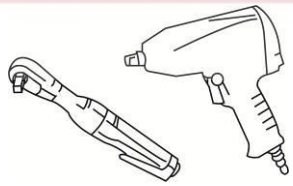
Steering system

Precautions

- When inspecting steering system, place the vehicle on level and dry ground.
- The bolts of the components in the steering system must be tightened to the specified torque.
- After overhauling the steering column assembly, steering gear and other steering mechanism, it is necessary to check wheel alignment.
- Maximum voltage of system should not exceed 18V, and minimum voltage should not be less than 9V.
- Check frequently and keep the tire pressure at the specified value.
- Once there is abnormal clearance, sticking, head swinging symptoms, it is necessary to find out where is the fault position, steering drive transmission unit, power steering system or steering pull rod system, and eliminate the fault.
- Check with care the parts of the steering system for abnormal impact frequently. For damaged parts or fault parts, it is necessary to timely replace it.
- Do not weld the part of steering gear and system rods in any manner.
- Regularly check if there is interference or abrasion of EPS wire harness, whether connector is loose. If any abnormality is found, timely replace it.

Preparation work

General Tools Table

No.	Tools	Overall Diagram	Instructions
1	Power tool		Removal and Installation of Bolts Nut

Electric Power Steering System Overview

Power steering system is designed to reduce driver's working intensity. As passenger cars need to run fast and the load to steering wheel increases, power steering gear becomes indispensable and is used very widely. Power steering system has such advantages:

It can reduce steering force on the steering wheel. It's especially obvious when taking a turning in the original place or at a low speed but a large turn angle.

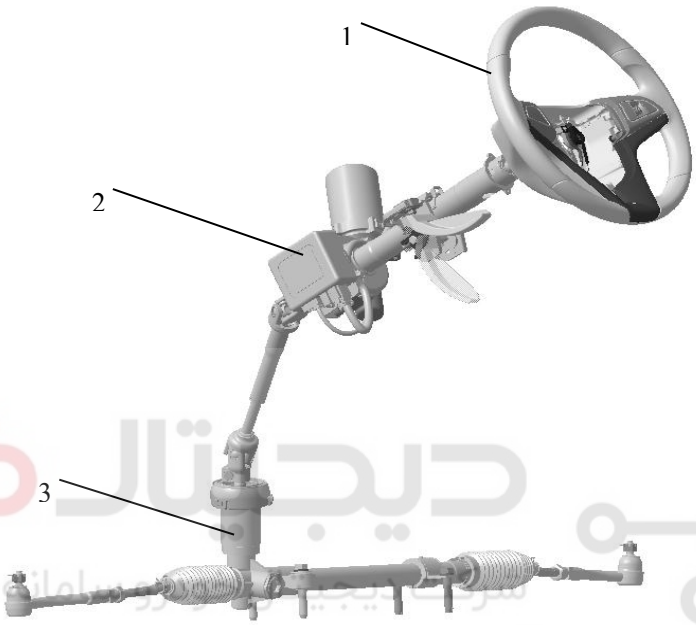
- Steering sensitivity is improved.
- The kickback of ground against the steering wheel is reduced.
- This can protating speedent wheels from turning suddenly if a tire explodes, thus ensuring service safety.
- If the allowed load of steering wheel is larger, it may increase freedom of the entire setup.

■ They are relatively more energy saving and environmental protection.

Composition of power steering system:

Power steering system consists of steering wheel assembly, steering pipe with intermediate shaft assembly, mechanical steering gear assembly, etc. Of which, mechanical steering gear is the actuating part of electric booster of steering system. Steering column motor is linked with the complete vehicle power supply system, which provides power source for the system.

The structure of power steering system is diagrammed as follows:



Structure diagram of power steering system

1-Steering wheel assembly 2-Steering column with intermediate shaft assembly
3-Mechanical steering gear assembly

Steering process:

When rotating steering wheel, torque sensor detects the change of torque exerted on the steering wheel, and instructs boosting motor to rotate through ECU control unit, so as to drive steering tie rod assembly to move and achieve boosting steering function.

Returning process:

After steering, the force exerted on the steering wheel disappears. Torque sensor detects the change of torque exerted on the steering wheel and instructs boosting motor stop rotates through ECU control unit. Under the effect of self-aligning torque of front wheel, the vehicle will travel straightly forward until the vehicle returns to straight traveling position.

Road feel effect:

Road feel effect refers to the ability of causing the steering feeling. When driver exerts force to the steering wheel, it also acts on the torsion bar of steering gear simultaneously, so that it's deformed torsionally. This deformation depends on wheel turning resistance; the deformation increases as the resistance increases. So the driver can feel the change of steering resistance based on the force he exerts to the steering wheel.

Steer wheel

Inspection in the car:

1) Check installation conditions

① Check if steering device assembly, front suspension, axles and steering column are installed correctly.

② Check if there is any moving clearance when steering wheel moves vertically, transversely and axially.

③ Check if set nuts and bolts of steering device assembly are loose.

2) Check the free travel of the steering wheel

① Turn the steering wheel to keep the front wheels straight forward. Start engine and rotate steering wheel leftwards or rightwards gently until front wheels begin to move. Measure the movement of the steering wheel on the excircle.

■ Free stroke of the steering wheel: 30 mm

② When the measured value exceeds the standard value, check installation of each joint of steering column and the steering mechanism. Correct or replace relevant parts as necessary.

③ If the idled travel exceeds 30mm still, shut off engine, make front wheels run in a line, exert 5 N along periphery of steering wheel and check the idled travel, which shall not exceed 10 mm. If it exceeds 10mm, check if the steering gear assembly is eligible.

④ If the travel is still at a limit, leave steering wheel in the middle when the engine is shut down, exert 4±0.6 N to the periphery of steering wheel and check the free travel.

■ Standard value: < 15 mm

⑤ If it exceeds the standard value, remove the steering gear and check the total torque of the pinion.

3) Check the middle.

① Ensure steering device assembly, steering column and steering wheel are installed correctly.

② After wheel alignment, perform the middle position inspection. Please refer to "Inspection of front wheel alignment".

③ Stop the vehicle straight forward, and confirm that the steering wheel in the middle.

④ Release the tie rod lock nut and rotate the adjustment level left and right for fine tuning to affirm whether the steering wheel is in the middle.

4) Check the static steering force of the steering wheel

① Stop the vehicle on a flat dry ground, and pull up the parking brake lever.

② Start the engine.

Caution:

■ The tire pressure value shall be within the standard value.

③ Rotate the steering at wheel 360° from the middle position to check the steering effort of the steering wheel and to check if there is obvious fluctuation.

■ Steering force of steering wheel: < 34 N Allowable fluctuation: < 5.9 N

④ If the steering force of the steering wheel exceeds the specified value, check or adjust the following items:

a. The lower swing arm and steering tie rod end for damage.

b. The gear preload of steering gear and the rotating torque of steering tie rod end.

c. The rotating torque of lower swing arm ball joint.

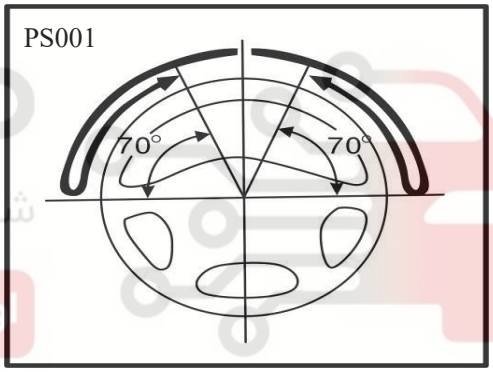
5) Check self-return of steering wheel

Caution:

■ Turn slowly and sharply to confirm whether its acting force and the returning performance have no difference along the left direction and the right direction by feeling.

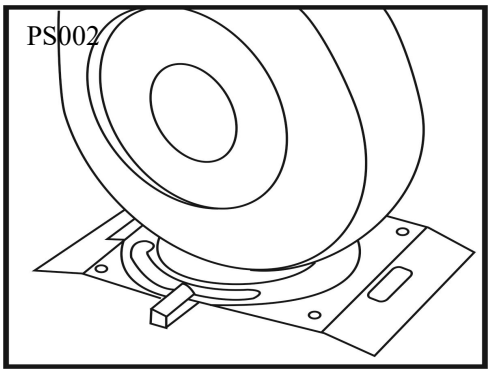
■ Be sure to execute the step on the safe road surface and in safe traffic condition, pay attention to safety.

Rotate the steering wheel at 90° and run at the speed of 35 km/h to hold for few seconds, and then release the steering wheel to return at least more than 70%.



6) Inspection of front wheel steering angle

① Check the toe-in of the front wheel and then its steering angle. Place the front wheel in the steering angle measures (front wheel positioning steering wheel) to check the maximum inner and outer wheel steering angle of the left and right wheels.



■ Inner wheel: 36°±1.5°

Outer wheel : 30°±1.5°

② When engine idles, measure steering angle by rotating steering wheel left and right to the end.

■ If the measured value is not within the standard range, adjust the tie rod.

The adjustment method of steering angle is as follows:

When the steering angle exceeds the standard value, release the lock nut of the left and right steering tie rods, rotate the left and right tie rods with the wrench respectively to adjust the steering angle to the standard value, and then lock the lock nut with the tightening torque of 50-55 N•m. When

adjusting the exposed length of the thread of left and right tie rod, pay attention to make the length of left and right tie rods uniform.

Caution:

- When the inner wheel steering angle exceeds standard, adjust the tie rod at this side to rotate outward to increase the inner wheel steering angle; and when the outer wheel steering angle exceeds standard, adjust the tie rod at this side to rotate outward to reduce the outer wheel steering angle.

Caution:

- The toe-in is related to other wheel alignment parameters and steering wheel adjustment.

7) Inspection of the tie rod end dust cover

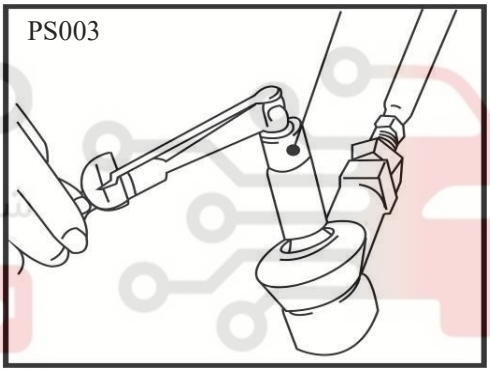
① Press with finger, and check the dust cover for cracks or damage.

② If there are cracks or damage on the dust cover, replace the steering tie rod end.

Caution:

- When the dust cover has cracks or damage, the tie rod end may be damaged jointly.

8) Check the rotating torque of the steering tie rod end


PS003

① Swing the tie rod 10 times quickly.

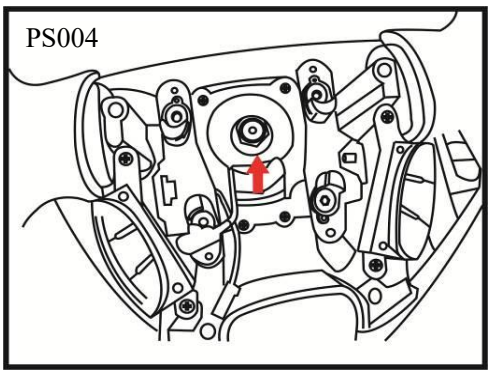
② Measure the swing resistance of the tie rod with a spring scale.

- Standard value: 0.5-3 N•m
- If the measured value is not within the standard value, replace.

Steering wheel assembly

Removal and installation:

1) Dismantle


PS004

① Disconnect the battery negative terminal, and wait for above 3 minutes.

② Remove the driver's airbag module from the steering wheel.

③ Lock steering and remove the set screw nut of the steering wheel.

- Tightening torque: 42-52 N•m

④ Lift up the steering wheel from the steering shaft.

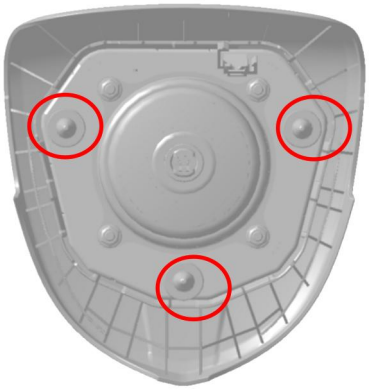
Caution: If it's not easy to pull it out, please use the steering wheel puller.

2) Install

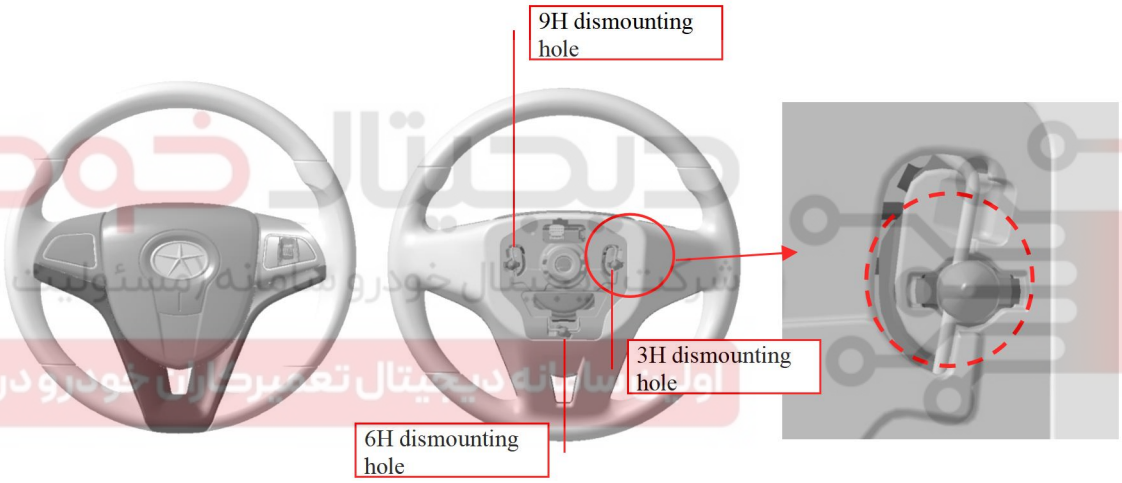
Install it according to the reverse order of dismantling.

Horn cover assembly dismounting as following steps:

1. Connection area between steering wheel and DAB clamp (red circle)



2. Assembly drawing of steering wheel and DA



Schematic Diagram of DAB Dismantling on Complete Vehicle (total 3 steps). Use the flathead screwdriver (15cm) as a special tool.

1. Dismantle 3H dismantling hole: rotate steering wheel for 90° counterclockwise, and use screwdriver to pry the groove of 3H dismantling hole (for detailed structure, refer to right above figure) to separate DAB claw from steering wheel bracket.

② Dismantle 6H dismantling hole: rotate steering wheel for 90° counterclockwise again, and use screwdriver to pry the groove of 6H dismantling hole (for detailed structure, refer to right above figure) to separate DAB claw from steering wheel bracket.

③ Dismantle 9H dismantling hole: turn steering wheel to middle position and rotate steering wheel for 90° clockwise again, and use screwdriver to pry the groove of 9H dismantling hole (for detailed structure, refer to right above figure) to separate DAB claw from steering wheel bracket.

3. Horn cover assembly

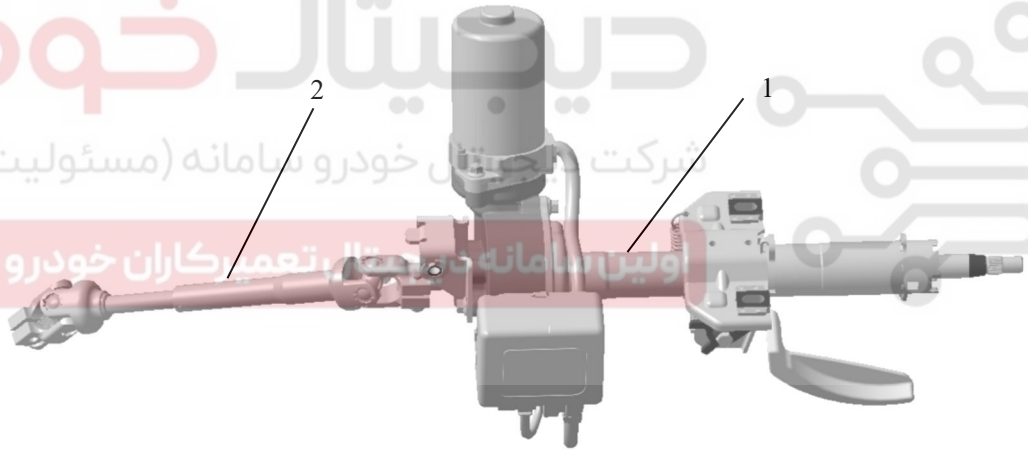
Align the steering wheel with connection area of DAB and press them; meanwhile Check if the clearance is uniform.

Caution:

- The installation can be performed only when wheels are in straight driving state and the steering wheel is in the middle. Or, make marks on the steering wheel and set bolt in advance before removal, and ensure that the marks are aligned during installation.
- The steering column must rotate smoothly and do not make click sound or shall not be stuck in the installing condition.
- After installing the other parts on the steering wheel, adjust the gradient of the steering wheel and the steering column 5-6 times; the maximum force applied for operating the locking position of the steering column shall not exceed 60-100 N. When the locking position of the steering column is in the free position, the maximum force applied for the gradient of the steering wheel and the steering column shall not exceed 100 N.
- Mounting position of clock spring (hair spring).
- Do not distort timer spring after tightening it.

Steering column assembly

Diagram of Steering Column Assembly:



Schematic diagram of Steering Column Assembly:

1- Steering column assembly 2- Countershaft assembly

Caution:

- Do not apply excessive axial force to the steering column assembly during removal and installation.
- Do not move the steering gear when removing the steering column.

Removal and installation:

1) Dismantle

① Park the vehicle straight.

② Disconnect the battery negative terminal, and wait for above 3 minutes.

③ Remove the driver airbag module.

④ Remove the steering wheel.

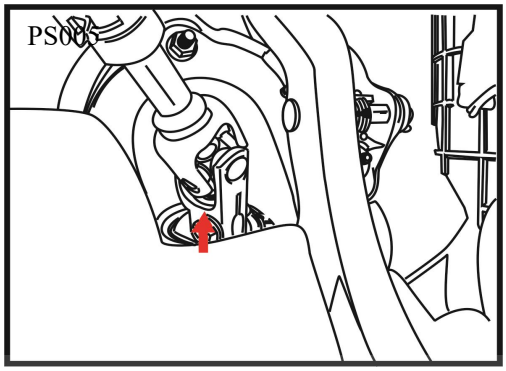
⑤ Remove the steering column upper and lower covers and driver's instrument panel lower.

⑥ Remove the combined switch assembly and clock spring from the steering column.

⑦ Disconnect all wire harness connectors on the steering column, and move away the wire harness from the steering column assembly.

⑧ Unscrew off the connecting bolts of steering column with lower shaft and separate the column from the steering gear.

■ Tightening torque: 30-35 N•m



⑩ Unscrew off the fixing nut on the steering column assembly, turn down the column and take out the column assembly.

■ Tightening torque: 20-30 N•m

2) Inspection after disassembly

① Check if steering column is cracked, deformed or otherwise damaged. If so, replace it.

② Check the spline of the steering column shaft for wear or broken tooth, and replace if any.

3) Disassemble

① Disassembly

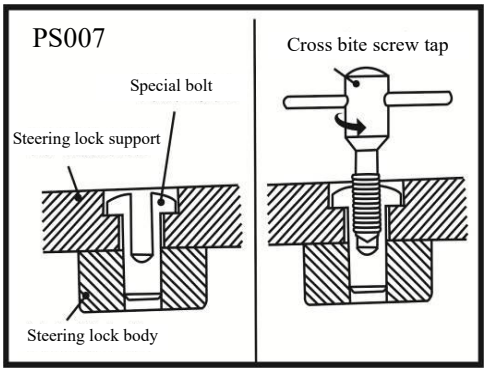
a. Unscrew connecting bolts of steering column and universal joint of connecting shaft, and then dismantle universal joint.

b. Remove the steering lock if necessary.

Caution:

■ Make sure to replace the special bolts when re-installing the steering lock.

c. Remove the adjustable steering column and bracket if necessary.



② Key point of disassembly

Removal of special bolts:

a. Use an electric drill to make a hole on the special bolt, which is big enough to receive the screw tap.

b. Use a negative screw tap to remove the special bolt.

4) Check after dismantling

① Check the adjusting bracket and spring for cracks and damage.

② Check if the steering lock mechanism is operated normally.

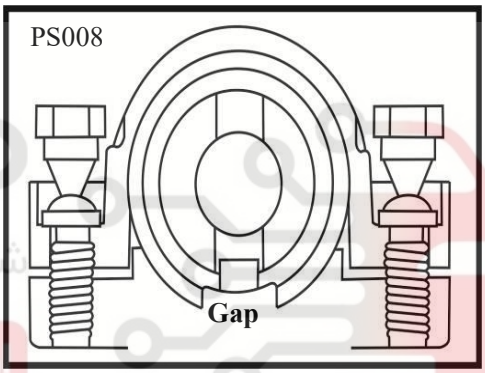
5) Assembly

Assemble steering lock assembly, bracket assembly and special bolt.

Caution:

■ When installing on the steering column assembly, align the steering lock assembly and the steering lock bracket with the lock notch of the steering column to temporarily lock the steering lock.

■ After confirming the steering lock correctly operates, lock the special bolt until the bolt head is locked off.



6) Installation

Install it according to the reverse order of dismantling.

Caution:

■ Do not reuse the unavailable part.

■ Keep the steering wheel in the middle and install the steering column assembly.

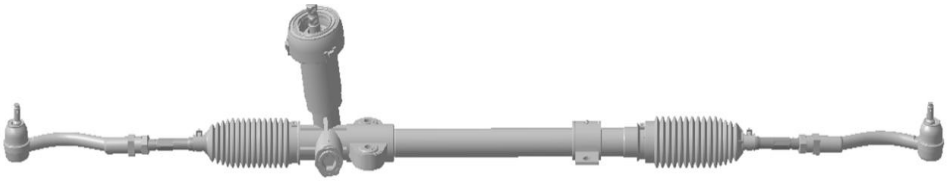
■ When installing the connecting shaft on the steering column, note the installation position.

7) Inspection after installation

When the vehicle stops straight, turn the steering wheel to the end several times, and confirm that the steering wheel is operated flexibly.

Power steering gear assembly

Component



Component Diagram of Steering Gear

Caution:

■ If rotating the steering wheel when separating the steering column from the steering gear assembly, it may injure the clock spring. So you must fix the steering wheel first.

Removal and installation:

Caution:

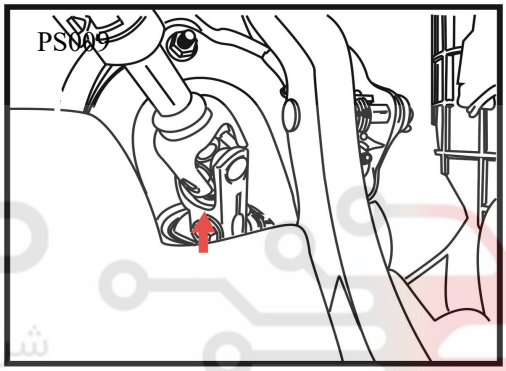
① Stop the vehicle straight forward.

② Disconnect connecting bolts of intermediate shaft assembly and mechanical steering gear from driver's cab, and then separate steering column and steering gear.

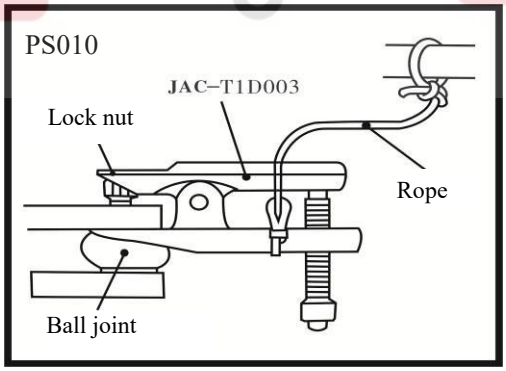
■ Tightening torque: 30-35 N•m

③ Remove the locking nut of the tie rod end.

■ Tightening torque: 50-55 N•m



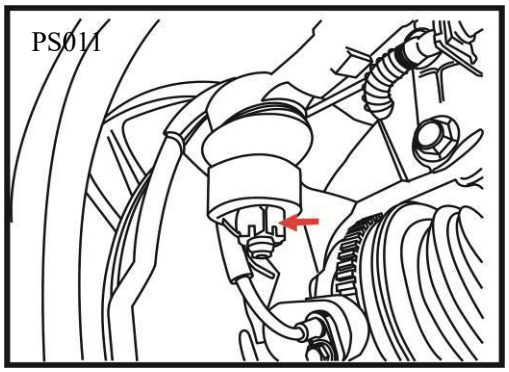
④ As shown in the figure, remove the steering tie rod end from the steering knuckle with special tool.



⑤ Remove the front sub-frame assembly and engine mount.

Caution:

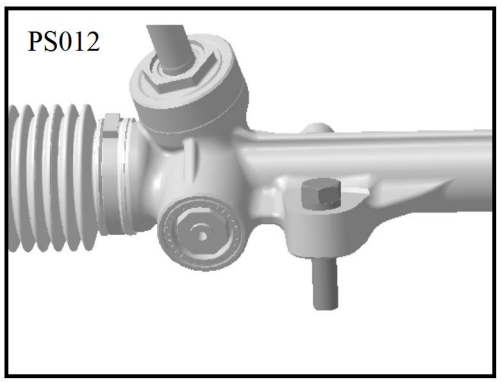
■ Please use jack to support.



⑥ Remove fixing bolt of mechanical steering gear on the sub-frame.

■ Tightening torque: 110-120 N•m

⑦ Take down power steering gear assembly on the frame.



Caution:

■ Take out slowly with care, and do not damage the tie rod dust cover.

2) Inspection after removal

① Mechanical steering

■ Check the gear rack for smooth operation and wear.

■ Check the gear preload.

a. Rotate the gear at the speed of 4-6 s per turn and measure the pre-load of the gear within the full range of the rack.

■ Standard value: 0.6-1.3 N•m

b. If the measured value exceeds the specified value, adjust the plug, and then re-check the gear preload.

c. If it is still incapable of obtaining the specified pre-load of the gear by adjusting the blockage, check or replace the blocking component.

② Steering tie rod

■ Check the rotating torque of steering tie rod.

a. Rotate the tie rod rapidly for 10 times.

b. Measure the swing resistance of the tie rod with a spring scale.

■ Standard value: 0.5-3 N•m

If the measured value is not within the standard value, replace.

Caution:

■ When the tie rod slowly swings without excessive clearance, it can be still used even if the measuring value is lower than standard value. If the measured value is high than 4.3 N•m, the tie rod must be replaced.

③ Tie rod dust cover

■ Check the dust cover for damage, and replace if any.

■ Check the dust cover for correct installation position.

3) Installation

Install it according to the reverse order of dismantling.

Caution: Do not reuse non-reusable components.

Caution:

- When machinery the power steering gear with the steering column, pay attention to the installation position.
- When machinery the power steering gear assembly, keep the tires on the level ground in an idle condition to finally tighten the nut and the bolt.
- Check the wheel alignment.

4) Inspection after installation

- Turn the steering wheel to the end left and right several times, and confirm that the steering wheel is operated flexibly.

EPS ECU DTC

Fault code	Description
C1111	Sensor main signal fault
C1115	Sensor sub-signal fault
C1114	Sensor power supply fault
C1113	Main and sub-fault of sensor
C1141	Motor and current open circuit
C1142	Motor and current is abnormal 1
C1145	Motor and current is abnormal 2
C1153	Power supply voltage is too low
C1112	Power supply voltage is too high
C1154	Abnormal relay
C1121	Speed signal fault 1
C1123	Speed signal fault 3
C1124	Speed signal fault 4
C1122	Engine revolving speed signal fault
C1155	Temperature is abnormal or ROM is error.

Countermeasures to common faults

Deviation (test the vehicle on a flat road from two directions);

Failure causes

1) Steered-wheel ball joint or front wheels are positioned incorrectly.
2) The steering lever system is twisted, deformed and over-worn.
3) Pretightening of rack inside steering gear is misadjusted.
4) Steering wheel vibrates, returns poorly or strikes driver's hand when .

Elimination of faults:

1) Adjust front-wheel alignment and ball joint of steered wheel.
2) Adjust or repair pretension of steering gear rack.
3) Check and adjust each joint of steering system as required.

Maintenance data and specification

Specification Table

Item	Specifications
Diameter of steering wheel	φ375mm
Steering column and lower shaft	Three-class crumple
Operation torque of steering wheel	4.5±0.5 N•m
Power steering gear rack travel	130±2 mm
Wire drive ratio	45.3
Circle number of steering wheel	2.87±0.1
Mechanical steering gear type	Pinion and rack

Fastening Torque Table

Item	Quantity	Fastening torque (N•m)
Fixing nut of steering wheel	1	42-52
Steering column mounting nut	2	20-25
Steering column mounting bolt	1	20-30
Steering column assembly and intermediate shaft assembly connecting bolt	1	30-35
Connecting bolt between intermediate shaft assembly and mechanical steering gear	1	30-35
Main fixing bolt of mechanical steering gear	2	100-110
Fixing bolt of mechanical steering gear	2	110-120
Steering tie rod tie-in adjusting nut	2	50-55
Steering gear ball head slotted nut	2	50-55