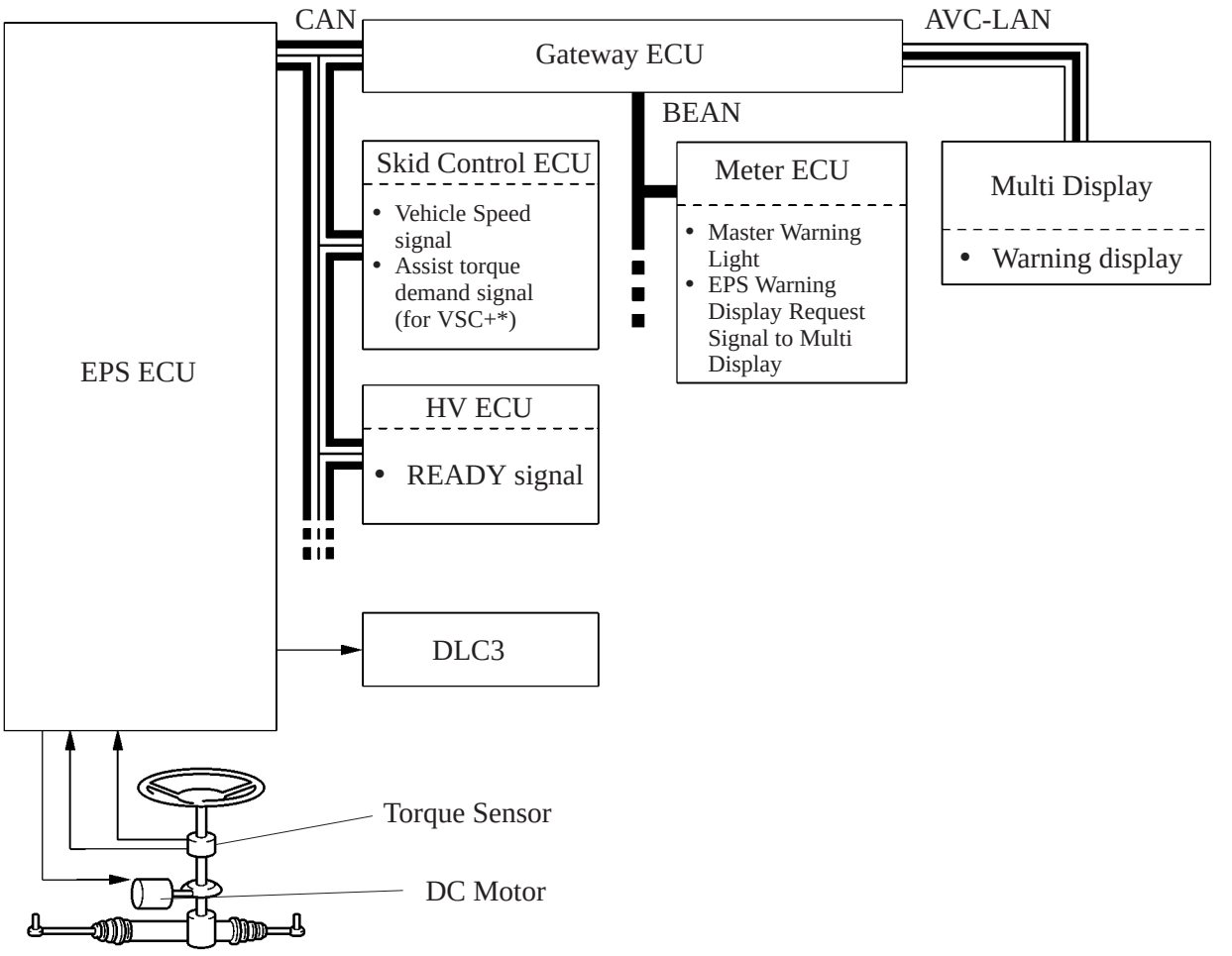
■EPS (Electric Power Steering)

1. General

- This system generates torque using a DC motor and a reduction mechanism that are mounted on the steering column to assist the driver's steering effort. The EPS ECU calculates the amount of power assist in accordance with the signals provided by the sensors and the ECUs.
- The EPS ECU maintains communication with the skid control ECU, HV ECU, and gateway ECU via CAN. In addition, the EPS ECU maintains communication with the meter ECU through the gateway ECU, via BEAN. For details, refer to Multiplex Communication on page BE-46.
- The EPS ECU has been changed from 16-bit CPU to 32-bit CPU to increase the speed for processing the signals.
- The VCS+ system, which controls steering assist torque when the VSC system is operating, has been adopted. While the VSC+ system is operating, the EPS ECU controls the assist torque of the DC motor upon the received assist torque demand signal from the skid control ECU. For details, refer to outline of VSC+, refer on page CH-40.
- This system offers excellent fuel economy characteristics because power assist is provided by the DC motor that is mounted on the steering column, and this motor consumes energy only when power assist is required.
- Unlike the conventional hydraulic power steering system, this system excels in serviceability because it dose not require pipes, vane pump, pulley and power steering fluid.

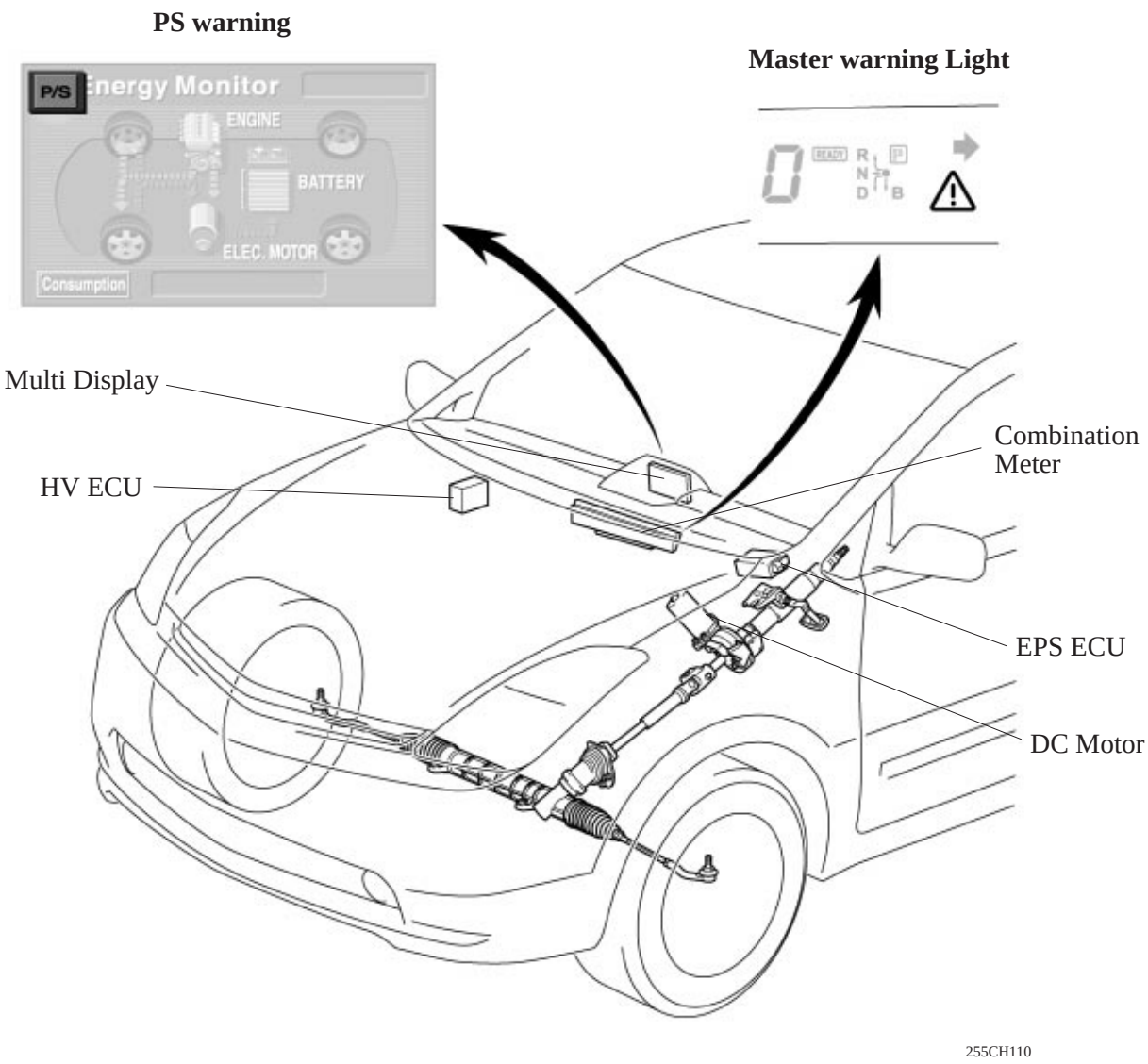
▶ System Diagram ◀



255CH109

*: Standard Equipment For European Models
Optional Equipment For Australian Models

2. Layout of Main Components



LHD Model

3. Function of Main Components

Components		Function
Steering Column	Torque Sensor	Detects the twist of the torsion bar with, this it calculates the torque that is applied to the torsion bar by changing it into an electrical signal, and outputs this to the EPS ECU.
	DC Motor	Generates power assist in accordance with a signal received from the EPS ECU.
	Reduction Mechanism	Reduces the speed of the DC motor through the use of a worm gear and a wheel gear and transmits it to the column shaft.
EPS ECU		Actuates the DC motor mounted on the steering column to providing power assist, based on the signals received from various sensors and vehicle speed sensor.
HV ECU		Transmits a READY signal to the EPS ECU, in order to inform the EPS system that it is ready to generate electricity.
Skid Control ECU		• Outputs speed sensor signals to the EPS ECU. • When VSC+* (Vehicle Stability Control +) is operating, the skid control ECU transmits an additional torque signal (which it has calculated in accordance with the signals from the sensors for the purpose of effecting cooperative control) to the EPS ECU.
Meter ECU		• Upon receiving a signal from the EPS ECU in the event of a system malfunction, the meter ECU illuminates the master warning light and simultaneously transmits a PS warning display request signal to the multi-information display.
Multi Display		In case of a malfunction in the system, displays the PS warning

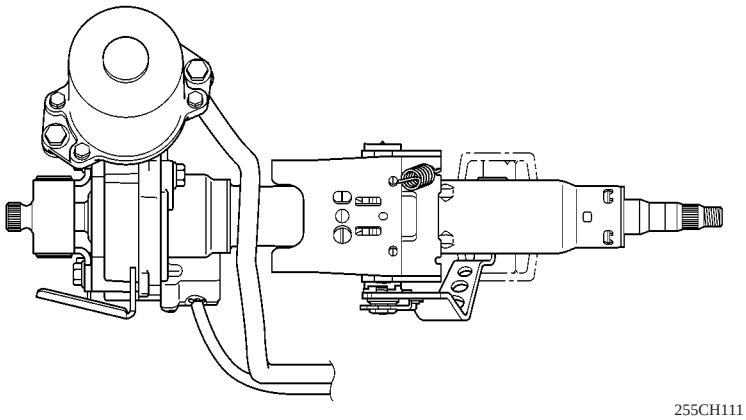
*: Standard Equipment For European Models
Optional Equipment For Australian Models

4. Construction and Operation

Steering Column

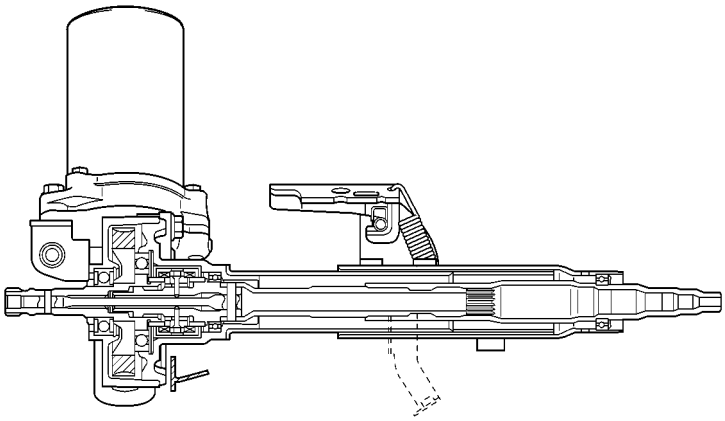
1) General

- The DC motor, reduction mechanism, and torque sensor, which are mounted on the steering gear on the previous model, have been relocated to the steering column on the new Prius.
- The torque sensor, which consists of a contact type variable resistor on the previous model, has been changed to an inductance type on the new Prius.



255CH111

Top View

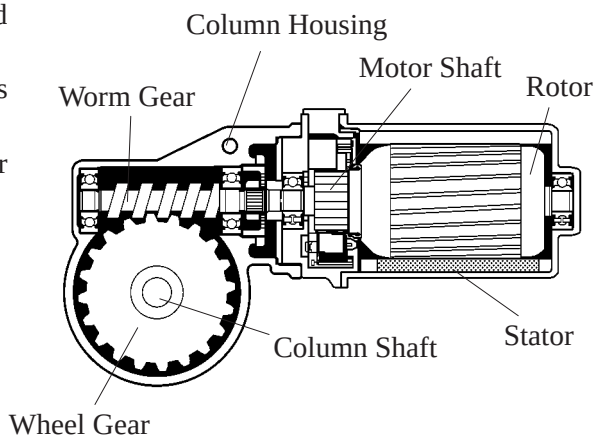


255CH112

Cross Section

2) DC Motor

The DC motor consists of the rotor, stator, and motor shaft.
The torque that is generated by the motor is transmitted via the joint to the worm gear.
Then this torque is transmitted via the wheel gear to the column shaft.

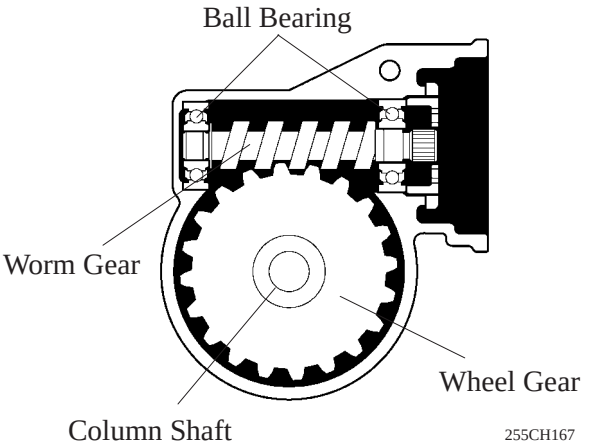


255CH166

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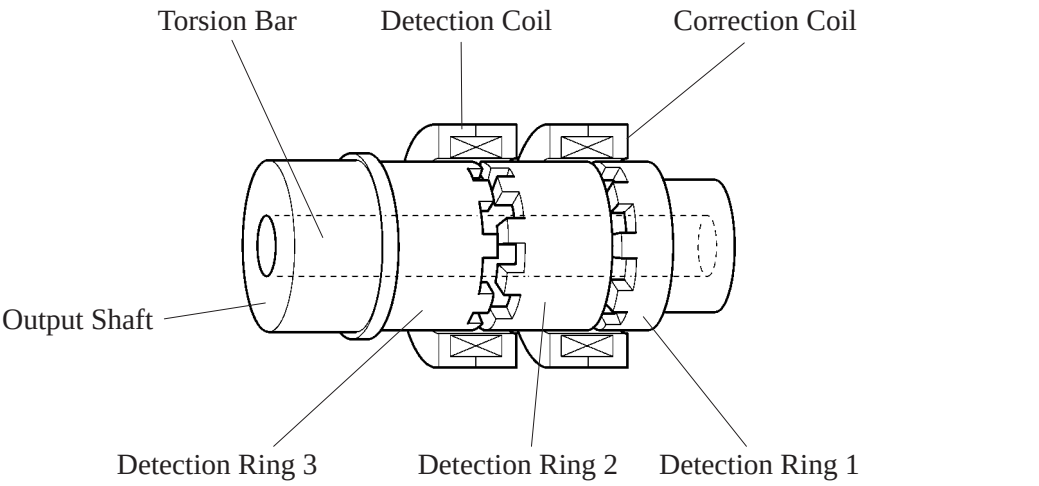
3) Reduction Mechanism

This mechanism reduces the speed of the DC motor via the worm gear and the wheel gear, and transmits it to the column shaft.
The worm gear is supported by the ball bearing in order to reduce noise and frictions.



4) Torque Sensor

- The torque sensor detects the twist of the torsion bar with this, it calculates the torque that is applied to the torsion bar by changing it into an electrical signal, and outputs this signal to the EPS ECU.
- Detection ring 1 and detection ring 2 are mounted on the input shaft, and detection ring 3 is mounted on the output shaft. The input shaft and the output shaft are jointed by the torsion bar. A detection coil and a correction coil are placed on the outside of the respective detection rings to complete an excitation circuit without making a contact.
- The function of detection ring 1 and 2 is to correct temperature. They detect the temperature changes that occur in the correction coil and correct the deviation that is caused by the temperature changes.
- The detection coil consists of a dual circuit that outputs two signals, VT1 (Torque Sensor Signal 1) and VT2 (Torque Sensor Signal 2). The ECU controls the assist amount based on there two signals and at the same time detects a sensor malfunction.



Service Tip

If the steering wheel, steering column, or steering gear is removed and reinstalled the zero point of the torque sensor must be adjusted. For details, see the new Prius Repair Manual (Pub. No. RM1076E)

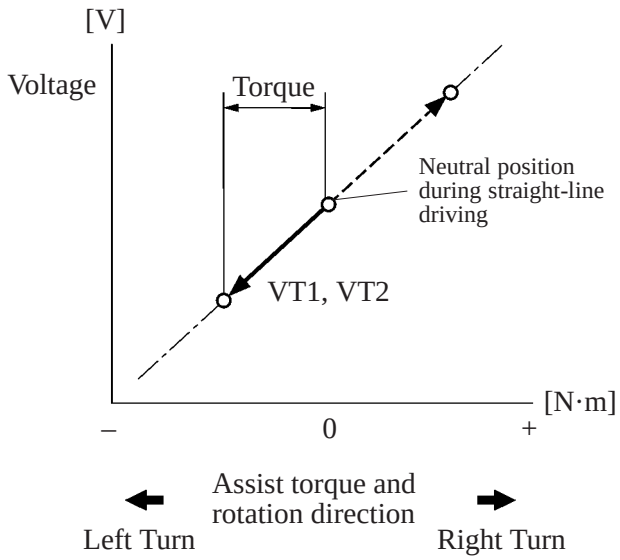
	Initialization	Calibration
Steering Wheel, Column and Gear	○	○
ECU	—	○

a. Straight-line Driving

If the vehicle is driven straight and the driver dose not turn the steering wheel, the specified voltage that is output at this time is determined by the ECU to indicate the neutral position of the steering. Therefore, it dose not apply current to the DC motor.

b. When Steering

When a driver turns the steering wheel to the right or left, the twist that is created in the torsion bar creates a relative displacement between detection ring 2 and detection ring 3.
This change is then converted into two electrical signals, VT1 and VT2, and sent to the EPS ECU.
When the steering wheel is turned to the left, a voltage that is lower than the neutral is output as shown in the diagram on the right.
The direction of the turn is thus detected according of steering assist is determined by the magnitude of the output value.



193CH30

EPS ECU

1) EPS Control

- The EPS ECU receives signals from various sensors, judges the current vehicle condition, and determines the assist ampere to be applied to the DC motor accordingly.
- On models equipped with the VSC+ (Vehicle Stability Control +) system, the EPS ECU effects cooperative control with the skid control ECU, in order to control the steering assist torque in accordance with information received from the skid control ECU. This facilitates the steering operation of the driver, thus realizing a high level of vehicle stability.
  For an outline of VSC+, refer to CH-40.

2) EPS ECU Temperature Sensor

A temperature sensor is provided in the EPS ECU to detect if the ECU overheats.
If the sensor detects that the ECU has overheated, the assist current to the DC motor is reduced in order to lower the temperature.

3) Diagnosis

- If the EPS ECU detects a problem in the EPS system, the master warning light that corresponds to the function in which the malfunction has been detected light up to alert the driver of the malfunction.
- At the same time, the DTCs (Diagnosis Trouble Codes) are stored in memory. The DTCs can be accessed the use of the intelligent tester II.

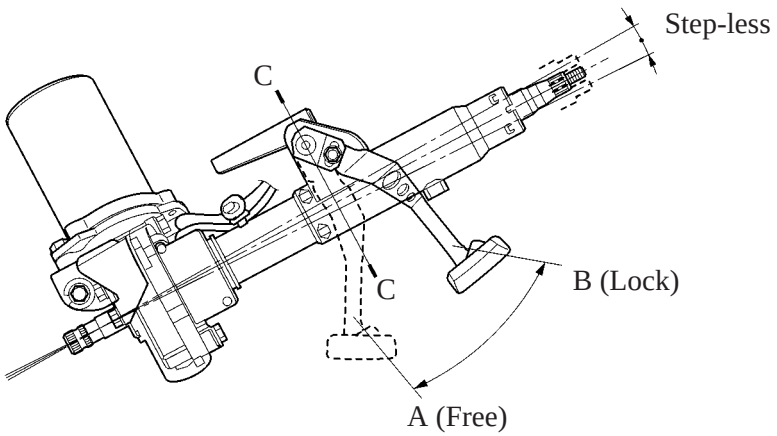
For details of the DTCs that are stored in EPS ECU memory, see the Prius Repair Manual (Pub. No. RM1076E).

4) Fail-Safe

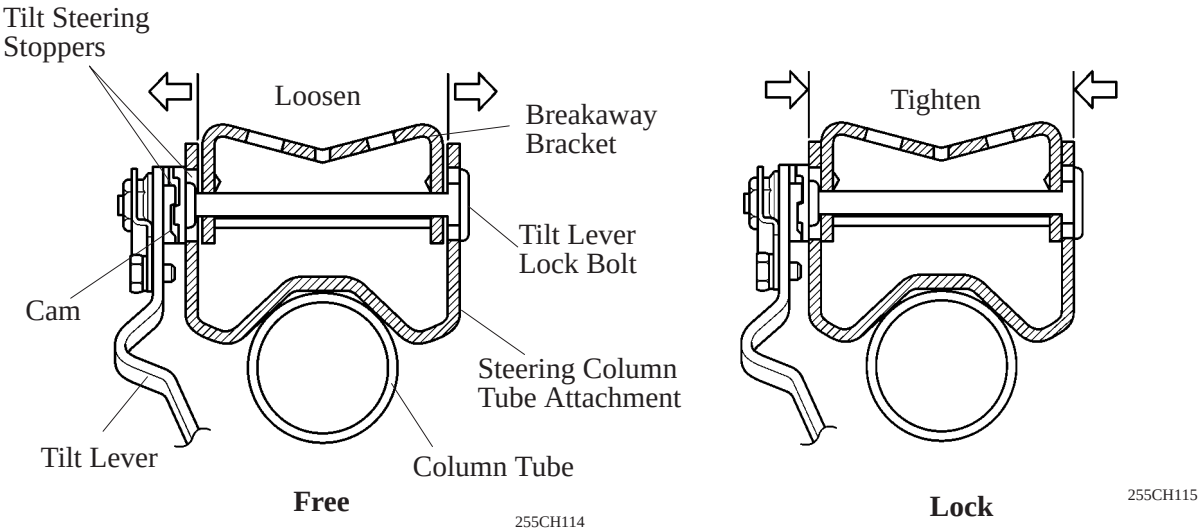
- If the EPS ECU detects a malfunction in the EPS system, it turns ON the master warning light on the combination meter and sounds a buzzer. At the same time, the EPS ECU causes a PS warning to appear on the multi-information display to inform the driver, and enters the fail-safe mode. As a result, the EPS system operates in the same manner as manual steering.
- In case of a malfunction, the fail-safe function activates and the ECU effects various controls. For details refer to the Prius Repair Manual (Pub. No. RM1076E).

Tilt Mechanism

The tilt mechanism mainly consists of a tilt lever, steering column tube attachment, breakaway bracket, tilt lever lock bolt and tilt steering stoppers.
When the tilt mechanism is in its locked state, the tilt lever at B position causes the cam of the tilt steering stoppers to tighten the steering column tube attachment.
When the tilt mechanism is in its free state, the tilt lever at A position causes the cam of the tilt steering stoppers to loosen the steering column tube attachment.



▶ C – C Cross Section ◀



Energy Absorbing Mechanism

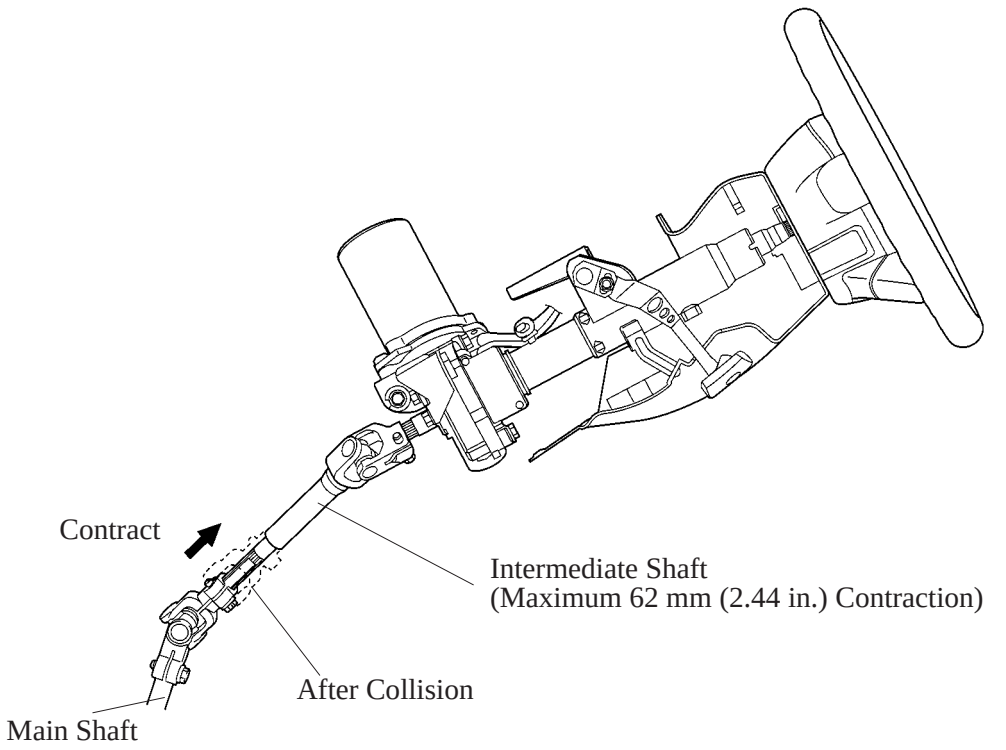
1) Constriction

The energy absorbing mechanism in the steering column consists of breakaway bracket, intermediate shaft, main shaft, and column tube. The steering column is mounted onto the instrument panel reinforcement via a breakaway bracket. The steering column and the steering gear box are connected with a contractile intermediate shaft.

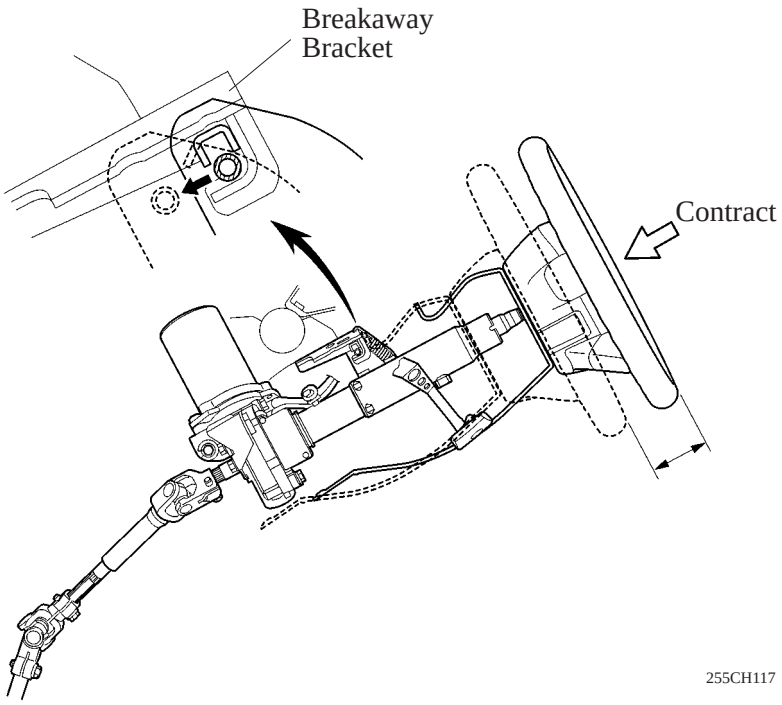
2) Operation

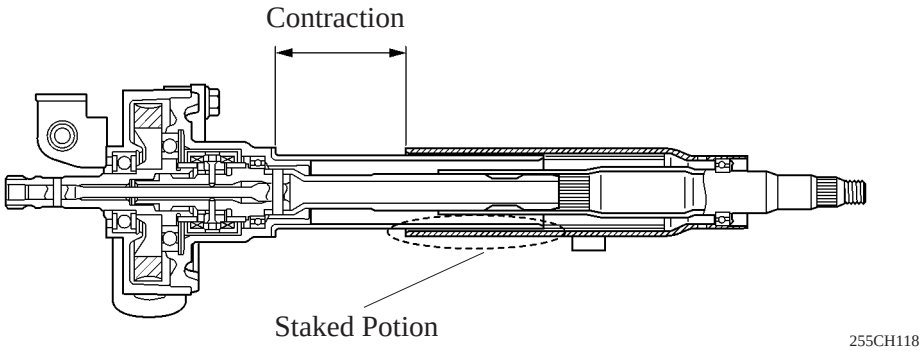
When the steering gear box moves during a collision (primary collision), the intermediate shaft contracts, thus reduces the chance that the steering column and the steering wheel protrude into the cabin.
When an impact is transmitted to the steering wheel in a collision (secondary collision), the steering wheel and the driver's airbag help absorb the impact. In addition, the breakaway bracket separates, and the column tube contracts. At this time, the friction resistance of the sliding portion, which is staked to the column tube, absorbs the energy. This sequential energy absorbing mechanism helps absorb the impact of the secondary collision.

▶ Primary Collision ◀

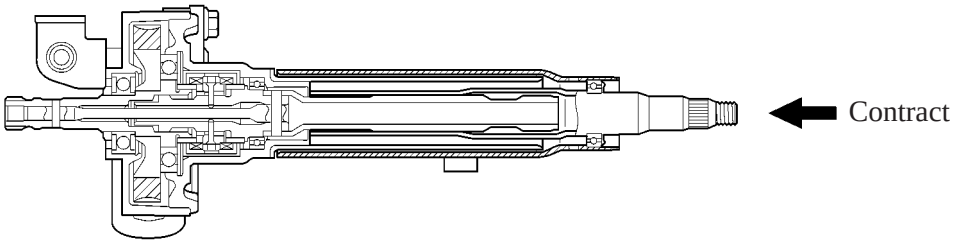


▶ Secondary Collision ◀





Before Collision



After Collision
(Maximum Contraction)