement method:

With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to the two pins of primary winding. At 20℃, the resistance should be 0.42-0.58Ω, while this value of secondary winding should be 11.2-14.8kΩ.

11. Spark Plug

The operating conditions of spark plug is extremely inclement, it is exposed to high pressure, high temperature and impact as well as strong corrosion from combustion product; therefore, it is a wearing part.

11.1 Outline drawing



Mono-pole   Triple-pole

11.2 Thermal performance

The spark plug must maintain a proper temperature to keep good working order. Practically, when insulator skirt of the spark plug maintains a temperature of 500-700℃, the oil drop that falls on the insulator can be burnt away immediately without carbon deposit formed. This temperature is called "self cleaning temperature of spark plug". With a temperature below this scope, the spark plug is liable to carbon deposit and electric leakage, thus causing ignition failure; with a temperature above this scope, when the mixed air is contacting with the red-hot insulator, pre-ignition may occur to produce knock, even it may burn in intake stroke and cause backfire.

11.3 Potential failures due to fall of ignition performance of spark plug

Starting difficulties, unsteady speed, chatter of engine, black smoke out of exhaust pipe, high fuel consumption and poor power.

11.4 Judge if the vehicle status matches with the spark plug type through color of spark plug

Yellow, brown yellow   normal   indicates that the combustion status of mixed air is normal

Black with carbon deposit   carbon deposit   check if the spark plug type matches and then replace with the spark plug with lower heat value (slow heat radiation).

Black with blot   soot   clean if the injector nozzle is dirty

Dilute if the mixture ratio of oil gas is too big.

Check ignition coil etc. if the high voltage is poor.

Black with oil stain   combustion of engine oil   check sealing status of the seal ring and if scratch is present on the cylinder wall.

Pearl overheating check if the spark plug type matches, and then replace with the spark plug with lower heat value (rapid heat radiation).

11.6 Regular replacement and use overdue

The spark plug is the low-value consumption goods. Though cheaper compared with other matching parts, its ignition performance directly affects the performance of the engine. Therefore, it needs regular replacement. For the spark plug used in our vehicles, we suggest that you should replace the spark plug at the following mileages: 10,000-15,000 km (single electrode); 15,000-25,000 km (multi electrode).

Ignition performance fall of spark plug will make fuel consumption rise and power drop off. The economic loss caused by excessive fuel consumption unconsciously will even afford to hundreds of new spark plugs. Use overdue makes the working condition of the engine poor in long term and brings some damage to the engine.

11.7 Inspection and maintenance of the spark plug

The inspection items for spark plug mainly include carbon deposit, electrode burn through, gap, and sealing and spark jump performances of the spark plug etc.

The electrode gap of the spark plug should be 0.7-0.9mm. Too small electrode gap will reduce the breakdown voltage and weaken the spark intensity; while too big electrode gap will increase the voltage required by the spark plug and cause spark out, especially when the ignition coil is aging and the ignition system is in poor maintenance, spark out is more liable to occur.

Common failures of spark plug: fall in sealing performance, air leak and soot at the air leakage position. The above failures can be inspected and judged through sealing performance test and spark jump test. Both sealing performance test and spark jump test can be conducted on a spark plug cleaning tester.

It is unscientific that some drivers and maintenance professionals remove the spark plug from the engine, place it on the cylinder head and inspect if it is in sound conditions using high voltage of the vehicle. In this test, the spark plug electrode is under an atmosphere other than a gas pressure of over 800KPa, its working pressure. Therefore, spark jump of a spark plug under an atmosphere does not indicate that it will also reliably produce spark jump under a high pressure conditions in the cylinder.

It is required that carbon deposit disposal and proper adjustment of spark plug gap should be done after a mileage of 10,000-15,000 km in its lifetime. When the temperature in cylinder rises, the electrode gap should be increased properly. That is, increase the electrode gap in summer while reduce it in winter. If the mixed air is strong, the electrode gap should be increased; otherwise, decreased. In plain region, the electrode gap should be decreased while in plateau region, increased.

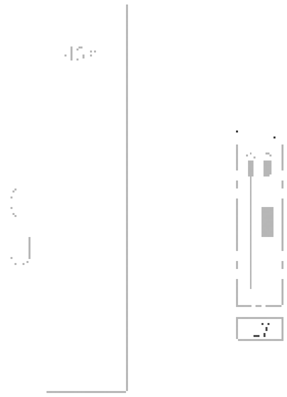
12. Carbon Canister Solenoid Valve Control

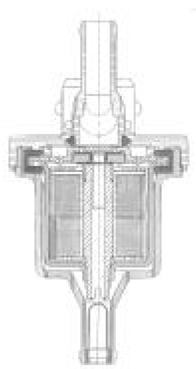
12.1 Function:

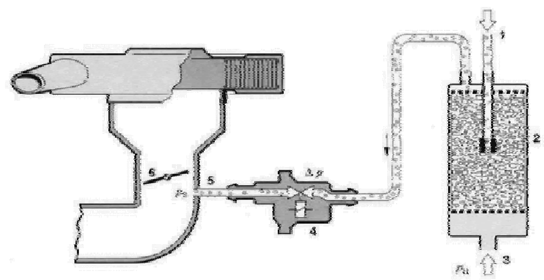
Carbon canister solenoid valve is a device used to enable the fuel steam in fuel tank to enter cylinder to combust through control of ECU. Through controlling duty cycle of a solenoid valve, ECU can accomplish open and close of the solenoid valve.

12.2 Working principle:

The canister control valve is composed of solenoid, armature iron and valve etc. There is a filter net at the inlet. The airflow through the canister control valve at one hand depends on the duty cycle of the electric pulse output of canister control valve by ECU, and at another hand depends on the pressure difference between the inlet and the outlet of the canister control valve. The canister control valve will be closed when there is not any electric pulse.







Installation drawing of canister control valve

12.4 Installation attentions

See above installation drawing for connection among canister control valve, carbon canister and intake manifold.

- In order to avoid transfer of solid borne noise, floating installation of the canister control valve on the hose is recommended.
- During installation, make sure that the airflow direction meets the specification.
- Appropriate measures such as filtering and purge etc. must be taken to prevent such foreign material as particles from entry into the canister control valve from carbon canister or hose.

It is recommended that a corresponding protective strainer (size of grid $<50\mu m$) should be installed on outlet of carbon canister.

12.5. Failure effects and judgment method

- Failure effects: Failure of functions etc.

Reasons for general failure: corrosion or poor sealing performance etc. due to entry of foreign material into inside of the valve.

- Maintenance precautions:

1. During installation, make sure that the airflow direction meets the specification;

2. In case of control valve failure due to black particle inside the valve body, when replacement of the control valve is required, check the status of the canister;

3. During maintenance, try to avoid entry of such liquid as water and oil etc. into the valve;

4. In order to avoid transfer of solid borne noise, floating installation of the canister control valve on the hose is recommended.

- Simple measurement method:

With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to both pins of the canister control valve. The rated resistance at 20℃ should read 26±4Ω.

13. Electronic Accelerator Pedal

13.1 Function:

The electronic accelerator pedal has cancelled the conventional throttle guy and the position of accelerator pedal is fed back to ECU by means of electronic signal, through which ECU can calculate and control the action of the electronic accelerator pedal. Two sets of Hall sensors are integrated in the pedal; ECU can compare and analyze the two signals, if one signal is improper, ECU will duly access the other signal and light the failure indicator.

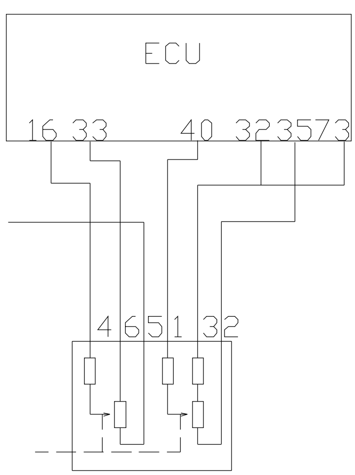
13.2 Working principle:

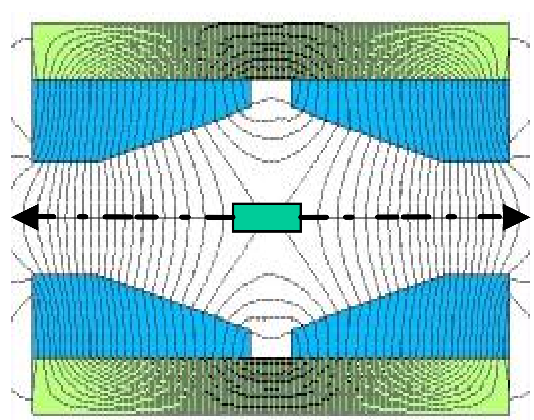
The pedal is a Hall sensor. The fixed Hall generator and signal processing circuit are installed on fixed mounting of the pedal. The two permanent magnets with different magnetic sheet thickness act together with the pedal. When the pedal acts, the magnetic flux passing the Hall generator will also change accordingly, the signal processing circuit will process these signals and then send them to ECU.

13.3 Detection:

The relationship between the two signals of the accelerator pedal is that signal 1 is equal to signal voltage.

At idle speed position, the voltage of signal 1 is 4.59 and that of signal 2 is 4.30. When the pedal is at middle position, the voltage will be the minimum; when the pedal is at either end position, the voltage will be the maximum.





14. Three-way Catalytic Converter

14.1 Function:

Three-way catalytic converter is used to convert the noxious gas in tail gas into such innocuous gases as carbon dioxide and water etc. At 300-800℃, the conversion efficiency of three-way catalytic converter is maximum; with a temperature below this scope, the conversion efficiency will be very poor, while, with a temperature above this scope, the three-way catalytic converter may be burnt out. Three-way catalytic converter can exert better conversion efficiency only when the oxygen sensor works. In control strategies of ECU, there are several protective modes for three-way catalytic converter, and ECU can protect the three-way catalytic converter by regulating air-fuel ratio and ignition advance angle.

15. Fan Control

15.1 Function:

In order to abstract heat from engine system and from condenser with A/C turned on, fan control is affected by the signal to ECU sent by water temperature sensor; When water temperature is high (above the threshold value set by ECU), the fan will run, and when water temperature is low (below the threshold value set by ECU), the fan will also run; with A/C turned on, the fan will run at low speed.

15.2 Composition:

DC electric motor double fan (high and low speed change).

15.3 Installation requirements:

The fan is installed between the rear of radiator and the engine, be careful when installing: not to damage fin of fan blade, otherwise, running noise of the fan will increase, if serious, it may lead to sharp fall of heat radiation effect of the engine.

15.4 Failure diagnosis:

Fan control circuit is a short or open circuit to ground;
The fan has failure itself;
Too loud fan noise;
Failure in power supply circuit of fan.

15.5 Troubleshooting:

First, validate whether it is a high speed fan system problem or a low speed fan system problem. Provided that this is a fan control system problem, use a diagnostic tester to locate the failure point, and then validate whether it is a short-circuit or a break in control circuit.

Failure symptom: the fan failure may result in rise of engine coolant temperature and poor refrigeration of A/C system.

15.6. Fan Control:

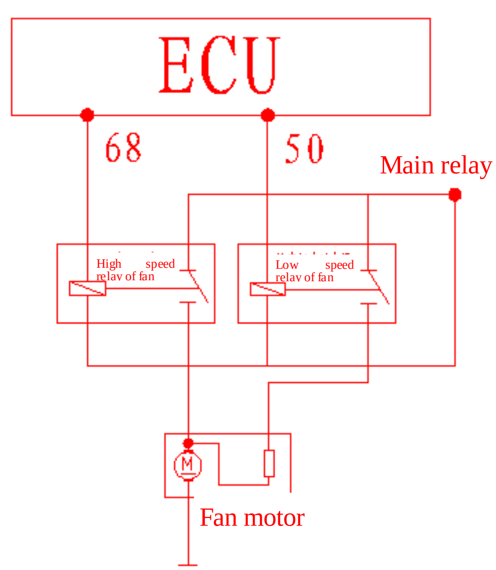
Turn-on of low gear of fan:

1. Temperature of engine coolant: 96℃-102℃;
2. On request for A/C, the fan will start up;
3. When driving speed is too high, the fan will start up;

High speed startup of fan:

1. Engine coolant temperature sensor failure;
2. Air flow meter failure;
3. Engine coolant temperature exceeds 102℃.

Pins:



Brief sketch map of fan control

1. High speed fan control (corresponds to ECU50#);
2. Low speed fan control (corresponds to ECU68#);

The operating mode of fan after engine stops:
1. Failure of intake air temperature sensor of engine, delay 60s;
2. Failure of intake air temperature sensor of engine, delay 60s;
3. Engine coolant temperature exceeds 100.5℃, delay 60s;
4. Engine coolant temperature exceeds 70.5℃, delay 60s.

16. Position Sensor of Double Brake Pedal

16.1 Function:

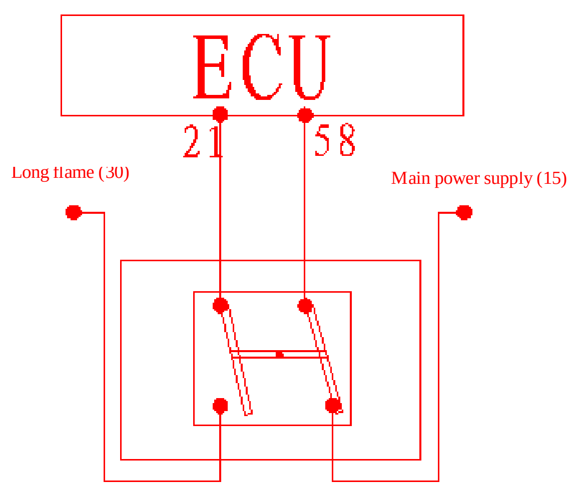
制动开关传感器是将刹车信号送给 ECU，ECU 根据（原文不全）

16.2 Working principle:

Inside the brake switch, there are two mutually independent switches with one normal close and the other normal open. After applying the accelerator pedal, the former normal close switch turns to be normal open, while the normal open one turns to be normal close. Both signals will be sent to ECU to be used to control other systems. Whenever the two signals disaccord, ECU will enter failure mode, the electronic throttle will not respond when applying the accelerator pedal and the engine will maintain idle speed working state.

Composition: the double brake switch is installed on the bracket of the brake pedal and contains two independent switches inside.

Installation requirement: the assembly is installed on the pedal and there is a thread adjusting mechanism on the switch for stroke adjustment of the switch and effective stroke adjustment of the brake switch.



Double brake switch

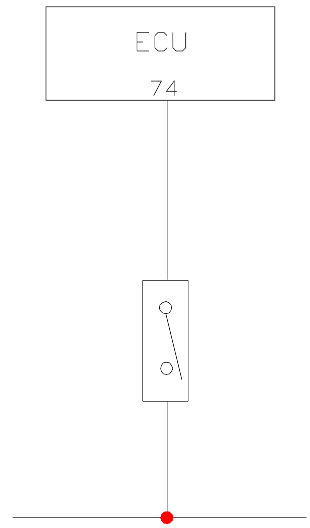
17. Clutch Position Sensor

17.1 Function:

Clutch position switch provides ECU with the signal of clutch position, but this signal can only be used to distinguish between disengaging and engaging positions of the clutch.

17.2 Working principle:

ECU provides clutch position switch with a 12V power supply; when the clutch is under disengaging state, the power supply will ground and ECU will lose 12V high potential signal, by which the position of the clutch can be judged.



18. A/C Control

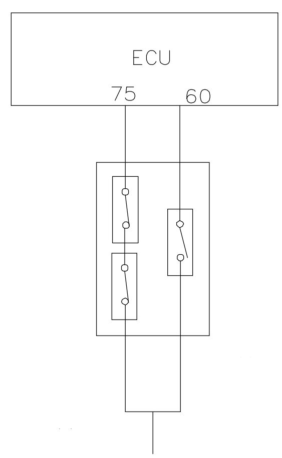
By receiving the A/C signal from A/C switch, ECU can control working of A/C compressor. ECU also can receive the signals from high and low pressure switches of A/C to ensure safety of A/C system. When A/C signal is sent to ECU through high and low pressure switches, if the low pressure switch breaks, ECU will not receive the A/C signal; the compressor is thus unable to work. If A/C system has a too high pressure, the high pressure switch will break and A/C signal can not be provided to ECU; so, ECU will immediately cut off the compressor. When system pressure is normal or a little higher (medium pressure), the medium pressure switch will cut in; thus, ECU can control the fan to run immediately at high speed to ensure a system pressure within the normal range.

Cut off pressure of the low pressure switch: 0.12Mpa

Cut-in pressure of the medium voltage switch: 1.6Mpa

Cut off pressure of the high pressure switch: 3.2Mpa

Through evaporator temperature sensor of the A/C system, ECU can also protect the A/C system and prevent evaporator case from freezing. When the temperature provided by the evaporator temperature sensor is blow 3.75℃, ECU will cut off the compressor; when the temperature is above this degree, ECU will automatically engage the compressor to let it work.



Chapter Two Fundamental Principle for Failure Diagnosis of Electronic Fuel Injection System

1. Failure Information Records

The ECU monitors sensor, actuator, related circuit, malfunction indicator and battery voltage etc., and even EUC itself continuously. At the same time, the ECU inspect the reliability test on sensor signal output, actuator driving signal and internal signal (e.g.: closed loop control, knock control, idle speed control and accumulator voltage control etc.). ECU will set the malfunction record on RAM malfunction memory immediately once the malfunction or the unlikelihood signal is detected. The failure information records are stored in the form of diagnostic trouble code (DTC) and are displayed in the precedence order of occurrence of the failures.
Failures can be divided into “stable state failures” and “random failures” (for example, caused by transient open circuit of wires or poor contact of inserted parts) by failure frequency.

2. Failure State

Once duration of occurrence of an identified failure exceeds the given stabilization time for the first time, ECU will account it as a stable failure and then store it as a “stable state failure”. If this failure disappears, it will be stored as a “random failure” and “non-existent”. If this failure is identified again, it will still be a “random failure”, but a “existent” early failure that will not affect average service of the engine.

3. Failure Types

- Short circuit to positive pole of power supply
- Short circuit to ground
- Open circuit (for the case where there are pull-up resistors or pull-down resistors during input stage, ECU will recognize failure of open circuit at input port as that of short circuit to positive pole of power supply or that of short circuit to ground)
- Signals can not be used

4. Failure Frequency Counter

- For every identified failure, a separate frequency counter numerical value (Hz) will be set.
- This numerical value (Hz) for frequency counter determines the time this failure

information record will be stored in memory after the identified failure disappears (after troubleshooting).

- When a failure is identified for the first time, Hz will be set as its initial value 40. If failure status does not change, then this numerical value will maintain all along.
- Once it is identified that this failure has disappeared and the state has held for a certain time, whenever the engine starts with success (its engine speed has exceeded the value at end of starting) once, Hz will decrease by 1. At this point, ECU will believe that this failure has disappeared, but the failure information record still exists.
- If a failure (for example, as a result of poor contact) frequently appears and disappears, then Hz will increase by 1, but will not exceed its given upper limit value 100.
- If value of Hz has been decreased to zero, the failure information records in this failure memory will be completely cleared.

5. Limp Home

For some identified significant failures, when duration exceeds the given stabilization time, ECU will take appropriate software countermeasures, for example, closing some control functions such as closed loop control of oxygen sensor etc. and setting substituted values for some data that are considered to be suspect and so forth. At this point, though the working condition of the engine is comparatively poor, the auto can still run. The purpose to do this is to enable the auto limply run home or to a service station for overhaul, so as to avoid the embarrassment that the auto breaks down on highway or afield. Once it is identified that the failure has disappeared and Hz has fell to below 40, use of normal data will be resumed again.

6. Failure Alert

In the electric control system, when failure take places in any of such important parts as ECU, absolute pressure sensor in intake manifold, throttle position sensor, coolant temperature sensor, knock sensor, oxygen sensor, phase sensor, injector, two driver stages of step motor of idle speed actuator, canister control valve, or fan relay at corresponding failure location, ECU will give an alarm through lightening of failure indicator lamp until this failure location restores.

7. Readout of Failure

The failure information records can be called out of ECU through a trouble diagnosis tester. If the failure relates to the function of mixed air (fuel and air) proportional regulator, then the engine must at least run for 4 minutes before reading out failure information records; especially for failure in oxygen sensor, be sure not to detect data until the engine runs and warms up.

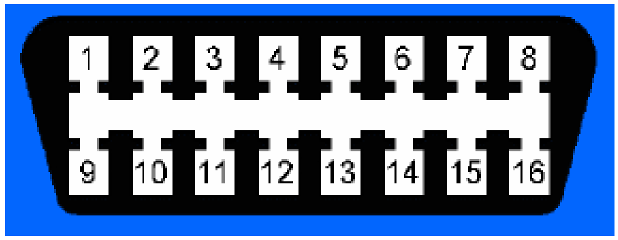


Figure 3-1 ISO 9141-2 Standard Diagnostic Connector

8. Clearing Failure Information Records

After the failure is removed, the failure information records in memory should be cleared. The diagnostic trouble code can be cleared through the following approaches:

- When the numerical value of frequency counter in ECU reaches zero, the failure information records in failure memory will be automatically cleared.
- Employing fault diagnostic tester to clear records of failure with the instruction of “reset memory for records of failure”.
- Pulling out connectors of ECU or disconnecting wires of battery to clear records of failure in external ram.

9. Failure Locating

After obtaining failure information records through above means, only rough location where the failure takes place is aware, but this does not mean that the failure has been located; because the cause that triggers a piece of failure information may be damage of electric element (such as sensor, actuator or ECU etc.), lead break, lead short-circuit to ground or anode of battery, even may be mechanical failure.

The failure is intrinsic and the result of its extrinsic representations is a variety of symptoms. After a symptom is found, first, check for failure information records with a trouble diagnosis tester or based on the flash code, after that, remove the correlated failure in accordance with the failure information, and then locate the failure based on symptom of the engine.

10. Failure Code Table

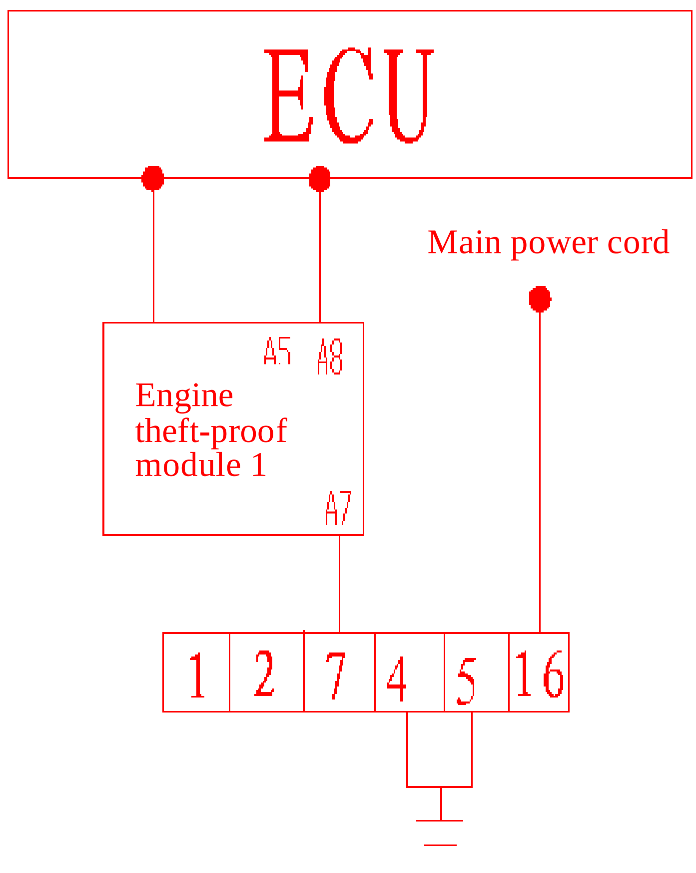
No.	DTC	Explanation	Failure class
1	P0016	Improper relative installation position between camshaft and crankshaft	class5
2	P0030	Failure in heating control circuit of upstream oxygen sensor	class31
3	P0031	Too low voltage in heating control circuit of upstream oxygen sensor	class31

4	P0032	Too high voltage in heating control circuit of upstream oxygen sensor	class31
5	P0105	Signal failure of intake air pressure sensor	class31
6	P0106	Improper signal from intake air pressure sensor	class31
7	P0107	Too low voltage in signal circuit of intake air pressure sensor	class31
8	P0108	Too high voltage in signal circuit of intake air pressure sensor	class31
9	P0112	Too low voltage in signal circuit of intake air temperature sensor	class5
10	P0113	Too high voltage in signal circuit of intake air temperature sensor	class5
11	P0117	Too low voltage in signal circuit of engine coolant temperature sensor	class31
12	P0118	Too high voltage in signal circuit of engine coolant temperature sensor	class31
13	P0121	Improper signal from electronic throttle position sensor 1	class34
14	P0122	Too low voltage in signal circuit of electronic throttle position sensor 1	class34
15	P0123	Too high voltage in signal circuit of electronic throttle position sensor 1	class34
16	P0130	Improper signal from upstream oxygen sensor	class31
17	P0131	Too low voltage in signal circuit of upstream oxygen sensor	class31
18	P0132	Too high voltage in signal circuit of upstream oxygen sensor	class31
19	P0134	Failure in signal circuit of upstream oxygen sensor	class31
20	P0201	Failure in 1# cylinder injector control circuit	class5
21	P0202	Failure in 2# cylinder injector control circuit	class5
22	P0203	Failure in 3# cylinder injector control circuit	class5
23	P0204	Failure in 4# cylinder injector control circuit	class5
24	P0219	Engine revolution exceeds the maximum revolution limit	class5
25	P0221	Improper signal from electronic throttle position sensor 2	class34
26	P0222	Too low voltage in signal circuit of electronic throttle position sensor 2	class34
27	P0223	Too high voltage in signal circuit of electronic throttle position sensor 2	class34
28	P0261	Too low voltage in 1# cylinder injector control circuit	class5
29	P0262	Too high voltage in 1# cylinder injector control circuit	class5
30	P0264	Too low voltage in 2# cylinder injector control circuit	class5
31	P0265	Too high voltage in 2# cylinder injector control circuit	class5
32	P0267	Too low voltage in 3# cylinder injector control circuit	class5
33	P0268	Too high voltage in 3# cylinder injector control circuit	class5
34	P0270	Too low voltage in 4# cylinder injector control circuit	class5
35	P0271	Too high voltage in 4# cylinder injector control circuit	class5
36	P0321	Improper signal of crankshaft top dead center	class33
37	P0322	Engine speed signal failure	class33
38	P0324	Failure in knock signal processing chip and its circuit	class5
39	P0327	Too low voltage in signal circuit of knock sensor	class31
40	P0328	Too high voltage in signal circuit of knock sensor	class31

41	P0340	Failure in signal circuit of phase sensor	class5
42	P0341	Improper signal from phase sensor	class5
43	P0342	Too low voltage in signal circuit of phase sensor	class5
44	P0343	Too high voltage in signal circuit of phase sensor	class5
45	P0444	Failure in control circuit of canister control valve	class31
46	P0458	Too low voltage in control circuit of canister control valve	class31
47	P0459	Too high voltage in control circuit of canister control valve	class31
48	P0480	Failure in relay control circuit of electronic cooling fan (low speed)	class5
49	P0481	Failure in relay control circuit of electronic cooling fan (high speed)	class5
50	P0501	Improper speed signal	class5
51	P0504	Improper signal of brake pedal A/B	class5
52	P0506	Engine speed under idle speed control is below the target idle speed	class5
53	P0507	Engine speed under idle speed control is above the target idle speed	class5
54	P0537	Too low voltage in signal circuit of evaporator temperature sensor	class5
55	P0538	Too high voltage in signal circuit of evaporator temperature sensor	class5
56	P0560	Improper system voltage signal	class33
57	P0562	Too low system voltage signal	class33
58	P0563	Too high system voltage signal	class33
59	P0571	Failure in signal circuit of brake pedal	class5
60	P0601	Failure in EEPROM of ECU	class33
61	P0602	Unprogrammed failure in ECU	class33
62	P0604	Failure in RAM of ECU	class34
63	P0605	Failure in ROM of ECU	class34
64	P0606	Safety monitoring function failure of electronic throttle	class34
65	P0627	Failure in control circuit of fuel pump relay	class33
66	P0628	Too low voltage in control circuit of fuel pump relay	class33
67	P0629	Too high voltage in control circuit of fuel pump relay	class33
68	P0645	Failure in control circuit of A/C compressor relay	class5
69	P0646	Too low voltage in control circuit of A/C compressor relay	class5
70	P0647	Too high voltage in control circuit of A/C compressor relay	class5
71	P0688	Improper output voltage of main relay	class33
72	P0689	Too low output voltage of main relay	class33
73	P0690	Too high output voltage of main relay	class33
74	P0691	Too low voltage in relay control circuit of electronic cooling fan (low speed)	class5
75	P0692	Too high voltage in relay control circuit of electronic cooling fan (low speed)	class5
76	P0693	Too low voltage in relay control circuit of electronic cooling fan (high speed)	class5

77	P0694	Too high voltage in relay control circuit of electronic cooling fan (high speed)	class5
78	P0704	Improper clutch pedal signal	class5
79	P1336	Restrictive effect of safety monitoring torque of electronic throttle	class34
80	P1545	The deviation between physical location and target location of electronic throttle overruns	class34
81	P1558	Too large opening resistance of electronic throttle	class34
82	P1559	Failure in self-study process of electronic throttle	class34
83	P1564	System voltage fails to meet the conditions for self-study of electronic throttle	class34
84	P1565	Failure in self-study of initialization of lower limit position of electronic throttle	class34
85	P1568	Too large restoration resistance of electronic throttle	class34
86	P1579	Fails to meet the conditions for self-study of electronic throttle	class34
87	P1604	Failure in self-study of gain adjustment of electronic throttle	class34
88	P1610	Unprogrammed error in Secret Key and Security Code	class39
89	P1611	Security Code acceptance error	class39
90	P1612	Challenge request failed	class36
91	P1613	Immo Code request failed	class36
92	P1614	Transponder check error	class36
93	P1677	Too high voltage in control circuit of detector lamp (SVS)	class5
94	P1678	Too low voltage in control circuit of detector lamp (SVS)	class5
95	P1679	Failure in control circuit of detector lamp (SVS)	class5
96	P2106	Failure in driver stage of electronic throttle	class34
97	P2122	Too low voltage in signal circuit of electronic accelerator pedal position sensor 1	class34
98	P2123	Too high voltage in signal circuit of electronic accelerator pedal position sensor 1	class34
99	P2127	Too low voltage in signal circuit of electronic accelerator pedal position sensor 2	class34
100	P2128	Too high voltage in signal circuit of electronic accelerator pedal position sensor 2	class34
101	P2138	Improper signal from electronic accelerator pedal position sensor	class34
102	P2177	Self-study value of closed loop air fuel ratio control is above the upper limit (normal load zone)	class5
103	P2178	Self-study value of closed loop air fuel ratio control is below the lower limit (normal load zone)	class5
104	P2187	Self-study value of closed loop air fuel ratio control is above the upper limit (idle speed zone)	class5
105	P2188	Self-study value of closed loop air fuel ratio control is below the lower limit (idle speed zone)	class5

106	P2191	Self-study value of closed loop air fuel ratio control is above the upper limit (heavy load zone)	class5
107	P2192	Self-study value of closed loop air fuel ratio control is below the lower limit (heavy load zone)	class5



Electrical Schematic Diagram of Diagnostic Interface

11. The Steps for Implementation of Failure Diagnosis According to Failure Information Records

11.1 Electronic Throttle Failure

Failure codes: P012, P0122, P0123, P022, P0222, P0223, P1336, P154, P1558, P1559, P1564, P1565, P1568, P1579, P1604

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull out the joint of throttle position sensor on harness; use a multimeter to check if the magnitude of voltage between its 3# and 5# pins is around 12V and if a 5V voltage is present between 6# and 2# pins.	Yes	Next step
		No	5
3	Use a multimeter to check if the resistance values between 1#, 4# and 6# pins of the sensor are between 0.5kΩ and 1.6kΩ.	Yes	Next step
		No	Replace the sensor
4	Meanwhile, use a multimeter to check if it is break or short circuit between 1#, 4# and 6# pins of throttle position sensor and ECU38#, 54#, 36#; or, turn blade of the throttle to observe if its resistance value jumps and if the resistance values between 1#, 4# and 6# change accordingly with rotation of throttle.	Yes	Replace the sensor
		No	Replace ECU
5	Connect an adaptor between ECU and harness, use a multimeter respectively check if it is break or short circuit between 1#, 2#, 6# and 4# pins of the sensor and 10#, 32#, 36# and 54# pins of ECU joint.	Yes	Repair or replace wire harness
		No	Replace ECU

Note: This auto adopts the electronic throttle body and has cancelled former step motor, and the functions that were accomplished by the stop motor on a common throttle body are now completely accomplished by the throttle driving motor. The electronic throttle can not be repaired and failure rate of the throttle body is very low, if damaged, replacing the assembly is the only choice to deal with the problem.

Special attention: The electronic throttle body can not be disassembled and repaired at service station; in addition, after replacing electronic throttle body, be sure to let it carry out self-study; otherwise, unsteady working at idle speed of engine may occur. See also the section about electronic throttle for detailed study scheme. Maintenance of the throttle body is analogous to that of the common valve body.

11.2 Knock Sensor failure

Failure codes: P0324, P0327, P0328

No.	Operating steps	Result	Follow up steps
1	Close the ignition switch, and the engine stops.		Next step
2	Pull out the joint of knock sensor on harness, use a multimeter to check if both resistance values between 1# and 2# pins and between 1# pin and shielded wire (sensor shield) pin of knock sensor are more than 1MΩ.	Yes	Next step
		No	Replace with a new sensor
3	Knock on the edge of knock sensor with a small hammer and check with multimeter if there is communicating signal output between sensor pin 1# and 2#.	Yes	Next step
		No	Replace the sensor
4	Turn on the ignition switch but do not start the engine.		Next step
5	Connect an adaptor between ECU and harness, use a multimeter respectively check if it is break or short circuit between 19#, 20# pins of ECU and 1#, 2# pins of sensor joint.	Yes	Repair or replace wires
		No	Replace ECU

Note: Generally, knock sensor is not liable to damage. When disassembling and installing the knock sensor, be careful not to leave dirt on the contact surface of the sensor and the engine body and do not add any gasket. If the sensor is damaged, it will have an comparatively great effect on economical efficiency and emission of the engine. After the knock sensor is damaged, the electric control system of the engine will lock ignition advance angle of the engine at a fixed ignition angle, so, the acceleration performance of the engine will fall and economical efficiency and emission of the engine will also be greatly affected.

11.3 Air Pressure Sensor Failure

Failure codes: P0102, P0103, P0112, P0113

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull out joint of intake air pressure sensor on harness; use a multimeter to check if a 5V voltage is present between 2# and 3# pins of the joint.	Yes	4
		No	Next step
3	Between ECU and harness, use a multimeter to respectively check if it is break or short circuit between 42# and 33# pins of ECU and 1#, 2#, 3#, 4# pins of sensor joint.	Yes	Repair or replace harness
		No	Next step
4	Replace the intake air temperature pressure sensor.		Next step

Note: In case the sensor shorts to 5V or 12V power supply or ground, the engine may not start up or stop running.

11.4 Front Oxygen Sensor Failure

Failure codes: P0130, P0131, P0132, P0134, P0135

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull off the connector of harness of oxygen sensor. Check the voltage between pin 1# (+) and 2# (-) with multimeter and detect if it is around 12V.	Yes	Next step
		No	4
3	Use a multimeter to check if the resistance value between 1# and 2# pins of the oxygen sensor is between 2Ω and 5Ω at 23℃.	Yes	Replace ECU
		No	Replace the sensor
4	Check if heating circuit of the oxygen sensor is normal.	Yes	Next step
		No	Check the circuit
5	Check if it is short circuit or break circuit between the pin 2# of oxygen sensor and main relay 87# pin and between the sensor connector 1# pin and ECU 1# pin with multimeter.	Yes	Repair or replace harness
		No	Next step
6	Connect the oxygen sensor connector of harness and use neutral. Start the engine and leave it at idle speed until its coolant temperature reaches to the normal value.		Next step
7	Pull off the oxygen sensor connector of harness. Check the battery output voltage between pin 3# (+) and pin 4# (-) of the sensor with multimeter and detect if it is from 0.1 to 0.9V (after the engine warms up).	Yes	Next step
		No	Replace the sensor
8	Connect the adaptor between ECU and harness. Check if it is short circuit or break circuit between the pin 36# and pin 13# of ECU and the sensor connector pin 3# and pin 4# respectively with multimeter.	Yes	Repair or replace harness
		No	Replace ECU
9	Plug in the oxygen sensor connector of harness and use neutral. Start the engine and leave it at idle speed until its coolant temperature reaches to the normal value.		Next step
10	Connect special diagnostic tester for Chery to read part of data stream of the engine, and then observe if part of data stream of the sensor fluctuates between 100mv and 900mv.	Yes	Next step
		No	Replace the sensor
11	Start the engine and let it run at idle speed until coolant temperature reaches normal value.		Next step

12	Connect special diagnostic tester for Chery to read part of data stream of the engine, and then carefully observe part of data stream of the sensor; apply the accelerator pedal to bottom and then rapidly release it, observe if the output voltage of the oxygen sensor can reach below 100mv.	Yes	Check other part
		No	Replace the sensor

Note: when checking data flow of the oxygen sensor, be sure to note working position of the engine and let the working temperature of the engine reach the normal value, because the oxygen sensor only can start to work normally when the temperature is over 300℃.

11.5 Rear Oxygen Sensor Failure

Failure codes: P0136, 0137, 0138, 0036, 0037, 0038, 0054

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull off the oxygen sensor connector of harness. Check the voltage between pin 1# (+) and 2# (-) with multimeter and detect if it is around 12V.	Yes	Next step
		No	4
3	Use a multimeter to check if the resistance value between 1# and 2# pins of the oxygen sensor is between 2Ω and 5Ω at 23℃.	Yes	Replace ECU
		No	Replace the sensor
4	Check if heating circuit of the oxygen sensor is normal.	Yes	Next step
		No	Check the circuit
5	Check if it is short circuit or break circuit between pin 2# of oxygen sensor and main relay 87# pin and between the sensor connector 1# pin and ECU 1# pin with multimeter.	Yes	Repair or replace harness
		No	Next step
6	Connect the oxygen sensor connector of harness and use neutral. Start the engine and leave it at idle speed until its coolant temperature reaches to the normal value.		Next step
7	Validate if the three-way catalytic converter works normally.	Yes	Next step
		No	Replace the three-way catalytic converter
8	Pull out the oxygen sensor joint on harness. Rapidly apply the accelerator pedal for several times, and then use a multimeter to check if a output voltage between 0.1V and 0.9V is present between 3# (+) and 4# (-) pins of the sensor (after the engine warms up).	Yes	Next step
		No	Replace the sensor
9	Connect the adaptor between ECU and harness. Check if it is short circuit or break circuit between the pin 36# and pin 55# of ECU and the sensor connector 3# and 4# pins respectively with multimeter.	Yes	Repair or replace harness
		No	Replace ECU
10	Connect the oxygen sensor connector of harness and use neutral. Start the engine and leave it at idle speed until its coolant temperature reaches to the normal value.		Next step
11	Connect special diagnostic tester for Chery to read part of data stream of the engine, and then observe	Yes	Next step

	part of data stream of the engine, and then observe if part of data stream of the oxygen sensor is around 100 under standard idling operation.	No	Replace the sensor or the three-way catalytic converter
12	Start the engine and let it run at idle speed until coolant temperature reaches normal value.		Next step
13	Connect special diagnostic tester for Chery to read part of data stream of the engine, and then carefully observe part of data stream of the sensor; rapidly apply the accelerator pedal for several times and observe if the output voltage of the oxygen sensor fluctuates within a comparatively large scope.	Yes	Check other part
		No	Replace the sensor

Note: The characteristics and operating principle of rear oxygen sensor is basically the same as those of front oxygen sensor, in special conditions, they can be interchanged to use. The only difference between them is their different installation sites (working atmospheres), therefore, during maintenance and diagnostic processes of the vehicle, please pay attention to some inspection techniques for front and rear oxygen sensors.

11.6. Coolant Temperature Sensor Failure

Failure codes: P0112, P0113

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull out joint of coolant temperature sensor on harness; use a multimeter to check if the magnitude of voltage between 1# (+) and 2# (-) pins of this joint is around 5V.	Yes	Next step
		No	4
3	Use a multimeter to check if the resistance value between 1# and 2# pins of the sensor is in proportion to its temperature (refer to relevant part in this service manual).	Yes	Replace ECU
		No	Replace the sensor
4	Use a multimeter to check if it is break or short circuit between 17# and 29# pins of ECU and 2# and 1# pins of sensor joint.	Yes	Repair or replace harness
		No	Replace ECU
5	Start the engine, while engine coolant temperature rises, check if the voltages on two wires of the sensor falls as water temperature of the engine rises.	Yes	Next step
		No	Replace the sensor
6	Start the engine, disconnect the connector of water temperature sensor, and then observe if cooling fan of the engine starts up and runs at high speed.	Yes	Check other part
		No	Replace the ECU or the circuit

11.7 Failure in Driver Stage of Injector

Failure codes: P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271

No.	Operating steps	Result	Follow up steps
1	Close the ignition switch, and the engine stops.		Next step
2	Pull out each electromagnetic injector joint on harness in turn, and then lap the two pins of multimeter between 2# pin of the joint and the engine.		Next step
3	Put the ignition switch to “ON”. Observe if, at the instant when the ignition switch cuts in, the multimeter displays an around 12V voltage value of battery (mainly check if the injector has power supply, which is provided by main relay).	Yes	Repeat 2
		All yes	6
		No	Next step
4	Use a multimeter to check in turn if it is break or short circuit between 87# pin of output terminal of main relay of the engine and 1# pin of each electromagnetic injector joint.	Yes	Repair or replace harness
		No	Next step
5	Repair or replace fuel pump relay and main relay and their circuits.	Yes	Repair or replace harness
6	Connect the adaptor between ECU and harness; use a multimeter to check in turn if it is break or short circuit between 27#, 7#, 47# or 6# pins of ECU and 2# pin of each corresponding electromagnetic injector joint on harness.	No	Next step
7	Use a multimeter to check in turn if a resistance between 12Ω and 16Ω is present at 20℃ between 1# and 2# pins (and resistance value of injector) of the electromagnetic injectors.	Yes	Repeat 7
		All yes	Next step
		No	Replace the electromagnetic injector
8	Re-plug all electromagnetic injector joints, engage the gear to neutral position, start the engine, and then let it run at idle speed. Pull out all electromagnetic injector joints on harness in turn. Whenever a joint is pulled out, observe if engine vibration is aggravated accordingly (equivalent to spark out experiment).	Yes	Repeat 8
		No	Replace ECU

Note: The damage probability of injector is very low; its main failure is carbon deposit in injection nozzle, which may result in atomization of fuel injection, poor spray and unsteady idle speed of engine; therefore, when inspecting, above failure should be inspected as an emphasis.

11.8 Failure in Driver Stage of Canister Control Valve

Failure codes: P0443, 0444, 0445

No.	Operating steps	Result	Follow up steps
1	Start the engine and let it run at idle speed until engine coolant temperature reaches normal value.		Next step
2	Pull out canister control valve joint on harness; use a multimeter to check if an around 8.6V battery voltage is present between two pins of this joint.	Yes	Next step
		No	5 (check positive wire)
3	Re-plug the canister control valve joint on harness, increase engine revolution to 2000rpm, and then touch the valve body by hand to check if the canister control valve has slight vibration and impact (frequency control).	Yes	Next step
		No	7 (check ground wire)
4	Use a multimeter to check if the resistance value between A# and B# pins of the canister control valve is around 25Ω (20℃).	Yes	Replace ECU
		No	Replace the canister control valve
5	Check if it is short circuit or break circuit between the pin of main relay 87# and the pin of canister control valve 1# with multimeter.	Yes	Repair or replace the harness
		No	Next step
6	Repair or replace the main relay and the circuit.		
7	Cut off the engine; connect the adaptor between ECU and harness, and use a multimeter to check if it is break or short circuit between 46# pin of ECU and A# pin of the canister control valve.	Yes	Repair or replace harness
		No	Replace ECU
8	With ignition switch ON, disconnect canister control valve joint, and then use a multimeter to check the A# and B# pins at harness end of solenoid valve.		Next step
9	Use a multimeter to check if an around 12V battery voltage is present between B# pin and ground wire.	Yes	Next step
		No	Check feed circuit
10	Use a multimeter to check if an around 3.6V battery voltage is present between A# pin and ground wire.	Yes	Check other part
		No	Check ECU circuit or replace the ECU

Note: The carbon canister solenoid valve is used for the emission control system, a system set up for environmental protection and air pollution prevention. When engine runs at idle speed or under heavy load operating mode, the solenoid valve will not participate in the work. A malfunction of this solenoid valve will result in unsteady operating mode of the engine. These details should be noted during maintenance process.

11.9 Failure in Driver Stage of Malfunction Indicator Lamp (MIL)

Failure codes: P1677, P1678, P1679

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON"		Next step
2	Disassemble the dashboard, and then use a multimeter to check if it is break or short circuit between 29#, 30# pins at instrument end and 62#, 81# pins of ECU.	Yes	Check the circuit
		No	Next step
3	Replace the instrument and then check if it is normal	Yes	Next step
		No	Replace the instrument
4	Replace ECU, and then re-check if it works normally.	Yes	Replace ECU
		No	Check other part
5	Check CAN circuit for the place where is grounding or short.	Yes	Replace the harness
		No	Check other part

Note: The malfunction indicator lamp is controlled by ECU. When a failure occurs in the system, ECU will control the malfunction indicator lamp to light. There are two kinds of malfunction indicator lamps on this auto (engine failure indicator lamp and EPC), but the engine failure indicator lamp on the instrument may be shielded in the system, that is, when a failure occurs, EPC lamp will light, which should be noted during maintenance process.

11.10 Failure in Driver Stage of 1#, 2# Coils of Step Motor

Failure codes: P1682, 1683

No.	Operating steps	Result	Follow up steps
1	Turn on the ignition switch but do not start the engine.		Next step
2	Pull out connector of the electronic throttle, and then check if the resistance value between 5# and 3# pins of the connector is around 6.1Ω.	Yes	Next step
		No	Replace the electronic throttle body
3	Pull out the connector, and then use a multimeter to check if a 12V alternate voltage is present between 5# and 3# connectors of the electronic throttle.	Yes	Next step
		No	Check the circuit
4	Use a multimeter to check if a 12V voltage is present between the connector of the harness and ground when the key is ON.	Yes	Replace the idle speed actuator
		No	Next step
5	Between ECU and harness, use a multimeter respectively to check if it is break or short circuit between 67#, 65# pins of ECU and 5# pin of the connector and between 66#, 64# pins of ECU and 3# pin of the connector.	Yes	Repair or replace the harness
		No	Replace ECU

Note: Much about failure diagnosis for other parts has been involved above.

11.11 Crankshaft Position Sensor Failure

Failure code: P0016

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”.		Next step
2	Pull out camshaft position sensor joint on harness, and then use a multimeter to check if the voltage between 1# pin of this joint and ground wire is around 12V (battery voltage).	Yes	Next step
		No	Check circuit and main power supply
3	Pull out camshaft position sensor joint on harness, and then use a multimeter to check if the voltage between 2# pin of this joint and ground wire is around 11.5V (power supply from ECU and the voltage is below the battery voltage).	Yes	Next step
		No	Check circuit and ECU
4	Use a multimeter to check if it is break or short circuit between 79# pin of ECU and 2# pin of sensor joint.	Yes	Repair or replace the harness
		No	Next step
5	Pull out camshaft position sensor joint on harness, and then use a multimeter to check if it is conducting between 3# pin of this joint and ground wire.	Yes	Next step
		No	Replace the sensor
6	Connect the sensor connector and start the engine.		Next step
7	Use a oscillometer to check if an around 6V square wave signal output is present in 2# signal cable.	Yes	Check other part
		No	Replace the sensor

Note: The camshaft position sensor is an auxiliary sensor and has great effect on emission of the system. When failure occurs in this sensor, the vehicle will be difficult to start; though the vehicle will be basically normal after startup, driving restrictive practice will be found on the engine and the maximum revolution of engine can not exceed 4000rpm.

11.12 Craftshaft Position Sensor Failure

Failure codes: P0321, P0322, P0219

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull out crankshaft position sensor joint on harness, use a multimeter to check if it is short or break circuit between 1# pin of this joint and 34# pin of ECU.	Yes	Check the circuit
		No	Next step
3	Pull out crankshaft position sensor joint on harness, use a multimeter to check if it is short or break circuit between 3# pin of this joint and 15# pin of ECU.	Yes	Next step
		No	Check circuit and ECU
4	Use a multimeter to check if it is break or short circuit between 79# pin of ECU and 2# pin of sensor joint.	Yes	Repair or replace the harness
		No	Next step
5	Pull out crankshaft position sensor joint on harness, and then use a multimeter to check if the two signal cables on the sensor has a resistance value of around 1000Ω.	Yes	Next step
		No	Replace the sensor
6	Connect the sensor connector and start the engine.		Next step
6	Use an oscillometer to check if signal waveform output is present in signal cable.	Yes	Check other part
		No	Replace the sensor

Note: Crankshaft position sensor is the main sensor of electronic control unit of engine. If crankshaft position sensor failure occurs, the engine will be difficult to start; acceleration performance of the engine will be greatly restricted after startup; the maximum revolution of the engine can not exceed 3800rpm; meanwhile, emission of the engine will deteriorate.

11.12 Ignition Coil Failure

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”.		Next step
2	Pull out ignition coil joint on harness, and then use a multimeter to check if the voltage between 3# pin of this joint and ground wire is an around 12V battery voltage.	Yes	Next step
		No	Check the circuit
3	Pull out ignition coil joint on harness, and then use a multimeter to check if it is short or break circuit between 1# pin of this joint and 5# pin of ECU.	Yes	Check circuit and ECU
		No	Next step
4	Pull out ignition coil joint on harness, and then use a multimeter to check if it is short or break circuit between 2# pin of this joint and 2# pin of ECU.	Yes	Check circuit and ECU
		No	Next step
5	Check if the resistance of primary coil of the sensor is around 0.9Ω.	Yes	Next step
		No	Replace the ignition coil
6	Check if the resistance of secondary coil of the sensor is around 14.5kΩ.	Yes	Next step
		No	Replace the ignition coil
7	Use an oscillometer to check if secondary ignition waveform of ignition cable of ignition system is normal.	Yes	Check other part
		No	Replace the ignition coil

Note: The ignition coil is mainly used to provide ignition system of engine with ignition energy. The failure rate of the coil itself is very low, but its failure probability can not be completely excluded. When failure occurs in ignition coil, the ignition energy of engine will be deficient, which may further lead to such failures as unsteady idle speed of engine and emission deterioration.

11.13 Accelerator Pedal Position Sensor Failure

Failure codes: P2106, P2122, P2123, P2127, P2128, P2138

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”.		Next step
2	Pull out accelerator pedal position sensor joint on harness, and then use a multimeter to check if an around 5V voltage signal is present between 3#, 6# pins of this joint and ground wire.	Yes	Next step
		No	Check the circuit
3	Pull out accelerator pedal position sensor joint on harness, and then use a multimeter to check if it is short or break circuit between 3#, 6# pins of this joint and 32#, 33# pins of ECU.	Yes	Check the circuit
		No	Next step
4	Pull out accelerator pedal position sensor joint on harness, and then use a multimeter to check if it is short or break circuit between 2#, 5# pins of this joint and 36#, 35# pins of ECU.	Yes	Check the circuit
		No	Next step
5	Pull out accelerator pedal position sensor joint on harness, and then use a multimeter to check if it is short or break circuit between 4#, 1# pins of this joint and 16#, 40# pins of ECU.	Yes	Check the circuit
		No	Next step
6	Use a diagnostic tester to read signal output of accelerator pedal position sensor, and then check if signal 1 increases as opening of accelerator pedal increases.	Yes	Next step
		No	Replace the sensor assembly
7	Use a diagnostic tester to read signal output of accelerator pedal position sensor, and then check if signal 2 increases as opening of accelerator pedal increases.	Yes	Check other part
		No	Replace the sensor assembly

Note: This pedal is an integrated circuit device, which can not be processed through repair; therefore, during maintenance process, the service station can maintain it by means of part replacement and can not disassemble the sensor.

11.14 Double Brake Switch

Failure codes: P0571, P0504

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”.		Next step
2	Pull out brake switch joint on harness, and then use a multimeter to check if it is short or break circuit between 1#, 2# pins of this joint and 21#, 58# pins of ECU.	Yes	Next step
		No	Check the circuit
3	Close the ignition switch, and then check if an around 12V battery voltage is present on 3# pin of the switch joint.	Yes	Next step
		No	Check the circuit
4	Open the ignition switch, and then check if an around 12V battery voltage is present on 4# pin of the switch joint.	Yes	Next step
		No	Check the circuit
5	Release brake pedal, disconnect sensor connector, and then check if 1# and 3# pins cut off.	Yes	Next step
		No	Replace the brake switch
6	Release brake pedal, disconnect sensor connector, and then check if 2# and 3# pins conducts.	Yes	Next step
		No	Replace the brake switch
7	Apply brake pedal, disconnect sensor connector, and then check if 1# and 3# pins conducts.	Yes	Next step
		No	Replace the brake switch
8	Apply brake pedal, disconnect sensor connector, and then check if 2# and 4# pins cut off.	Yes	Check other part
		No	Replace the brake switch

11.15 Theft-proof Control System Failure

No.	Operating steps	Result	Follow up steps
1	Insert the ignition key into the ignition lock.		Next step
2	Put the ignition switch to ON position, and then observe if engine failure indicator lamp or EPC lamp works normally (quick flash of failure indicator lamp or EPC lamp indicates a abnormal condition).	Yes	Check other part
		No	Next step
3	Connect a diagnostic tester to the system, and then enter corresponding diagnostic program unit to check if DTC exists in the system.	Yes	Remove the failure and clear the DTC
		No	Next step
4	Pull out theft-proof module joint on harness, and then use a multimeter to check if an around 12V operating voltage is present on A1#, A4# pins of the joint when ignition switch is under ON state.	Yes	Next step
		No	Check the circuit
5	Pull out theft-proof module joint on harness, and then use a multimeter to check if such electric and circuit failures as short circuit and break circuit exist in the circuit between A5#, A8# pins of this joint and 31# and 71# pins of ECU.	Yes	Check the circuit
		No	Next step
6	Pull out theft-proof module joint on harness, and then use a multimeter to check if poor contact exists between A2# pin of this joint and ground wire of the vehicle.	Yes	Check the circuit
		No	Next step
7	Pull out theft-proof module joint on harness, and then use Ohm Shift of the multimeter to check if the circuit between B1#, B2#, B3# pins of this joint and the coil exists.	Yes	Check the circuit
		No	Replace the theft-proof module

12. Steps for Implementation of Failure Diagnosis by Engine Symptom

12.1 Perform Preliminary Inspection First before Following the Steps for Implementation of Failure Diagnosis by Engine Symptom.

(1) Make sure that ECU and failure indicator lamp (or EPC lamp) have no off-normal phenomenon (excluding the models that have no failure indicator lamp).
(2) Use a failure diagnostic tester to check and make sure no failure information record exists.
(3) Employ failure diagnostic tester to check that hot idle data from electronic control system fall within normal scope.

Hot idle speed parameter table:

Name	Parameter
Air intake temperature	20-70℃
Battery voltage	12-14V (affected by engine revolution)
Temperature of engine coolant	80-90℃ (normal operating temperature)
Position of accelerator pedal	0%~99.00%
Air-fuel ratio control integrator	5%-5%
Ignition advance angle	5-10°(may change with fluctuation of engine revolution)
Outer corner of throttle	0%~99.61%
Fuel injection time	2-7ms (has a strong relation with engine revolution)
Engine revolution n	Expected idle speed ± 50rpm
Duty cycle of canister control valve	0%~99.9%
Self-adapting value of air-fuel ratio control	0.95-1.05
Self-adapting value of air-fuel ratio control	120-140
Intake manifold absolute pressure	350-650hPa
Voltage of oxygen sensor	Quickly fluctuates at 0.1-0.9V
Air intake pressure	

(4) Validate that the failure effect the owner complained exists and then locate the exact position of the symptom. Please note that the information provided by the customer is very important, especially the failure symptoms, occurrence time, position and if any other failure symptoms occurred before; these information can help technical personnel rapidly and effectively judge the failure, thus increasing maintenance speed and improving maintenance quality.
Then check the appearance:

- Check that grounding of wire harness is clean and firm.
- Check that vacuum pipeline is unbroken, twisted and in right connection.
- Check that there is no obstruction in pipe.
- Check that air intake pipe is not squashed or damaged.
- Check that the seal between throttle body and intake manifold is perfect.
- Check that ignition cable of ignition system is unbroken, no ageing and in right wiring.
- Check that wires are in right connection, no loosing or poor connection for connectors.

12.2 The Engine Does not Rotate or Rotates Slowly when Starting

No.	Operating steps	Result	Follow up steps
1	Use a multimeter to check if a voltage around 10-12.5V is present between two battery terminals.	Yes	Next step
		No	Repair or replace the battery
2	Put the ignition switch to "ON". Use a multimeter to check if a battery voltage around 10-12.5V is present on the terminal on the ignition switch that connects with anode of battery.	Yes	Next step
		No	Repair wiring terminal or replace cable
3	Maintain ignition switch at START position, and then use a multimeter to check if a voltage above 8V is present on the terminal on the ignition switch that connects with pull in winding of starting motor.	Yes	Next step
		No	Replace the ignition switch
4	Put the ignition switch at start position, check the anode terminal of starting motor by multimeter and observe the voltage if it is above 8V.	Yes	Next step
		No	Repair wiring terminal Or replace cable
5	Check if it is short circuit or break circuit in the starting motor.	Yes	Repair or replace the starting motor
		No	Next step
6	Check if there is jammed by poor lubricating.	Yes	Troubleshooting
		No	Next step
7	If the failure is happened in winter time, check if it is because of the wrong engine lubricant and gearbox oil causes the big resistance of the starting motor.	Yes	Replace with appropriate oil
		No	Check if other systems are normal

Note: When this problem occurs, mainly inspect voltage, starter and ground system. In modern sedan, lubricant has little effect on startup of the vehicle, so, basically, it needs not to allow for lubricant problem, but the problem if the engine has too large self resistance should be taken into consideration.

12.3 When Starting, Engine Can be Dragged to Rotate but Can not Start with Success.

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Pull out cylinder distribution wire, connect spark plug with the distance between electrode of spark plug and engine body as 8-10mm, use the starting motor to drag the engine to rotate, and then check if blue-white high-voltage spark occurs (disconnect all injection nozzles on the engine).	Yes	8
		No	Next step
3	Check if resistance value of ignition cable is normal (can not exceed 16kΩ).	Yes	Next step
		No	Repair, replace the ignition cable.
4	Check ignition coil and ignition cable for burn through, damage and crack.	Yes	Replace
		No	Next step
5	Check if ignition cable is normal.	Yes	Replace
		No	Next step
6	Check if the ignition coil is working normally.	Yes	Next step
		No	Replace
7	Check if connectors of ignition coil and ignition cable are connected properly.	Yes	Next step
		No	Connect the connectors properly
8	Put the ignition switch to "ON". Check if fuel pump relay and fuel pump can keep working for a period of time.	Yes	Next step
		No	Overhaul the fuel pump circuit
9	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	13
10	Pull off the fuel distributing pipe and the fuel injector; pull off the joints of fuel injector on the harness one by one. And supply the voltage of 12 V from battery to fuel injector directly and look if the fuel injector can inject normally.	Yes	12
		No	Next step
11		Yes	Next step

	Clean out the fuel injector and observe if it can work correctly.	No	Replace the fuel injector
12	Check if fuel is bad or moisture.	Yes	Replace fuel
		No	18
13	Check if the fuel pressure value is below 400 kPa.	Yes	Next step
		No	17
14	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	16
15	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Check other part
		No	Repair or replace the fuel pump
16	Check if there is leakage or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
17	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator
18	Check if it is break or short circuit between 1#, 2# pins of crankshaft position sensor and 34#, 15# pins of ECU.	Yes	Repair or replace the harness
		No	Next step
19	Check if the part of air intake system is leaking.	Yes	Repair
		No	Next step
20	Check if air flow meter works normally.	Yes	Repair or replace
		No	Next step
21	Check if the coolant temperature sensor is working correctly.	Yes	Next step
		No	Repair or replace
22	Check if the reason for the failure on starting is about mechanism, such as much cylinder clearance, cylinder leaking, and so on.	Yes	Remove the mechanical failure
		No	Replace ECU

Note: When checking this problem, if all parts in electronic fuel injection system are normal, consider if mechanical part of the engine works normally, or if cylinder pressure is normal and if air leakage exists and so forth.

12.4 Warm Starting Difficulty

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON". Use a special diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	9
3	Disconnect the connecting oil pipe and turn off the ignition switch. Observe the voltage of fuel system and look if it is around 300 kPa after an hour.	Yes	Next step
		No	Repair the fuel system to avoid leakage
4	Put the connecting oil pipe through, use fuel tube clamp to intercept the oil return pipe, meanwhile, close the fuel manometer valve. Turn off the ignition switch, after one hour, observe if pressure of fuel system still can maintain at around 400kPa.	Yes	Replace fuel pressure regulator
		No	Next step
5	Check if there is fuel leakage of fuel injector and oil pipe.	Yes	Replace the injector and fuel pipe
		No	Next step
6	Pull out water temperature sensor joint and start the engine. Observe if the engine can start with success.	Yes	Check coolant temperature and circuit
		No	Next step
7	Connect an adaptor between ECU and harness, check if a voltage around 5V is present on 39#, 17# pins, meanwhile, check if the resistance value of water temperature sensor is within normal scope.	Yes	Next step
		No	Repair or replace the harness
8	Replace ECU and perform warm start again; observe if the engine can be started successfully.	Yes	End
		No	Replace ECU
9	Check if there is jam or bending of fuel pipe and if the pressure regulator valve of oil pump is working correctly.	Yes	Next step
		No	Repair or replace
10	Check if there is battery voltage between the plugs of oil pump with multimeter.	Yes	Next step
		No	Repair or replace fuel pump relay and wires
11	Try to replace the fuel pump and see if the system can return to normal.	Yes	Next step
		No	Replace fuel pump

12	Check if the fuel pump is stopped up.	Yes	Replace fuel pump
		No	Replace ECU

Note: Warm starting difficulty is in connection with many systems, such as battery, throttle body and water temperature sensor etc. as well as mechanical part of the engine, such as valve sealing. Thermal expansion of engine under warm state may lead to rise of engine resistance.

12.5 Engine Speed is Normal, but it is Difficult to Start at any Time

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”. Use a special diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Eliminate the failure of air intake system leaking
4	Step on the throttle slightly and observe if it is easy to be started easily.	Yes	Replace the electronic throttle body
5	Connect fuel manometer valve. Short 30#, 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	9
6	Use a special joint to directly supply a 12V voltage and intermittent ground wire from battery to injector and check if the injector works normally (work intermittently).	Yes	8
		No	Next step
7	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
8	Replace fuel 8, and check if the fuel is deteriorated or moisture.	Yes	Replace fuel
		No	14
9	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	13
10	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for 3s, and then check if fuel pressure can be built up.	Yes	Next step
		No	12
11	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace fuel pressure regulator
		No	Repair and replace fuel injector and oil pipe
12	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
13	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe

		No	Replace fuel pressure regulator
14	When engine coolant is at low temperature, pull out electronic throttle body on harness and observe if engine revolution will rise.	Yes	Next step
		No	Check electronic throttle body for damage
15	Put the ignition switch to "ON". Check if voltage on the following pins of ECU is normal: if it is a battery voltage around 12V on 12#, 14#, 15# pins; if the voltage between 51#, 53#, 3#, 61#, 80# pins and the wire is zero.	Yes	Next step
		No	Check wires and plugs
16	Check if ignition advance angle is normal.	Yes	Next step
		No	Check other systems
17	Check if cylinder compression pressure of engine is normal, if low, add a little engine oil into each cylinder and re-measure if the cylinder pressure is normal.	Yes	Next step
		No	Troubleshooting
18	If air cleaner or airflow sensor is choked.	Yes	Repair or replace
		No	Next step
19	Check if the coolant temperature sensor is working correctly.	Yes	Replace ECU
		No	Repair or replace

Note: Note if theft-proof system has started up. After theft-proof system has started up, when starting the engine, the staring motor can run normally, but the engine can not start; therefore, please note if this system can work normally.

12.6 Cold Starting Difficulty

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Use a multimeter to check if the coolant temperature sensor is normal. (A 2.8KΩ electric resistance can also be connected in series between 39# and 17# pins of ECU to start the engine in stead of the coolant temperature sensor. If the engine can start, it indicates off normal of coolant temperature sensor.)	Yes	Next step
		No	Replace the sensor
3	Put the ignition switch to "ON". Check if voltage on the following pins of ECU is normal: if it is a battery voltage around 12V on 12#, 14#, 15# pins; if the voltage between 51#, 53#, 3#, 61#, 80# pins and the wire is zero.	Yes	Next step
		No	Check wires and plugs
4	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
5	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Eliminate the leakage failure of air intake system
6	Step on the throttle slightly and observe if it is easy to be started easily.	Yes	Check the electronic throttle
		No	Next step
7	When engine coolant is at low temperature, pull out electronic throttle body joint on harness and observe if engine revolution will rise.	Yes	Next step
		No	Check the electric throttle body
8	Connect fuel manometer valve. Let 86# pin of fuel pump relay directly ground. Turn on ignition switch to make fuel pump relay and fuel pump work, and then check if fuel pressure is at around 400kPa.	Yes	Next step
		No	12
9	Use a special joint to directly provide a 12V electricity and ground wire from battery to injector and check if the injector works normally.	Yes	11
		No	Next step
10	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
11	Check if fuel is deteroprated or moisture.	Yes	Replace fuel

		No	17
12	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	16
13	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	15
14	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Check fuel pressure regulator and fuel pump
		No	Repair and replace fuel injector and oil pipe
15	Check if the oil intake pipe is leaky or jammed.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
16	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator or fuel pump
17	Check if the pressure of cylinder is normal.	Yes	Next step
		No	Troubleshooting
18	Check if the engine air intake system is leaky.	Yes	Repair
		No	Next step
19	If air cleaner or airflow sensor is choked.	Yes	Repair or replace
		No	Replace ECU

Note: The cold starting problem relates to more failure points, among which water temperature sensor is comparatively important, because it is the major parameter for determination of injection pulse-width when starting the engine. In case of a water temperature sensor failure or it generates a false signal, the system can not judge the temperature and starting difficulty may occur.

12.7 Unsteady Idle Speed at Any Time

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check if electronic throttle system of engine works normally.	Yes	Repair or replace the electronic throttle
		No	Next step
3	Turn on ignition switch, connect an adaptor between ECU and harness, and then check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Check wires and plugs
		No	Next step
4	Let engine run at idle speed, spark out cylinder in turn, and observe if engine revolution will fall and fluctuate (cut fuel to injector).	Yes	8
		No	Next step
5	Check the fuel injectors of each cylinder and look if they are in right conditions.	Yes	Next step
		No	Check fuel injector and wires
6	Check if resistance value of ignition cable of each cylinder is normal (can not exceed 16kΩ).	Yes	Next step
		No	Replace
7	Check if ignition system works normally.	Yes	Maintain
		No	Next step
8	Check if the spark plug is in right conditions.	Yes	Next step
		No	Replace spark plug
9	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	13
10	Use a special joint to directly provide a 12V power supply and intermittent ground wire signal from battery to injector and check if the injector can work intermittently.	Yes	12
		No	Next step
11	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
12	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	18

13	Check if the fuel pressure value is below 300kPa.	Yes	Next step
		No	17
14	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	16
15	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace fuel pressure regulator
		No	Repair and replace fuel injector and oil pipe
16	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil return pipe
		No	Replace oil pump
17	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator
18	Check the pressure of air intake pipe and if the sense port of air intake temperature sensor is jammed.	Yes	Use detergent to wash
		No	Next step
19	Let engine run at idle speed, after coolant temperature reaches the active temperature of closed loop control, observe if the oxygen sensor works normally (rapidly fluctuate between 0.1V and 0.9V).	Yes	Next step
		No	Check the oxygen sensor and harness
20	Check if the engine air intake system is leaky.	Yes	Remove leakage
		No	Next step
21	Check if the pressure of cylinder is normal.	Yes	Next step
		No	Troubleshooting
22	Let engine run at idle speed, after coolant temperature reaches normal value, then use a special diagnostic tester to check if ignition advance angle is within the standard scope.	Yes	Replace ECU
		No	Check other part

Note: Unsteady idle speed relates to many systems, such as air leak, carbon deposit and throttle body etc.; before replacing a part, make sure that air cleaner, spark plug and ignition system of engine are normal.

12.8 Unsteady Idle Speed during Warming up Process

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Eliminate the leakage failure of air intake system
4	Turn on ignition switch, connect an adaptor between ECU and harness, and then check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Next step
		No	Overhaul
5	Before finish of warming up of engine, pull out the joint on electronic throttle body and observe if engine revolution will change.	Yes	Next step
		No	Check the electric throttle body
6	Check if the coolant temperature sensor is working correctly.	Yes	Next step
		No	Replace
7	Let engine run at idle speed, after coolant temperature reaches normal value, then use a special short diagnostic tester to check if ignition advance angle is normal.	Yes	Replace ECU
		No	Check the ignition timing mechanism

Note: Unsteady idle speed occurs seldom during warming up process, its troubleshooting is similar to that for previous case, but validate if water temperature sensor works normally in advance.

12.9. Unsteady Idle Speed after Warming up

1	Put the ignition switch to “ON”. Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Turn on ignition switch, connect an adaptor between ECU and harness, and then check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Next step
		No	Repair or replace the harness
3	Turn off the engine. Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
4	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Eliminate the leakage failure of air intake system
5	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	9
6	Use a special joint to directly provide a 12V power supply and intermittent ground wire from battery to injector and check if the injector can work intermittently.	Yes	8
		No	Next step
7	Clean out the fuel injector and look if it can work correctly.	Yes	Replace
		No	Replace fuel injector
8	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	14
9	Check if the fuel pressure value is below 300kPa.	Yes	Next step
		No	13
10	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	12
11	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace fuel pressure regulator
		No	Repair and replace fuel injector and oil pipe

12	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
13	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator
14	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle is normal.	Yes	Next step
		No	Check other systems
15	Pull off the coolant temperature sensor and observe if the engine is in right conditions.	Yes	Replace the coolant temperature sensor
		No	Next step
16	Check if the compression pressure of cylinder is normal.	Yes	Next step
		No	Troubleshooting
17	Check if resistance value of ignition cable of each cylinder is normal (can not exceed 16kÙ).	Yes	Next step
		No	Replace
18	Check if ignition coil and ignition cable system works normally and if crack exists on ignition coil.	Yes	Replace
		No	Next step
19	Check if the spark plug is in right conditions.	Yes	Replace ECU
		No	Replace spark plug

Note: After finish of warming up, engine will enter normal idle speed state, under which, unsteady revolution is in connection to many factors, such as spark plug, ignition cable, ignition coil, if air leak exists in the system, if carbon deposit exists in the system and if cylinder pressure is normal an so forth.

12.10 Unsteady Idle Speed or Extinguish with Load (A/C etc.)

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Turn on A/C switch, connect an adaptor between ECU and harness, and then measure 75# pin of ECU to see if input signal is present (high potential signal loaded by A/C switch through high and low voltage switches).	Yes	Next step
		No	Check and repair air conditioning circuit
3	Check if the pressure of air conditioning system, the electromagnetic clutch of compressor and the air conditioning pump are in right conditions.	Yes	Next step
		No	Repair or replace
4	Check the voltage on 64#, 65#, 66# and 67# pins of ECU (for control of DC motor) as well as corresponding pins on valve body is normal.	Yes	Next step
		No	Check controlling circuit
5	Remove electronic throttle body and check if throttle is locked or is dumb to run.	Yes	Check the electric throttle body
		No	Next step
6	Start engine, turn on A/C, use a failure diagnosis tester to read such signals as air intake flow and engine revolution and check if engine acceleration occurs.	Yes	Replace ECU
		No	Replace the electronic throttle body

Note: 75# pin is the up level request signal. When turning on A/C switch, an up level signal will be sent to ECU through this pin, and then ECU will further check other systems of A/C. If all systems are normal, ECU will control A/C relay to ground and A/C system will start to work. 60# pin of ECU is medium voltage signal input; when high potential signal is loaded on this pin, cooling fan will start and run at high speed.

12.11 Periodic Unsteadiness (Have to Perform Self-study again after ECU is Power off)

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Check and repair air intake and leak
4	Let engine run at idle speed, spark out cylinder in turn, and observe if engine revolution will fall and fluctuate (it is prohibited to carry out spark out experiment by disconnecting ignition cable).	Yes	7
		No	Next step
5	Turn on ignition switch, connect an adaptor between ECU and harness, and then check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Next step
		No	Repair or replace cable
6	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle of the system is normal.	Yes	Next step
		No	Check other part
7	Check air intake system for such failures that may affect working of engine as blocking and air leak etc.	Yes	Sweep
		No	Next step
8	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	Next step
9	Use a special joint to directly provide a 12V power supply and intermittent ground wire from battery to injector and check if the injector can work intermittently.	Yes	Next step
		No	Check and repair oil injector and related wires
10	Check if the resistance values of cylinders' ignition cable are normal.	Yes	Next step
		No	Replace
11	Check if the ignition coil is damaged or cracked.	Yes	Replace
		No	Next step

12	Check if the spark plug is in right conditions.	Yes	Replace ECU
		No	Replace spark plug

Note: For periodic unsteadiness, mainly check air intake system for air leak or electronic throttle body for failure. Following are the steps for inspection of electronic throttle body: while turning on ignition key, throttle may jiggle; during self-checking procedure, throttle should act with actions of accelerator pedal.

12.12 Too High Idle Speed (Have to Perform Self-study again after ECU is Power off)

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check if throttle valve plate is locked and if failure exists in electronic throttle body.	Yes	Adjust or replace
		No	Next step
3	Check if the canister control valve, the fuel pressure regulator, the positive crankcase ventilation vacuum pipe and the vacuum pipe of brake system are mounted steadily or they are damaged.	Yes	Repair or replace
		No	Next step
4	Run the engine at idle speed and use neutral. Step on the accelerator and observe if the idle speed is too high.	Yes	Next step
		No	6
5	Clamp the vacuum pipe and observe if the idle speed becomes normal.	Yes	Repair or replace the vacuum booster
		No	Next step
6	Replace PVC valve and clamp the positive crankcase ventilation vacuum pipe. Observe if the idle speed becomes normal.	Yes	Replace PVC valve
		No	Next step
7	Clamp the canister control valve pipe and observe if the idle speed becomes normal.	Yes	Replace the canister control valve
		No	Next step
8	Check if electronic throttle body is dumb or locked.	Yes	Repair or replace
		No	Next step
9	Check other parts of air intake pipe for leakage.	Yes	Repair or replace
		No	Next step
10	Check if the gasket of fuel injector is in good condition.	Yes	Next step
		No	Replace the gasket
11	Check air intake system for air leak and air flow meter for normal working.	Yes	Replace ECU
		No	Replace the sensor

Note: Check if the system goes through self-study, if not, the system will be under failure mode or an uncertain state all the time, which may result in too high idle speed of engine. The other cause is air leak in the system, if air leakage in the system is too large and exceeds regulation and control range of ECU, idle speed fluctuation may occur.

12.13. Engine Revolution Speed is too Low or Flameout

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	Run the engine at idle speed and check if the engine revolution speed is normal at idle speed.	Yes	Next step
		No	Next step, overhaul with reference to idle speed failure entries
4	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Overhaul
5	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle of the system is normal.	Yes	Next step
		No	Check other systems
6	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	10
7	Use a special joint to directly provide a 12V power supply and intermittent ground wire from battery to injector and check if the injector can work intermittently.	Yes	9
		No	Next step
8	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
9	Check if fuel is bad or moisture.	Yes	Replace fuel
		No	15
10	Check if the fuel pressure value is below 350 kPa.	Yes	Next step
		No	14
11	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	13
12	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can	Yes	Replace fuel pressure regulator

	return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	No	Repair and replace fuel injector and oil pipe
13	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
14	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator
15	Put the ignition switch to "ON". Check if voltage on the following pins of ECU is normal: if it is a battery voltage around 12V on 12#, 14#, 15# pins; if the voltage between 51#, 53#, 3#, 61#, 80# pins and the wire is zero.	Yes	Next step
		No	Repair or replace cable
16	Check if ignition coil, ignition cable and spark plug are normal.	Yes	Replace ECU
		No	Adjust or replace the parts involved

Note: This phenomenon indicates a comparatively obvious failure and some minute details, such as if strainer of the system or exhaust pipe is blocked and so forth, should also be checked. For other causes, check spark plug and ignition cable etc.

12.14 Slow Response when Accelerating

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Turn off the engine. Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	Run the engine at idle speed and check if the engine revolution speed is normal at idle speed.	Yes	Next step
		No	Repair in accordance with idle speed failure item
4	Run the engine at idle speed and check if the air intake pressure is from 35 to 65 kPa.	Yes	Next step
		No	Overhaul
5	Put the ignition switch to "ON". Check if it is break or short circuit between 38#, 32#, 54#, 36# pins on ECU connector and 1#, 2#, 4#, 6# pins of throttle position sensor of electronic throttle valve body.	Yes	Next step
		No	Repair or replace Harness
6	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle is normal.	Yes	Next step
		No	Check other part
7	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 4000kPa.	Yes	Next step
		No	11
8	Use a special joint to directly provide 12V power supply and intermittent 12V power supply from battery to injector and check if the injector can work intermittently.	Yes	10
		No	Next step
9	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
10	Check if fuel is bad or moisture.	Yes	Replace fuel
		No	16
11	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	15
12	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	14

13	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace the pressure regulator
		No	Repair and replace fuel injector and oil pipe
14	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
15	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace the pressure regulator
16	Check if the exhaust system and three-way catalytic converter are jammed.	Yes	Replace or clean
		No	Replace ECU

Note: For slow response when accelerating, mainly check air intake pressure and injection pulse-width etc.; choked exhaust pipe and smudgy air cleaner may be causes for this problem. In addition, spark plug and ignition cable problems may also be causes.

12.15 Poor Performance and Disability when Accelerating.

1	Check if failure occurs, such as clutch slipping, low tire pressure, brake delay, wrong tire size and incorrect four-wheel alignment.	Yes	Repair
		No	Next step
2	Check if the electronic throttle can be full opening.	Yes	Next step
		No	Repair or replace the throttle
3	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
4	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check the ignition advance angle.	Yes	Next step
		No	Check the parts involved
5	Put the ignition switch to "ON". Check if it is break or short circuit between 38#, 32#, 54#, 36# pins on ECU connector and 1#, 2#, 4#, 6# pins of throttle position sensor of electronic throttle valve body. check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Next step
		No	Repair or replace Harness
6	Run the engine at idle speed and check if the air intake pressure is from 35 to 65kPa.	Yes	Next step
		No	Overhaul
7	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	11
8	Use a special joint to directly provide a 12V power supply and intermittent ground wire from battery to injector and check if the injector can work intermittently.	Yes	10
		No	Next step
9	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
10	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	16
11	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	15

12	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	14
13	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace the pressure regulator
		No	Repair and replace fuel injector and oil pipe
14	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
15	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace the pressure regulator
16	Check if leak and blocking exist in air intake system and if air flow meter works normally.	Yes	Next step
		No	Replace the sensor
17	Check if spark plug, ignition cable and ignition coil are normal.	Yes	Next step
		No	Replace or adjust
18	Check if it results from air conditioning system.	Yes	Check A/C system
		No	Replace ECU

Note: Poor acceleration of system relates to many factors, such as problem in mechanical part of the engine itself, cylinder pressure and carbon deposit on valve etc. In addition, it is also in connection with other systems, such as power steering system and A/C system.

12.16 Unable to Reach the Maximum Revolution when Accelerating

1	Put the ignition switch to “ON”. Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	With engine off, check if air cleaner is smooth (can not simply rely on visualization, remove the air cleaner and then perform test drive again) and if air intake system is chocked.	Yes	Next step
		No	Replace
3	Run the engine at idle speed and check if the engine revolution speed is normal at idle speed.	Yes	Next step
		No	Repair in accordance with idle speed failure item
4	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Overhaul
5	Put the ignition switch to “ON”. Check if it is break or short circuit between 38#, 32#, 54#, 36# pins on ECU connector and 1#, 2#, 4#, 6# pins of throttle position sensor of electronic throttle valve body.	Yes	Next step
		No	Repair or replace Harness
6	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle is normal.	Yes	Next step
		No	Check other part
7	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	11
8	Check if working positions of camshaft position sensor and crankshaft position sensor are normal.	Yes	Next step
		No	Replace the parts involved
9	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
10	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	16
11	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	15
12		Yes	Replace or clean

	Check if the exhaust system and three-way catalytic converter are jammed.	No	Replace ECU

Note: In case the engine is unable to reach its maximum revolution when accelerating, mainly check if exhaust pipe is chocked and air cleaner is smudgy. In addition, for electric control system of A21, in case of a failure in crankshaft or camshaft position sensor, ECU will take restrictive driving measures to restrict engine revolution to exceed certain value, which should be noted during maintenance process.

12.17 When Releasing Accelerator Pedal after Acceleration, Unsteady Idle Speed Occurs at Instant, even Extinguishes.

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	With engine off, check if air cleaner is smooth (can not simply rely on visualization, remove the air cleaner and then perform test drive again) and if air intake system is chocked.	Yes	Next step
		No	Replace
3	Run the engine at idle speed and check if the engine revolution speed is normal at idle speed.	Yes	Next step
		No	Repair in accordance with idle speed failure item
4	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Overhaul
5	Put the ignition switch to "ON". Check if it is break or short circuit between 38#, 32#, 54#, 36# pins on ECU connector and 1#, 2#, 4#, 6# pins of throttle position sensor of electronic throttle valve body.	Yes	Next step
		No	Repair or replace Harness
6	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle is normal.	Yes	Next step
		No	Check other part
7	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	11
8	Remove air intake hose, check if carbon deposit or other soil (this may result in air intake system of engine being chocked when the valve plate closes) exists.	Yes	Clear carbon deposit
		No	Next step
9	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
10	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	16
11		Yes	Next step

	Check if the fuel pressure value is below 400 kPa.	No	15
12	Check if the exhaust system and three-way catalytic converter are jammed.	Yes	Replace or clean
		No	Replace ECU

Note: For an electric control motor with the electronic throttle body, the main actuators of its air intake system are air flow meter and electronic throttle body. Air flow meter has very high operational reliability and very low failure rate, while, due to particularity of road status in China and affected by operating environment, choke is liable to occur between valve plate and valve body of the electronic throttle body, which may obstruct air from entering the engine and result in extinguish of engine.

12.18 A/C System Failure

1	Check if there is enough coolant, if the A/C belt, the A/C clutch and the pressure switch are in good condition.	Yes	Next step
		No	Troubleshooting
2	Let engine run at idle speed and turn on A/C switch. Enter A/C self diagnosis mode to check the A/C system for failure.	Yes	Remove the failure displayed
		No	Next step
3	Turn on the A/C switch and connect an adaptor between ECU and harness. Measure 75# pin (A/C switch) of ECU and see if there are input signals on it.	Yes	Next step
		No	Check the harness
4	If this vehicle adopts low level control, check if the air condition is working still even though it is turned off.	Yes	Replace or repair the harness
		No	Next step
5	Check if there is low level output at ECU pin No.69 (connect to the ground of pull in winding of A/C relay).	Yes	Repair the A/C replay and harness
		No	Replace ECU

Note: Different from the controlling means of other models, the A/C control system of A21 adopts the automatic A/C and uses double-pressure switch to control incorporation of the A/C system and the fan after A/C starts up.

13. Safety Precautions for System Maintenance

13.1 Safety Precautions for Diagnosis and Maintenance of Gasoline Injection Electronic Control System

(1) Disassembly and assembly requirements for electronic control unit (ECU):

- Controllers shall be removed before welding or paint-baking;
- When disassembling and installing the controller, be sure to set ignition switch to CLOSE position and disconnect the battery with the system for fear to damage the engine control unit during disassembly and installation.
- Power supply wires shall not be removed from battery when engine is in operation or electric system is in use;
- Do not use such heavy current equipment as charger etc. to start the engine by direct bridging;
- Note that the ambient temperature for the controller should not exceed 80℃.

(2) Requirements for cleanness: the following rules should be observed for any operation on oil-supply system and oil-injection system:
- The parts removed should be place at a clean site and covered properly; do not use the cloth (cotton cloth and gauze) with falling off fibre;

(3) Connect and disconnect the connectors of all sorts of harnesses and the connectors of failure diagnosis testers only after the ignition switch is turned off.
- When measuring mains voltage or ground wire grounding of the electronic control system, be sure to check if the connection order and mode are correct;
- Disconnect power cord or ground wire of battery from the system and disconnect harness connector of ECU; both operation modes above may cause loss of information about diagnosis and self-study stored in ECU (the retention time of information after the ECU installed is power off depends on the model).

(4) **Attentions during maintenance of fuel feed system (fuel feed line, fuel pump and fuel injection system):**

Disassembly or installation of oil pump on the tank full of oil or partly full of oil, please note:
- Before operation, get material ready near the fuel tank opening for absorption of heavy discharging fuel, so that, the fuel discharged can be duly absorbed;
- Avoid skin from direct contact with gasoline as best as you can;
- Before loosening a connection part, thoroughly clean this part and the area around the connecting pieces;
- Dishcloth shall be placed around the connecting part for avoide oil-spraying;

- If disassembled parts can not be repaired or for other processing immediately, store them properly.
- The spare parts can be taken out of their package only when they are to be installed; do not use the spare parts without package or with package heavily damaged;
- When installing an injector, be careful not to damage the O-gaskets at both ends of the injector; for installation convenience, apply a little lubricant on the O-gaskets.
- After fuel and fuel feed systems are disassembled, avoid use of compressed air and move of the vehicle as best as you can.

(5) **Safety precaution**

In order to avoid maintenance technical personnel from being injured and fuel injection and ignition devices from being damaged, please note:

In case the engine is running or under starting speed, disconnection of ignition harness is forbidden. Checking the engine for poor working of single cylinder **by means of spark test with ignition cable disconnected is not allowed**;

if it is required to drag the engine by the starter without starting the engine itself, for example, in the case of inspection of cylinder pressure of engine etc., disconnect the harness connectors on engine revolution sensor and camshaft (phase) sensor and connect each sensor properly after the corresponding job has finished, and then use a special diagnostic tester for Chery to clear the failure codes in the system;

When the engine is running at high speed, touching wheel train of engine and revolving parts are forbidden;

When the engine reaches normal operating temperature, both water temperature and pressure of cooling system are very high; therefore, in case maintenance for the cooling system of engine is required, perform corresponding operations only after the engine has stopped and the cooling system has been fully cooled.

When maintaining fuel system of engine, if maintenance for engine compartment is involved, perform the operations only after temperature inside engine compartment of the vehicle has adequately fell;

Under a state that power on of the system is normal, do not touch cooling fan of the engine by hand at any time, because the cooling fan may start up abruptly.

Service Manual for Chery

(SQR473F Engine-Mechanical)

After Sales Service Department of Chery
Automobile Sales Co., Ltd

CONTENTS

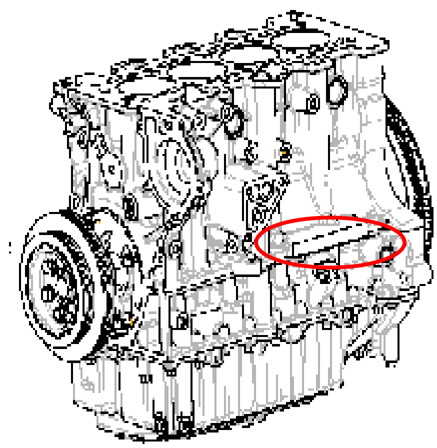
Chapter One Introduction of Characteristics

I. Overview

SQR473F engine is one of the ACTECO series engines that are jointly designed and developed by Chery company and AVL-a world famous engine design company. This engine adopts such advanced technologies as overhead double camshaft structure, 4 air valves, electronic throttle body and electronic accelerator pedal etc. In terms of such mandatory standard indexes as emission and noise, this engine is outdoes national standard and has reached overseas advanced stage.

II. Number Position of the Engine

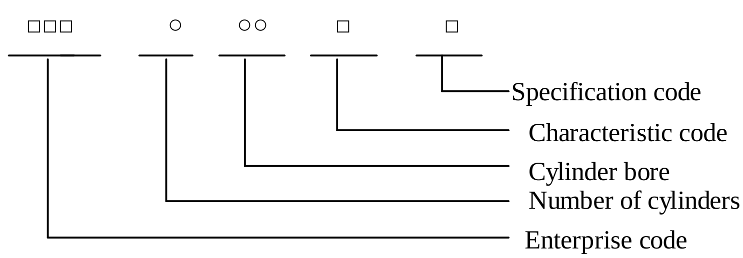
Number of the engine locates at right side of oil filter where bearing shell cover and cylinder block join.



III. Connotation of Engine Number

Each engine has a unique number, from which you can know some characteristics and information of the engine. Engine model should conform to requirements in GB725 and is consisted of enterprise code, number of cylinders of the engine, bore, characteristic code and specification code.

A complete engine model is as follows:



Among which, ○ indicates an Arabic numeral while □ indicates a letter.

The enterprise code is stipulated as SQR;

Number of cylinders of engine is a 1-2 digit integer;

The bore refers to diameter of cylinder sleeve, which is specified by a 2-3 digit integer with the decimal part rounded and millimeter as unit.

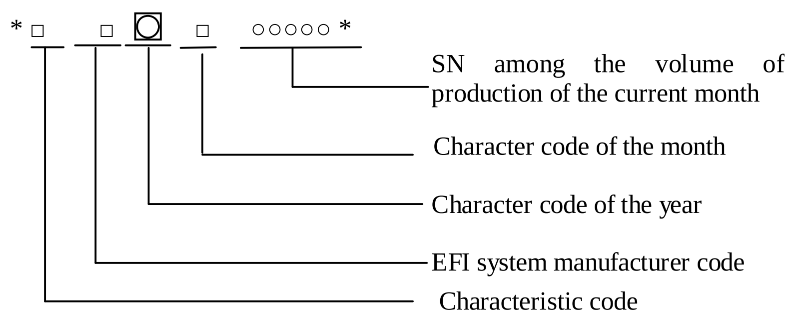
Characteristic code: indicates the most basic characteristics of an engine and is specified by 1 digit upper case English letter.

Specification code: specified by 1 digit upper case English letter, which is used as an additional distinguish code when distinguish is required in case structure, principal parameter or oil supply mode etc. has changed (for example, the stroke of engine has changed or the engine is a dual fuel engine) with number of cylinders, bore and characteristic code of the engine unchanged. For changes of peripheral parts of the engine (such as intake and exhaust manifolds), the engine model will keep unchanged, and engine assembly number will be changed for distinguish. Among the engines of the same series, the specification code will be used with “B” as the first (among which, do not use such letters as “I”, “O”, “Q”, “X” and “Z”). The default specification code for the first fundamental structure is “A”, which is omitted. The specification also can quote the characteristic code to express specific characteristics.

Position of engine model

The engine model should be printed at an obvious part on engine cylinder block and please see provisions in ***Assembly and Regulation Instruction of Engine*** for the specific position.

Leaving factory number of engine is composed of characteristic code of engine, EFI manufacturer code, character code of the year of production, character code of the month of production, sequence number of this engine among the engines of this model manufactured in that month and start stop sign “*”. Complete form of leaving factory number of a engine is as follows:



Among which, ○ indicates an Arabic numeral, □ indicates a letter and $\boxed{\bigcirc}$ indicates an Arabic numeral or a letter.

The characteristic code of engine should conform to above provision.

EFI system manufacturers: C-Motorola; D-Marelli; E-Delphi; F-UAES; G-Siemens; H-Troitec; B-Bosch

Chapter Two Specification

I. Engine Type and Major Parameters

No.	Item	Basic Parameters	
		SQR473	
	Type	SQR473H	SQR473F
		Vertical type, 4 cylinder, water cooling, 4 stroke, in-line double overhead camshaft, controlled burn rate, variable valve timing	Vertical type, 4 cylinder, water cooling, 4 stroke, in-line double overhead camshaft
1	Model	SQR473H	SQR473F
2	Fuel Supply Mode	Multi point electric control gasoline injection	
3	Cylinder Diameter (mm)	73.0	
4	Piston Stroke (mm)	77.5	
5	Working volume (L)	1.297	
6	Compression Ratio	10.0	
7	Type of Combustion Chamber	Ridge type	
8	Ignition Sequence	1-3-4-2	
9	Fuel Designation (not less than)	93# lead-free gasoline	
10	Volume of Engine Oil (L)	3.5 (new engine oil filter)	
11	Engine Oil Designation	SAE10W-40 (grade SJ or above)	
12	Crankshaft Rotational Direction	Clockwise (see from engine belt)	
13	Starting Mode	Electric starting	
14	Cooling Mode	Mandatory circulating antifreeze cooling	
15	Lubricating Mode	Combined type (pressure and splash lubrication)	
16	Net Mass (kg)	105	100

17	Crank Angle with Intake Valve Opening as 1mm (°)	400	369
	Crank Angle at 1mm before Intake Valve Closing (°)	610	569
	Crank Angle with Exhaust Valve Opening as 1mm (°)	200	140
	Crank Angle at 1mm before Exhaust Valve Closing (°)	390	350
18	Ignition Advance Angle (°CA)	12±5	12±5
19	Cylinder Compression Pressure (MPa) (200~300r/min)	1.00～1.35	
20	Overall Dimension (length×width×height)	613×507×734	
21	Electronic fuel injection system	UAES	

II. Major Maintenance Parameters of Engine

No.	Name	Dimension and tolerance	Fit clearance
1	473 engine cylinder hole	φ73.005±0.005	0.04
2	Piston skirt of 473 engine	φ72.965±0.009	
3	Main bearing saddle width of cylinder	$19.5^{0}_{-0.05}$	0.07~0.265
	Thickness of thrust plate	$2.4^{+0.05}_{0}$	
	Crankshaft main journal	$24.5^{+0.015}_{-0.030}$	

No.	Name	Dimension and tolerance	Fit clearance
4	Thickness of connecting rod big end	$22^{0}_{-0.1}$	0.15~0.4
	Width of crankshaft connecting rod journal	$22^{+0.30}_{+0.15}$	
5	First piston ring groove height	$1.2^{+0.05}_{+0.03}$	0.035~0.08
	Top compression ring height	$1.2^{-0.005}_{-0.03}$	
6	Second piston ring groove height	$1.5^{+0.04}_{+0.02}$	0.025~0.07
	Second compression ring height	$1.5^{-0.005}_{-0.030}$	
7	piston oil ring groove height	$2.5^{+0.03}_{+0.01}$	0.02~0.18
	Blade height of steel strip composite type oil ring	0.46±0.02	
	Bracing spring height of steel strip composite type oil ring	1.5±0.03	
8	Crankshaft key groove width	$5^{+0.014}_{-0.010}$	
9	Diameter of crankshaft front oil seal	$\Phi 36^{0}_{-0.1}$	
10	Diameter of crankshaft rear oil seal	$\Phi 75^{0}_{-0.1}$	
11	Outside diameter of engine oil dipstick tube	$f16.7^{0}_{-0.1}$	
	Diameter of cylinder block scale tube orifice	$f16.7^{+0.043}_{0}$	
12	Diameter of cylinder head valve guide orifice	φ6+0.015	
	Outside diameter of valve guide	φ11x6	-0.022～ -0.050
	Diameter of cylinder head valve guide bottom orifice	φ11H7	
13	Outside diameter of intake valve stem	φ5.98±0.008	+0.012～ +0.043
	Diameter of cylinder head intake valve guide orifice	φ6+0.015	
14	Exhaust valve stem diameter	φ5.96±0.008	+0.032～ +0.063
	Diameter of cylinder head exhaust valve guide orifice	φ6+0.015	
15	Diameter of camshaft first journal	$f32e6\begin{pmatrix}-0.050\\-0.066\end{pmatrix}$	+0.050～ +0.090
	Diameter of cylinder head first bearing hole	$\varnothing 32\ H7\begin{pmatrix}+0.025\\0\end{pmatrix}$	
16	Diameter of camshaft second journal	$f24e6\begin{pmatrix}-0.040\\-0.053\end{pmatrix}$	+0.040～ +0.074
	Diameter of cylinder head second bearing hole	$f24H7\begin{pmatrix}+0.021\\0\end{pmatrix}$	
17	Diameter of camshaft third journal	$f24e6\begin{pmatrix}-0.040\\-0.053\end{pmatrix}$	+0.040～

No.	Name	Dimension and tolerance	Fit clearance
	Diameter of cylinder head third bearing hole	$f\,24H7\left(^{+0.021}_{0}\right)$	+0.074
18	Diameter of camshaft fourth journal	$f\,24e6\left(^{-0.040}_{-0.053}\right)$	+0.040～+0.074
	Diameter of cylinder head fourth bearing hole	$f\,24H7\left(^{+0.021}_{0}\right)$	
19	Diameter of camshaft fifth journal	$f\,24e6\left(^{-0.040}_{-0.053}\right)$	+0.040～+0.074
	Diameter of cylinder head fifth bearing hole	$f\,24H7\left(^{+0.021}_{0}\right)$	
20	Camshaft thrust groove width	$30.65H7\left(^{+0.025}_{0}\right)$	+0.15～+0.20
21	Outside diameter of camshaft oil seal	$f\,50^{+0.4}_{+0.2}$	-0.005～-0.40
	Diameter of cylinder head oil seal hole	$f\,50H7\left(^{+0.025}_{0}\right)$	
22	Diameter of cylinder head jib hole	$f\,12G7\left(^{+0.024}_{+0.006}\right)$	+0.006～+0.035
	Outside diameter of hydraulic jib	φ12-0.011	
23	Diameter of crankshaft timing gear segment	Φ28f7	
	Bore diameter of crankshaft timing gear	φ28＋0.030	
24	Key groove dimension of crankshaft timing gear	$5^{+0.030}$	0~0.06
	Key groove width of crankshaft gear	$5^{+0.030}$	
	Semicircular key width	$5^{0}_{-0.030}$	
25	Bore diameter of crankshaft pulley	$\varphi 74^{+0.046}$	0.096~0.126
26	Outside diameter of timing gear	$\varphi 74^{-0.05}_{-0.08}$	

III. Primary Fit Clearance

Name	Fit Clearance
Axial clearance of crankshaft	0.07～0.265mm
Axial Clearance of Camshaft	0.15～0.20mm
Axial clearance of connecting rod	0.15～0.4mm
Fit clearance of connecting rod bearing	0.023～0.058mm
Fit clearance of main bearing	0.035～0.075mm
Fit clearance between intake valve stem and valve	0.012～0.043mm

guide	
Fit clearance between exhaust valve stem and valve guide	0.032～0.063mm
Fit clearance between hydraulic jib and cylinder head hole	0.006～0.035mm

IV. Engine Primary Tightening Torque Table

No.	Connection part	Part name	Bolt (thread specification)	Number of bolts/ gaskets (piece)	Tightening torque Nm (primary tightening)	Multiple steps tightening (torque + angle)		
						First step tightening torque (Nm)	Second step angle (°)	Third step angle (°)
1	Cylinder block main oil passage screw plug 1	Hexagonal socket head plug	M18×1.5	2	20+5	——	——	——
2	Cylinder block main oil passage screw plug 2	Hexagonal socket head plug	M10×1.5	1	20±3	——	——	——
3	Main bearing cap	Hexagon bolt	M11×1.5	4	——	45±5	180±10	——
4	Main bearing cap	Hexagon bolt	M11×1.5X92.5	6	——	45±5	180±10	——
5	Framework-cylinder block	Hexagon bolt	M8×1.25×55	10	20+3	——	——	——
6	Knock sensor-cylinder block	Hexagonal flange bolt	M8×1.25×35	1	20+0.5	——	——	——
7	Connecting rod cap-connecting rod body	Hexagon bolt	M8×1	8	——	25±3	90±5	——
8	Oil pump assembly-cylinder block	Hexagon bolt	M6×35	4	8+3	——	——	——
9	Engine oil collector bracket, separator-framework	Hexagonal flange bolt	M6×12	9	8+3	——	——	——
10	Bleeding plug-oil pan	Hexagon bolt	M16×1.5	1	25±3	——	——	——
11	Oil pan-framework	Hexagonal flange bolt	M7×20	18	15+3	——	——	——
12	Oil pan-framework	Hexagonal flange bolt	M7×35	3	15+3	——	——	——
13	Oil pan-framework	Hexagonal flange bolt	M7×90	4	15+3	——	——	——
14	Water pump-cylinder block	Hexagon bolt	M6×25	5	8+3	——	——	——
15	Cylinder head oil passage throttle bolt	Hexagon throttle bolt	M14×1.5	2	15+3	——	——	——
16	Camshaft bearing cap-cylinder head	Locating bolt	M6×1×30	18	9.5±1.5	——	——	——
17	Camshaft bearing cap-cylinder head	Hexagonal flange bolt	M6×1x30	2	9.5±1.5	——	——	——

No.	Connection part	Part name	Bolt (thread specification)	Number of bolts/ gaskets (piece)	Tightening torque Nm (primary tightening)	Multiple steps tightening (torque + angle)		
						First step tightening torque (Nm)	Second step angle (°)	Third step angle (°)
18	Phaser control valve-first camshaft cap	Inner hexagonal bolt	M6×1×15	2	8+3	——	——	——
19	Cylinder head-cylinder block	Inner hexagonal bolt	M10×1.5	10	——	50±5		
20	Valve cover assembly-cylinder head	Damping unit-valve cover	M6×1×30	12	8+3	——	——	——
21	Camshaft position sensor-valve cover	Inner hexagonal bolt	M6×1×15	2	8+0.5	——	——	——
22	Hanger-cylinder head	Hexagonal flange bolt	M8×14	2	20+5	——	——	——
23	Rear housing of timing gear-cylinder head	Cross head screw	M5×15	6	5+2	——	——	——
24	Phaser-camshaft	Inner TORX hollow bolt	M12×1.25	2	120±5	——	——	——
	Timing gear-camshaft	Bolt	M12×1.25	2	120±5	——	——	——
25	Inlet cam phaser cap-inlet cam phaser	Hexagon bolt		1	30	——	——	——
26	Exhaust cam phaser cap-exhaust cam phaser	Inner TORX bolt		1	30	——	——	——
27	Oil filter assembly-oil filter seat	Screw sleeve	M20×1.5	1	25±3	——	——	——
29	Oil filter joint		M20×1.5	1	25±3	——	——	——
30	Oil filter seat-cylinder block	Inner hexagonal bolt	M8×25	3	20+5	——	——	——
31	Oil pressure switch-oil filter		M14×1.25×12（13×13）	1	12±2	——	——	——
32	Thermostat assembly-cylinder head	Hexagon bolt	M6×60	3	8+3	——	——	——
33	Thermostat cover-thermostat case	Hexagonal flange bolt	M6×20	4	8+3	——	——	——
34	Coolant senser-thermostat shell		M12×1.5	1	20+5	——	——	——
35	Crankshaft timing gear-crankshaft	Hexagonal flange bolt	M13×1.5	1	——	130±10	65±5	——
36	Crankshaft pulley-crankshaft timing gear	Hexagonal flange bolt	M8×1×15	6	——	25±5	30±5	——
37	Flywheel-crankshaft	Hexagonal flange bolt	M8×1.25	8	——	15±5	30±5	——
38	Signal wheel-flywheel	Hexagon bolt	M8×1.25	6	8±2	——	——	——
39	Timing belt-tensioner assembly-cylinder block	Hexagonal flange bolt	M8×55	1	27±3	——	——	——
40	Timing belt-idler assembly-cylinder head	Hexagonal flange bolt	M10×60	1	40+5	——	——	——
41	Bulkhead-crankshaft locating pin hole	Hexagonal flange bolt	M16×1.5	1	25±3	——	——	——

No.	Connection part	Part name	Bolt (thread specification)	Number of bolts/ gaskets (piece)	Tightening torque Nm (primary tightening)	Multiple steps tightening (torque + angle)		
						First step tightening torque (Nm)	Second step angle (°)	Third step angle (°)
42	Front lower cover of timing gear-engine	Hexagonal flange bolt	M6×24	5	8+3	——	——	——
43	Front upper cover of timing gear-engine	Inner hexagonal bolt	M6×30	1	8+3	——	——	——
44	Front upper cover of timing gear-engine	Hexagon bolt	M6×16	4	8+3	——	——	——
45	Air compressor bracket-cylinder block	Hexagonal flange bolt	M8×25	1	10+3	——	——	——
46	Air compressor bracket-cylinder block	Hexagonal flange bolt	M8×65	3	30+3	——	——	——
47	Power steering pump-steering pump bracket	Hexagonal flange bolt	M8×125	1	20+5	——	——	——
48	Power steering pump-steering pump bracket	Hexagonal flange bolt	M8×25	1	20+5	——	——	——
49	Power steering pump-steering pump bracket	Hexagonal flange bolt	M8×80	1	20+5	——	——	——
50	A/C compressor assembly-air compressor bracket	Hexagonal flange bolt	M8×100	1	20＋5	——	——	——
51	Air compressor assembly-air compressor bracket	Hexagonal flange bolt 1	M8×30	1	20+5	——	——	——
52	Generator assembly-generator bracket	Hexagonal flange bolt	M10×90	1	30＋5	——	——	——
53	Generator lower bracket-cylinder block	Hexagonal flange bolt	M10×45	2	40＋5	——	——	——
54	Ignition coil assembly-bracket	Hexagon bolt	M6×1×50	4	8+3	——	——	——
55	Spark plug-cylinder head	Hexagon bolt	M14×1.25	4	30+3	——	——	——
56	Intake manifold-cylinder head	Stud bolt	M6×1×25	9	3+2	——	——	——
57	Intake manifold-cylinder head	Hexagon nut	M6	9	8+3	——	——	——
58	Delivery pipe assembly-air intake pipe	Hexagonal flange bolt	M6×20	2	8+3	——	——	——
59	Throttle body assembly-air intake pipe	Hexagon bolt	M6×1×50	4	8+3	——	——	——
60	Bracket-air intake pipe	Hexagon bolt	M8×30	2	20+5	——	——	——
61	Bracket-air intake pipe	Hexagonal flange bolt	M8×40	2	20+5	——	——	——
62	Engine oil dipstick tube-air compressor bracket	Inner hexagonal bolt	M6×16	1	8+3	——	——	——
63	Engine oil dipstick tube-framework	Hexagon bolt	M6×16	1	8+3	——	——	——

No.	Connection part	Part name	Bolt (thread specification)	Number of bolts/ gaskets (piece)	Tightening torque Nm (primary tightening)	Multiple steps tightening (torque + angle)		
						First step tightening torque (Nm)	Second step angle (°)	Third step angle (°)
64	Exhaust manifold-cylinder head	Stud bolt	M8×1×46	9	12+3	——	——	——
65	Exhaust manifold-cylinder head	Hexagon nut	M8	9	20+5	——	——	——
66	Exhaust pipe thermal shield-exhaust pipe	Hexagon bolt	M8×12	3	20+5	——	——	——
67	Oil return pipe bracket-cylinder block	Hexagon bolt	M8×20	1	20+5	——	——	——
68	Oil return pipe hollow screw		M14×1.5	1	15+3	——	——	——
69	Bracket-oil-gas separator	Inner hexagonal bolt	M5×14	2	6+2	——	——	——
70	Bracket-oil-gas separator	Inner hexagonal bolt	M6×14	2	8+3	——	——	——
85	Other		M4		2.5±0.5	——	——	——
			M5		5±1.5	——	——	——
			M6		8±3	——	——	——
			M7		15±3	——	——	——
			M8		20±5	——	——	——
			M10		40±5	——	——	——

V. The Parts where Lubrication are Required during Assembly of Engine

No.	Lubrication parts	Type of lubricant
1	Piston pin and pin hole	SJ10W-40
2	Piston ring groove	SJ10W-40

3	Connecting rod bearing shell and connecting rod journal	SJ10W-40
4	Cylinder sleeve hole	SJ10W-40
5	Main bearing lining and crankshaft main journal	SJ10W-40
6	Crankshaft thrust sheet (at oil groove side) and thrust surface	SJ10W-40
7	Head and thread of connecting rod bolt	SJ10W-40
8	Head and root of main bearing cap bolt	SJ10W-40
9	Rear oil seal edge and crankshaft oil seal journal	SJ10W-40
10	Head and root of cylinder head bolt	SJ10W-40
11	Valve guide orifice	SJ10W-40
12	Valve stem	SJ10W-40
13	Valve oil seal lip	SJ10W-40
14	Valve seat insert	SJ10W-40
15	Valve keeper ring groove	SJ10W-40
16	Cam and journal of camshaft	SJ10W-40
17	Camshaft bearing hole	SJ10W-40
18	External surface and base plane of hydraulic jib	SJ10W-40
19	Hydraulic jib hole and valve rocker arm head	SJ10W-40
20	Outer ring of oil pump	SJ10W-40
21	Edge or journal of camshaft oil seal	SJ10W-40
22	Intake and exhaust phaser control valve gaskets	SJ10W-40
23	Journal of intake and exhaust phaser	SJ10W-40

VI. The Parts where Rubber Coating are Required during Assembly of Engine

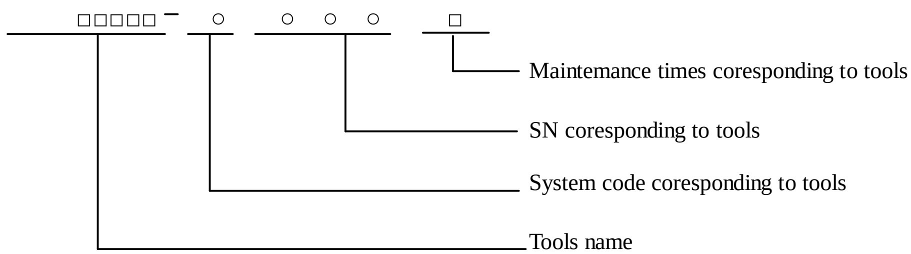
No.	Parts where rubber coating are required	Type of sealant
1	Cylinder block bowl plug	Loctite 648
2	Cylinder block main oil passage plug	Loctite 243
3	Junction plane of framework and cylinder block	Loctite 515
4	Outer ring of crankshaft rear oil seal	Loctite 243
5	Framework and oil pan	Loctite 5910
6	Cylinder head bowl plug	Loctite 648
7	Main oil passage screw plug	Loctite 243
8	Base plane of first bearing cap	Loctite 574
9	Water temperature sensor	Loctite 243
10	Oil pressure switch	Loctite 243
11	Flywheel bolt	Loctite 243
12	Oil pan main oil passage plug	Loctite 243
13	Engine oil collector separator bolt	Loctite 243

Chapter Three Special Tools

Please use the special tools that we designated to perform maintenance, otherwise it will cause accident or damage the machine.

I. Connotation of Special Tool Number

In order to know or find the tool clearly according to parts number and improve maintenance efficiency, special tools numbering is stipulated as follows:



□ indicates a letter ○ indicates an Arabic numeral

Nomenclature of the tool: for a standard part, please use the brand and model recommended by Chery company as reference. For example, CH indicates a non standard part, which means it is a special tool for repair of this part verified by After Sales Service Department of Chery Automobile Sales Co., Ltd. HAZET indicates a standard tool produced by this company.

Connotation of system code corresponding to the tool:

Number	Position
1	Chassis
2	Engine
3	Transmission
4	Accessory
5	Body

Corresponding series number of tools: from 001 to 999.

Times of modifications of the tool:

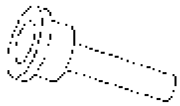
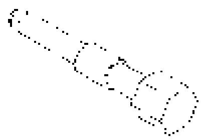
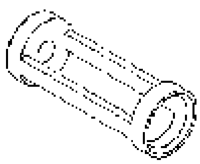
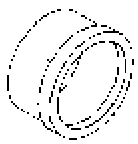
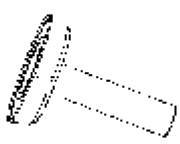
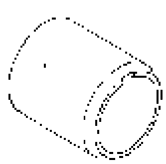
Number	Modification
A	First modification
B	Second modification
C	Third modification
D	Fourth modification

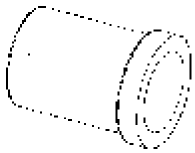
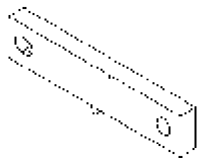
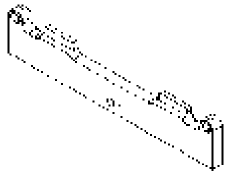
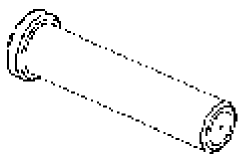
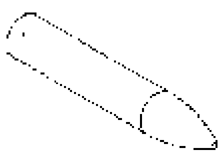
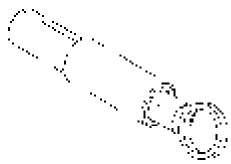
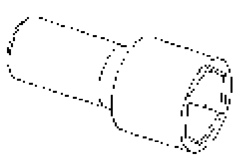
Note: In alphabetical order. Bigger SN means more modification times.

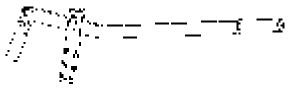
For example: CH-1002A means it is the 2# special tool for repair of chassis system that has been verified by After Sales Service Department of Chery Automobile Sales Co., Ltd., who commits production of this tool to other manufacturer. This tool is of the first modification.

HAZET-6290-1CT means it is a standard tool produced by HAZET company with its model as 6290-1CT.

II. Special Tools Chart

CH-20002 	Installation tool for camshaft oil seal: used to install camshaft oil seal.	Same as A5
CH-20003 	Engine timing tool: used to time crankshaft.	Same as A5
CH-20004 	Adaptor: used to install and remove valve spring (match with Eastar special tool MLR-MD998772A).	Same as A5
CH-20005 	Installation tool for crankshaft rear oil seal: used to install crankshaft rear oil seal.	Same as A5
CH-20006 	Installation handle for crankshaft rear oil seal: used to install crankshaft rear oil seal.	Same as A5
CH-20007 	Installation sleeve for crankshaft front oil seal: used to install crankshaft front oil seal.	Same as A5

CH-20008 	Installation sleeve for crankshaft front oil seal	Same as A5
CH-20009 	Locating tool for flywheel: used to locate flywheel.	Same as A5
CH-20010 	Camshaft timing tool: used to time camshaft.	Same as A5
CH-20011 	Installation tool for camshaft oil seal: used to install camshaft oil seal.	Same as A5
CH-20012 	Valve oil seal guide sleeve: used to install valve oil seal.	Same as A5
CH-20013 	Valve oil seal remover: used to remove valve oil seal.	Same as A5
CH-20015 	Belt pulley bolt remover: used to remove belt pulley clip.	Same as A5

CH-20017 	Installation tool for valve keeper: used to install valve keeper.	Same as A5
CH-20018-A 	Valve spring remover: used to remove valve spring.	Same as A5

Recommended tools

	Loop wheel machine: used to raise engine.
	Engine maintenance workbench: the workbench for disassembly and assembly of engine.
	Fuel pressure gauge: used to measure oil pressure of engine.

	Pressure gauge for cylinder: used to measure cylinder pressure. When measuring, remove spark plug first, screw instrument pipe orifice into the position of spark plug, use starter to drag the engine to rotate, and then fetch the maximum reading of the pressure gauge for cylinder as cylinder pressure of this cylinder.

Chapter Four Measurement of Cylinder Pressure

I. Detection of Cylinder Pressure

Measurement of cylinder pressure is the major index for judgment of engine working condition, through which, we can definitely judge if a certain system of engine works well. Therefore, during maintenance of engine, measurement of cylinder pressure is indispensable.

1. Measuring process

Please select a cylinder pressure gauge with accurate reading and let its pointer return to zero; otherwise, it may affect accuracy of reading.

1.1 Turn off ignition switch, pull out all ignition cables from spark plug side, and then pull out harness connector of injection nozzle.

1.2 Use a spark plug sleeve to loosen the spark plug whose cylinder will be measured. **Explanation:** do not remove the spark plug whose cylinder will not be measured.

1.3 Screw the cylinder pressure gauge joint slowly and vertically into the spark plug hole. Do not screw too tightly for fear that it may be difficult to disassemble.

1.4 Step down clutch pedal, start the engine and let it run for about 5-6s, then fetch the numerical value.

2. Judgment of cylinder pressure value

2.1 Correct cylinder pressure

The standard cylinder pressure value should be 10-13.5bar. With use of engine, this value will fall, but it should not be below 9bar with the pressure difference among cylinders not exceeding 3bar.

2.2 In case cylinder pressure of engine is below the standard value, it indicates deficiency of cylinder pressure, the main cause of which may be untight piston ring seal or valve. Please further analyze and check.

When starting the engine, ensure adequate quantity of electricity. Correct cylinder pressure can only be measured out with revolution of engine as 200-300r/min.

Chapter Five Disassembly of Power-assisted Steering System

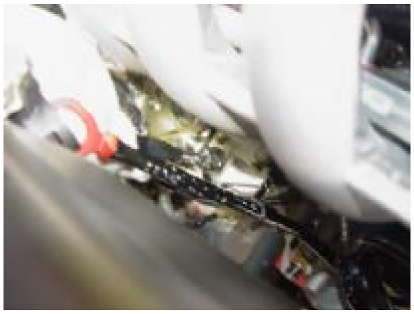
I. Disassembly Procedure

1. Use a snap ring pliers to loosen the clamp on connecting hose of steering fluid reservoir and steering pump. Use a clean container to reclaim the steering fluid.

2. Use a 21# sleeve to remove the fixing bolt of steering pump oil pipe.
Torque: 20+5Nm.

3. Use a 10# sleeve to loosen the (upper) fixing bolt of steering pump adjusting bracket.
Torque: 20+5Nm.

4. Use a 10# sleeve to loosen the (lower) fixing bolt of steering pump adjusting bracket.
Torque: 20+5Nm.



5. Use a 10# open end wrench to loosen the adjusting bolt of steering pump bracket, and then pull the steering pump upwards to loosen and take off the belt.

6. Use a 10# sleeve to loosen the connecting bolt of steering pump and compressor bracket, pull out harness connector, and then dismount the steering pump assembly.

Note: when dismounting the steering pump, please block the oil pipe joint with clean cotton cloth.

II. Overhaul

Steering pump can not be repair, if such failure as abnormal noise or oil leak exists, replace the assembly.

III. Installation of the Steering Pump

1. Follow the order adverse to that of disassembly to install.
2. After installation of steering oil pump, duly adjust tightness of belt through adjusting bolt.
3. After power steering pump is properly installed, refill with special steering pump oil, and then bleed air for the power steering pump after the engine starts.
4. Air bleeding method:
4.1 Hoist the vehicle to let its front wheels leave ground.
4.2 Turn the steering wheel left and right to the ends (duration for each time should not exceed 5s, otherwise, the power steering pump is likely to be burnt out) until the oil pump does not make sound. Note that oil storage kettle should not be lack of steering pump oil.

Chapter Six Disassembly of A/C Compressor

I. Disassembly Procedure

Before disassembling the compressor, disassemble the steering oil pump first.

1. Use a 12# sleeve and a universal joint connecting rod to loosen the connecting bolt of A/C high and low pressure pipelines. (**Note:** if there is R134a in the condenser, use a special equipment to reclaim first.)

After the pipeline is loosened, immediately block high and low pressure holes of the compressor with clean cotton cloth to avoid entry of foreign material into the compressor!

2. Hoist the vehicle and then use a 13# sleeve to loosen the fixing bolt of the compressor from underside.
Torque: 20+5Nm.

3. Lower the vehicle and then use a 13# sleeve to loosen the fixing bolt of the compressor from upside. Use a 13# sleeve to loosen the fixing bolt at middle of the compressor, and then dismount the compressor assembly.
Torque: 20+5Nm.

II. Overhaul of Compressor

Inside of the compressor are assembled with highly machined fine parts, in case abnormal noise or internal failure is found, replace the assembly.

III. Installation procedure

For the installation order, please refer to the disassembly order, and then follow the order adverse to that for disassembly to install. It should be noted that, when installing the A/C pipeline joint on the compressor, be sure to replace with a new gasket and tight the joint at specified torque to avoid leak.

Chapter Seven Disassembly of Generator

I. Disassembly Procedure

Before disassembling the generator, remove the connecting line of battery first.

1. Use a 10# sleeve to remove the connecting line of battery.

2. Use a 10# sleeve to loosen the fixing bolt of generator adjusting bracket, and then take off the adjusting bracket.
Torque: 30+5Nm.

3. Use a 13# sleeve to remove lower fixing bolt of the generator.
Torque: 40+5Nm.

4. Use a 10# sleeve to remove the fixing bolt of generator anode harness, pull out the harness connector, remove the belt and then take out the generator.

II. Overhaul of Generator

In case the generator makes abnormal noise or its yield is too high or too low, replace the assembly.

III. Installation Procedure

The installation order of the generator is adverse to that for its disassembly. After the generator is installed, adjust deflection of the belt.

Chapter Eight Replacement of Engine Timing Belt

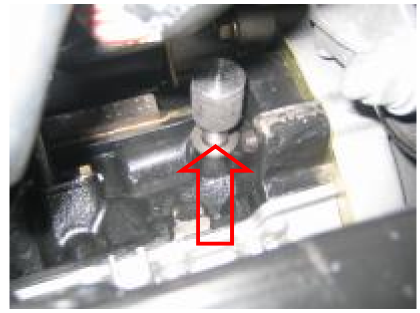
I. Disassembly Procedure

In order to ensure normal and highly effective working of the engine, replacing the timing belt at 50,000km mileage is recommended.

1. Disassembly of engine timing belt:

1.1 Follow the disassembly methods for power-assisted steering pump, compressor and generator to disassemble the generator and compressor belt.

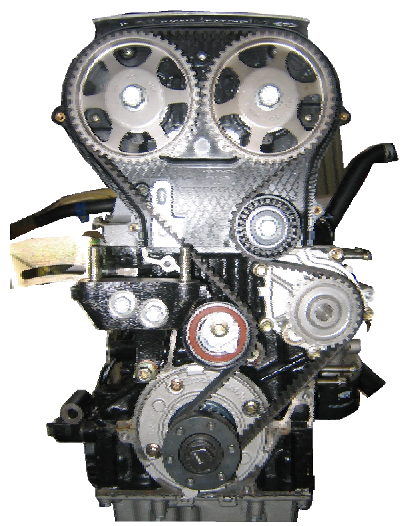
1.2 Use a 5mm hexagon wrench to remove the five fixing bolts on timing upper cover.	
1.3 The positions of the five fixing bolts on timing upper cover are shown by the red circles in the figure.	
1.4 Use a 13# sleeve to loosen the crankshaft timing adjusting hole bolt. (The adjusting bolt is at upside of the starter)	

1.5 Insert the special tool CH-20003 into the timing hole and tighten, use a wrench to turn the big nut in the crankshaft pulley to make the crankshaft rotate, at the same time, slowly screw in CH-20003 until the crankshaft can not rotate back and forth any longer.	
1.6 Use a 13# sleeve to remove the six fixing bolts of crankshaft pulley and take out the crankshaft pulley. Torque: 55+5 Nm.	
1.7 Use a 10# sleeve to remove the six fixing bolts on timing lower cover.	
1.8 The positions of the six fixing bolts on timing lower cover are shown by the red circles in the figure.	
1.9 It should be specially explained that, the position of the fixing bolt at left upside on the lower cover is very occult, for removal of which, use of universal joint connecting rod is required. Alternatively, use a 13mm sleeve to remove the three bolts of suspension bracket to take off the suspension bracket.	

1.10 Use a 10# sleeve to loosen the fixing bolt of the tension pulley to take off the timing belt. Torque: 27±3 Nm. Note: when taking off the timing belt, pay attention to running direction of the belt and refer to running direction of the engine crankshaft and the arrowhead direction on the belt.	

II. Installation of Timing Belt

1. Loosen the fixing bolt of tension pulley and turn the tension pulley to minimum tension position.
2. Install the belt.
3. Use a 5mm hexagon wrench to turn the tension pulley, when it turns to a position that the hexagon wrench and the fixing bolt are roughly on the same horizontal line, stop and tighten the fixing bolt.
4. Install timing lower cover.
5. Install crankshaft pulley.
6. Install relevant accessories and check deflection of the belt.
7. Install timing upper cover.
8. The installed timing belt is as shown in the figure.



Note:
During the disassembly process, be sure not to turn crankshaft/camshaft; otherwise, ignition timing will need re-check.

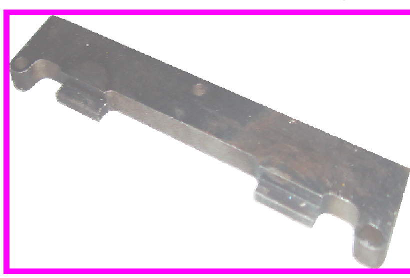
III. Adjustment of Timing (general overhaul)

1. Turn the crankshaft to make the four pistons align on a horizontal line in the cylinders, screw the special tool into the crankshaft timing adjusting hole at left rear of the cylinder (last segment of the crankshaft), and then make the crankshaft unable to turn left and right (the bolt of the special tool must enter into the screw hole plane of the cylinder).
2. After intake and exhaust camshaft is installed properly, install the camshaft timing gear, turn the groove at tail of intake and exhaust camshaft to horizontal direction, and then insert the special tool into the groove and fix.
3. After crankshaft and camshaft have been fixed according to requirements, install timing belt. In order to facilitate installation of timing belt, temporarily do not tighten the bolt fixing the timing gear onto camshaft and let it rotate freely, then fix the timing gear bolt after the tensioner pulley has fastened the timing belt to the specified value. After that, install other parts.

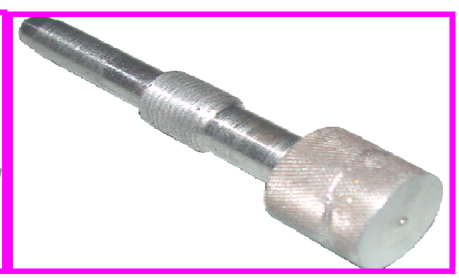
IV. Adjustment of Timing (minor overhaul)

Replace valve spring, grind valve and replace camshaft (do not raise the engine).

1. Remove the valve cover.
2. Remove the timing gear cover. Turn the timing gear.
3. Let the groove at tail of intake and exhaust camshaft on a horizontal line, then insert the projecting portion of the special tool into the groove and fix.
4. Turn the crankshaft, screw the special tool into the crankshaft timing adjusting hole at left rear of the cylinder (last segment of the crankshaft), and then make the crankshaft unable to turn left and right (if the cylinder head is removed, it can be found that the pistons of the four cylinders now align at a horizontal position).
5. Install timing belt and make tightness of the belt conform to requirements.
6. Fasten the fixing bolt of timing gear.
7. Install other accessories, such as timing cover and belt pulley etc.



Special tool for camshaft timing check
(CH-20010)



Special tool for crankshaft timing check
(CH-20003)

Chapter Nine Disassembly of Engine Assembly

I. Disassembly Procedure

Note:

Please use regular equipment, especially for such equipment as crane etc., so as to avoid occurrence of accident.

Before any disassembly job, disassemble cathode of battery first, so as to protect safety of electricity consumption equipment.

When disassembling engine suspension, pay attention to disassembly order, so as to avoid occurrence of accident.

1. Disassembly of engine wire harness

1.1 Pull out the connecting plug of engine wire harness.

1.2 Use a 10# sleeve to loosen the fixing bolt of engine ground.

2. Use a 10# sleeve to remove the fixing bolt and bearer of battery.

3. Use a 13# sleeve to remove the bolt of battery support fixed mount.

4. Disassembly of cooling system.

4.1 Hoist the vehicle, place away a coolant collector, unscrew bleeder bolt of the water tank to discharge the coolant.

4.2 Use the snap ring pliers to loosen the clamp on connecting pipe of water tank.

4.3 Use the snap ring pliers to loosen the connecting water pipe of A/C heating water tank.

4.4 Use the snap ring pliers to loosen other connecting water pipes.

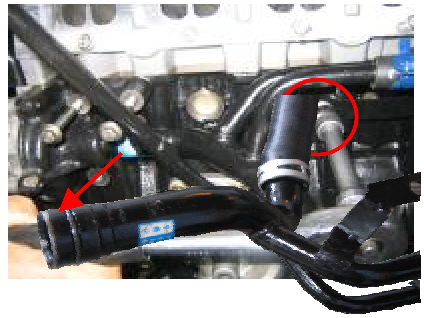
5. Disassembly and installation of water pump assembly:

5.1 Remove upper and lower covers of timing gear (refer to disassembly and installation of gear and belt of timing gear).

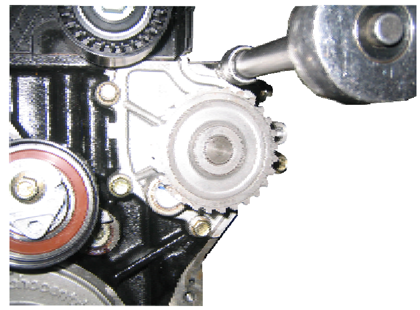
5.2 Use a caliper to take off the clamps on the three discharging tubes and then pull out the rubber hoses.

5.3 Use a 10mm sleeve to remove the fixing bolt of discharging tube of water pump and then pull out the discharging tube.

Note: in case the O-ring on discharging tube of water pump is loose, broken or aging, be sure to replace.



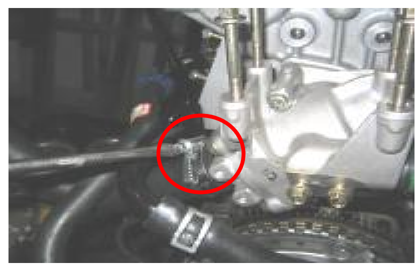
5.4 Use a 10mm sleeve to remove the fixing bolt of water pump and then take out the water pump assembly; when removing, be careful not to damage cushion of the water pump, if damaged, replace with a new one. The water pump can not be decomposed to maintain.



5.5 Check water seal of the water pump for water leak; if water pump bearing is loose, replace the assembly. Follow the order adverse to that for disassembly of the water pump to install it.

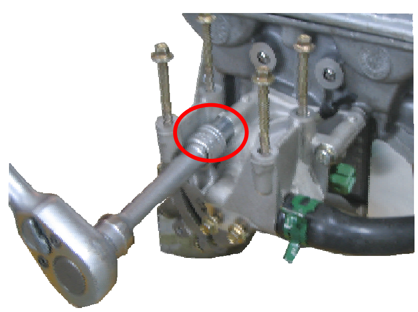
5.6 Disassembly and installation of thermostat

5.7 Use a caliper to take off the clamps on the two discharging tubes and then pull out the rubber hoses.



5.8 Use a 10mm sleeve to remove the fixing bolt of thermostat cover and then take out the thermostat.

5.9 Use a 10mm socket wrench to remove the thermostat seat. Be careful not to damage the thin sheet gasket.



6. Inspection of thermostat:

(1) Under normal temperature, inspect seating status of the valve and it should tightly seat.

(2) Inspect opening temperature and maximum stroke of the valve.

Opening temperature of the valve is 87±2℃

Maximum stroke of the valve is 8mm

Full opening temperature of the valve is 104℃

(3) Then check if the valve closes at the temperature 5℃ lower than the opening temperature. If not compliant, replacement with a new thermostat is required. Follow the order adverse to that for disassembly of the thermostat to install it. When installing, check if the gasket of the thermostat is damaged, if thermostat seat and thermostat cover casing plane are satisfactory. Check the sealing gasket for damage, if damaged, replace with new sealing element.

7. Disassembly of A/C pipeline

See **Disassembly of A/C Compressor** for disassembly of A/C pipeline.

8. Disassembly of power-assisted steering pipeline.

See **Disassembly of Power-assisted Steering Oil Pump** for disassembly of power-assisted steering pipeline.

9. Disassembly of intake and exhaust manifold.

9.1 Use a 10# sleeve to remove the fixing bolt of air intake pipe.

9.2 Use a cross-head screwdriver to loosen the clamp connecting intake hose and electronic throttle body.

9.3 Use a 13# sleeve to remove the connecting bolt of three-way catalytic converter and exhaust intermediate pipe.
Torque: 60±5 Nm.

9.4 Use a 10# sleeve to remove heat insulating mattress of exhaust pipe.

9.5 Use a 13# sleeve to remove the connecting bolt of exhaust manifold and three-way catalytic converter.
Torque: 60±5 Nm.

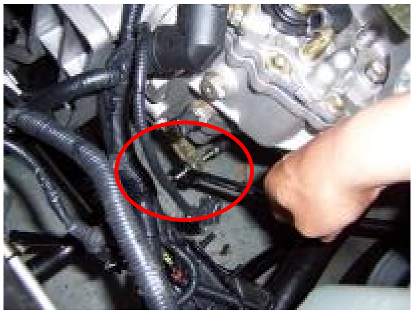
9.6 Use a 13# sleeve to remove the fixing bolt of exhaust manifold.

10. Disassembly of connecting portion of transmission case.

10.1 Use pliers to remove the fixing steel wire clip of gearshift control cable.

10.2 Use pliers to remove the fixing clip of gearshift control cable outer case and then take off the gearshift control cable.

10.3 Use a 13# sleeve to loosen the adjusting screw of clutch control cable and then take off the clutch control cable.



10.4 Use a 13# sleeve to loosen the fixing bolt of clutch control cable on the transmission case.

10.5 Use a 17# wrench to loosen the bleeding bolt of transmission case to discharge the gear oil.

10.6 See **Service Manual for Chassis** for disassembly of suspension travel portion.

10.7 Use a crow to pry out the half shaft.

11. Disassembly of suspension portion

11.1 Use a 13# sleeve to remove the fixing bolt for rear engine mount bracket of transmission case.

Torque: 60±5Nm.

11.2 Use a 18# sleeve to loosen the fixing bolt for front engine mount bracket.
Torque: 80±5 Nm.

11.3 Use a crane to hoist the engine until the iron chain just bears tensile force.

11.4 Use a 15# sleeve to loosen the fixing bolt for right engine mount bracket. (at rear of transmission)
Torque: 100±5 Nm.

11.5 Use a 13# sleeve to loosen the three connecting bolts for right engine mount bracket.
Torque: 65±5Nm.

11.6 Use a 13# sleeve to loosen the three connecting bolts for left engine mount bracket.
11.7 Pull out oil pipe connector and junctions of relevant pipelines. Make sure that relevant junction parts have all detached.
11.8 Hoist the engine up.

12. Separation of transmission case assembly and engine

12.1 Use a 10# sleeve to remove the gearshift control cable bracket on the transmission case.

12.2 Use a 13# sleeve to loosen the four fixing bolts for front engine mount bracket.

Torque: 65±5Nm.

12.3 Use a 13# sleeve to remove the connecting bolt of transmission case and engine, and then make the engine and the transmission separate.

Torque: 100±10 Nm.

II. Installation Procedure

1. Please follow the order adverse to that for disassembly to install, but care should be taken for the following matters.

(1) When hoisting, do not install exhaust manifold first, because the longitudinal separation of engine compartment is not big enough; otherwise, it may affect the assembly.

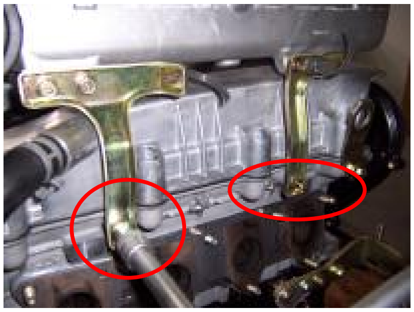
(2) After installation, please adjust the stroke of clutch pedal. When adjusting, adjust it to a proper position according to the corresponding requirements, in case of a too big free stroke of clutch, it may make sound when shifting gear or fail to release; while in case of a too small stroke, wear of friction plate may be accelerated and travel weakness may occur, if severely, the friction plate may be burnt out.

Chapter Ten Disassembly of Intake Manifold

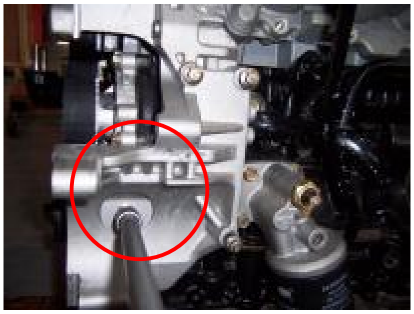
I. Disassembly Procedure

1. Use an 8# sleeve to remove the four fixing bolts of ignition coil and then remove such connections as ignition cable/injection nozzle harness etc.

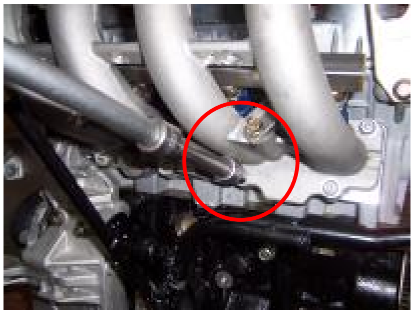
2 Use a 10# sleeve to remove the bolt of intake manifold fixing bracket.



3. Use a 10# sleeve to remove the fixing bolt of compressor bracket.
Torque: 30±3 Nm.



4 Use a 10# sleeve to remove the fixing bolt of intake manifold and then take off the intake manifold assembly.
Torque: 8+3Nm.

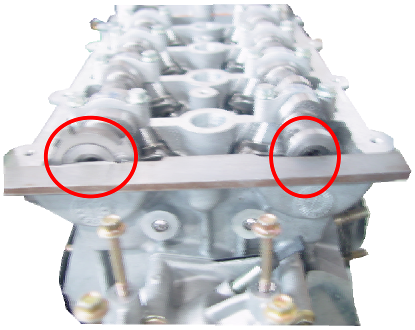


Chapter Eleven Disassembly of Cylinder Head

I. Disassembly Procedure

1 Use a 10# sleeve to remove the fixing bolt of valve cover.
Torque: 8±3 Nm.

2. Get the special tool CH-20010 stuck into the groove on camshaft.



3. Use a 18# sleeve to loosen the fixing bolt of camshaft timing gear.

Torque: 120±5Nm.

Note:

There is no difference between intake camshaft and exhaust camshaft, they can be interchanged.

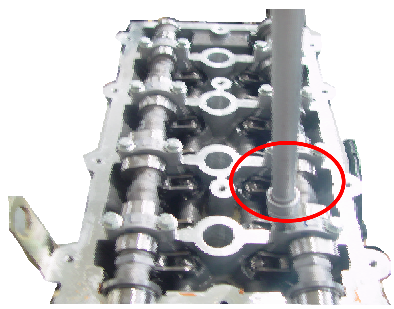
4. Use a cross-head screwdriver to loosen the fixing bolt on inner fender of timing gear and then take out the inner fender of timing gear.

5. Use a 10# sleeve to remove the fixing bolt of camshaft bearing, take out the camshaft assembly and then the hydraulic tappet system.

Torque: 9.5±1.5 Nm.

Note:

The positions of both camshaft bearing and bolts, including the order of camshaft bearing, are unchangeable, and should be conformity with the marks during assembly/disassembly.

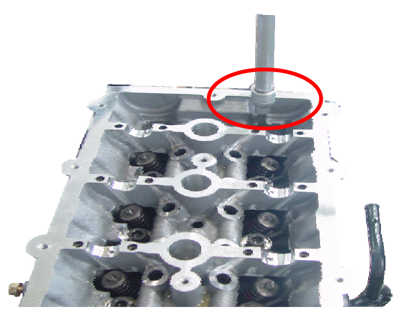


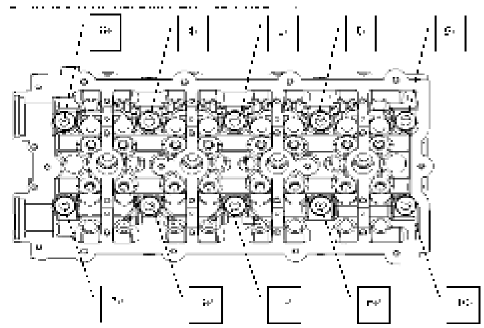
6. Use an hexagon torque wrench to loosen the fixing bolt of cylinder head and then take off the cylinder head assembly.

Torque: 50±5 Nm.

Note:

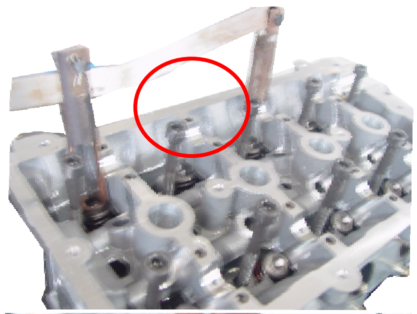
Follow the order as shown in the figure to loosen the fixing bolts of cylinder head.





7. Disassembly of valve

7.1 Use a special tool to press down the valve spring, take out the locking plate, and then take off valve spring, valve and valve seat insert.



7.2 Use a special tool to pull out the valve oil seal.

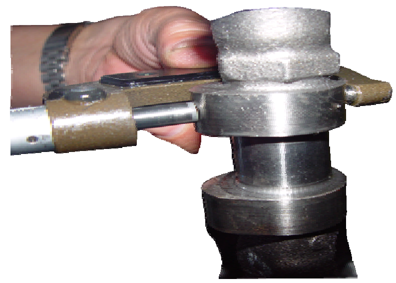
II. Overhaul of Cylinder Head System

1. Detection of camshaft

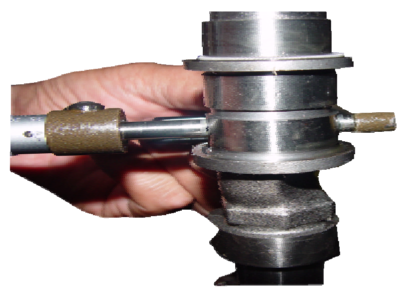
1.1 Measurement of height of cam. Use an outside micrometer to measure wheel height of the cam.

Wheel height of the intake camshaft: 37.11mm.

Wheel height of the exhaust camshaft: 37.09mm.



1.2 Inspection of camshaft journal. Use an outside micrometer to measure each journal of the camshaft, please see **Specification Table** for specific data.

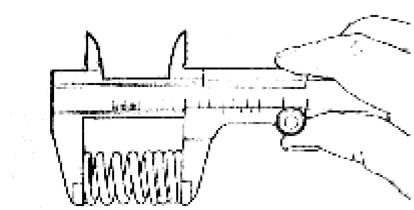


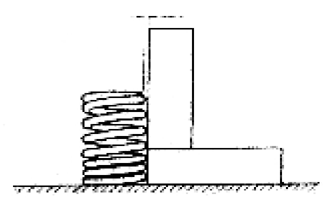
2. Detection of valve

2.1 Detection of valve spring. Two items of data of valve spring should be measured.

Length of the spring: 49mm

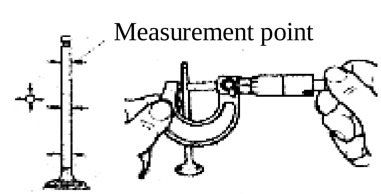
Squareness of the spring: 1.2mm (limit)





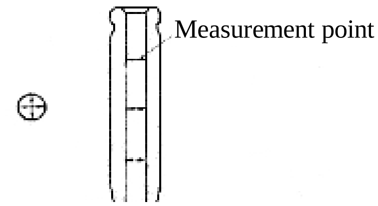
2.2. Detection of valve.

2.2.1 Measurement of diameter of valve stem



2.2.2 Measurement of valve guide inside diameter

Use an inside micrometer to measure inside diameter of the guide.



Note:

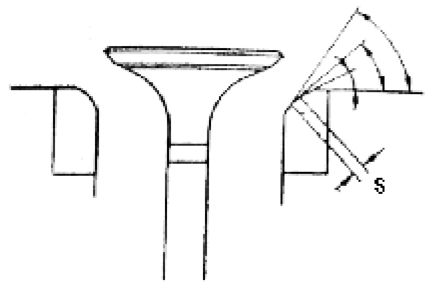
If abnormal noise is generated due to serious wear of valve guide, do not replace the valve guide, because the assembly technique requirements to valve guide is very strict; please replace the cylinder head assembly.

Fit clearance between intake valve stem and valve guide: 0.012~0.043mm

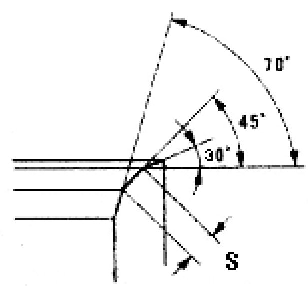
Fit clearance between exhaust valve stem and valve guide: 0.032~0.063mm

2.3 Boring and grinding valve seat insert

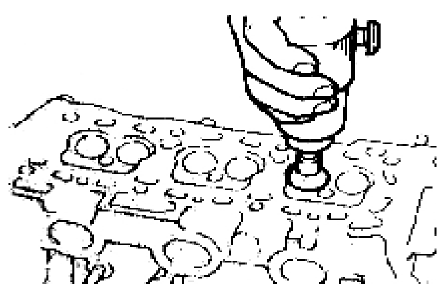
2.3.1 Inspection of fitting surface of valve. Apply a circle of red lead on the valve sealing strip and then gently place the strip onto the valve seat insert, softly and forcibly press it down, but do not turn it. Take out the valve, observe if there is broken part on the red lead, if any, boring and grinding the valve seat insert is required.



2.3.2 Select an appropriate reamer, use 45° conical surface as cooperate standard value to check valve cooperation position: the optimal position is the center of the valve, if not so, be sure to revise. Cut on the conical surface 70° inward and 30° outward at the center of the cooperation position.

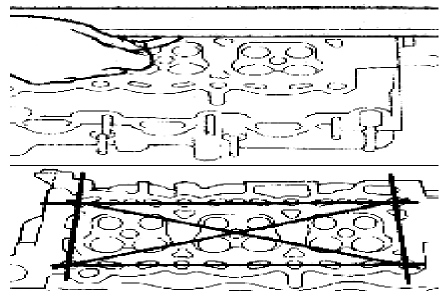


2.3.3 Perform seat grinding for the valve sealing strip with polishing compound



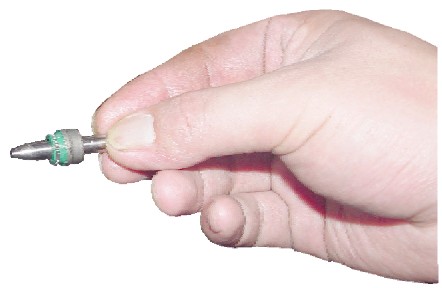
2.3.4 Detection of planeness of cylinder head

Follow the method as shown in the figure to measure planeness of the cylinder head with a feeler gauge; the planeness of the cylinder should not exceed 0.05-0.10mm, if exceeding this valve, replace the cylinder head assembly.

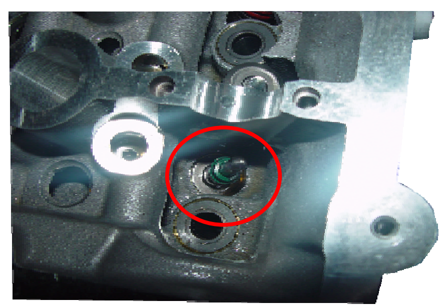


III. Assembly of Cylinder Head Assembly

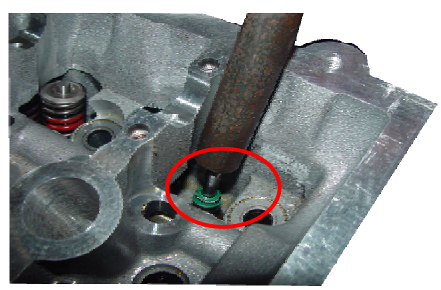
1. Please follow the order adverse to that for disassembly of cylinder head to install, but care should be taken for the following matters during installation.
2. Use the special tool CH-20012 to install new valve oil seal onto the guide first.



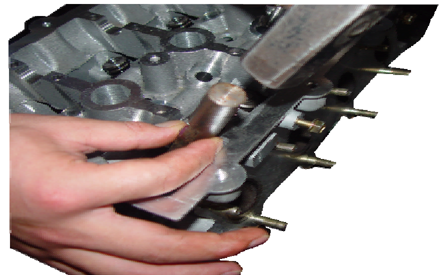
3. Insert big end of the guide onto the valve guide.



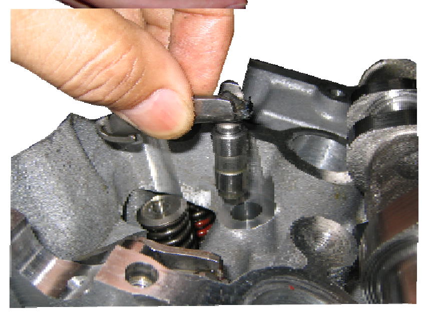
4. Envelope the special tool onto CH-20012, and then softly and forcibly compact.



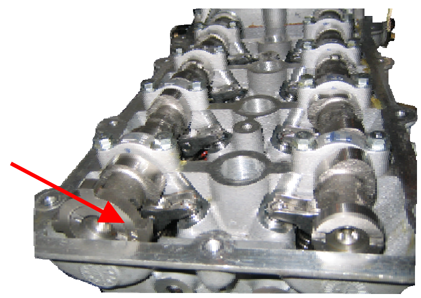
5. Use a hammer to knock the valve oil seal installation tool, when a metal crash sound is heard, take out CH-20012.



6. The methods for installation and assembly of valve spring are the same. Then install valve, spring, keeper, top barrel and rocker arm. (when installing the top barrel, add a little engine oil into the hole).



7. Install camshaft and camshaft bearing shell cover assembly.



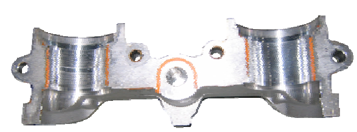
Note:

When installing, remember to differentiate intake camshaft from exhaust cam. The intake camshaft has a gear at tail, and pay attention to the diacritical marks on camshaft bearing shell covers.

8. Installation of camshaft and oil seal

8.1 After adding engine oil on the camshaft bearing shell, place intake and exhaust camshafts, cover bearing shell covers properly, install the fixing bolts for the bearing shell covers, and then use a 10mm sleeve to hold down the bearing shell covers step by step (the two bolts on the one and the same bearing shell cover should be tightened at the same time). Torque: 8.5±1.5 Nm.

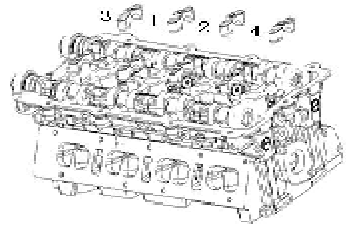
9. Remember to apply sealant to the position as shown in the figure when installing the first bearing shell.



10. Tightening order of camshaft bearing shell cover. Tighten the camshaft bearing shell cover as shown in the figure.

Installation of camshaft oil seal:

Apply a little engine oil on the camshaft oil seal, envelop the oil seal onto the camshaft, and then install use the special tool.



11. Remember to check elasticity of valve cover gasket for aging and breakdown, if any, replace with new one. When installing, pay attention to installation position.

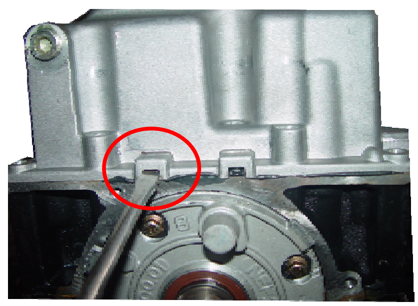
12. Tighten the valve cover bolt.

Chapter Twelve Disassembly and Installation of Oil Pump and Lubrication System

I. Disassembly Procedure

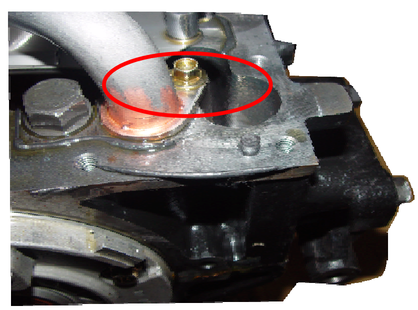
1. Roll over the engine and use a 10# sleeve to remove the fixing bolt of oil pan.
Torque: 15+3 Nm

2. Use a screwdriver to pry out the oil pan at the given position for prying out on the oil pan.

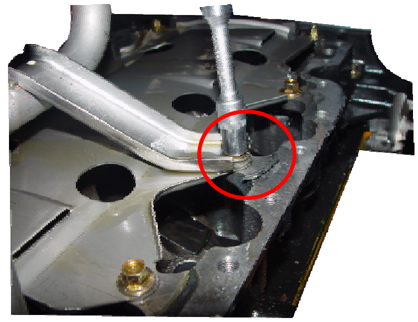


Note:
Because the oil pan and cylinder block are sealed with glue, so, do not knock with such hard articles as hammer etc. when disassembling, use a rubber hammer to slowly strike at left and right instead.

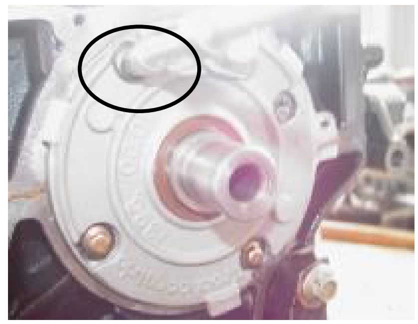
3. Use a 10# sleeve to remove the fixing bolt of engine oil strainer.



4. Use an 8# sleeve to remove the fixing bolt of engine oil guard board.

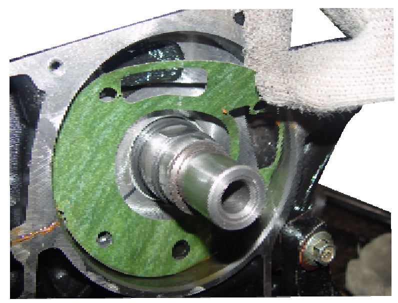


5. Use an 8# sleeve to remove the four fixing bolts of oil pump.
Torque: 8+3Nm



6. Take off the oil pump assembly and then the oil pump shim.

Note:
Do not split the oil pump shim forcibly when disassembling for fear to cause leak.

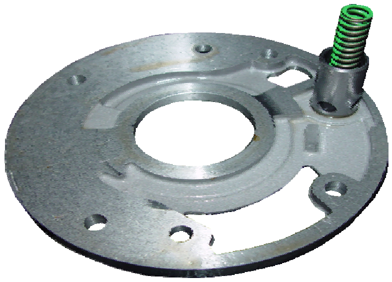


7. Use an hexagon wrench to remove the two connecting bolts of oil pump.

8. Use a screwdriver to pry the crankshaft front oil seal and then take out the oil seal.

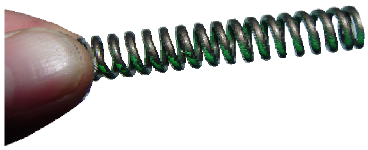
II. Overhaul of Oil Pump

if it is suspected that engine oil pressure may has problem, disassemble the oil pump and check elastic force of relief valve spring and if the valve is locked.



Note:

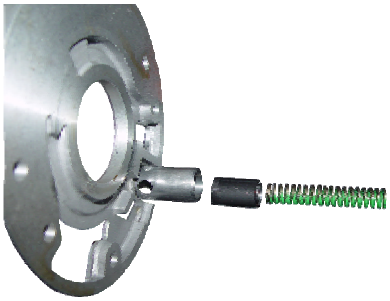
The oil pump is of inner rotor type, which can not be maintained under normal conditions, because its finish size and material ensure its reliability.



III. Installation Procedure

The installation order is adverse to that for disassembly, but care should be taken for the following matters.

1. The installation direction of oil pump relief valve is as shown in the figure.



2. Completely and softly shovel off the glue on the surface of oil pan with a flat shovel and then apply new sealant uniformly (see the table above for type of the sealant).

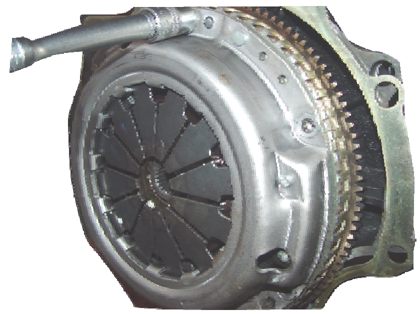
Note:

As soon as new sealant is applied properly, assemble at once; otherwise, the sealant may freeze, which may affect the sealing effect.

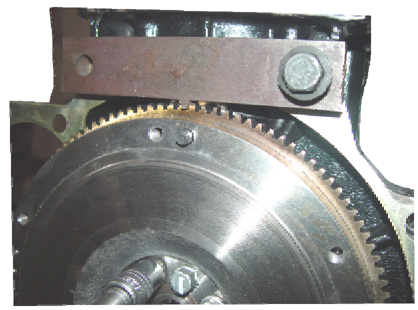
Chapter Thirteen Disassembly of Crank-Connecting Rod Mechanism

I. Disassembly Procedure

1 Use a 13# sleeve to remove the fixing bolt of clutch cover.
Torque: 23±2 Nm



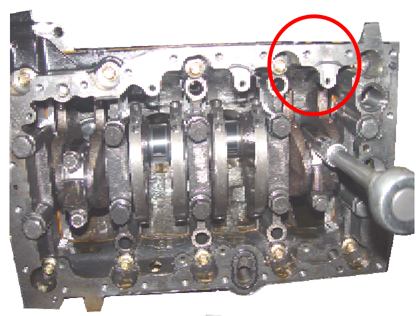
2. Use the special tool CH-20009 to lock the crankshaft and then use a 13# sleeve to remove the connecting bolt of flywheel and crankshaft.



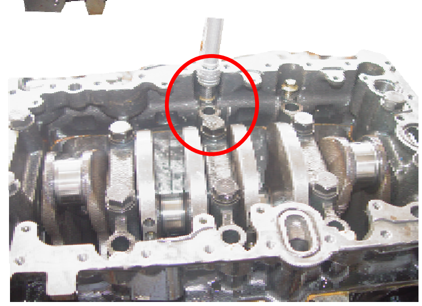
3. Use a 13# sleeve to loosen the fixing bolt of connecting rod bearing cylinder by cylinder and then t[illegible]f the piston and connecting rod assembly.

Note:

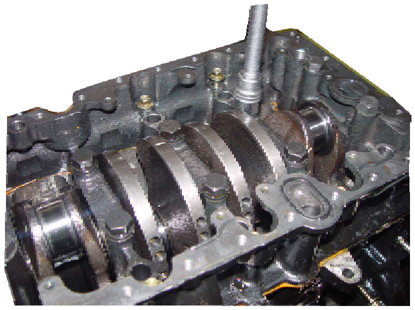
After the pistons are taken out of the cylinders, reset and connect the bearing caps of connecting rod big end and bolts properly and then put them by order.



4. Use a 10# sleeve to remove the fixing bolt of crankshaft lower bearing cap and cylinder block.



5. Use a 19# sleeve to remove the fixing bolt of crankshaft main bearing cap.



Note:
The surface between cylinder block and bearing cap is ensured by high precision machining plane, so, do not use any hard article to scuff this surface.

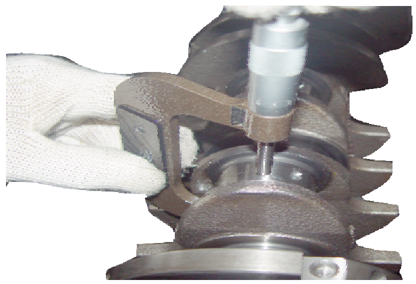
6. Take off crankshaft rear oil seal assembly, remove bearing shell cover, and then take off crankshaft assembly.

II. Overhaul of Crank-Connecting Rod System

1. Detection of crankshaft.

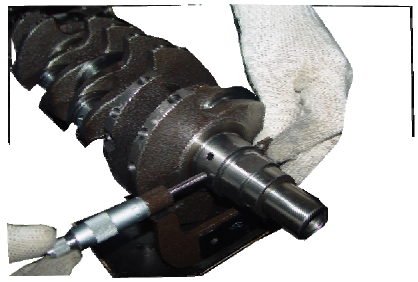
1.1 Detection of crankshaft main journal: use an outside micrometer to measure main journal of crankshaft and the normal value should be 46.01mm.

1.2 Detection of connecting rod journal: use an outside micrometer to measure connecting rod journal of crankshaft and the normal value should be 44.485-44.495mm.



1.3 Measurement of main journal clearance: place a plastic feeler gauge on the crankshaft main journal, tighten the main bearing shell cover to specified torque and then loosen it, use the thickness check list on the plastic feeler gauge to read the value. The normal value should be: 0.02-0.06mm. Use the same method to measure connecting rod journal clearance.

1.4 Measurement of crankshaft axial clearance: tighten the main bearing shell cover to specified torque and then use a dial gauge to measure the crankshaft axial clearance. When measuring, push the crankshaft off the dial gauge first and keep the dial gauge has certain amount of compression, set the pointer to zero, and then push the crankshaft to the adverse direction and the numerical value fetched from the dial gauge will be the crankshaft axial clearance. The normal value should be 0.02-0.30mm. If exceeding this scope, replace the crankshaft thrust sheet or the crankshaft.



2. Detection of piston

2.1 Detection of piston diameter: use an outside micrometer to measure the piston diameter. When measuring, remember to measure at the place about 11mm up from lower end of the piston. The normal value should be φ72.965±0.009.

2.2 The piston pin is of semi-floating type, which can not be disassembled during maintenance, because it can not be assembled using common machining technique after disassembled. If abnormal noise occurs due to improper piston pin clearance, replace the piston assembly.

2.3 Measurement of piston ring.

2.3.1 Measurement of piston ring end play: first, place the piston ring into cylinder.

2.3.2 Push the piston head vertically against the piston ring in the cylinder and let the piston ring be on a plane.

2.3.3 Use a feeler gauge to measure the gap between piston ring ends and the normal value should be: 0.2mm.

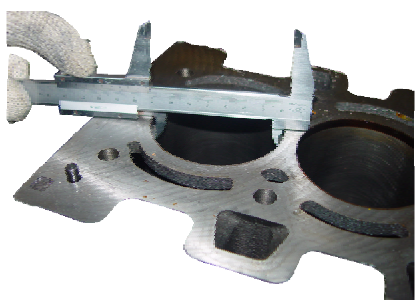
2.3.4 Measurement of piston ring side clearance: place the removed piston ring into the ring groove (lean to one side as possible) and then place a feeler gauge into the other side to measure the clearance; certain resistance feeling after the feeler gauge is placed in indicates that the measurement with feeler gauge will be correct. The normal value should be 0.03mm. Unit: mm

Contents	First ring	Second ring	Third ring
End play	0.2	0.4	/
Side clearance	0.03	0.03	/
Thickness	1.2	1.6	/

3. Measurement of roundness and cylindricity of cylinder

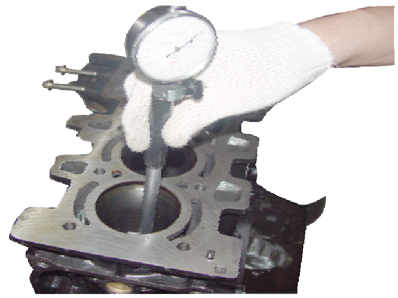
3.1 Select appropriate cylinder gauge and outside micrometer.

3.2 Use a vernier caliper to measure rough diameter of the cylinder hole.

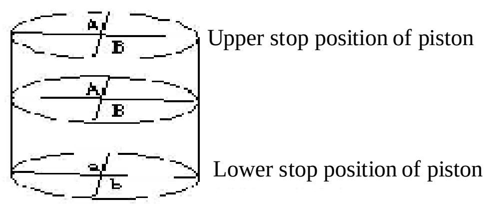


3.3 Adjust the outside micrometer to the data measured out by the vernier caliper, select the splicing pole suitable to the range of the cylinder gauge, and then set the outside micrometer to zero according to this data.

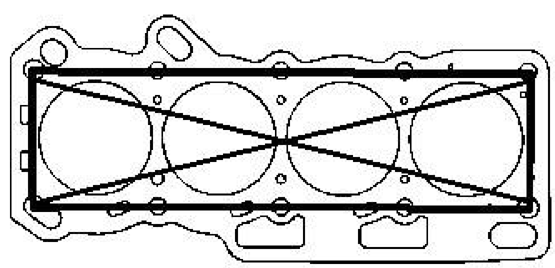
3.4 Place the cylinder gauge into the cylinder to measure; when measuring, the yawing angle of cylinder gauge should not exceed 15º. Fetch the maximum numerical value.



3.5 The measuring position of the cylinder gauge in cylinder is as shown in the figure.
Calculation method for roundness: A-B or a-b
Calculation method for cylindricity: the difference of maximum diameter subtracting minimum diameter among A, a, B, and b.
The normal value should be: if roundness or cylindricity exceeds the range, replace with new cylinder block or install new cylinder sleeve.



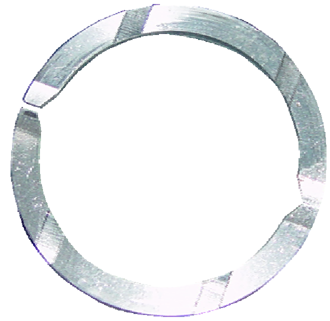
3.6 Measurement of planeness of cylinder block: use steel rule and feeler gauge to measure planeness of the cylinder block. If the planeness exceeds the range, replace the cylinder block.



III. Installation of Crank-Connecting Rod System

The installation order is adverse to that for disassembly, but care should be taken for the following matters. 1. Installation of crankshaft thrust sheet.

When installing the crankshaft thrust sheet, leave the side with oil groove outwards.



2. Installation of crankshaft front oil seal

2.1 Clear smudge on oil seal seat ring, and then apply a layer of lubricant on the seat ring.

2.2 Apply a layer of engine lubricant on the oil seal lip.

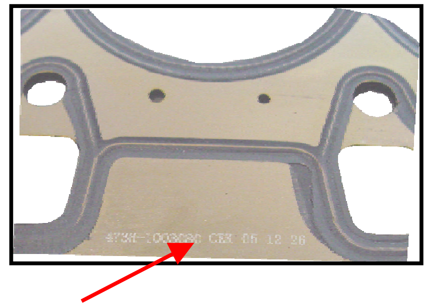
2.3 Enclose the new oil seal with lubricant applied into the special tool. Press the special tool against the oil seal seat ring and softly strike to compact.

3. Installation of crankshaft rear oil seal

3.1 Clean the oil seal seat ring. Dip engine oil with a piece of gauze and then use it to clear the impurities inside the oil seal seat ring.

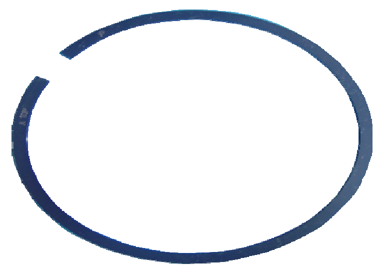
3.2 Apply a layer of engine oil uniformly on crankshaft rear oil seal lip and a little engine oil uniformly on outer ring of oil seal. Envelope the oil seal onto the special tool and then press it into the oil seal seat ring.

4. When installing cylinder cushion, install it with the side with word up.

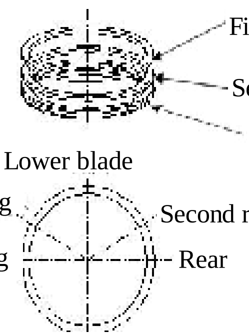


> Note:
>
> The cylinder cushion has been applied with sealant, so, providing that the cylinder head or cylinder block has been disassembled, be sure to replace the cylinder cushion.

5. When installing piston ring, remember to leave the side of the second ring with word up.



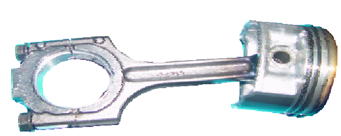
6. The opening position of the piston ring during installation is as shown in the figure.



7. The label on piston head prompts direction and position of installation.

8. Use a special tool to install the piston ring.

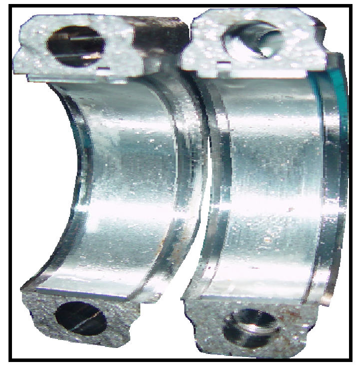
9. When installing connecting rod bearing shell, pay attention to installation mark.



10. Method for shell matching.

Note:

The machining technique for connecting rod and connecting rod shell cap adopts Instantly Swell and Break machining method, so, each machined surface maintains the shape of original material. When installing, keep any sundries out of this machined surface. In addition, only the two machined surface of the same connecting rod can completely engage.



The tightening torque for installing the fixing bolt of connecting rod bearing is 25±3Nm (then turn 90±5° clockwise).

11. Use the piston installation special tool to install the piston.

12. Tighten the fixing bolt of connecting rod bearing cap.

Tightening torque:

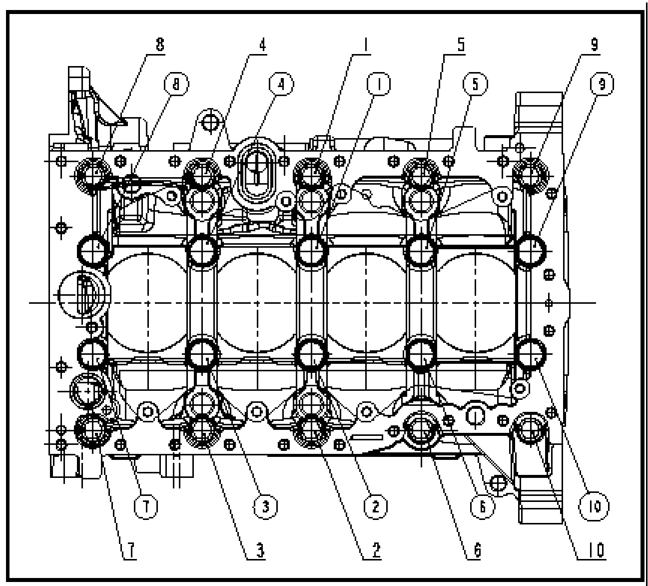
First time: 25±3Nm. Second time: turn 90±5 °.

13. Install the main bearing cap and then follow the order as shown in the figure to tighten the bolt.

Tightening torque:

First time: 45±5Nm.

Second time: turn 180±10°.



14. Tighten the fixing bolt of main bearing cap and cylinder block.

Torque: 20+3 Nm.

Service Manual for Chery

(QR513 Transmission Case)

After Sales Service Department of Chery
Automobile Sales Co., Ltd

CONTENTS

Foreword

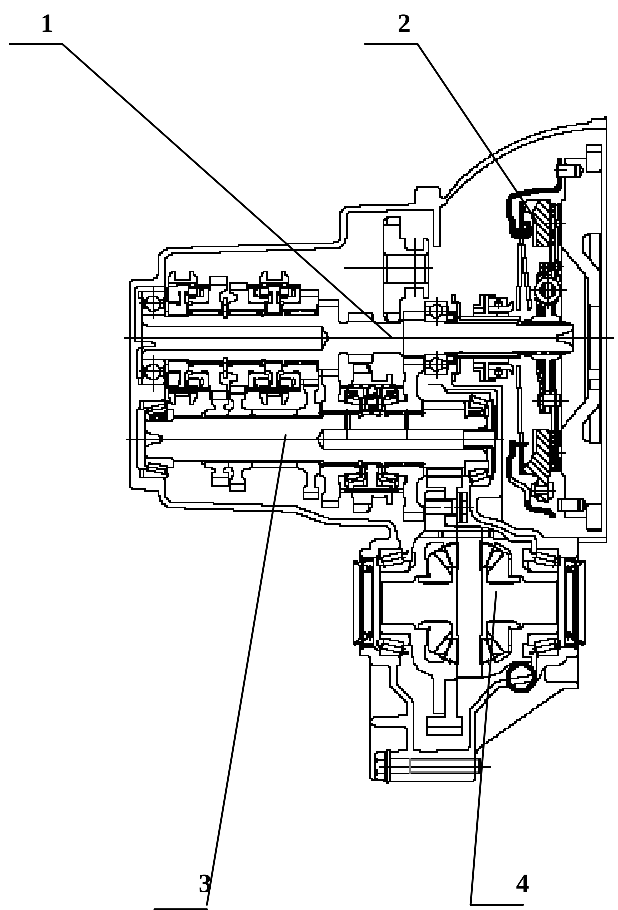
1. This service manual applies to use and maintenance of QR513 transmission manufactured by Chery Automobile Co., Ltd.

2. ***Service Manual for QR513 Transmission*** describes relations among various parts and assemblies of this transmission, which provide the maintenance personnel with a reference when maintaining and repairing QR513 transmission.

3. Due to restrictions of the compiler's level and other conditions, errors and imperfections may exist in this service manual. During maintenance and use, please inform us of any problem in and improvement idea on QR513 transmission and this service manual, so that we can correct and perfect this service manual, for which we express our thanks herein.

Chapter One Introduction of QR513 Transmission

I. Assembly Drawing of QR513 Transmission



1. Input shaft 2. Clutch 3. Output shaft 4. Differential

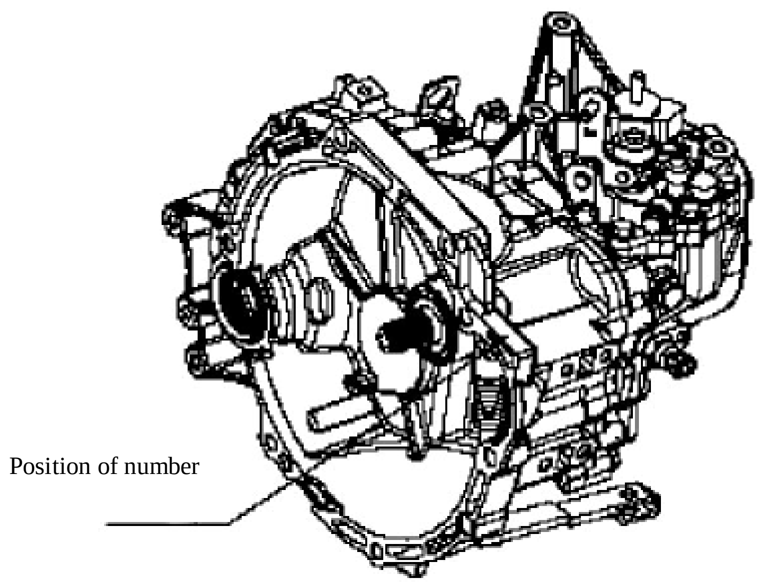
II. Driving Characteristics of QR513 Transmission

This transmission achieves five forward gears and one reverse gear through three groups of synchronizers and two shafts-input shaft and output shaft; all forward gears adopt conventional engagement system while reverse gear adopts a gliding idler device. The synchronizers of the first and second gears are installed on output shaft while the synchronizers of the third, fourth and fifth gears are installed on input shaft. When the transmission is shifted to various gears, these synchronizers will engage with corresponding gear hub to enable transmission of power, and then the driving gear of main decelerator will drive the driven gear of main decelerator and differential assembly to rotate, which will drive the drive shaft to drive the wheels to rotate.

III. SN of QR513 Transmission

1. Print position of SN of QR513 transmission

The print position of SN of QR513 series transmission is as shown in the figure:



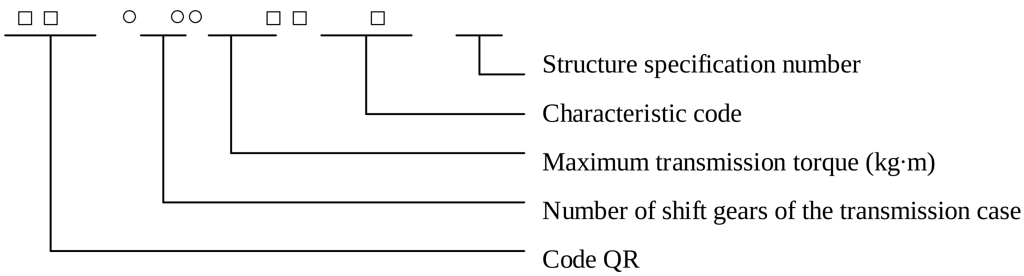
2. Composition and connotation of SN of QR513 transmission

SN of QR513 series transmission is consisted of model and leaving factory number of the transmission case.

1) Model of the transmission case

Model of the transmission case is composed of code QR, number of shift gears of the transmission, maximum transmission torque, characteristic code and structure specification number.

A complete transmission case model is as follows:

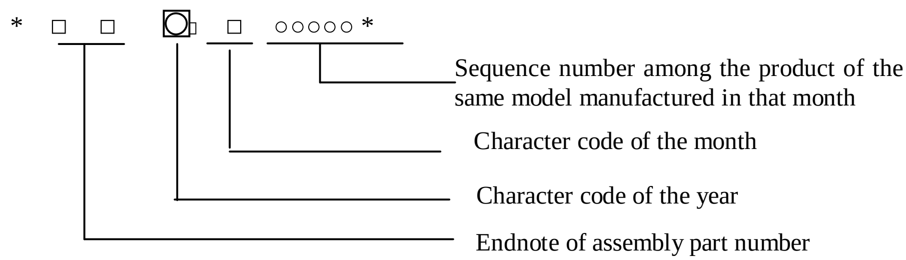


Among which, ○ indicates an Arabic numeral while □ indicates a letter.

2) Leaving factory number

Leaving factory number is composed of endnote of assembly part number (for that without endnote, us AA), character code of the year of production, character code of the month of production, sequence number of this transmission case among the transmission cases manufactured in that month and start stop sign "*". See Table 1 and Table 2 for check list of character codes of the year and of the month.

Complete form of leaving factory number of a transmission case is as follows:



Among which, ○ indicates an Arabic numeral, □ indicates a letter and indicates an Arabic numeral or a letter. The endnote locates at tail end of the part code, for a fundamental model, no endnote. The endnote should be modified when modification is made to structure, dimension, material, heat treatment requirements and surface treatment etc. of the part or assembly on the basis of original product. The English letter in the code should be upper case letter (use in sequence with "A" as the first), in order to avoid confusion, do not use "I", "O" and "X". When the modification does not affect interchangeability, use "A" as the first; when the modification affects interchangeability, skip "A", use "B" as the first.

Table 1 Character Codes Indicating the Years

Year	Code	Year	Code
1999	X	2015	F
2000	Y	2016	G
2001	1	2017	H
2002	2	2018	J
2003	3	2019	K

2004	4	2020	L
2005	5	2021	M
2006	6	2022	N
2007	7	2023	P
2008	8	2024	R
2009	9	2025	S
2010	A	2026	T
2011	B	2027	V
2012	C	2028	W
2013	D	2029	X
2014	E	2030	Y

Table 2 Character Codes Indicating the Months

Month	Code	Month	Code
January	A	July	G
February	B	August	H
March	C	September	J
April	D	October	K
May	E	November	L
June	F	December	M

3) Illustration

For example: QR513MHA MH5H00001 indicates the first transmission case with the model as QR513MHA manufactured in August, 2005.

IV. Specification of QR513 Transmission

	QR513 Series Transmission			
Type	Machine Gear Mesh			
Model	QR513MHA		QR513MHB	
Gear shift	Velocity Ratio	Teeth Ratio	Velocity Ratio	Teeth Ratio
First Gear	3.545	39/11	3.167	38/12
Second Gear	2.05	41/20	2.05	41/20
Third Gear	1.423	37/26	1.423	37/26
Fourth Gear	1.065	33/31	1.065	33/31
Fifth Gear	0.865	32/37	0.865	32/37
Reverse Gear	3.364	37/11	3.364	37/11
Main reduction ratio	4.056	73/18	75	16

Speedometer	0.806	29/36	0.806	29/36
Largest input torque	130 Nm			
Lubricant oil type	GL-4 75W-90			
Volume of lubricant	1.8L			

V. Maintenance Instruction

- In order to ensure maintenance quality of the transmission, when operating, please be careful and ensure cleanness of each part of the transmission.
- Use appropriate tools or special tools.
- Strictly follow the specification to assembly or adjustment to maintain so as to ensure that the transmission can accomplish a favorable working position.

Chapter Two Decomposition of QR513 Transmission

I. Decomposition Process for QR513 Transmission

1. Bleeding lubricant in transmission

First, drive the vehicle onto a maintenance platform or hoist the vehicle and keep it on a horizontal plane, screw off the bleeding plug as shown by the arrowhead, and then use a clean container to accommodate lubricant of the transmission to completely bleed the lubricant in the transmission.

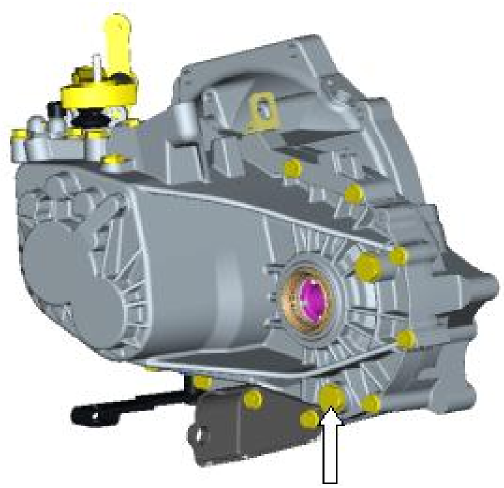


Figure 1

2. Disassembly of external parts of transmission

Switch the transmission to NEUTRAL position; use an appropriate tool to remove the locating seat of the fork shaft as shown in Figure 2; Connecting bolts for gearshift housing and transmission housing and the screws for backup lamp switch and idler shaft.

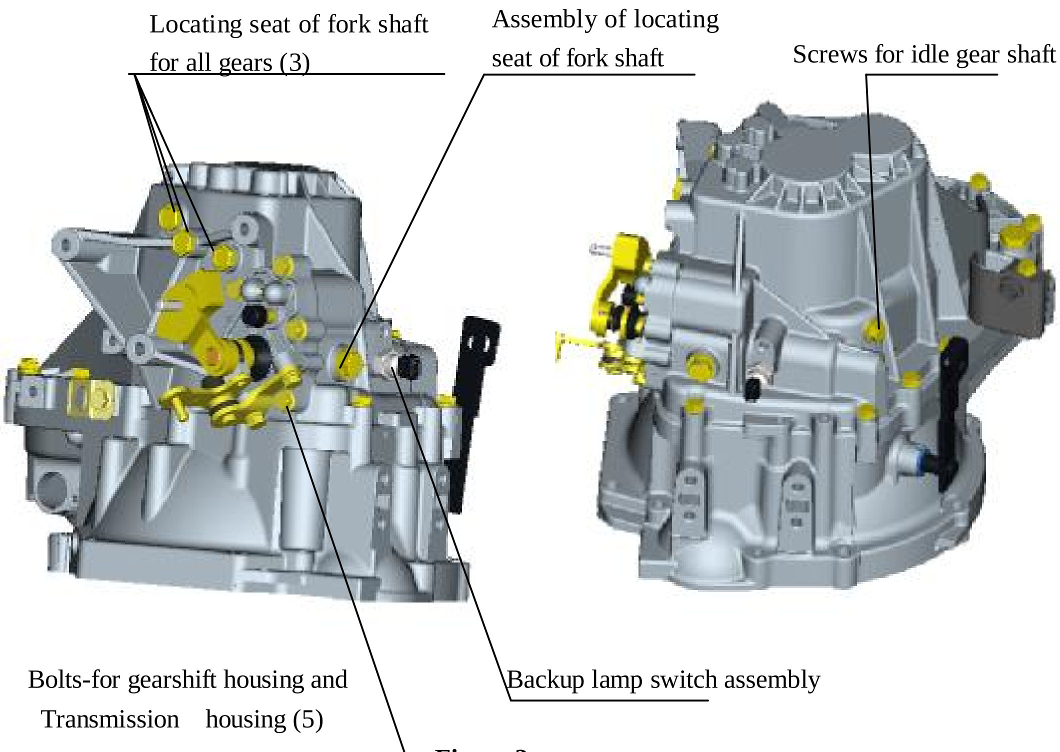


Figure 2

3. Separation of gear shift mechanism and transmission

Remove the gearshift mechanism assembly from the place as shown in Figure 3; as a result of sealant, the disassembly process may be difficult, so, use such tools as a hand hammer etc. to knock on the bulge at flank of housing of the gearshift mechanism, and then take out the whole gearshift mechanism assembly until the two housings completely separate; remember to be slow when taking out the gearshift mechanism assembly, so as to prevent the return spring as shown in the figure from dropping out inside the transmission; during disassembly, be careful not to damage the junction planes of the two housings, so as to avoid oil leak after re-assembly.

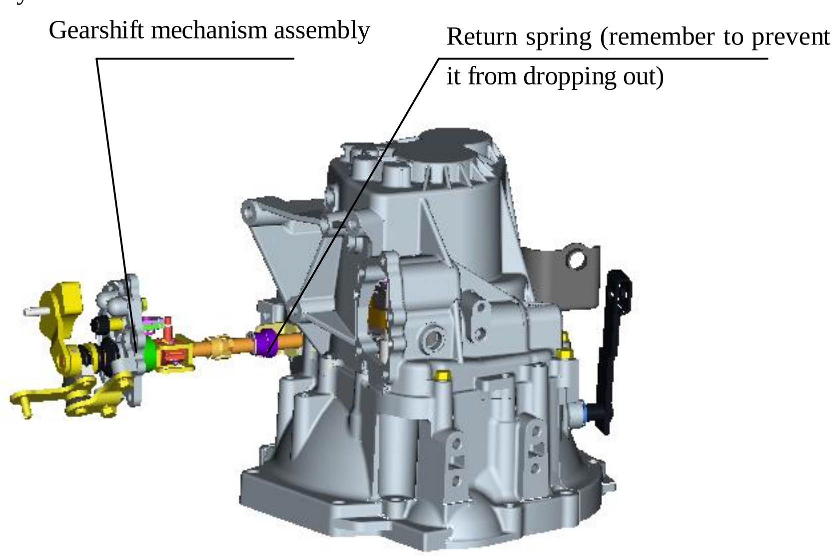


Figure 3

4. Disassembly of the connecting bolts for clutch and transmission housings

Use a tool to remove the connecting bolts for transmission and clutch housings as shown in Figure 4. Remember to remove the bolts both inside and outside the clutch housing when disassembling, and a sleeve with long connecting rod is required when removing the bolts inside the clutch.

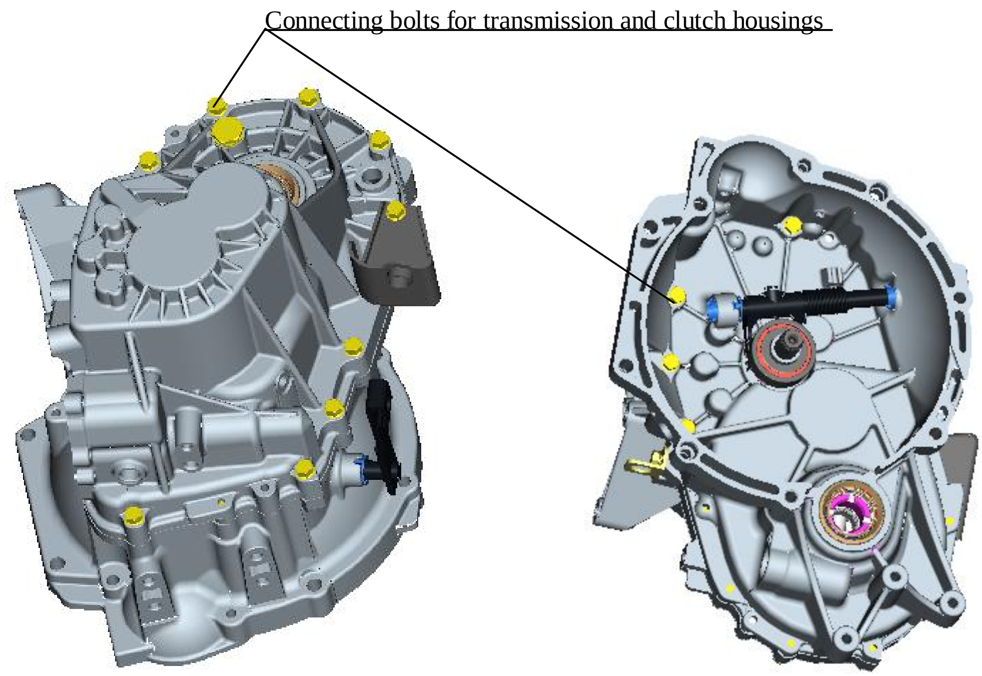


Figure 4

5. Separation of transmission and clutch housings

After the bolts for transmission and clutch housings are removed, separate clutch housing and transmission housing (Figure 5). as a result of sealant, the separation process may be difficult, so, use such tools as a hand hammer etc. to knock on the bulge at flank of housing of the transmission, and then take out the whole transmission housing until the two housings completely separate; during disassembly, be careful not to damage the junction planes of the two housings, so as to avoid oil leak of the transmission after re-assembly.

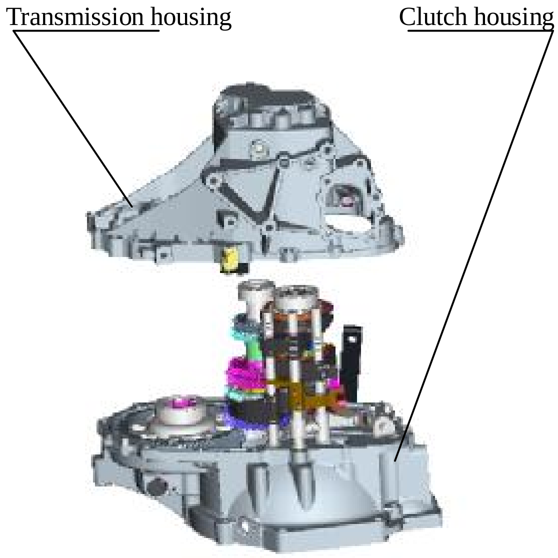


Figure 5

6. Separation of interior transmission parts and fork module from the housing

After transmission housing and clutch housing are separated, keep the clutch housing flat at the place as shown in Figure 6, remove the bolts for bracket of reverse gear rocker arm, take out the reverse gear rocker arm assembly and the pin on idler drive, and then take out input shaft, output shaft and fork mechanism together (when taking out, gently shake, meanwhile, press the driven gear of main decelerator along the direction of arrowhead as shown in the figure to take out the assembly of input shaft, output shaft and idler as well as fork mechanism); when taking out, remember to avoid interference between bearing retainer of output shaft and big gear ring of differential and prevent the bearing retainer from damage.

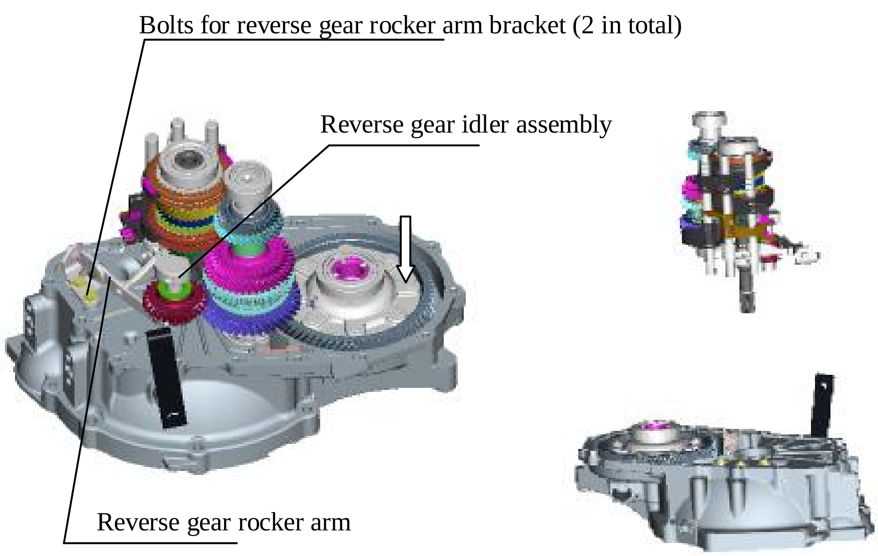


Figure 6

7. Separation of differential assembly and clutch housing

Separate differential assembly and clutch housing, and then simply take out the differential assembly as shown in Figure 7.

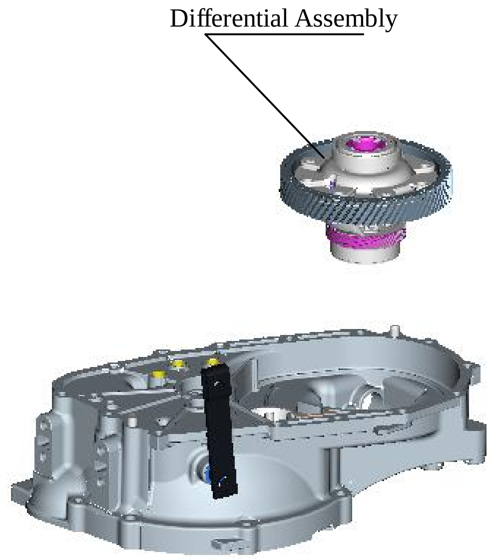


Figure 7

8. Disassembly of gearshift fork mechanism

Use a hammer and a special tool to knock off all spring pins and then use a snap ring pliers or other special tool to take the split washer off the fork shaft (when taking off the split washer, prevent it from deformation), and then disassemble each part of the gearshift mechanism.

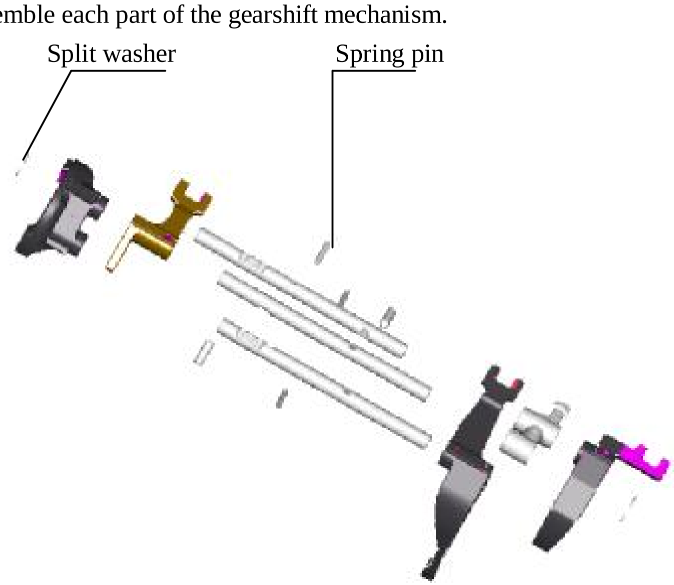


Figure 8

9. Disassembly of gearshift mechanism

As shown in Figure 9, remove the gearshift arm bracket bolts and reverse gear lockup mechanism bolts first, use a hammer and a special tool to knock off all spring pins, use a special tool to remove the split washer, and then disassemble each part of the gearshift mechanism.

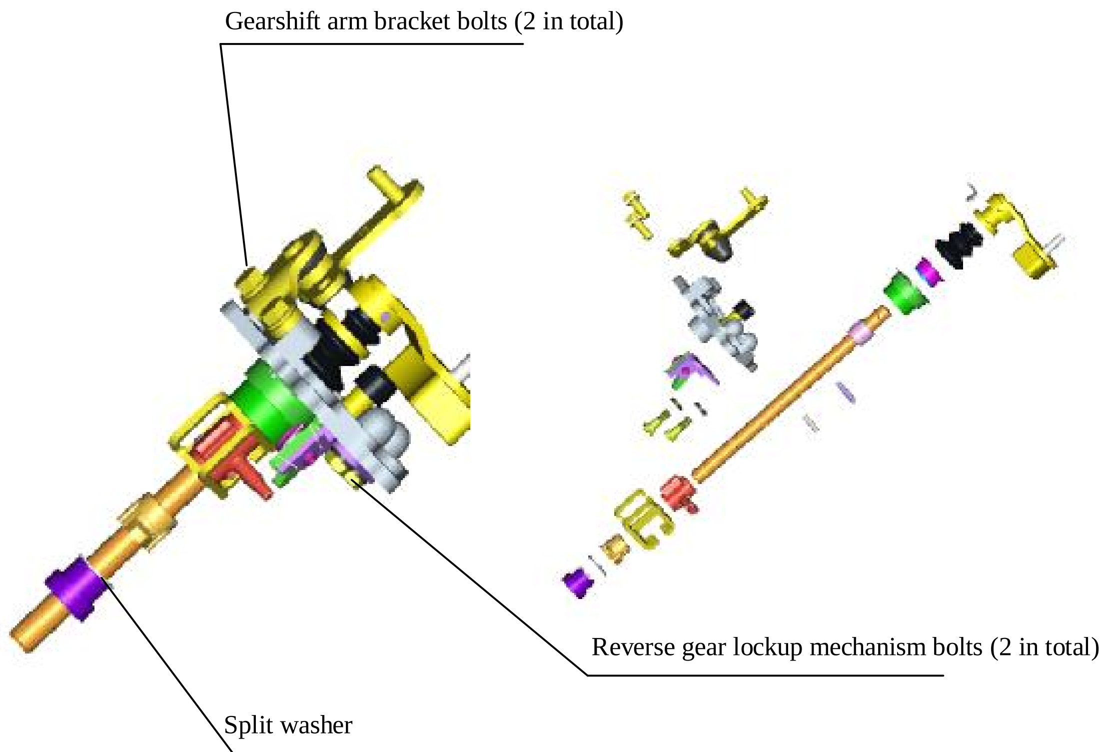


Figure 9

10. Disassembly of input shaft

As shown in Figure 10, Use a special tool (such as bearing remover etc.) to remove the two bearings on the input shaft first, use a special tool to remove the rear snap ring, and then take off the fifth gear synchronizer assembly.

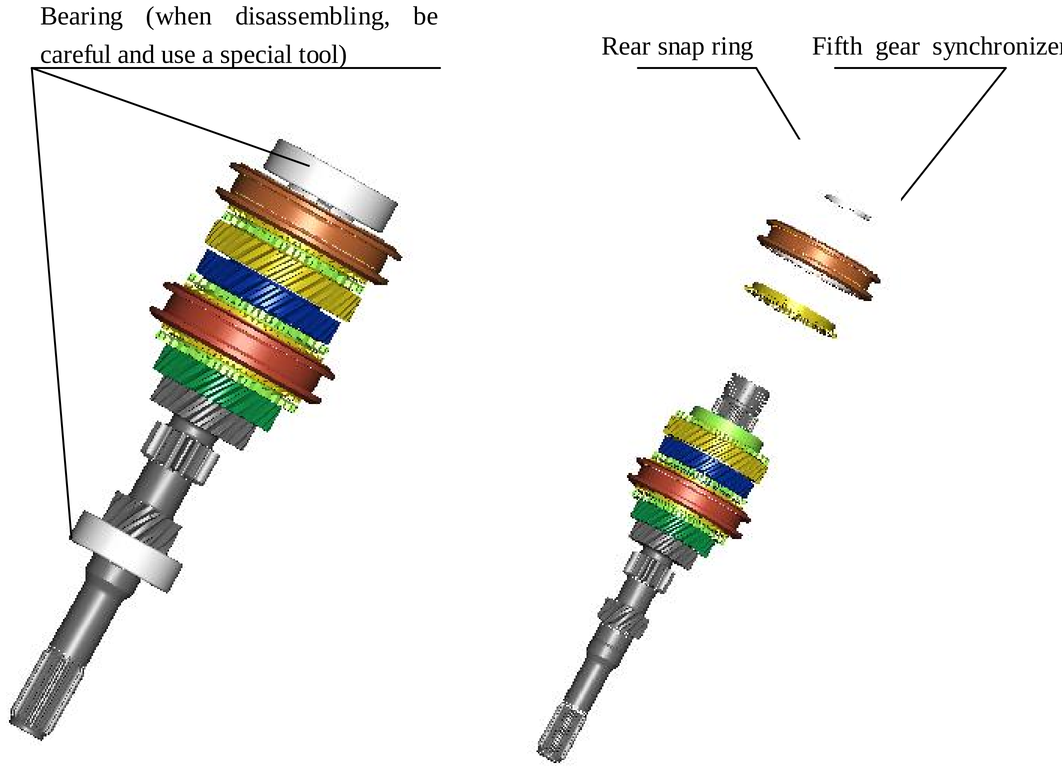


Figure 10

After the fifth gear synchronizer assembly is removed, remove the remaining parts such as shift gears, needle bearings and synchronizers in turn as shown in Figure 11; when disassembling, be sure to keep the synchronizer of each gear concurrent with its corresponding synchronizer ring.

Figure 11

11. Disassembly of output shaft

The method and process for disassembly of output shaft are basically the same as those for input shaft and the output shaft can be disassembled to the status as shown in Figure 12.

Figure 12

12. Disassembly of differential

As shown in Figure 13, use a special tool to take off the two bearings first, remove the bolts for driven gear and differential housing, remove the driven gear, knock off the fixing pin of the planetary gear, and then take out every part inside the differential (Figure 14).

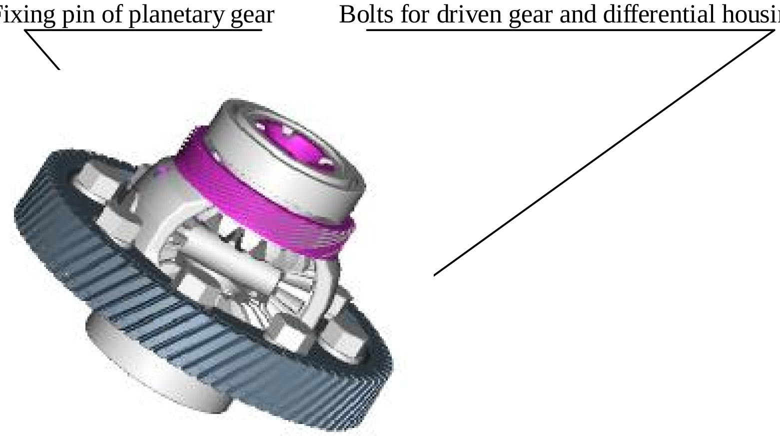


Figure 13

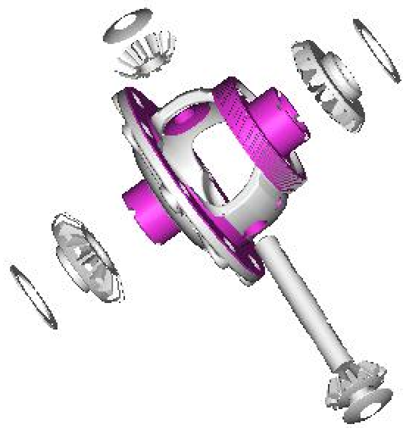


Figure 14

13. Disassembly of release mechanism of clutch

As shown in Figure 15, take off release bearing of the clutch first, remove the bolts for release fork, and then draw the release shaft assembly off the clutch housing (during the drawing off process, be sure to prevent the release return spring from ejection); also, remove the bush and dismount release mechanism of the clutch from the clutch housing.

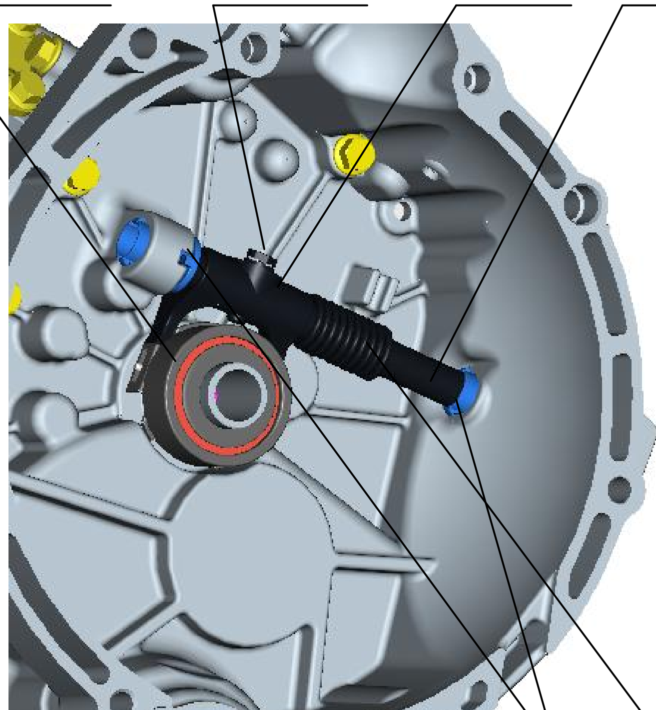


Figure 15

Be sure to use special tool and be careful to remove the oil seal on the clutch housing, because excessive deformation or damage of the oil seal may result in oil leak of the transmission. Use a special tool to remove the two oil seals on the clutch housing, and then remove the remaining bushes, oil ducts and outer rings of bearings as shown in Figure 16. Replacing with new oil seals after the former ones are removed is recommended.

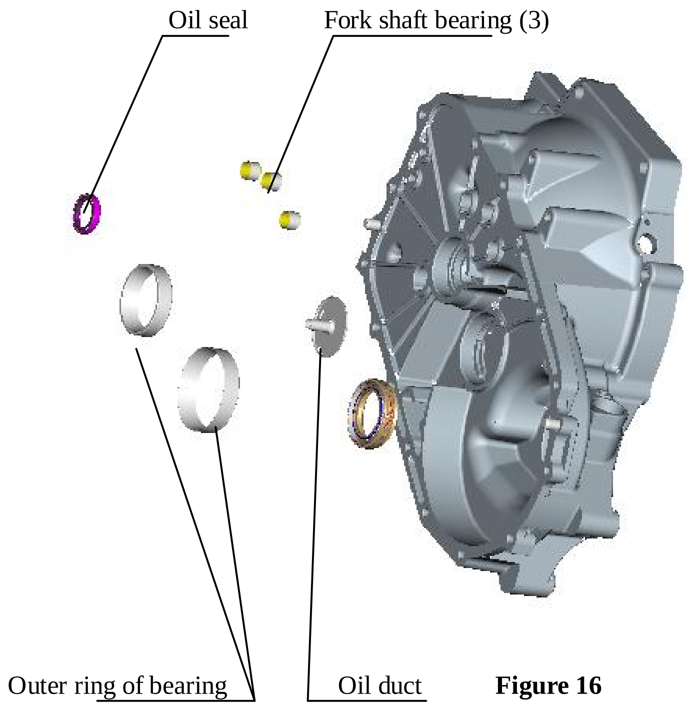


Figure 16

14. Disassembly of transmission housing

As shown in Figure 17, use a special tool to remove the oil seal of transmission housing, and then remove oil drain channel, fork shaft bush and linear bearing.

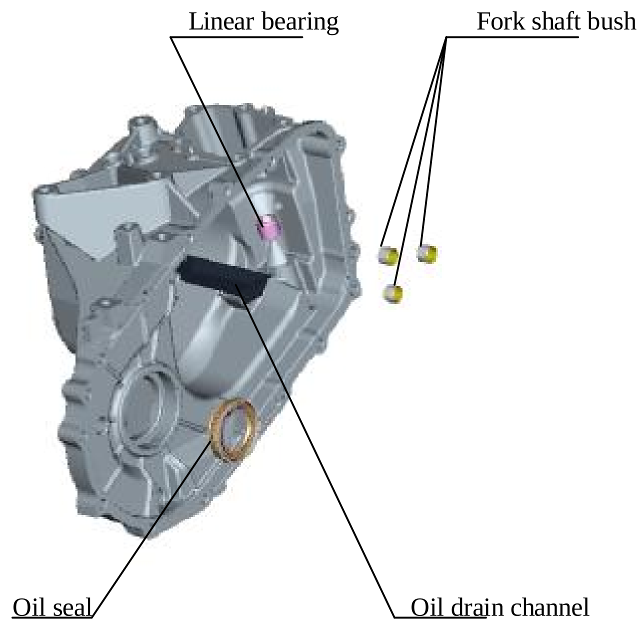


Figure 17

Chapter Three Assembly and Regulation of QR513 Transmission

I. Assembly of QR513 Transmission

After disassembly, visually inspect parts for any abnormal condition such as deformation etc, and make records; Replace the damaged parts, clean and wash all parts, then reassemble.

1. Assembly of differential assembly

Fit adjustment gaskets respectively at backsides of the two half axle gears, and then install the two half axle gears together with their gaskets into the differential. When fitting adjustment gaskets for the half axle gears, select the gasket with thickness as 1.2mm first. Fit spherical washers for the planetary gear, and then simultaneously engage the two planetary gears with the two half axle gears (fit them to correct positions while turning the gears). Insert the planetary gear shaft; note that the fixing pin hole on the shaft should align correctly with that on the differential housing both in the position and along the direction. Measure the clearance between the half axle gear and the planetary gear, and the normalized value should be **0.025~0.150mm**; if the clearance does not conform to the normalized value, replace the adjustment gaskets for the half axle gear, and then re-measure the clearance until it conforms to the standard with uniform clearance at both sides. Drive down the fixing pin of planetary gear shaft from the fixing pin hole at the side of differential housing with flange with the pin with end surface of the pin hole. Install driven gear of main decelerator and ensure that the installation end surface of the gear fits well with the end surface of the differential housing, and then fix the driven gear of main decelerator with bolts (apply sealant to full thread of the bolt before installation); screw the bolts home with the torque as **130±5Nm** cornerwise and alternately; respectively press in an inner ring of front and rear bearings from each of both ends of the differential housing and check if it has been pressed to the designated position. Note that the lubricant applied onto adjustment gaskets for half axle gears, planetary gear gaskets, junction surface of planetary gear and planetary gear shaft, junction surface of half axle gear and differential housing should be the same as that used inside the transmission. Refer to Figure 18.

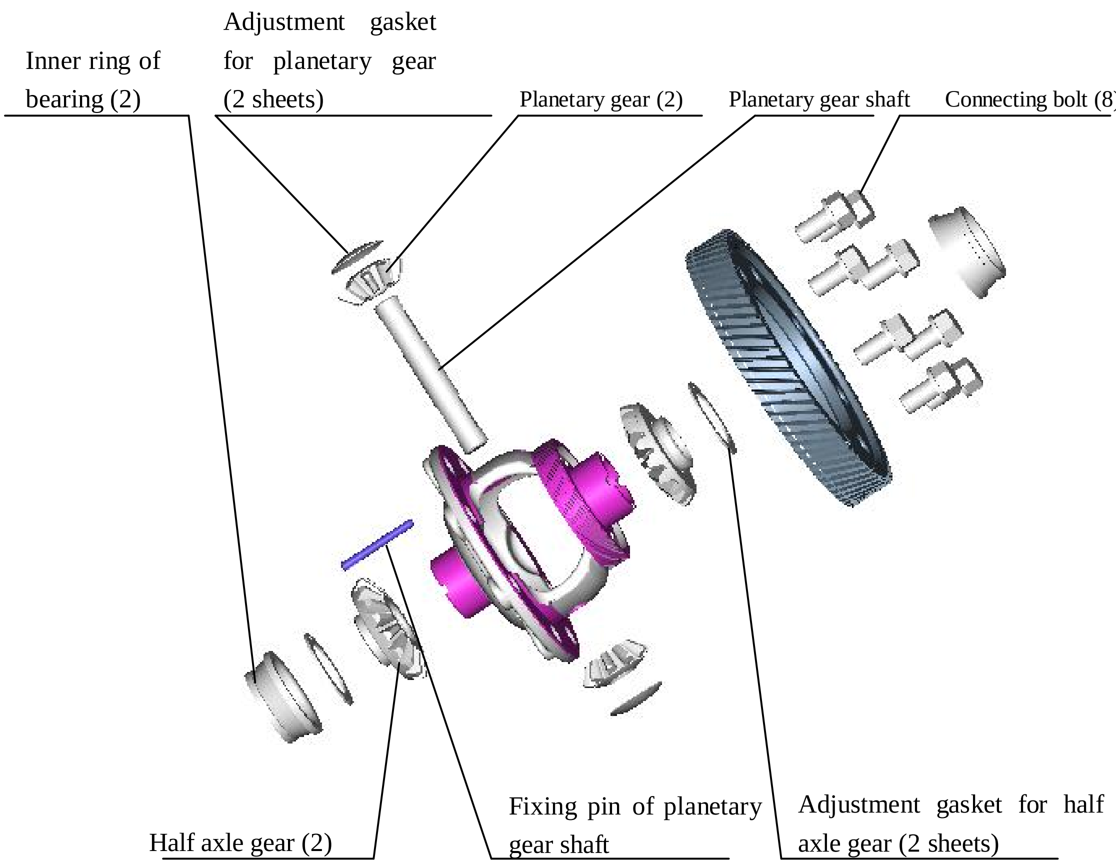


Figure 18

2. Assembly of clutch housing

Use a hammer and a special tool to fit oil seal of input shaft with spring side of the oil seal up and grease applied to lip of the oil seal. Use a special tool and a hamper to fit right side oil seal of differential with end surface of the oil seal flush with the housing surface, and then apply grease to lip of the oil seal. See Figure 19.

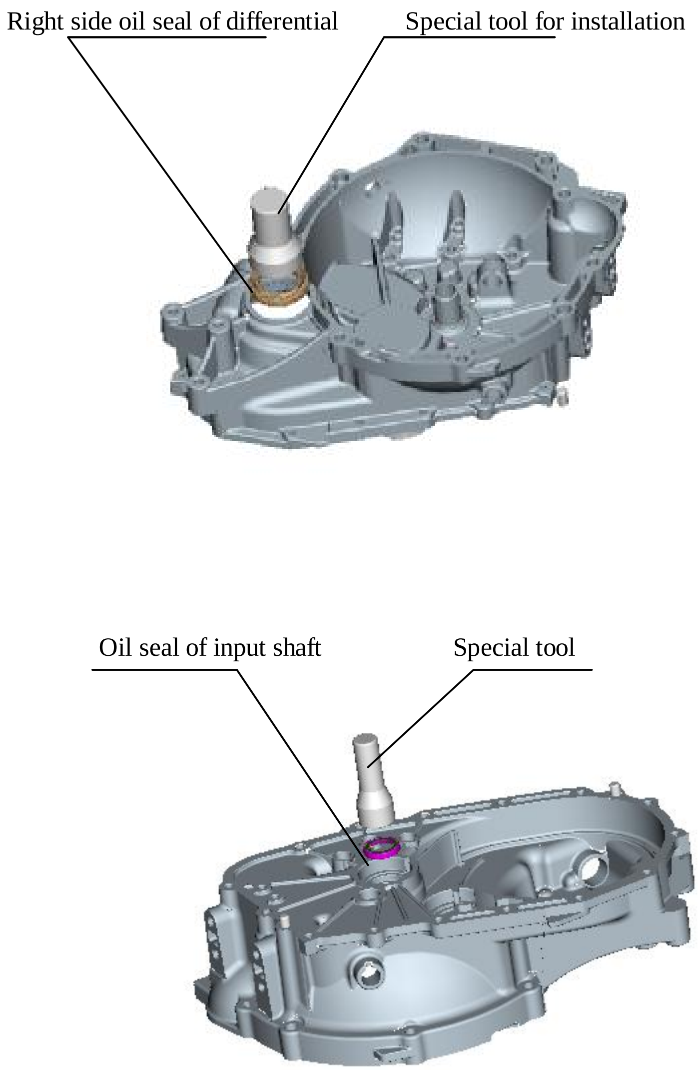


Figure 19

First, install the oil duct of output shaft to its designated position as shown in Figure 20 (note that the oil inlet and outlet of the oil duct should align with those on the housing), and then use a special tool to respectively install the outer rings of the front bearing of output shaft and the differential bearing.

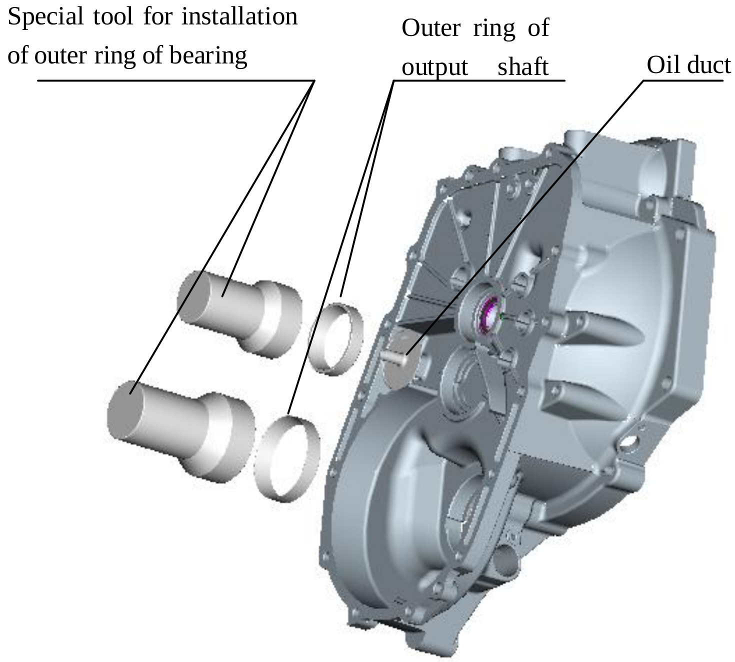


Figure 20

The tool for installation of oil seal can be used to install the three bushes. When installing the bushes, stagger the gap on the bush and that on the clutch housing (the two gaps can not coincide), as shown in Figure 21.

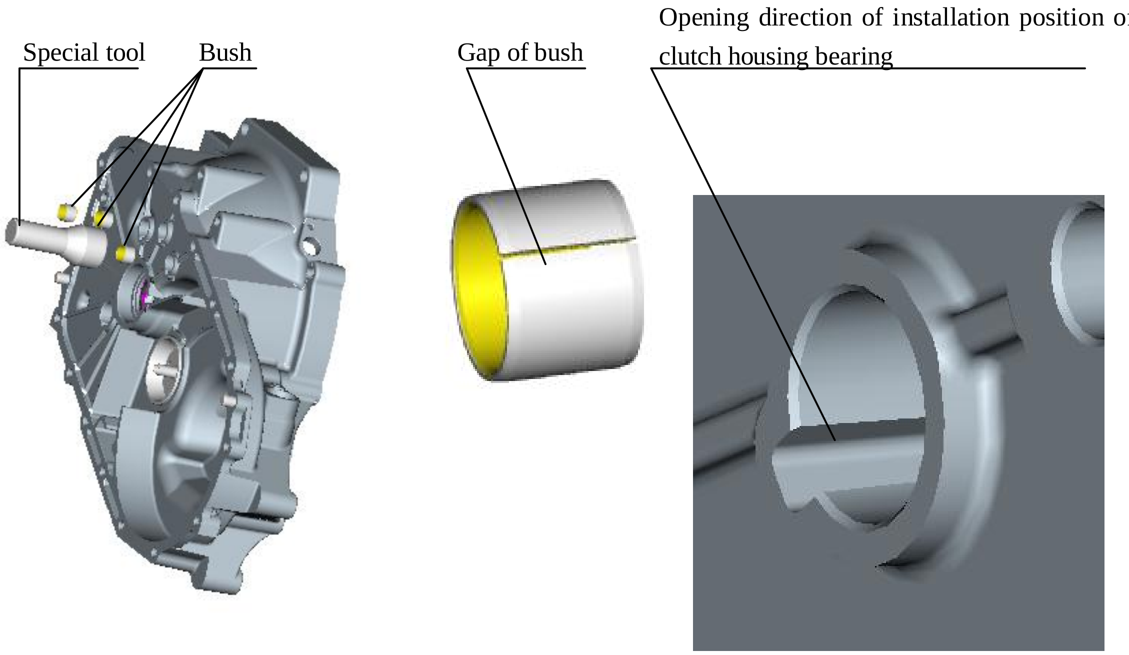
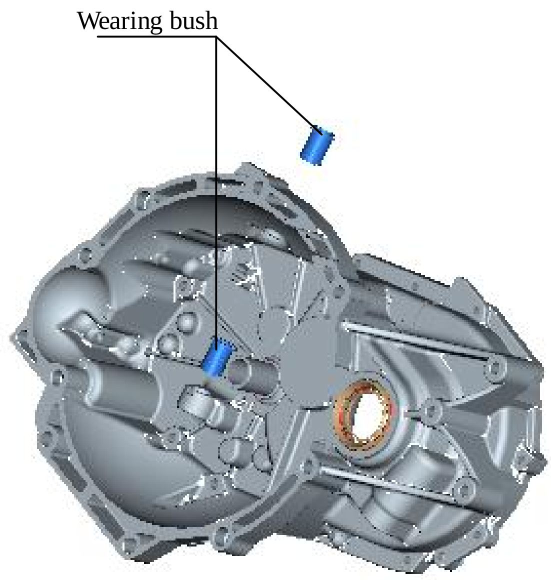


Figure 21



Now start to install release bearing assembly and release bearing as shown in Figure 22. First, install the two wearing bushes to their designated positions, and then put the release bearing through bush, release return torsion spring, release fork (release fork and release bearing should be assembled properly in advance, and then set the release bearing onto the housing) and bush in turn up to its designated position, finally, tighten the release arm bolts (with torque as **20±2Nm**). See Figure 23.

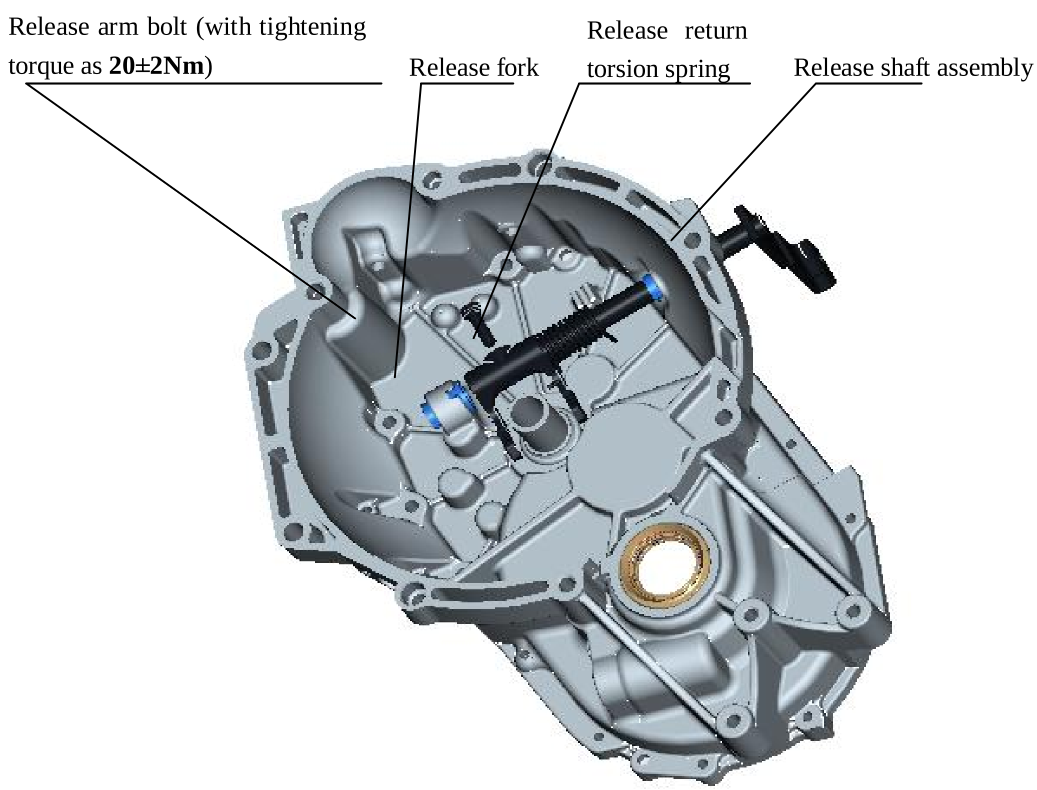


Figure 23

3. Assembly of transmission housing

First, use a special tool to fit oil seal of the differential to its designated position (when fitting the oil seal, care should be taken to prevent oil leak in the future, and replacement with new oil seal is recommended), and then respectively install oil drain channel, bush (**note:** the installation process for this bush is the same as that for the bush of clutch housing above), linear bearing etc. to their designated positions. See Figure 24.

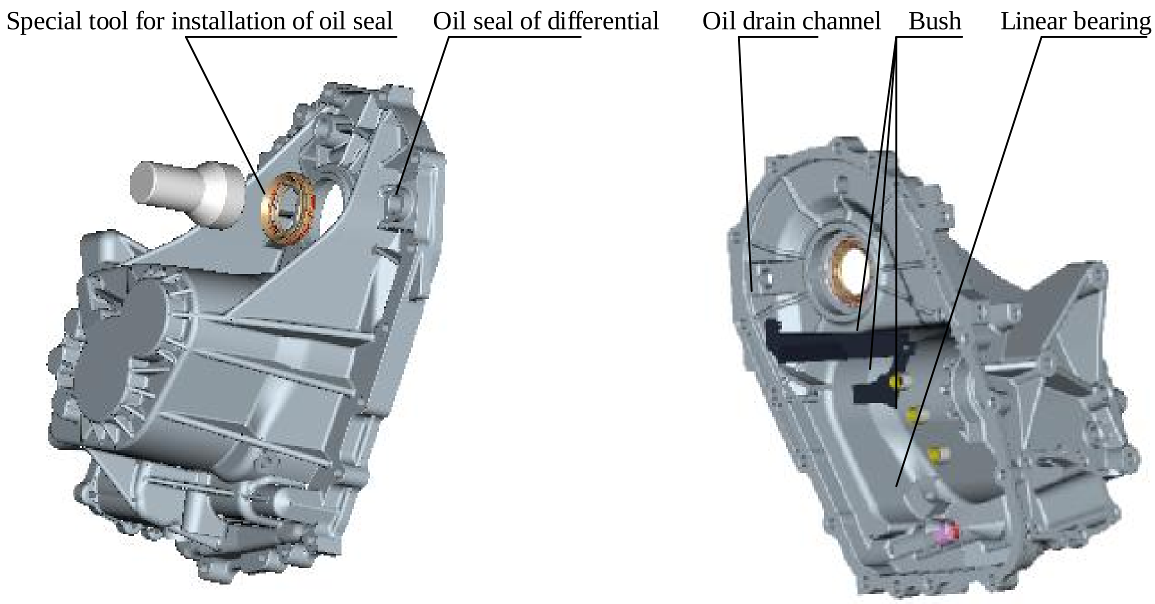


Figure 24

4. Assembly of gearshift mechanism assembly

Assembly of gearshift mechanism assembly is comparatively simple, which can refer to the disassembly process of the gearshift mechanism assembly. Remember to check the amount of parts to prevent neglected installation. Please refer to Figure 25 for tightening torque of the bolt.

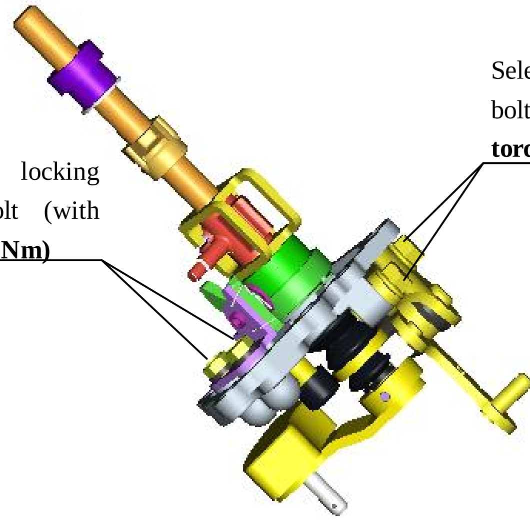


Figure 25

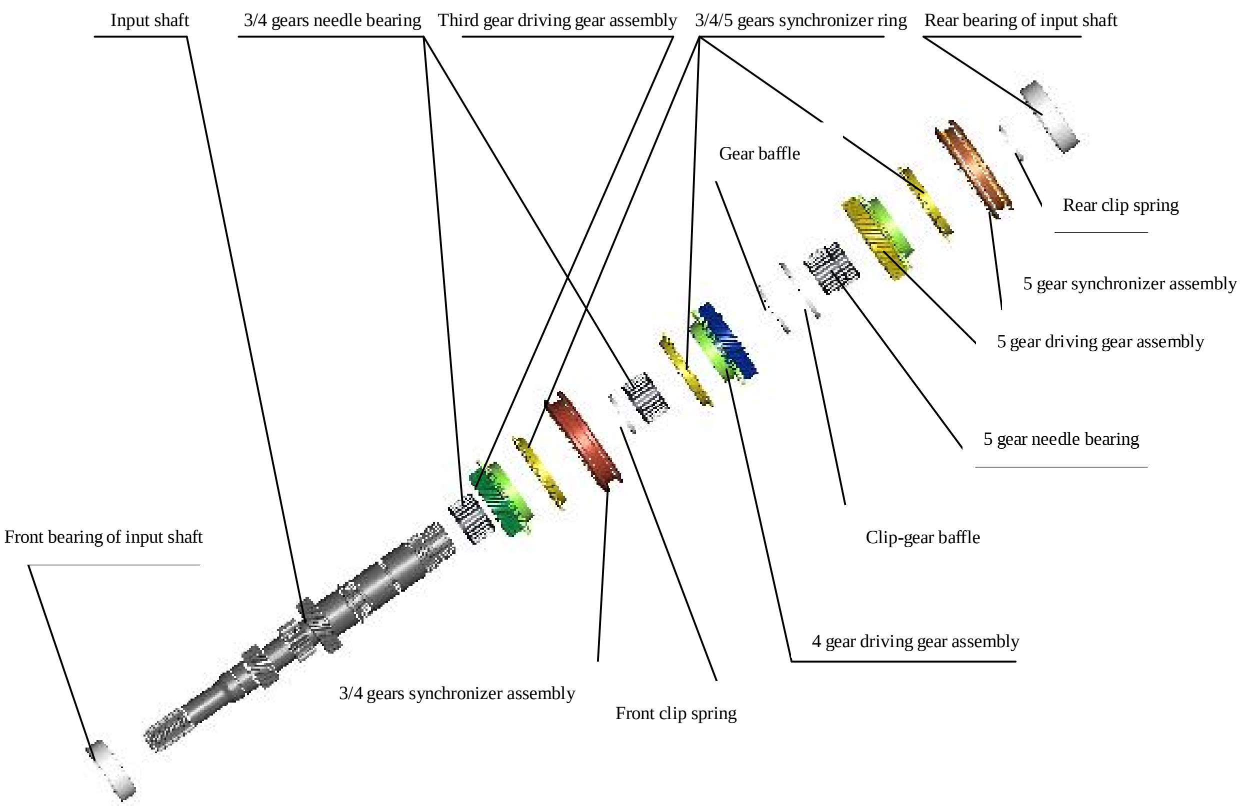
5. Assembly of gearshift fork assembly

Assembly of gearshift fork assembly is comparatively simple, which can be assembled with reference to the disassembly drawing.

6. Regulation and assembly of input shaft assembly

Place the input shaft with its end with clutch spline down, and then set the third gear needle bearing applied with the gear oil of the same designation as that used inside the transmission assembly onto the input shaft. Set the third gear driving gear assembly in from upside of input shaft with the end with synchronizer cone of the gear assembly up, and then check and make sure that the gear assembly can rotate freely. Set a 3/4/5 gears synchronizer ring in from upside of input shaft with conical surface of the synchronizer ring applied with the gear oil of the same designation as that used inside the transmission assembly, and then check and make sure that the synchronizer ring should envelop loosely on synchronizer cone of the third gear driving gear assembly and can rotate relative to the synchronizer cone. Press 3/4 gears synchronizer assembly onto the input shaft with the end surface of gear hub with two oil grooves down, turn the synchronizer ring to make its guide block completely enter the groove corresponding to the gear hub, and then make sure that the synchronizer ring is not locked. Fit front snap ring of input shaft; when fitting, try to use the thicker snap ring, if really unsuitable, select the snap ring of next thinner level, and then check if the snap ring has really enter the groove with the clearance between the snap ring and the groove not exceeding 0.05mm. Set a 3/4 gears needle bearing applied with the gear oil of the same designation as that used inside the transmission assembly onto the input shaft from upside of the input shaft. Set a 3/4/5 gears synchronizer ring applied with the gear oil of the same designation as that used inside the transmission assembly in from upside of the input shaft. Set the fourth gear driving gear assembly in from upside of input shaft with the end with synchronizer cone of the gear assembly down (the guide block of 3/4 gears synchronizer ring should completely enter the groove corresponding to the gear hub), and then make sure that the gear assembly can rotate freely. Set friction ball of gear, fender and clamp in from upside of input shaft, and then perform axial orientation for the fourth gear driving gear. Set fifth gear needle bearing applied with the gear oil of the same designation as that used inside the transmission assembly onto the input shaft from upside of the input shaft. Set fifth gear driving gear assembly in from upside of input shaft with the end with synchronizer cone of the gear assembly up, and then make sure that the gear assembly can rotate freely. Set a 3/4/5 gears synchronizer ring in from upside of input shaft with conical surface of the synchronizer ring applied with the gear oil of the same designation as that used inside the transmission assembly, and then check and make sure that the synchronizer ring should envelop loosely on synchronizer cone of the fifth gear driving gear assembly and can rotate relative to the synchronizer cone. Press fifth gear synchronizer assembly onto the input shaft with the end surface of gear hub with oil groove down, turn the synchronizer ring to make its guide block completely enter the groove corresponding to the gear hub, and then make sure that the synchronizer ring is not locked. Fit rear snap ring of input shaft; when fitting, try to use the thicker snap ring, if really unsuitable, select the snap ring of next thinner level, and then check if the snap ring has really enter the groove with the clearance between the snap ring and the groove not exceeding 0.07mm. Simultaneously press front and rear bearings of input shaft onto the input shaft with the side of front bearing of input shaft having word down and the side of rear bearing of input shaft having word up, and then check and make sure that the outer rings of the bearings can rotate freely. Refer to Figure 26.

Note: There are two friction balls between the bearing baffles (2 sheets). Be careful to install them in full.



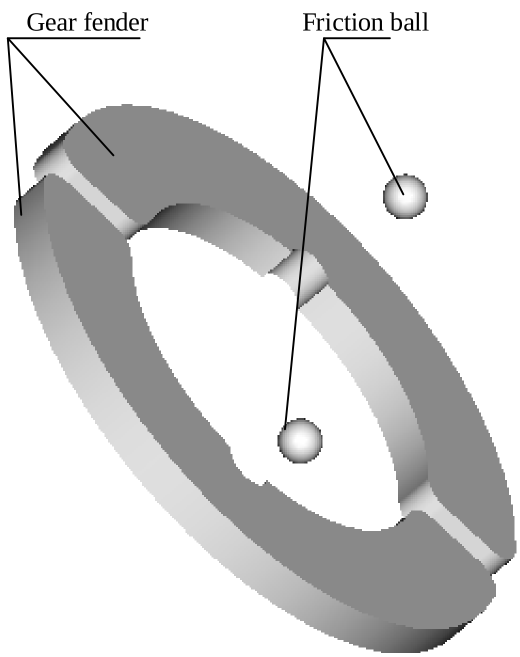


Figure26

7. Regulation and assembly of output shaft assembly

With the end of output shaft with driving gear of main decelerator down, set first gear needle bearing in onto output shaft from upside of the output shaft; before installation of the needle bearing, apply the gear oil of the same designation as that used inside the transmission assembly on it. Set first gear driven gear assembly in from upside of output shaft with the end with synchronizer cone of the gear assembly up, and then check if the gear assembly can rotate freely. Set a 1/2 gears synchronizer ring assembly in from upside of output shaft and the three finger jaws of balking ring of the synchronizer ring should completely enter the three corresponding grooves on the first gear driven gear assembly; before installation of the synchronizer ring assembly, apply the gear oil of the same designation as that used inside t Clamp-gear fender ibly on three conical surfaces of the sync 3/4 gears synchronizer assembly that the synchronizer ring assembly envelops loosely on the synchronizer cone of the first gear driving and driven gears assembly and can turn a certain angle relative to the synchronizer cone. Press 1/2 gears synchronizer assembly onto the input shaft with the end of external gear of 1/2 gears hub sleeve wit the synchronizer ring to make its guide block completely enter the groove correspond Front snap ring , and then make sure that the synchronizer ring is not locked. Fit front snap ring of output shaft; when fitting, try to use the thicker snap ring, if really unsuitable, select the snap ring of next thinner level, and then check if the snap ring has really enter the groove with the clearance between the snap ring and the groove not exceeding 0.05mm. Set a 1/2 gears synchronizer ring assembly in from upside of output shaft; before installation of the synchronizer ring assembly, apply the gear oil of the same designation as that used inside the transmission assembly on three conical surfaces of the synchronizer ring. Set a second gear needle bearing onto output shaft from upside of the output shaft; before installation of the needle bearing, apply the gear oil of the same designation as that used inside the transmission assembly on it. Set second gear driven gear assembly in from upside of output shaft with the end with synchronizer cone of the gear assembly down (the three grooves on the gear assembly should completely envelop the three corresponding finger jaws on 1/2 gears synchronizer cone), and then check and make sure that the gear assembly can rotate freely. Set the third gear driven gear in from upside of output shaft with the end with boss of the gear up, and then check and make sure that the 1/2 gears synchronizer ring assembly is not locked. Set 3/4 gears driven gear bush and then fourth gear driven gear in from upside of output shaft, with the end with boss of the gear down. Set fifth gear driven gear in from upside of output shaft with the end with boss of the gear up. When fitting, try to use the thicker snap ring, if really unsuitable, select the snap ring of next thinner level, and then check if the snap ring has really enter the groove with the clearance between the snap ring and the groove not exceeding 0.05mm. Simultaneously press inner rings of front and rear bearings of output onto the output shaft. See Figure 27.

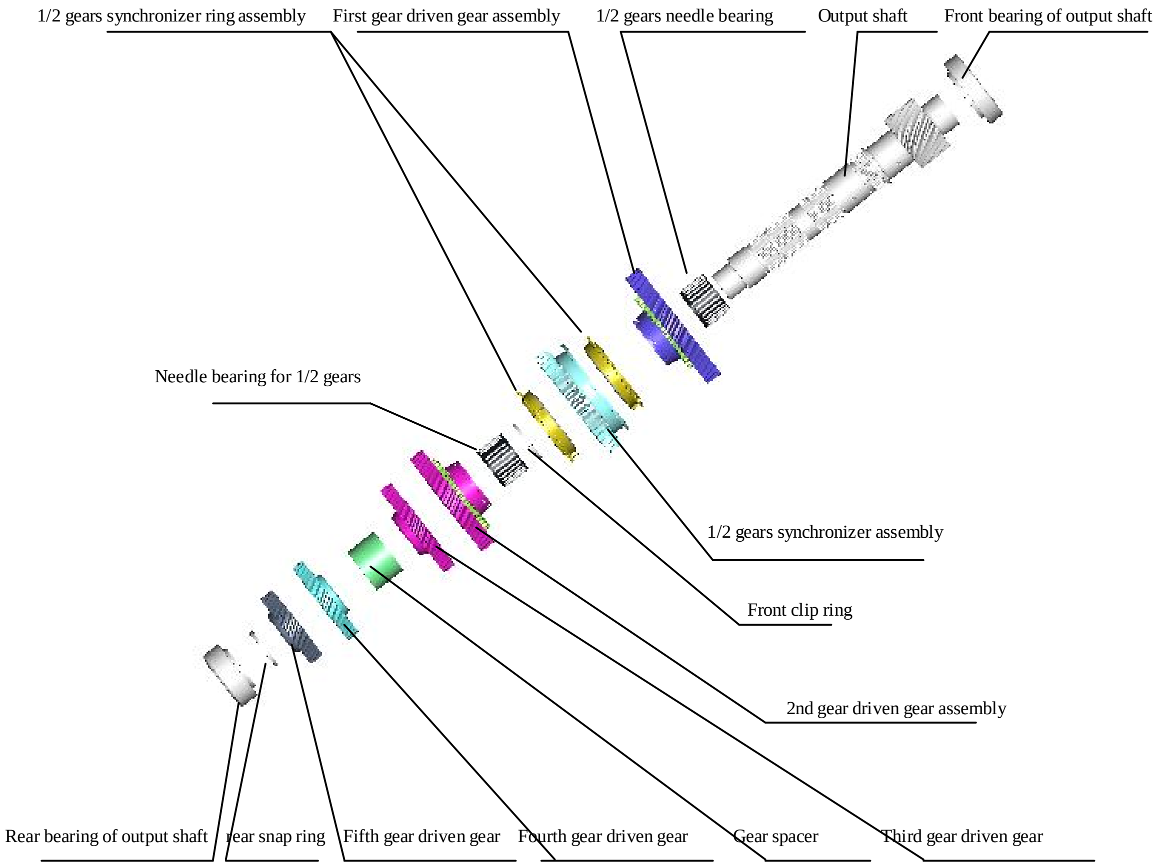


Figure 27

8. Assembly and regulation of transmission assembly

Place the clutch as shown in Figure 28 first, and then assemble the differential assembly to its designated position.

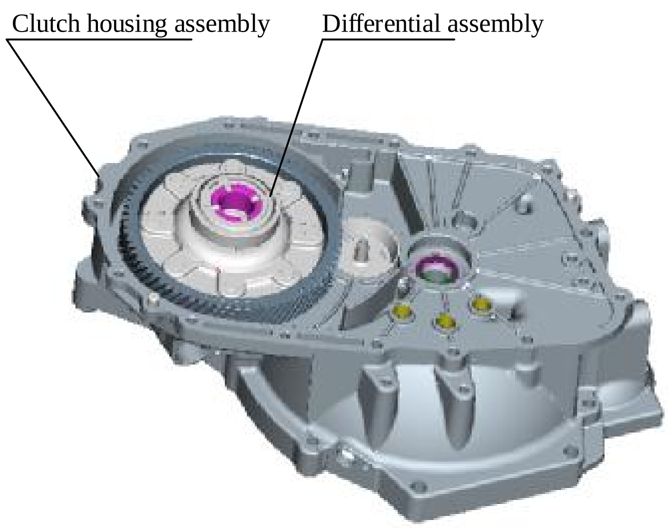


Figure 28

Assemble gearshift fork assembly, input shaft assembly and output shaft assembly together as shown in Figure 29, and then install them together onto clutch housing assembly. When assembling, wrap front end spline of input shaft with polyvinyl chloride adhesive tape to prevent damage to oil seal. After installation, turn each gear to ensure favorable engagement.

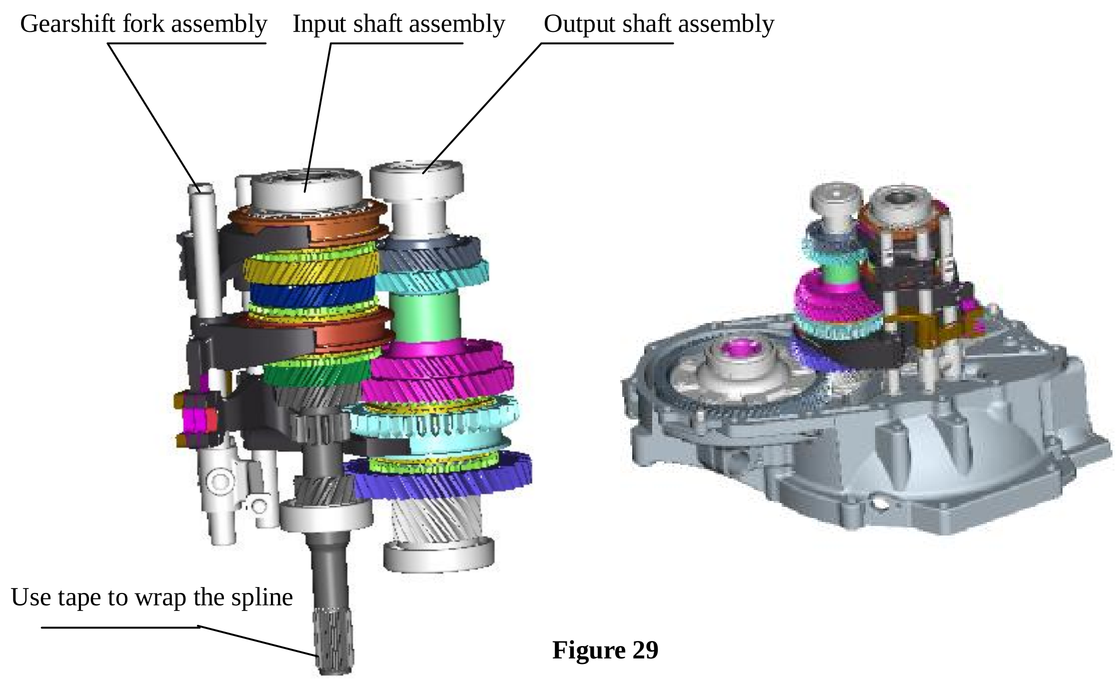


Figure 29

Install the assembled idler assembly (assembly of idler assembly is comparatively simple, please refer to its disassembly process) onto clutch housing, and then install reverse gear fork mechanism assembly with tightening torque of the two reverse gear rocker arm bracket bolts as **25±2Nm**. Clean the junction part of clutch and transmission housings and apply sealant (oil resistance silicone sealant, HZ1213Q/320222 YAP02-92) on it, and then install the magnet. See Figure 30.

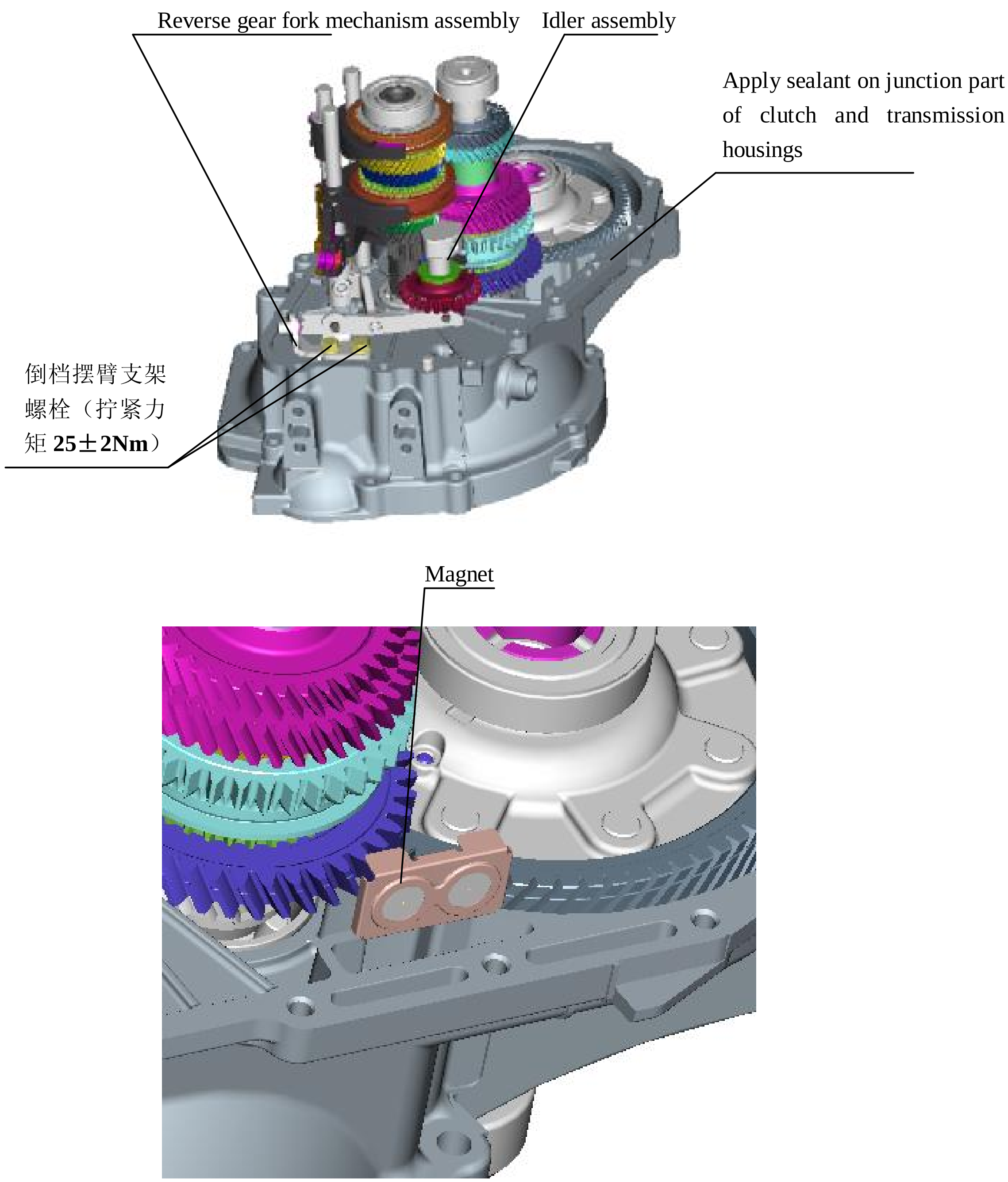


Figure 30

Assemble transmission housing and clutch housing together and then fasten them with connecting bolts. Before fastening, apply **thread locking glue (262 type anaerobic adhesive)** on the bolts properly. Tighten the diagonal bolts first as possible to ensure favorable fastening and sealing effects, and the tightening torque for the bolts are **25±2Nm**. **Note: the two connecting bolts at oil drain hole are a little longer than other connecting bolts, and the bracket should be installed first.** See Figure 31.

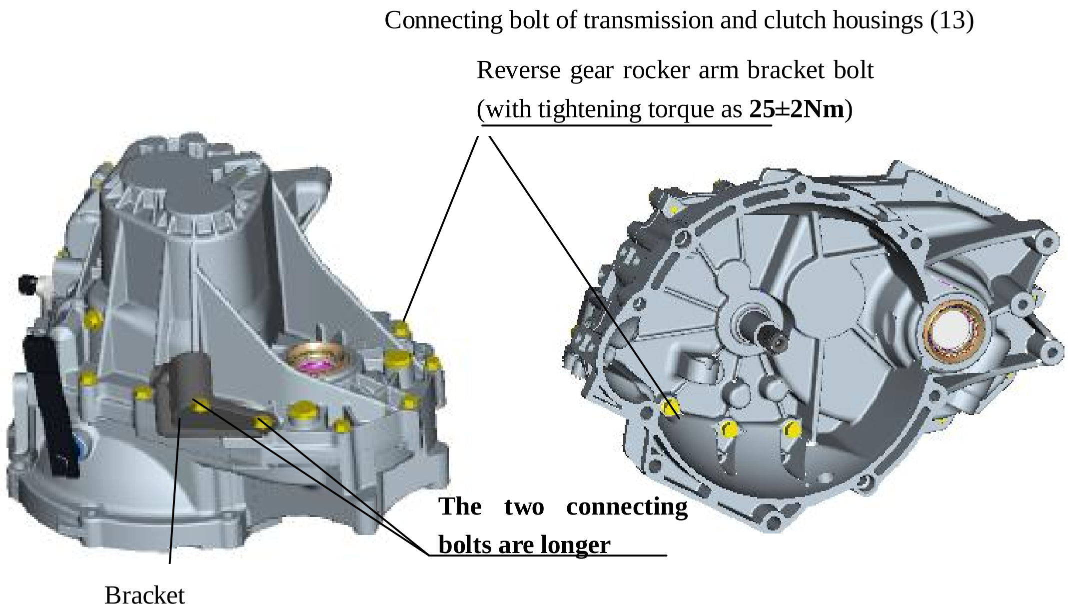


Figure 31

To install the assembled gearshift mechanism assembly onto the transmission, clean the junction part of gearshift housing and transmission housing and apply sealant on it (oil resistance silicone sealant, HZ1213Q/320222 YAP02-92), align one end of gearshift shaft with the linear bearing inside the transmission and align the locating hole on gearshift housing with the locating pin on transmission housing, and then tighten the connecting bolts of gearshift housing and transmission housing with the tightening torque as **25±2Nm**. See Figure 32.

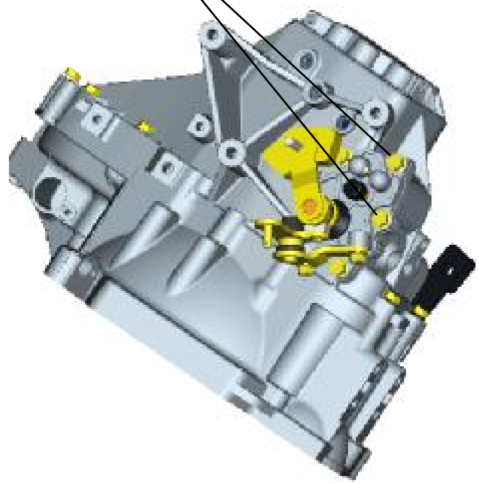


Figure 32

9. Disassembly of external accessories of transmission

Respectively install locating seats of 1/2 gears fork shaft and 3/4/5 gears fork shaft. Before installation, apply **thread fastening glue (262 type anaerobic adhesive)** on the thread, and the tightening torque for the bolts are **20±2Nm**. **Note: the locating seat of 1/2 gears fork shaft is longer than that of 3/4/5 gears fork shaft.** Then install locating seat of gearshift shaft, before installation, apply **thread fastening glue (262 type anaerobic adhesive)** on the thread, and the tightening torque for the bolts are **32±2.5Nm**; and install backup lamp switch assembly, before installation, apply **thread fastening glue (262 type anaerobic adhesive)** on the thread, and the tightening torque for the bolts are **20±2Nm.** See Figure 33**.**

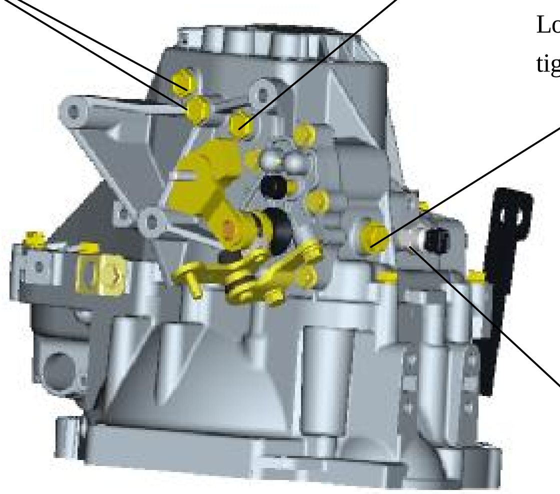


Figure 33

Follow by installation of screw of reverse gear idler shaft. Align the screw of reverse gear idler shaft with the threaded hole on the idler shaft, and then tighten it with the tightening torque as **38±2.5Nm**; after that, tighten bleeding plug with tightening torque as **44±3Nm**; finally, install oil limit plug onto the transmission, but do not tighten it then. See Figure 34.

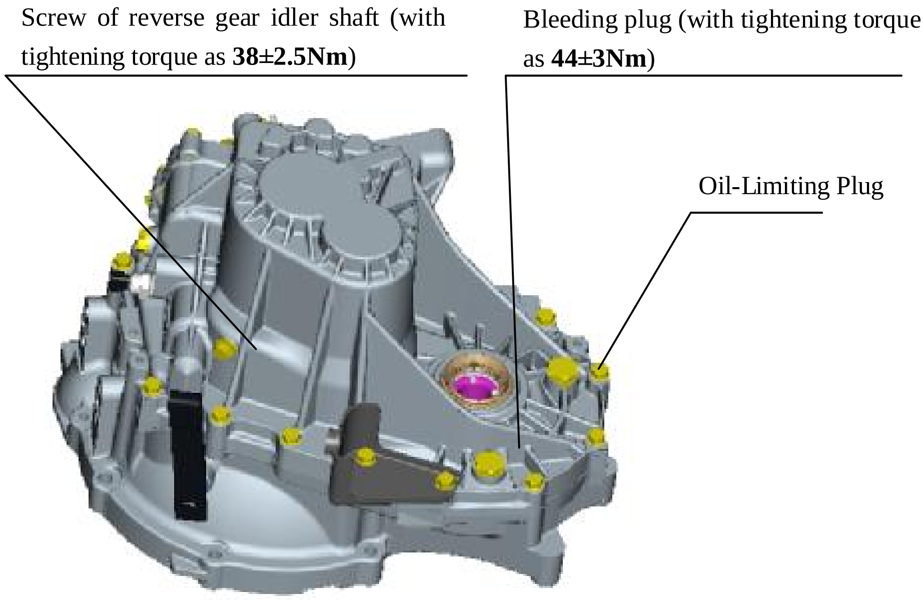


Figure 34

10. Refilling and volume regulation of transmission lubricant

After the transmission is installed onto the vehicle, park the vehicle on a flat road surface, then use the tool for refilling to refill transmission lubricant. The lubricant refilled should at least conform to API GL-4 SAE 75W-90 specification. Refill through installation hole of speed sensor as shown in Figure 35 with the refilling volume as 1.8L. after refilling, open the oil limit plug to regulate the lubricant to specified volume, and then tighten the oil limit plug with the tightening torque as **44±3Nm**.

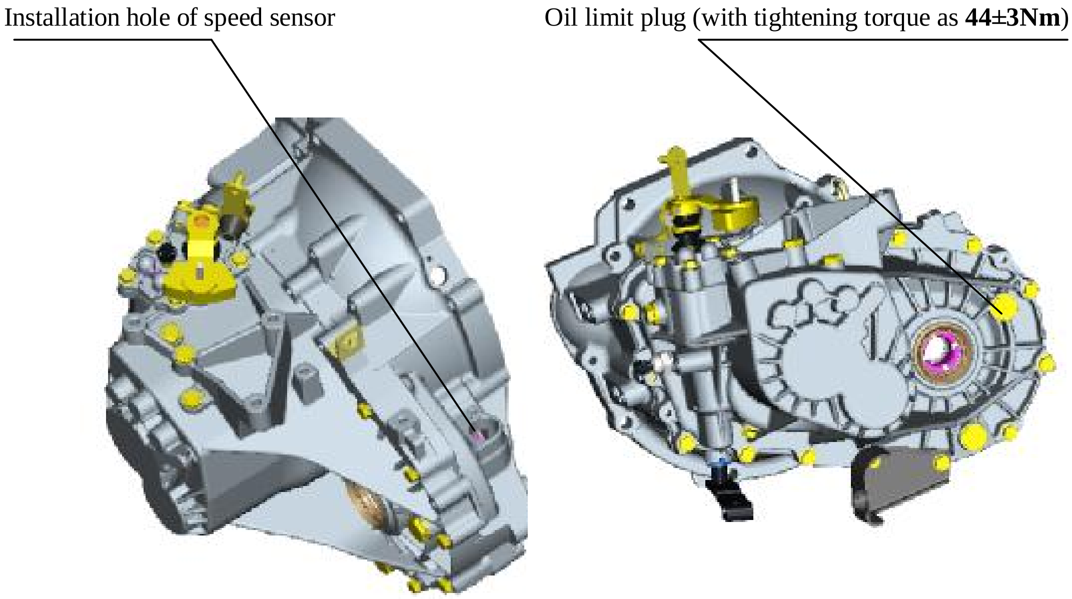


Figure 35

After the above steps, assembly and regulation to the transmission assembly are accomplished.

II. Tightening Torque Table for Fasteners

Position	**Tightening torque (N.m)**
Reverse gear rocker arm bracket bolt	25±2
Connecting bolts for clutch and transmission housings	25±2
Reverse gear idler shaft screw	38±2.5
Connecting bolts for gearshift and transmission housings	25±2
Gearshift shaft locating seat assembly	32±2.5
Reverse switch assembly	20±2
Fork shaft locating seats of gears	20±2
Bleeding\oil limit plug	44±3
Clutch release fork bolt	20±2
Clutch release arm bolt\nut	20±2
Selector Lever Bracket Bolt	25±2
Main decelerator driven gear bolt	130±5
Reverse gear lockup mechanism bolt	18±2

Chapter Four General Failures and Troubleshooting

Failure status	Possible reason	Troubleshooting
Excessive or abnormal noise	Damaged input or/and output shaft bearing(s)	Replace the bearing
	Gear tooth faces damaged due to knocking, burr or pit corrosion existing, or poor contact between them.	Repair or replace the gear
	Incorrect gear shaft position and clearance	Check and adjust
	Low oil level, insufficient lubrication	Fill oil to the specified level
	Foreign matter(s) existing in the assembly	Check and remove
Oil leakage	Excessively worn or damaged oil seal(s)	Replace
	Uneven sealant smearing or damaged seal gasket(s)	Replace the seal gasket(s) or sealant
	Failure to timely recondition junction surface(s) damage due to knocking	Check and repair
	Damaged differential bearing	Replace
Difficult to implement gear shift	Improper clutch adjustment and incomplete release.	Adjustment
	Improper gearshift transmission system adjustment or movement obstruction occurring	Check and adjust
	Synchronizer ring(s) fails to work	Replace
Gear jump	Worn synchronizer gear sleeve(s) or tooth cone surface(s) of gear junction	Replace related components
	Improper gearshift transmission system adjustment	Check and adjust
No gear	Loose gearshift transmission system	Overhauling
	Loose gearshift arm of transmission	Repair
Abnormally damaged bearing(s)	Metal impurities contained in transmission oil	Replace
	Insufficient lubrication or unqualified transmission oil	Replace
	Using of unqualified bearing(s)	Replace

Service Manual for Chery

(UMC EFI for 473F Engine)

After Sales Service Department of Chery
Automobile Sales Co., Ltd.

CONTENTS

Chapter One Disassembly and Installation of Electronic Fuel Injection System

I. Disassembly and Installation of Components of Electronic Fuel Injection System

1. Disassembly and installation of engine control unit (ECU).

2. Position and disassembly of intake air pressure sensor.

3. Position and disassembly of camshaft position sensor.

4. Remove fixing hoop of intake hose.

5. Remove the four fixing bolts of electronic throttle body.
Pull out the connector and take out the electronic throttle body.

6. Use a screwdriver to press down the fixed clip of the injection nozzle connector and then pull out the connector.

7. Use a screwdriver to press down the fixed clip of the knock sensor connector and then pull out the connector.

8. The water temperature sensor is behind the thermostat seat.

9. Pull out the connector of the ignition primary coil by hand.

10. Pull out the connector of the engine tachogenerator by hand.

Chapter Two Principle of Electronic Fuel Injection System

I. Overhaul of System Components

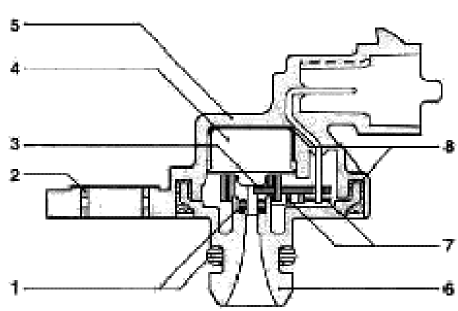
1. Intake Air Temperature Pressure Sensor

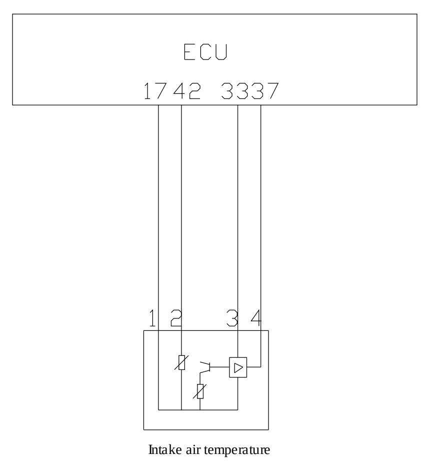
1.1 Function of the sensor:

Detect air intake pressure and temperature in air intake manifold, which will be provided to ECU as main load signal of engine; ECU will calculate injection pulse-width based on this signal.

1.2 Principle of the sensor:

Intake air temperature pressure sensor is a sensor that integrates an intake air pressure sensor and an intake air temperature sensor. Absolute pressure sensor element of intake manifold is composed of a silicon chip. A pressure diaphragm is etched on the silicon chip. On the pressure diaphragm, there are 4 piezo-resistances, which serve as strain sensors and constitute a Wheatstone bridge. In addition to this pressure diaphragm, a signal processing circuit is also integrated on the silicon chip. The silicon chip and a metal housing constitute a closed reference, where the absolute pressure of the gas inside approaches to zero. Thus, a micro-electronic mechanical system is formed. The active face of the silicon chip stands a pressure close to zero, while its back face stands the pending measuring intake manifold absolute pressure introduced by a connecting pipe. The thickness of the silicon chip is merely several μm, so the absolute pressure change in intake manifold will bring mechanical deformation to the silicon chip. The 4 piezo-resistances will accordingly deform and their resistances also change. The voltage signal in linear relation to the pressure is formed after process by the signal processing circuit on the silicon chip. The intake temperature sensor element is a negative temperature coefficient (NTC) resistance, which will change with the intake temperature. This sensor sends out a voltage indicating the intake temperature change to the controller.





Cross-section view for sensor of air absolute pressure and temperature in intake manifold

1 Gasket 2 Stainless Steel Sleeve 3 PCB Board 4 Sensing Element 5 Housing 6 Pressure Bracket 7 Soldering 8 Bonded With Bonding Agent

1.3 Parameters of technical features

This sensor is designed to be mounted on the plane of auto engine intake manifold. The pressure connecting pipe together with the temperature sensor protrudes inside the intake manifold and an O gasket is used to enable atmosphere-proof.

If it is mounted on an auto through an appropriate method (picks up pressure from the intake manifold and the pressure connecting pipe tilts down etc.), it can be ensured that no condensed water will be formed on the pressure-sensitive element.

Drilling and fixing on the intake manifold must be carried out according to the supply drawing so as to ensure a long seal and a good tolerance to fretting by agent.

The reliable contact of electric connection of a joint will mainly be affected by the joints of components and parts, and it is also in relation to the material quality and dimensional precision of the joint fitted with it on the harness.

1.4 Failure effects and judgment method

- Failure effects: spark extinction and poor idling etc.
- General Failure Reason:

  1. Abnormal high voltage or inverse strong current occur during working;

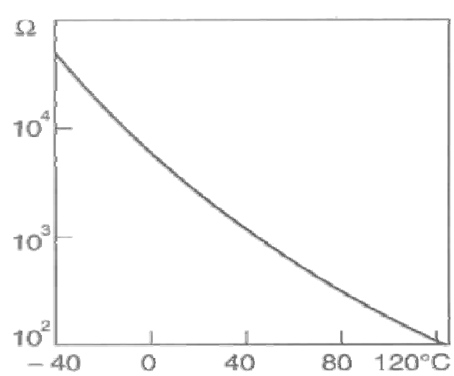
  2. The vacuum element is damaged during maintenance.
- Maintenance precautions: during maintenance, impinge using high pressure gas toward the vacuum element is prohibited; when replacing the sensor after a failure is found, remember to check if output voltage and current of the generator is normal.
- Simple measurement method:

1.4.1 Temperature sensor:

With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to 1# and 2# pins of the sensor; At 20℃, the rated resistance should be 2.5 kΩ±5%, and the other corresponding resistances can be measured out from the characteristic curve in above chart. Analogue method can also be used when measuring, i.e., use an electric drier to blow the sensor (be careful not to be too close to the sensor), and then observe the change of the sensor resistance. At this point, the sensor resistance should fall.

1.4.2 Pressure sensor:

With the joint connected, turn the digital multimeter to DC Voltage shift, and then connect the black pen to ground while the red pen respectively to 3# and 4# pins. Under idle speed state, 3# pin should have a 5V reference voltage while the voltage on 4# pin should be around 1.3V (the actual value depends on the model); Under no load state, when opening the throttle slowly, the voltage on 4# pin may change little; when opening the throttle rapidly, the voltage on 4# pin may reach around 4V instantly (the actual value depends on the model) and then fall to around 1.5V (the actual value depends on the model).



2. Tachogenerator of Engine

2.1 Function of the sensor:

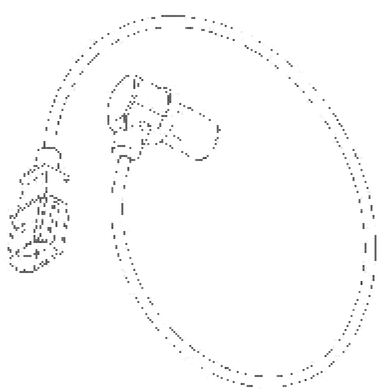
As one of the uppermost sensors of engine, the tachogenerator of engine provides ECU with rev signal, acceleration signal and crank angle signal etc. of engine. ECU will calculate injection pulse-width, injection time and ignition timing through these signals and provide the instruments with rev signal of engine.

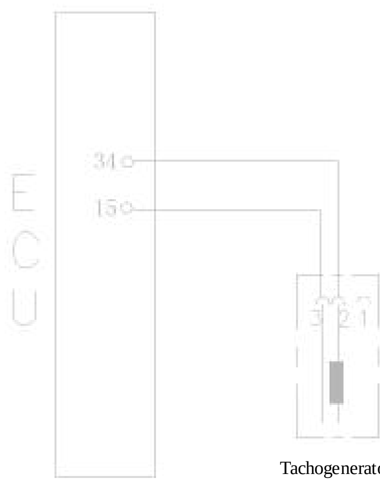
2.2 Principle of the sensor:

The inductive tachogenerator work together with pulse disc, it is used in ignition system without distributor providing engine speed and crank shaft top dead center information.

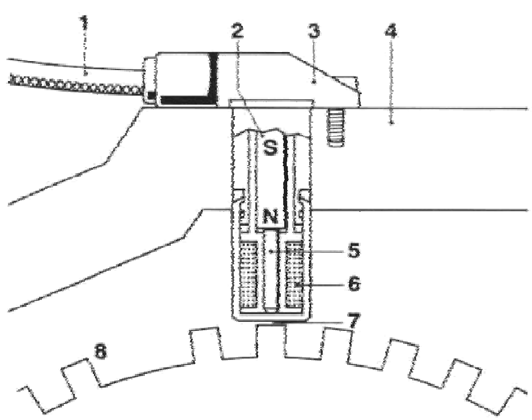
Inductive tachogenerator is made up of a permanent magnet and coil outside of magnet.

Pulse disc is a tooth disc with 60 teeth originally but there are two teeth opening. Pulse disc is assembled on crank shaft and rotate with crankshaft. When the tooth tip passes through closely the end of the inductive engine tachogenerator, the pulse disc made of the ferromagnetic material will cut the line of magnetic force of the permanent magnet in the inductive engine tachogenerator to generate inductive voltage in the coil as engine speed signal output.





Tachogenerator



1. Shielded wire
2. Permanent magnet
3. Housing of sensor
4. Installation bracket
5. Soft magnet core
6. Coil
7. Air gap
8. 60-2 gear ring

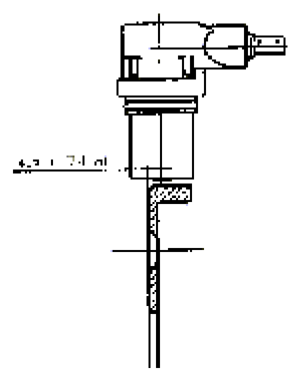
2.3 Parameters of technical features

Item	Value			Unit
	Min.	Typical	Max.	
Resistance under a room temperature of 20 ℃	774	860	946	**W**
Inductance	310	370	430	mH
Output voltage at a crankshaft revolution of 416rpm	>1650			mV

2.4 Installation attentions:

- For the inductive tachogenerator, it is permitted to take out from its pack before it is assembled to the auto or testing device right away.
- Inductive tachogenerator is assembled by press in method but not hammer tapping.
- Partly micro-encapsulated bolt M6´12 for fixing of the inductive engine tachogenerator is recommended.
- The tightening torque is 8±2Nm.
- Gas clearance between inductive tachogenerator and pulse disc tip is **0.8-1.2mm**.

Dimension d (see the figure below): 4.7mm.



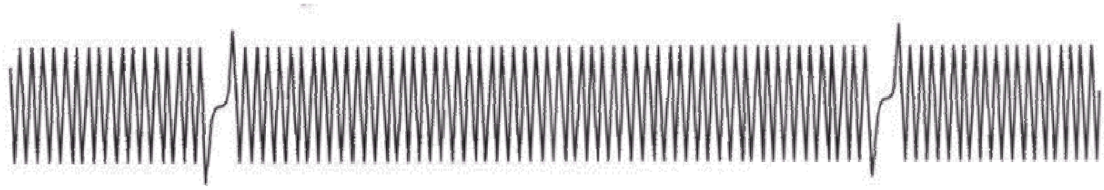
Installation of the tachogenerator

2.5 Failure effects and judgment method:

- Failure effects: start failure etc.
- General cause of the failure: man induced failure.
- Maintenance precautions: during maintenance, the tachogenerator should be installed by using press-in method instead of hammering method.
- Simple measurement method:

1. With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to 2# and 3# pins; At 20℃, the rated resistance should be 860Ω±10%.

2. With the joint connected, turn the digital multimeter to AC Voltage shift, and then connect the two meter pens respectively to 2# and 3# pins of the sensor; start the engine and voltage output should be present at this point. (Inspection with vehicle oscilloscope is recommended).



Oscillogram in Test

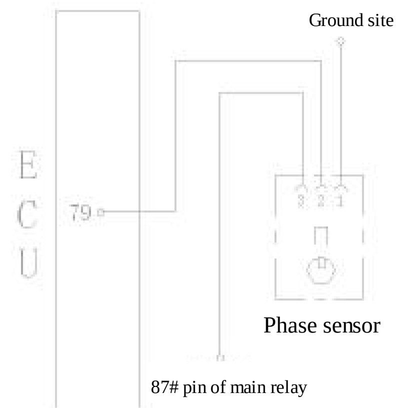
3. Phase Sensor

3.1 Function of the sensor:

Provide ECU with phase signal, i.e. help crankshaft position sensor of engine to judge it is then at compressing top dead center or air exhaust top dead center.

3.2 Principle of the sensor:

The phase sensor is consisted of the Hall generator installed on the valve cover and the signal wheel machined on the intake camshaft. When the camshaft rotates, the signal wheel will make the magnetic flux passing the Hall generator change, thus generating a variable Hall signal.



3.3 Effects and judgment method:

- Failure effects: over proof emission and fuel consumption rise etc.
- General cause of the failure: man induced failure.
- Simple measurement method:

(connect the joint) switch on ignition switch but do not start the engine; put digital multimeter on DC volt shift, connect two meter pen to No. 1 and No. 3 sensor connectors and make sure there is 12V reference voltage. Start the engine, check if it is in good conditions of No.2 pin by oscillograph on vehicle.

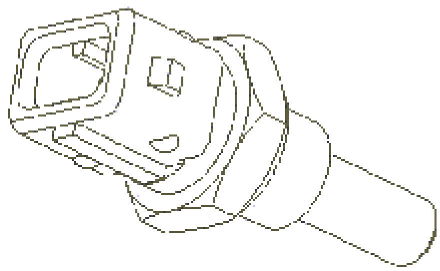
4. Water Temperature Sensor

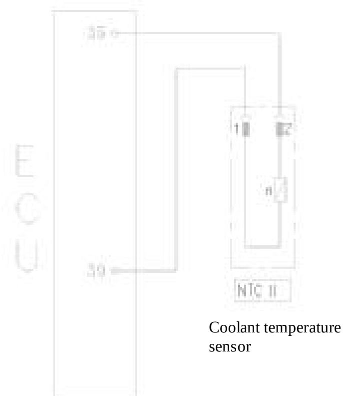
4.1 Function of the sensor:

The water temperature sensor simultaneously provides ECU and instruments with water temperature signal. ECU will calculate and regulate injection pulse-width and ignition advance angle through water temperature signal. In addition, through water temperature signal, ECU also can control turn-on and turn-off of cooling fan to prevent engine from damage caused by overheat.

4.2 Principle of the sensor:

The water temperature sensor is a minus temperature coefficient type electric resistance model sensor; the higher the temperature is, the less the resistance will be. But, temperature rise and resistance fall are not in linear relation.





4.3 Parameters of technical features

(1) Data limit

Item	Value	Unit
Rated voltage	Can only be run by ECU	
Rated resistance at 20℃	2.5 ±5%	kW
Range of running temperature	-30 to +130	℃
Max. measuring current passing the sensor	1	mA
Permissible vibration acceleration	600	m/s^2

4.4 Installation attentions

Coolant temperature sensor is installed on the cylinder body and the copper heat conducted socket is inserted into coolant. There are thread on the socket, and screw in coolant temperature sensor onto the threaded hole on cylinder block by the hexagon head of the socket. The maximum permissible tightening torque is 15Nm.

4.5 Failure effects and judgment method

- Failure effects: starting difficulties etc.
- General cause of the failure: man induced failure.
- Simple measurement method:

With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to 1# and 2# pins of the sensor; At 20℃, the rated resistance should be 2.5kΩ±5% and the others can be measured out from the characteristic curve in above chart. Analogue method can also be used when measuring, i.e., dip the working area of the sensor in boiled water (dip for adequate time), observe the resistance change of the sensor, at this point, the resistance should fall to 300Ω-400Ω(the actual value depends on the temperature of the boiled water).

5. Knock Sensor

5.1 Function of the sensor:

The knock sensor provides ECU with knock signal. When the engine generates knock, ECU will control to gradually reduce ignition advance angle to eliminate the knock; when no knock occurs during certain strokes, ECU will gradually increase ignition advance angle to enable the engine to obtain max. torque.

5.2 Principle of the sensor:

Knock sensor is a kind of vibrating acceleration sensor and is assembled on cylinder block. Either single or multiple can be installed. The sense organ of the sensor is a piezoelectric element. The vibration of cylinder block is transferred to piezoelectric crystal by mass block inside of sensor. The piezoelectricity crystalloid gets pressure from mass block vibration, producing voltage on two polar and transferring vibration signals to voltage signal and output it. See the following frequency response characteristic curve. Because the frequency of knock vibration signal is much higher than the normal engine vibration signal, the ECU can separate the signal into knock signal and non-knock signal.

5.3 Attentions

Knock sensor has a hole in the middle, through which it is fastened on the cylinder by a M8 bolt. For the aluminum alloy block, using long bolt with 30 mm; for the casting iron, using 25mm bolt. The tightening torque is 20±5Nm. The installation position should ensure that the sensor is liable to receive vibration signals from all cylinders. Decide the optimal installation position of knock sensor through modal analysis to the engine body. Generally, for a 4-cylinder engine, the knock sensor is installed between 2# cylinder and 3# cylinder; for a 3-cylinder engine, it is installed at the center of 2# cylinder. Do not let liquid such as engine oil, coolant, brake fluid and water etc. contact the sensor long. Use of gasket of any type is not allowed in installation. The sensor must cling to the cylinder tightly through its metal surface. During wiring of sensor signal cables, do not make the signal cables resonate; otherwise, they may break. Be sure to prevent turning on of high voltage between 1# and 2# pins of the sensor; otherwise, damage to the piezoelectric element may occur.

5.4 Effects and judgment method

Failure effects: poor acceleration etc.

- Reasons for general failures: long time contact of liquid such as engine oil, coolant, brake fluid and water etc. with the sensor, which may corrode the sensor.
- Maintenance precautions: (see installation attentions)
- Simple measurement method: (remove the joint) put digital multimeter at ohm shift, and contact the No. 1, No. 2 and No. 3 pin with its two meter pens. The resistance value should be more than 1MΩ¸ under normal temperature. Leave the digital multimeter at millivolt shift, and tap around the sensor using little hammer, there should be voltage signal output.

6. Electric Throttle Body

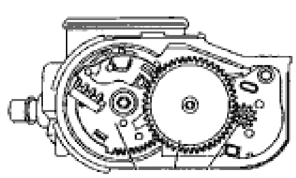
6.1 Function:

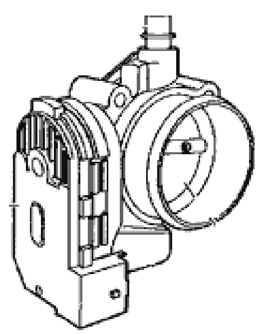
The electronic throttle body can automatically open or close the throttle according to the driver's will to apply the accelerator pedal to let the engine work under the corresponding operating mode. The electronic throttle has cancelled the conventional throttle guy and the opening of throttle is controlled by ECU based on the signal from accelerator pedal and other signals (such as A/C, power assisted steering, back and gearshift etc.) through an electronic step motor inside the electronic throttle body. In addition to cancel of conventional idle speed by-pass and idle speed step motor, there are also throttle position sensors on the electronic throttle body to feed back the opening of the throttle. This suite of throttle position sensor is different from the common one; totally two suites of throttle position sensors are installed inside the electronic throttle body to monitor rationality of the signals from the latter; when any problem occurs in a certain signal, ECU can still use the other suite of signals to work on.

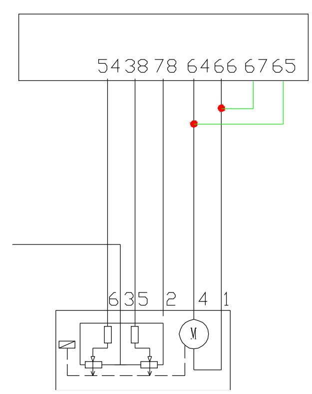
6.2 Working principle:

The throttle driving motor is a micro motor, which is composed of multi steel stators in a circle and a rotor, with one coil on each steel stator. The rotor is a permanent magnet with a nut at its center. All stators coils are constantly power on. As long as the direction of current of one coil is changed, the rotor will turn a certain angle. When the directions of current of all stator coils is changed in a proper order, a rotating magnetic field is formed, which will drive the rotor made from permanent magnet rotate along a certain direction. Its principle is just that of a micro direct current motor.

This motor drives a suite of special gear reducing mechanism and a bidirectional spring; when the system is under power off condition, this mechanism can ensure that the opening of throttle valve plate maintains at a safe position where is bigger than that for idle speed but not too high, so that the vehicle can continue to run; if engine ECU has entered this failure mode, when applying the accelerator pedal, the valve plate of the electronic throttle body will no longer act.







Electronic throttle

6.3 Failure diagnosis:

ECU can monitor short-circuit and break of coil of the throttle driving motor, and light the engine failure light in case of such failure to let the engine enter failure mode, when the engine fails to accelerate, has very poor driving performance and needs maintenance immediately.

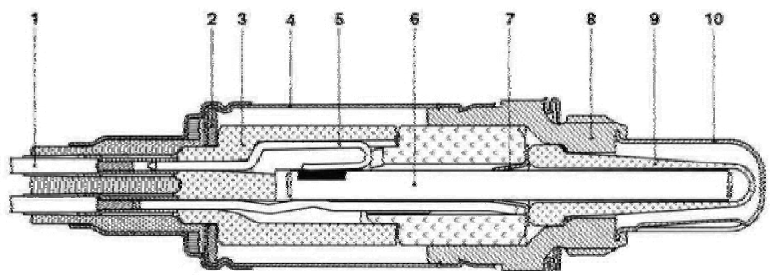
7. Oxygen Sensor

7.1 Function of the sensor:

Oxygen sensor is one of the principal sensors on modern autos; it can feed back the mixture strength by detecting oxygen content in exhaust gas. ECU will correct the mixed gas based on the signals fed back by the oxygen sensor, i.e. control injection pulse-width to let the mixed gas always maintain an approximately ideal air-fuel ratio (14.7:1).

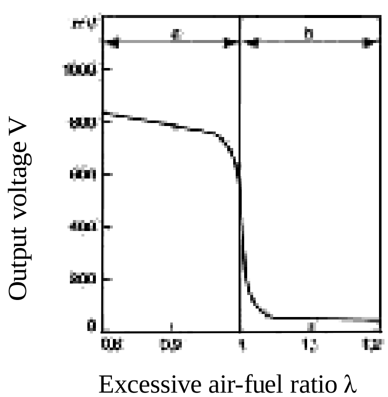
7.2 Principle of the sensor:

Sensing element of oxygen sensor is a kind of ceramic tube with holes, and outside of tube walls are surrounded by engine exhaust gas and inside is air. Ceramic sensor element is a kind of solid state electrolyte with electrical heating tube inside (as shown in the figure).



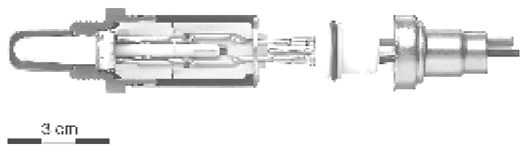
Cross-section view of oxygen sensor

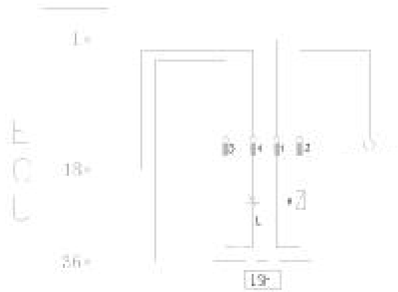
1. Cable 2. Dish washer 3. Insulation bush 4. Protective bush
5. Clamp fitting of heating element 6. Heating rod 7. Contact pad
8. Sensor seat 9. Ceramic probe 10. Protection sleeve



Characteristic Curve of oxygen sensor at 600 ℃

The operation of the oxygen sensor is achieved by converting the concentration difference of oxygen ion between inside and outside of the ceramic sensor element to the voltage signal output. It bears the characteristic of solid electrolyte once the temperature of the ceramic sensor element reaches 350℃. Because of the particularity of its materials, the oxygen ion can pass the ceramic sensor element freely. Taking advantage of this characteristic, the concentration difference will be converted to electric potential difference to form electric signal output. If the mixed gas is comparatively thick, the oxygen ion thickness difference between inside and outside of the ceramic tube will be higher and the potential difference will also be higher, then a mass of oxygen ion will move from inside to outside, so, the output voltage is comparatively high (close to 800mV-1000mV); If the mixed gas is comparatively thin, the oxygen ion thickness difference between inside and outside of the ceramic tube will be smaller and the potential difference will also be smaller, then just a few of oxygen ion will move from inside to outside, so, the output voltage is comparatively low (close to 100mV). The signal voltage will mutate near theoretical equivalent air-fuel ratio (λ=1), see the figure above.





Every oxygen sensor bears a cable and the other end of the cable is the wire connector. The wire connector of oxygen sensor produced by our company has four pins:

No.1 connects to the positive pole of heater power supply (white);
No.2 connects to the negative pole of heater power supply (white);
No.3 connects to signal negative pole (gray);
No.4 connects to signal positive (black).

7.3 Parameters of technical features

- The requirement to exhaust pipe: the segment of exhaust pipe in the area before the oxygen sensor must be heated up rapidly. If possible, the exhaust pipe should be designed to be tilting down to avoid accumulation of condensed water in front of the oxygen sensor.
- Do not inappropriately heat up the metal snap ring of the cable at oxygen sensor side, especially after the engine is shut down.
- Do not apply purge fluid, oiliness fluid or volatile solid on connector of the oxygen sensor.
- The screw thread of the oxygen sensor is M18 ×1.5.
- The size of the hexagonal head wrench for the oxygen sensor is 22-0.33.

The tightening torque for the oxygen sensor is 40-60Nm.

7.4 Failure effects and judgment method

- Failure effects: poor idling, poor acceleration, over proof tail gas and excessive fuel consumption etc.
- General causes of the failure:

1. Moisture entering inside of sensor, and when the temperature is changed, the pin will be broken;

2. The oxygen sensor "intoxicates". (Pb, S, Br, Si)

Maintenance precautions: application of cleaning fluid, oiliness fluid or volatile solid on the oxygen sensor during maintenance is prohibited.

- Simple measurement method:

1. Remove joint, put digital multimeter to ohm shift, connect meter pen to No.1 (white) and No.2 (white) pins of the sensor. The resistance value is 1~6Ω at constant temperature.

2. With the joint connected, under idle speed state, when the working temperature of the oxygen sensor reaches 350℃, turn the digital multimeter to DC Voltage shift and connect the two meter pens respectively to 3# (gray) and 4# (black) pins; at this point, the voltage should fluctuate rapidly between 0.1-0.9V.

8. Fuel Pump Assembly

8.1 Function of fuel pump:

Fuel pump is used to deliver the fuel in the fuel tank to inside the engine at a certain pressure for combustion. It also needs to regulate the fuel pressure duly as required by system pressure (non fuel return type). Generally, the system fuel pressure provided by fuel pump is around 3.5-4bar.

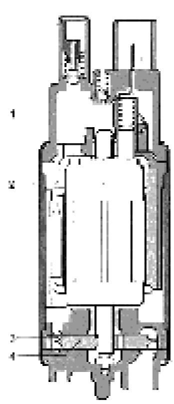
8.2 Operating principle of fuel pump:

The electrical fuel pump is comprised of the DC motor, vane pump and end cover (integrates check valve, relief valve and anti-electromagnetic interference element) as shown in following figure.

The pump and the motor are installed on the same shaft within same closed housing. The pump and electromotor are full of gasoline for coolant and greasing inside of the casing. The accumulator provide power to electric fuel pump via fuel pump relay, and the relay switches on electric fuel pump only when engine starting and running. When the engine stops for some reason, the pump will stop to run by itself.

The max pressure at the outlet of the electrical fuel pump shall be between 450 and 650 kPa, depending on the relief valve. Because the system is a non fuel return system, the pressure of the whole fuel system will be controlled by the fuel pressure regulator. The value is 400KPa in general.

The electric fuel pump has different flow to the engine's request. In order to facilitate the production, the electromotor revolutions of EKP13 series electric fuel pumps of the same structure are adjusted by changing the coil's number of turns, and thus the flow is adjusted. Therefore, do not apply an electric fuel pump for one model to another at will.



Cross-section view of electric fuel pump

8.3 Parameters of technical features

Under certain fuel supply pressure, the flow of the electric fuel pump is in direct proportion to voltage. The fuel pumps used by complete vehicle manufacturers are different.

8.4 Installation attentions

EKP13 series electric fuel pump can only be used inside fuel tank. When installing the fuel pump, the filter net at fuel inlet with mesh size not bigger than 60m or arranged with the customer must be installed. Be careful not to let the fuel jet from air vent spray on the filter net at fuel inlet, fuel pump bracket or fuel tank wall. Be careful when carrying the fuel pump. First, be sure to protect the filter net at fuel inlet from load and impact. The fuel pump should be taken out of the plastic wrapping material with care only when installing. The viser can be taken off only when the fuel pump is to be installed. Takeoff of the filter net at fuel inlet is absolutely not allowed. The foreign material that enters the fuel inlet of the fuel pump or the filter net may lead to damage of the fuel pump.

8.5 Failure effects and judgment method

- Failure effect: strong running noise, poor acceleration, failure to start (starting difficulties) etc.
- Reasons for general failures: use of inferior fuel leads to:

  1. Accumulated colloid became insulation layer;
  2. Fuel pump bushing and armature blocked;
  3. Components of fuel level sensor eroded.
- Maintenance precautions:

1. The electric fuel pump has different flow according to the requirement of engine. The pump with same shape and possible to assemble perhaps is not available. For service, the part number of replaced fuel pump must be in conformity with the original ones;

2. Do not run the pump at dry status to prevent the pump from accident;

3. Please pay attention to take cleaning measures for fuel tank and pipeline and replace fuel filter in case replace fuel pump.

Simple measurement method:

1. With the joint removed, swift the digital multimeter on ohm shift, connect the two meter pens to two pins of pump respectively to measure the inner resistance, it is indicated that is not at zero or infinite (that is non short circuit, open circuit status).

2. With the joint connected, connect the fuel pressure gauge onto the sucker, start the engine and then observe if the fuel pump works; if the fuel pump does not run, check if mains voltage is present at “+” pin; if the fuel pump works, under idling mode, check if the fuel pressure is about 400kPa.

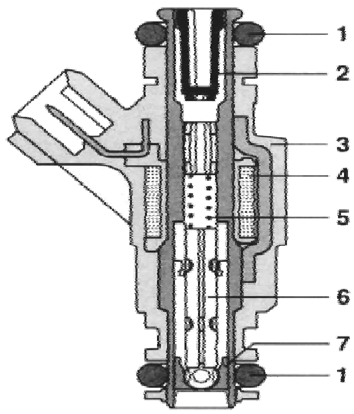
9. Injector

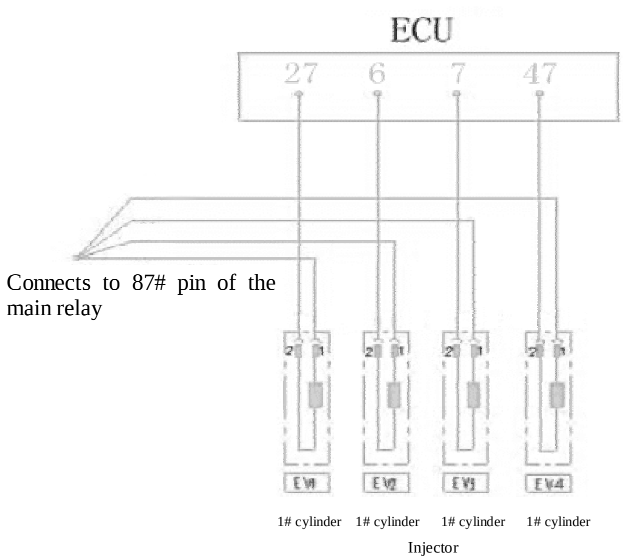
9.1 Function of injector:

ECU controls the coil of the injector through pulse to make the injector open or close, so that, appropriate fuel will be injected into air intake pipe in due time to mix with air.

9.2 Working principle:

ECU sends electrical impulse to injector coil to form magnetic field force. When magnetic field force increase to resultant force that enough to conquer return spring pressure, needle valve gravity and friction force, the needle valve begin to rise up and start the injection process. The pressure of return spring makes needle valve close again when the injection impulse is stopped.





Circuit diagram of electromagnetic injector

9.3 Parameters of technical features

Item	Value			Unit
	Min.	Typical	Max.	
Operating pressure (pressure difference)		350		KPa
Injector electric resistance at 20℃	11		16	W

Allowable fuel:

The injector can only use the fuel in compliance with the provisions in GB 17930-1999 (for vehicle unleaded gasoline) and GWKB 1-1999 (harmful substance control standard for vehicle gasoline), and detergent is required to be added into gasoline. It should be specially pointed out that too long storage of gasoline may make it deteriorate. Especially, the taxi with a (LPG and gasoline) dual-fuel engine uses LPG as fuel long and gasoline is only used for startup, so, daily consumption of gasoline is little. However, because the fuel pump runs long, so the temperature of fuel tank is quite high. If gasoline is stored in the fuel tank of such auto, it may quite liable to oxidation and deterioration, which may lead to choke even damage of injector.

9.4 Installation attentions

- Use specific connector for certain injector and no mixed use will be allowable.
- For installation convenience, it is recommended to daub silica-free clean engine oil on the

surface of the O-ring at the upside of the injector where it connects with the fuel distributing pipe. Be careful not to let engine oil contaminate inside of the injector and the nozzle.

- Place the injector in its bracket vertically along injector bracket, then fix it to the bracket with retaining clips. Note:

① By location mode, the remaining clips for injector fall into axial location remaining clip and axial and radial location remaining clip; misuse should be avoided.

② For installation of an axially located injector, make sure that the bayonet at middle of the remaining clip is completely locked into the groove of the injector and the grooves at both sides of the remaining clip are completely locked into the outskirt flanging of the injector seat.

③ When installing an injector that both axial and radial locations are required, use an axial and radial location remaining clip and place the locating piece of the injector and the locating pin of the injector seat respectively into the corresponding grooves on the location remaining clip.

④ If the injector has two grooves, be careful not to place by mistake, refer to the installation site of the original.

- Installation of injector should be done by hand and knocking the injector with such tools as hammer etc. is prohibited.
- When disassemble/reassemble the fuel injector, the O ring must be replaced. And pay attention to not damage the sealing surface of the injector.
- Do not pull the support gasket of O-ring out of the injector. When installing, avoid damage to fuel inlet end, support ring, nozzle plate and electric connector of the injector. If damaged, use is prohibited.
- After installation of injector, perform leakproofness detection for fuel distributing pipe assembly. It is acceptable only when no leakage exists.
- The failure part must be disassembled by hand. Remove remaining clip of the injector first, and then pull out the injector from the injector seat. After disassembly, ensure cleanliness of the injector seat and avoid contamination.

9.5 Failure effects and judgment method

- Failure effects: Poor idling, poor acceleration, failure to start (starting difficulties) etc.
- Reasons for general failures: failure caused by colloid accumulation inside the injector due to lack of maintenance.
- Maintenance precautions: (see installation attentions)
- Simple measure method:

(remove the joint) swift the digital multimeter on ohm shift, connect the meter pens to the two pins of injector. The rated resistance should be 11 - 16Ω¸ when it is 20℃.

Suggestion: regularly wash and analyze the injector using a special washer analyzer for injector.

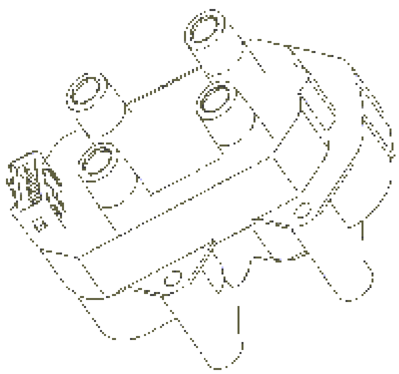
10. Ignition Coil

10.1 Function of ignition coil:

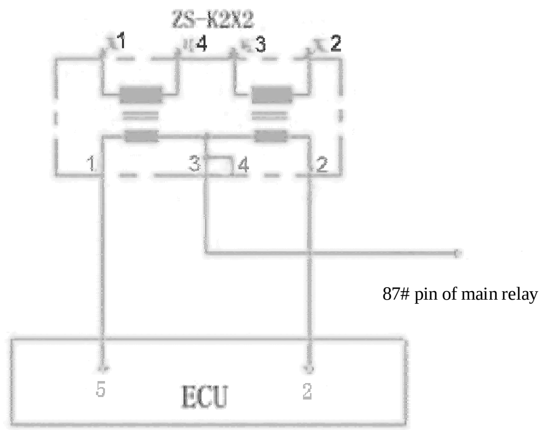
Primary and secondary circuits are integrated inside the ignition coil; when ECU controls on-off of current in the primary coil, a high voltage as high as thousands volts will be generated in the secondary coil, which will then generate spark through ignition cable and spark plug to ignite the mixed air in the cylinder.

10.2 Working principle

Ignition coil ZS - K2 ´2 consists of two primary windings, two secondary windings, mandrel, and casing. When one of the primary windings grounding channel is connected, the primary winding is in charging. Once the primary winding circuit is cut off by ECU, the charging will be stopped. At the same time, the high voltage is sensed in the secondary winding and making the spark plug discharging. There is a different with the distributor ignition coil: for the ignition coil ZS - K2 ´2, there is one spark plug on both side of the secondary winding, so the both spark plugs can ignite at the same time. These two primary windings power on/off alternatively, correspondently, these two secondary windings discharge alternatively.



Double spark ignition coil



10.3 Technical characteristic

Item		Value			Unit
		Min.	Typical	Max.	
Nominal voltage			14		V
Resistance (20 to 25℃)	Primary winding	0.42	0.5	0.58	W
	Secondary winding	11.2	13.0	14.8	kW
Inductance (20 to 25℃)	Primary winding	3.4	4.1	4.8	mH
	Secondary winding	26.5	32.0	37.5	H
Voltage produced	50pF load	30			kV
	50pF//1MW load	23			kV

10.4 Failure effects and judgment method

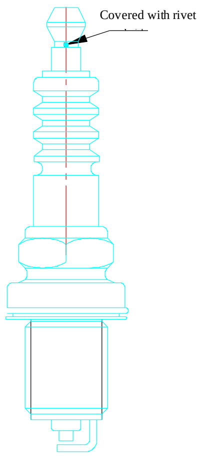
- Failure effects: start failure etc.
- Reasons for the failures: burn out due to too strong current, damage by external force etc.
- Maintenance precautions: use of “test ignition by short circuit” to test the ignition function is prohibited during maintenance to avoid damage to the electronic controller.
- Simple measurement method:

With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to the two pins of primary winding. At 20℃, the resistance should be 0.42-0.58Ω, while this value of secondary winding should be 11.2-14.8kΩ.

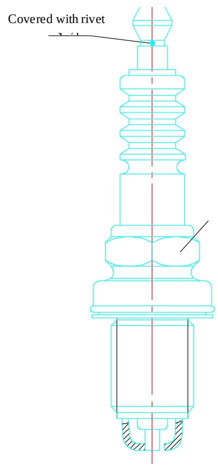
11. Spark Plug

The operating conditions of spark plug is extremely inclement, it is exposed to high pressure, high temperature and impact as well as strong corrosion from combustion product; therefore, it is a wearing part.

11.1 Outline drawing



Mono-pole



Triple-pole

11.2 Thermal performance

The spark plug must maintain a proper temperature to keep good working order. Practically, when insulator skirt of the spark plug maintains a temperature of 500-700℃, the oil drop that falls on the insulator can be burnt away immediately without carbon deposit formed. This temperature is called “self cleaning temperature of spark plug”. With a temperature below this scope, the spark plug is liable to carbon deposit and electric leakage, thus causing ignition failure; with a temperature above this scope, when the mixed air is contacting with the red-hot insulator, pre-ignition may occur to produce knock, even it may burn in intake stroke and cause backfire.

11.3 Potential failures due to fall of ignition performance of spark plug

Starting difficulties, unsteady speed, chatter of engine, black smoke out of exhaust pipe, high fuel consumption and poor power.

11.4 Judge if the vehicle status matches with the spark plug type through color of spark plug

Yellow, brown yellow   normal   indicates that the combustion status of mixed air is normal

Black with carbon deposit   carbon deposit   check if the spark plug type matches and then replace with the spark plug with lower heat value (slow heat radiation).

Black with blot   soot   clean if the injector nozzle is dirty

Dilute if the mixture ratio of oil gas is too big.

Check ignition coil etc. if the high voltage is poor.

Black with oil stain   combustion of engine oil   check sealing status of the seal ring and if scratch is present on the cylinder wall.

Pearl overheating check if the spark plug type matches, and then replace with the spark plug with lower heat value (rapid heat radiation).

11.6 Regular replacement and use overdue

The spark plug is the low-value consumption goods. Though cheaper compared with other matching parts, its ignition performance directly affects the performance of the engine. Therefore, it needs regular replacement. For the spark plug used in our vehicles, we suggest that you should replace the spark plug at the following mileages: 10,000-15,000 km (single electrode); 15,000-25,000 km (multi electrode).

Ignition performance fall of spark plug will make fuel consumption rise and power drop off. The economic loss caused by excessive fuel consumption unconsciously will even afford to hundreds of new spark plugs. Use overdue makes the working condition of the engine poor in long term and brings some damage to the engine.

11.7 Inspection and maintenance of the spark plug

The inspection items for spark plug mainly include carbon deposit, electrode burn through, gap, and sealing and spark jump performances of the spark plug etc.

The electrode gap of the spark plug should be 0.7-0.9mm. Too small electrode gap will reduce the breakdown voltage and weaken the spark intensity; while too big electrode gap will increase the voltage required by the spark plug and cause spark out, especially when the ignition coil is aging and the ignition system is in poor maintenance, spark out is more liable to occur.

Common failures of spark plug: fall in sealing performance, air leak and soot at the air leakage position. The above failures can be inspected and judged through sealing performance test and spark jump test. Both sealing performance test and spark jump test can be conducted on a spark plug cleaning tester.

It is unscientific that some drivers and maintenance professionals remove the spark plug from the engine, place it on the cylinder head and inspect if it is in sound conditions using high voltage of the vehicle. In this test, the spark plug electrode is under an atmosphere other than a gas pressure of over 800KPa, its working pressure. Therefore, spark jump of a spark plug under an atmosphere does not indicate that it will also reliably produce spark jump under a high pressure conditions in the cylinder.

It is required that carbon deposit disposal and proper adjustment of spark plug gap should be done after a mileage of 10,000-15,000 km in its lifetime. When the temperature in cylinder rises, the electrode gap should be increased properly. That is, increase the electrode gap in summer while reduce it in winter. If the mixed air is strong, the electrode gap should be increased; otherwise, decreased. In plain region, the electrode gap should be decreased while in plateau region, increased.

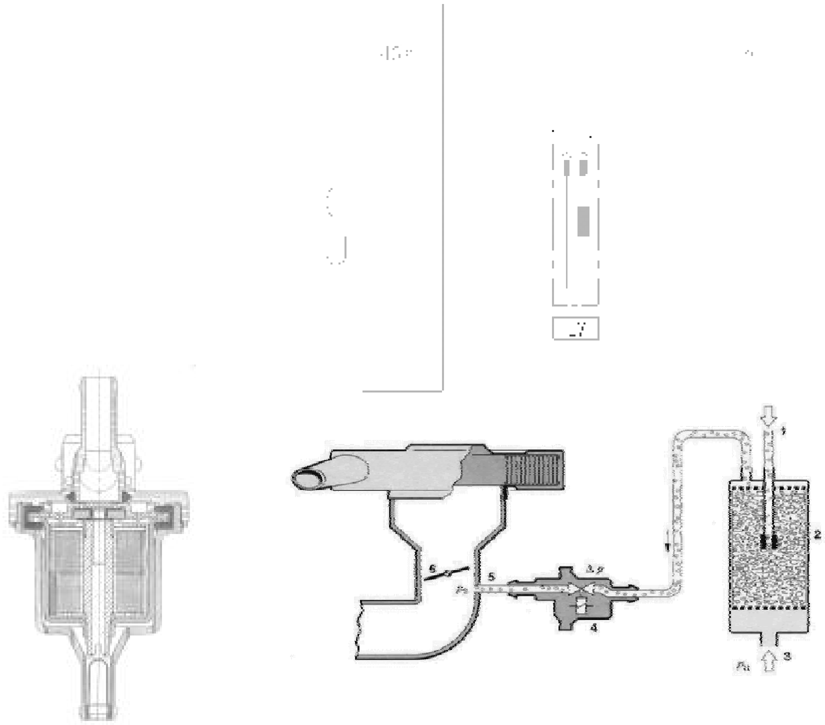
12. Carbon Canister Solenoid Valve Control

12.1 Function:

Carbon canister solenoid valve is a device used to enable the fuel steam in fuel tank to enter cylinder to combust through control of ECU. Through controlling duty cycle of a solenoid valve, ECU can accomplish open and close of the solenoid valve.

12.2 Working principle:

The canister control valve is composed of solenoid, armature iron and valve etc. There is a filter net at the inlet. The airflow through the canister control valve at one hand depends on the duty cycle of the electric pulse output of canister control valve by ECU, and at another hand depends on the pressure difference between the inlet and the outlet of the canister control valve. The canister control valve will be closed when there is not any electric pulse.



1 From fuel tank
2 Canister
3 Atmosphere
4 Canister control valve
5 To intake manifold
6 Throttle

Installation drawing of canister control valve

12.4 Installation attentions

See above installation drawing for connection among canister control valve, carbon canister and intake manifold.

- In order to avoid transfer of solid borne noise, floating installation of the canister control valve on the hose is recommended.
- During installation, make sure that the airflow direction meets the specification.
- Appropriate measures such as filtering and purge etc. must be taken to prevent such foreign material as particles from entry into the canister control valve from carbon canister or hose.

It is recommended that a corresponding protective strainer (size of grid<50μm) should be installed on outlet of carbon canister.

12.5. Failure effects and judgment method

- Failure effects: Failure of functions etc.

Reasons for general failure: corrosion or poor sealing performance etc. due to entry of foreign material into inside of the valve.

- Maintenance precautions:

1. During installation, make sure that the airflow direction meets the specification;

2. In case of control valve failure due to black particle inside the valve body, when replacement of the control valve is required, check the status of the canister;

3. During maintenance, try to avoid entry of such liquid as water and oil etc. into the valve;

4. In order to avoid transfer of solid borne noise, floating installation of the canister control valve on the hose is recommended.

- Simple measurement method:

With the joint removed, turn the digital multimeter to Ohm shift, and then connect the two meter pens respectively to both pins of the canister control valve. The rated resistance at 20℃ should read 26±4Ω.

13. Electronic Accelerator Pedal

13.1 Function:

The electronic accelerator pedal has cancelled the conventional throttle guy and the position of accelerator pedal is fed back to ECU by means of electronic signal, through which ECU can calculate and control the action of the electronic accelerator pedal. Two sets of Hall sensors are integrated in the pedal; ECU can compare and analyze the two signals, if one signal is improper, ECU will duly access the other signal and light the failure indicator.

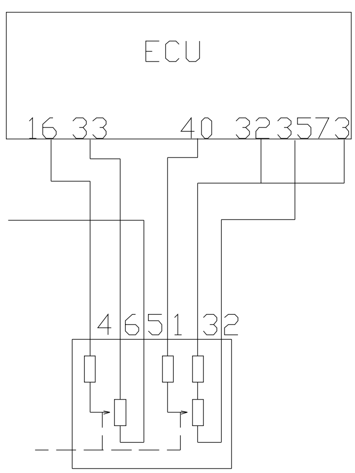
13.2 Working principle:

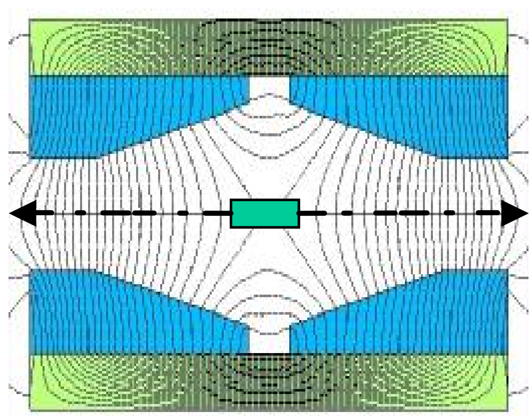
The pedal is a Hall sensor. The fixed Hall generator and signal processing circuit are installed on fixed mounting of the pedal. The two permanent magnets with different magnetic sheet thickness act together with the pedal. When the pedal acts, the magnetic flux passing the Hall generator will also change accordingly, the signal processing circuit will process these signals and then send them to ECU.

13.3 Detection:

The relationship between the two signals of the accelerator pedal is that signal 1 is equal to signal voltage.

At idle speed position, the voltage of signal 1 is 4.59 and that of signal 2 is 4.30. When the pedal is at middle position, the voltage will be the minimum; when the pedal is at either end position, the voltage will be the maximum.





14. Three-way Catalytic Converter

14.1 Function:

Three-way catalytic converter is used to convert the noxious gas in tail gas into such innocuous gases as carbon dioxide and water etc. At 300-800℃, the conversion efficiency of three-way catalytic converter is maximum; with a temperature below this scope, the conversion efficiency will be very poor, while, with a temperature above this scope, the three-way catalytic converter may be burnt out. Three-way catalytic converter can exert better conversion efficiency only when the oxygen sensor works. In control strategies of ECU, there are several protective modes for three-way catalytic converter, and ECU can protect the three-way catalytic converter by regulating air-fuel ratio and ignition advance angle.

15. Fan Control

15.1 Function:

In order to abstract heat from engine system and from condenser with A/C turned on, fan control is affected by the signal to ECU sent by water temperature sensor; When water temperature is high (above the threshold value set by ECU), the fan will run, and when water temperature is low (below the threshold value set by ECU), the fan will also run; with A/C turned on, the fan will run at low speed.

15.2 Composition:

DC electric motor double fan (high and low speed change).

15.3 Installation requirements:

The fan is installed between the rear of radiator and the engine, be careful when installing: not to damage fin of fan blade, otherwise, running noise of the fan will increase, if serious, it may lead to sharp fall of heat radiation effect of the engine.

15.4 Failure diagnosis:

Fan control circuit is a short or open circuit to ground;

The fan has failure itself;

Too loud fan noise;

Failure in power supply circuit of fan.

15.5 Troubleshooting:

First, validate whether it is a high speed fan system problem or a low speed fan system problem. Provided that this is a fan control system problem, use a diagnostic tester to locate the failure point, and then validate whether it is a short-circuit or a break in control circuit.

Failure symptom: the fan failure may result in rise of engine coolant temperature and poor refrigeration of A/C system.

15.6. Fan Control:

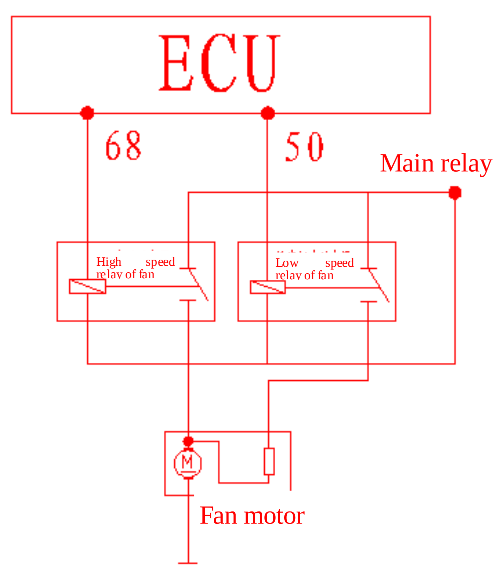
Turn-on of low gear of fan:

1. Temperature of engine coolant: 96℃-102℃;
2. On request for A/C, the fan will start up;
3. When driving speed is too high, the fan will start up;

High speed startup of fan:

1. Engine coolant temperature sensor failure;
2. Air flow meter failure;
3. Engine coolant temperature exceeds 102℃.

Pins:



Brief sketch map of fan control

1. High speed fan control (corresponds to ECU50#);
2. Low speed fan control (corresponds to ECU68#);

The operating mode of fan after engine stops:
1. Failure of intake air temperature sensor of engine, delay 60s;
2. Failure of intake air temperature sensor of engine, delay 60s;
3. Engine coolant temperature exceeds 100.5℃, delay 60s;
4. Engine coolant temperature exceeds 70.5℃, delay 60s.

16. Position Sensor of Double Brake Pedal

16.1 Function:

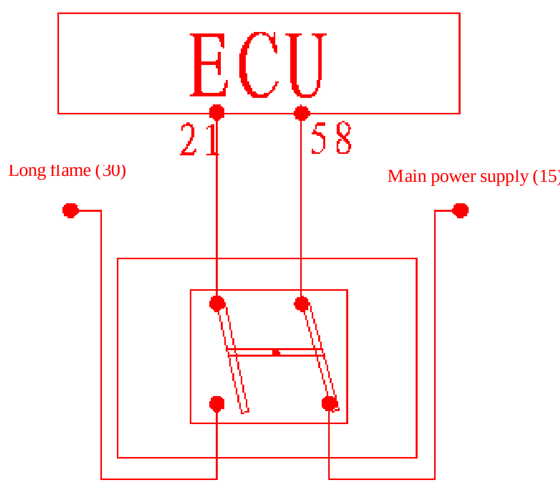
制动开关传感器是将刹车信号送给 ECU，ECU 根据（原文不全）

16.2 Working principle:

Inside the brake switch, there are two mutually independent switches with one normal close and the other normal open. After applying the accelerator pedal, the former normal close switch turns to be normal open, while the normal open one turns to be normal close. Both signals will be sent to ECU to be used to control other systems. Whenever the two signals disaccord, ECU will enter failure mode, the electronic throttle will not respond when applying the accelerator pedal and the engine will maintain idle speed working state.

Composition: the double brake switch is installed on the bracket of the brake pedal and contains two independent switches inside.

Installation requirement: the assembly is installed on the pedal and there is a thread adjusting mechanism on the switch for stroke adjustment of the switch and effective stroke adjustment of the brake switch.



Double brake switch

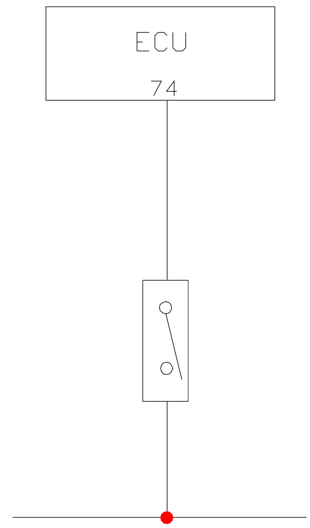
17. Clutch Position Sensor

17.1 Function:

Clutch position switch provides ECU with the signal of clutch position, but this signal can only be used to distinguish between disengaging and engaging positions of the clutch.

17.2 Working principle:

ECU provides clutch position switch with a 12V power supply; when the clutch is under disengaging state, the power supply will ground and ECU will lose 12V high potential signal, by which the position of the clutch can be judged.



18. A/C Control

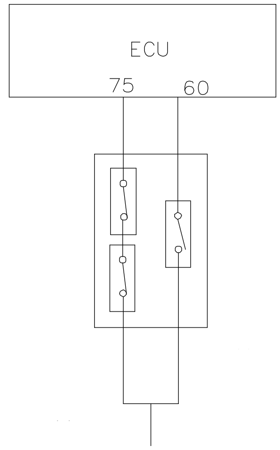
By receiving the A/C signal from A/C switch, ECU can control working of A/C compressor. ECU also can receive the signals from high and low pressure switches of A/C to ensure safety of A/C system. When A/C signal is sent to ECU through high and low pressure switches, if the low pressure switch breaks, ECU will not receive the A/C signal; the compressor is thus unable to work. If A/C system has a too high pressure, the high pressure switch will break and A/C signal can not be provided to ECU; so, ECU will immediately cut off the compressor. When system pressure is normal or a little higher (medium pressure), the medium pressure switch will cut in; thus, ECU can control the fan to run immediately at high speed to ensure a system pressure within the normal range.

Cut off pressure of the low pressure switch: 0.12Mpa

Cut-in pressure of the medium voltage switch: 1.6Mpa

Cut off pressure of the high pressure switch: 3.2Mpa

Through evaporator temperature sensor of the A/C system, ECU can also protect the A/C system and prevent evaporator case from freezing. When the temperature provided by the evaporator temperature sensor is blow 3.75℃, ECU will cut off the compressor; when the temperature is above this degree, ECU will automatically engage the compressor to let it work.



Chapter Two Fundamental Principle for Failure Diagnosis of Electronic Fuel Injection System

1. Failure Information Records

The ECU monitors sensor, actuator, related circuit, malfunction indicator and battery voltage etc., and even EUC itself continuously. At the same time, the ECU inspect the reliability test on sensor signal output, actuator driving signal and internal signal (e.g.: closed loop control, knock control, idle speed control and accumulator voltage control etc.). ECU will set the malfunction record on RAM malfunction memory immediately once the malfunction or the unlikelihood signal is detected. The failure information records are stored in the form of diagnostic trouble code (DTC) and are displayed in the precedence order of occurrence of the failures.

Failures can be divided into “stable state failures” and “random failures” (for example, caused by transient open circuit of wires or poor contact of inserted parts) by failure frequency.

2. Failure State

Once duration of occurrence of an identified failure exceeds the given stabilization time for the first time, ECU will account it as a stable failure and then store it as a “stable state failure”. If this failure disappears, it will be stored as a “random failure” and “non-existent”. If this failure is identified again, it will still be a “random failure”, but a “existent” early failure that will not affect average service of the engine.

3. Failure Types

- Short circuit to positive pole of power supply
- Short circuit to ground
- Open circuit (for the case where there are pull-up resistors or pull-down resistors during input stage, ECU will recognize failure of open circuit at input port as that of short circuit to positive pole of power supply or that of short circuit to ground)
- Signals can not be used

4. Failure Frequency Counter

- For every identified failure, a separate frequency counter numerical value (Hz) will be set.
- This numerical value (Hz) for frequency counter determines the time this failure

information record will be stored in memory after the identified failure disappears (after troubleshooting).

- When a failure is identified for the first time, Hz will be set as its initial value 40. If failure status does not change, then this numerical value will maintain all along.
- Once it is identified that this failure has disappeared and the state has held for a certain time, whenever the engine starts with success (its engine speed has exceeded the value at end of starting) once, Hz will decrease by 1. At this point, ECU will believe that this failure has disappeared, but the failure information record still exists.
- If a failure (for example, as a result of poor contact) frequently appears and disappears, then Hz will increase by 1, but will not exceed its given upper limit value 100.
- If value of Hz has been decreased to zero, the failure information records in this failure memory will be completely cleared.

5. Limp Home

For some identified significant failures, when duration exceeds the given stabilization time, ECU will take appropriate software countermeasures, for example, closing some control functions such as closed loop control of oxygen sensor etc. and setting substituted values for some data that are considered to be suspect and so forth. At this point, though the working condition of the engine is comparatively poor, the auto can still run. The purpose to do this is to enable the auto limply run home or to a service station for overhaul, so as to avoid the embarrassment that the auto breaks down on highway or afield. Once it is identified that the failure has disappeared and Hz has fell to below 40, use of normal data will be resumed again.

6. Failure Alert

In the electric control system, when failure take places in any of such important parts as ECU, absolute pressure sensor in intake manifold, throttle position sensor, coolant temperature sensor, knock sensor, oxygen sensor, phase sensor, injector, two driver stages of step motor of idle speed actuator, canister control valve, or fan relay at corresponding failure location, ECU will give an alarm through lightening of failure indicator lamp until this failure location restores.

7. Readout of Failure

The failure information records can be called out of ECU through a trouble diagnosis tester. If the failure relates to the function of mixed air (fuel and air) proportional regulator, then the engine must at least run for 4 minutes before reading out failure information records; especially for failure in oxygen sensor, be sure not to detect data until the engine runs and warms up.

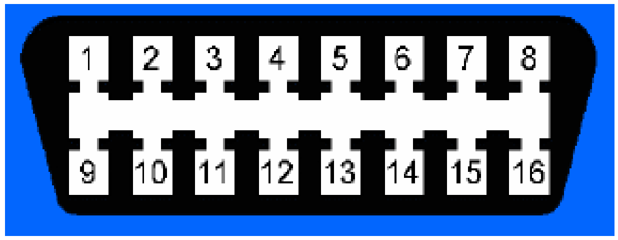


Figure 3-1 ISO 9141-2 Standard Diagnostic Connector

8. Clearing Failure Information Records

After the failure is removed, the failure information records in memory should be cleared. The diagnostic trouble code can be cleared through the following approaches:

- When the numerical value of frequency counter in ECU reaches zero, the failure information records in failure memory will be automatically cleared.
- Employing fault diagnostic tester to clear records of failure with the instruction of “reset memory for records of failure”.
- Pulling out connectors of ECU or disconnecting wires of battery to clear records of failure in external ram.

9. Failure Locating

After obtaining failure information records through above means, only rough location where the failure takes place is aware, but this does not mean that the failure has been located; because the cause that triggers a piece of failure information may be damage of electric element (such as sensor, actuator or ECU etc.), lead break, lead short-circuit to ground or anode of battery, even may be mechanical failure.

The failure is intrinsic and the result of its extrinsic representations is a variety of symptoms. After a symptom is found, first, check for failure information records with a trouble diagnosis tester or based on the flash code, after that, remove the correlated failure in accordance with the failure information, and then locate the failure based on symptom of the engine.

10. Failure Code Table

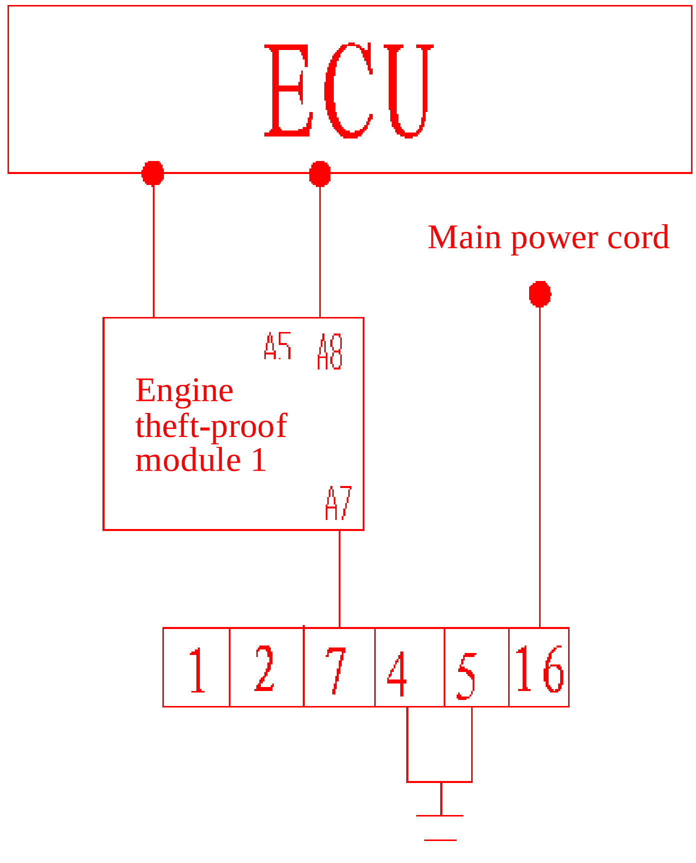
No.	DTC	Explanation	Failure class
1	P0016	Improper relative installation position between camshaft and crankshaft	class5
2	P0030	Failure in heating control circuit of upstream oxygen sensor	class31
3	P0031	Too low voltage in heating control circuit of upstream oxygen sensor	class31

4	P0032	Too high voltage in heating control circuit of upstream oxygen sensor	class31
5	P0105	Signal failure of intake air pressure sensor	class31
6	P0106	Improper signal from intake air pressure sensor	class31
7	P0107	Too low voltage in signal circuit of intake air pressure sensor	class31
8	P0108	Too high voltage in signal circuit of intake air pressure sensor	class31
9	P0112	Too low voltage in signal circuit of intake air temperature sensor	class5
10	P0113	Too high voltage in signal circuit of intake air temperature sensor	class5
11	P0117	Too low voltage in signal circuit of engine coolant temperature sensor	class31
12	P0118	Too high voltage in signal circuit of engine coolant temperature sensor	class31
13	P0121	Improper signal from electronic throttle position sensor 1	class34
14	P0122	Too low voltage in signal circuit of electronic throttle position sensor 1	class34
15	P0123	Too high voltage in signal circuit of electronic throttle position sensor 1	class34
16	P0130	Improper signal from upstream oxygen sensor	class31
17	P0131	Too low voltage in signal circuit of upstream oxygen sensor	class31
18	P0132	Too high voltage in signal circuit of upstream oxygen sensor	class31
19	P0134	Failure in signal circuit of upstream oxygen sensor	class31
20	P0201	Failure in 1# cylinder injector control circuit	class5
21	P0202	Failure in 2# cylinder injector control circuit	class5
22	P0203	Failure in 3# cylinder injector control circuit	class5
23	P0204	Failure in 4# cylinder injector control circuit	class5
24	P0219	Engine revolution exceeds the maximum revolution limit	class5
25	P0221	Improper signal from electronic throttle position sensor 2	class34
26	P0222	Too low voltage in signal circuit of electronic throttle position sensor 2	class34
27	P0223	Too high voltage in signal circuit of electronic throttle position sensor 2	class34
28	P0261	Too low voltage in 1# cylinder injector control circuit	class5
29	P0262	Too high voltage in 1# cylinder injector control circuit	class5
30	P0264	Too low voltage in 2# cylinder injector control circuit	class5
31	P0265	Too high voltage in 2# cylinder injector control circuit	class5
32	P0267	Too low voltage in 3# cylinder injector control circuit	class5
33	P0268	Too high voltage in 3# cylinder injector control circuit	class5
34	P0270	Too low voltage in 4# cylinder injector control circuit	class5
35	P0271	Too high voltage in 4# cylinder injector control circuit	class5
36	P0321	Improper signal of crankshaft top dead center	class33
37	P0322	Engine speed signal failure	class33
38	P0324	Failure in knock signal processing chip and its circuit	class5
39	P0327	Too low voltage in signal circuit of knock sensor	class31
40	P0328	Too high voltage in signal circuit of knock sensor	class31

41	P0340	Failure in signal circuit of phase sensor	class5
42	P0341	Improper signal from phase sensor	class5
43	P0342	Too low voltage in signal circuit of phase sensor	class5
44	P0343	Too high voltage in signal circuit of phase sensor	class5
45	P0444	Failure in control circuit of canister control valve	class31
46	P0458	Too low voltage in control circuit of canister control valve	class31
47	P0459	Too high voltage in control circuit of canister control valve	class31
48	P0480	Failure in relay control circuit of electronic cooling fan (low speed)	class5
49	P0481	Failure in relay control circuit of electronic cooling fan (high speed)	class5
50	P0501	Improper speed signal	class5
51	P0504	Improper signal of brake pedal A/B	class5
52	P0506	Engine speed under idle speed control is below the target idle speed	class5
53	P0507	Engine speed under idle speed control is above the target idle speed	class5
54	P0537	Too low voltage in signal circuit of evaporator temperature sensor	class5
55	P0538	Too high voltage in signal circuit of evaporator temperature sensor	class5
56	P0560	Improper system voltage signal	class33
57	P0562	Too low system voltage signal	class33
58	P0563	Too high system voltage signal	class33
59	P0571	Failure in signal circuit of brake pedal	class5
60	P0601	Failure in EEPROM of ECU	class33
61	P0602	Unprogrammed failure in ECU	class33
62	P0604	Failure in RAM of ECU	class34
63	P0605	Failure in ROM of ECU	class34
64	P0606	Safety monitoring function failure of electronic throttle	class34
65	P0627	Failure in control circuit of fuel pump relay	class33
66	P0628	Too low voltage in control circuit of fuel pump relay	class33
67	P0629	Too high voltage in control circuit of fuel pump relay	class33
68	P0645	Failure in control circuit of A/C compressor relay	class5
69	P0646	Too low voltage in control circuit of A/C compressor relay	class5
70	P0647	Too high voltage in control circuit of A/C compressor relay	class5
71	P0688	Improper output voltage of main relay	class33
72	P0689	Too low output voltage of main relay	class33
73	P0690	Too high output voltage of main relay	class33
74	P0691	Too low voltage in relay control circuit of electronic cooling fan (low speed)	class5
75	P0692	Too high voltage in relay control circuit of electronic cooling fan (low speed)	class5
76	P0693	Too low voltage in relay control circuit of electronic cooling fan (high speed)	class5

77	P0694	Too high voltage in relay control circuit of electronic cooling fan (high speed)	class5
78	P0704	Improper clutch pedal signal	class5
79	P1336	Restrictive effect of safety monitoring torque of electronic throttle	class34
80	P1545	The deviation between physical location and target location of electronic throttle overruns	class34
81	P1558	Too large opening resistance of electronic throttle	class34
82	P1559	Failure in self-study process of electronic throttle	class34
83	P1564	System voltage fails to meet the conditions for self-study of electronic throttle	class34
84	P1565	Failure in self-study of initialization of lower limit position of electronic throttle	class34
85	P1568	Too large restoration resistance of electronic throttle	class34
86	P1579	Fails to meet the conditions for self-study of electronic throttle	class34
87	P1604	Failure in self-study of gain adjustment of electronic throttle	class34
88	P1610	Unprogrammed error in Secret Key and Security Code	class39
89	P1611	Security Code acceptance error	class39
90	P1612	Challenge request failed	class36
91	P1613	Immo Code request failed	class36
92	P1614	Transponder check error	class36
93	P1677	Too high voltage in control circuit of detector lamp (SVS)	class5
94	P1678	Too low voltage in control circuit of detector lamp (SVS)	class5
95	P1679	Failure in control circuit of detector lamp (SVS)	class5
96	P2106	Failure in driver stage of electronic throttle	class34
97	P2122	Too low voltage in signal circuit of electronic accelerator pedal position sensor 1	class34
98	P2123	Too high voltage in signal circuit of electronic accelerator pedal position sensor 1	class34
99	P2127	Too low voltage in signal circuit of electronic accelerator pedal position sensor 2	class34
100	P2128	Too high voltage in signal circuit of electronic accelerator pedal position sensor 2	class34
101	P2138	Improper signal from electronic accelerator pedal position sensor	class34
102	P2177	Self-study value of closed loop air fuel ratio control is above the upper limit (normal load zone)	class5
103	P2178	Self-study value of closed loop air fuel ratio control is below the lower limit (normal load zone)	class5
104	P2187	Self-study value of closed loop air fuel ratio control is above the upper limit (idle speed zone)	class5
105	P2188	Self-study value of closed loop air fuel ratio control is below the lower limit (idle speed zone)	class5

106	P2191	Self-study value of closed loop air fuel ratio control is above the upper limit (heavy load zone)	class5
107	P2192	Self-study value of closed loop air fuel ratio control is below the lower limit (heavy load zone)	class5



Electrical Schematic Diagram of Diagnostic Interface

11. The Steps for Implementation of Failure Diagnosis According to Failure Information Records

11.1 Electronic Throttle Failure

Failure codes: P012, P0122, P0123, P022, P0222, P0223, P1336, P154, P1558, P1559, P1564, P1565, P1568, P1579, P1604

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull out the joint of throttle position sensor on harness; use a multimeter to check if the magnitude of voltage between its 3# and 5# pins is around 12V and if a 5V voltage is present between 6# and 2# pins.	Yes	Next step
		No	5
3	Use a multimeter to check if the resistance values between 1#, 4# and 6# pins of the sensor are between 0.5kΩ and 1.6kΩ.	Yes	Next step
		No	Replace the sensor
4	Meanwhile, use a multimeter to check if it is break or short circuit between 1#, 4# and 6# pins of throttle position sensor and ECU38#, 54#, 36#; or, turn blade of the throttle to observe if its resistance value jumps and if the resistance values between 1#, 4# and 6# change accordingly with rotation of throttle.	Yes	Replace the sensor
		No	Replace ECU
5	Connect an adaptor between ECU and harness, use a multimeter respectively check if it is break or short circuit between 1#, 2#, 6# and 4# pins of the sensor and 10#, 32#, 36# and 54# pins of ECU joint.	Yes	Repair or replace wire harness
		No	Replace ECU

Note: This auto adopts the electronic throttle body and has cancelled former step motor, and the functions that were accomplished by the stop motor on a common throttle body are now completely accomplished by the throttle driving motor. The electronic throttle can not be repaired and failure rate of the throttle body is very low, if damaged, replacing the assembly is the only choice to deal with the problem.

Special attention: The electronic throttle body can not be disassembled and repaired at service station; in addition, after replacing electronic throttle body, be sure to let it carry out self-study; otherwise, unsteady working at idle speed of engine may occur. See also the section about electronic throttle for detailed study scheme. Maintenance of the throttle body is analogous to that of the common valve body.

11.2 Knock Sensor failure

Failure codes: P0324, P0327, P0328

No.	Operating steps	Result	Follow up steps
1	Close the ignition switch, and the engine stops.		Next step
2	Pull out the joint of knock sensor on harness, use a multimeter to check if both resistance values between 1# and 2# pins and between 1# pin and shielded wire (sensor shield) pin of knock sensor are more than 1MΩ.	Yes	Next step
		No	Replace with a new sensor
3	Knock on the edge of knock sensor with a small hammer and check with multimeter if there is communicating signal output between sensor pin 1# and 2#.	Yes	Next step
		No	Replace the sensor
4	Turn on the ignition switch but do not start the engine.		Next step
5	Connect an adaptor between ECU and harness, use a multimeter respectively check if it is break or short circuit between 19#, 20# pins of ECU and 1#, 2# pins of sensor joint.	Yes	Repair or replace wires
		No	Replace ECU

Note: Generally, knock sensor is not liable to damage. When disassembling and installing the knock sensor, be careful not to leave dirt on the contact surface of the sensor and the engine body and do not add any gasket. If the sensor is damaged, it will have an comparatively great effect on economical efficiency and emission of the engine. After the knock sensor is damaged, the electric control system of the engine will lock ignition advance angle of the engine at a fixed ignition angle, so, the acceleration performance of the engine will fall and economical efficiency and emission of the engine will also be greatly affected.

11.3 Air Pressure Sensor Failure

Failure codes: P0102, P0103, P0112, P0113

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull out joint of intake air pressure sensor on harness; use a multimeter to check if a 5V voltage is present between 2# and 3# pins of the joint.	Yes	4
		No	Next step
3	Between ECU and harness, use a multimeter to respectively check if it is break or short circuit between 42# and 33# pins of ECU and 1#, 2#, 3#, 4# pins of sensor joint.	Yes	Repair or replace harness
		No	Next step
4	Replace the intake air temperature pressure sensor.		Next step

Note: In case the sensor shorts to 5V or 12V power supply or ground, the engine may not start up or stop running.

11.4 Front Oxygen Sensor Failure

Failure codes: P0130, P0131, P0132, P0134, P0135

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull off the connector of harness of oxygen sensor. Check the voltage between pin 1# (+) and 2# (-) with multimeter and detect if it is around 12V.	Yes	Next step
		No	4
3	Use a multimeter to check if the resistance value between 1# and 2# pins of the oxygen sensor is between 2Ω and 5Ω at 23℃.	Yes	Replace ECU
		No	Replace the sensor
4	Check if heating circuit of the oxygen sensor is normal.	Yes	Next step
		No	Check the circuit
5	Check if it is short circuit or break circuit between the pin 2# of oxygen sensor and main relay 87# pin and between the sensor connector 1# pin and ECU 1# pin with multimeter.	Yes	Repair or replace harness
		No	Next step
6	Connect the oxygen sensor connector of harness and use neutral. Start the engine and leave it at idle speed until its coolant temperature reaches to the normal value.		Next step
7	Pull off the oxygen sensor connector of harness. Check the battery output voltage between pin 3# (+) and pin 4# (-) of the sensor with multimeter and detect if it is from 0.1 to 0.9V (after the engine warms up).	Yes	Next step
		No	Replace the sensor
8	Connect the adaptor between ECU and harness. Check if it is short circuit or break circuit between the pin 36# and pin 13# of ECU and the sensor connector pin 3# and pin 4# respectively with multimeter.	Yes	Repair or replace harness
		No	Replace ECU
9	Plug in the oxygen sensor connector of harness and use neutral. Start the engine and leave it at idle speed until its coolant temperature reaches to the normal value.		Next step
10	Connect special diagnostic tester for Chery to read part of data stream of the engine, and then observe if part of data stream of the sensor fluctuates between 100mv and 900mv.	Yes	Next step
		No	Replace the sensor
11	Start the engine and let it run at idle speed until coolant temperature reaches normal value.		Next step

12	Connect special diagnostic tester for Chery to read part of data stream of the engine, and then carefully observe part of data stream of the sensor; apply the accelerator pedal to bottom and then rapidly release it, observe if the output voltage of the oxygen sensor can reach below 100mv.	Yes	Check other part
		No	Replace the sensor

Note: when checking data flow of the oxygen sensor, be sure to note working position of the engine and let the working temperature of the engine reach the normal value, because the oxygen sensor only can start to work normally when the temperature is over 300℃.

11.5 Rear Oxygen Sensor Failure

Failure codes: P0136, 0137, 0138, 0036, 0037, 0038, 0054

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”.		Next step
2	Pull off the oxygen sensor connector of harness. Check the voltage between pin 1# (+) and 2# (-) with multimeter and detect if it is around 12V.	Yes	Next step
		No	4
3	Use a multimeter to check if the resistance value between 1# and 2# pins of the oxygen sensor is between 2Ω and 5Ω at 23℃.	Yes	Replace ECU
		No	Replace the sensor
4	Check if heating circuit of the oxygen sensor is normal.	Yes	Next step
		No	Check the circuit
5	Check if it is short circuit or break circuit between pin 2# of oxygen sensor and main relay 87# pin and between the sensor connector 1# pin and ECU 1# pin with multimeter.	Yes	Repair or replace harness
		No	Next step
6	Connect the oxygen sensor connector of harness and use neutral. Start the engine and leave it at idle speed until its coolant temperature reaches to the normal value.		Next step
7	Validate if the three-way catalytic converter works normally.	Yes	Next step
		No	Replace the three-way catalytic converter
8	Pull out the oxygen sensor joint on harness. Rapidly apply the accelerator pedal for several times, and then use a multimeter to check if a output voltage between 0.1V and 0.9V is present between 3# (+) and 4# (-) pins of the sensor (after the engine warms up).	Yes	Next step
		No	Replace the sensor
9	Connect the adaptor between ECU and harness. Check if it is short circuit or break circuit between the pin 36# and pin 55# of ECU and the sensor connector 3# and 4# pins respectively with multimeter.	Yes	Repair or replace harness
		No	Replace ECU
10	Connect the oxygen sensor connector of harness and use neutral. Start the engine and leave it at idle speed until its coolant temperature reaches to the normal value.		Next step
11	Connect special diagnostic tester for Chery to read part of data stream of the engine, and then observe	Yes	Next step

	part of data stream of the engine, and then observe if part of data stream of the oxygen sensor is around 100 under standard idling operation.	No	Replace the sensor or the three-way catalytic converter
12	Start the engine and let it run at idle speed until coolant temperature reaches normal value.		Next step
13	Connect special diagnostic tester for Chery to read part of data stream of the engine, and then carefully observe part of data stream of the sensor; rapidly apply the accelerator pedal for several times and observe if the output voltage of the oxygen sensor fluctuates within a comparatively large scope.	Yes	Check other part
		No	Replace the sensor

Note: The characteristics and operating principle of rear oxygen sensor is basically the same as those of front oxygen sensor, in special conditions, they can be interchanged to use. The only difference between them is their different installation sites (working atmospheres), therefore, during maintenance and diagnostic processes of the vehicle, please pay attention to some inspection techniques for front and rear oxygen sensors.

11.6. Coolant Temperature Sensor Failure

Failure codes: P0112, P0113

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull out joint of coolant temperature sensor on harness; use a multimeter to check if the magnitude of voltage between 1# (+) and 2# (-) pins of this joint is around 5V.	Yes	Next step
		No	4
3	Use a multimeter to check if the resistance value between 1# and 2# pins of the sensor is in proportion to its temperature (refer to relevant part in this service manual).	Yes	Replace ECU
		No	Replace the sensor
4	Use a multimeter to check if it is break or short circuit between 17# and 29# pins of ECU and 2# and 1# pins of sensor joint.	Yes	Repair or replace harness
		No	Replace ECU
5	Start the engine, while engine coolant temperature rises, check if the voltages on two wires of the sensor falls as water temperature of the engine rises.	Yes	Next step
		No	Replace the sensor
6	Start the engine, disconnect the connector of water temperature sensor, and then observe if cooling fan of the engine starts up and runs at high speed.	Yes	Check other part
		No	Replace the ECU or the circuit

11.7 Failure in Driver Stage of Injector

Failure codes: P0201, P0202, P0203, P0204, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271

No.	Operating steps	Result	Follow up steps
1	Close the ignition switch, and the engine stops.		Next step
2	Pull out each electromagnetic injector joint on harness in turn, and then lap the two pins of multimeter between 2# pin of the joint and the engine.		Next step
3	Put the ignition switch to “ON”. Observe if, at the instant when the ignition switch cuts in, the multimeter displays an around 12V voltage value of battery (mainly check if the injector has power supply, which is provided by main relay).	Yes	Repeat 2
		All yes	6
		No	Next step
4	Use a multimeter to check in turn if it is break or short circuit between 87# pin of output terminal of main relay of the engine and 1# pin of each electromagnetic injector joint.	Yes	Repair or replace harness
		No	Next step
5	Repair or replace fuel pump relay and main relay and their circuits.	Yes	Repair or replace harness
6	Connect the adaptor between ECU and harness; use a multimeter to check in turn if it is break or short circuit between 27#, 7#, 47# or 6# pins of ECU and 2# pin of each corresponding electromagnetic injector joint on harness.	No	Next step
7	Use a multimeter to check in turn if a resistance between 12Ω and 16Ω is present at 20℃ between 1# and 2# pins (and resistance value of injector) of the electromagnetic injectors.	Yes	Repeat 7
		All yes	Next step
		No	Replace the electromagnetic injector
8	Re-plug all electromagnetic injector joints, engage the gear to neutral position, start the engine, and then let it run at idle speed. Pull out all electromagnetic injector joints on harness in turn. Whenever a joint is pulled out, observe if engine vibration is aggravated accordingly (equivalent to spark out experiment).	Yes	Repeat 8
		No	Replace ECU

Note: The damage probability of injector is very low; its main failure is carbon deposit in injection nozzle, which may result in atomization of fuel injection, poor spray and unsteady idle speed of engine; therefore, when inspecting, above failure should be inspected as an emphasis.

11.8 Failure in Driver Stage of Canister Control Valve

Failure codes: P0443, 0444, 0445

No.	Operating steps	Result	Follow up steps
1	Start the engine and let it run at idle speed until engine coolant temperature reaches normal value.		Next step
2	Pull out canister control valve joint on harness; use a multimeter to check if an around 8.6V battery voltage is present between two pins of this joint.	Yes	Next step
		No	5 (check positive wire)
3	Re-plug the canister control valve joint on harness, increase engine revolution to 2000rpm, and then touch the valve body by hand to check if the canister control valve has slight vibration and impact (frequency control).	Yes	Next step
		No	7 (check ground wire)
4	Use a multimeter to check if the resistance value between A# and B# pins of the canister control valve is around 25Ω (20℃).	Yes	Replace ECU
		No	Replace the canister control valve
5	Check if it is short circuit or break circuit between the pin of main relay 87# and the pin of canister control valve 1# with multimeter.	Yes	Repair or replace the harness
		No	Next step
6	Repair or replace the main relay and the circuit.		
7	Cut off the engine; connect the adaptor between ECU and harness, and use a multimeter to check if it is break or short circuit between 46# pin of ECU and A# pin of the canister control valve.	Yes	Repair or replace harness
		No	Replace ECU
8	With ignition switch ON, disconnect canister control valve joint, and then use a multimeter to check the A# and B# pins at harness end of solenoid valve.		Next step
9	Use a multimeter to check if an around 12V battery voltage is present between B# pin and ground wire.	Yes	Next step
		No	Check feed circuit
10	Use a multimeter to check if an around 3.6V battery voltage is present between A# pin and ground wire.	Yes	Check other part
		No	Check ECU circuit or replace the ECU

Note: The carbon canister solenoid valve is used for the emission control system, a system set up for environmental protection and air pollution prevention. When engine runs at idle speed or under heavy load operating mode, the solenoid valve will not participate in the work. A malfunction of this solenoid valve will result in unsteady operating mode of the engine. These details should be noted during maintenance process.

11.9 Failure in Driver Stage of Malfunction Indicator Lamp (MIL)

Failure codes: P1677, P1678, P1679

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON"		Next step
2	Disassemble the dashboard, and then use a multimeter to check if it is break or short circuit between 29#, 30# pins at instrument end and 62#, 81# pins of ECU.	Yes	Check the circuit
		No	Next step
3	Replace the instrument and then check if it is normal	Yes	Next step
		No	Replace the instrument
4	Replace ECU, and then re-check if it works normally.	Yes	Replace ECU
		No	Check other part
5	Check CAN circuit for the place where is grounding or short.	Yes	Replace the harness
		No	Check other part

Note: The malfunction indicator lamp is controlled by ECU. When a failure occurs in the system, ECU will control the malfunction indicator lamp to light. There are two kinds of malfunction indicator lamps on this auto (engine failure indicator lamp and EPC), but the engine failure indicator lamp on the instrument may be shielded in the system, that is, when a failure occurs, EPC lamp will light, which should be noted during maintenance process.

11.10 Failure in Driver Stage of 1#, 2# Coils of Step Motor

Failure codes: P1682, 1683

No.	Operating steps	Result	Follow up steps
1	Turn on the ignition switch but do not start the engine.		Next step
2	Pull out connector of the electronic throttle, and then check if the resistance value between 5# and 3# pins of the connector is around 6.1Ω.	Yes	Next step
		No	Replace the electronic throttle body
3	Pull out the connector, and then use a multimeter to check if a 12V alternate voltage is present between 5# and 3# connectors of the electronic throttle.	Yes	Next step
		No	Check the circuit
4	Use a multimeter to check if a 12V voltage is present between the connector of the harness and ground when the key is ON.	Yes	Replace the idle speed actuator
		No	Next step
5	Between ECU and harness, use a multimeter respectively to check if it is break or short circuit between 67#, 65# pins of ECU and 5# pin of the connector and between 66#, 64# pins of ECU and 3# pin of the connector.	Yes	Repair or replace the harness
		No	Replace ECU

Note: Much about failure diagnosis for other parts has been involved above.

11.11 Crankshaft Position Sensor Failure

Failure code: P0016

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”.		Next step
2	Pull out camshaft position sensor joint on harness, and then use a multimeter to check if the voltage between 1# pin of this joint and ground wire is around 12V (battery voltage).	Yes	Next step
		No	Check circuit and main power supply
3	Pull out camshaft position sensor joint on harness, and then use a multimeter to check if the voltage between 2# pin of this joint and ground wire is around 11.5V (power supply from ECU and the voltage is below the battery voltage).	Yes	Next step
		No	Check circuit and ECU
4	Use a multimeter to check if it is break or short circuit between 79# pin of ECU and 2# pin of sensor joint.	Yes	Repair or replace the harness
		No	Next step
5	Pull out camshaft position sensor joint on harness, and then use a multimeter to check if it is conducting between 3# pin of this joint and ground wire.	Yes	Next step
		No	Replace the sensor
6	Connect the sensor connector and start the engine.		Next step
7	Use a oscillometer to check if an around 6V square wave signal output is present in 2# signal cable.	Yes	Check other part
		No	Replace the sensor

Note: The camshaft position sensor is an auxiliary sensor and has great effect on emission of the system. When failure occurs in this sensor, the vehicle will be difficult to start; though the vehicle will be basically normal after startup, driving restrictive practice will be found on the engine and the maximum revolution of engine can not exceed 4000rpm.

11.12 Craftshaft Position Sensor Failure

Failure codes: P0321, P0322, P0219

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”.		Next step
2	Pull out crankshaft position sensor joint on harness, use a multimeter to check if it is short or break circuit between 1# pin of this joint and 34# pin of ECU.	Yes	Check the circuit
		No	Next step
3	Pull out crankshaft position sensor joint on harness, use a multimeter to check if it is short or break circuit between 3# pin of this joint and 15# pin of ECU.	Yes	Next step
		No	Check circuit and ECU
4	Use a multimeter to check if it is break or short circuit between 79# pin of ECU and 2# pin of sensor joint.	Yes	Repair or replace the harness
		No	Next step
5	Pull out crankshaft position sensor joint on harness, and then use a multimeter to check if the two signal cables on the sensor has a resistance value of around 1000Ω.	Yes	Next step
		No	Replace the sensor
6	Connect the sensor connector and start the engine.		Next step
6	Use an oscillometer to check if signal waveform output is present in signal cable.	Yes	Check other part
		No	Replace the sensor

Note: Crankshaft position sensor is the main sensor of electronic control unit of engine. If crankshaft position sensor failure occurs, the engine will be difficult to start; acceleration performance of the engine will be greatly restricted after startup; the maximum revolution of the engine can not exceed 3800rpm; meanwhile, emission of the engine will deteriorate.

11.12 Ignition Coil Failure

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON".		Next step
2	Pull out ignition coil joint on harness, and then use a multimeter to check if the voltage between 3# pin of this joint and ground wire is an around 12V battery voltage.	Yes	Next step
		No	Check the circuit
3	Pull out ignition coil joint on harness, and then use a multimeter to check if it is short or break circuit between 1# pin of this joint and 5# pin of ECU.	Yes	Check circuit and ECU
		No	Next step
4	Pull out ignition coil joint on harness, and then use a multimeter to check if it is short or break circuit between 2# pin of this joint and 2# pin of ECU.	Yes	Check circuit and ECU
		No	Next step
5	Check if the resistance of primary coil of the sensor is around 0.9Ω.	Yes	Next step
		No	Replace the ignition coil
6	Check if the resistance of secondary coil of the sensor is around 14.5kΩ.	Yes	Next step
		No	Replace the ignition coil
7	Use an oscillometer to check if secondary ignition waveform of ignition cable of ignition system is normal.	Yes	Check other part
		No	Replace the ignition coil

Note: The ignition coil is mainly used to provide ignition system of engine with ignition energy. The failure rate of the coil itself is very low, but its failure probability can not be completely excluded. When failure occurs in ignition coil, the ignition energy of engine will be deficient, which may further lead to such failures as unsteady idle speed of engine and emission deterioration.

11.13 Accelerator Pedal Position Sensor Failure

Failure codes: P2106, P2122, P2123, P2127, P2128, P2138

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”.		Next step
2	Pull out accelerator pedal position sensor joint on harness, and then use a multimeter to check if an around 5V voltage signal is present between 3#, 6# pins of this joint and ground wire.	Yes	Next step
		No	Check the circuit
3	Pull out accelerator pedal position sensor joint on harness, and then use a multimeter to check if it is short or break circuit between 3#, 6# pins of this joint and 32#, 33# pins of ECU.	Yes	Check the circuit
		No	Next step
4	Pull out accelerator pedal position sensor joint on harness, and then use a multimeter to check if it is short or break circuit between 2#, 5# pins of this joint and 36#, 35# pins of ECU.	Yes	Check the circuit
		No	Next step
5	Pull out accelerator pedal position sensor joint on harness, and then use a multimeter to check if it is short or break circuit between 4#, 1# pins of this joint and 16#, 40# pins of ECU.	Yes	Check the circuit
		No	Next step
6	Use a diagnostic tester to read signal output of accelerator pedal position sensor, and then check if signal 1 increases as opening of accelerator pedal increases.	Yes	Next step
		No	Replace the sensor assembly
7	Use a diagnostic tester to read signal output of accelerator pedal position sensor, and then check if signal 2 increases as opening of accelerator pedal increases.	Yes	Check other part
		No	Replace the sensor assembly

Note: This pedal is an integrated circuit device, which can not be processed through repair; therefore, during maintenance process, the service station can maintain it by means of part replacement and can not disassemble the sensor.

11.14 Double Brake Switch

Failure codes: P0571, P0504

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”.		Next step
2	Pull out brake switch joint on harness, and then use a multimeter to check if it is short or break circuit between 1#, 2# pins of this joint and 21#, 58# pins of ECU.	Yes	Next step
		No	Check the circuit
3	Close the ignition switch, and then check if an around 12V battery voltage is present on 3# pin of the switch joint.	Yes	Next step
		No	Check the circuit
4	Open the ignition switch, and then check if an around 12V battery voltage is present on 4# pin of the switch joint.	Yes	Next step
		No	Check the circuit
5	Release brake pedal, disconnect sensor connector, and then check if 1# and 3# pins cut off.	Yes	Next step
		No	Replace the brake switch
6	Release brake pedal, disconnect sensor connector, and then check if 2# and 3# pins conducts.	Yes	Next step
		No	Replace the brake switch
7	Apply brake pedal, disconnect sensor connector, and then check if 1# and 3# pins conducts.	Yes	Next step
		No	Replace the brake switch
8	Apply brake pedal, disconnect sensor connector, and then check if 2# and 4# pins cut off.	Yes	Check other part
		No	Replace the brake switch

11.15 Theft-proof Control System Failure

No.	Operating steps	Result	Follow up steps
1	Insert the ignition key into the ignition lock.		Next step
2	Put the ignition switch to ON position, and then observe if engine failure indicator lamp or EPC lamp works normally (quick flash of failure indicator lamp or EPC lamp indicates a abnormal condition).	Yes	Check other part
		No	Next step
3	Connect a diagnostic tester to the system, and then enter corresponding diagnostic program unit to check if DTC exists in the system.	Yes	Remove the failure and clear the DTC
		No	Next step
4	Pull out theft-proof module joint on harness, and then use a multimeter to check if an around 12V operating voltage is present on A1#, A4# pins of the joint when ignition switch is under ON state.	Yes	Next step
		No	Check the circuit
5	Pull out theft-proof module joint on harness, and then use a multimeter to check if such electric and circuit failures as short circuit and break circuit exist in the circuit between A5#, A8# pins of this joint and 31# and 71# pins of ECU.	Yes	Check the circuit
		No	Next step
6	Pull out theft-proof module joint on harness, and then use a multimeter to check if poor contact exists between A2# pin of this joint and ground wire of the vehicle.	Yes	Check the circuit
		No	Next step
7	Pull out theft-proof module joint on harness, and then use Ohm Shift of the multimeter to check if the circuit between B1#, B2#, B3# pins of this joint and the coil exists.	Yes	Check the circuit
		No	Replace the theft-proof module

12. Steps for Implementation of Failure Diagnosis by Engine Symptom

12.1 Perform Preliminary Inspection First before Following the Steps for Implementation of Failure Diagnosis by Engine Symptom.

(1) Make sure that ECU and failure indicator lamp (or EPC lamp) have no off-normal phenomenon (excluding the models that have no failure indicator lamp).
(2) Use a failure diagnostic tester to check and make sure no failure information record exists.
(3) Employ failure diagnostic tester to check that hot idle data from electronic control system fall within normal scope.

Hot idle speed parameter table:

Name	Parameter
Air intake temperature	20-70℃
Battery voltage	12-14V (affected by engine revolution)
Temperature of engine coolant	80-90℃ (normal operating temperature)
Position of accelerator pedal	0%~99.00%
Air-fuel ratio control integrator	5%-5%
Ignition advance angle	5-10°(may change with fluctuation of engine revolution)
Outer corner of throttle	0%~99.61%
Fuel injection time	2-7ms (has a strong relation with engine revolution)
Engine revolution n	Expected idle speed ± 50rpm
Duty cycle of canister control valve	0%~99.9%
Self-adapting value of air-fuel ratio control	0.95-1.05
Self-adapting value of air-fuel ratio control	120-140
Intake manifold absolute pressure	350-650hPa
Voltage of oxygen sensor	Quickly fluctuates at 0.1-0.9V
Air intake pressure	

(4) Validate that the failure effect the owner complained exists and then locate the exact position of the symptom. Please note that the information provided by the customer is very important, especially the failure symptoms, occurrence time, position and if any other failure symptoms occurred before; these information can help technical personnel rapidly and effectively judge the failure, thus increasing maintenance speed and improving maintenance quality.
Then check the appearance:

- Check that grounding of wire harness is clean and firm.
- Check that vacuum pipeline is unbroken, twisted and in right connection.
- Check that there is no obstruction in pipe.
- Check that air intake pipe is not squashed or damaged.
- Check that the seal between throttle body and intake manifold is perfect.
- Check that ignition cable of ignition system is unbroken, no ageing and in right wiring.
- Check that wires are in right connection, no loosing or poor connection for connectors.

12.2 The Engine Does not Rotate or Rotates Slowly when Starting

No.	Operating steps	Result	Follow up steps
1	Use a multimeter to check if a voltage around 10-12.5V is present between two battery terminals.	Yes	Next step
		No	Repair or replace the battery
2	Put the ignition switch to "ON". Use a multimeter to check if a battery voltage around 10-12.5V is present on the terminal on the ignition switch that connects with anode of battery.	Yes	Next step
		No	Repair wiring terminal or replace cable
3	Maintain ignition switch at START position, and then use a multimeter to check if a voltage above 8V is present on the terminal on the ignition switch that connects with pull in winding of starting motor.	Yes	Next step
		No	Replace the ignition switch
4	Put the ignition switch at start position, check the anode terminal of starting motor by multimeter and observe the voltage if it is above 8V.	Yes	Next step
		No	Repair wiring terminal Or replace cable
5	Check if it is short circuit or break circuit in the starting motor.	Yes	Repair or replace the starting motor
		No	Next step
6	Check if there is jammed by poor lubricating.	Yes	Troubleshooting
		No	Next step
7	If the failure is happened in winter time, check if it is because of the wrong engine lubricant and gearbox oil causes the big resistance of the starting motor.	Yes	Replace with appropriate oil
		No	Check if other systems are normal

Note: When this problem occurs, mainly inspect voltage, starter and ground system. In modern sedan, lubricant has little effect on startup of the vehicle, so, basically, it needs not to allow for lubricant problem, but the problem if the engine has too large self resistance should be taken into consideration.

12.3 When Starting, Engine Can be Dragged to Rotate but Can not Start with Success.

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Pull out cylinder distribution wire, connect spark plug with the distance between electrode of spark plug and engine body as 8-10mm, use the starting motor to drag the engine to rotate, and then check if blue-white high-voltage spark occurs (disconnect all injection nozzles on the engine).	Yes	8
		No	Next step
3	Check if resistance value of ignition cable is normal (can not exceed 16kΩ).	Yes	Next step
		No	Repair, replace the ignition cable.
4	Check ignition coil and ignition cable for burn through, damage and crack.	Yes	Replace
		No	Next step
5	Check if ignition cable is normal.	Yes	Replace
		No	Next step
6	Check if the ignition coil is working normally.	Yes	Next step
		No	Replace
7	Check if connectors of ignition coil and ignition cable are connected properly.	Yes	Next step
		No	Connect the connectors properly
8	Put the ignition switch to "ON". Check if fuel pump relay and fuel pump can keep working for a period of time.	Yes	Next step
		No	Overhaul the fuel pump circuit
9	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	13
10	Pull off the fuel distributing pipe and the fuel injector; pull off the joints of fuel injector on the harness one by one. And supply the voltage of 12 V from battery to fuel injector directly and look if the fuel injector can inject normally.	Yes	12
		No	Next step
11		Yes	Next step

	Clean out the fuel injector and observe if it can work correctly.	No	Replace the fuel injector
12	Check if fuel is bad or moisture.	Yes	Replace fuel
		No	18
13	Check if the fuel pressure value is below 400 kPa.	Yes	Next step
		No	17
14	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	16
15	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Check other part
		No	Repair or replace the fuel pump
16	Check if there is leakage or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
17	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator
18	Check if it is break or short circuit between 1#, 2# pins of crankshaft position sensor and 34#, 15# pins of ECU.	Yes	Repair or replace the harness
		No	Next step
19	Check if the part of air intake system is leaking.	Yes	Repair
		No	Next step
20	Check if air flow meter works normally.	Yes	Repair or replace
		No	Next step
21	Check if the coolant temperature sensor is working correctly.	Yes	Next step
		No	Repair or replace
22	Check if the reason for the failure on starting is about mechanism, such as much cylinder clearance, cylinder leaking, and so on.	Yes	Remove the mechanical failure
		No	Replace ECU

Note: When checking this problem, if all parts in electronic fuel injection system are normal, consider if mechanical part of the engine works normally, or if cylinder pressure is normal and if air leakage exists and so forth.

12.4 Warm Starting Difficulty

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”. Use a special diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	9
3	Disconnect the connecting oil pipe and turn off the ignition switch. Observe the voltage of fuel system and look if it is around 300 kPa after an hour.	Yes	Next step
		No	Repair the fuel system to avoid leakage
4	Put the connecting oil pipe through, use fuel tube clamp to intercept the oil return pipe, meanwhile, close the fuel manometer valve. Turn off the ignition switch, after one hour, observe if pressure of fuel system still can maintain at around 400kPa.	Yes	Replace fuel pressure regulator
		No	Next step
5	Check if there is fuel leakage of fuel injector and oil pipe.	Yes	Replace the injector and fuel pipe
		No	Next step
6	Pull out water temperature sensor joint and start the engine. Observe if the engine can start with success.	Yes	Check coolant temperature and circuit
		No	Next step
7	Connect an adaptor between ECU and harness, check if a voltage around 5V is present on 39#, 17# pins, meanwhile, check if the resistance value of water temperature sensor is within normal scope.	Yes	Next step
		No	Repair or replace the harness
8	Replace ECU and perform warm start again; observe if the engine can be started successfully.	Yes	End
		No	Replace ECU
9	Check if there is jam or bending of fuel pipe and if the pressure regulator valve of oil pump is working correctly.	Yes	Next step
		No	Repair or replace
10	Check if there is battery voltage between the plugs of oil pump with multimeter.	Yes	Next step
		No	Repair or replace fuel pump relay and wires
11	Try to replace the fuel pump and see if the system can return to normal.	Yes	Next step
		No	Replace fuel pump

12	Check if the fuel pump is stopped up.	Yes	Replace fuel pump
		No	Replace ECU

Note: Warm starting difficulty is in connection with many systems, such as battery, throttle body and water temperature sensor etc. as well as mechanical part of the engine, such as valve sealing. Thermal expansion of engine under warm state may lead to rise of engine resistance.

12.5 Engine Speed is Normal, but it is Difficult to Start at any Time

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to "ON". Use a special diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Eliminate the failure of air intake system leaking
4	Step on the throttle slightly and observe if it is easy to be started easily.	Yes	Replace the electronic throttle body
5	Connect fuel manometer valve. Short 30#, 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	9
6	Use a special joint to directly supply a 12V voltage and intermittent ground wire from battery to injector and check if the injector works normally (work intermittently).	Yes	8
		No	Next step
7	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
8	Replace fuel 8, and check if the fuel is deteriorated or moisture.	Yes	Replace fuel
		No	14
9	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	13
10	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for 3s, and then check if fuel pressure can be built up.	Yes	Next step
		No	12
11	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace fuel pressure regulator
		No	Repair and replace fuel injector and oil pipe
12	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
13	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe

		No	Replace fuel pressure regulator
14	When engine coolant is at low temperature, pull out electronic throttle body on harness and observe if engine revolution will rise.	Yes	Next step
		No	Check electronic throttle body for damage
15	Put the ignition switch to “ON”. Check if voltage on the following pins of ECU is normal: if it is a battery voltage around 12V on 12#, 14#, 15# pins; if the voltage between 51#, 53#, 3#, 61#, 80# pins and the wire is zero.	Yes	Next step
		No	Check wires and plugs
16	Check if ignition advance angle is normal.	Yes	Next step
		No	Check other systems
17	Check if cylinder compression pressure of engine is normal, if low, add a little engine oil into each cylinder and re-measure if the cylinder pressure is normal.	Yes	Next step
		No	Troubleshooting
18	If air cleaner or airflow sensor is choked.	Yes	Repair or replace
		No	Next step
19	Check if the coolant temperature sensor is working correctly.	Yes	Replace ECU
		No	Repair or replace

Note: Note if theft-proof system has started up. After theft-proof system has started up, when starting the engine, the staring motor can run normally, but the engine can not start; therefore, please note if this system can work normally.

12.6 Cold Starting Difficulty

No.	Operating steps	Result	Follow up steps
1	Put the ignition switch to “ON”. Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Use a multimeter to check if the coolant temperature sensor is normal. (A 2.8KΩ electric resistance can also be connected in series between 39# and 17# pins of ECU to start the engine in stead of the coolant temperature sensor. If the engine can start, it indicates off normal of coolant temperature sensor.)	Yes	Next step
		No	Replace the sensor
3	Put the ignition switch to “ON”. Check if voltage on the following pins of ECU is normal: if it is a battery voltage around 12V on 12#, 14#, 15# pins; if the voltage between 51#, 53#, 3#, 61#, 80# pins and the wire is zero.	Yes	Next step
		No	Check wires and plugs
4	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
5	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Eliminate the leakage failure of air intake system
6	Step on the throttle slightly and observe if it is easy to be started easily.	Yes	Check the electronic throttle
		No	Next step
7	When engine coolant is at low temperature, pull out electronic throttle body joint on harness and observe if engine revolution will rise.	Yes	Next step
		No	Check the electric throttle body
8	Connect fuel manometer valve. Let 86# pin of fuel pump relay directly ground. Turn on ignition switch to make fuel pump relay and fuel pump work, and then check if fuel pressure is at around 400kPa.	Yes	Next step
		No	12
9	Use a special joint to directly provide a 12V electricity and ground wire from battery to injector and check if the injector works normally.	Yes	11
		No	Next step
10	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
11	Check if fuel is deteroprated or moisture.	Yes	Replace fuel

		No	17
12	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	16
13	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	15
14	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Check fuel pressure regulator and fuel pump
		No	Repair and replace fuel injector and oil pipe
15	Check if the oil intake pipe is leaky or jammed.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
16	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator or fuel pump
17	Check if the pressure of cylinder is normal.	Yes	Next step
		No	Troubleshooting
18	Check if the engine air intake system is leaky.	Yes	Repair
		No	Next step
19	If air cleaner or airflow sensor is choked.	Yes	Repair or replace
		No	Replace ECU

Note: The cold starting problem relates to more failure points, among which water temperature sensor is comparatively important, because it is the major parameter for determination of injection pulse-width when starting the engine. In case of a water temperature sensor failure or it generates a false signal, the system can not judge the temperature and starting difficulty may occur.

12.7 Unsteady Idle Speed at Any Time

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check if electronic throttle system of engine works normally.	Yes	Repair or replace the electronic throttle
		No	Next step
3	Turn on ignition switch, connect an adaptor between ECU and harness, and then check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Check wires and plugs
		No	Next step
4	Let engine run at idle speed, spark out cylinder in turn, and observe if engine revolution will fall and fluctuate (cut fuel to injector).	Yes	8
		No	Next step
5	Check the fuel injectors of each cylinder and look if they are in right conditions.	Yes	Next step
		No	Check fuel injector and wires
6	Check if resistance value of ignition cable of each cylinder is normal (can not exceed 16kΩ).	Yes	Next step
		No	Replace
7	Check if ignition system works normally.	Yes	Maintain
		No	Next step
8	Check if the spark plug is in right conditions.	Yes	Next step
		No	Replace spark plug
9	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	13
10	Use a special joint to directly provide a 12V power supply and intermittent ground wire signal from battery to injector and check if the injector can work intermittently.	Yes	12
		No	Next step
11	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
12	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	18

13	Check if the fuel pressure value is below 300kPa.	Yes	Next step
		No	17
14	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	16
15	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace fuel pressure regulator
		No	Repair and replace fuel injector and oil pipe
16	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil return pipe
		No	Replace oil pump
17	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator
18	Check the pressure of air intake pipe and if the sense port of air intake temperature sensor is jammed.	Yes	Use detergent to wash
		No	Next step
19	Let engine run at idle speed, after coolant temperature reaches the active temperature of closed loop control, observe if the oxygen sensor works normally (rapidly fluctuate between 0.1V and 0.9V).	Yes	Next step
		No	Check the oxygen sensor and harness
20	Check if the engine air intake system is leaky.	Yes	Remove leakage
		No	Next step
21	Check if the pressure of cylinder is normal.	Yes	Next step
		No	Troubleshooting
22	Let engine run at idle speed, after coolant temperature reaches normal value, then use a special diagnostic tester to check if ignition advance angle is within the standard scope.	Yes	Replace ECU
		No	Check other part

Note: Unsteady idle speed relates to many systems, such as air leak, carbon deposit and throttle body etc.; before replacing a part, make sure that air cleaner, spark plug and ignition system of engine are normal.

12.8 Unsteady Idle Speed during Warming up Process

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Eliminate the leakage failure of air intake system
4	Turn on ignition switch, connect an adaptor between ECU and harness, and then check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Next step
		No	Overhaul
5	Before finish of warming up of engine, pull out the joint on electronic throttle body and observe if engine revolution will change.	Yes	Next step
		No	Check the electric throttle body
6	Check if the coolant temperature sensor is working correctly.	Yes	Next step
		No	Replace
7	Let engine run at idle speed, after coolant temperature reaches normal value, then use a special short diagnostic tester to check if ignition advance angle is normal.	Yes	Replace ECU
		No	Check the ignition timing mechanism

Note: Unsteady idle speed occurs seldom during warming up process, its troubleshooting is similar to that for previous case, but validate if water temperature sensor works normally in advance.

12.9. Unsteady Idle Speed after Warming up

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Turn on ignition switch, connect an adaptor between ECU and harness, and then check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Next step
		No	Repair or replace the harness
3	Turn off the engine. Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
4	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Eliminate the leakage failure of air intake system
5	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	9
6	Use a special joint to directly provide a 12V power supply and intermittent ground wire from battery to injector and check if the injector can work intermittently.	Yes	8
		No	Next step
7	Clean out the fuel injector and look if it can work correctly.	Yes	Replace
		No	Replace fuel injector
8	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	14
9	Check if the fuel pressure value is below 300kPa.	Yes	Next step
		No	13
10	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	12
11	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace fuel pressure regulator
		No	Repair and replace fuel injector and oil pipe

12	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
13	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator
14	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle is normal.	Yes	Next step
		No	Check other systems
15	Pull off the coolant temperature sensor and observe if the engine is in right conditions.	Yes	Replace the coolant temperature sensor
		No	Next step
16	Check if the compression pressure of cylinder is normal.	Yes	Next step
		No	Troubleshooting
17	Check if resistance value of ignition cable of each cylinder is normal (can not exceed 16kÙ).	Yes	Next step
		No	Replace
18	Check if ignition coil and ignition cable system works normally and if crack exists on ignition coil.	Yes	Replace
		No	Next step
19	Check if the spark plug is in right conditions.	Yes	Replace ECU
		No	Replace spark plug

Note: After finish of warming up, engine will enter normal idle speed state, under which, unsteady revolution is in connection to many factors, such as spark plug, ignition cable, ignition coil, if air leak exists in the system, if carbon deposit exists in the system and if cylinder pressure is normal an so forth.

12.10 Unsteady Idle Speed or Extinguish with Load (A/C etc.)

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Turn on A/C switch, connect an adaptor between ECU and harness, and then measure 75# pin of ECU to see if input signal is present (high potential signal loaded by A/C switch through high and low voltage switches).	Yes	Next step
		No	Check and repair air conditioning circuit
3	Check if the pressure of air conditioning system, the electromagnetic clutch of compressor and the air conditioning pump are in right conditions.	Yes	Next step
		No	Repair or replace
4	Check the voltage on 64#, 65#, 66# and 67# pins of ECU (for control of DC motor) as well as corresponding pins on valve body is normal.	Yes	Next step
		No	Check controlling circuit
5	Remove electronic throttle body and check if throttle is locked or is dumb to run.	Yes	Check the electric throttle body
		No	Next step
6	Start engine, turn on A/C, use a failure diagnosis tester to read such signals as air intake flow and engine revolution and check if engine acceleration occurs.	Yes	Replace ECU
		No	Replace the electronic throttle body

Note: 75# pin is the up level request signal. When turning on A/C switch, an up level signal will be sent to ECU through this pin, and then ECU will further check other systems of A/C. If all systems are normal, ECU will control A/C relay to ground and A/C system will start to work. 60# pin of ECU is medium voltage signal input; when high potential signal is loaded on this pin, cooling fan will start and run at high speed.

12.11 Periodic Unsteadiness (Have to Perform Self-study again after ECU is Power off)

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Check and repair air intake and leak
4	Let engine run at idle speed, spark out cylinder in turn, and observe if engine revolution will fall and fluctuate (it is prohibited to carry out spark out experiment by disconnecting ignition cable).	Yes	7
		No	Next step
5	Turn on ignition switch, connect an adaptor between ECU and harness, and then check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Next step
		No	Repair or replace cable
6	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle of the system is normal.	Yes	Next step
		No	Check other part
7	Check air intake system for such failures that may affect working of engine as blocking and air leak etc.	Yes	Sweep
		No	Next step
8	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	Next step
9	Use a special joint to directly provide a 12V power supply and intermittent ground wire from battery to injector and check if the injector can work intermittently.	Yes	Next step
		No	Check and repair oil injector and related wires
10	Check if the resistance values of cylinders' ignition cable are normal.	Yes	Next step
		No	Replace
11	Check if the ignition coil is damaged or cracked.	Yes	Replace
		No	Next step

12	Check if the spark plug is in right conditions.	Yes	Replace ECU
		No	Replace spark plug

Note: For periodic unsteadiness, mainly check air intake system for air leak or electronic throttle body for failure. Following are the steps for inspection of electronic throttle body: while turning on ignition key, throttle may jiggle; during self-checking procedure, throttle should act with actions of accelerator pedal.

12.12 Too High Idle Speed (Have to Perform Self-study again after ECU is Power off)

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check if throttle valve plate is locked and if failure exists in electronic throttle body.	Yes	Adjust or replace
		No	Next step
3	Check if the canister control valve, the fuel pressure regulator, the positive crankcase ventilation vacuum pipe and the vacuum pipe of brake system are mounted steadily or they are damaged.	Yes	Repair or replace
		No	Next step
4	Run the engine at idle speed and use neutral. Step on the accelerator and observe if the idle speed is too high.	Yes	Next step
		No	6
5	Clamp the vacuum pipe and observe if the idle speed becomes normal.	Yes	Repair or replace the vacuum booster
		No	Next step
6	Replace PVC valve and clamp the positive crankcase ventilation vacuum pipe. Observe if the idle speed becomes normal.	Yes	Replace PVC valve
		No	Next step
7	Clamp the canister control valve pipe and observe if the idle speed becomes normal.	Yes	Replace the canister control valve
		No	Next step
8	Check if electronic throttle body is dumb or locked.	Yes	Repair or replace
		No	Next step
9	Check other parts of air intake pipe for leakage.	Yes	Repair or replace
		No	Next step
10	Check if the gasket of fuel injector is in good condition.	Yes	Next step
		No	Replace the gasket
11	Check air intake system for air leak and air flow meter for normal working.	Yes	Replace ECU
		No	Replace the sensor

Note: Check if the system goes through self-study, if not, the system will be under failure mode or an uncertain state all the time, which may result in too high idle speed of engine. The other cause is air leak in the system, if air leakage in the system is too large and exceeds regulation and control range of ECU, idle speed fluctuation may occur.

12.13. Engine Revolution Speed is too Low or Flameout

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	Run the engine at idle speed and check if the engine revolution speed is normal at idle speed.	Yes	Next step
		No	Next step, overhaul with reference to idle speed failure entries
4	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Overhaul
5	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle of the system is normal.	Yes	Next step
		No	Check other systems
6	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	10
7	Use a special joint to directly provide a 12V power supply and intermittent ground wire from battery to injector and check if the injector can work intermittently.	Yes	9
		No	Next step
8	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
9	Check if fuel is bad or moisture.	Yes	Replace fuel
		No	15
10	Check if the fuel pressure value is below 350 kPa.	Yes	Next step
		No	14
11	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	13
12	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can	Yes	Replace fuel pressure regulator

	return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	No	Repair and replace fuel injector and oil pipe
13	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
14	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace fuel pressure regulator
15	Put the ignition switch to “ON”. Check if voltage on the following pins of ECU is normal: if it is a battery voltage around 12V on 12#, 14#, 15# pins; if the voltage between 51#, 53#, 3#, 61#, 80# pins and the wire is zero.	Yes	Next step
		No	Repair or replace cable
16	Check if ignition coil, ignition cable and spark plug are normal.	Yes	Replace ECU
		No	Adjust or replace the parts involved

Note: This phenomenon indicates a comparatively obvious failure and some minute details, such as if strainer of the system or exhaust pipe is blocked and so forth, should also be checked. For other causes, check spark plug and ignition cable etc.

12.14 Slow Response when Accelerating

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	Turn off the engine. Check the air cleaner and look if it is open.	Yes	Next step
		No	Replace
3	Run the engine at idle speed and check if the engine revolution speed is normal at idle speed.	Yes	Next step
		No	Repair in accordance with idle speed failure item
4	Run the engine at idle speed and check if the air intake pressure is from 35 to 65 kPa.	Yes	Next step
		No	Overhaul
5	Put the ignition switch to "ON". Check if it is break or short circuit between 38#, 32#, 54#, 36# pins on ECU connector and 1#, 2#, 4#, 6# pins of throttle position sensor of electronic throttle valve body.	Yes	Next step
		No	Repair or replace Harness
6	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle is normal.	Yes	Next step
		No	Check other part
7	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 4000kPa.	Yes	Next step
		No	11
8	Use a special joint to directly provide 12V power supply and intermittent 12V power supply from battery to injector and check if the injector can work intermittently.	Yes	10
		No	Next step
9	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
10	Check if fuel is bad or moisture.	Yes	Replace fuel
		No	16
11	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	15
12	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	14

13	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace the pressure regulator
		No	Repair and replace fuel injector and oil pipe
14	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
15	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace the pressure regulator
16	Check if the exhaust system and three-way catalytic converter are jammed.	Yes	Replace or clean
		No	Replace ECU

Note: For slow response when accelerating, mainly check air intake pressure and injection pulse-width etc.; choked exhaust pipe and smudgy air cleaner may be causes for this problem. In addition, spark plug and ignition cable problems may also be causes.

12.15 Poor Performance and Disability when Accelerating.

1	Check if failure occurs, such as clutch slipping, low tire pressure, brake delay, wrong tire size and incorrect four-wheel alignment.	Yes	Repair
		No	Next step
2	Check if the electronic throttle can be full opening.	Yes	Next step
		No	Repair or replace the throttle
3	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
4	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check the ignition advance angle.	Yes	Next step
		No	Check the parts involved
5	Put the ignition switch to "ON". Check if it is break or short circuit between 38#, 32#, 54#, 36# pins on ECU connector and 1#, 2#, 4#, 6# pins of throttle position sensor of electronic throttle valve body. check if the voltage between 17# and 42# pins of ECU, between 39# and 17# pins of ECU (signal output terminal of intake air temperature sensor and coolant temperature sensor) as well as 64#, 65#, 66#, 67# pins of ECU (for control of DC motor) is normal.	Yes	Next step
		No	Repair or replace Harness
6	Run the engine at idle speed and check if the air intake pressure is from 35 to 65kPa.	Yes	Next step
		No	Overhaul
7	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	11
8	Use a special joint to directly provide a 12V power supply and intermittent ground wire from battery to injector and check if the injector can work intermittently.	Yes	10
		No	Next step
9	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
10	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	16
11	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	15

12	Close the fuel manometer valve. Re-engage the ignition switch to let the fuel pump run for a period of time, and then check if fuel pressure can be built up.	Yes	Next step
		No	14
13	Open the valve of fuel gauge and clamp the oil return pipe by oil return baffle so that the oil can not return. Check if the oil pressure occurs immediately.	Yes	Replace the pressure regulator
		No	Repair and replace fuel injector and oil pipe
14	Check if there is leaking or jam in oil intake pipe.	Yes	Repair or replace oil intake pipe
		No	Replace oil pump
15	Check if the oil return pipe is bended or jammed.	Yes	Repair or replace oil return pipe
		No	Replace the pressure regulator
16	Check if leak and blocking exist in air intake system and if air flow meter works normally.	Yes	Next step
		No	Replace the sensor
17	Check if spark plug, ignition cable and ignition coil are normal.	Yes	Next step
		No	Replace or adjust
18	Check if it results from air conditioning system.	Yes	Check A/C system
		No	Replace ECU

Note: Poor acceleration of system relates to many factors, such as problem in mechanical part of the engine itself, cylinder pressure and carbon deposit on valve etc. In addition, it is also in connection with other systems, such as power steering system and A/C system.

12.16 Unable to Reach the Maximum Revolution when Accelerating

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	With engine off, check if air cleaner is smooth (can not simply rely on visualization, remove the air cleaner and then perform test drive again) and if air intake system is chocked.	Yes	Next step
		No	Replace
3	Run the engine at idle speed and check if the engine revolution speed is normal at idle speed.	Yes	Next step
		No	Repair in accordance with idle speed failure item
4	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Overhaul
5	Put the ignition switch to "ON". Check if it is break or short circuit between 38#, 32#, 54#, 36# pins on ECU connector and 1#, 2#, 4#, 6# pins of throttle position sensor of electronic throttle valve body.	Yes	Next step
		No	Repair or replace Harness
6	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle is normal.	Yes	Next step
		No	Check other part
7	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	11
8	Check if working positions of camshaft position sensor and crankshaft position sensor are normal.	Yes	Next step
		No	Replace the parts involved
9	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
10	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	16
11	Check if the fuel pressure value is below 300 kPa.	Yes	Next step
		No	15
12		Yes	Replace or clean

	Check if the exhaust system and three-way catalytic converter are jammed.	No	Replace ECU

Note: In case the engine is unable to reach its maximum revolution when accelerating, mainly check if exhaust pipe is chocked and air cleaner is smudgy. In addition, for electric control system of A21, in case of a failure in crankshaft or camshaft position sensor, ECU will take restrictive driving measures to restrict engine revolution to exceed certain value, which should be noted during maintenance process.

12.17 When Releasing Accelerator Pedal after Acceleration, Unsteady Idle Speed Occurs at Instant, even Extinguishes.

1	Put the ignition switch to "ON". Use a failure diagnostic tester to check if any failure information record exists.	Yes	Remove the failure displayed
		No	Next step
2	With engine off, check if air cleaner is smooth (can not simply rely on visualization, remove the air cleaner and then perform test drive again) and if air intake system is chocked.	Yes	Next step
		No	Replace
3	Run the engine at idle speed and check if the engine revolution speed is normal at idle speed.	Yes	Next step
		No	Repair in accordance with idle speed failure item
4	After starting successfully, check if air intake consumption of the engine at idle speed is around 300Kg/h (remember to check if cylinder pressure is normal).	Yes	Next step
		No	Overhaul
5	Put the ignition switch to "ON". Check if it is break or short circuit between 38#, 32#, 54#, 36# pins on ECU connector and 1#, 2#, 4#, 6# pins of throttle position sensor of electronic throttle valve body.	Yes	Next step
		No	Repair or replace Harness
6	Let engine run at idle speed, after coolant temperature reaches normal value, then use a diagnostic tester to check if ignition advance angle is normal.	Yes	Next step
		No	Check other part
7	Connect fuel manometer valve. Short 30# and 87# pins of fuel pump relay to make the fuel pump run, and then check if fuel pressure is around 400kPa.	Yes	Next step
		No	11
8	Remove air intake hose, check if carbon deposit or other soil (this may result in air intake system of engine being chocked when the valve plate closes) exists.	Yes	Clear carbon deposit
		No	Next step
9	Clean out the fuel injector and look if it can work correctly.	Yes	Next step
		No	Replace fuel injector
10	Check if fuel is deteroprated or moisture.	Yes	Replace fuel
		No	16
11		Yes	Next step

	Check if the fuel pressure value is below 400 kPa.	No	15
12	Check if the exhaust system and three-way catalytic converter are jammed.	Yes	Replace or clean
		No	Replace ECU

Note: For an electric control motor with the electronic throttle body, the main actuators of its air intake system are air flow meter and electronic throttle body. Air flow meter has very high operational reliability and very low failure rate, while, due to particularity of road status in China and affected by operating environment, choke is liable to occur between valve plate and valve body of the electronic throttle body, which may obstruct air from entering the engine and result in extinguish of engine.

12.18 A/C System Failure

1	Check if there is enough coolant, if the A/C belt, the A/C clutch and the pressure switch are in good condition.	Yes	Next step
		No	Troubleshooting
2	Let engine run at idle speed and turn on A/C switch. Enter A/C self diagnosis mode to check the A/C system for failure.	Yes	Remove the failure displayed
		No	Next step
3	Turn on the A/C switch and connect an adaptor between ECU and harness. Measure 75# pin (A/C switch) of ECU and see if there are input signals on it.	Yes	Next step
		No	Check the harness
4	If this vehicle adopts low level control, check if the air condition is working still even though it is turned off.	Yes	Replace or repair the harness
		No	Next step
5	Check if there is low level output at ECU pin No.69 (connect to the ground of pull in winding of A/C relay).	Yes	Repair the A/C replay and harness
		No	Replace ECU

Note: Different from the controlling means of other models, the A/C control system of A21 adopts the automatic A/C and uses double-pressure switch to control incorporation of the A/C system and the fan after A/C starts up.

13. Safety Precautions for System Maintenance

13.1 Safety Precautions for Diagnosis and Maintenance of Gasoline Injection Electronic Control System

(1) Disassembly and assembly requirements for electronic control unit (ECU):

- Controllers shall be removed before welding or paint-baking;
- When disassembling and installing the controller, be sure to set ignition switch to CLOSE position and disconnect the battery with the system for fear to damage the engine control unit during disassembly and installation.
- Power supply wires shall not be removed from battery when engine is in operation or electric system is in use;
- Do not use such heavy current equipment as charger etc. to start the engine by direct bridging;
- Note that the ambient temperature for the controller should not exceed 80℃.

(2) Requirements for cleanness: the following rules should be observed for any operation on oil-supply system and oil-injection system:

- The parts removed should be place at a clean site and covered properly; do not use the cloth (cotton cloth and gauze) with falling off fibre;

(3) Connect and disconnect the connectors of all sorts of harnesses and the connectors of failure diagnosis testers only after the ignition switch is turned off.

- When measuring mains voltage or ground wire grounding of the electronic control system, be sure to check if the connection order and mode are correct;
- Disconnect power cord or ground wire of battery from the system and disconnect harness connector of ECU; both operation modes above may cause loss of information about diagnosis and self-study stored in ECU (the retention time of information after the ECU installed is power off depends on the model).

(4) **Attentions during maintenance of fuel feed system (fuel feed line, fuel pump and fuel injection system):**

Disassembly or installation of oil pump on the tank full of oil or partly full of oil, please note:

- Before operation, get material ready near the fuel tank opening for absorption of heavy discharging fuel, so that, the fuel discharged can be duly absorbed;
- Avoid skin from direct contact with gasoline as best as you can;
- Before loosening a connection part, thoroughly clean this part and the area around the connecting pieces;
- Dishcloth shall be placed around the connecting part for avoide oil-spraying;

- If disassembled parts can not be repaired or for other processing immediately, store them properly.
- The spare parts can be taken out of their package only when they are to be installed; do not use the spare parts without package or with package heavily damaged;
- When installing an injector, be careful not to damage the O-gaskets at both ends of the injector; for installation convenience, apply a little lubricant on the O-gaskets.
- After fuel and fuel feed systems are disassembled, avoid use of compressed air and move of the vehicle as best as you can.

(5) **Safety precaution**

In order to avoid maintenance technical personnel from being injured and fuel injection and ignition devices from being damaged, please note:

In case the engine is running or under starting speed, disconnection of ignition harness is forbidden. Checking the engine for poor working of single cylinder **by means of spark test with ignition cable disconnected is not allowed**;

if it is required to drag the engine by the starter without starting the engine itself, for example, in the case of inspection of cylinder pressure of engine etc., disconnect the harness connectors on engine revolution sensor and camshaft (phase) sensor and connect each sensor properly after the corresponding job has finished, and then use a special diagnostic tester for Chery to clear the failure codes in the system;

When the engine is running at high speed, touching wheel train of engine and revolving parts are forbidden;

When the engine reaches normal operating temperature, both water temperature and pressure of cooling system are very high; therefore, in case maintenance for the cooling system of engine is required, perform corresponding operations only after the engine has stopped and the cooling system has been fully cooled.

When maintaining fuel system of engine, if maintenance for engine compartment is involved, perform the operations only after temperature inside engine compartment of the vehicle has adequately fell;

Under a state that power on of the system is normal, do not touch cooling fan of the engine by hand at any time, because the cooling fan may start up abruptly.