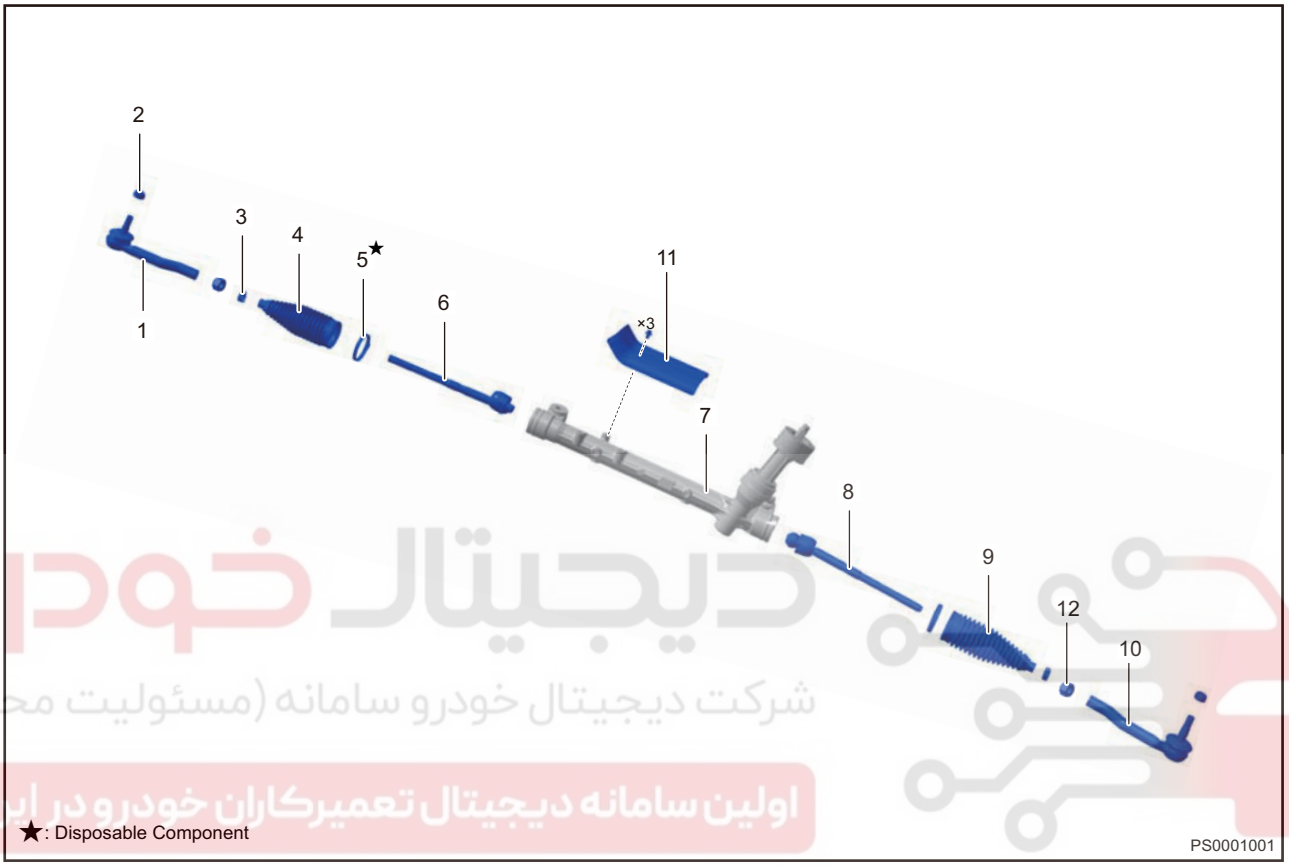
ELECTRONIC POWER STEERING

GENERAL INFORMATION

Overview

Description

Electronic Power Steering



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

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.

Calibration

Calibrating Steering Angle Sensor

1. Prerequisites for sensor calibration:
   (a) Perform zero point calibration after steering angle sensor is installed.
   (b) Calibration should be performed at front (four) wheel alignment station (make sure that the four wheel alignment parameters are correct).
   (c) Before calibrating, straighten up the vehicle and wheels must be in straight lines along proceeding direction. Difference between the two angles should meet toe-in of four wheel alignment parameters value. Steering wheel must be adjusted to center.
   (d) Before calibrate a calibrated sensor again, always calibrate it again to make it return uncalibrated state.

Caution:

Steering wheel must be centered in the actual calibration. If not, even correct data can cause wrong calibration when performing four wheel alignment. This problem may not be detected at factory. Long-term cumulative errors may be caused or over range phenomenon may occur when turning steering wheel fully during actual driving, leading EPS system light to turn on. Therefore, when performing four wheel alignment, the steering wheel should be centered.

Refer to EPS calibration in this section for detailed operation procedures.

Steering wheel centering or steering performance are affected by manufacturing error, requirements for four wheels alignment toe-in and steering wheel centering are as following:

1. Before placing four wheels alignment adjuster, determine steering wheel left and right turn travels are same relative to horizontal position (assembly error 0 tooth, error on both sides ≤ 12°).
2. After placing four wheels alignment adjuster, first rotate steering wheel to left and right to determine rotation angle of one side ≥ 45°, then returns to horizontal position.
3. Install steering wheel fixed level.
4. Use calibration device to complete center position calibration of steering wheel rotation angle.
5. When adjusting front wheel toe-in, it is necessary to adjust steering gear left and right tie rods. Loosen locking nut of steering gear tie rod when adjusting, use wrench to rotate inner lever in hexagonal position of outer lever, until toe-in value reaches specified value, then tighten locking nut. If threads exposed outside on left and right levers are greatly not equal (difference between left and right levers threads exposed outside are more than 3 threads), please recheck if steering wheel is centered. It is necessary to set outer lever flat square position with wrench while tightening, tighten torque of nut is 55 ± 5 N·m.

Warning:

Caution

- Center steering wheel manually: install steering wheel, and rotate steering gear to left and right travels limit, and check steering gear total number of turns (2.81 turns), then center steering wheel based on the number of turns.
- Check if steering wheel is centered: rotate steering wheel to left and right fully, and check steering wheel spoke state and see if it is symmetric relative to right ahead, not overlapped (it is overlapped only when number of turns is integer).

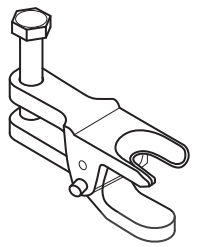
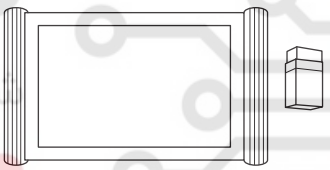
Specifications

Torque Specifications

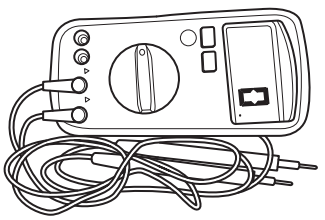
Description	Torque (N·m)
Coupling Nut Between Steering Tie Rod and Steering Knuckle	45 ± 5
Coupling Bolt Between Steering Gear Input Shaft and Steering Column with Intermediate Shaft Assembly	1st step: 20 ± 2 N·m 2nd step: 90° ± 5°
Steering Gear Fixing Bolt	180 ± 18
Fixing Nut of Steering Gear Lower Joint Boot	1.5 ± 0.5

Tools

Special Tools

Ball Pin Separator	 024
Diagnostic Tester	 001

General Tool

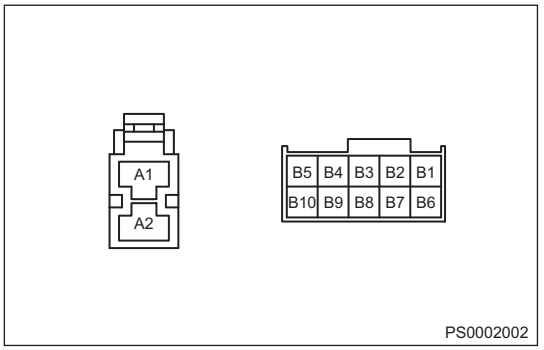
Digital Multimeter	 002

EPS Controller Pin Definition

1. EPS Terminal

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

Pin	Definition
A1	Power supply
A2	Ground



Vehicle signal: Controller signal connector (connector B)

Pin	Definition
B1	IGN (b)
B3	-
B5	-
B2	CAN1-H
B4	CAN1-L
B6	-
B7	-
B8	-
B9	-
B10	-

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:

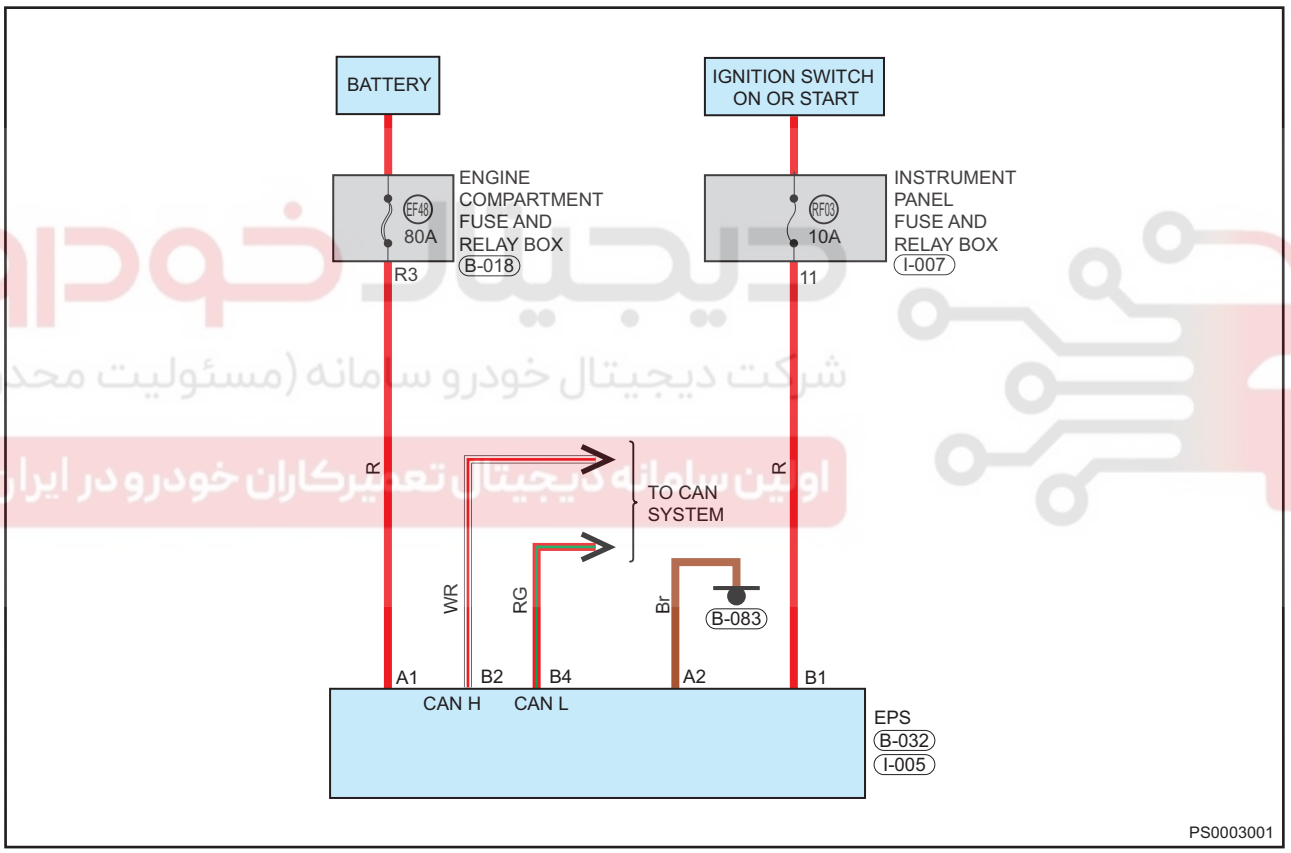
1. Remove ground bolt or screw.
2. Check all contact surfaces for tarnish, dirt and rust, etc.
3. Clean as necessary to ensure that contacting is in good condition.
4. Reinstall bolt or screw securely.
5. Check if add-on accessories interfere with ground circuit.
6. If several wire harnesses are crimped 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.

Diagnostic Trouble Code (DTC) Chart

C1200-44	Data Flash Operation Error
C1201-44	Data Flash Verify Error
C1202-49	ECU Hardware Error
C1203-00	ECU Reset Error
C1204-48	ECU SW Monitoring Error
C1205-45	Flash Code Verify Error
C1206-07	High Friction
C1207-49	Index Sensor Error
C1208-49	Output Stage Error
C1209-49	Phase Current Error
C120A-49	Rotor Position Sensor Error
C120B-49	Rotor Position Sensor Slave Channel Error
C120C-07	Steering Oscillation
C120D-00	Steering Angle Implausible
C120E-00	Steering Angle No Initialization
C120F-00	Steering Angle Sensor Not Calibrated
C1210-49	Steering Angle Sensor Self Test Error
C1211-1C	Supply Voltage Abnormal during Initialization
C1212-1C	Supply Voltage Uncritical Too High Warning
C1213-1C	Supply Voltage Uncritical Too High
C1214-17	Supply Voltage Critical Too High
C1215-1C	Supply Voltage Uncritical Too Low Warning
C1216-1C	Supply Voltage Uncritical Too Low
C1217-16	Supply Voltage Critical Too Low
C1218-4B	Over Temperature Reduction
C1219-4B	Temperature Out of Range
C121A-49	Torque Sensor Error
C121B-46	XCP Flash Data Changed
U0100-87	Lost Communication With EMS
U0129-87	Lost Communication With Brake System Control Module, Missing Message
U0140-87	Lost Communication With Body Control Module, Missing Message
U0401-81	Invalid Data Received From EMS
U0418-81	Invalid Data Received From BSM
U0422-81	Invalid Data Received From BCM
C121C-00	Software Configuration Invalid
C122D-48	ECU SW Information Error

DTC	C1212-1C	Supply Voltage Uncritical Too High Warning
DTC	C1213-1C	Supply Voltage Uncritical Too High
DTC	C1214-17	Supply Voltage Critical Too High
DTC	C1215-1C	Supply Voltage Uncritical Too Low Warning
DTC	C1216-1C	Supply Voltage Uncritical Too Low
DTC	C1217-16	Supply Voltage Critical Too Low

Circuit Diagram



Description

DTC	DTC Definition	DTC Detection Condition	Possible Cause
C1212-1C	Supply Voltage Uncritical Too High Warning	Ignition switch OFF, engine does not run	Circuit Voltage Below Threshold Circuit Voltage Above Threshold Component internal fault
C1213-1C	Supply Voltage Uncritical Too High		
C1214-17	Supply Voltage Critical Too High		
C1215-1C	Supply Voltage Uncritical Too Low Warning		
C1216-1C	Supply Voltage Uncritical Too Low		
C1217-16	Supply Voltage Critical Too Low		

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.

OK

Standard voltage: not less than 12 V.

Result

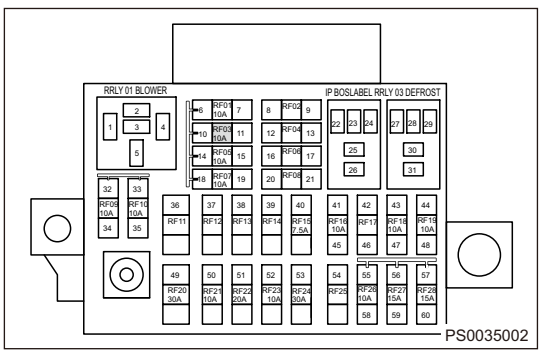
Proceed to
OK
NG

NG → **Check and repair battery**

OK

2	**Check fuse**

(a) Turn ignition switch to OFF.
(b) Disconnect the negative battery cable.
(c) Remove the fuse EF48 (80 A), RF03 (10 A) from engine compartment fuse and relay box.



(d) Check if fuse is blown.

Normal

Fuse is not burned out

Result

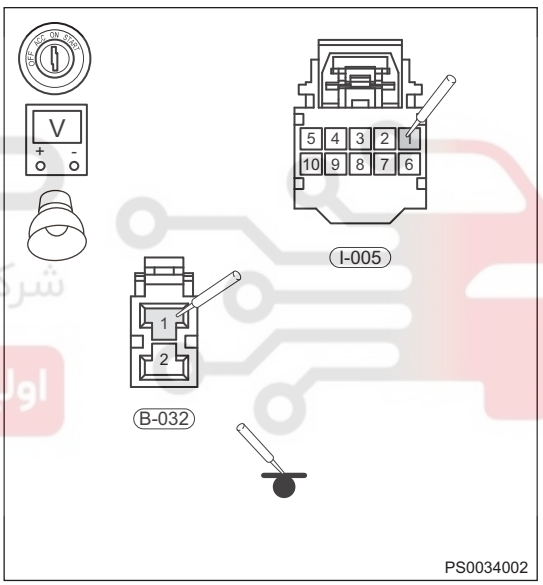
Proceed to
Normal
NG

NG → **Replace fuse**

Normal

3 Inspect power supply voltage

(a) Turn ignition switch to OFF.
(b) Disconnect electric power steering module connectors B-032 and I-005.
(c) Turn ignition switch to ON.
(d) Check voltage between B-032 (A1) - body ground with multimeter voltage band, and check if 21W test light comes on.
Check voltage between I-005 (B1) - body ground with multimeter voltage band, and check if 21W test light comes on.



Multimeter Connection	Condition	Specified Condition
B-032 (A1) - Body ground	Ignition switch ON	Not less than 12 V
I-005 (B1) - Body ground	Ignition 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**

Normal

4 Inspect ground

(a) Turn ignition switch to OFF.
(b) Disconnect electric power steering module connector B-126.

(c) Check continuity between B-032 (A2) - body ground with multimeter ohm band.

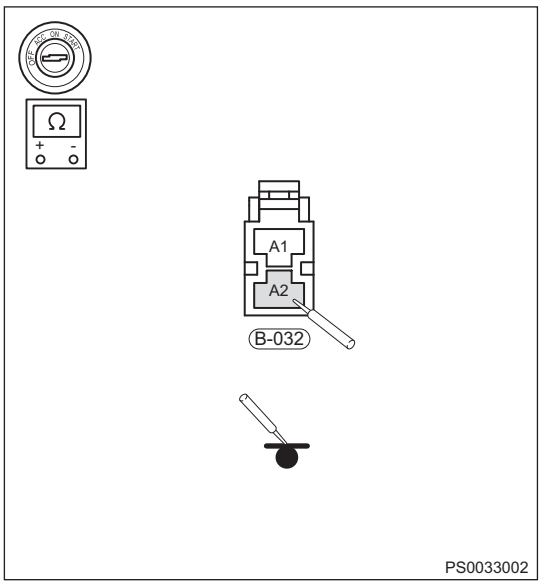
Multimeter Connection	Condition	Specified Condition
B-032 (A2) - Body ground	Ignition switch OFF	≤ 1 Ω

OK

Ground point is normal

Result

Proceed to
OK
NG



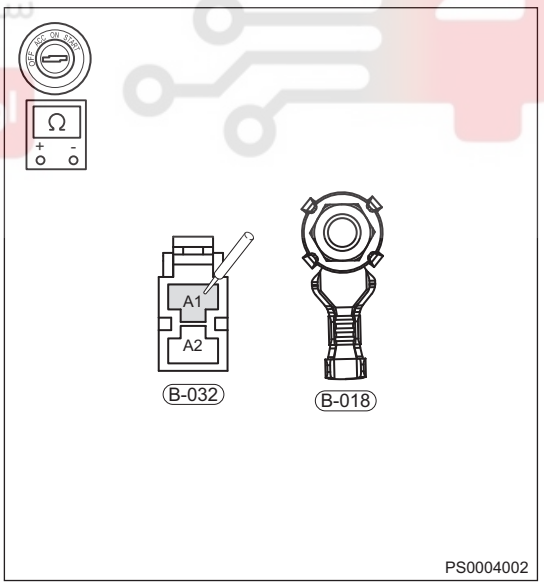
NG → **Repair or replace ground point**

OK

5 Check wire harness and connector

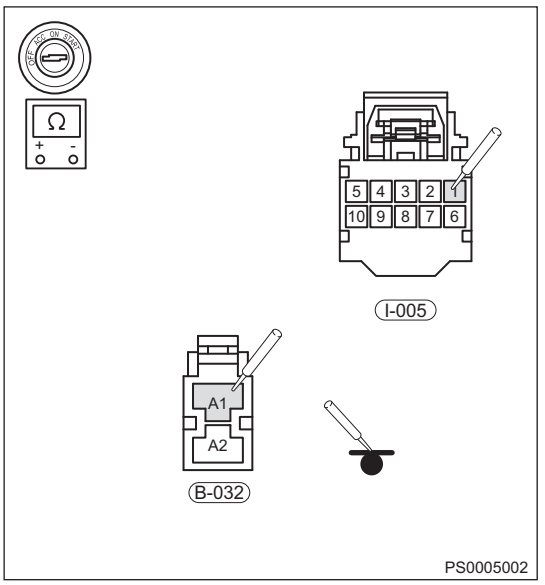
(a) Turn ignition switch to OFF.
(b) Disconnect electric power steering module connectors B-032 and I-005.
(c) Check continuity between B-032 (A1) - B-018 with multimeter ohm band.

Multimeter Connection	Condition	Specified Condition
B-032 (A1) - B-018	Ignition switch OFF	≤ 1 Ω



(d) Check continuity between B-032 (A1) - ground and I-005 (B1) - ground with multimeter ohm band.
Check for Short

Multimeter Connection	Condition	Specified Condition
B-032 (A1) - Ground	Ignition switch OFF	∞
I-005 (B1) - Ground	Ignition switch OFF	∞



(e) Check continuity between B-032 (A1) - battery (+) and I-005 (B1) - battery (+) with multimeter ohm band.
Check for Short

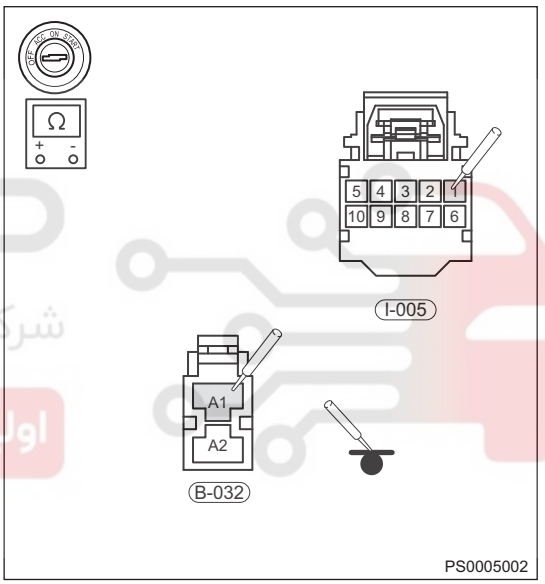
Multimeter Connection	Condition	Specified Condition
B-032 (A1) - Battery (+)	Ignition switch OFF	∞
I-005 (B1) - Battery (+)	Ignition switch OFF	∞

OK

Wire harness and connector are normal

Result

Proceed to
OK
NG



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

DTC	C1207-49	Index Sensor Error

DTC	C1200-44	Data Flash Operation Error

DTC	C1201-44	Data Flash Verify Error

DTC	C1202-49	ECU Hardware Error

DTC	C1203-00	ECU Reset Error

DTC	C121A-49	Torque Sensor Error

Description

DTC	DTC Definition	DTC Detection Condition	Possible Cause
C1207-49	Index Sensor Error	Ignition switch ON	• Electric Power Steering Module Error
C1200-44	Data Flash Operation Error		
C1201-44	Data Flash Verify Error		
C1202-49	ECU Hardware Error		
C1203-00	ECU Reset Error		
C121A-49	Torque Sensor Error		

CAN Network DTC

U0100-87	Lost Communication With EMS
U0129-87	Lost Communication With Brake System Control Module,Missing Message
U0140-87	Lost Communication With Body Control Module,Missing Message
U0401-81	Invalid Data Received From EMS
U0418-81	Invalid Data Received From BSM
U0422-81	Invalid Data Received From BCM

Refer to Chapter 32 CAN System

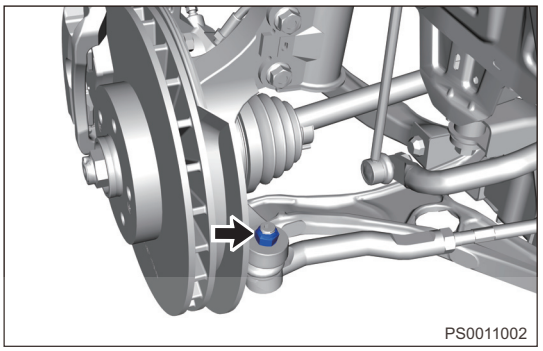
ON-VEHICLE SERVICE

Ball Pin 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 front left wheel (See page 20-8).
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
   45 ± 5 N·m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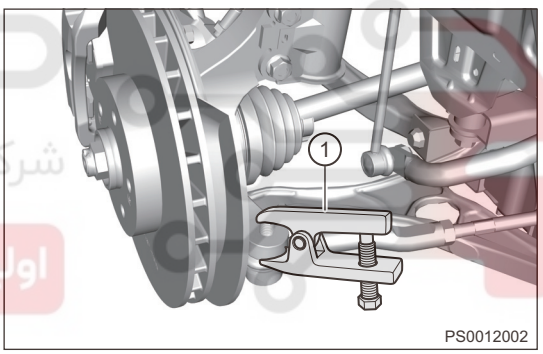
   (b) Install ball pin separator (1), and separate steering tie rod ball pin from steering knuckle assembly.



PS0012002

   (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

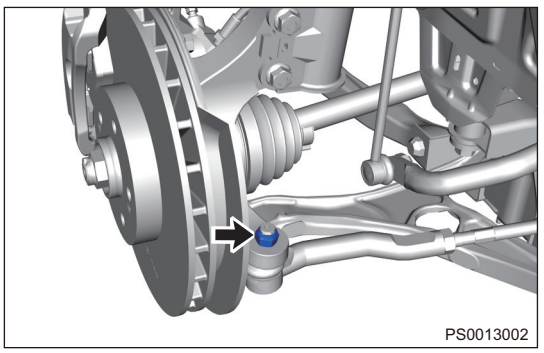
1. Installation is in the reverse order of removal.
   Caution:
   - After installing tie rod ball pin assembly, it is necessary to perform wheel alignment procedure.

Steering Gear Assembly

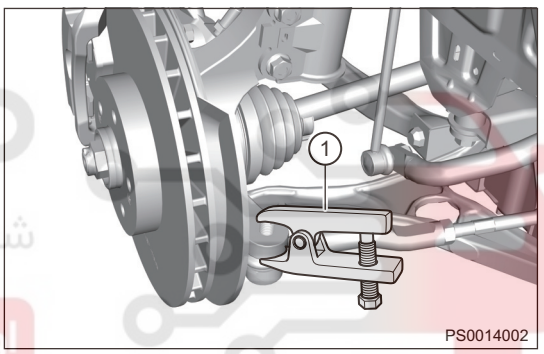
Removal

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.

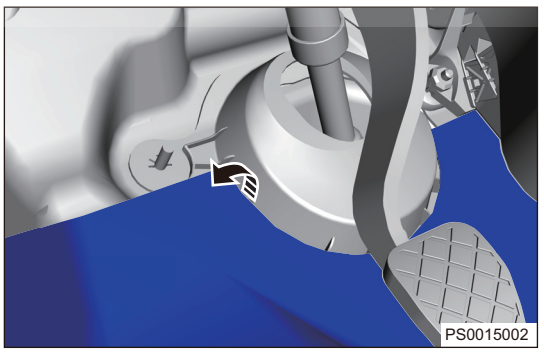
   Tightening torque
   45 ± 5 N·m



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

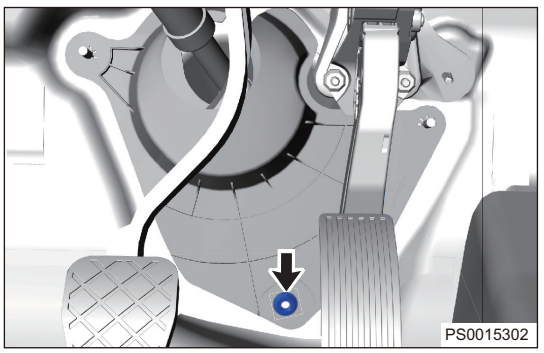


6. Remove coupling bolt between steering column with intermediate shaft assembly and steering gear input shaft.
   (a) Turn over carpet under driver seat in the direction of arrow.

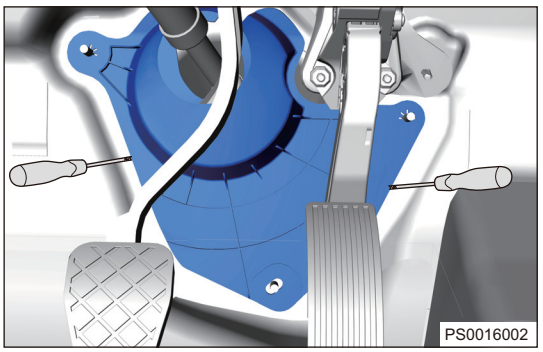


   (b) Remove 1 fixing nut (arrow) from steering gear lower joint boot.

   Tightening torque
   1.5 ± 0.5 N·m

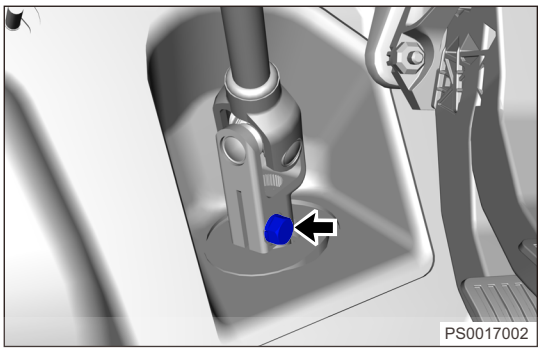


(c) Using a screwdriver wrapped with protective tape, remove steering gear lower joint boot from 2 studs.



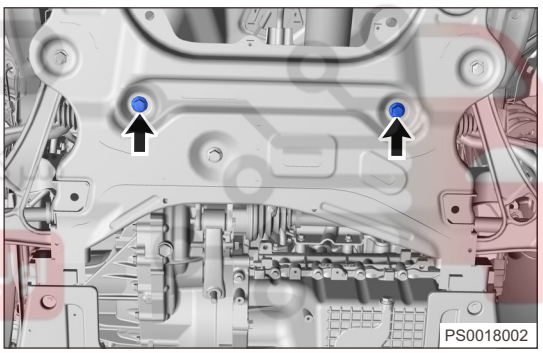
(d) Remove coupling bolt (arrow) between steering column with intermediate shaft assembly and steering gear input shaft.

Tightening torque
1st step: 20 ± 2 N·m 2nd step: 90° ± 5°

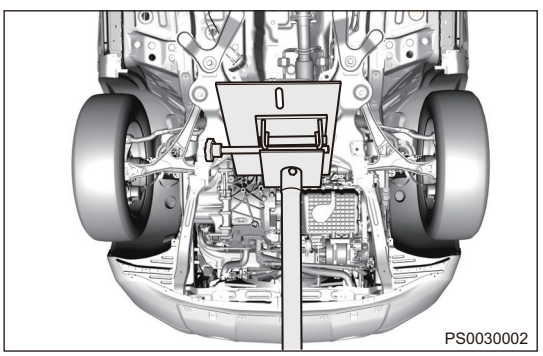


7. Remove 2 fixing bolts (arrow) fixing steering gear assembly from sub frame.

Tightening torque
180 ± 18 N·m

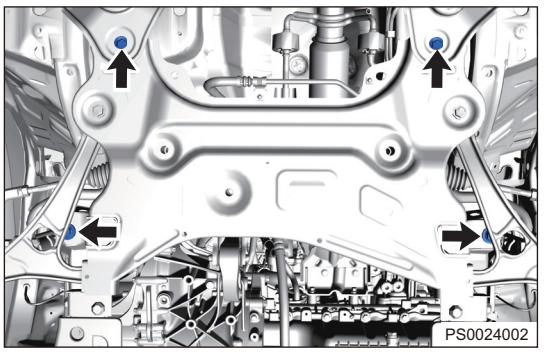


8. Using a transmission carrier, support the front sub frame welding assembly.



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

Tightening torque
180 ± 18 N·m



10. 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.

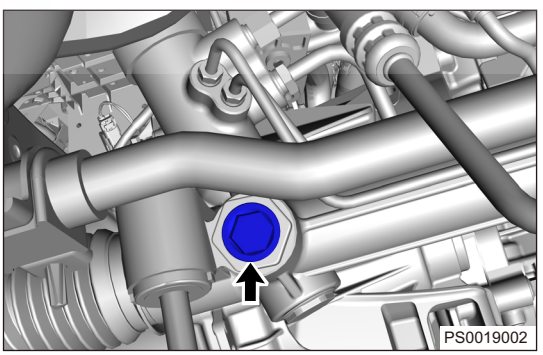
Installation

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.

Adjustment of Steering Gear Clearance

1. Operation method: set wheel in straight driving position.
2. Rotate steering wheel to both sides.
3. If steering gear noise is heard, adjust adjustment bolt (arrow) until noise is not heard while rotating steering wheel.



4. Tighten adjustment bolt by 1/8 turn (about 45°).
5. Perform the road test.
6. If steering gear cannot return to center position, loosen adjustment bolt by 15°.
7. Perform the road test.

Steering Wheel Assembly

Removal

WARNING:

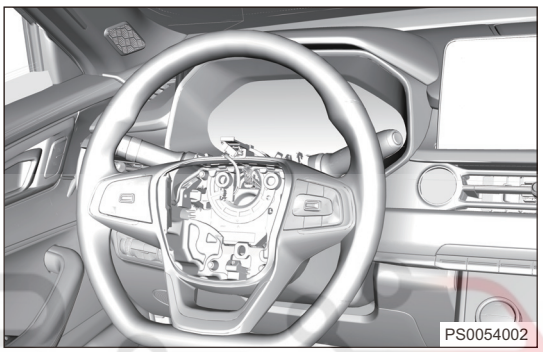
- Be sure to read precautions for SRS airbag before removing steering wheel.

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.

   Caution:

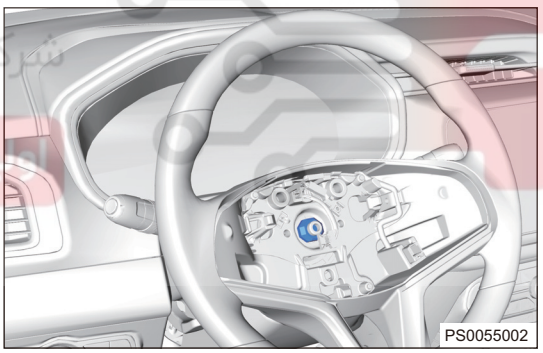
   - Wait at least 90 seconds after disconnecting the negative battery cable to prevent airbag and belt pretensioner from being activated.
4. Remove the driver airbag assembly.
5. Remove the steering wheel assembly.

   (a) Disconnect steering wheel shortcut connector, horn connector and steering wheel heating connector.

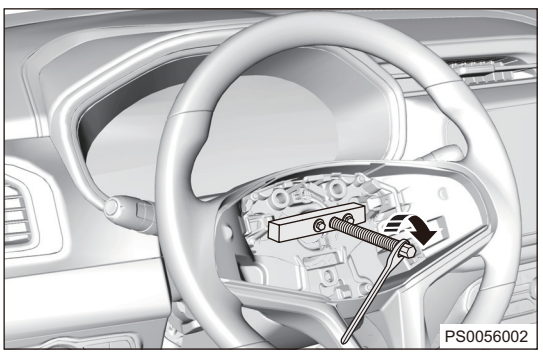


   (b) Secure the steering wheel assembly, and put matchmarks on steering wheel assembly and steering column assembly, then remove steering wheel assembly fixing nut (arrow).

   Tightening torque
   30 ± 3 N·m



   (c) As shown in the illustration, install the steering wheel remover, and then tighten it with a wrench to loosen the steering wheel assembly from steering column assembly.



   (d) Remove the steering wheel assembly.

   Caution:

   - Be careful when removing steering wheel assembly to prevent damage to airbag connector and horn connector on spiral cable.

Inspection

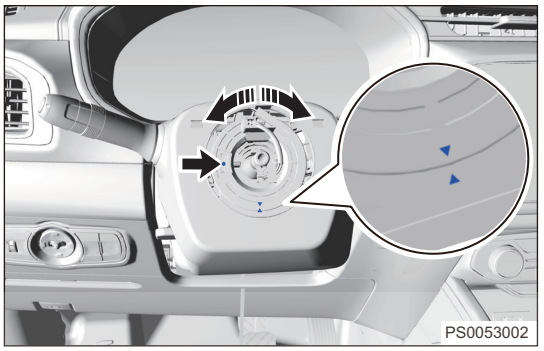
1. Check steering wheel assembly body for damage or deformation. Replace steering wheel assembly if necessary.
2. Check spline in steering wheel assembly for damage. Replace steering wheel assembly if necessary.

Installation

Caution:

- Check that front wheels are in straight-ahead position before installing steering wheel assembly.
- After installing the steering wheel assembly, perform the steering angle sensor calibration.

1. Adjust the spiral cable to correct position (arrow).



Hint:

- Fully turn spiral cable inner circle clockwise when realigning the center, and then turn it counterclockwise to align with the center while yellow ball occurs in the clear vertical window. Failure to follow these instructions may affect normal function of airbag system and cause injury to driver.

2. Pass the airbag connector, horn connector through the hole of steering wheel assembly, and connect the steering wheel quick button connector. Then align the matchmarks on steering wheel assembly and steering column assembly to install the steering wheel assembly.
3. Other installation procedures are in the reverse order of removal.

   Caution:

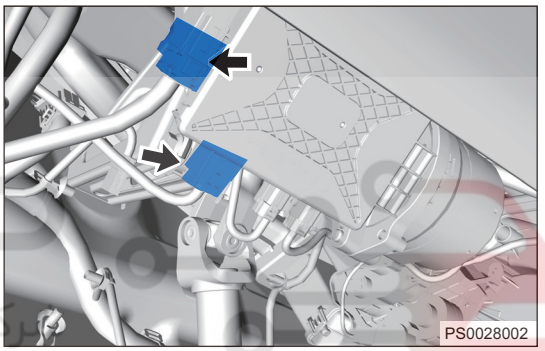
   - Tighten steering wheel assembly fixing nut to specified torque.
   - Install each connector in place.
   - After repairing, check that airbag system operates normally.

Steering Column with Intermediate Shaft Assembly

Removal

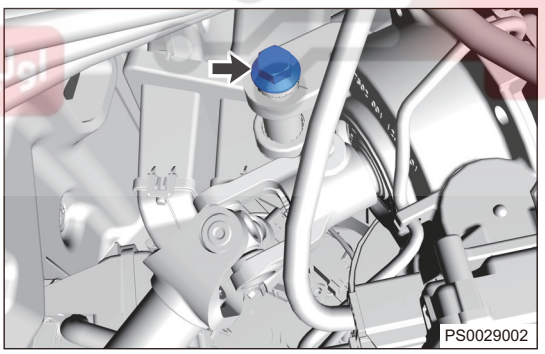
1. Set the steering wheel to straight-ahead position.
2. Turn off all electrical equipment and the ignition switch.
3. Disconnect the negative battery cable.
4. Remove the driver airbag assembly.
5. Remove the steering wheel assembly.
6. Remove the combination switch cover.
7. Remove the spiral cable.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

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



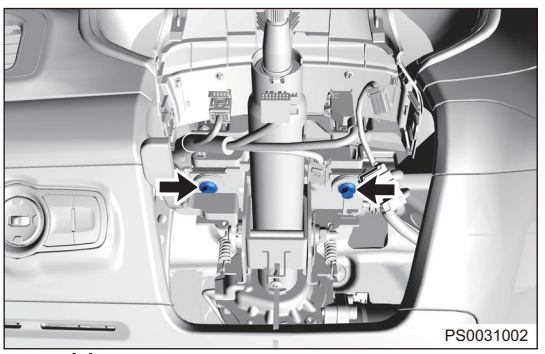
(b) Remove 1 fixing bolt (arrow) from steering column lower bracket.

Tightening torque
50 ± 5 N·m



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

Tightening torque
25 ± 3 N·m



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

Caution:
- Wear glove during removal, so as to 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, so as to prevent steering column from collapse.
- DO NOT touch interior ornaments when removing steering column with intermediate shaft assembly to avoid scratching interior ornaments.

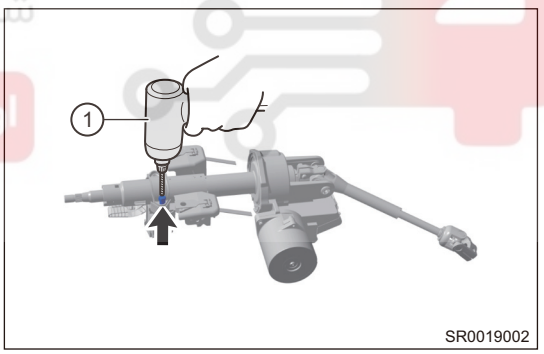
Installation

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, so as to prevent steering column from collapse.
   - DO NOT loosen steering column adjustment handle before upper bracket bolt is tightened, prevent bracket from falling and assembly is not in place.
   - 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. It is necessary to perform motor position sensor calibration after assembling.

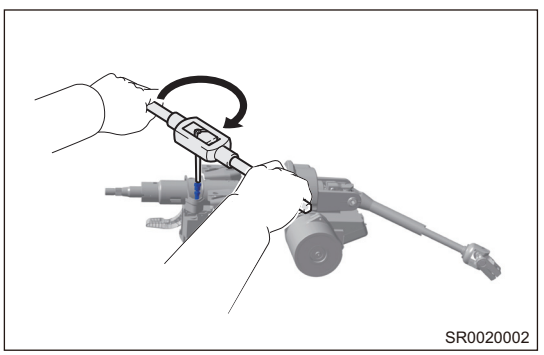
Disassembly

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



SR0019002

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

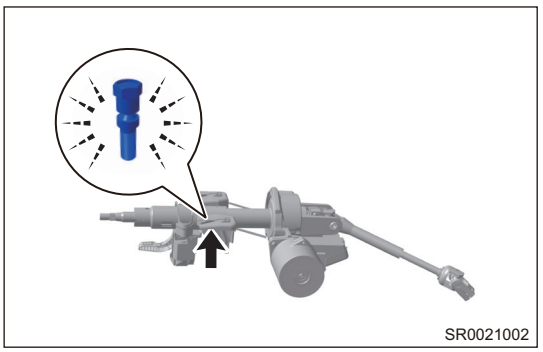

SR0020002

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 electronic steering column lock.
   (a) Install electronic steering column lock to steering column assembly with new electronic 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:
   - 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.
   - DO NOT loosen steering column adjustment handle before upper bracket bolt is tightened, prevent bracket from falling and assembly is not in place.
   - 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. It is necessary to perform motor position sensor calibration after assembling.