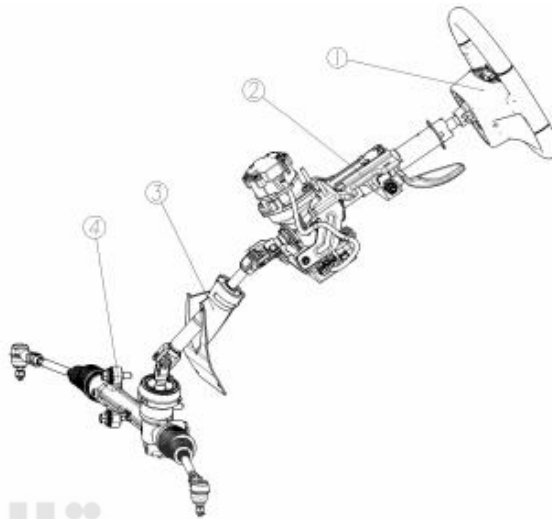


IV. Workshop Manual of Steering System System

I. Overview

(1) Structure Outline

Electric power steering system structure map



1. Steering Wheel Assembly

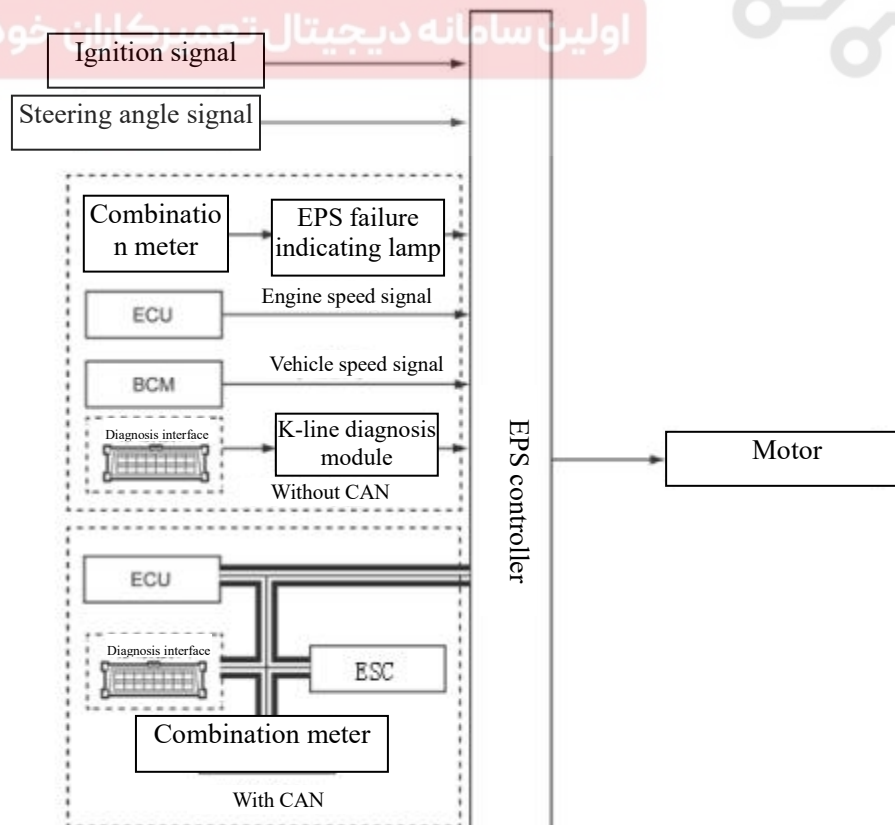
2. Steering Column with Intermediate Shaft Assembly
Intermediate Shaft Hood Assembly

3. Steering

4. Steering Gear

(2) System Principle

System Working Principle Diagram



Chassis System Maintenance Manual

(3) maintenance parameters

Item	Specification
Manual Steering Gear Type	Gear Rack
Steering Wheel Diameter	$\phi 375\text{mm}$
Steering column with counter-shaft assembly	Three level collapse
Operating Torque of Steering Wheel	$\leq 5\text{N}\cdot\text{m}$
Rack Stroke of Manual Gear Steering	$145\pm 1\text{mm}$
Line Angle Transmission Ratio	48.41mm/r
Steering Wheel Laps	$3\sim 0.04$

(4) Torque parameter

No.	Item	Tightening Torque (N · m)
1	Fixed Nut of Steering Wheel	42-52
2	Turn the upper end of the column to connect the tube nut with the fixing nut	20-30
3	Steering the lower end of the column connected to the tube beam fixing bolts	20-30
4	Steering intermediate shaft and steering column connection bolts	33-38
5	Steering intermediate shaft and steering gear connection bolts	33-38
6	Steering gear and front sub frame connection bolts	90-110
7	Steering rod and steering knuckle connected slotted nut	30-38
8	Toe-in adjusting nut of steering gear pull rod	45-55

(5) Maintenance Precautions

1. When inspecting the steering system, the vehicle should be placed on a level and dry ground.
2. The bolts of the components of steering system must be tightened to the specified torque.
3. Wheel alignment should be checked, after the maintenance of steering column assembly, steering gear and other steering devices, then conduct steering angle sensor signal calibration and initialization with diagnostic device.
4. The maximum voltage of the system must not exceed 16V and the minimum voltage must not be lower than 9V.
5. Always check and maintain the tire pressure in line with regulations.
6. In the event of an abnormal gap, unsmooth steering and wheel swaying, analyze that the problems happened on which part of the steering driving assembly, power steering system or steering rod system and solve it.

7. Always check carefully whether the components of steering system are subject to abnormal impact or not. Replace the damaged parts or defective parts in time
8. Do not weld the steering gear and the components of system rod in any way.
9. Regularly check the EPS harness for interference and wear, check the connector for looseness, if there is any abnormality, please replace it.
10. Steering column assembly, the intermediate shaft assembly, the steering assembly damage should be replaced as a whole, can not be split components.

(6) Common tool and special tool



II. Malfunction Diagnosis

(1) EPS Fault code table

No.	DTC Code	DTC Number (HEX)	Description
	Fault Code	Fault Code	Description
1	C110117	510117	Voltage High voltage is too high
2	C110216	510216	Voltage Low voltage is too low
3	C110921	510921	IGN Signal Error Ignition voltage signal error
4	C111201	511201	Sensor Supply Voltage Error EPS Internal motor position sensor or torque angle sensor voltage error
5	C125901	525901	Steering Angle Sensor-electrical Corner sensor malfunction
6	C126154	526154	Steering Angle Sensor is not Calibrated Turn angle sensor not calibrated
7	C129002	529002	Torque Sensor Signal Error Torque sensor signal error
8	C160398	560398	EPS Thermal Protection EPS overheat protection
9	C160404	560404	ECU Hardware Error EPS Controller hardware error
10	C170401	570401	ECU Failsafe Relay Fault EPS controller failsafe relay fault
11	C240101	640101	Motor Position Sensor Error EPS motor position sensor fault
12	C241201	641201	Motor Short or Open EPS motor is short or open circuit
13	C241301	641301	Motor Current Error EPS motor current fault
14	U007300	C07300	Control Module Communication Bus Off Controller module communication blocked
15	U010000	C10000	EMS_EngSt1 Message Lost Communication With EMS EMS speed signal and EMS lost communication
16	U011500	C11500	EMS_EngSt3 Message Lost Communication With EMS Start-stop function signal and EMS lost communication
17	U012900	C12900	ESC_VehSpd Message Lost Communication With Brake System Control Module ESC speed message and brake system control module lost communication
18	U040100	C40100	EMS_EngSt1 Message Invalid Data Received From EMS Engine signal is invalid
19	U041800	C41800	ESC_VehSpd Message Invalid Data Received From Brake System Control Module

Chassis System Maintenance Manual

No.	DTC Code	DTC Number (HEX)	Description
	Fault Code	Fault Code	Description
			vehicle speed signal invalid
20	U014600	C14600	GW VehSt Message Absent
			Gateway vehicle status message is lost

(2) Troubleshooting

No.	Symptom	Cause	deal with	Remark
1	The car is biased	Steering rod loose ball or improper positioning of the front wheel	Adjust the front wheel alignment or steering rod ball	Vehicle steering system inspection
		Steering rod system appears distorted or excessive wear	Inspect and adjust the various connections of the steering system according to regulations	
		steering gear rack preload imbalance	Adjust or repair steering rack rack preload	
2	Powerless sometimes, or the car to restart or return to normal or turn heavy	Each harness connector loose, poor contact	Check and reconnect the defective harness connector firmly	
		Loose motor contact loose	Reinstall the fuse to ensure that it is installed properly	
		Motor Malfunction	Replace the motor	
		CAN signal lost	Provide relevant signals to EPS	
		Tire pressure is not enough	Supplementary tire pressure	
3	abnormal sound of steering	Electronic power steering controller failure	Replace electronic steering assist controller	
		Bolt nut loose	Tighten the nut bolts according to the installation standards	
		Interference during steering	Handle related issues of interference	

III. Vehicle steering system inspection

1) Check the installation condition

① Check the installation condition of steering system assembly, front suspension and wheel.

② Check the steering wheel for movement clearance when it moves up and down, left and right and axially.

③ Check the fixed bolts and nuts of steering system device assembly for looseness.

2) Check the free stroke of steering wheel

Chassis System Maintenance Manual

① Rotate the steering wheel and keep the front wheel in straight forward position. Start the engine and rotate the steering wheel to left and right slightly until the front wheels start moving. Measure the movement of the steering wheel on the outer circle.

■ Steering wheel free travel: 30mm (or 10 °)

② When the measured value exceeds the standard value, check the steering column for each joint's connection with steering mechanism. According to the situation to be corrected or replace the relevant parts.

③ If the free-wheeling travel is still over 30mm (or 10 °), turn the engine off, keep the front wheels in a straight line, apply a force of 5N along the circumference of the steering wheel and check the free-wheeling stroke for no more than 10mm (or 4 °). If it is more than 10mm (or 4 °), check the steering gear assembly is qualified or not.

④ If the stroke is still at its limit, place the steering wheel in the neutral position with the engine off, apply a force of $4 \pm 0.6\text{N}$ on the circumference of the steering wheel, and check the free travel.

■ Standard value: <15mm (or 6 °)

⑤ If the standard value is exceeded, remove the steering gear and check if the total pinion torque accord with the requirement.

3) Check the middle position of steering device

① Make sure that the steering gear assembly, steering column and steering wheel are installed correctly.

② Conduct the middle position inspection after wheel alignment. Please refer to "Front Wheel Alignment Inspection"

③ Park the vehicle straight ahead and confirm that the steering wheel is in middle position.

4) Check the static steering torque of steering wheel

① Park the vehicle on a level and dry ground, pull up the parking brake handle or EPB.

② Start the engine.

Attention:

■ The tire pressure should be within the standard value.

③ Turn the steering wheel 360 ° from the neutral position, check the steering wheel steering torque, and whether there is any obvious fluctuation.

■ Steering Torque of Steering Wheel: <30N permitted fluctuations: <5N

④ Please check or adjust the following items if the steering torque of steering wheel exceeds the specified value.

Chassis System Maintenance Manual

- a. Check the lower suspension arm and steering tie rod ball head for damage.
- b. Gear preload of steering gear and drive torque of steering tie rod ball head.
- c. Driving torque of lower suspension arm ball head.

5) Check the automatic return of steering wheel

Attention:

■ Conduct the slow and rapid turns, confirm that whether the force or return situation are the same in the left and right or not through feeling

■ This step must be performed on the safe pavement and traffic conditions, pay attention to the safety.

① Turn the steering wheel 90 ° and drive at 35km/h for a few seconds and then release the steering wheel for a minimum of 70% return.

6) Check the steering angle of front wheel

① Check the steering angle of front wheel after inspection of front wheel toe-in Place the front wheel on the steering angle measurer (Front wheel alignment steering wheel), check the maximum inner and outer wheel steering angle of the left and right wheels.

■ Inner Wheel: $35.1^{\circ} \pm 1.5^{\circ}$

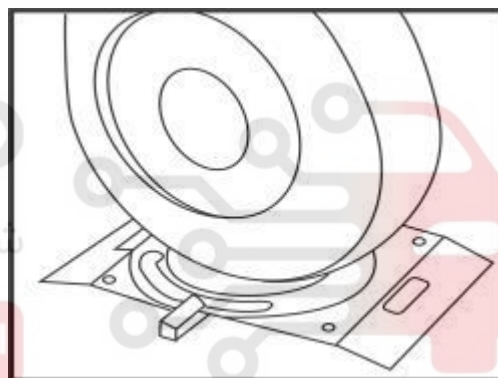
Outer Wheel: $31.6^{\circ} \pm 1.5^{\circ}$

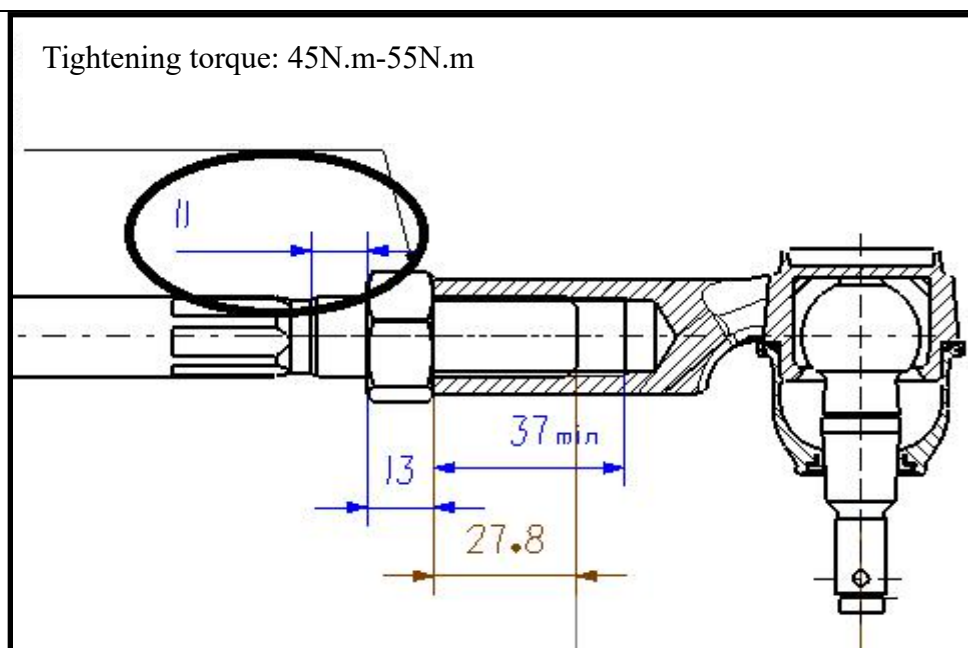
② When the engine is idling, turn the steering wheel left and right to the limit position to measure the steering angle

■ 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, loosen the lock nut of the left and right steering tie rods, use the wrench to rotate the left and right tie rods to adjust the steering angle to the standard value, and then tighten up the lock nut, the tightening torque is $45 \sim 55 \text{ N} \cdot \text{m}$. When adjusting the length of the left and right tie rod threads exposed (as shown in the circle in the diagram), pay attention to make sure that the length of left and right tie rod is consistent





Schematic Diagram of Tie Rod

Attention:

■ When the steering angle of inner wheel exceeds the standard value, the steering angle of inner wheel will increase by adjusting the tie rod on this side to rotate outward, when the steering angle of outer wheel exceeds the standard value, the steering angle of outer wheel will decrease by adjusting the tie rod on this side to rotate outward.

Attention:

■ The toe-in is interrelated with the remaining four-wheel alignment and steering angle adjustment.

7) Check the dust cover of ball head

① Press the the dust cover of ball head with your finger to check the dust cover for crack or damage

② If the dust cover is cracked or damaged, the tie rod ball head must be replaced.

Attention:

■ When the dust cover is cracked or damaged, it may also damage the ball head.

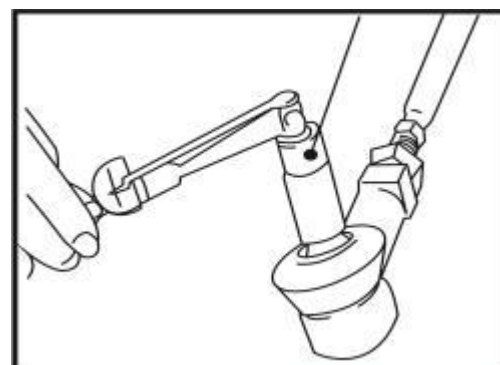
8) Check the driving torque of steering tie rod ball head

① Swing the tie rod for 10 times quickly.

② Measure the swing resistance of tie rod with spring balance resistance.

■ Standard value: 1.5~5 N•m

■ If the measured value is not within the standard value, please replace it.



IV. Steering wheel assembly

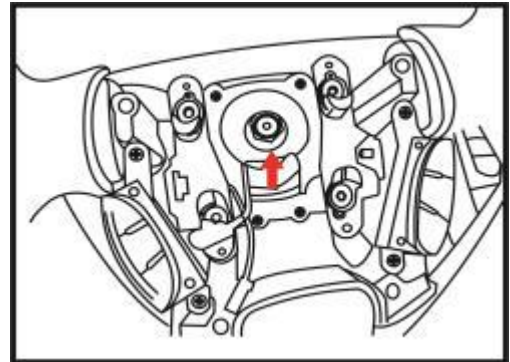
(1) Removal and Installation:

1) Removal

① Disconnect the battery negative terminal and wait for more than 3 minutes.

② disassemble the driver safety airbag module from the steering wheel.

③ Remove the fixed nut of steering wheel after steering is locked.



■ Tightening Torque: 42~52 N•m

④ Pull out the steering wheel from the steering column head shaft

Note: When pulling out the steering wheel, tighten the steering wheel nut to the steering wheel to prevent damage to the service personnel when pulling out the steering wheel.

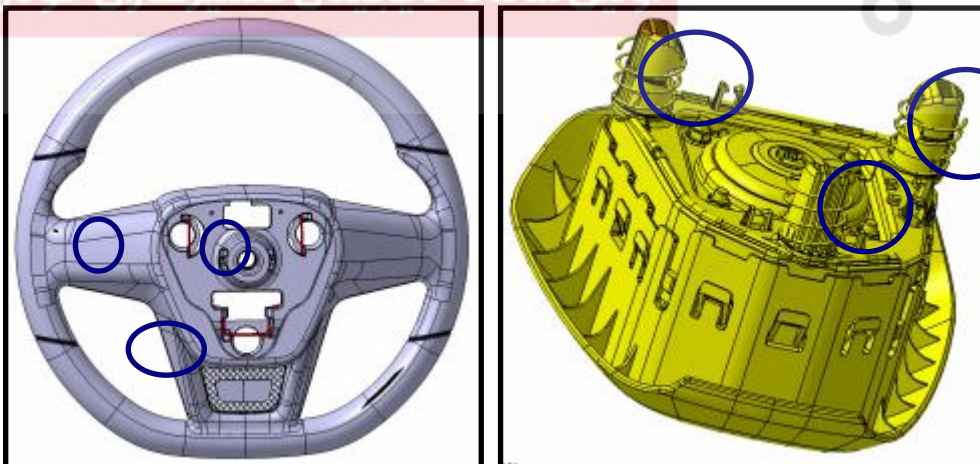
If you can not easily pull out, please use the steering wheel pull tools.

2) Installation

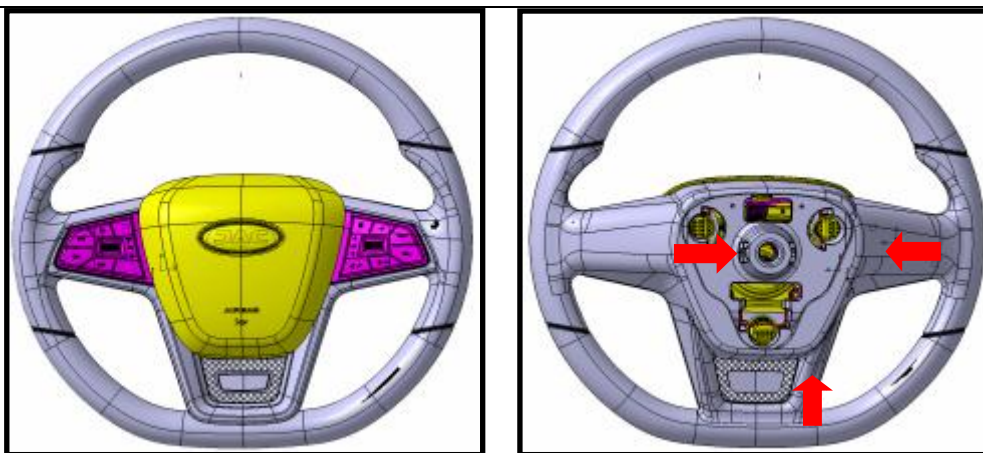
Install in the reverse order of removal

The specific step for DAB assembly(horn hood)removal(two removal schemes)is as follows:

1) Steering Wheel and DAB Clamping Area(Blue Circle)

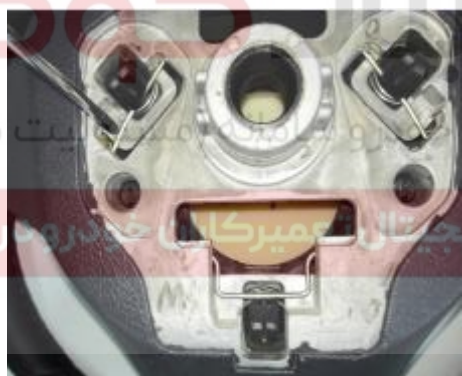


2) Steering Wheel and DAB Assembly Drawing



Method 1: DAB Disassembly Diagram(three steps in total), removal tool diameter $\phi 5\text{mm}$ (cross screwdriver);

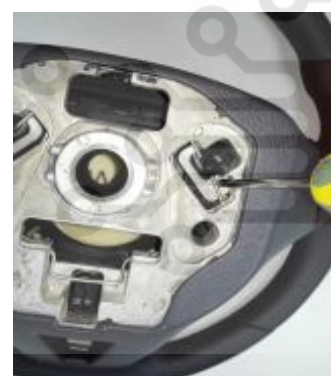
(1) First rotate the steering wheel spoke from three o'clock direction to twelve o'clock direction, hold the steering wheel with one hand, put the hexagon screwdriver into the guide groove with the other hand, pull out the horn hood clasp with hexagon screwdriver, at this time, the horn hood of steering wheel bounces at 3 o'clock direction, which indicates that the steering wheel and horn hood have been separated at this point.



9H location diagram



6H location diagram



3H location diagram

(2) Then rotate the steering wheel spoke from six o'clock direction to twelve o'clock, hold the steering wheel with one hand, put the hexagon screwdriver into the guide groove with the other hand, pull out the horn hood clasp with hexagon screwdriver, at this time, the horn hood of steering wheel bounces at six o'clock direction, which indicates that the steering wheel and horn hood have been separated at this point.

(3) First rotate the steering wheel spoke from nine o'clock direction to twelve o'clock direction, hold the steering wheel with one hand, put the hexagon screwdriver into the guide groove with the other hand, pull out the horn hood clasp with hexagon screwdriver, at this time, the horn hood of steering wheel bounces at 9 o'clock direction, which indicates that the steering wheel and horn hood have been separated at this point.

Method 1: DAB Disassembly Diagram(two steps in total), removal tool diameter $\phi 6\text{mm}$ (flat screwdriver);

(1) Hold the steering wheel by one hand, and push the tool inward through 4H removal and

Chassis System Maintenance Manual

installation hole by the other hand, making the hook of DAB three o'clock and ormig spring of steering wheel separate;

(2) Hold the steering wheel by one hand, and push the tool inward through 7H removal and installation hole by the other hand, making the hook of DAB six o'clock and 9 o'clock and ormig spring of steering wheel separate;



4H location diagram



7H location diagram

3) Assembly of the horn cover assembly

The steering wheel is aligned with corresponding clamping area of DAB and press it, check whether the matching clearance is evenly or not.

Attention:

- The installation must be carried out with the steering wheel in the middle position and the tires in a straight line. Or make marks on the steering wheel and steering column head before disassembly, make sure that the marks are matched during installation.

- Under installation condition, the steering column must be rotated smoothly and free of clicks or sticking.

- After installation other components on the steering wheel, adjust the inclination of steering wheel and steering column for 5 ~ 6 times, the maximum force to operate the locking position of steering column handle must not exceed 49 ~ 90N. When the locking position of steering wheel column handle is in free position, the maximum operation force of steering wheel and steering column inclination must not exceed 80N.

- Installation position of clock spring(balance spring)

- Do not distort the steering wheel excessively after the clock spring is tightened.

V. Steering counter shaft cover

Removal and Installation:

1) Disassembly

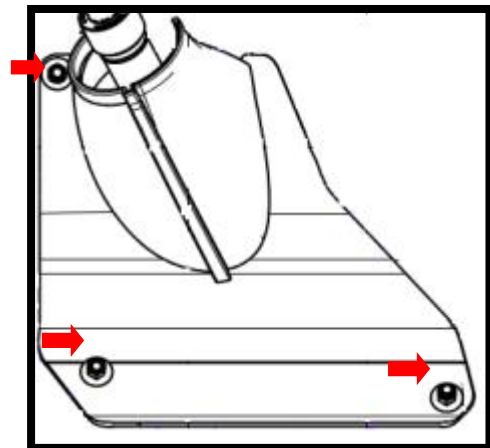
① Park the vehicle in the straight line and stop.

② Loosen the nut on the steering counter-shaft cover by wrench, and then directly pull out the steering counter-shaft cover from the 3 installation points.

2) Installation

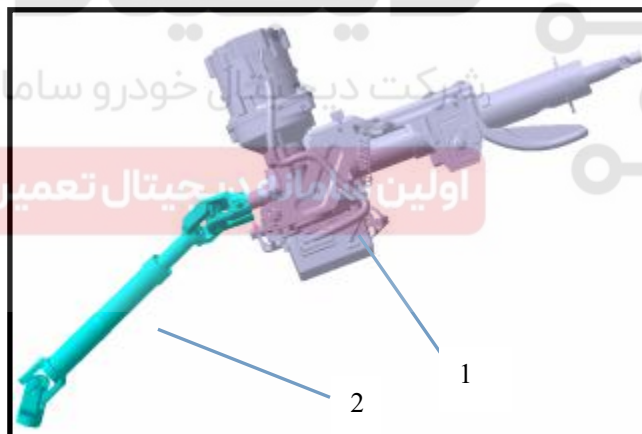
① Park the vehicle in the straight line and stop.

② Directly install the steering counter-shaft cover on the 3 installation points, and then tighten the 3 nuts, the tightening torque is 4~6Nm.



VI. Steering column with counter-shaft assembly

VI. Steering column with counter-shaft assembly



Schematic Diagram of Steering Column assembly

1-Steering Column Assembly 2-Steering Counter-shaft Assembly

Attention:

■ Please do not exert excessive axial force on the steering column with intermediate shaft assembly during installation and removal.

■ Please do not move the steering gear when removing the steering column with intermediate shaft assembly

Removal and Installation:

3) Disassembly

① Park the vehicle in the straight line.

Chassis System Maintenance Manual

② Disconnect the battery negative terminal and wait for more than 3 minutes.

③ Remove the driver airbag module and disconnect the connecting harness of clock spring.

④ Remove the steering wheel.

⑤ Remove the upper and lower guards of steering column and the lower part of dashboard on the driver side.

⑥ Disconnect the wiring harness that is installed on the combination switch, clock spring and mechanical ignition lock (or electronic ignition lock) and the external harness connector that is installed on the steering column (disconnect the external connector, don't disconnect the internal connector), and then remove the harness from the steering column assembly

⑦ Disassemble the combination switch assembly and clock spring from the steering tube

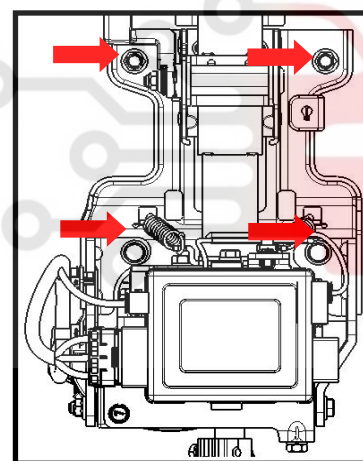
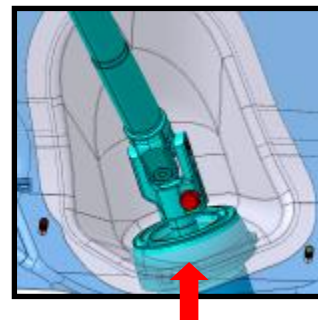
⑧ After removing the steering counter-shaft cover, remove the connecting bolts of the steering column with countershaft assembly and the steering gear, separate the steering column with countershaft assembly and the steering gear.

■ Fastening torque: 33~38 N·m

⑨ Remove the fixed bolt of steering column assembly

⑩ Remove the fixed bolt of the steering column assembly, lower the steering column, and remove the steering column assembly.

■ Tighten torque: 20~30 N·m



2) Inspection After Removal

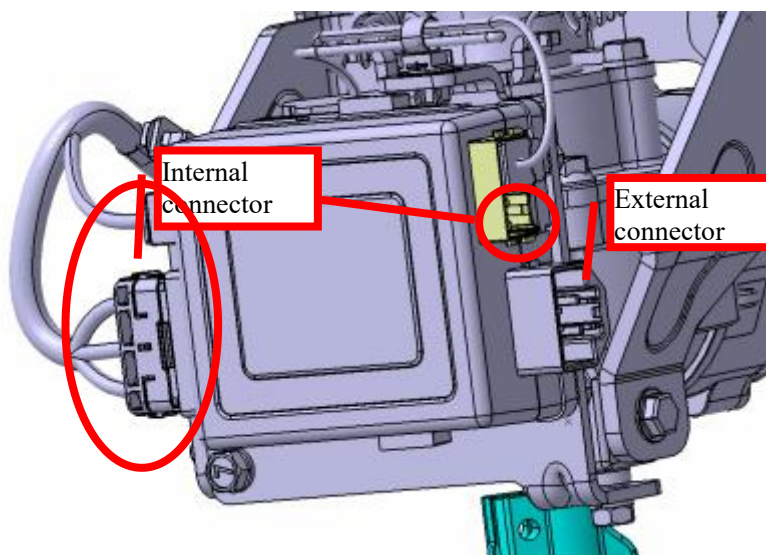
① Check the steering column for crack, deformation or other damage. If there is any of the above conditions, please replace it.

② Check the steering column shaft spline wear, broken teeth, if there are above conditions, please replace.

3) Disassembly

① Disassembly

a. Loosen the connecting bolts between the steering column and the



Chassis System Maintenance Manual

steering intermediate shaft and then remove the steering intermediate shaft assembly.

b. Remove the mechanical ignition lock (or electronic ignition lock) if necessary

Attention:

■ The special bolts must be replaced when reinstalling the mechanical ignition lock (or electronic ignition lock)

c. If necessary, remove the steering column and bracket.

② Disassembly key point

Removal of Special Bolt:

a. Using drill, drill special bolt enough to fit into the screw hole.

b. Use the anti-screw tap, remove the special bolt.

4) Inspection After Disassembly

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

② Check whether the operation of mechanical ignition lock (or electronic ignition lock) is normal or not.

5) Installation

Assemble the mechanical ignition lock (or electronic ignition lock), mechanical ignition lock (or electronic ignition lock) bracket and special bolts.

Attention:

■ When the mechanical ignition lock (or electronic ignition lock) and the mechanical ignition lock (or electronic ignition lock) bracket are installed on the steering column assembly, align the locking notch of steering column, lock the mechanical ignition lock (or electronic ignition lock) temporarily.

■ After confirming that the mechanical ignition lock (or electronic ignition lock) is correct, lock the special bolt until the bolt head breaks.

6) Installation

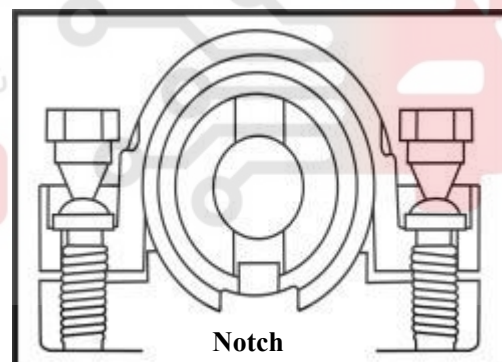
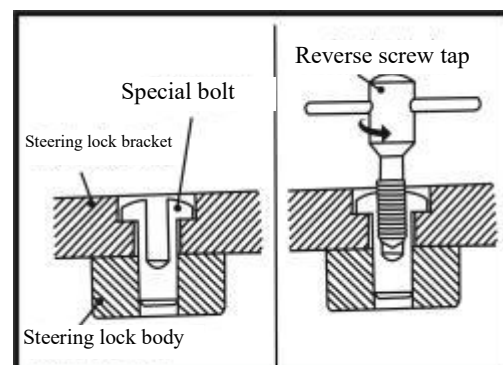
Install in the reverse order of removal

Note:

■ Do not reuse the unusable parts

■ When installing the steering counter-shaft on the steering column assembly or steering gear assembly, please pay attention to the installation position.

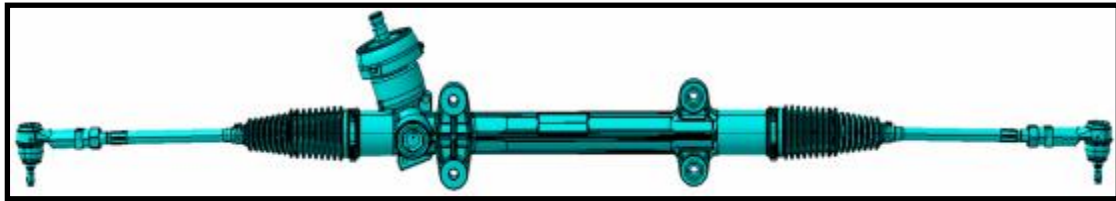
7) Inspection After Installation



Chassis System Maintenance Manual

When the vehicle is parked in a straight line, rotate the steering wheel to the left and right for several times to confirm that the steering wheel is flexible

VII. Steering gear assembly



Mechanical steering gear diagram

Attention:

■ If the steering wheel is rotated while separating the steering column with the intermediate shaft assembly and the steering gear assembly, the clock spring may be damaged, therefore, make sure that the steering wheel has been fixed to prevent rotation.

Removal and Installation:

1) Disassemble

Attention:

① Park the vehicle straight ahead.

② First remove the steering counter-shaft cover the cab, and then

remove the connecting bolt of steering counter-shaft assembly and steering gear, separate the steering counter-shaft assembly and the steering gear, and the removal step is same as the removal step ③ of the steering column with the intermediate shaft assembly.

■ Fastening torque: 33~38 N·m

③ Pull out the opening pin by plier, and then remove the tie rod ball head slotted nut.

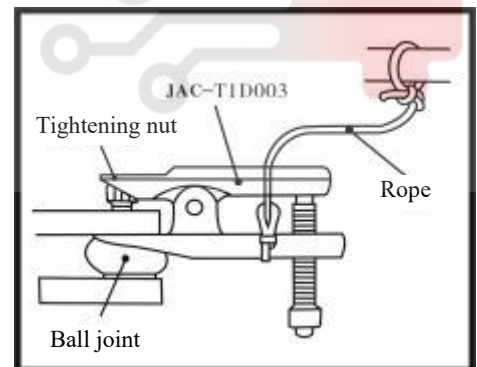
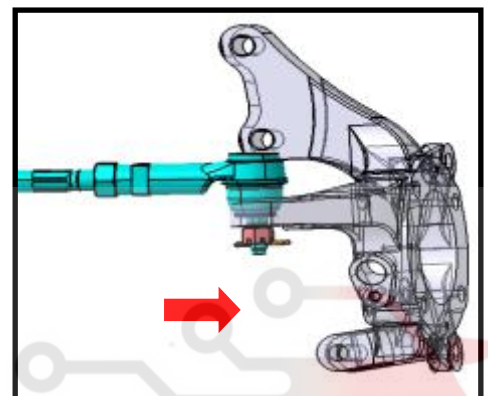
■ Fastening torque: 30~38 N·m

④ As shown in the figure, use a special tool to remove the steering tie rod ball head from the steering knuckle.

⑤ Remove the fixed nut of manual steering gear from the subframe

■ Fastening torque: 90~110 N·m

⑥ Take down the manual steering gear assembly from the vehicle frame.



Attention:

- Be careful to remove it slowly and do not damage the dust cover of tie rod.

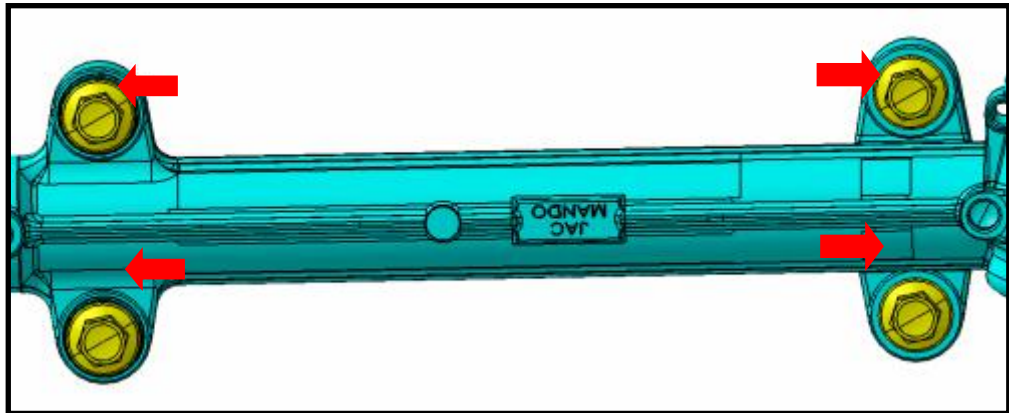
2) Inspection After Removal

① Mechanism

Steering Gear

- Check the rack and pinion for smooth working, check the rack and pinion for wear.

- Check the preload of gear.



- a. The gear is rotated at a speed of 4 to 6 seconds per revolution, and the gear preload is measured within the full stroke of the rack.

- Standard Value: $0.8 \sim 2 \text{ N} \cdot \text{m}$

- b. If the measured value exceeds the standard value, replace the parts.

Steering tie rod

Check the tie rod turning torque.

- a. Swing the tie rod for 10 times quickly

- b. Measure the swing resistance of tie rod with spring balance

- Standard value: $1.5 \sim 5 \text{ N} \cdot \text{m}$

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

Attention:

- If the tie rod is slowly wobbled without excessive clearance, even if the measured value is lower than the standard value can also be used.

③ Dust cover of tie rod

- Check the dust cover for damage, if any, please replace it.
- Check whether the installation state of dust cover is correct or not. Distortion is not allowed.

3) Installation

Install in the reverse order of removal

Note: Please do not reuse the non-reusable parts

Attention:

- Pay attention to the mounting position when connecting the mechanical steering gear and

Chassis System Maintenance Manual

steering column.

■When removing the manual steering gear assembly, keep the tires on a level ground under no-load condition and conduct the final tightening of the nuts and bolts.

■Check the wheel alignment.

4)Inspection After Installation

■Rotate the steering wheel to the left and right for several times to confirm whether the operation of steering wheel is flexible or not.

VIII. S7 EPS system after-sales calibration procedure

1. After EPS replacement, the following steps shall be followed for debugging.

2. After EPS replacement, the following steps shall be followed for debugging. It needs steering angle signal of EPS, after replacing it, need to calibrate and match;

3. When the relevant chassis parts need to be replaced, the following steps shall be followed for debugging when the four-wheel positioning is required. The output value of EPS steering signal should match the four-wheel positioning parameter <front toe-in>.

Step	Content	Facility	Remark
Step1	The steering system mechanical position is centered,make sure that the steering wheel left and right corner of steering system are the same,so that the left and right stroke of steering gear rack are consistent.	The steering system mechanical position is aligned with equipment, refer to the equipment or other equipment currently being used by the manufacturing company;	This step should be operated on the four wheel aligner to avoid moving the vehicle after the alignment
Step 2	After the steering system mechanical centering and calibration, keep the position to install the steering wheel, and then fix the steering wheel for subsequent four-wheel positioning operation;	Fix the steering wheel with level or other equipment	This step should be carried out on the four wheel aligner to avoid moving the vehicle after the alignment;
Step 3	Four wheel alignment,adjust the four wheel alignment parameters	Four Wheel Aligner	After the debugging work is completed,make sure that the steering system is in the mechanical centering position;
Step 4	EPS system calibration, make the angle of the steering angle sensor match with the mechanical center position. After the center position of the angle sensor is calibrated,it can output the real and effective value of the steering wheel angle and correspond to the running state of the vehicle, for example, when the vehicle travels straight,	Diagnosis scanner	During calibration,avoid turning the steering wheel.

Chassis System Maintenance Manual

Step	Content	Facility	Remark
	the output of the corner signal is zero(relative value). For details, refer to calibration process.		
Step 5	Check if the calibration is successful: Use the diagnostic instrument to check if succeed. You can also refer to the EPS fault indicator lamp < for reference only> on the instrument. If the yellow indicator lamp is off, it indicates the calibration is successful. Otherwise, recalibrate.		The yellow failure lamp indicates that the system has not been calibrated or the calibration deviation is greater than 50 degrees. Red lamp indicates that the system is out of order and needs to be checked with diagnostic device.

Relationship of steering system and other system

1). EPS and ESC system

If the wheel speed signal from ESC is incorrect, it may cause EPS no assisting power or weakened assisting power.

2). EPS and EMS system

If the engine speed signal from EMS is incorrect, it may cause EPS no assisting power or weakened assisting power.

3). EPS and instrument system

If the signal from the instrument system is incorrect, the information conveyed by the EPS malfunction lamp will be inaccurate;

The correct display mode is as follows:

- 1) Under the normal circumstances, when the system is powered on, the instrument self-inspection lamp will be lit in red for about three seconds and then go out.
- 2) If the system malfunctions, then the red lamp will be on during the work process or the red lamp will not go out after the system is powered on.
- 3) If the yellow EPS alarm lamp is showed on ICM, indicating that the EPS system is not calibrated or the calibration is unsuccessful or the calibration left and right difference is greater than 50 degrees;