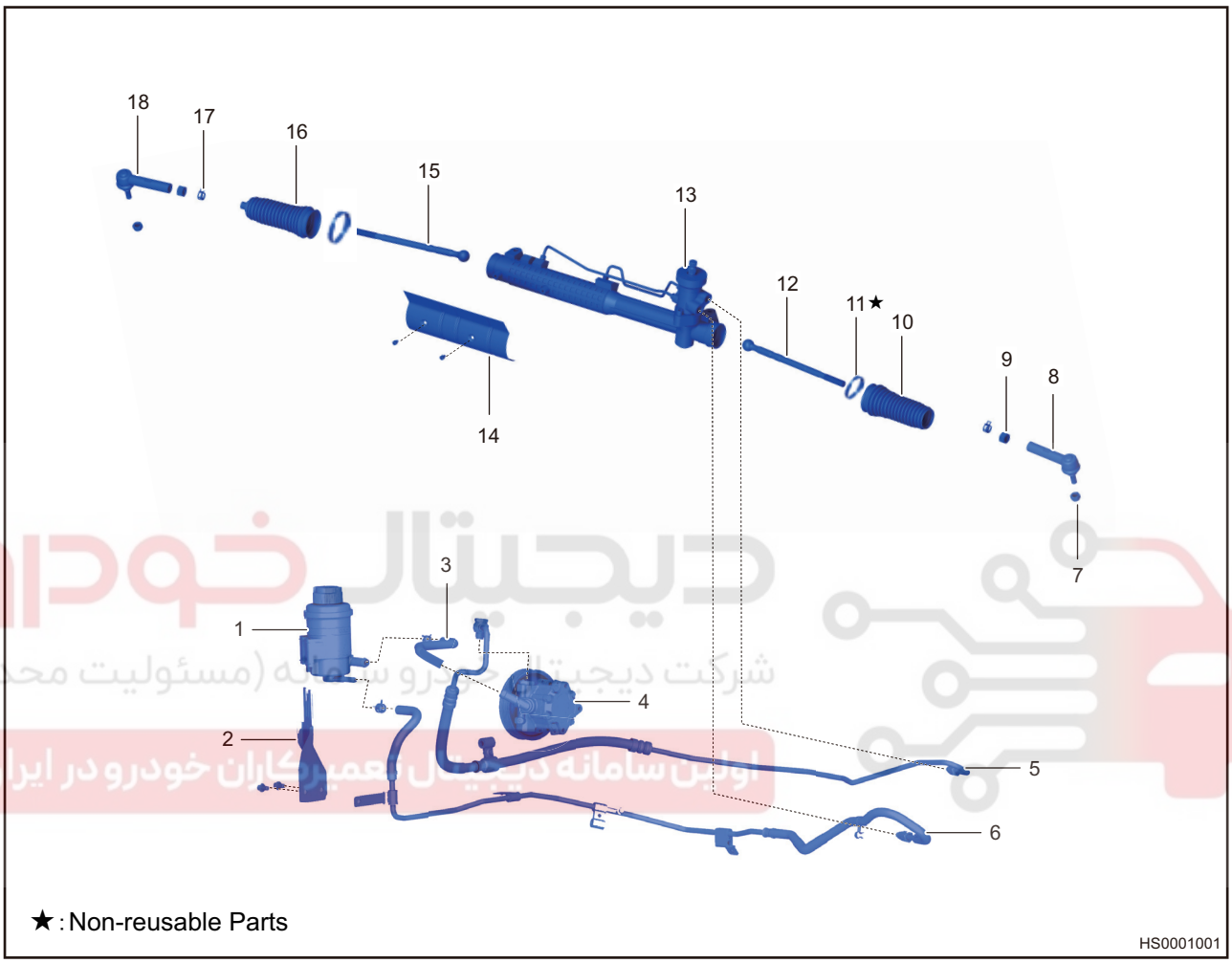
HYDRAULIC ASSIST STEERING

GENERAL INFORMATION

Overview

Description

Hydraulic Assist Steering



1 - Steering Fluid Reservoir	2 - Steering Fluid Reservoir Bracket
3 - Fluid Suction Pipe Assembly	4 - Steering Pump
5 - High Pressure Fluid Pipe Assembly	6 - Fluid Return Pipe Assembly
7 - Steering Tie Rod Ball Pin Locking Nut	8 - Left Steering Tie Rod Ball Pin
9 - Steering Tie Rod Fixing Nut	10 -Left Steering Tie Rod Boot
11 - Clamping Ring	12 - Left Steering Tie Rod Assembly
13 - Steering Gear	14 - Steering Gear Heat Insulator
15 - Right Steering Tie Rod Assembly	16 - Right Steering Tie Rod Boot
17 - Elastic Clamp	18 - Right Steering Tie Rod Ball Pin

Hydraulic assist steering system consists of power steering pump assembly, steering gear assembly, steering fluid pipe and steering fluid reservoir assembly and so on. This system can reduce steering force when driver operates steering wheel, thus improving operation convenience and driving safety.

Steering Gear Assembly

Steering gear assembly is rack & pinion type, which is characterized by simple and compact construction and high steering sensitivity. Piston rod is integrated with rack, and there is a boot at the connection between steering tie rod assembly and rack. Length of steering tie rod can be adjusted properly to match with the toe-in. Tie rod ball pin assembly and steering knuckle are connected and tightened by a locking nut.

Power Steering Pump Assembly

Power steering pump assembly is connected with steering gear assembly by high pressure fluid pipe, and connected with steering fluid reservoir assembly by fluid suction pipe. Never operate power steering pump assembly without fluid. Try to avoid turning steering wheel to the limit position for more than 5 seconds during operation.

Steering Fluid Pipe

Steering fluid pipe is used to deliver power steering fluid. Steering fluid pipes are divided into steel pipe, hose and hybrid type according to the length and operating features of each component. Ferrule connection is adopted between steel pipe and hose of high pressure fluid pipe assembly, which has reliable sealing. Joint bolts are used to connect steel pipe and O-ring is used for sealing. Tighten the bolts to guarantee reliable sealing. Components are connected by hose and tightened by clamp.

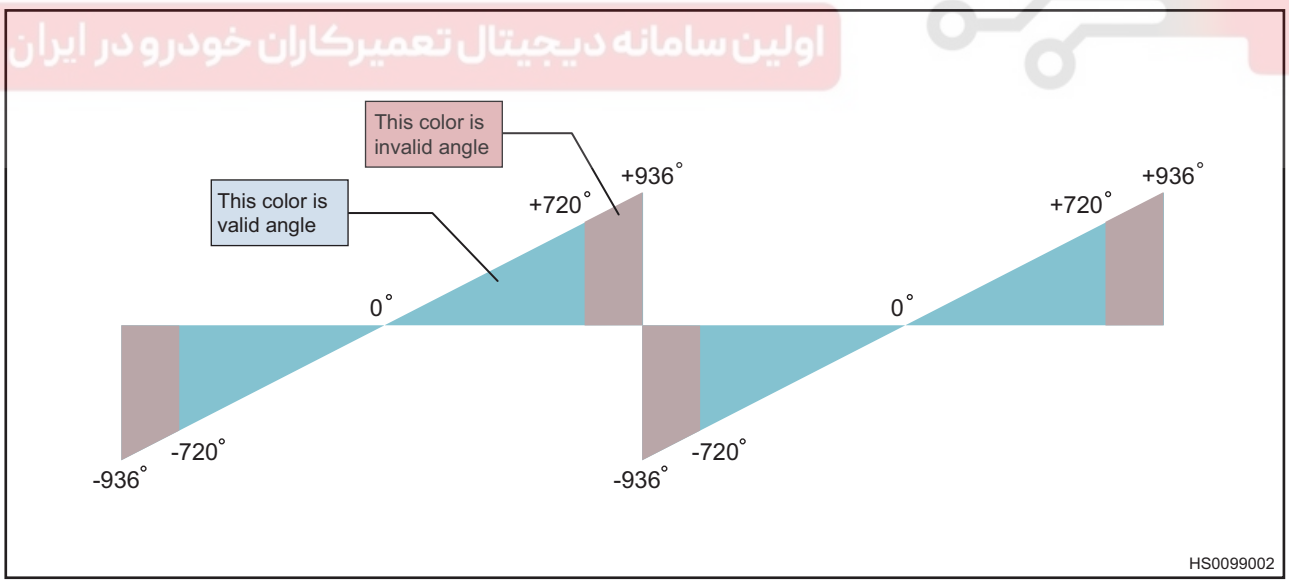
Steering Fluid Reservoir Assembly

Main functions of steering fluid reservoir assembly: store fluid and supply it to steering pump and system.

Operation

Steering gear assembly converts the circular motion of steering wheel into linear motion of rack by engaging the rack and pinion inside. Power steering pump assembly delivers fluid into steering gear assembly to drive pistons moving toward the direction made by driver. Piston transmits force to steering knuckle by steering tie rod assembly, thus reducing steering effort when driver turns steering wheel. If steering assist is ineffective, it is necessary to increase more steering effort.

Angle Sensor Calibration Operation Specification



Steering Angle Sensor Position Description

1. The effective range of angle sensor angle: ⩽ ± 720 °. For the parts that have been calibrated, the initial calibration and recalibration can be performed within this range.
2. The ineffective range of angle sensor angle: -720° - 936°, +720° - +936°. For the parts that have been calibrated, the initial calibration and recalibration cannot be performed within this range.

Precautions

If the angle sensor is rotated after the steering wheel is removed during repair, the angle sensor cannot sent signal normally beyond the range of ± 720°. If the ESP malfunction indicator light illuminates after the vehicle is reloaded. In this case, it is necessary to reference the operating way in "Correction Method 2 for that Angle cannot be Calibrated (vehicle has related removal records)" and rotate the angle sensor 2 turns clockwise to solve the problem.

Service precautions for angle sensor installation

1. When repairing or installing the angle sensor, it must be ensured that the tire is adjusted to a straight line and the steering wheel is level.
2. When the vehicle steering system is being repaired (eg, steering wheel, steering column, steering gear, steering intermediate shaft), ensure that the spiral cable assembly is neutral and cannot rotate freely.
3. When the combination switch assembly is repaired, the spiral cable assembly should keep neutral and not rotated (for example, fix it with a neutral pin or tape).
4. Keep the neutral position of the spiral cable after removal (for example, fix it with a neutral pin or tape).
5. Keep the angel sensor in neutral position after removal (for example, fix it with tape).

Correction method 1 for that angle cannot be calibrated (vehicle has no relevant removal records)

1. The ESP malfunction light illuminates while the vehicle is running, and the vehicle has no relevant removal records.
2. Read the fault code to confirm if it is a steering angle fault.
3. Run the vehicle to repair station, make the tire in-line and steering wheel in horizontal position.
4. Operate the diagnostic tester with ignition switch in ON state and clear the steering angle history trouble code.
5. Vehicle battery is powered off for 15 seconds, the vehicle is restarted after power-on, and the fault light goes off.
6. The vehicle is re-calibrated in the four-wheel station. Refer to the repair standard for calibration items.

Warning:

- If the previous calibration deviation is serious, the fault light may illuminate again if direction is rotated after step 5 due to the angle range being out of tolerance.
- If the previous calibration deviation is not serious, the fault may not trigger at that time if direction is rotated after step 5, but it still needs to be re-calibrated.
- If the historical fault codes on vehicle are cleared, the ESP still reports the steering angle fault and illuminates the fault light or cannot be re-calibrated, when the vehicle is powered-on 15s after battery is disconnected, which indicates that angle sensor may have been accidentally rotated beyond its effective angle recognition range, and it is necessary to operate according to angle cannot be calibrated, the correct method 2.

Correction method 2 for that angle cannot be calibrated (vehicle has relevant removal records)

1. The ESP fault light illuminates if the vehicle has relevant removal records.
2. Read the fault code to confirm if it is a steering angle fault.
3. Run the vehicle to repair station, make the tire in-line and steering wheel in horizontal position.
4. Remove the spiral cable and angle sensor.
5. In removal condition, rotate the angle sensor 2 turns clockwise and keep it.
6. Keep the rotated condition, reinstall it to the spiral cable and install it to vehicle.
7. Operate the diagnostic tester with ignition switch in ON state and clear the steering angle history trouble code.
8. Vehicle battery is powered off for 15 seconds, the vehicle is restarted after power-on, and the fault light goes off.

9. The vehicle is re-calibrated in the four-wheel station. Refer to the repair standard for calibration items.

Warning:

- If the previous calibration deviation is serious, the fault light may illuminate again if direction is rotated after step 8 due to the angle range being out of tolerance.
- If the previous calibration deviation is not serious, the fault may not trigger at that time if direction is rotated after step 8, but it still needs to be re-calibrated.
- If the historical fault codes on vehicle are cleared, the ESP still reports the steering angle fault and illuminates the fault light when the vehicle is powered-on 15s after battery is disconnected, it is necessary to check the line and ESP system.

Specifications

Torque Specifications

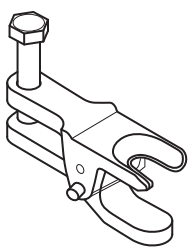
Description	Torque (N·m)
Clamping Bolt Between High Pressure Fluid Pipe and Steering Gear Assembly	30 ± 3
Clamping Bolt Between Fluid Return Pipe and Steering Gear Assembly	30 ± 3
Steering Pump Fixing Bolt	25 ± 4
Fixing Bolt Between Steering Gear and Front Sub Frame Welding Assembly	110 ± 10
Locking Nut of Through Bolt Between Rear Mounting Bracket and Rear Mounting Cushion Assembly	80 ± 5
Locking Nut Between Ball Pin Assembly and Steering Knuckle Assembly	35 ± 3
High Pressure Fluid Pipe Joint Hollow Bolt	45 ± 3
Coupling Bolt Between Front Sub Frame Assembly and Body	180 ± 18
Coupling Bolt Between Steering Column with Intermediate Shaft Assembly and Steering Gear Input Shaft	30 ± 3

Power Steering Fluid Specification

Type	Capacity (L)
Power Steering Fluid (AFT III)	Added fluid to level between "MAX" and "MIN" marks

Tool

Special Tool

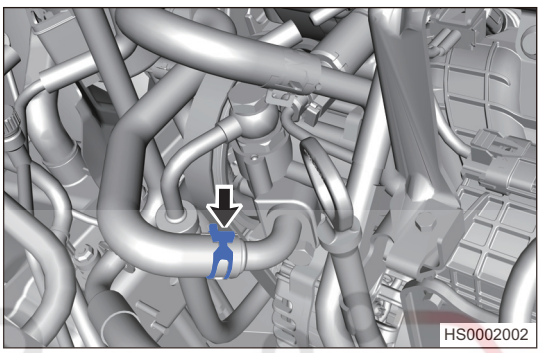
Ball Pin Separator	 024

DIAGNOSIS & TESTING

Steering Fluid Replacement

Steering Fluid Draining

1. Set the steering wheel to straight-ahead position.
2. Turn off all electrical equipment and the ENGINE START STOP switch.
3. Disconnect the negative battery cable.
4. Turn the ENGINE START STOP switch to ACC.
5. Open the steering fluid reservoir cap.
6. Remove the engine lower protector assembly (See page 51-21).
7. Remove fluid suction pipe clamp (arrow) from power steering pump assembly.



8. Place a fluid container under the fluid suction pipe, and disconnect the fluid suction pipe joint to collect steering fluid flowing out from fluid suction pipe and steering pump.
9. Turn the steering wheel left and right to limit positions, and repeat the operation several times to fully drain steering fluid in steering system as possible.

Caution:

- If steering fluid sprays on your skin, immediately wash it off with water.
- It is harmful to your skin, if contacting with power steering fluid for a long time.
- Steering wheel should not be in limit positions for more than 5 seconds.

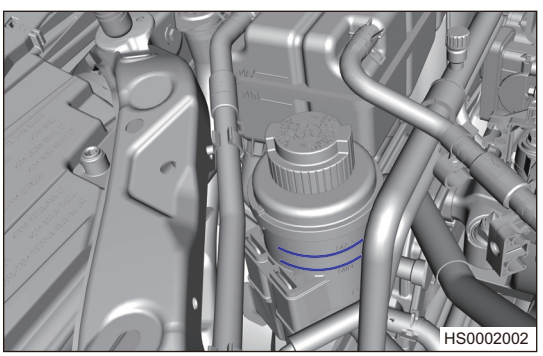
Steering Fluid Adding

Warning/Caution/Hint

Caution:

- DO NOT apply foaming or expired steering fluid to vehicle. Otherwise, it may damage power steering pump assembly.

1. Open steering fluid reservoir cap, and add steering fluid to reservoir until the level reaches "MAX" mark.



2. Start engine and run it at idle to drive power steering pump assembly, thus filling the whole steering system with steering fluid.

3. Observe fluid level of fluid reservoir while engine is running. If fluid level drops below "MIN" mark, add steering fluid to a proper level in time to prevent fluid level from dropping excessively and avoid air entering power steering pump assembly.
4. If bubbles occur in steering fluid reservoir, perform bleeding procedures. Check that level is between "MAX" and "MIN" marks when there are no bubbles in fluid reservoir and fluid level does not change any longer.

Caution:

- If steering fluid sprays on your skin, immediately wash it off with water.
- It is harmful to your skin, if contacting with power steering fluid for a long time.

Bleeding Procedures

It is necessary to perform bleeding procedures when bubbles occur in steering fluid reservoir assembly and fluid has emulsified or there is excessive noise in power steering pump assembly. Bleeding procedures are as follows:

1. Open steering fluid reservoir cap.
2. Raise vehicle with a lift (with front wheels off ground).
3. Start engine (idling) and turn steering wheel left and right to limit positions (do not stay at the limit positions for more than 2 seconds). Repeat several times to completely bleed air in system from the reservoir. Observe fluid level of fluid reservoir during bleeding. If fluid level drops below "MIN" mark, add steering fluid to proper level in time.
4. After repeatedly turning steering wheel to limit positions several times, center the steering wheel, run engine at idle for 3 to 5 minutes and observe whether there are still bubbles in fluid reservoir. If there are still bubbles, perform above procedures again until no bubbles are bled. If there are still problems, perform steering system inspection.

ON-VEHICLE SERVICE

Steering Fluid Reservoir Assembly

Removal

Warning/Caution/Hint

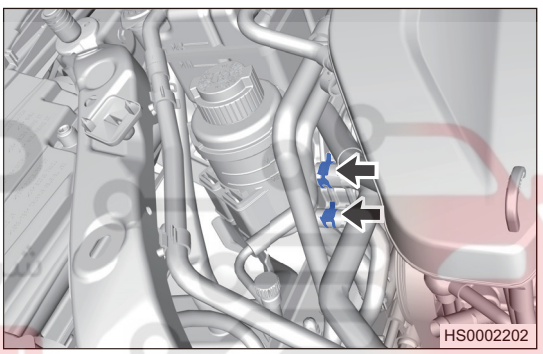
- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- When removing and installing high temperature components and surrounding components, wait and operate until they cools down to normal temperature to avoid being burned.
- Prevent skin and eyes from contacting with steering fluid.

Caution:

- After disconnecting steering line, seal it immediately to prevent foreign matter from entering.
- Never run power steering pump assembly when steering fluid is insufficient.
- Steering wheel should not be in the limit position for more than 5 seconds.
- Never start engine with hose loosened or disconnected.
- Never allow hose to contact with high temperature exhaust pipe.

1. Drain the steering fluid (See page 29-7).
2. Remove the steering fluid reservoir assembly.

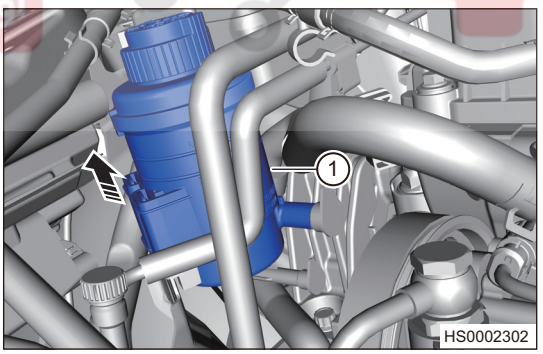
   (a) Remove inlet and return pipe clamp (arrow) on steering fluid reservoir, and disconnect the connection between inlet and return pipe assembly and steering fluid reservoir assembly.



   (b) Remove steering fluid reservoir (1) from steering fluid reservoir bracket.

   Caution:

   - Using a plug, clog disconnected pipe to prevent foreign matters from entering.



Inspection

1. Check steering fluid reservoir assembly for breakage or deformation. Replace fluid reservoir if necessary.
2. Check if there is contamination in steering fluid reservoir assembly. Clean or replace if necessary.

Installation

1. Installation is in the reverse order of removal.

   Caution:
   - Install fluid suction pipe clamp and fluid return pipe clamp in place.
   - Never tap or hit the fluid reservoir.
   - After adding the power steering fluid, perform bleeding procedure and check the system for leakage.

Steering Fluid Pipe

Removal

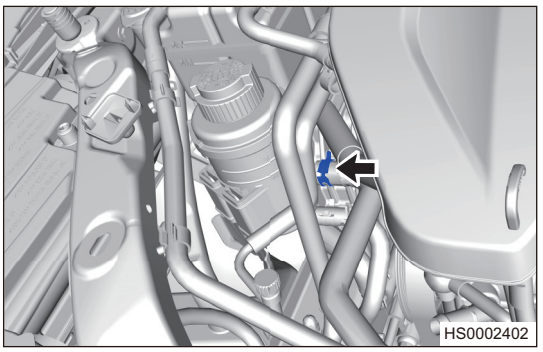
Warning/Caution/Hint

- Collect steering fluid residue in line with a container when disconnecting the line.

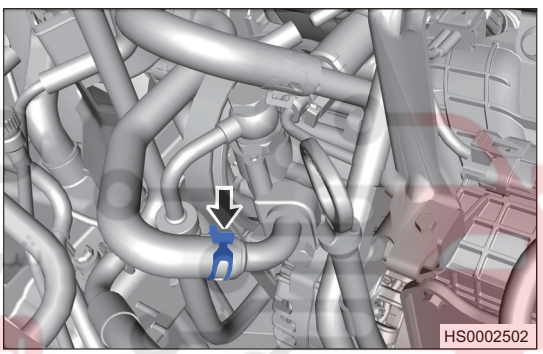
Removal

1. Drain the steering fluid (See page 29-7).
2. Remove the fluid suction pipe.

(a) Remove fluid suction pipe clamp (arrow) from steering fluid reservoir, and disconnect connection between fluid suction pipe and steering fluid reservoir assembly.



(b) Remove fluid suction pipe clamp (arrow) from power steering pump assembly side, and disconnect connection between fluid suction pipe and power steering pump assembly.

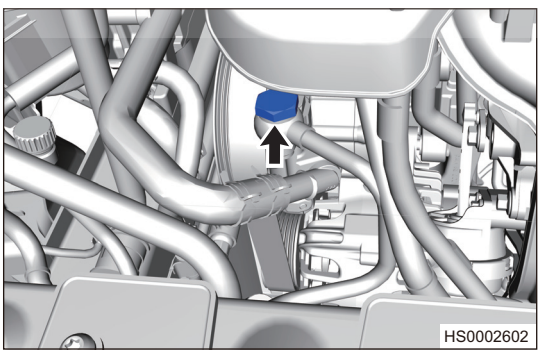


(c) Remove the fluid suction pipe.

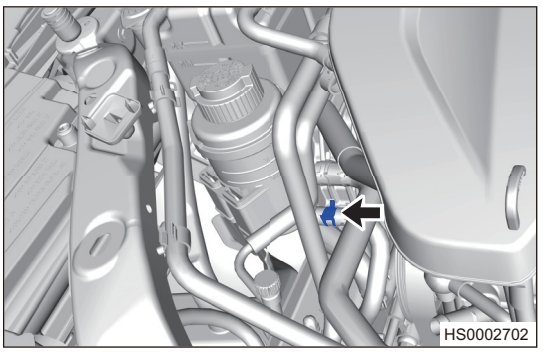
3. Remove high pressure fluid pipe and fluid return pipe.

(a) Remove high pressure fluid pipe joint hollow bolt (arrow) from power steering pump assembly.

Tightening torque
45 ± 3 N·m

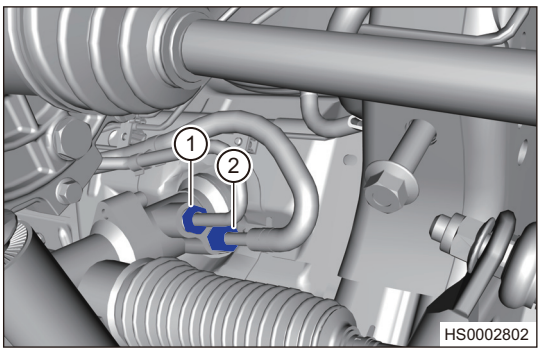


(b) Remove fluid return pipe clamp (arrow) from steering fluid reservoir assembly.



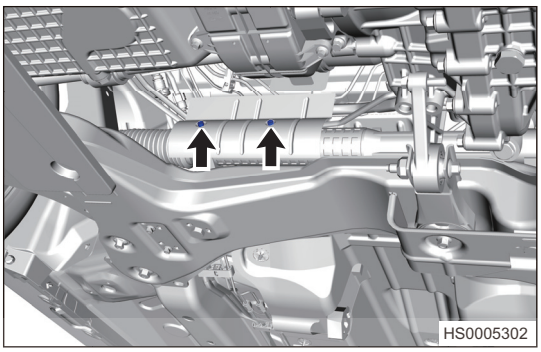
(c) Remove high pressure fluid pipe clamping bolt (1) and fluid return pipe clamping bolt (2) from steering gear assembly.

Tightening torque
30 ± 3 N·m



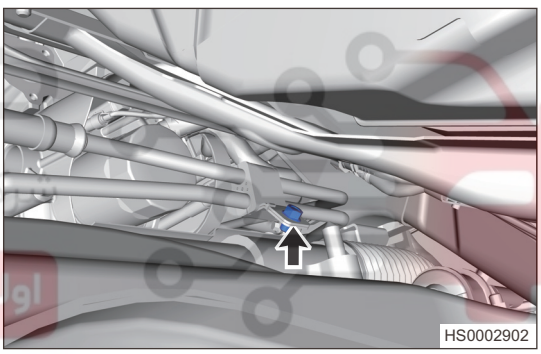
(d) Remove 2 fixing bolts (arrow) from steering gear heat insulator.

Tightening torque
10 ± 1 N·m



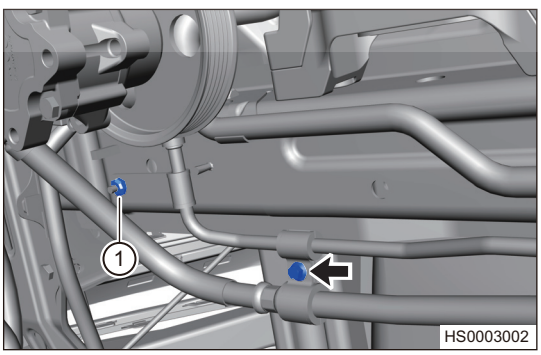
(e) Remove bracket bolt (arrow) between high pressure fluid pipe and fluid return pipe.

Tightening torque
9 ± 1.5 N·m



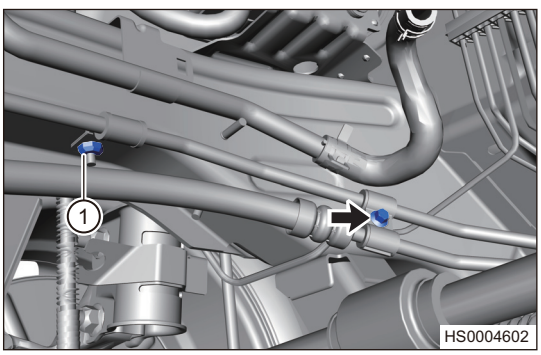
(f) Remove bracket bolt (arrow) between high pressure fluid pipe and fluid return pipe and remove the nut (1) from fluid return pipe bracket.

Tightening torque
7 ± 1 N·m



(g) Remove bracket bolt (arrow) between high pressure fluid pipe and fluid return pipe and remove the nut (1) from fluid return pipe bracket.

Tightening torque
7 ± 1 N·m



(h) Remove high pressure fluid pipe and fluid return pipe.

Inspection

1. Check steering fluid pipe for cracks, wear or blockage. Replace steering fluid pipe assembly if necessary.
2. Check steering fluid pipe joint and O-ring for deformation or damage. Replace steering fluid pipe assembly if necessary.
3. Check if steering fluid pipe bracket is normal. Replace it if necessary.

Installation

1. Installation is in the reverse order of removal.

   Caution:
   - Never tap or squeeze steering fluid pipe.
   - Tighten fixing nut and bolt to specified torque.
   - After adding the power steering fluid, perform bleeding procedure and check the system for leakage.
   - O-rings cannot be reused, replace it with a new one during installation.

Power Steering Pump Assembly

Removal

Warning/Caution/Hint

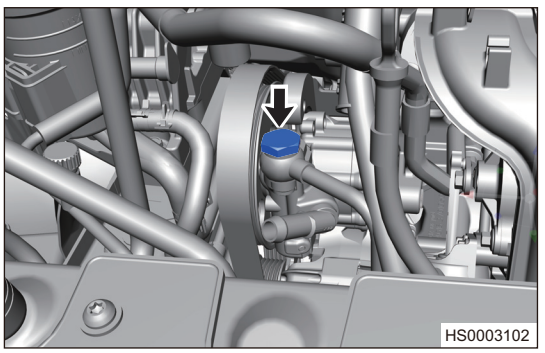
- Collect steering fluid flowing from line with a container when disconnecting the line.

1. Drain the steering fluid (See page 29-7).
2. Remove the accessory drive belt (See page 07-19).
3. Remove the power steering pump assembly.

(a) Remove the high pressure fluid pipe joint hollow bolt (arrow).

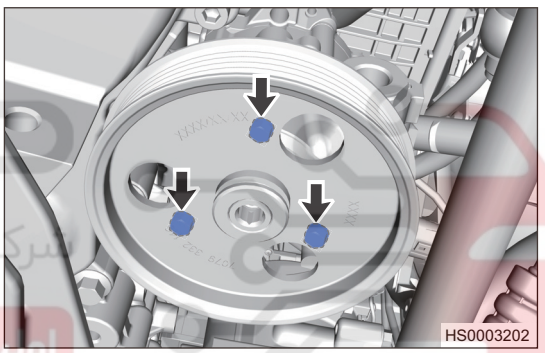
Warning:
Using a plug, clog disconnected steering system line to prevent foreign matter from entering.

Tightening torque
45 ± 3 N·m



(b) Remove 3 fixing bolts (arrow) from steering pump and then remove the steering pump.

Tightening torque
25 ± 4 N·m



(c) Remove the steering pump.

Inspection

1. Check power steering pump assembly for blockage or damage, and power steering pump bearing for looseness and abnormal noise. Replace the power steering pump assembly if necessary.
2. Check if power steering pump pulley is normal. Replace the steering pump assembly if necessary.

Installation

1. Installation is in the reverse order of removal.

Caution:

- Tighten fixing bolts to the specified torque.
- DO NOT tap or hit power steering pump assembly.

Ball Pin Assembly

Removal

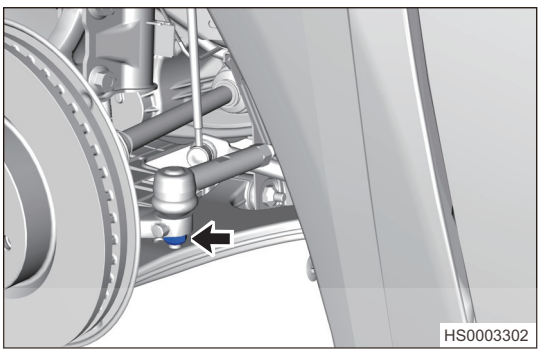
Warning/Caution/Hint

Use same procedures for right and left sides. Procedures listed below are for left side.

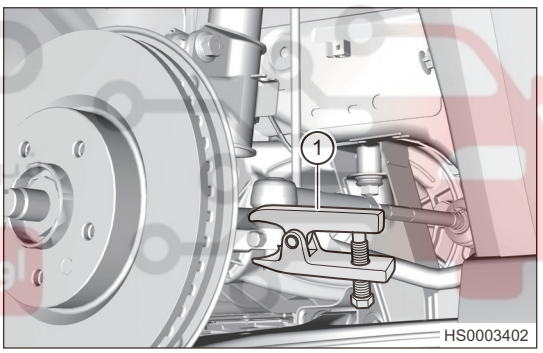
1. Set the steering wheel to straight-ahead position.
2. Turn off all electrical equipment and the ENGINE START STOP switch.
3. Disconnect the negative battery cable.
4. Remove the front left wheel (See page 24-8).
5. Remove the ball pin assembly.

(a) Remove locking nut (arrow) between left steering tie rod ball pin assembly and front left steering knuckle assembly.

Tightening torque
35 ± 3 N·m



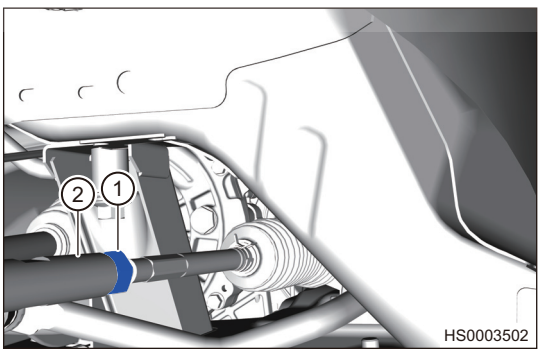
(b) Install ball pin separator (1), and separate steering tie rod ball pin from steering knuckle assembly.



(c) Loosen the steering tie rod adjustment nut (1), and turn the ball pin assembly (2) counterclockwise to remove it.

Hint:
- When removing the ball pin assembly, record the revolutions during removal, to make the front wheel toe-in closer to setting value after installation.

Tightening torque
55 ± 5 N·m



Inspection

1. Check tie rod ball pin for looseness. Replace ball pin assembly if necessary.
2. Check tie rod ball pin bush rubber for damage. Replace ball pin assembly if necessary.

Installation

1. Installation is in the reverse order of removal.

Caution:
- After installing tie rod ball pin assembly, it is necessary to perform wheel alignment procedure.

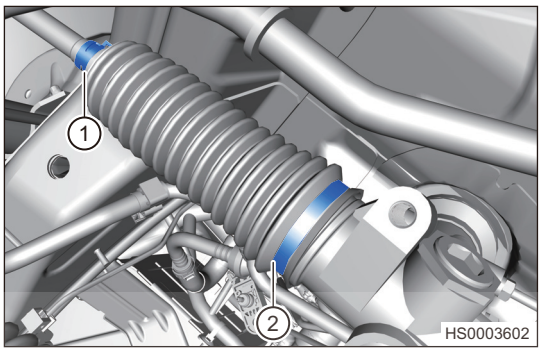
Steering Tie Rod Assembly

Removal

Warning/Caution/Hint

- Use same procedures for right and left sides.
- Procedures listed below are for left side.

1. Remove the front wheel (See page 24-8).
2. Remove the tie rod ball pin assembly (See page 29-15).
3. Remove the steering tie rod assembly.
   (a) Remove the steering tie rod boot elastic clamp (1).
   (b) Remove steering tie rod boot clamping ring (2) and remove steering tie rod boot.



   (c) Using a wrench, remove the tie rod assembly.

Inspection

1. Check steering tie rod boot for damage, and if clamp is normal. Replace the steering tie rod boot and clamp if necessary, to prevent water and dust from entering and causing parts failure prematurely.
2. Check steering tie rod assembly for deformation or wear and ball for insufficient lubrication. Replace the steering tie rod assembly or add grease if necessary.

Installation

1. Installation is in the reverse order of removal.
   Caution:
   - It is necessary to apply thread locker to ball.
   - It is necessary to fit the steering tie rod ball face and the rack face closely.
   - After installing steering tie rod assembly, it is necessary to perform wheel alignment procedure.
   - Clamping ring cannot be reused, replace it with a new one during installation.

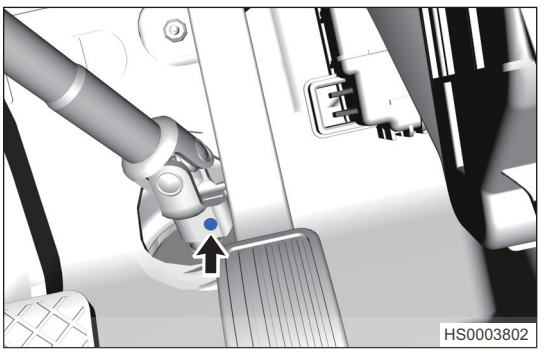
Power Steering Gear with Tie Rod Assembly

Removal

1. Set the steering wheel to straight-ahead position.
2. Turn off all electrical equipment and the ENGINE START STOP switch.
3. Disconnect the negative battery cable.
4. Drain the steering fluid (See page 29-7).
5. Remove the front wheel (See page 24-8).
6. Remove the coupling bolt between column lower fork and steering gear.

   (a) Remove coupling bolt (arrow) between steering column with intermediate shaft assembly and steering gear input shaft.

   Tightening torque
   30 ± 3 N·m

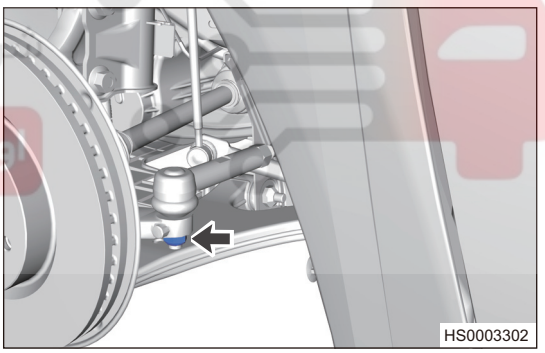


7. Separate ball pin assembly and steering knuckle.

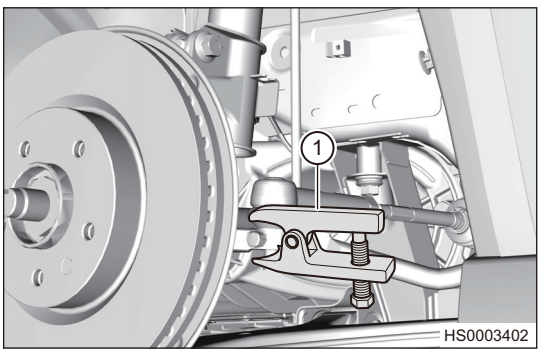
   Hint:
   - Use same procedures for right and left sides.
   - Procedures listed below are for left side.

   (a) Remove locking nut (arrow) between left steering tie rod ball pin assembly and front left steering knuckle assembly.

   Tightening torque
   35 ± 3 N·m



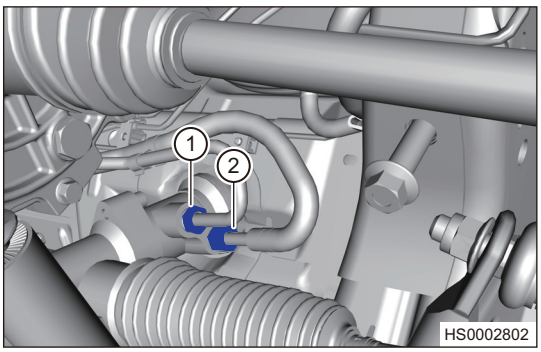
   (b) Install ball pin separator (1), and separate steering tie rod ball pin from steering knuckle assembly.



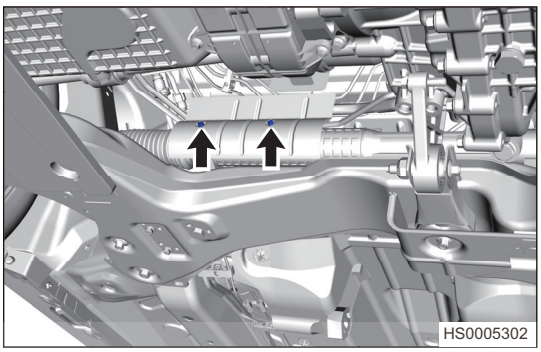
8. Use an engine equalizer to hang the engine.
9. Support the front sub frame welding assembly with a transmission carrier.
10. Remove the power steering gear with tie rod assembly.

(a) Remove high pressure fluid pipe clamping bolt (1) and fluid return pipe clamping bolt (2) from steering gear assembly. Disconnect connection between fluid return pipe/high pressure pipe and steering gear assembly separately.

Tightening torque
30 ± 3 N·m

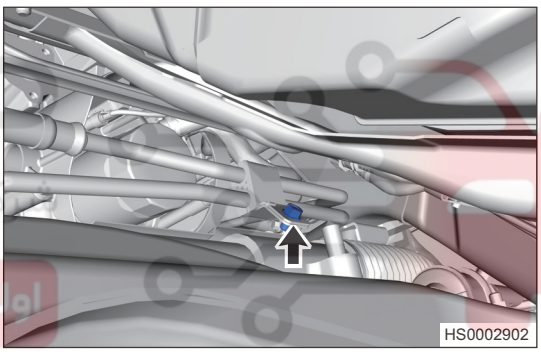


(b) Remove 2 fixing bolts (arrow) from steering gear heat insulator.



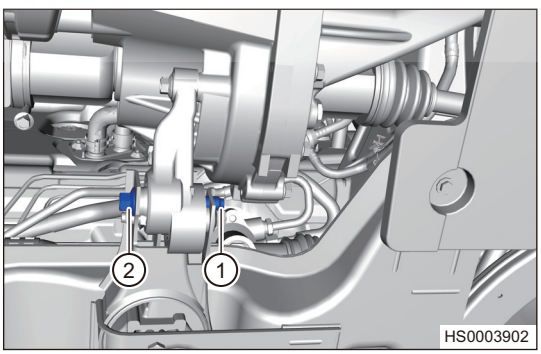
(c) Remove bolt from high pressure fluid pipe and fluid return pipe bracket.

Tightening torque
9 ± 1.5 N·m



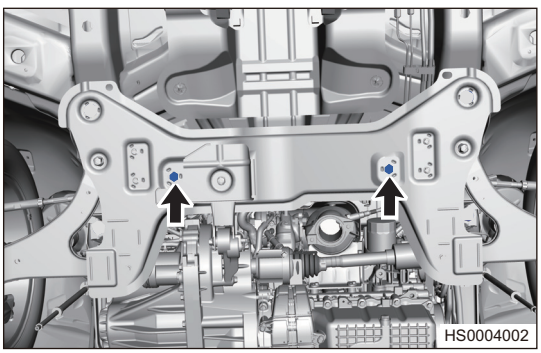
(d) Remove locking nut (1) of through bolt between rear mounting bracket and rear mounting cushion assembly and remove through bolt (2).

Tightening torque
80 ± 5 N·m



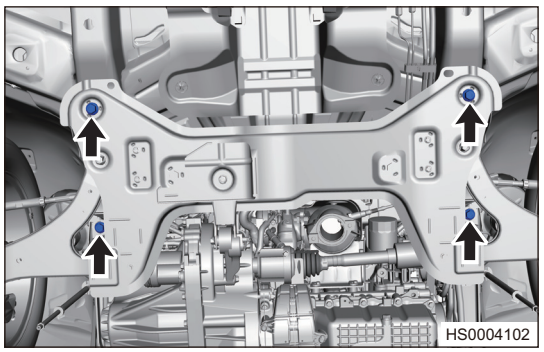
(e) Remove 2 fixing bolt between steering gear and front sub frame welding assembly.

Tightening torque
110 ± 10 N·m



(f) Remove 4 fixing bolts (arrow) between sub frame and vehicle body.

Tightening torque
180 ± 18 N·m



(g) Slowly lower the front sub frame welding assembly (descending distance is about 40 mm), and remove steering gear with tie rod assembly.

Inspection

1. Check steering gear housing for damage or deformation, and rack and pinion for sticking. Replace the steering gear assembly if necessary.
2. Check if steering tie rod boot, clamp and clamping ring are normal. Replace them if necessary to prevent water and micro dust from entering and causing parts failure prematurely.
3. Check steering tie rod assembly and ball pin assembly for serious wear. Replace steering tie rod assembly and ball pin assembly if necessary.

Installation

1. Installation is in the reverse order of removal.

Caution:

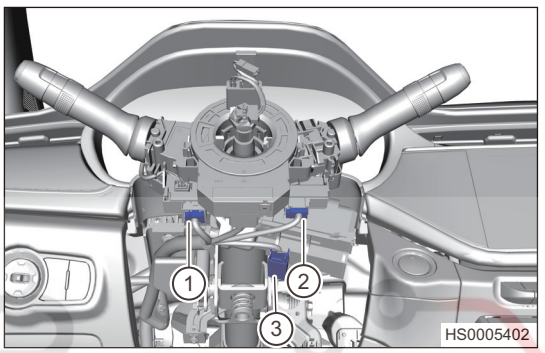
- After installing steering gear assembly, perform front wheel alignment procedure.
- Clamping ring cannot be reused, replace it with a new one after removal.

Hydraulic Assist Steering Column with Intermediate Shaft Assembly

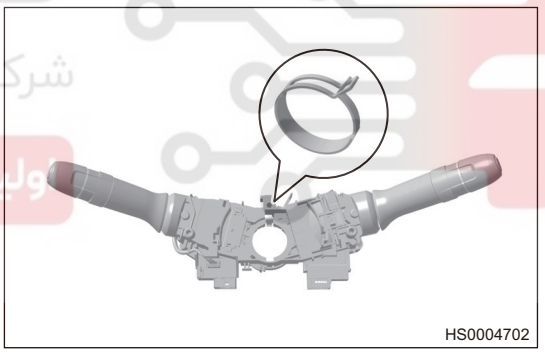
Removal

1. Set the steering wheel to straight-ahead position.
2. Turn off all electrical equipment and the EGNINE START STOP switch.
3. Disconnect the negative battery cable.
4. Remove the driver airbag assembly (See page 32-65).
5. Remove the steering wheel assembly (See page 28-9).
6. Remove the combination switch cover (See page 28-11).
7. Remove the spiral cable (See page 32-79).
8. Remove the left lower protector assembly (See page 48-11).
9. Remove the combination switch assembly.

   (a) Disconnect combination light switch connector (1), wiper switch connector (2) and steering column lock connector (3).



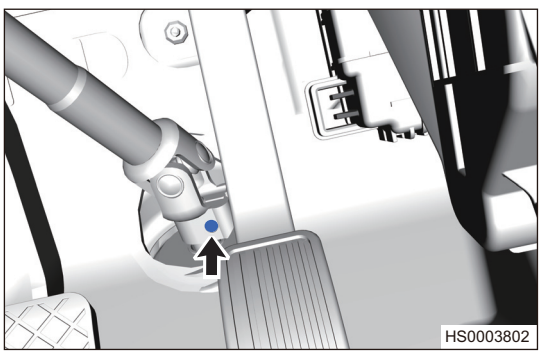
   (b) Loosen combination switch clamp and pull combination switch outward, then disconnect combination switch from steering column to remove combination switch.



10. Remove the steering column with intermediate shaft assembly.

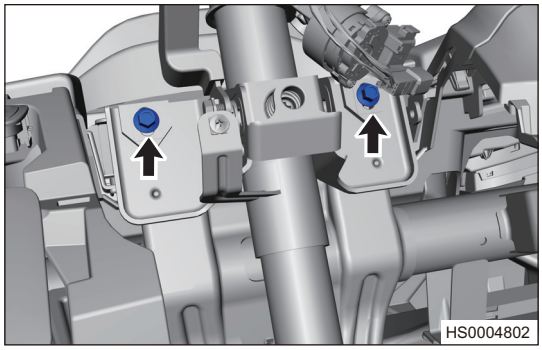
    (a) Remove coupling bolt (arrow) between steering column with intermediate shaft assembly and steering gear input shaft.

    Tightening torque
    30 ± 3 N·m



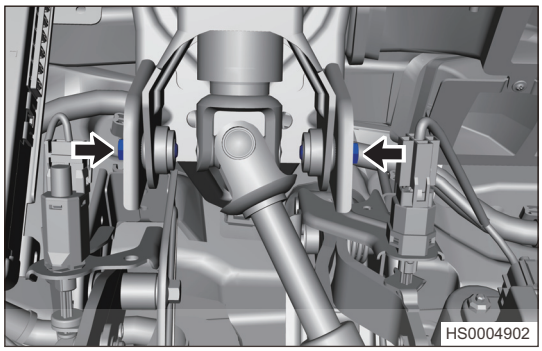
(b) Remove 2 fixing bolts (arrow) from steering column upper bracket.

Tightening torque
25 ± 4 N·m


HS0004802

(c) Remove 2 fixing bolts (arrow) from steering column lower bracket.

Tightening torque
25 ± 4 N·m


HS0004902

(d) Remove the steering column with intermediate shaft assembly.

Installation

1. Installation is in the reverse order of removal.

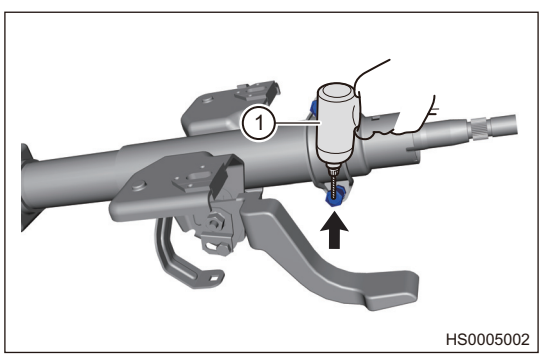
Caution:

- Wear glove during removal, prevent hands are contacted with steering column, which may cause rust.
- DO NOT hold steering column handle position, but steering column position; do not bump, strike steering column when taking, carrying or assembling it, prevent steering column from collapse.
- Adjustment handle is in locking state after steering column is assembled, do not transfer to next station, prevent handle is knocked during operation, which may cause person damage or handle breakage.
- DO NOT touch interior ornaments when installing steering column with intermediate shaft assembly to avoid scratching interior ornaments.

Disassembly

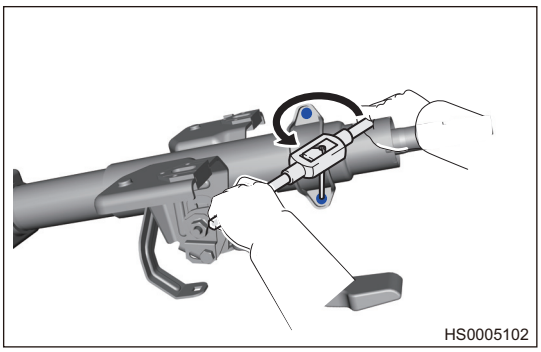
1. Remove the steering column lock.

(a) Using an electric drill (1), drill a hole on anti-theft bolt (arrow) of steering column lock.



HS0005002

(b) Using a screw remover, remove anti-theft bolt of steering column lock.



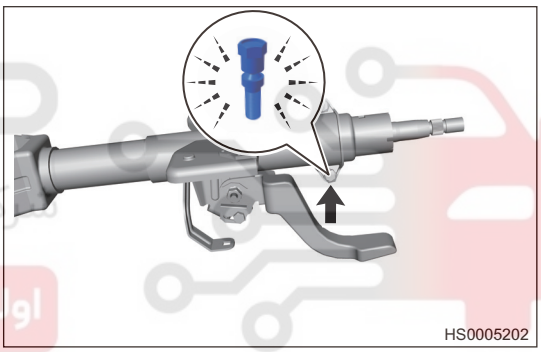
Inspection

1. Check steering column assembly for wear, cracks or deformation, and welding or correction is not allowed. Replace steering column assembly if necessary.
2. Check steering column bearing for looseness, wear or sticking. Replace steering column assembly if necessary.

Assembly

1. Install the steering column lock.

(a) Install steering column lock to steering column assembly with new steering column lock anti-theft bolt, and then tighten anti-theft bolt until head is disengaged.



Installation

1. Installation is in the reverse order of removal.

Caution:

- Tighten fixing nuts, bolts and screws in place.
- When installing fixing bolts and screws, be sure to tighten to specified torques.
- Anti-theft bolt cannot be reused, replace it with a new one during installation.

ELECTRONIC POWER STEERING

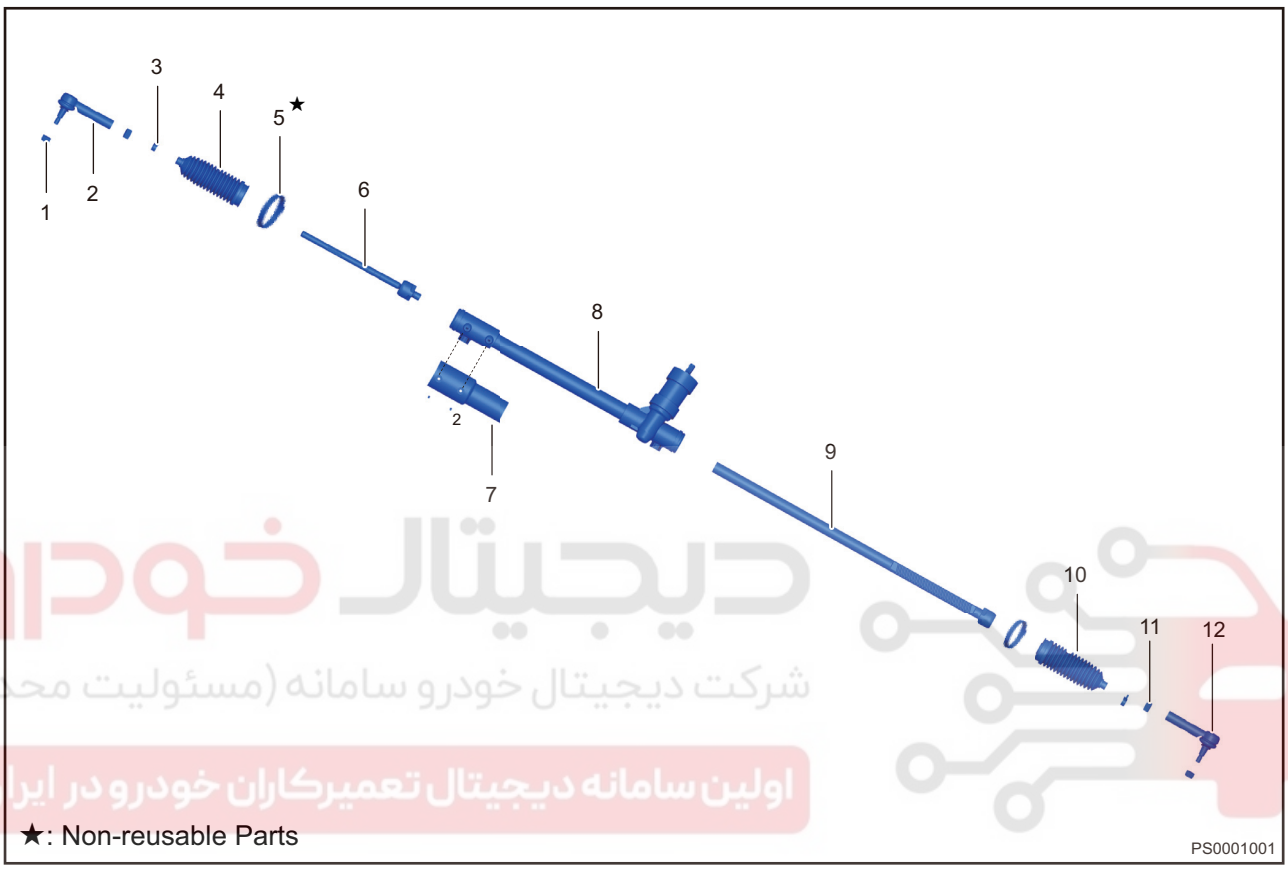
30

GENERAL INFORMATION

Overview

Description

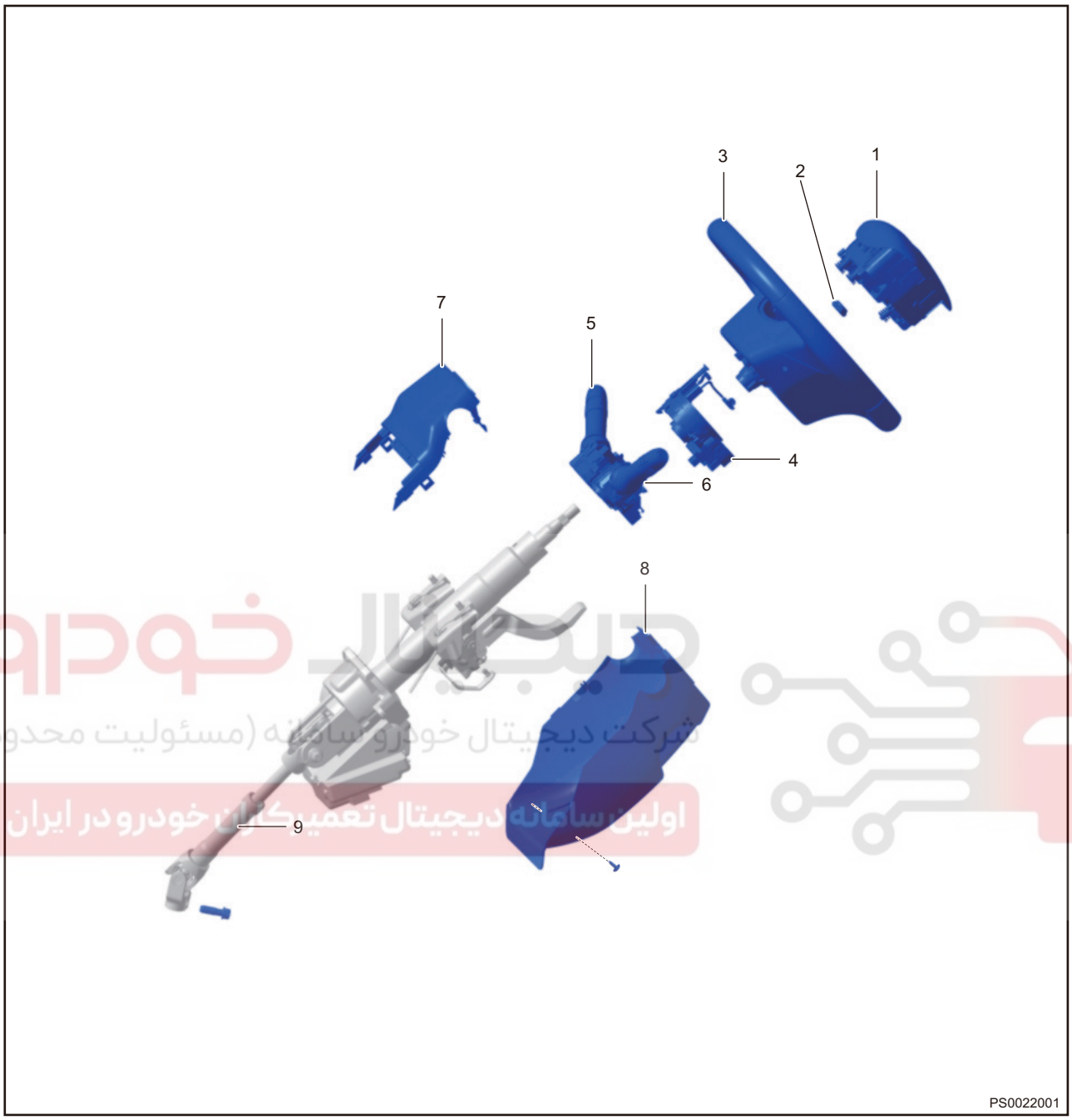
Electronic Power Steering



1 - Steering Tie Rod Ball Pin Locking Nut	2 - Right Steering Tie Rod Ball Pin
3 - Small Clamp	4 - Right Steering Tie Rod Boot
5 - Big Clamp	6 - Right Steering Tie Rod Assembly
7 - Steering Gear Heat Insulator	8 - Steering Gear Assembly
9 - Left Steering Tie Rod Assembly	10 - Left Steering Tie Rod Boot
11 - Steering Tie Rod Fixing Nut	12 - Left Steering Tie Rod Ball Pin

This vehicle adopts the electronic power steering system, which can reduce the workload when driver operates the steering wheel, thus improving operation convenience and driving safety.

Electronic Power Steering Column

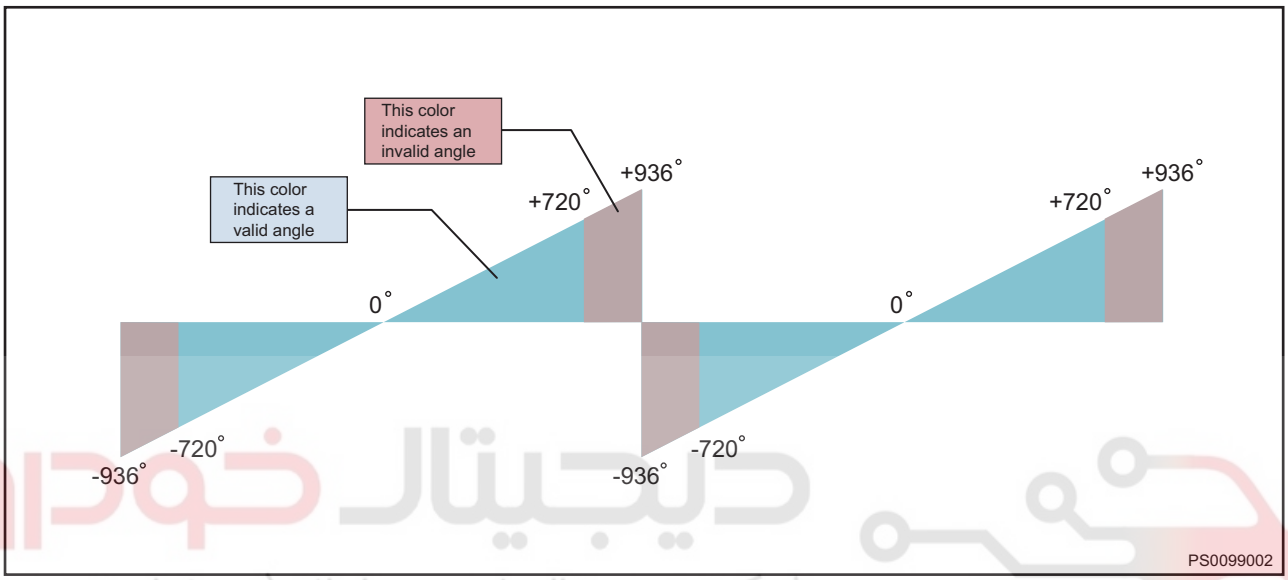


1 - Driver Airbag	2 - Steering Wheel Assembly Fixing Nut
3 - Steering Wheel Assembly	4 - Spiral Cable
5 - Wiper Switch	6 - Headlight Turn Fog Switch
7 - Combination Switch Upper Cover	8 - Combination Switch Lower Cover
9 - Steering Column with Intermediate Shaft Assembly	

Operation

When driver rotates the steering wheel, torque sensor installed on steering column sends detected torque acting on steering wheel to steering assist control unit. Based on information such as steering torque, vehicle speed (provided by vehicle CAN line), steering wheel rotation angle, steering wheel rotation speed and characteristic curve stored in control unit, control unit calculates required steering torque based on specified algorithm, and controls motor operation. The steering assist is provided by motor drive column, thus steering rack operates.

Angle Sensor Calibration Operation Specification



Steering angle sensor position description

1. The effective range of the angle sensor angle: ≤ ± 720°, for the parts that have been calibrated, the initial calibration and recalibration can be performed within this interval.
2. The ineffective range of the angle sensor angle: -720° - 936°, +720° - +936°, for the parts that have been calibrated, the initial calibration and recalibration can not be performed within this interval.

Precautions

If the angle sensor is rotated after the steering wheel is removed during repair, the angle sensor can not sent signal normally after exceeding ±720°. If the vehicle is reloaded, the ESP error malfunction light will be illuminated. In this case, recalibration requires reference to the "angle can not be calibrated, the correct method 2 (vehicle has related removal)" operation method, the angle sensor is rotated 2 times clockwisely to solve the problem.

Angle sensor installation service precautions

1. When repairing or installing the angle sensor, it must be ensured that the tire is adjusted to a straight line and the steering wheel is level.
2. When the vehicle steering system is being repaired (eg, steering wheel, steering column, steering gear, steering intermediate shaft), ensure that the spiral cable assembly is neutral and does not rotate freely.
3. When the combination switch assembly is repaired, the spiral cable assembly should be neutral and not rotated (eg, fix with a neutral pin or tape).
4. Keep the neutral position of the spiral cable after removal (eg, fix with a neutral pin or tape).
5. Keep the neutral position of the angel sensor after removal (eg, fix with tape).

Angle cannot be calibrated corrective method 1 (vehicle has not relevant removal)

1. The ESP malfunction light illuminated while the vehicle is running, and the vehicle has no relevant removal records.
2. Read the fault code to confirm if it is a steering angle fault.

3. Run the vehicle to repair station, make the tire in-line and steering wheel in horizontal position.
4. Operate the diagnostic tester under vehicle ignition switch ON state to remove the steering angle history trouble code.
5. Vehicle battery is powered off for 15 seconds, the vehicle is restarted after power-on, and the fault light is turned off.
6. The vehicle is recalibrated in the four-wheeled station, and refer to the repair standard for the calibration items.

Warning:

If the previous calibration deviation is serious, rotation direction after step 5 may illuminate the fault light again due to the angle range being out of tolerance.

If the previous calibration deviation is not serious, rotation direction after step 5 may not trigger the fault at that time, but it still needs to be recalibrated.

If clears the historical fault code of the vehicle, the battery is powered on to start the vehicle after 15 seconds of powered off, and the ESP still reports the steering angle fault and illuminate the fault light, or cannot be recalibrated, it may be the angle sensor has been accidentally rotated beyond its effective angle recognition range, and it is necessary to operate according to angle can not be calibrated, the correct method 2.

Angle cannot be calibrated corrective method 2 (vehicle has relevant removal)

1. The ESP fault light is illuminated after the vehicle is relevant removed.
2. Read the fault code to confirm if it is a steering angle fault.
3. Run the vehicle to repair station, make the tire in-line and steering wheel in horizontal position.
4. Remove the spiral cable and angle sensor.
5. Rotate the angle sensor 2 times clockwise in the removal state and keep it.
6. Keep the rotated state, reinstall to the spiral cable and install it to vehicle.
7. Operate the diagnostic tester under vehicle ignition switch ON state to remove the steering angle history trouble code.
8. Vehicle battery is powered off for 15 seconds, the vehicle is restarted after power-on, and the fault light is turned off.
9. The vehicle is recalibrated in the four-wheeled station, and refer to the repair standard for the calibration items.

Warning:

If the previous calibration deviation is serious, rotation direction after step 8 may illuminate the fault light again due to the angle range being out of tolerance.

If the previous calibration deviation is not serious, rotation direction after step 8 may not trigger the fault at that time, but it still needs to be recalibrated.

If clears the historical fault code of the vehicle, the battery is powered on to start the vehicle after 15 seconds of powered off, and the ESP still reports the steering angle fault and illuminate the fault light, it is necessary to check the line and ESP system.

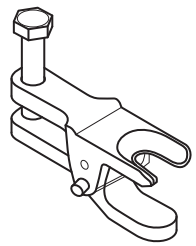
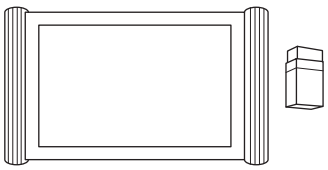
Specifications

Torque Specifications

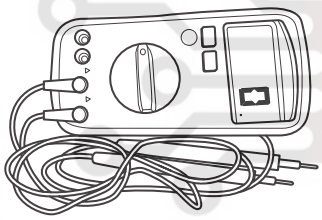
Description	Torque (N·m)
Coupling Nut Between Steering Tie Rod and Steering Knuckle	35 ± 3
Coupling Bolt Between Steering Gear Input Shaft and Steering Column with Intermediate Shaft Assembly	55 ± 5 N·m
Steering Gear Fixing Bolt	110 ± 10

Tools

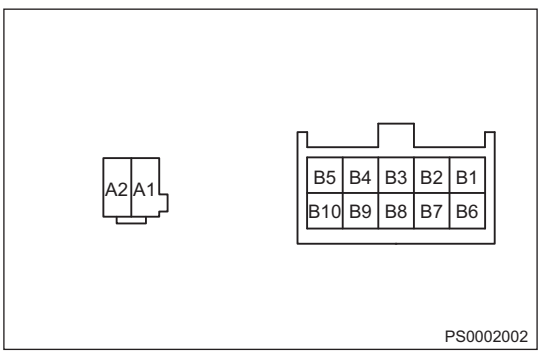
Special Tools

Ball Pin Separator	 024
Diagnostic Tester	 001

General Tool

Digital Multimeter	 002

EPS Controller Pin Definition



PS0002002

1. EPS Terminal

Vehicle power supply: Controller power supply connector (connector A)

Pin	Definition
A 1	Motor power supply
A 2	Ground

Vehicle signal: Controller signal connector (connector B)

Pin	Definition
B 1	IGN1b
B 3	CAN1-L
B 5	-
B 2	CAN1-H
B 4	-
B 6	-
B 7	-
B 8	-
B 9	-
B 10	-

DIAGNOSIS & TESTING

Diagnosis Content

Diagnostic Help

1. Connect diagnostic tester to Data Link Connector (DLC), and make it communicate with vehicle electronic module through data network.
2. Confirm that malfunction is current, and carry out diagnostic test and repair procedures.
3. If Diagnostic Trouble Code (DTC) cannot be cleared, it indicates that there is a current malfunction.
4. Only use a digital multimeter to measure voltage of electronic system.
5. Refer to any Technical Bulletin that applied to the malfunction.
6. Visually check the related wire harness.
7. Check and clean Electronic Power Steering controller (EPS controller) ground related to latest DTC.
8. If multiple trouble codes were set, use circuit diagrams and look for any common ground circuit or power supply circuit applied to DTC.

Intermittent DTC Troubleshooting

If malfunction is intermittent, perform the following:

- Check if connector is loose.
- Check if wire harnesses are worn, pierced, pinched or partially broken.
- Observe the diagnostic tester data that is related to this circuit.
- Wiggle related wire harness and connector and observe if signal in related circuit is interrupted.
- Try to duplicate the conditions under which DTC was set.
- Look for data that has changed or DTC to reset during wiggle test.
- Look for broken, bent, protruded or corroded terminals.
- Inspect sensors and mounting areas for damage, foreign matter, etc. that will cause incorrect signals.
- Use data recorder or oscilloscope to help diagnose intermittent malfunctions.
- Remove the EPS controller from malfunctioning vehicle and install it to a new vehicle to perform a test. If DTC cannot be cleared, EPS controller is malfunctioning. If DTC can be cleared, reinstall EPS controller to original vehicle.

Ground Inspection

Ground points are often exposed to moisture, dirt or other corrosive areas. Corrosion (rust) may form additional resistance. This additional resistance will change the way in which a circuit works. A loose or corroded ground point can seriously affect control circuit. Check the ground points as follows:

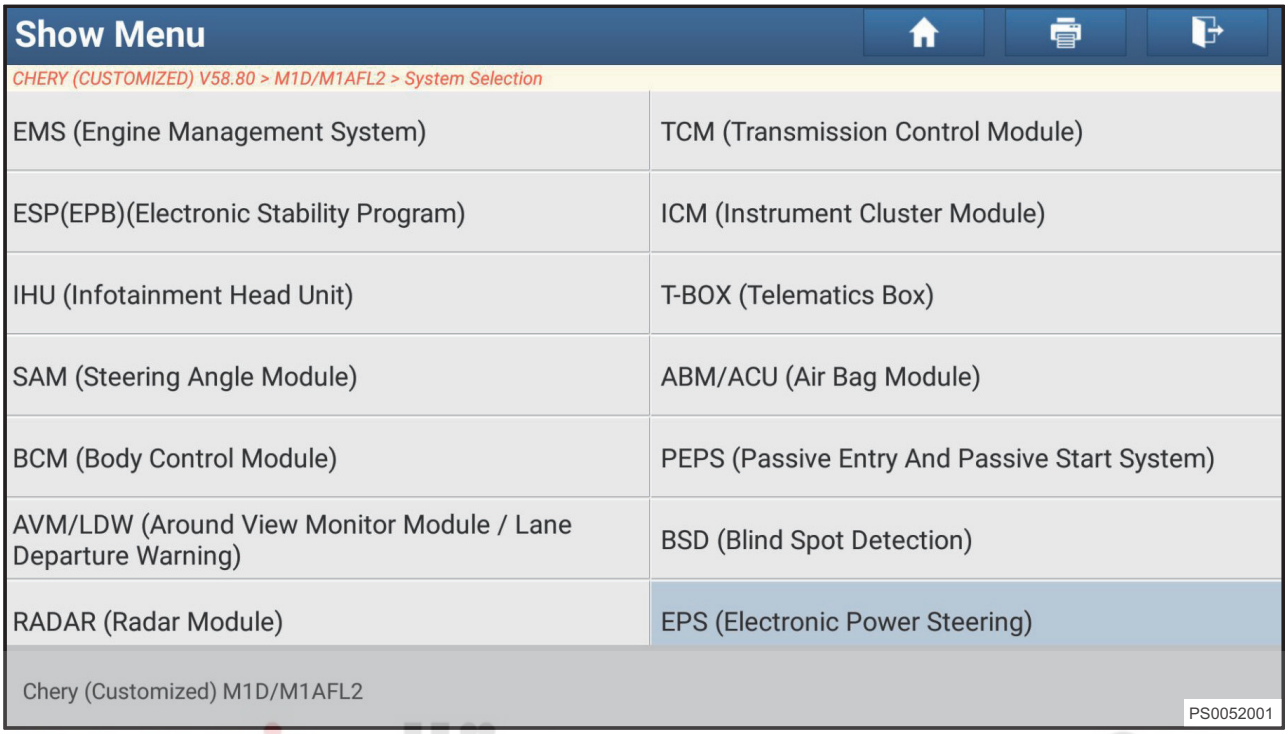
1. Remove ground bolt or screw.
2. Check all contact surfaces for tarnish, dirt and rust, etc.
3. Clean as necessary to ensure that contacting is in good condition.
4. Reinstall bolt or screw securely.
5. Check if add-on accessories interfere with ground circuit.
6. If several wire harnesses are crimped into one ground terminal, check for proper crimps. Make sure that all wires are clean, securely fastened and good contacted without crimping any excessive insulation coat.

Read Datastream

1. Connect diagnostic tester, turn ignition switch ON.
   (a) Select "M1D/M1AFL2" model.

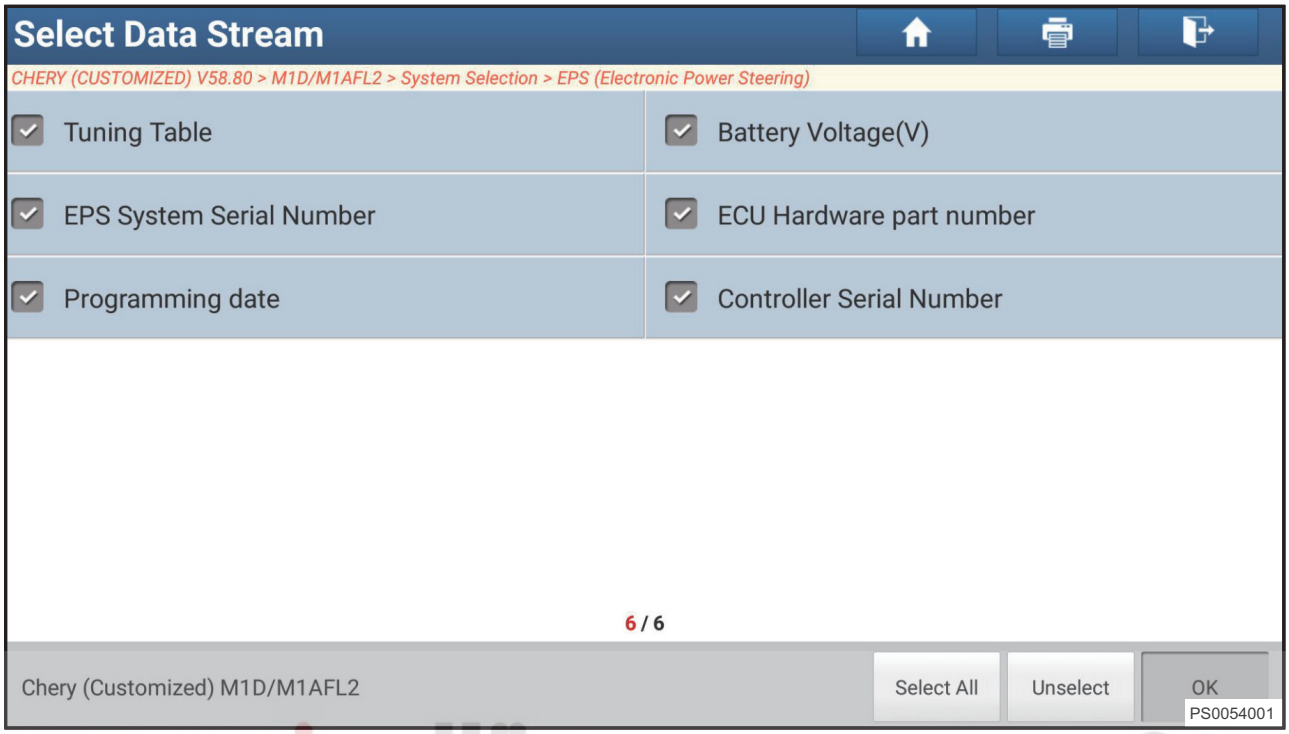
   (b) Go to next interface, click "System Selection"

(c) Go to next interface, click "EPS (Electric Power Steering)"



(d) Go to next interface, click "Read Data Stream"

(e) Go to next interface, click "Select All" and click "OK"



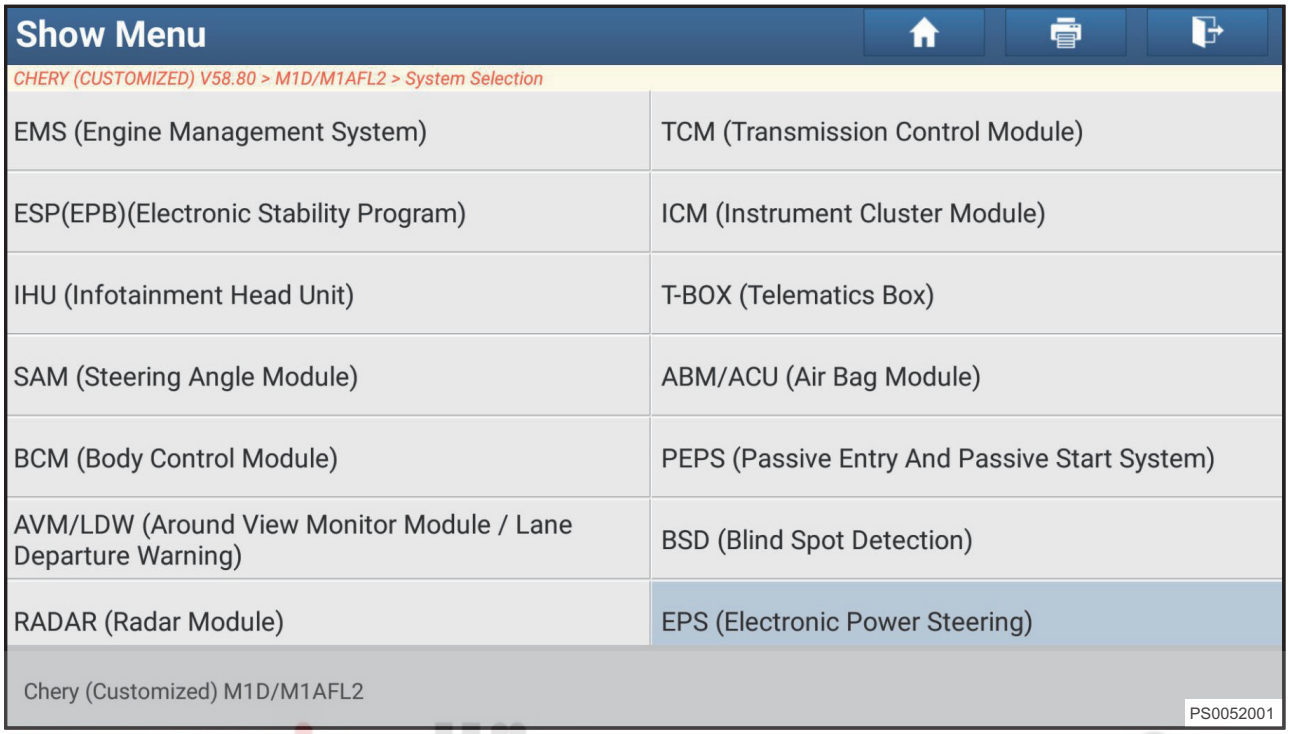
(f) At this point, the diagnostic tester interface is as shown in illustration.

Write in Vehicle Configuration Information

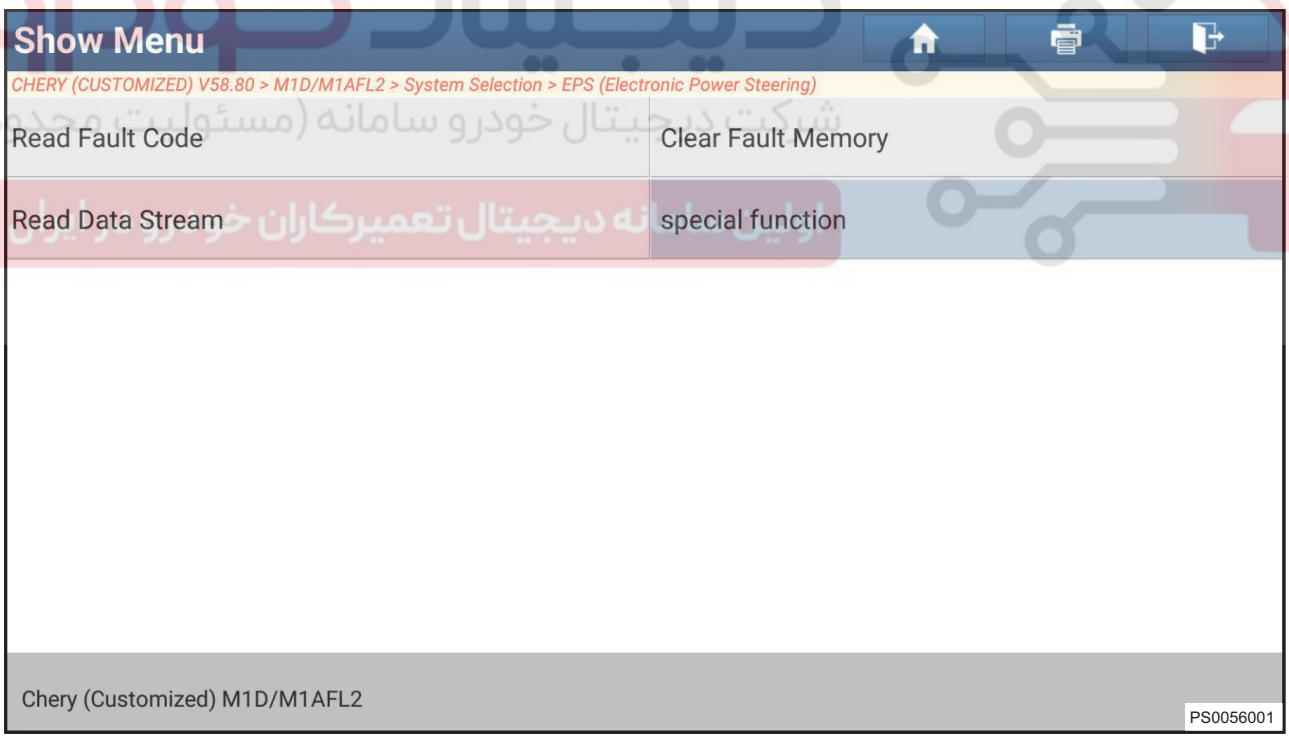
1. Connect diagnostic tester, turn ignition switch ON.
   (a) Go to next interface, click "M1D/M1AFL2" model

   (b) Go to next interface, click "System Selection"

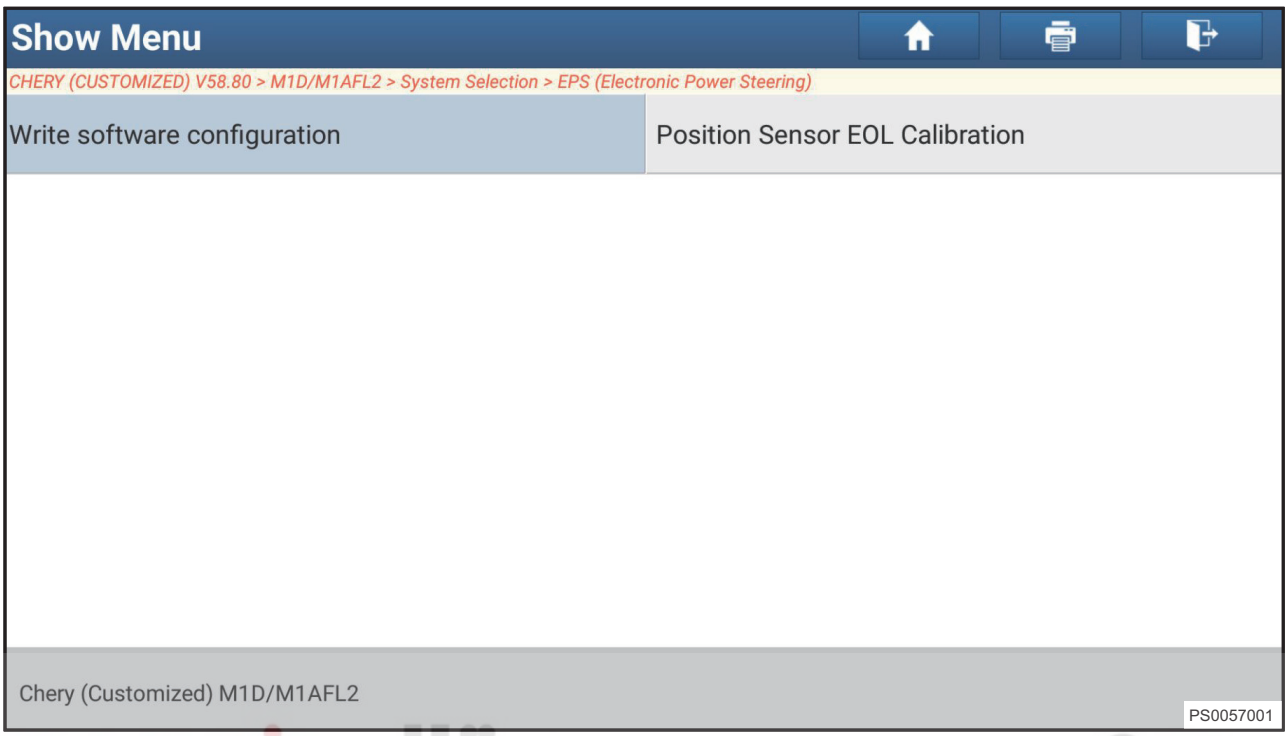
(c) Go to next interface, click "EPS (Electric Power Steering)"



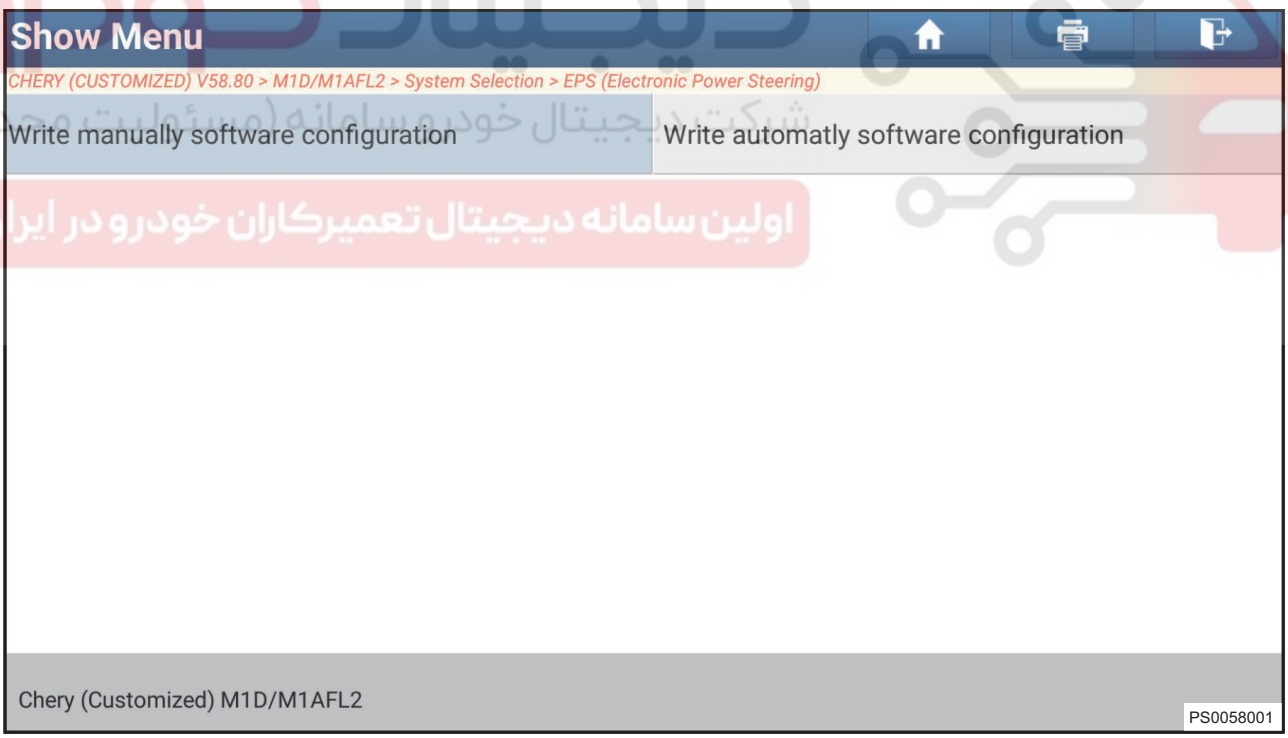
(d) Go to next interface, click "special function"



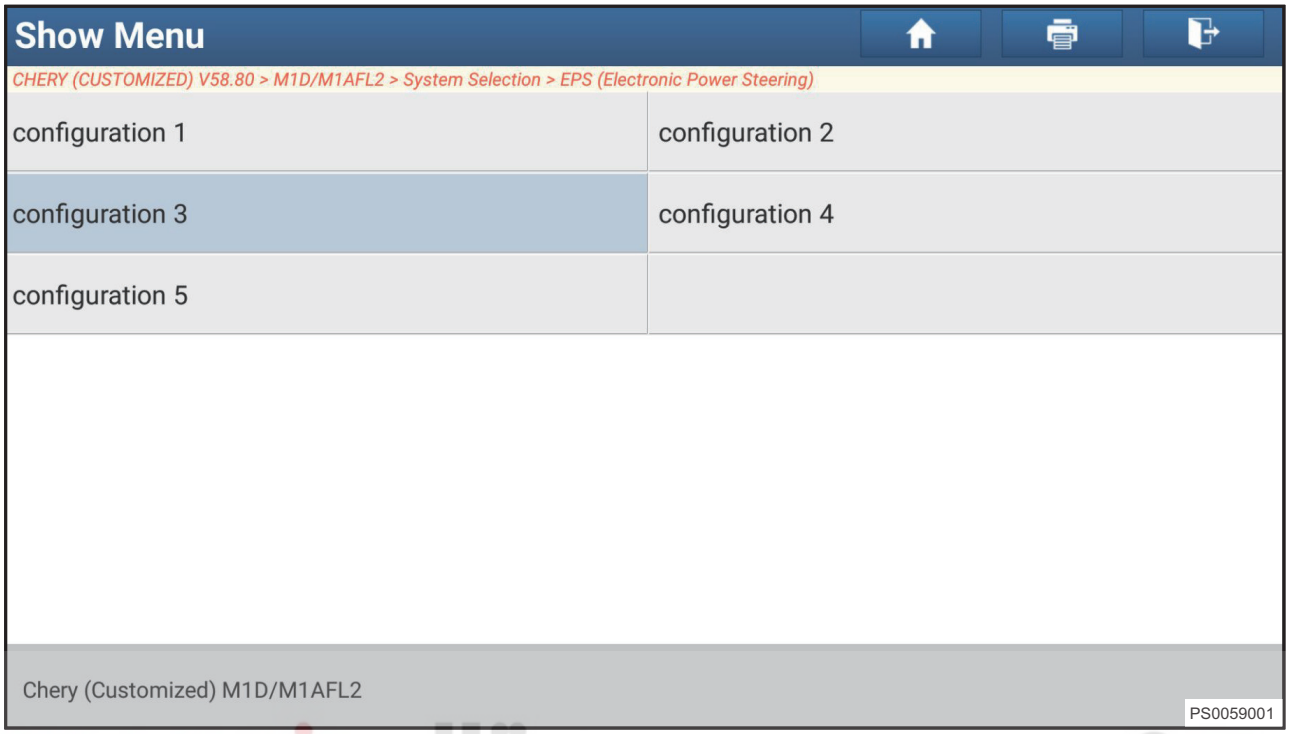
(e) Go to next interface, click "Write software configuration"



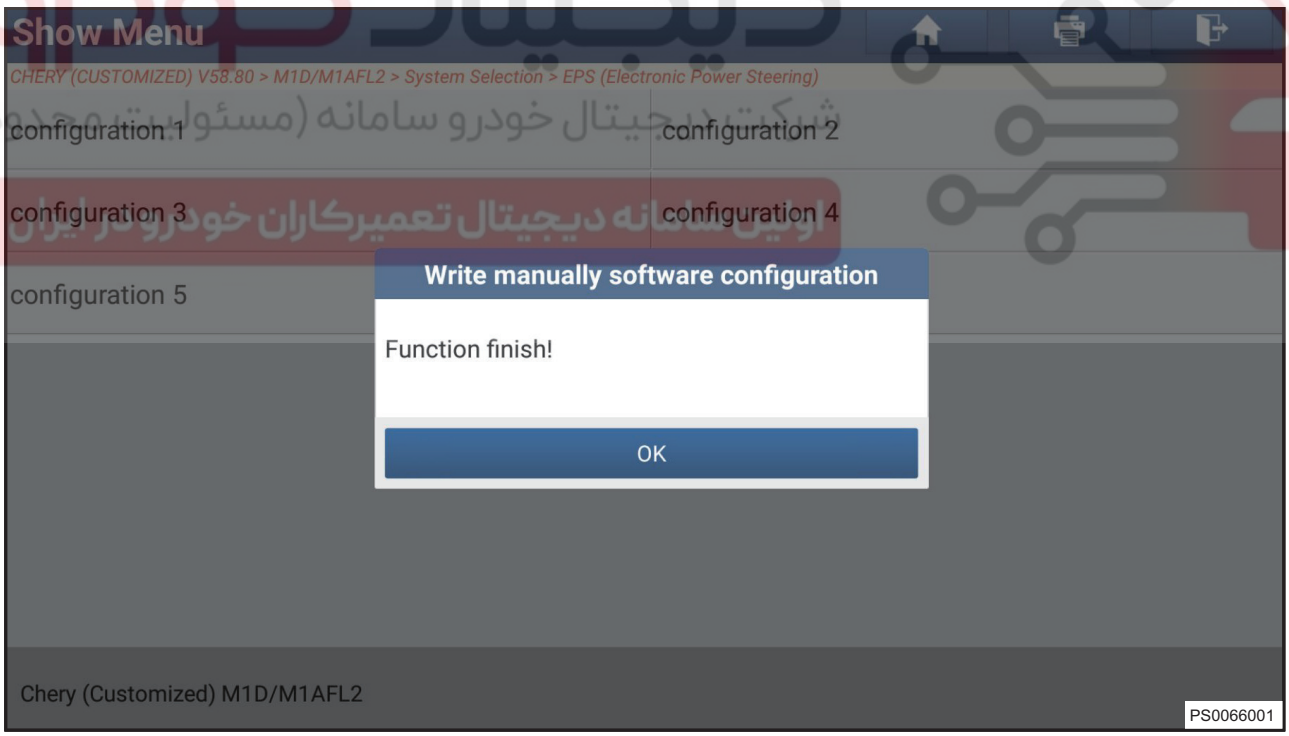
(f) Go to next interface, click "Write manually software configuration"



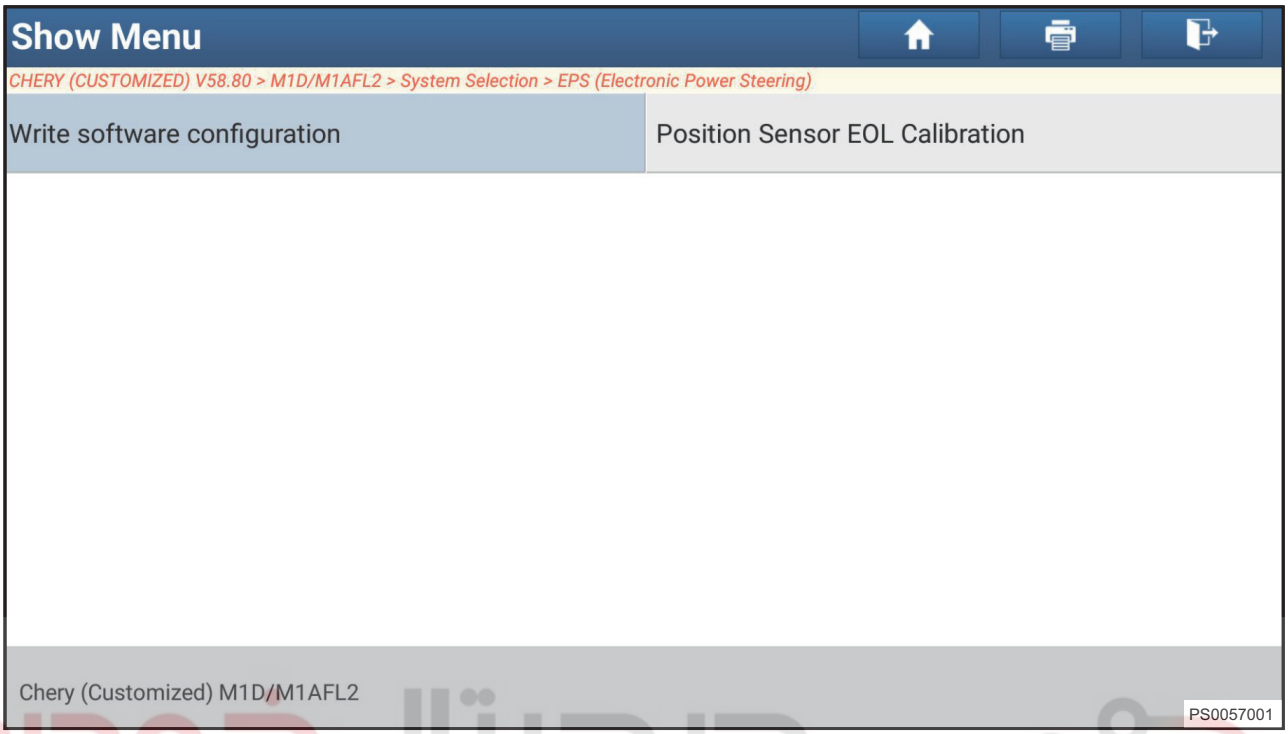
(g) Go to next interface, click "configuration 3"



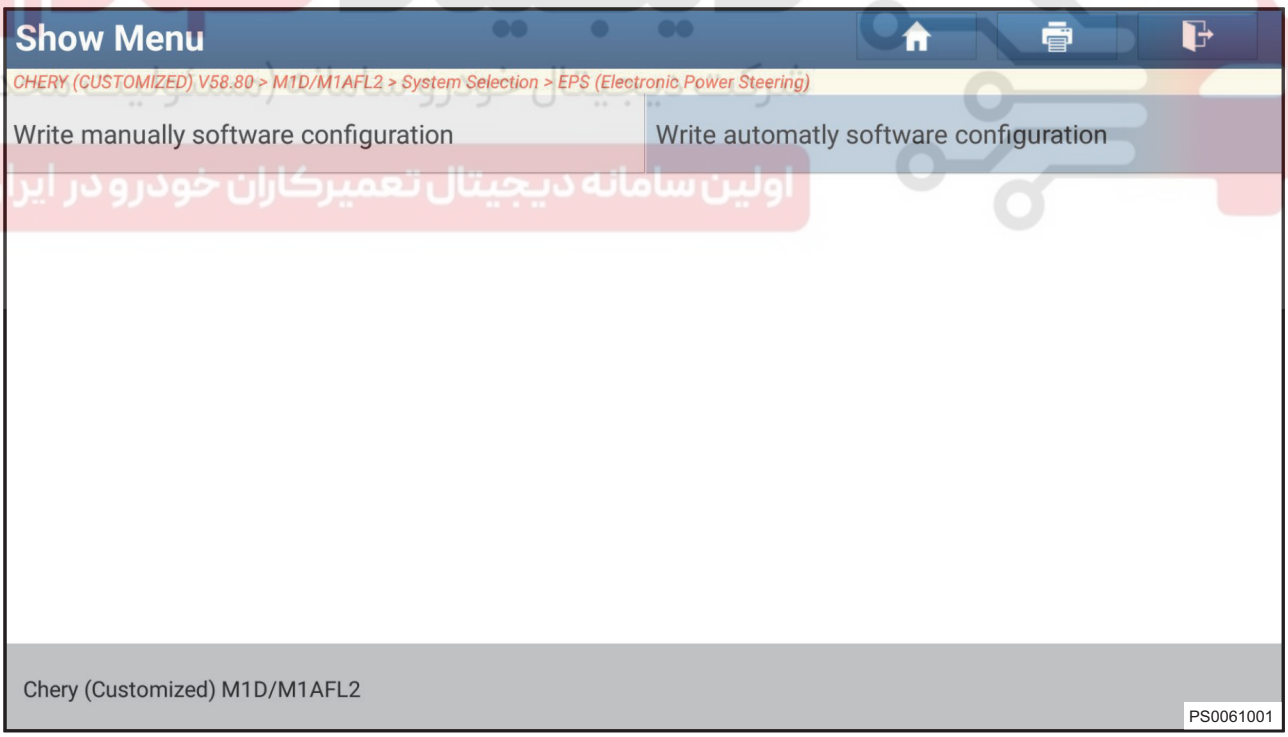
(h) Hint "Function finish" and click "OK"



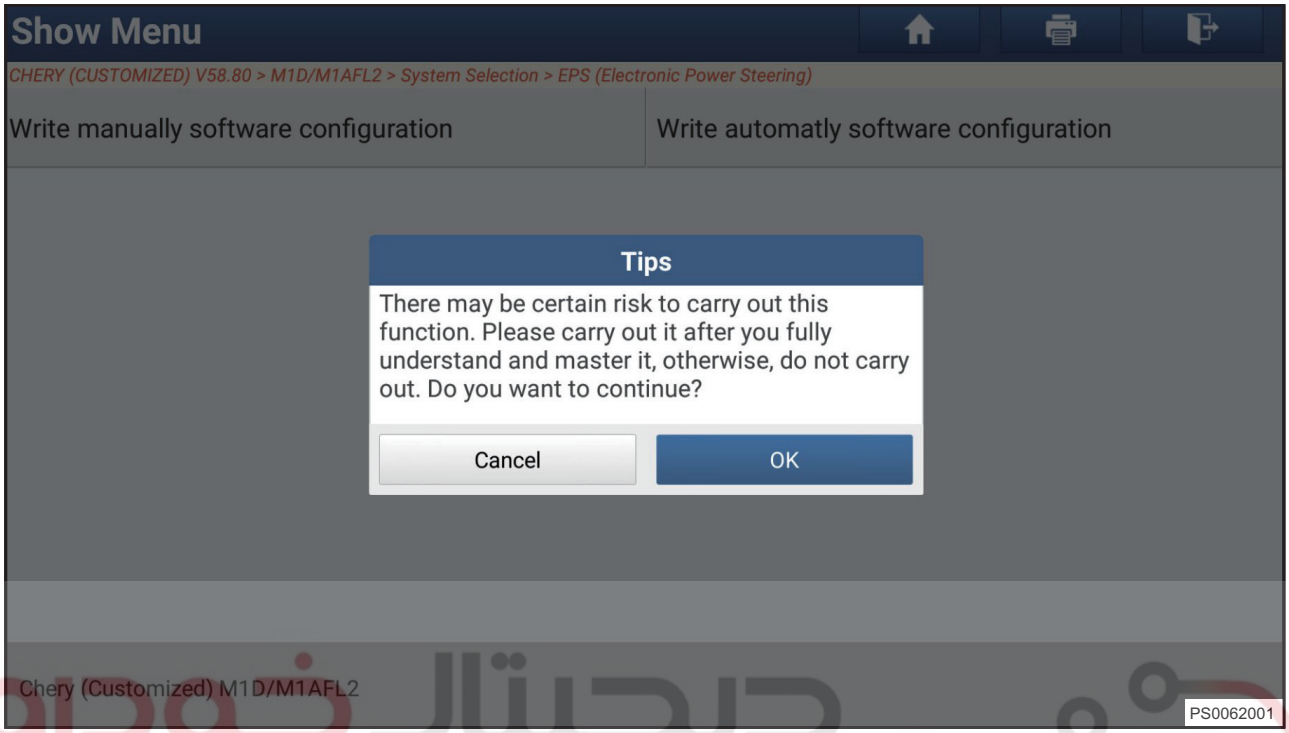
(i) Automatically write the vehicle configuration information and go to step 6 "Write software configuration".



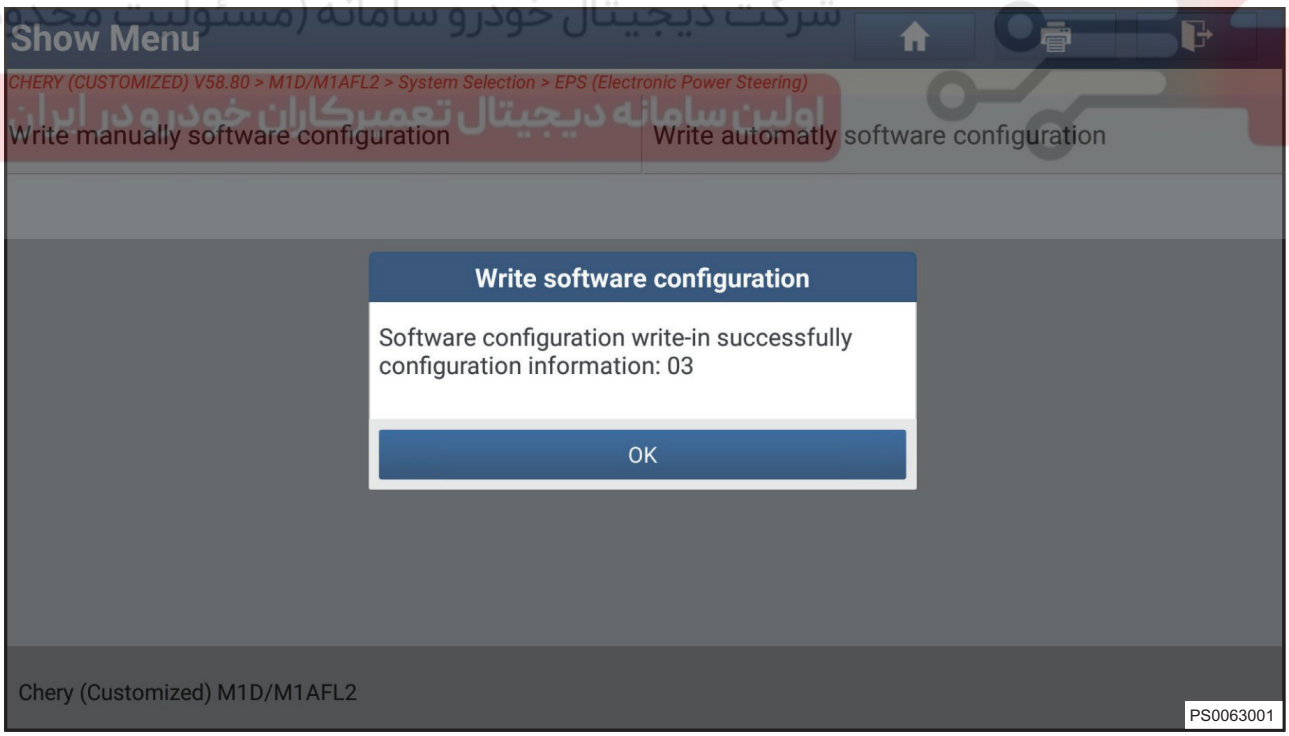
(j) Go to next interface, click "Write automatically software configuration"



(k) Hint "There may be certain risk to carry out this function. Please carry out it after you fully understand and master it, otherwise, do not carry out. Do you want to continue?" Then click "OK".



(l) Go to next interface "Software configuration write-in successfully Configuration: 03", then click OK.



(m) After the ignition is turned OFF, restart the engine and complete the configuration write.

Calibrating Steering Angle Sensor

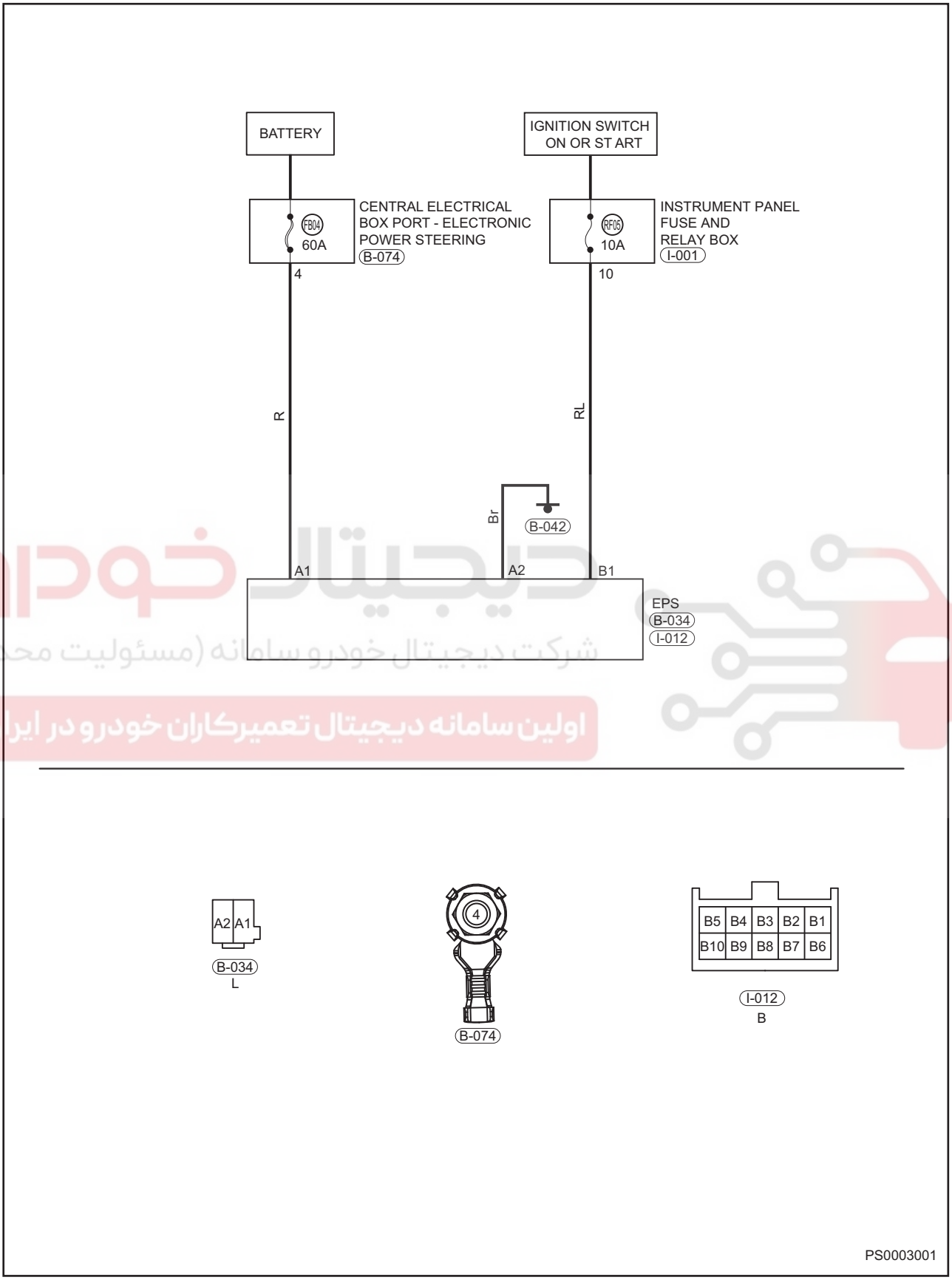
This function is reserved, so the steering angle sensor calibration is not required when replacing EPS assembly.

Diagnostic Trouble Code (DTC) Chart

Mark	Description	Possible Cause
C1325	Flash Programming Malfunction	EOL vehicles have not made Tuning options
C1300	Steering Shaft Torque Sensor Malfunction	T1 signal overpressure, T2 signal overpressure
C1301	Steering Angle Sensor Signal Error	90° phase triangle wave with error 90° ± 15
C1350	Electronic Power Steering Motor Malfunction	Motor position and speed signal measurement error
C1323	ECU Is Faulted	DSP, RAM, memory and other defects or overheating protection
C1901	Battery Voltage Low	< 9 V
C1902	Battery Voltage High	> 16 V
C1324	Module Configuration Failure	Motor shaft breakage, etc.
C1302	Steering Angle Sensor Not Trimmed	Not checked
U1027	Missing ECU Message	Loss of vehicle peed signal, loss of engine signal
U1000	Bus Off Fault	Short circuit between CANH and ANL

DTC	C1300	Steering Shaft Torque Sensor Malfunction
DTC	C1301	Steering Angle Sensor Signal Error
DTC	C1350	Electronic Power Steering Motor Malfunction
DTC	C1323	ECU Is Faulted
DTC	C1901	Battery Voltage Low
DTC	C1902	Battery Voltage High
DTC	C1324	Module Configuration Failure
DTC	C1302	Steering Angle Sensor Not Trimmed

Circuit Diagram



Description

DTC	DTC Definition	DTC Detection Condition	Possible Cause
C1300	Steering Shaft Torque Sensor Malfunction	ENGINE START STOP switch OFF, engine does not run	• Circuit voltage below threshold • Circuit voltage above threshold • Component internal fault • Electric power steering module fault
C1301	Steering Angle Sensor Signal Error		
C1350	Electronic Power Steering Motor Malfunction		
C1323	ECU Is Faulted		
C1901	Battery Voltage Low		
C1902	Battery Voltage High		
C1324	Module Configuration Failure		
C1302	Steering Angle Sensor Not Trimmed		

Caution:
When performing circuit diagnosis and test, always refer to the circuit diagram for specific circuit and component information.

Procedure

1	Check battery voltage

(a) Check if battery voltage is normal.
(b) Check battery voltage with multimeter voltage band.

Normal

Standard voltage: not less than 12 V.

Result

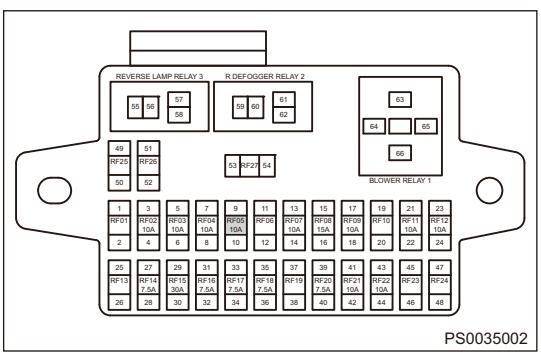
Proceed to
OK
NG

NG → **Check and repair battery**

OK

2	Check fuse

(a) Turn ENGINE START STOP switch to OFF.
(b) Disconnect the negative battery cable.
(c) Remove the fuse FB04 (60A), RF05 (10A) from engine compartment fuse and relay box.



(d) Check if fuse is blown.

OK

Fuse is not burned out

Result

Proceed to
OK
NG

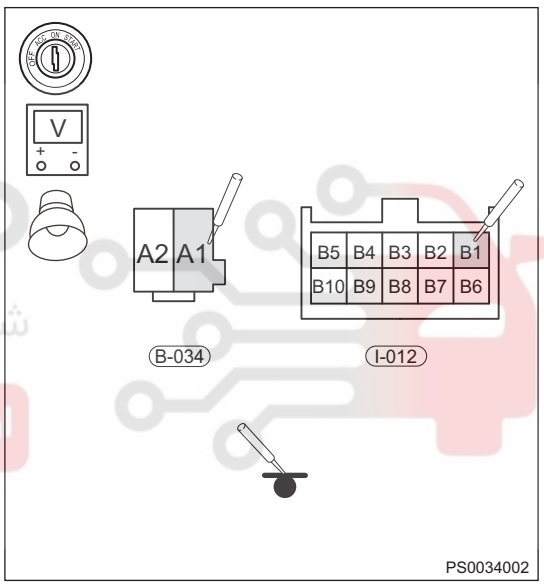
NG → **Replace fuse**

OK → 30

3	Inspect power supply voltage

(a) Turn ENGINE START STOP switch to OFF.
(b) Disconnect electric power steering module connectors B-034 and I-012.
(c) Turn ENGINE START STOP switch to ON.
(d) Check voltage between B-034 (A1) - body ground with multimeter voltage band, and check if 21W test light comes on.
Check voltage between I-012 (B1) - body ground with multimeter voltage band, and check if 21W test light comes on.

Multimeter Connection	Condition	Specified Condition
B-034 (A 1) - Body ground	ENGINE START STOP switch ON	Not less than 12 V
I-012 (B 1) - Body ground	ENGINE START STOP switch ON	Not less than 12 V



OK

Power supply voltage is normal

Result

Proceed to
OK
NG

NG → **Repair and replace power supply wire harness**

OK

4	Inspect ground

(a) Turn ENGINE START STOP switch to OFF.
(b) Disconnect electric power steering module connector B-034.

(c) Check continuity between B-034 (A2) and body ground with multimeter ohm band.

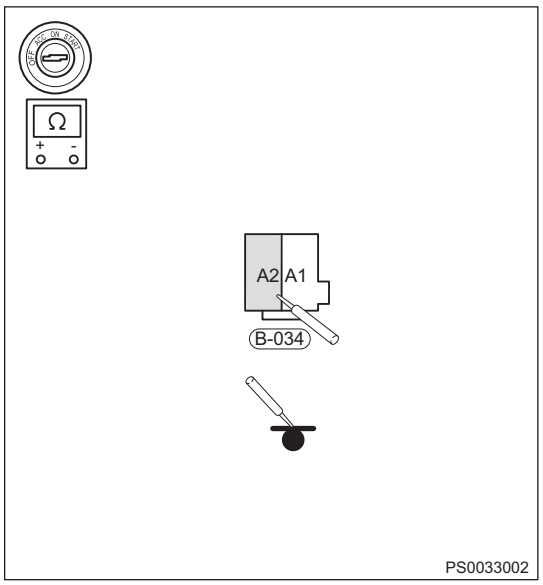
Multimeter Connection	Condition	Specified Condition
B-034 (A 2) - Body ground	ENGINE START STOP switch OFF	⩽ 1 Ω

OK

Ground point is normal

Result

Proceed to
OK
NG



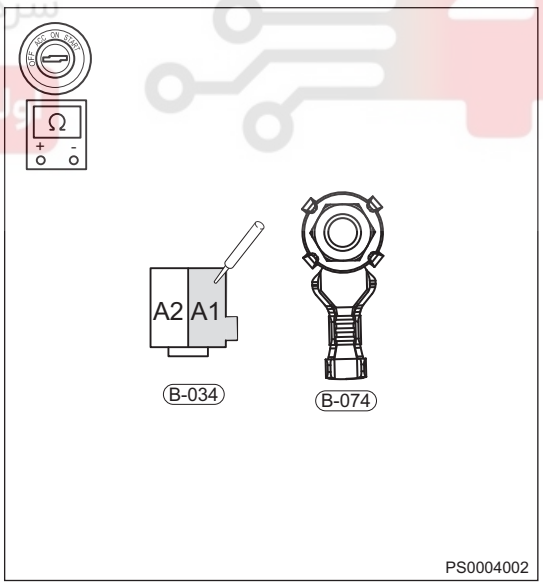
NG → **Repair or replace ground point**

OK

5 Check wire harness and connector

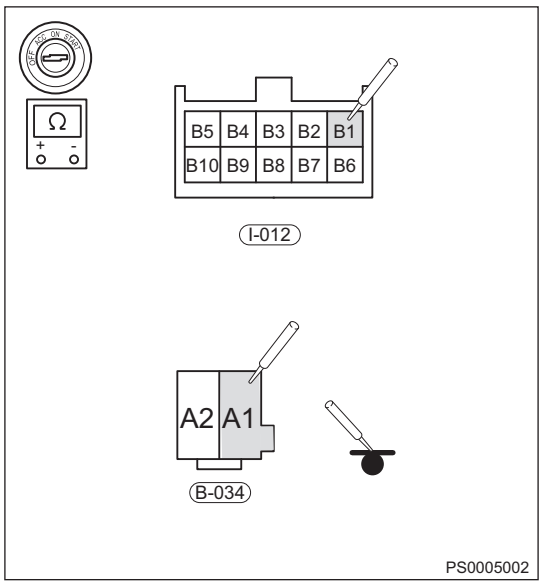
(a) Turn ENGINE START STOP switch to OFF.
(b) Disconnect electric power steering module connectors B-034 and I-012.
(c) Using ohm band of multimeter, check for continuity between B-034 (A1) and B-074 (4).

Multimeter Connection	Condition	Specified Condition
B-034 (A 1) - B-074 (4)	ENGINE START STOP switch OFF	⩽ 1 Ω



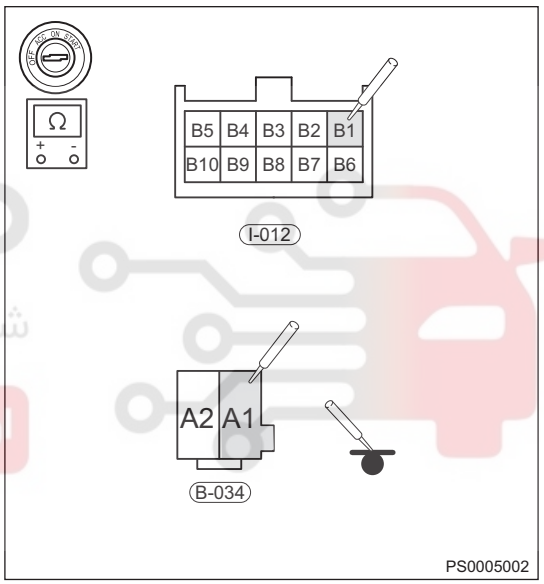
(d) Check continuity between B-034 (A1) - ground and I-012 (B1) - ground with multimeter ohm band.
Check for Short

Multimeter Connection	Condition	Specified Condition
B-034 (A 1) - Ground	ENGINE START STOP switch OFF	∞
I-012 (B 1) - Ground	ENGINE START STOP switch OFF	∞



(e) Check continuity between B-034 (A1) - battery (+) and I-012 (B1) - battery (+) with multimeter ohm band.
Check for Short

Multimeter Connection	Condition	Specified Condition
B-034 (A 1) - Battery (+)	ENGINE START STOP switch OFF	∞
I-012 (B 1) - Battery (+)	ENGINE START STOP switch OFF	∞



OK
Wire harness and connector are normal

Result

Proceed to
OK
NG

OK	**System operates normally**
NG	**Repair or replace control circuit wire harness and connector**

Flash Write Program Error

C1325	Flash Programming Malfunction

Refer to Chapter 34 CAN System

CAN Network DTC

U1027	Missing ECU Message
U1000	Bus Off Fault

Note

In the case of parking or driving at low speed, if fully turn or close fully turn the steering wheel, the steering force may gradually become heavy. It has a fever phenomenon when touching the electric power module, which is a normal phenomenon. This is mainly because the electronic power steering system is designed to prevent overheating damage, and the overheating protection function is adopted. This situation does not need to panic. Stop turning the steering wheel or stall the engine for a while, the system will automatically return to normal.

ON-VEHICLE SERVICE

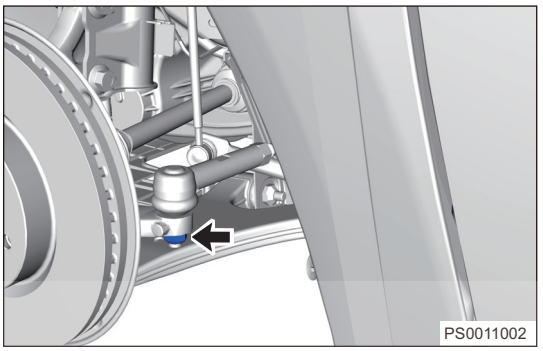
Ball Pin Assembly

Removal

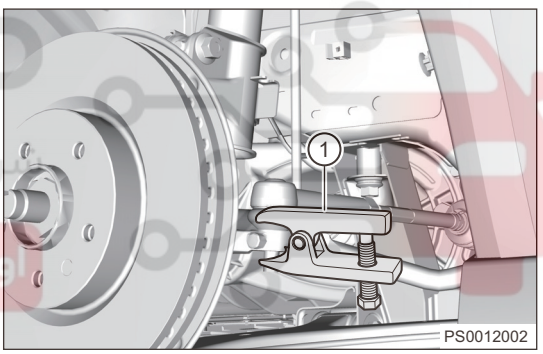
1. Set the steering wheel to straight-ahead position.
2. Turn off all electrical equipment and the ENGINE START STOP switch.
3. Disconnect the negative battery cable.
4. Remove the front left wheel (See page 24-8).
5. Remove the ball pin assembly.

(a) Remove locking nut (arrow) between left steering tie rod ball pin assembly and front left steering knuckle assembly.

Tightening torque
35 ± 3 N·m



(b) Install ball pin separator (1), and separate steering tie rod ball pin from steering knuckle assembly.



(c) Remove ball pin assembly.

Inspection

1. Check tie rod ball pin for looseness. Replace ball pin assembly if necessary.
2. Check tie rod ball pin bush rubber for damage. Replace ball pin assembly if necessary.

Installation

1. Installation is in the reverse order of removal.
   Caution:
   - After installing tie rod ball pin assembly, it is necessary to perform wheel alignment procedure.

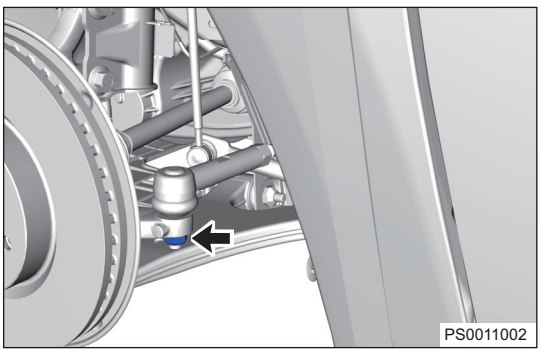
Steering Gear Assembly

Removal

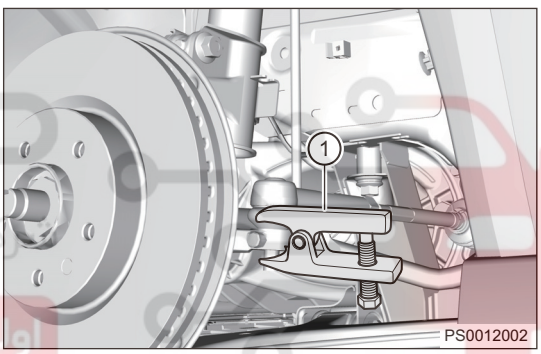
1. Set the front wheels to straight-ahead position.
2. Turn off all electrical equipment and the ignition switch.
3. Disconnect the negative battery cable.
4. Remove the front left/right wheel.
5. Remove tie rod ball pin.

(a) Remove locking nut (arrow) between left steering tie rod ball pin assembly and front left steering knuckle assembly.

Tightening torque
35 ± 3 N·m



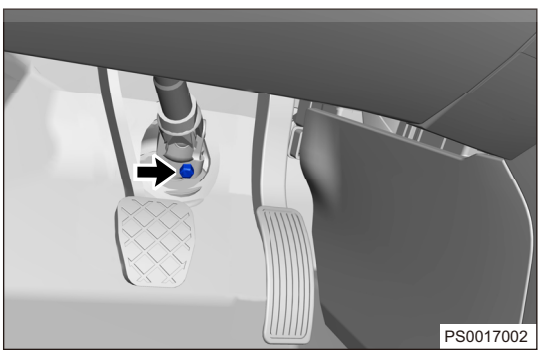
(b) Install ball pin separator (1), and separate steering tie rod ball pin from steering knuckle assembly.



6. Remove coupling bolt between steering column with intermediate shaft assembly and steering gear input shaft.

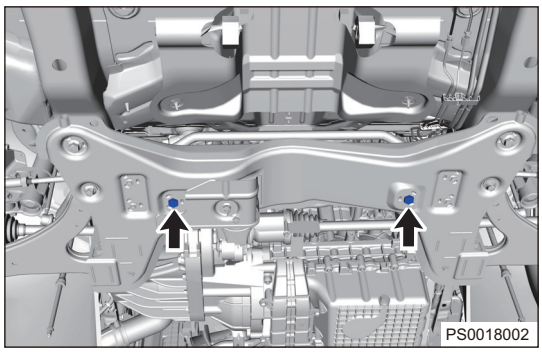
(a) Remove coupling bolt (arrow) between steering column with intermediate shaft assembly and steering gear input shaft.

Tightening torque
55 ± 5 N·m



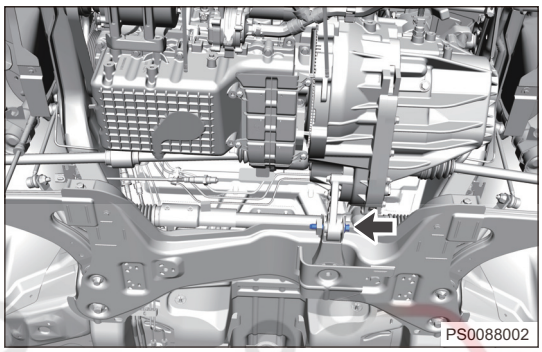
7. Remove 2 fixing bolts (arrow) between steering gear assembly and sub frame.

Tightening torque
110 ± 10 N·m

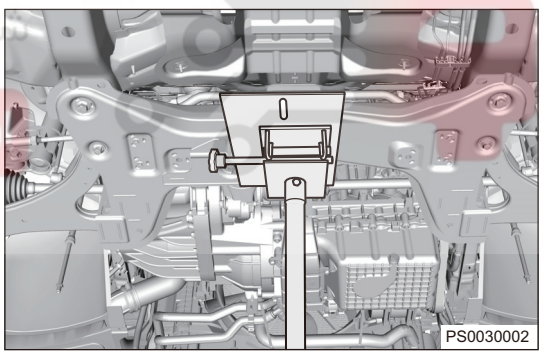


8. Remove coupling bolt and nut (arrow) between rear mounting cushion assembly upper body and rear mounting cushion assembly lower body.

Tightening torque
80 ± 5 N·m

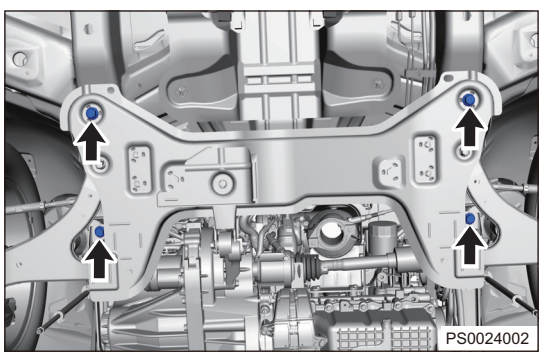


9. Using a transmission carrier, support the front sub frame welding assembly.



10. Remove 4 fixing bolts (arrow) between sub frame and vehicle body, and lower sub frame slowly.

Tightening torque
180 ± 18 N·m



11. Remove the steering gear assembly.

Inspection

1. Check if steering gear dust boot is damaged, clamp is loosen. Replace them if necessary to prevent water and micro dust from entering and causing parts failure prematurely.
2. Check if steering gear is damaged. Replace the steering gear assembly if necessary.

Installation

1. Installation is in the reverse order of removal.

   Caution:

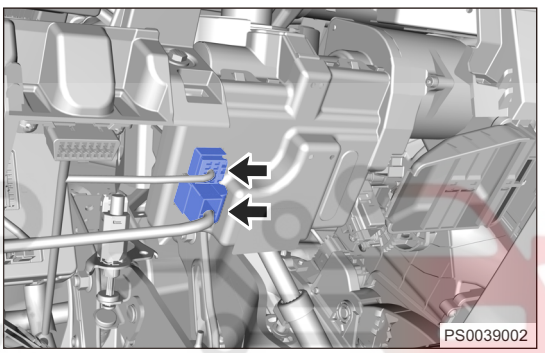
   - Install coupling bolt between steering column lower joint and steering gear input shaft securely.
   - After installing steering gear assembly, perform front wheel alignment procedure.

Steering Column with Intermediate Shaft Assembly

Removal

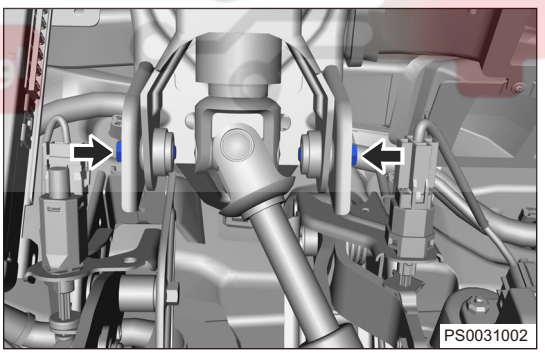
1. Set the steering wheel to straight-ahead position.
2. Turn off all electrical equipment and the ignition switch.
3. Disconnect the negative battery cable.
4. Remove the driver airbag assembly (See page 32-65).
5. Remove the steering wheel assembly (See page 28-9).
6. Remove the combination switch cover (See page 28-11).
7. Remove the spiral cable (See page 32-79).
8. Remove the combination switch assembly (See page 37-39).
9. Remove the left lower protector assembly (See page 48-11).
10. Remove coupling bolt between steering column with intermediate shaft assembly and steering gear input shaft (See page 28-13).
11. Remove the steering column with intermediate shaft assembly.

(a) Disconnect 2 connectors (arrow) from EPS controller.



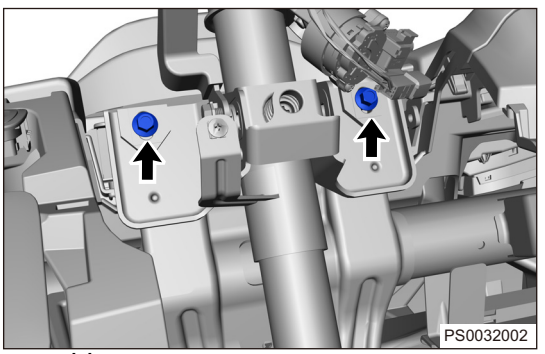
(b) Remove 2 fixing bolt (arrow) from steering column lower bracket.

Tightening torque
25 ± 4 N·m



(c) Remove 2 fixing nuts (arrow) from steering column upper bracket.

Tightening torque
25 ± 4 N·m



(d) Remove the steering column with intermediate shaft assembly.

Caution:

- Wear glove during removal, prevent hands contacting with steering column, which may cause rust.
- DO NOT hold steering column handle position, but steering column position; do not bump, strike steering column when taking, carrying or assembling it, prevent steering column from collapse.
- DO NOT touch interior ornaments when removing steering column with intermediate shaft assembly to avoid scratching interior ornaments.

Installation

1. Installation is in the reverse order of removal.

   Caution:

   - Wear glove during removal, prevent hands are contacted with steering column, which may cause rust.
   - DO NOT hold steering column handle position, but steering column position; do not bump, strike steering column when taking, carrying or assembling it, prevent steering column from collapse.
   - Adjustment handle is in locking state after steering column is assembled, do not transfer to next station, prevent handle is knocked during operation, which may cause person damage or handle breakage.
   - DO NOT touch interior ornaments when installing steering column with intermediate shaft assembly to avoid scratching interior ornaments.
2. Write the vehicle configuration after the assembly is completed.
3. EPS steering angle initialization is required after the electric column of vehicle is replaced or after the engine is restarted (By restarting the engine, the vehicle speed is increased to 30 km/h, and the driving in straight line for about 50m to complete the steering angle initialization.)