



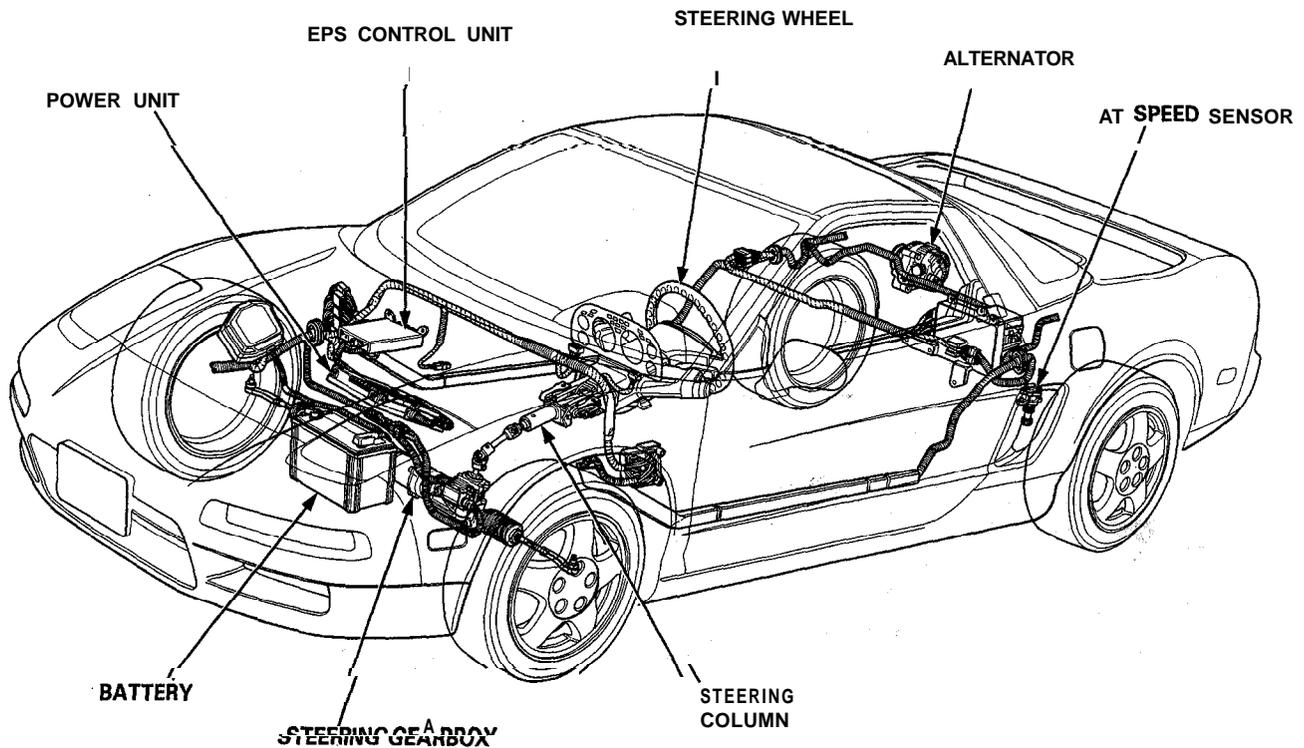
System Description

Electrical Power Steering (EPS)

Outline

The NSX uses an electric motor-driven power steering, which possesses the characteristics best suited for a mid engine automobile. This system is a power-assisted steering device, with a motor inside the steering gearbox driven by the control unit and power unit. Its distinctive features are described below:

- Minimized loss of engine horsepower are decreased, fuel consumption.
- A linear steering feel and the reduction of kick back.
- Since it requires no complicated hydraulic piping, etc., the system is compact and light in weight.

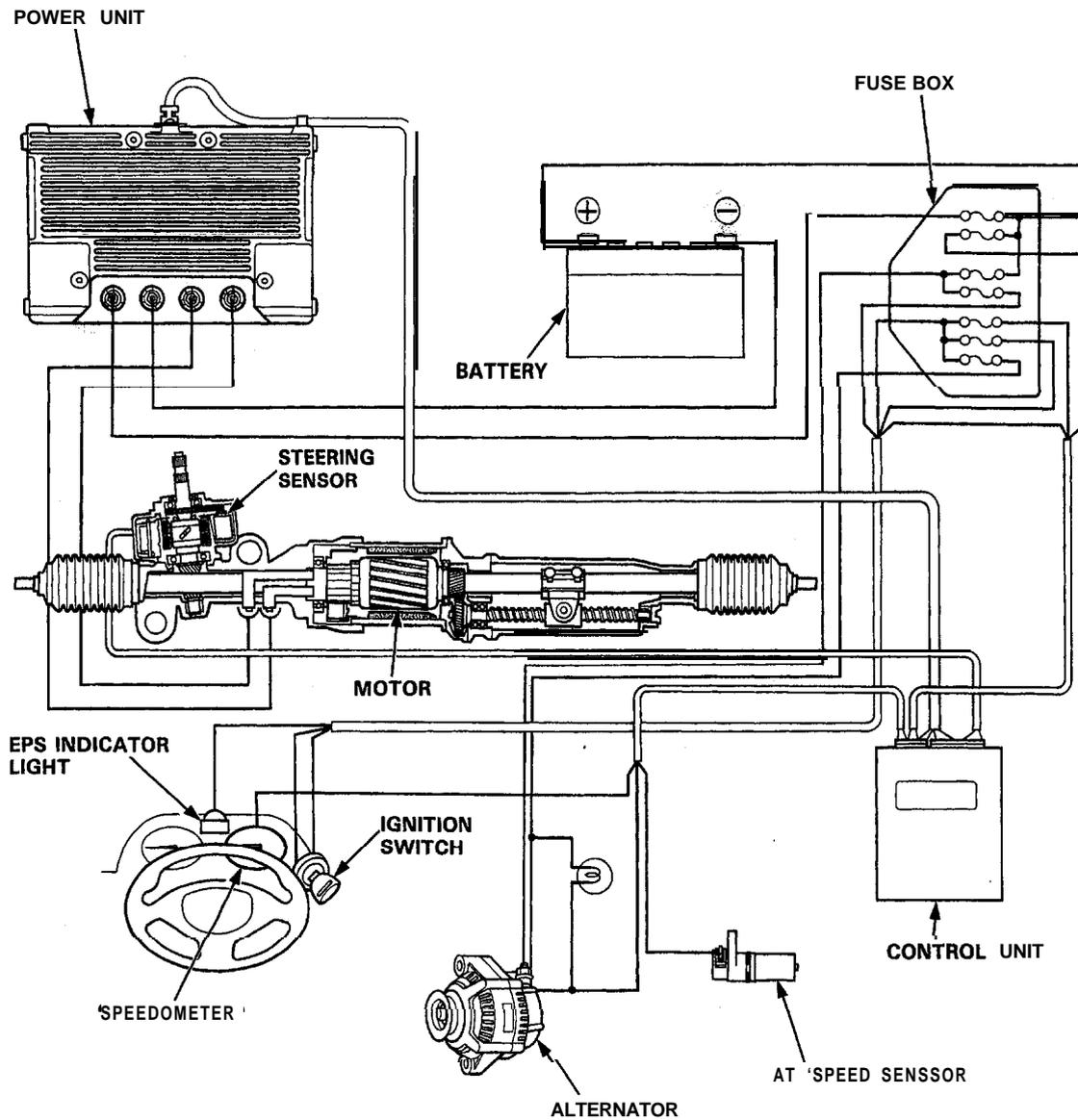


System Description

-Major Components

The Electrical Power Steering system is composed of the following major components:

- A steering gearbox that converts rotary operation of the steering wheel into transverse operation via a rack and pinion mechanism. Steering sensors and an actuating motor are incorporated.
- A control unit that computes the optimum amount of power assistance, taking into account steering torque, steering speed, and vehicle speed. Selfdiagnosis functions are included.
- A power unit that drives the motor according to the signals from the control unit. A current sensor is built in to give feedback information to the control unit. Two relays shut off the power if a problem in the system occurs.
- Two speed sensors, the speedometer and the automatic transmission sensor, send vehicle speed information to the control unit. Two sensors are used as a double-check.





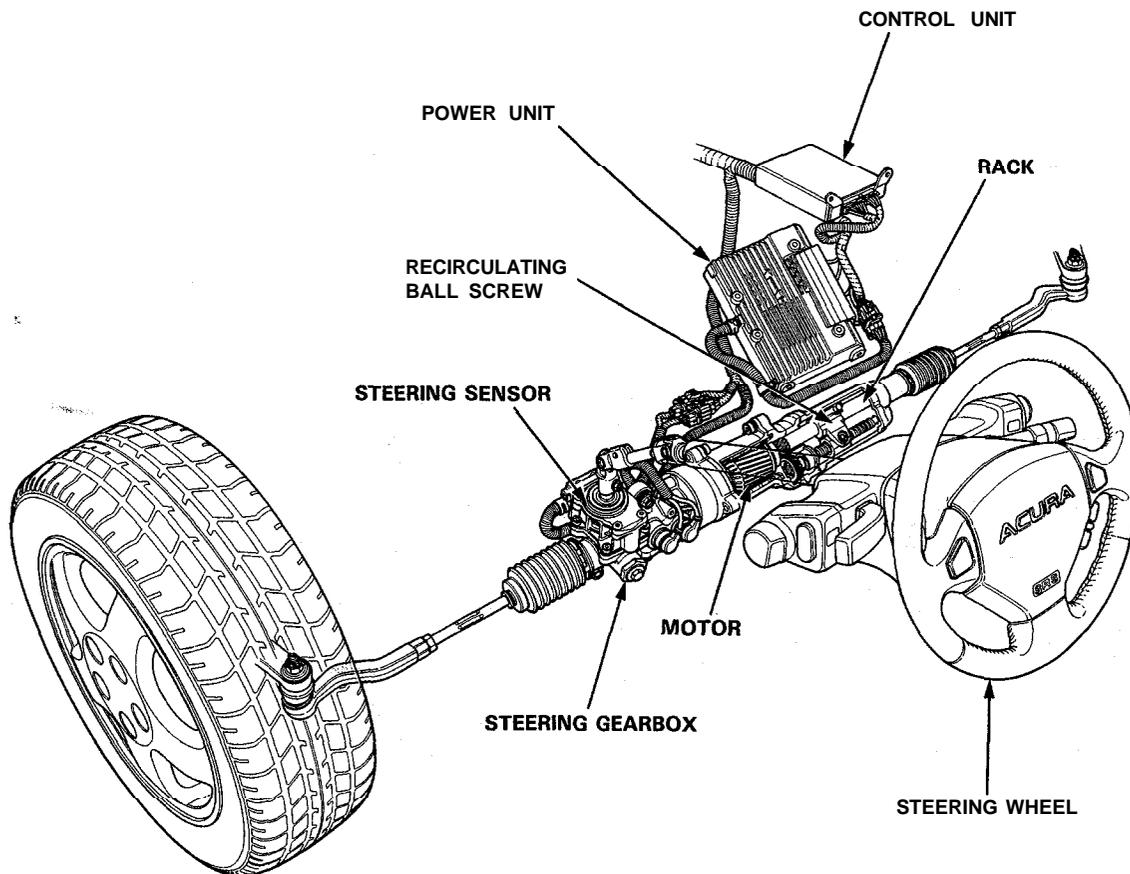
-System Operation

Manual Steering Operation

Steering wheel input rotates the pinion of the gearbox through the universal joint. Due to the rack and pinion mechanism, the rotation of pinion is converted into a transverse motion at the rack, which steers the front wheels through the tie-rods and knuckles the same as an ordinary rack and pinion system.

Assisting Operation

In addition to the manual steering operation, the steering sensor on the pinion shaft transmits a signal to the control unit when it receives a steering input. The control unit calculates an adequate motor control with addition of speed signals the two speed sensors, then transmits a control signal to the power unit. Based on the signal from the control unit, the power unit drives the motor inside the gearbox. The torque generated by the motor is transmitted to ball screw through gears and converted into an assisting thrust in the axial direction of rack. The assisting thrust acts in the steering direction and lessens the steering force required at the steering wheel.



System Description

*Function and Operation

Steering Sensor

The steering sensor consists of a torque sensor, an interface, and the rotation sensor.

Torque Sensor

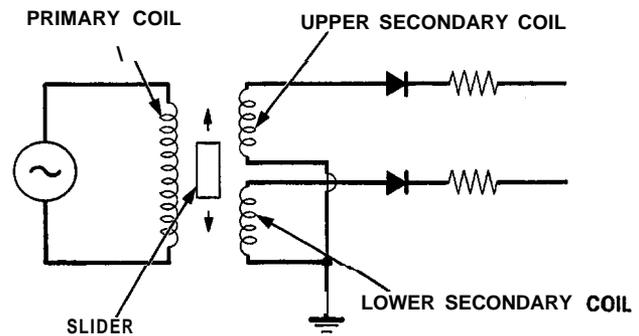
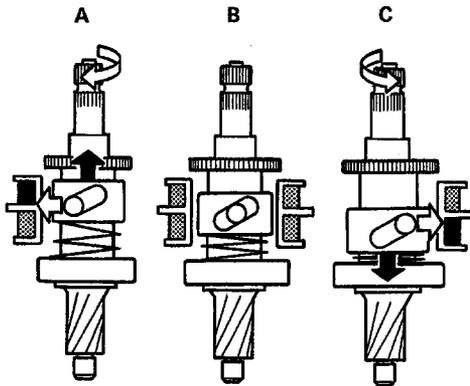
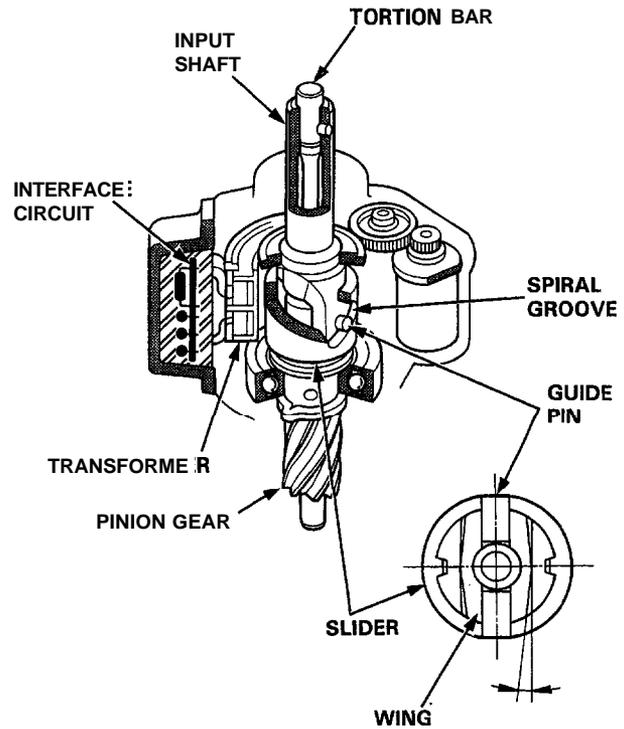
The torque sensor converts steering torque input and its direction to voltage signals, in conjunction with the interface.

A torsional force caused by steering operation is converted to an axial movement of a slider core. A variable differential transformer is installed around the slider core. Within the transformer are three coils, primary coil on the inside, and two secondary coils, one for right turns and one for left turns.

Alternating current is passed through the primary coil when the system is energized. The amount of mutual induction from the primary coil to the secondary coils changes depending on the position of the slider coil. The input shaft and the slider are one piece. Rotation of the shaft moves the slider in a circular direction. The pinion is turned via the torsion bar. The slider core is installed on the pinion shaft on grooves, and turns with the pinion shaft.

When there is little resistance, the input shaft, torsion bar, pinion shaft, and the slider core turn together to the same angle. The slider core does not move up/down.

When there is resistance on the input shaft (hard to steer situation), and the slider pin is turned at an angle by the steering wheel, the torsion bar is twisted due to the resistance. Accordingly, the pinion shaft turns at a smaller angle. The difference in the turning angles changes the position of the slider pin in the groove, forcing the slider core upward or downward, depending on the direction of the turn.



DWG No.	Steering condition	Slider movement	Induction voltage on secondary coil
A	Steering to right (load steering)	Upward shift	Voltage on upper coil increases and that on the lower decreases
B	Advancing straight ahead (no load steering)	Neutral	Voltage on upper and lower coils are equal
C	Steering to left (load steering)	Downward shift	Voltage on lower coil increases and that on the upper decreases

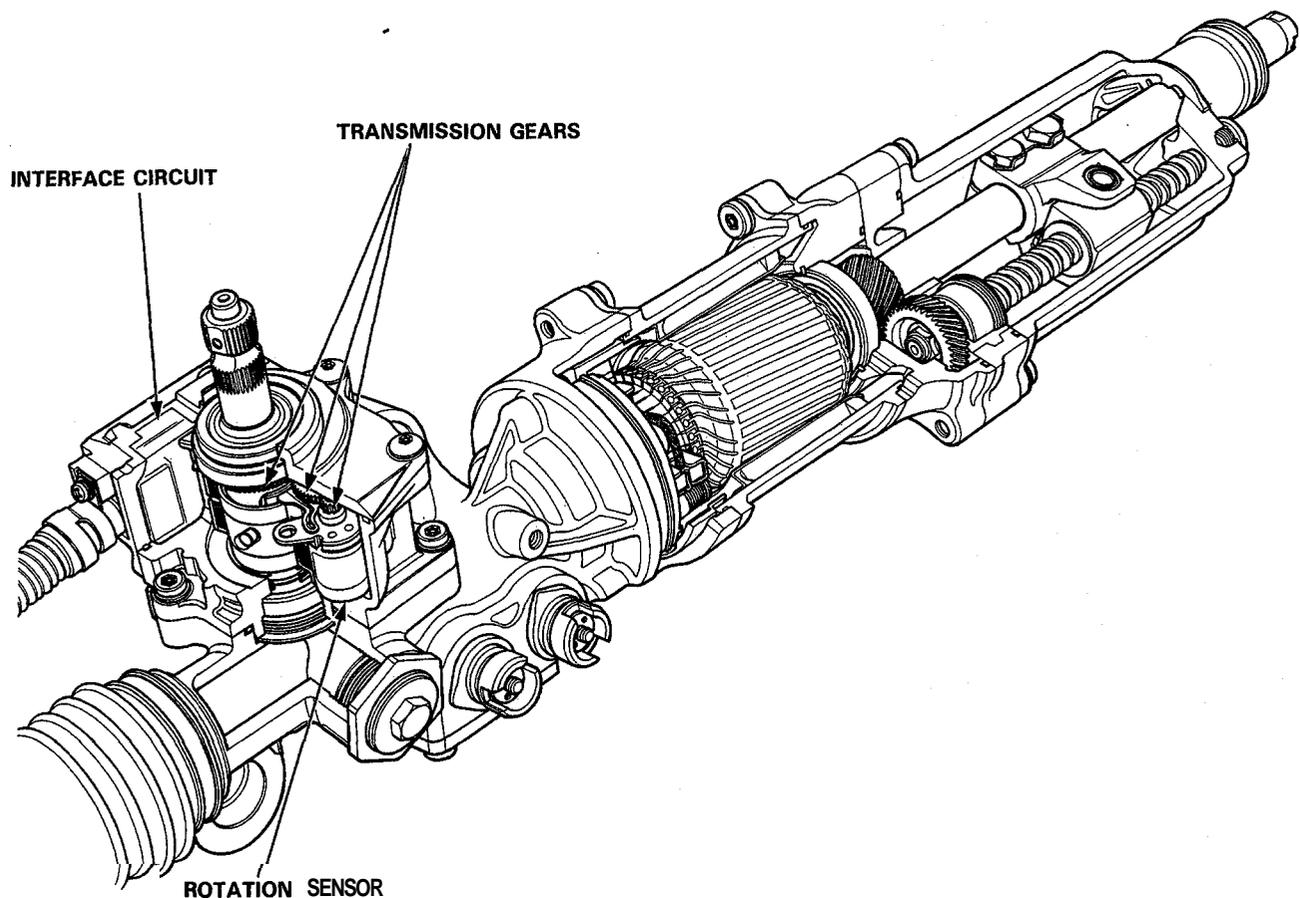


Rotation Sensor

The rotation sensor is housed inside the steering gearbox near the pinion. It converts the rotation speed and direction of steering into voltage signals. The rotation of the steering wheel is transmitted to the pinion, which drives the sensor by accelerating its speed through the three pieces of transmission the gears. Acting as a kind of direct current generator, the sensor generates direct current voltage proportionately with the rotational speed of the pinion. When the steering direction is reversed, the voltage is generated in the opposite direction. No power is generated when driving straight ahead without turning the steering wheel.

Interface Circuit

The interface circuit is housed inside the steering gearbox near the pinion. It rectifies and amplifies the signals from the torque sensor and the rotation sensor and transmits steering signals to the control unit. A phase compensating circuit is also built in, which changes the output signals in accordance with the drive signals input from the control unit.



System Description

Control Unit

The control unit receives input signals from the car's speed sensors, torque sensor and steering rotation sensor, and outputs control signals to the power unit. It performs a multitude of control works including a circuit which diagnoses troubles in each functional part of the system and the control unit itself. The control unit operates the system while the engine is in the process of starting, on receipt of voltage generated by the alternator. The system remains operational if the engine stalls with the ignition switch in ON position.

< Basic Control >

- (1) Travelling speeds are compiled into data, receiving input signals from the car's speed sensors.
- (2) The magnitude and direction of torque are compiled into data, receiving input signals from the torque sensor.
- (3) The rotational speed and direction of steering are compiled into data, receiving input signals from the steering rotation sensor.
- (4) Determination of motor torque data from the prescribed assisting force map, based on the car speed data, steering rotational speed data and the steering torque data.
- (5) Changeover of control modes and output of control signals to the power unit, based on data on car speed, direction of torque and rotational direction of steering.

Normal Control Mode:

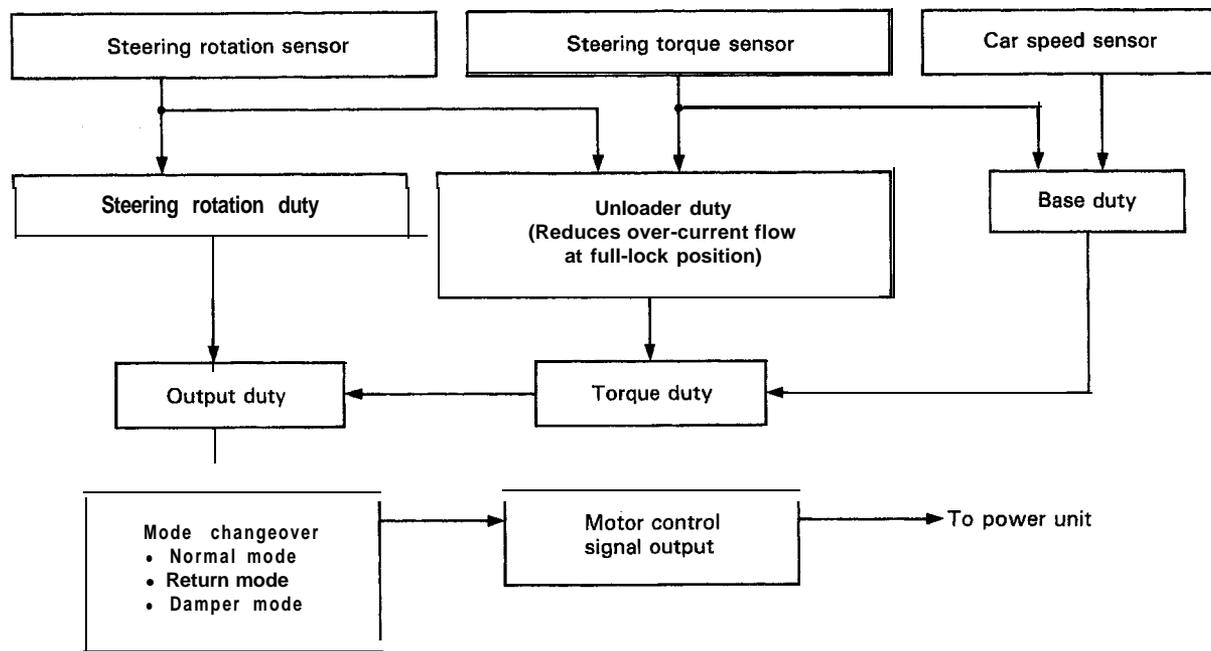
The rotational direction of motor is determined after changing over to the left/right steering mode in accordance with torque direction data. The mode is switched to the straight ahead mode when the output data is zero.

Return Control Mode:

According to torque direction data and steering rotational direction data, the mode is changed over to the return control mode to improve the steering return characteristic.

Damper Control Mode:

According to car speed data, torque value data and steering rotational speed data, the mode is changed over to the damper control mode to improve the convergence property of the steering.





Self-Diagnosis Function

The EPS control unit monitors the system inputs and outputs, and the driving current of the motor. If there is a problem in the system, the control unit turns the system off by actuating the relay in the power unit. Power assist stops and normal manual steering operation resumes. The control unit also turns the EPS indicator light on to alert the driver, and memorizes the problem in the form of a code. Connecting the terminals of the service check connector with a jumper wire enables the EPS indicator light to blink the problem code when the ignition switch is turned on.

Unloader Control

If the steering wheel is turned fully and held in the full-lock position, the steering torque reaches the maximum point, and an over-current flows to the motor and the power unit. The control unit detects this and reduces the current flow to the motor.

Average Moving Current Control

The electric current flow to the motor is estimated from the current values detected by the current sensor, and the average current is obtained at two second intervals. The motor driving current is suppressed when the average current value exceeds a predetermined marginal value. The control unit regulates the motor current during continuous loading to suppress any excessive temperature rise in the power unit and the motor.

Over-Voltage Control

If there is an excessive increase in power source voltage due to a poor battery condition, an alternator voltage regulator problem, etc., the motor assisting force increases, resulting in excessive control. To prevent this, the control unit signals to the power unit are corrected to ensure that adequate assisting force is generated.

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System Description

Power Unit

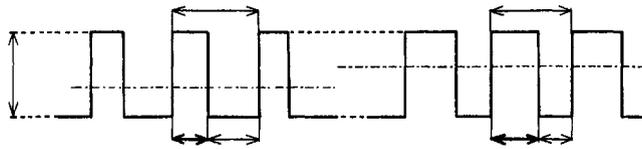
The power unit consists of a driving circuit, current sensor, field effect transistor (FET) bridge circuit, and two relays. It receives control signals from the CPU and controls the driving current of the motor. The driving circuit controls the rotational direction and speed of the motor by driving the FET bridge circuit with a pulse width modulation (PWM) method on receipt of an input of driving signals from the control unit.

<Rotational Speed Control >

The PWM driving signal is a digital signal repeating the process of voltage ON/OFF at a constant frequency, which changes the ratio of ON time per one cycle of this signal. The ratio is called the duty ratio. When there is a change in duty ratio, the average voltage changes as smoothly as an analog type. The ratio of digital signal voltage (E) and the average voltage (V) is called the duty ratio (δ). Its relationship is expressed by $V = E \times \delta$. When the duty ratio is low, the rotational speed of motor is slow. As the duty ratio increases, the rotational speed increases to increase the torque.

(Motor rotational speed slow)

(Motor rotational speed fast)



<Rotational Direction Control >

Normal Mode Control:

The table below shows the normal control mode to control the flow of current from the battery:

Steering condition	FET (1)	FET (2)	FET (3)	FET (4)	Motor operation
Steering to right	ON	OFF	OFF	PWM	Operates in direction steering to the right
Straight ahead	OFF	OFF	OFF	OFF	Stops
Steering to left	OFF	ON	PWM	OFF	Operates in direction steering to the left

("PWM" in the table indicates PWM control based on torque sensor data).

Return Control Mode:

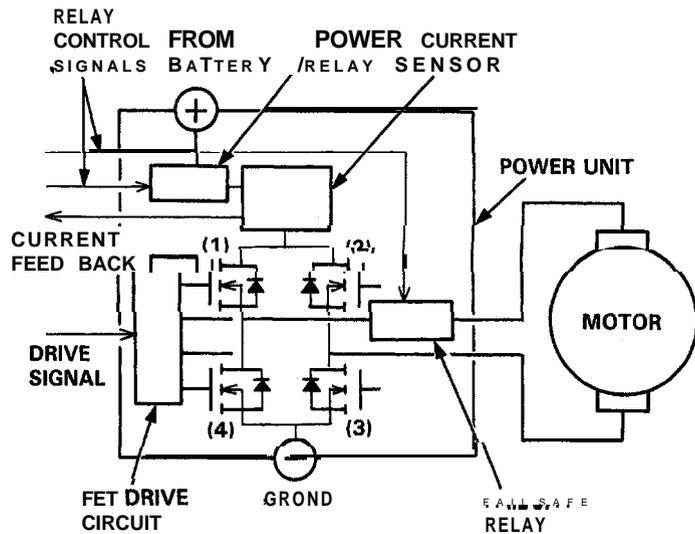
Return control mode improves the steering return characteristics. ("PWM" in the table denotes PWM control based on torque sensor data while "PWM-r" PWM control based on rotation sensor).

Damper Control Mode:

The damper mode control which improves the convergence of steering, is performed with damper mode signals from the control unit. In this mode, a short current circuit is formed on the motor side by turning off FET (1) and (2), and on FET (3) and (4), which suppresses the returning speed of the steering.

<Motor Driving Current Control >

A current sensor, power relay and fail-safe relay are built into the power unit. The current sensor detects motor driving current and transmits data to the control unit. If there is a problem in the system, a cut-off signal is sent from the control unit to relay, then the relay cuts off motor current to switch to manual steering operation.



Steering condition	FET (1)	FET (2)	FET (3)	FET (4)
Return from right steering to straight ahead	PWM-r	OFF	OFF	PWM
Return from left steering to straight ahead	OFF	PWM-r	PWM	OFF

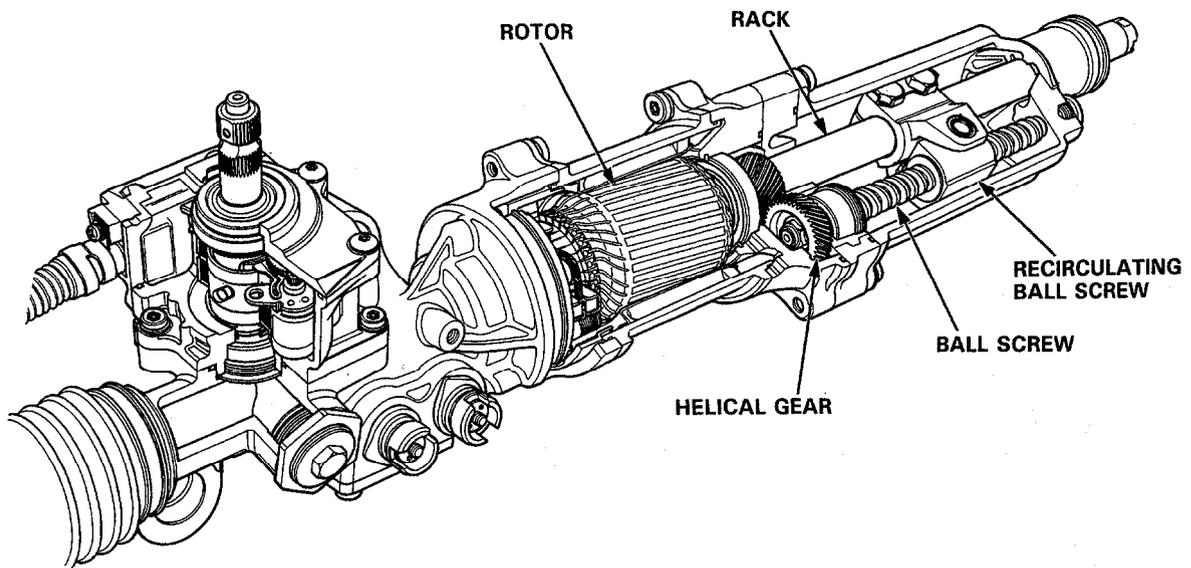


Steering Gearbox

<Motor and Power Assist Mechanism >

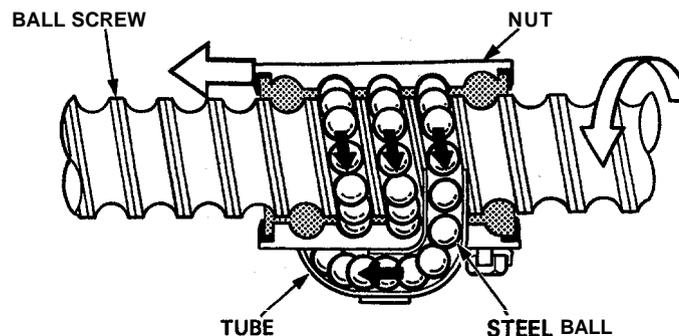
A motor is housed inside the gearbox housing. It consists of a yoke with a permanent magnet fixed in it, a rotor with a field coil, and brushes which pass electricity to rotor commutators. The motor is on the rack shaft of the steering gearbox. The drive current from the power unit flows through the power relay and fail-safe relay to the brushes of the motor. The drive current flows to rotor commutators through brushes, exciting the field coil of the rotor and rotates the rotor with the magnetic action of the permanent magnet inside the yoke. The rotor rotates in the opposite direction when the direction of drive current is reversed.

The rotation torque of the motor is transmitted to the ball screw through the helical gear. The rotation torque on the ball screw is converted into assist thrust in the direction of steering rack by the recirculating ball screw. The recirculating ball screw acts to reduce the steering thrust put into the steering rack through the joint to lessen the steering force required at the steering wheel.

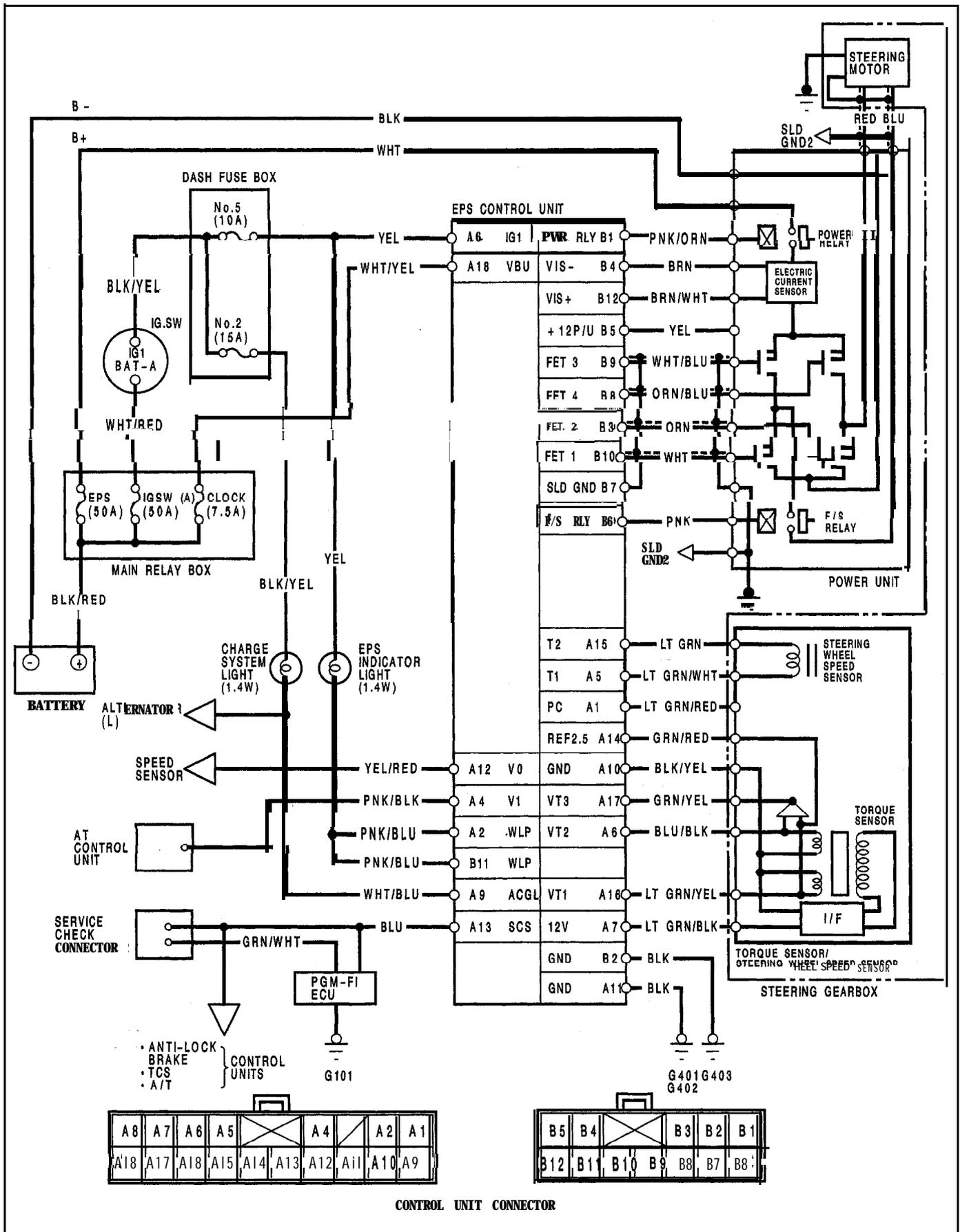


<Recirculating Ball Screw >

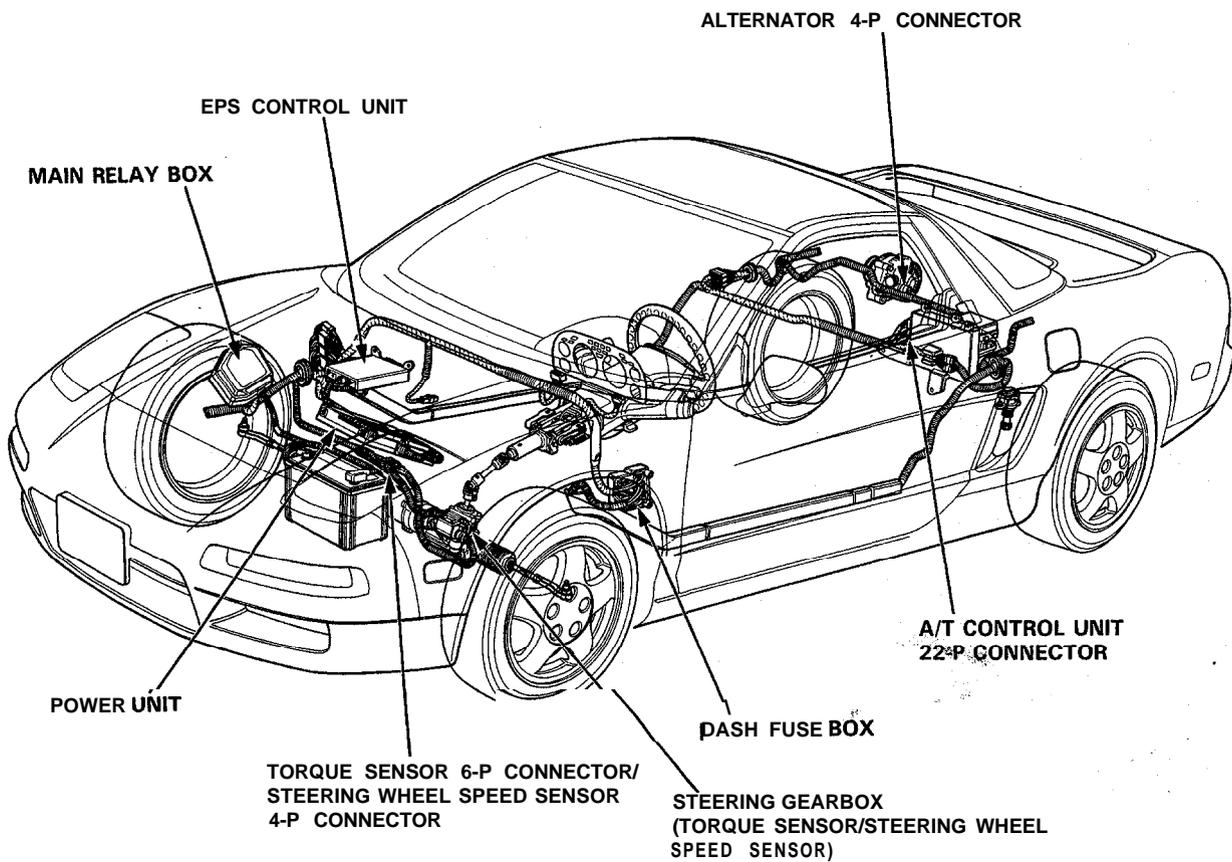
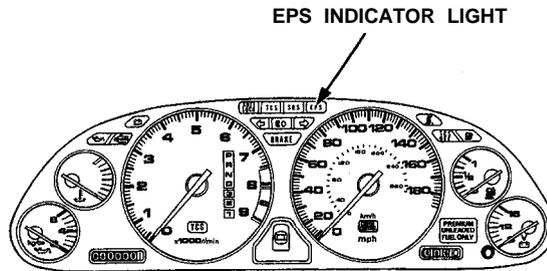
The recirculating ball screw is constructed so that balls roll between the screw shaft and the nut, and those coming out of the screw face enter the screw groove again through a tube for recirculation. The rotation torque on the shaft is converted into thrust in axial direction as the slope of the screw shaft presses against the nut through balls. Since the torque conversion is made in this method through the screw shaft and balls, the friction is small, high transmission efficiency is obtained for both the forward and backward directions, and the steering feels identical to the ordinary manual steering. Furthermore, since the force from the backward direction (force pressing the steering rack) is converted into the rotation torque of the screw shaft, instantaneous kick-back from road surface will rapidly rotate the motor. In such a rapid rotation, the inertia of the motor increases, which acts to reduce the kick-back. Any great kick-back will be transmitted from the steering rack to the torque sensor on the pinion, which acts to twist the pinion shaft in the same direction as the input direction of kick-back. As a result, the motor operates the kick-back to reduce assist force.



Circuit Diagram



Wiring Locations



Troubleshooting

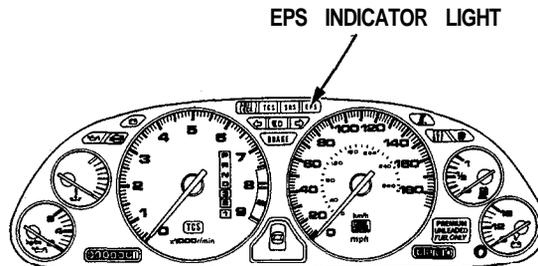
-Troubleshooting Precautions

- Always use the test harness to verify the resistance, voltage, current and other electrical characteristics for the EPS control unit, torque sensor, steering circuit sensor, power unit, and their connectors.
The test probe must not make direct contact with the connector terminals.
- Make sure that the terminals are not bent or damaged in any way when a test harness is installed.
- A digital circuit tester must be used to perform the inspections.
An analog circuit tester must be used only when this procedure is indicated in the specification figures.
- The EPS system connector should not be disconnected except when necessary.
- Inspect the connection condition and ground of each EPS system connector before performing the troubleshooting procedures.

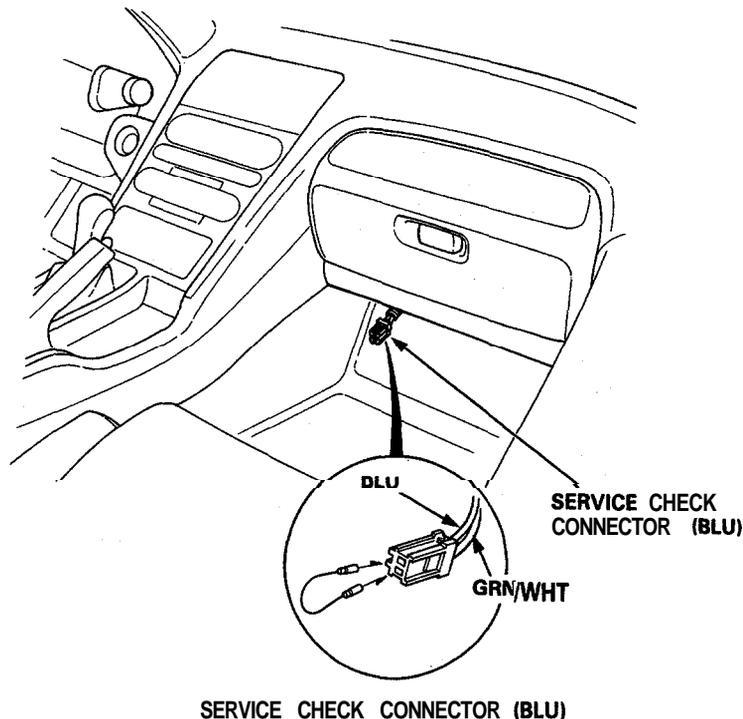


-Troubleshooting Procedures

Under normal conditions, the EPS indicator light in the gauge assembly comes on when the ignition switch is turned to the ON position, then goes off after the engine is started. This indicates that the bulb and its circuits are operating correctly.



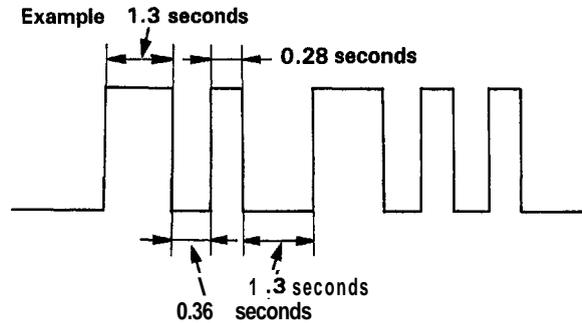
When the EPS control unit senses an abnormality in the system, the control unit memorizes the problem, the EPS indicator light blinks at equal intervals, and the power steering assist is turned off. When the EPS indicator light has been reported on, connect the two terminals of the service check connector with a jumper wire. Then turn on the ignition switch and observe the blinking frequency.



Troubleshooting

Problem Code Display

When the service check connector terminals are connected with a jumper wire, the EPS control unit blinks the EPS indicator light to indicate the problem code. The problem codes are indicated by a series of long and short blinks. One long blink equals 10 short blinks. Add the long and short blinks together to determine the problem code, then refer to the Troubleshooting Chart on page 17-51.



The control unit can memorize any number of simultaneous problems. The problem codes are repeated sequentially beginning with the lowest number.

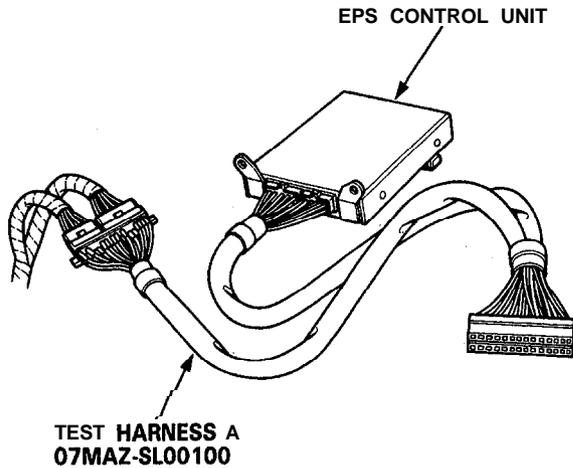
The problem code is stored in the control unit memory even when the ignition switch is turned off. After repairing the EPS system, disconnect the CLOCK fuse in the relay box for more than 10 seconds to reset the EPS control unit memory.



-Test Harness Installation

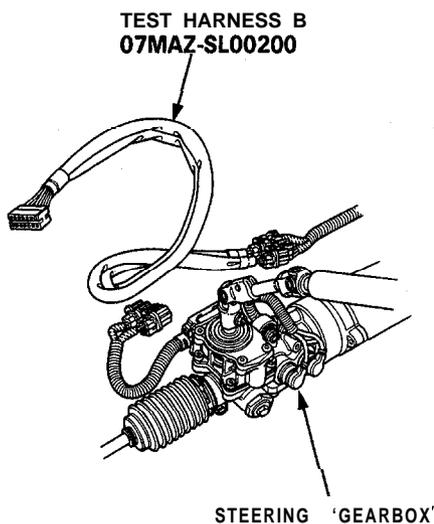
Test Harness A

- Remove the glove box and disconnect the EPS control unit connector. Connect test harness A.



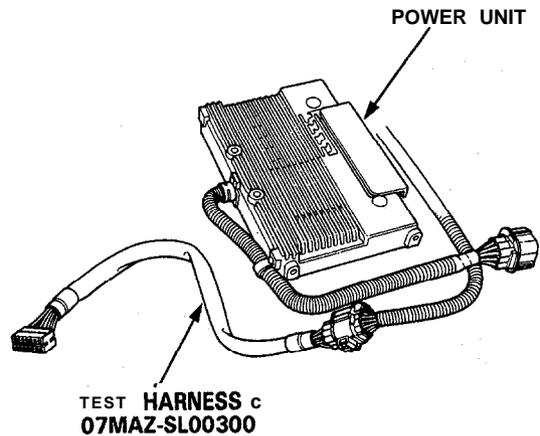
Test Harness B

- Disconnect the torque sensor and steering speed sensor connectors and connect test harness B.



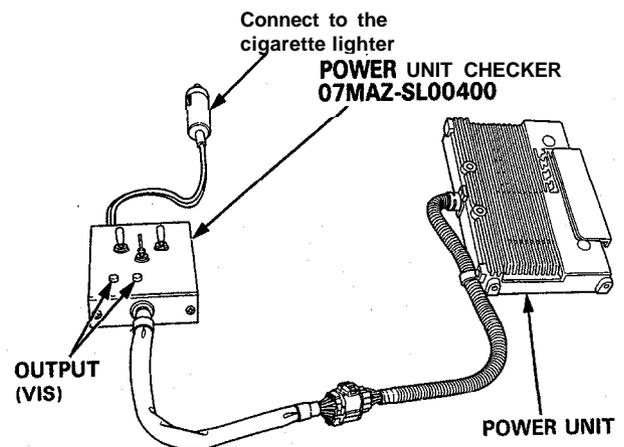
Test Harness C

- Pull the carpet back from the passenger's side and remove the power unit cover. Disconnect the connector and connect test harness C.



Power Unit Checker

- Pull the floor carpet back from the passenger's side and remove the power unit cover. Disconnect the connector and connect the power unit checker.
- Remove the cigarette lighter and connect the power unit checker.



Flowcharts

Steering is heavy.

Start the engine.

Is the EPS indicator light on?
YES

Refer to the Troubleshooting Chart (see page 17-51).

NO
Check the tire pressure and front wheel-alignment.

Are they normal?
NO
Correct the air pressure or wheel alignment.

YES
Park the vehicle on a level surface with the wheels pointing straight ahead.

Measure the stationary swing operation load. Refer to the chart on the left.

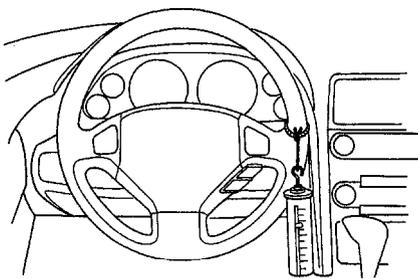
Is it within specification?
NO
Inspect the mechanical steering system.

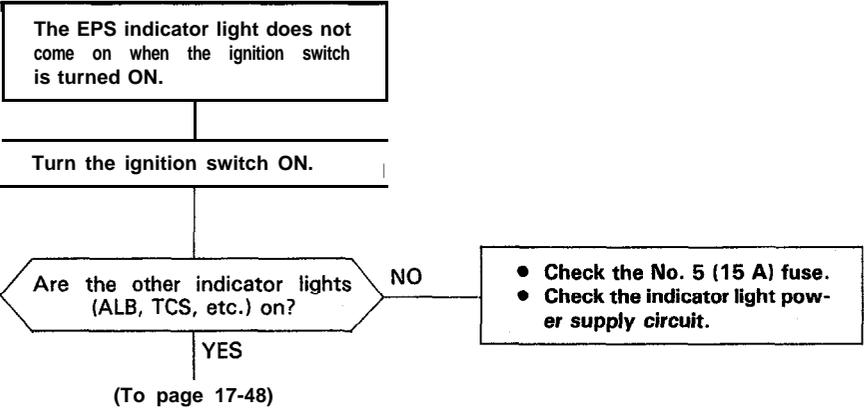
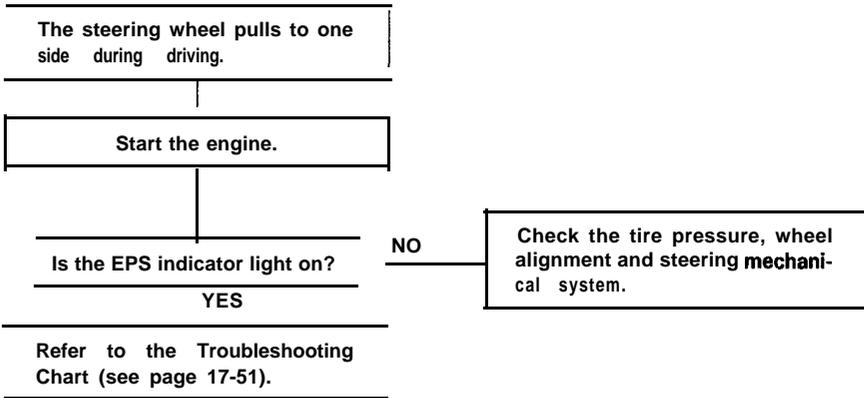
YES
EPS system is OK.

- **Power Assist Check with Car Parked**
Connect a spring scale to the steering wheel and turn the wheel. Read the measurement when the front wheels start to move.

Operation standard

Condition	Stationary swing operation load
Without power assist (engine off)	12 kg (24.46 lb) maximum
With power assist (engine running)	4.2 kg (9.26 lb) maximum





(cont'd)

Troubleshooting

-Flowcharts (cont'd)

(From page 17-47)

Turn the ignition switch OFF and connect test harness A.

Turn the ignition switch ON.

Ground the A2 terminal to the body.

Is the EPS indicator light on?

YES

NO

Turn the ignition switch OFF.

Remove the gauge assembly and inspect the EPS indicator bulb.

Is the bulb burned out?

YES

NO

Turn the ignition switch ON.

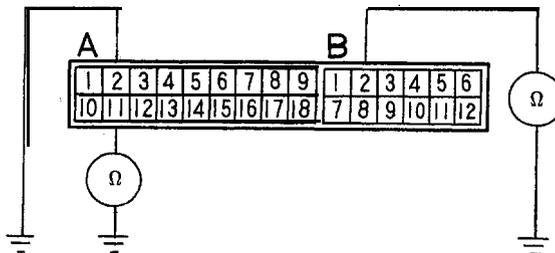
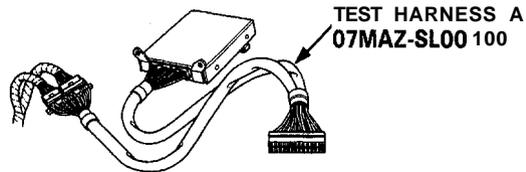
Ground the No. 8 (PNK/BLU) terminal of the 30-P gauge assembly connector to body.

Is the EPS indicator light on?

NO

YES

Repair open in the **PNK/BLU** wire between the gauge assembly and EPS control unit.



Check the continuity between terminals **B2** and **A1** and the body ground. If continuity is present, replace the EPS control unit. If there is no continuity, check the ground of terminals **B2** and **A1**.

Replace the indicator light bulb.

PNK/BLU WIRE



View from terminal side

The circuit in the gauge assembly is defective.



The EPS indicator light stays on after the engine is started.

Start the engine.

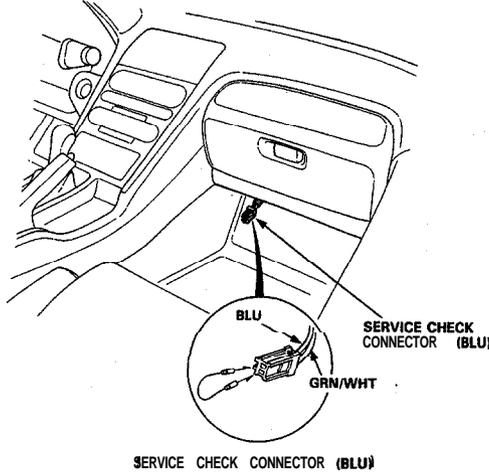
Is the charging system light off?

NO
Check the charging system (see section 23).

YES

Stop the engine.

Short the service check connector and turn the ignition switch ON.



Is a problem code displayed?

YES
Refer to the Troubleshooting Chart (see page 17-51).

NO
Turn the ignition switch OFF.

Disconnect EPS control unit connectors A and B.

Turn the ignition switch ON.

Is the EPS indicator light off?

NO
Repair short to ground in the PNK/BLU wire between the gauge assembly and the EPS control unit.

YES

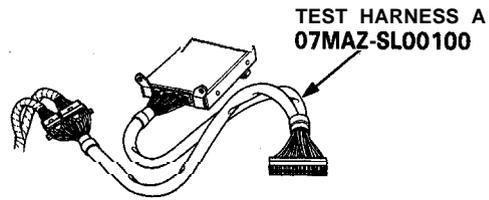
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Troubleshooting

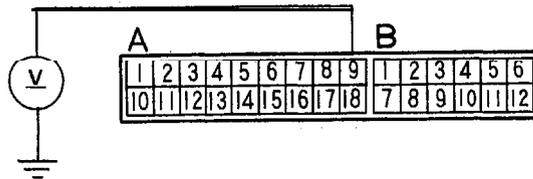
Flowcharts (cont'd)

(From page 17-49)



Turn the ignition switch OFF and connect test harness A.

Start the engine and check the voltage between the A9 terminal and body ground.



Is there more than 12 V?

NO

Repair open in the **WHT/BLU** wire between the EPS control unit and the alternator.

YES

Check the EPS control unit power supply (see page 17-59). If it is O.K. substitute a **known-good** EPS control unit and recheck.



-Troubleshooting Chart

The EPS has been reported on:

Connect the service check connector with a jumper wire (see page 17-43). Turn on the ignition switch.
Read the problem code and perform the troubleshooting according to the troubleshooting chart below.

Page reference	Problem code	EPS Indicator light	System indicated	Related components								
				EPS control unit	Torque sensor	Steering wheel speed sensor	EPS power unit	Speed sensor signal	Wire harness	No 2 (15 A) fuse	EPS motor	
17-52	11	☉	Torque sensor (VT ₁ , VT ₂)	○	0					0		
	12	☉	Torque sensor (VT ₃)	0	0					0		
	13	☉	Torque sensor (VTA)	0	0					0		
	14	☉	Torque sensor (REF 2.5)	0	0					0		
17-54	21	☉	Steering wheel speed sensor	0		○				0		
17-56	22	☉	EPS power unit	○		0	○			0		0
17-59	31	○	Power supply (ECU ignition input)	0				○		0	0	
17-60	33	☉	Speed sensor signal. input	0					○	0		
17-62	23,34 41,42 43,44	☉	EPS control unit	○								

Troubleshooting

-Flowcharts

Problem code 11, 12, 13 and 14:
 • Torque sensor related problems.

Turn the ignition switch OFF.

Connect the EPS test harness A.

Turn the ignition switch ON.

Check the voltage between the A7 (+) and A10 (-) terminals.

Is there more than 8.5 V?

NO

Substitute a known-good EPS control unit and recheck.

YES

Position the steering wheel so the front wheels are pointing straight ahead. Release the steering wheel and check the voltage between the terminals indicated in the chart on the right and A10 (-) terminal.

Turn the steering wheel to the left side and gradually apply force when the wheel is turned all the way to the left. At this time, check the voltage between the terminals indicated in the chart on the right and A10 (-) terminal. Turn the steering wheel to the right and use the same method to check the voltage.

Are all the voltages within the standard values?

YES

Substitute a known-good EPS control unit and recheck.

NO

(To page 17-53)

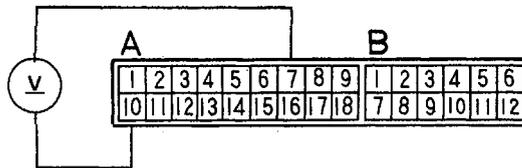
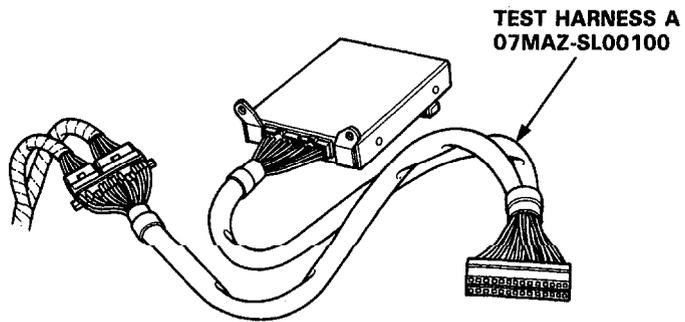


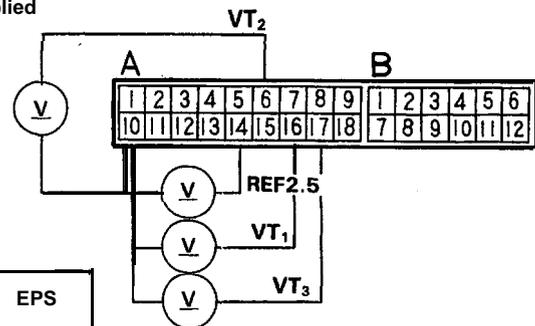
Chart of Standard Output Values

Test harness A terminal No. (Name)	Standard Value (V)		
	Straight ahead	Turned to the left	Turned to the right
A16 (VT ₁)	(*1)2.82 ± 0.55	(*1)-(-0.25)	(*1)-(+0.25)
A 6 (VT ₂)	(*2)2.82 ± 0.55	(*2)-(+0.25)	(*2)-(-0.25)
A17 (VT ₃)	(*3) 2.5 ± 0.30	(*3)-(-2.5)	(*3)-(+2.5)
A14 (REF 2.5)	2.5 ± 0.17	2.5 ± 0.17	2.5 ± 0.17
A10 (GND)			

*: VT when the wheels are straight

NOTE: The indication (* 1)-(-0.25) means that the voltage decreases 0.25 V maximum when the steering wheel is turned compared to the VT₁ value when the wheels are positioned straight ahead.

NOTE: The output variations of VT₁, VT₂ and VT₃ must correspond to the manually applied force.





(From page 17-52)

Turn the ignition switch OFF.

Disconnect the torque sensor 6-P connector from the steering gearbox and connect the test harness B.

Disconnect the test harness A from the EPS control unit only.

Check the continuity between the terminals of the test harness A and B as indicated in the chart on the right.

Is there continuity?

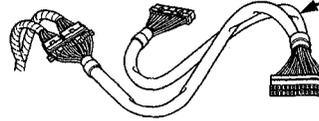
YES

Check the continuity on terminals A6, A7, A10, A14, A16 and A17 individually to body ground.

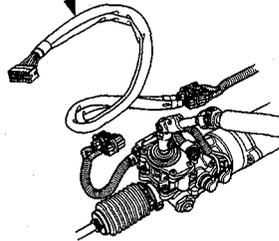
Is there continuity?

Faulty torque sensor. Replace the steering gearbox assembly.

TEST HARNESS B
07MAZ-SL00200



TEST HARNESS A
07MAZ-SL00100



A						B					
1	2	3	4	5	6	1	2	3	4	5	6
10	11	12	13	14	15	7	8	9	10	11	12

1	2	3	4	5	6
7	8	9	10	/	/

Terminal Name	Test harness A terminal No.	Test harness B terminal No.
12v	A7	3
VT ₁	A16	2
VT ₂	A6	1
VT ₃	A17	5
REF2.5	A14	4
GND	A10	6

NO

Repair in the wire with no continuity.

YES

Repair short in the wire with continuity to body ground.

(cont'd)

Troubleshooting

Flowcharts (cont'd)

Problem code 21:

- Steering wheel speed sensor related problem.

Turn the ignition switch OFF and disconnect the ESP control unit connectors.

Connect test harness A to the wire harness side only.

Position the steering wheel so the front wheels are pointing straight ahead.

Measure the voltage between the A5 (+) and A15 (-) terminals.

Turn the steering wheel to the left and check the voltage between the A5 (+) and A15 (-) terminals.

NOTE:

- Turn the steering wheel at an approx. speed of 180° per second.
- Use an analog tester.

Do the voltages match the standard values in the chart on the right?

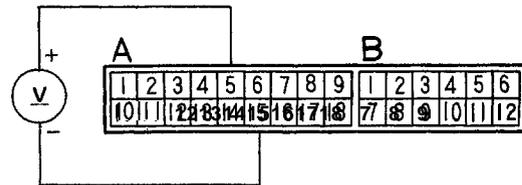
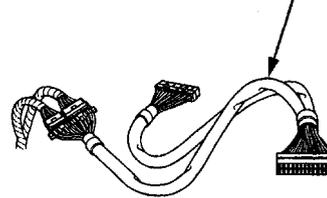
YES

Substitute a known-good EPS control unit and recheck.

NO

(To page 17-55)

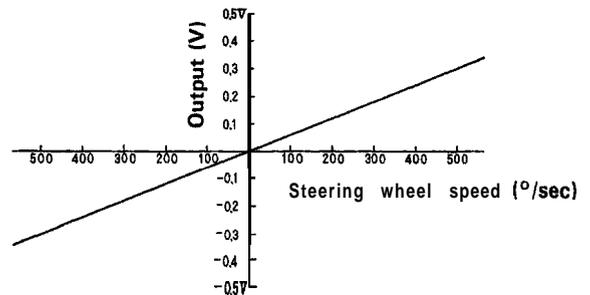
TEST HARNESS A
07MAZ-SL00100



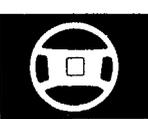
Standard Output Values

Steering wheel operation	Standard
Straight ahead	0 v
Turned to the left	Approx. -0.1 V
Turned to the right	Approx. +0.1 V

Output Characteristics



NOTE: The output must correspond to the steering wheel speed.



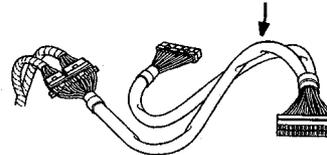
(From page 17-54)

Disconnect the steering wheel angle sensor 4-P connector from the steering gear box and connect test harness B.

Check the continuity between the terminals of the test harness A and B as indicated in the chart on the right:

Terminal Name	Test harness A terminal No.	Test harness B terminal No.
T ₁	A5	10
T ₂	A15	9

TEST HARNESS A
07MAZ-SL00100



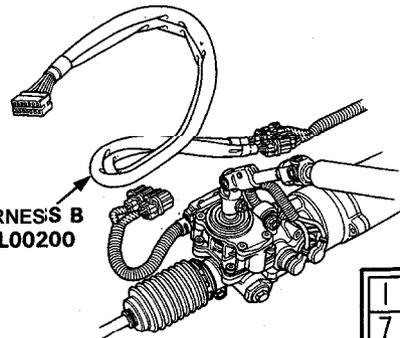
NOTE: Only connect the wire harness side.

Is there continuity? NO

Repair open in the wire with no continuity.

A									B					
1	2	3	4	5	6	7	8	9	1	2	3	4	5	6
10	11	12	13	14	15	16	17	18	7	8	9	10	11	12

Check the continuity on terminals A5 and A15 individually to body ground.



TEST HARNESS B
07MAZ-SL00200

1	2	3	4	5	6
7	8	9	10	/	/

Is there continuity? YES

Repair short in the wire with continuity to body ground.

Faulty steering wheel angle sensor.
Replace the steering gearbox assembly.

(cont'd)

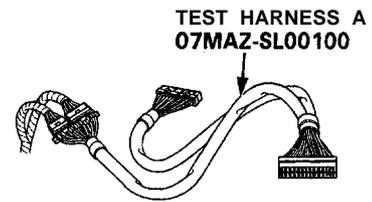
Troubleshooting

-Flowcharts (cont'd)

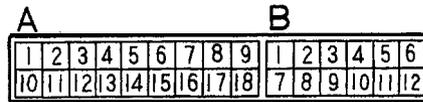
Problem code 22:

- EPS power unit related problem.

Turn the ignition switch OFF and connect test harness A to the wire harness only.



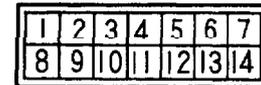
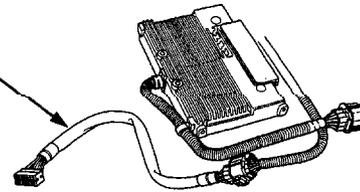
Disconnect the EPS power unit connector and connect the test harness C.



Check the continuity between the terminals of the test harness A and C as indicated in the chart on the right.

TEST HARNESS C
07MAZ-SL00300

Terminal Name	Test harness A terminal No.	Test harness B terminal No.
+12 P/U	B5	14
FS RLY	B6	10
PWR RLY	B1	11
FET 4	B8	4
FET 3	B9	5
EFT 2	B3	1
FET 1	B10	2
VIS +	B12	6
VIS -	B4	6
SLO GND	B7	9



Is there continuity? NO

Repair open in the wire with no continuity.

YES

Check the continuity on terminals as indicated in the chart individually to body ground.

Is there continuity? YES

Repair short in the wire with continuity to body ground.

NO

Disconnect the negative and positive cables from the battery.

(To page 17-57)



(From page 17-56)

Remove the RED and BLU wires from the power unit.

Check for continuity between the RED and BLU wires.

Is there continuity? NO

Check for continuity RED and BLU wires individually to body ground.

Is there continuity? YES

Connect the RED and BLU wires to the power unit terminals and the battery terminals.

Check the voltage between the WHT (+) and BLK (-) terminals on the power unit.

Is there battery voltage? NO

(To page 17-58)

Remove the RED and BLU wires from the EPS motor on the steering gearbox.

Check for continuity RED wire between the power unit and EPS motor. Use the same method to check for BLU wire.

Is there continuity? NO

Repair open in RED or BLU wire with no continuity.

Faulty EPS motor. Replace the steering gearbox assembly.

Remove the RED and BLU wires from the EPS motor on the steering gearbox.

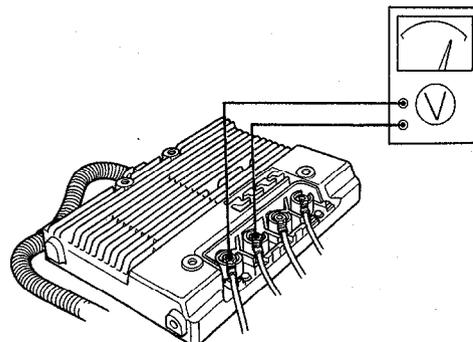
Check for continuity RED and BLU wires individually to body ground.

Is there continuity? YES

Repair short in RED or BLU wire with continuity to body ground.

Faulty EPS motor. Replace the steering gearbox assembly.

Repair open in the WHT or BLK wire between the power unit and the battery, or check for a blown EPS (50 A) fuse in the main relay box.

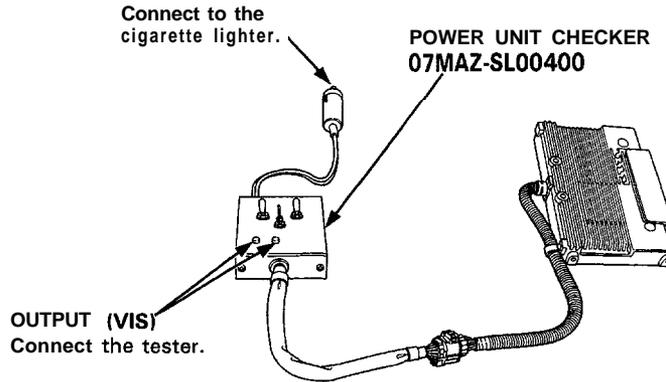
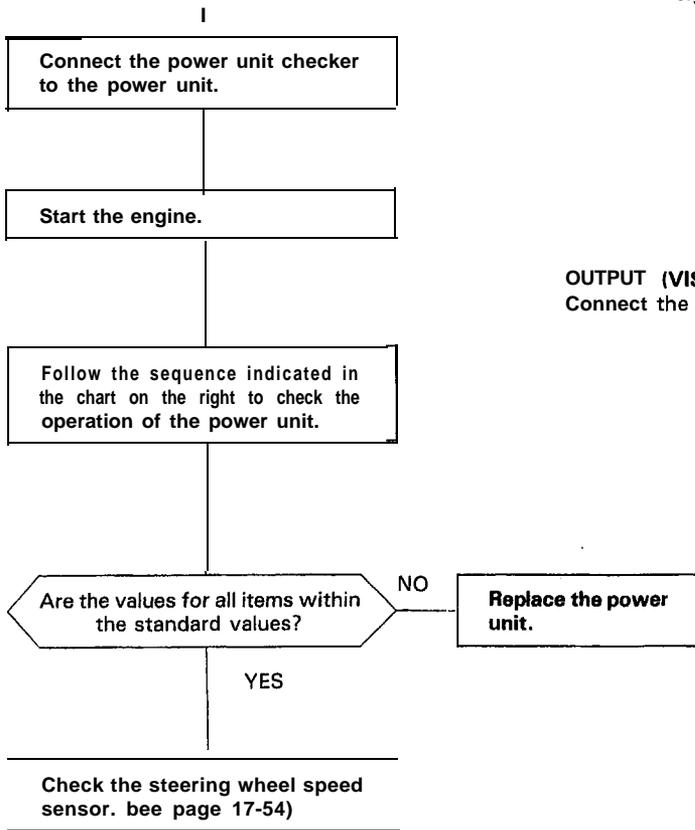


(cont'd)

Troubleshooting

-Flowcharts (cont'd)

(From page 17-57)



CAUTION: Be careful because the steering wheel will rotate if the FET drive switch is turned ON.

Power Unit Checker Operation Sequence

Se-quence	Check Item	Check Operation			Standard Value (VIS Output)
		F/S Relay	Power Relay	EFT Drive	
1	All ON trouble	OFF	OFF	OFF	1.0 V ± 0.7 V
2	F/S Relay ON trouble	OFF	ON	ON for left and right	1.0 V ± 0.7 V
3	Power Relay ON trouble	ON	OFF	ON for left and right	1.0 V ± 0.7 V
4	FET Operation left	ON	ON	ON for left	(*) + (1.25 V ± 0.5 V)
5	FET operation right	ON	ON	ON for right	(*) + (1.25 V ± 0.5 V)

(*) : VIS output of sequence 1

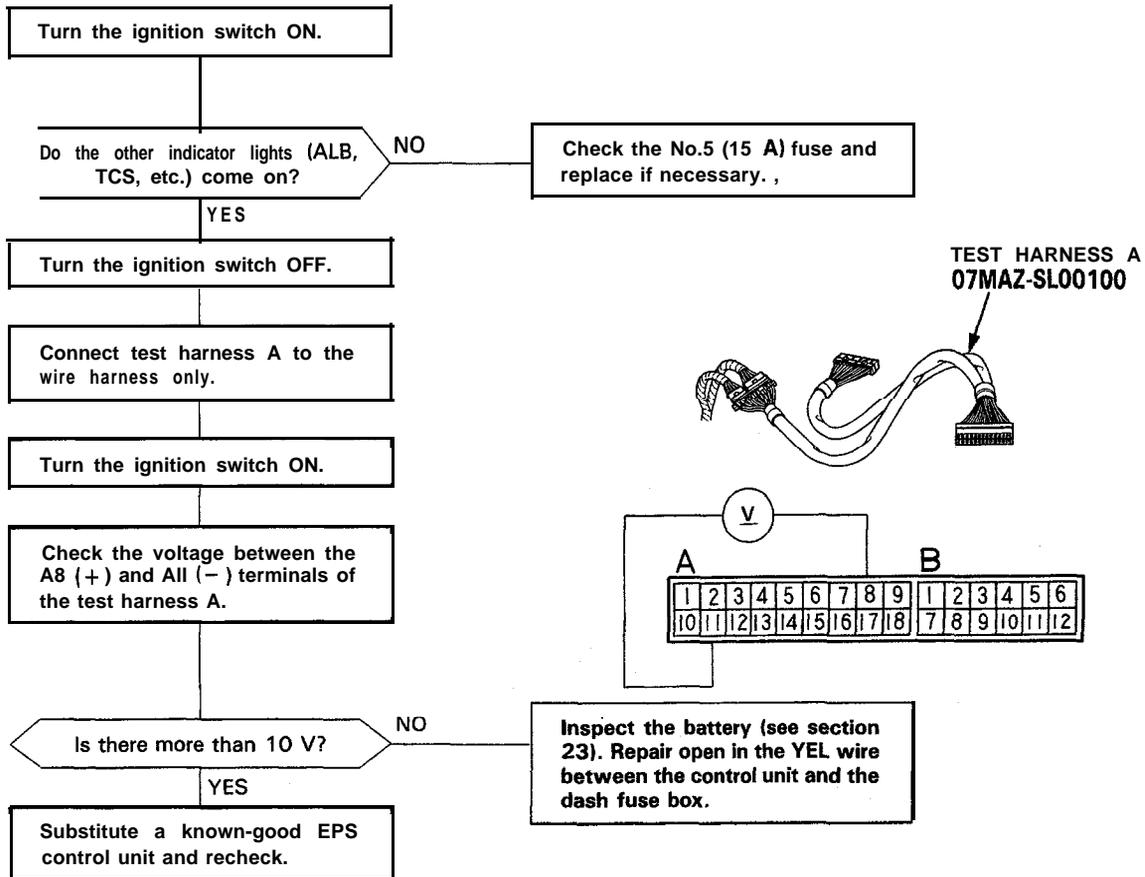
NOTE:

- When the steering wheel is turned to the left and right lock point in sequence 4 and 5, turn on the FET drive switch.
- This operation must be completed in a short period of time under maximum load (within 10 sec.) because the motor load is large.



Problem code 3 1:

- EPS control unit related problem.



(cont'd)

Troubleshooting

-Flowcharts (cont'd)

Problem code 33:

- Speed sensor related problem.

NOTE: Before performing the troubleshooting, check the related systems described below.

Is the speedometer operating normally?	NO	Inspect the speed sensor and speedometer system.
	YES	
Does the A/T warning indicator come on?	NO	Proceed the troubleshooting procedures described below.
	YES	
		Perform the A/T troubleshooting (see section 14).

Check the speed sensor signal (Vo).

Turn the ignition switch OFF.

Connect test harness A to the wire harness only.

Disconnect the 3-P connector from the speed sensor.

Check for continuity between the No.1 (YEL/RED) terminal of the 3-P connector and the No.1 terminal of the test harness A.

Is there continuity?

NO

Repair open in the YEL/RED wire between the EPS control unit and speed sensor.

YES

Check the continuity between the No. 1 (YEL/RED) terminal and body ground.

Is there continuity?

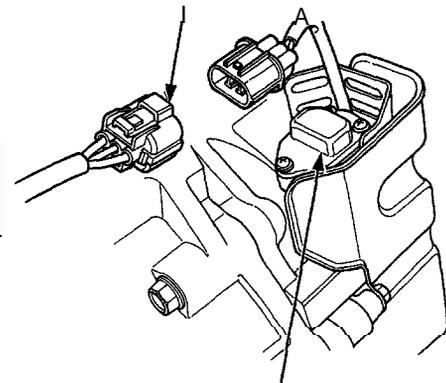
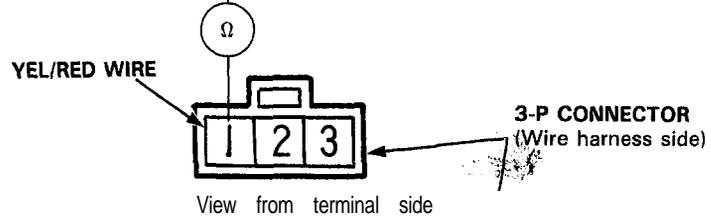
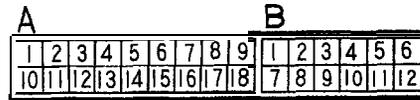
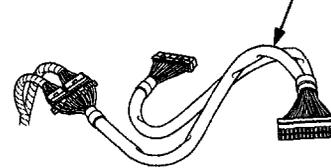
YES

Repair short in the wire with continuity to body ground.

NO

(To page 17-61)

TEST HARNESS A
07MAZ-SL00100



SPEED SENSOR



Check the A/T speed sensor signal (V_1).

(From page 19-60)

Connect test harness A to the EPS control unit.

Disconnect the 22-P connector from the A/T control unit.

Turn the ignition switch ON and check the voltage between the No. 18 (PNK/BLK) terminal of the 22-P connector and body ground.

Is there approximately 5 V?

YES
Substitute a known-good A/T control unit and recheck.

NO

Turn the ignition switch OFF.

Remove the test harness A from the EPS control unit only.

Check for continuity between the A4 terminal of the test harness A and No. 18 (PNK/BLK) terminal of the 22-P connector.

Is there continuity?

NO
Repair open in the PNK/BLK wire between the EPS control unit and A/T control unit.

YES

Check for continuity between the A4 terminal and body ground.

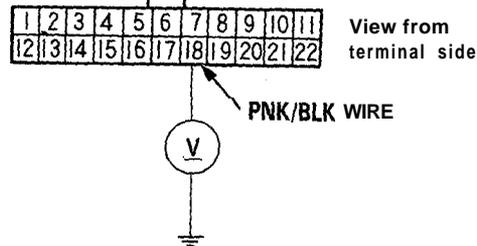
Is there continuity?

YES
Repair short in the PNK/BLK wire with continuity to body ground.

NO

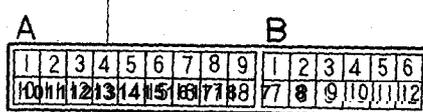
Substitute a known-good EPS control unit and recheck.

22-P CONNECTOR (To A/T CONTROL UNIT)
(Wire harness side)

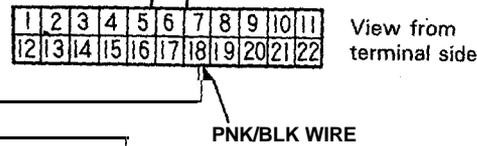


NOTE: Do not connect the connector on the control unit side of test harness A.

TEST HARNESS A
07MAZ-SL00100



22-P CONNECTOR (Wire harness side)



(cont'd)

Troubleshooting

Flowcharts (cont'd)

Problem code 23, 34, 41, 42, 43 and 44:

● EPS control unit related problem.

Check for poor connections or loose wires at the EPS control unit. If there is no abnormality, replace the EPS control unit.

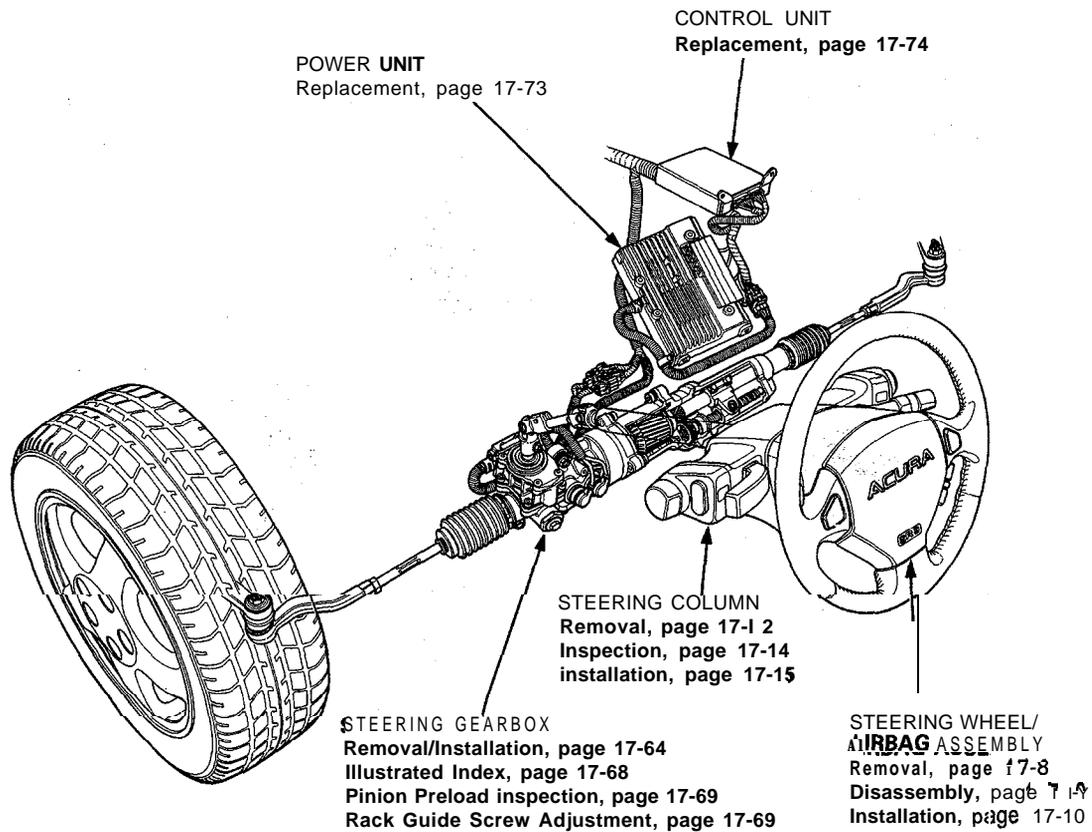


Component Location

Index

NOTE:

- If an intact airbag assembly has been removed from a scrapped car or has been found defective or damaged during transit, storage or service, it should be deployed (See section 231).
- Before removing the gearbox, remove the ignition key to lock the steering shaft.
- After installing the gearbox, check the wheel alignment and adjust if necessary.

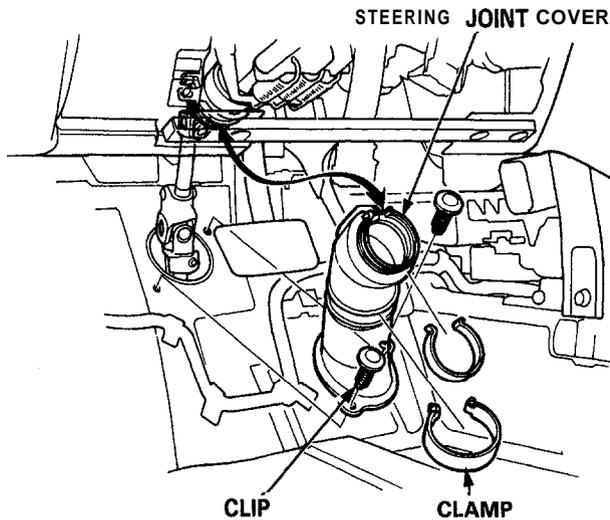


Power Steering

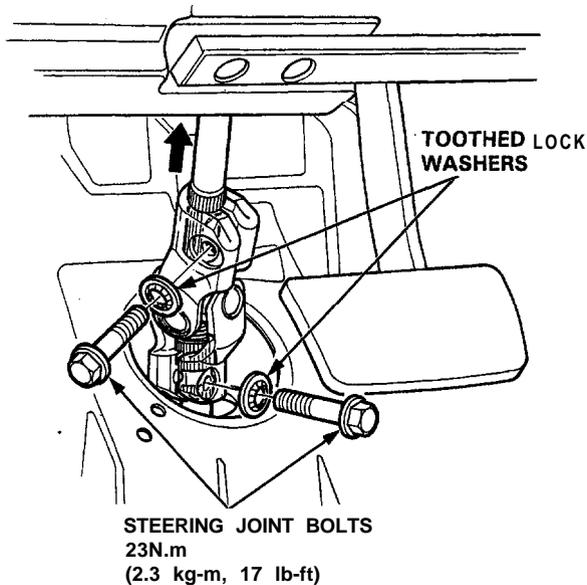
-Gearbox Removal/Installation

NOTE: Before removing the steering gearbox, align the front wheels ahead straight.

1. Remove the steering joint cover.



2. Remove the steering joint bolts, and move the joint toward the column.

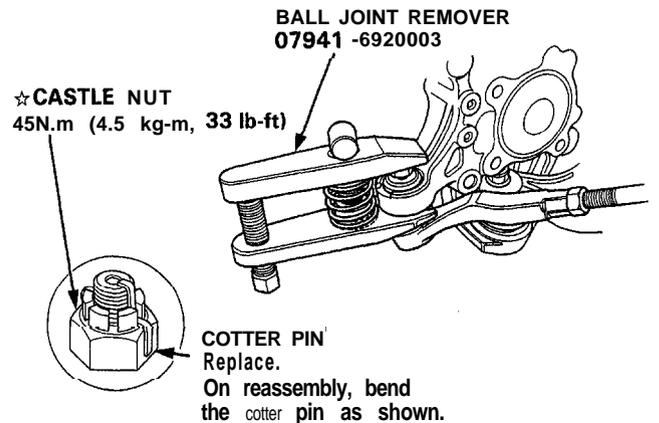


3. Raise the car and place safety stands in the proper locations (See section 1).
4. Remove the front wheels.
5. Remove the cotter pin from the tie-rod ball joint nut and remove the nut.

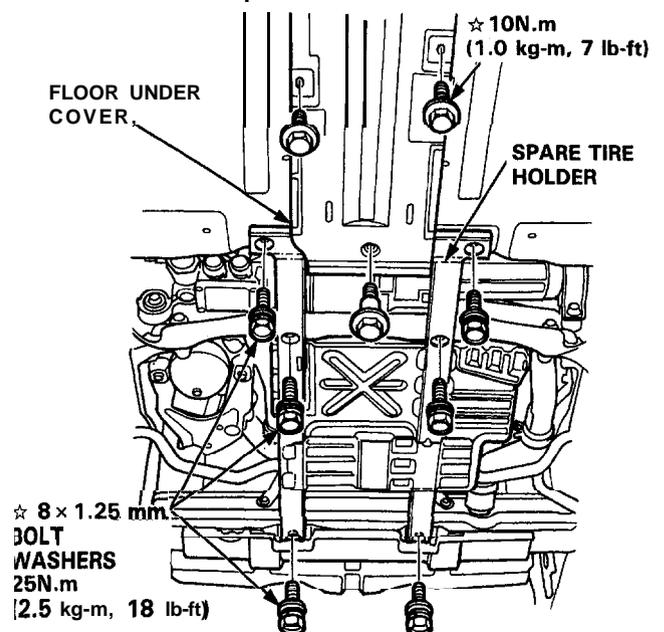
6. Install the 12 mm hex nut on the ball joint. Be sure that the 12 mm hex nut is flush with the ball joint pin end, or the threaded section of the ball joint pin might be damaged by the ball joint remover.
7. Separate the tie-rod ball joint and knuckle using the special tool.

CAUTION: Avoid damaging the ball joint boot.

NOTE: If necessary, apply penetrating type lubricant to loosen the ball joint.



8. Remove the folding spare tire and spare tire holder plate.
9. Remove the battery.
10. Remove the spare tire holder.



*Corrosion resistant bolt/nut

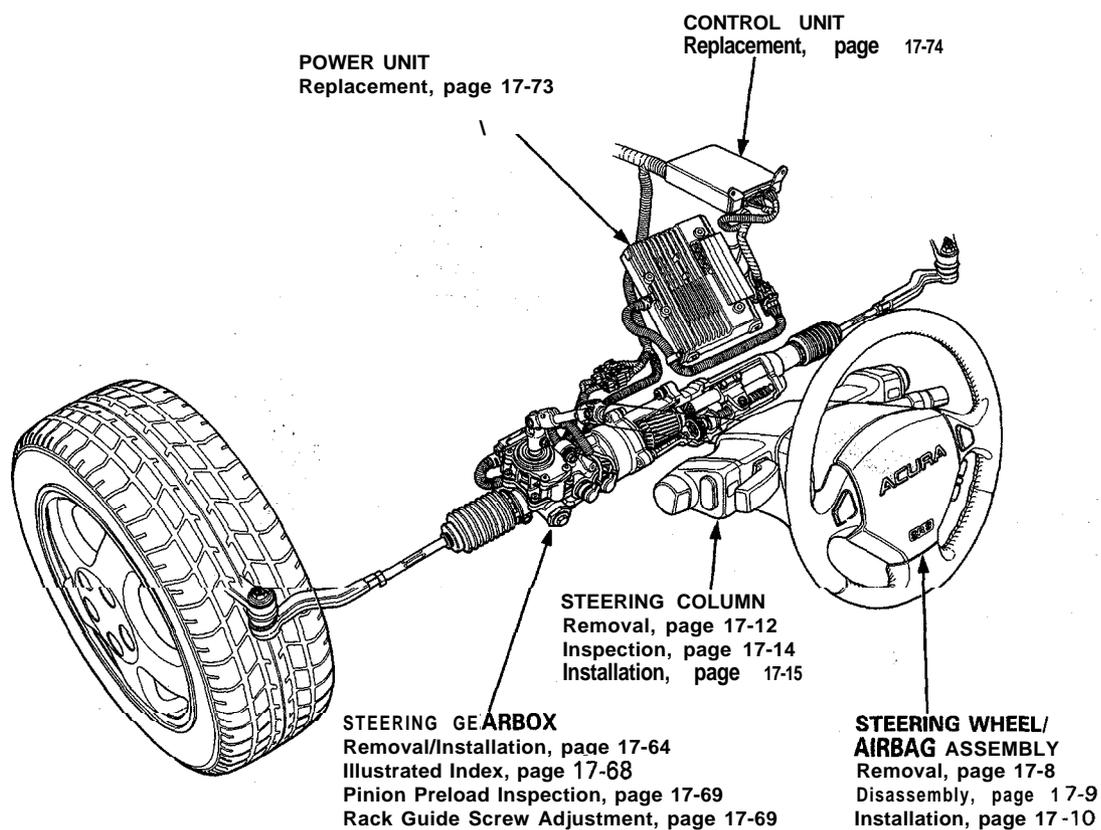


Component Location

Index

NOTE:

- If an intact airbag assembly has been removed from a scrapped car or has been found defective or damaged during transit, storage or service, it should be deployed (See section 23).
- Before removing the gearbox, remove the ignition key to lock the steering shaft.
- After installing the gearbox, check the wheel alignment and adjust if necessary.

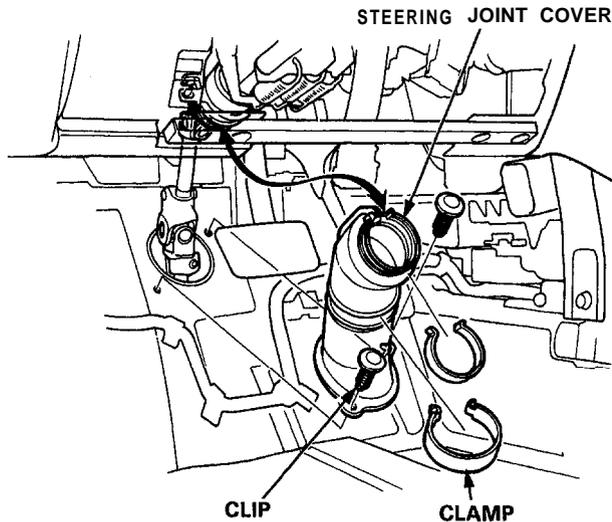


Power Steering

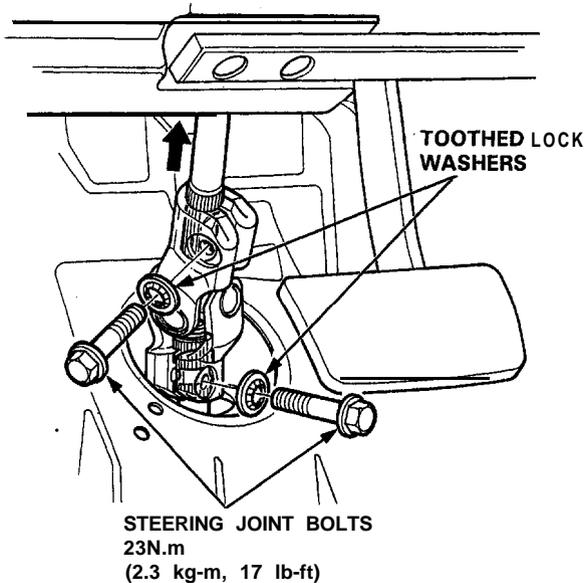
-Gearbox Removal/Installation

NOTE: Before removing the steering gearbox, align the front wheels ahead straight.

1. Remove the steering joint cover.



2. Remove the steering joint bolts, and move the joint toward the column.

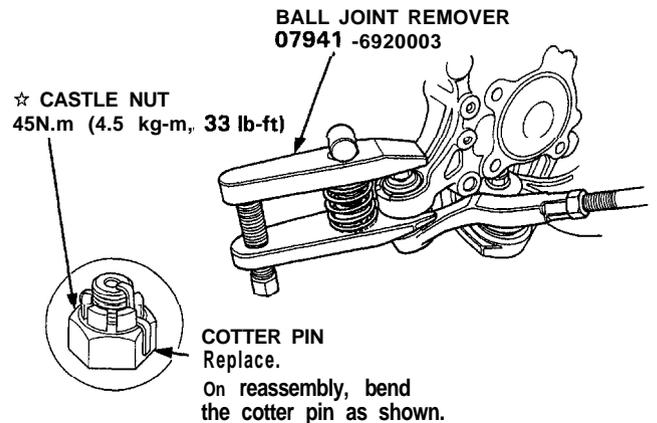


3. Raise the car and place safety stands in the proper locations (See section 1).
4. Remove the front wheels.
5. Remove the cotter pin from the tie-rod ball joint nut and remove the nut.

6. Install the 12 mm hex nut on the ball joint. Be sure that the 12 mm hex nut is flush with the ball joint pin end, or the threaded section of the ball joint pin might be damaged by the ball joint remover.
7. Separate the tie-rod ball joint and knuckle using the special tool.

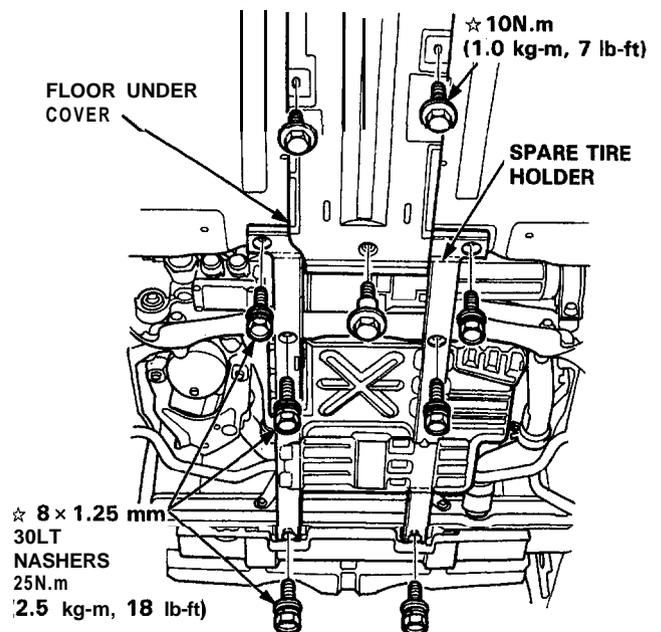
CAUTION: Avoid damaging the ball joint boot.

NOTE: If necessary, apply penetrating type lubricant to loosen the ball joint.



*Corrosion resistant bolt/nut

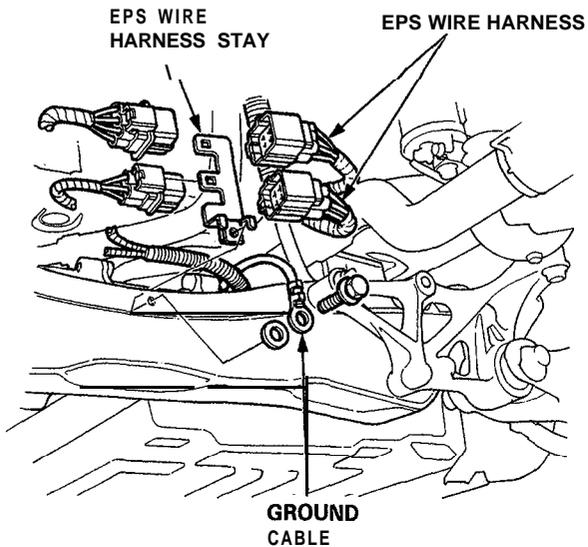
8. Remove the folding spare tire and spare tire holder plate.
9. Remove the battery.
10. Remove the spare tire holder.



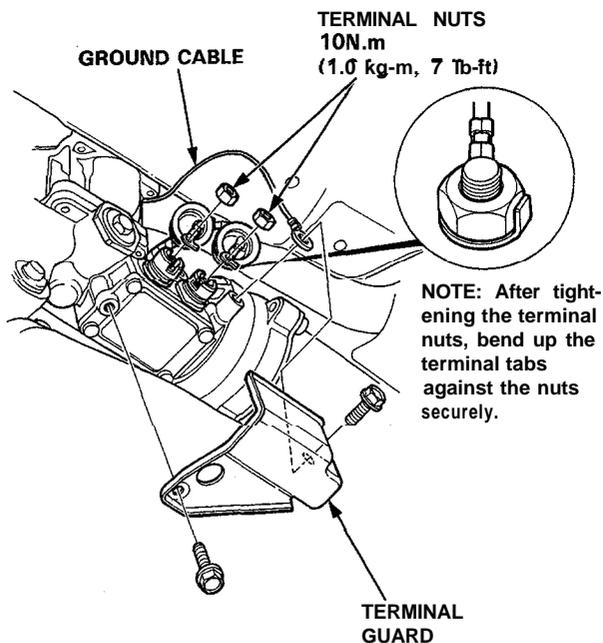
* Corrosion resistant bolt/nut



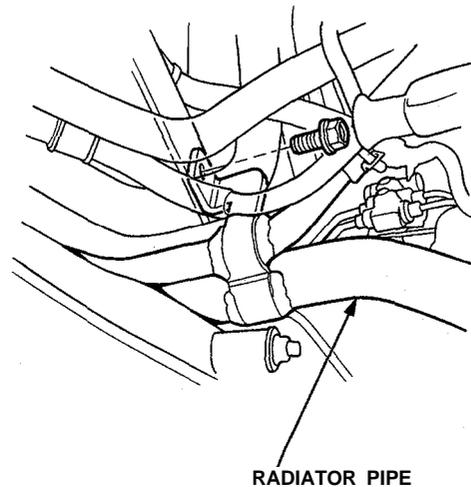
11. Disconnect the connectors from the EPS wire harness.
12. Remove the ground cable by removing the EPS wire harness stay.



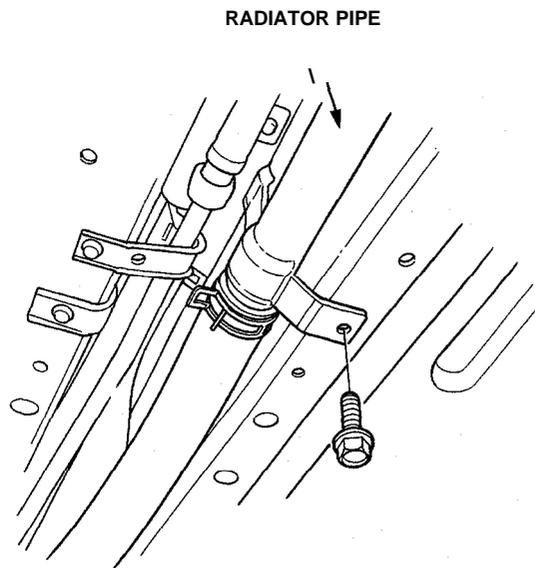
13. Remove the terminal guard and ground cable.
14. Remove the terminal nuts and the wires from the gearbox terminals.



15. Remove the radiator pipe bracket at the firewall.



16. Remove the radiator pipe bracket at the floor, and space the radiator pipe away from and gearbox.



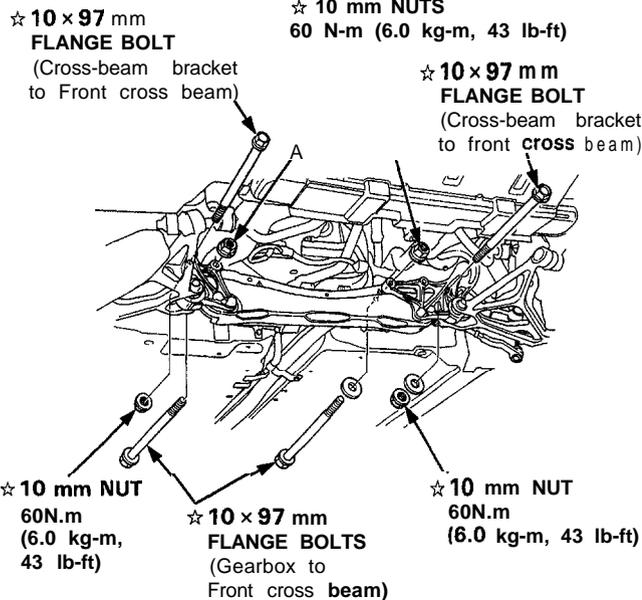
(cont'd)

▪ Gearbox Removal/Installation (cont'd)

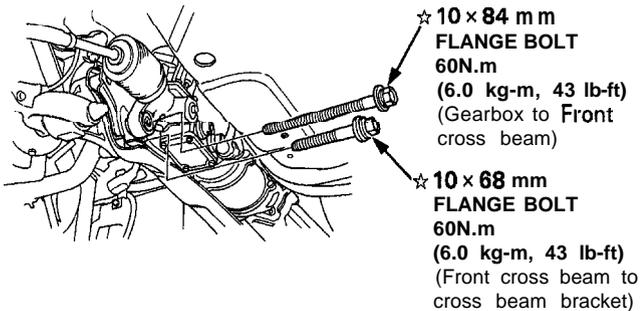
CAUTION: Before removing the gearbox, place a stand jack under the gearbox and front cross-beam to lightly support them.

Lower the gearbox together with the cross-beam.

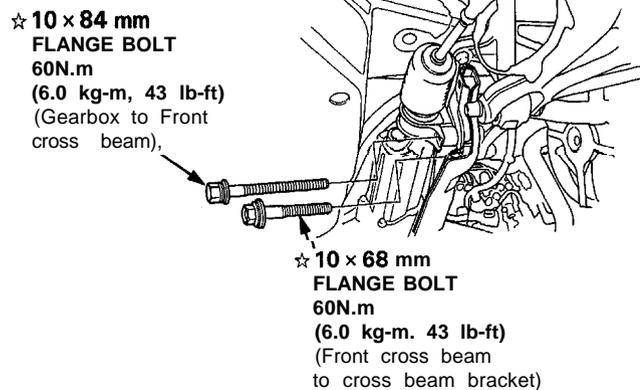
17. Remove the bolts and nuts of the gearbox and cross-beam.



LEFT SIDE



RIGHT SIDED

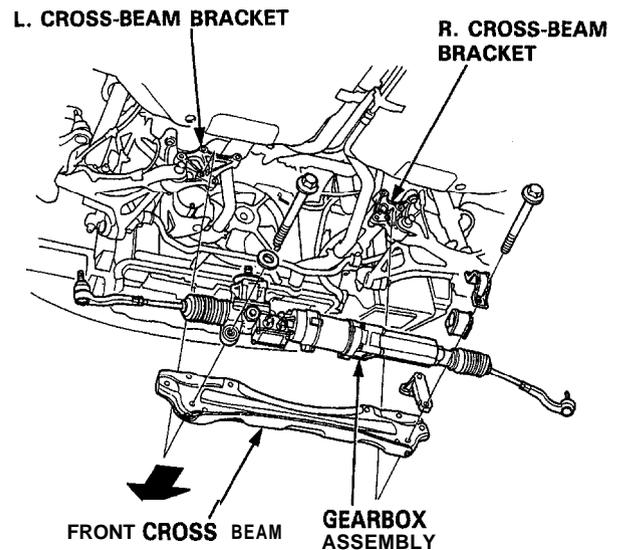


☆ Corrosion resistant bolt/nut

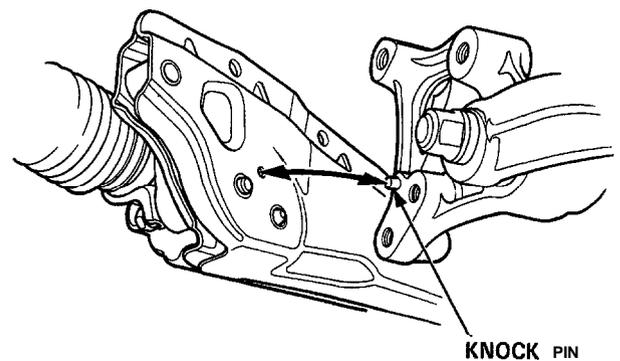
18. Lower the gearbox and cross-beam with care so as not to interfere with the radiator pipe.

NOTE: The cross beam is attached to the cross beam bracket with knock pins.

Remove the cross beam by lightly taping on it with a plastic hammer, then remove the gearbox.



19. When installing the cross beam to the cross beam bracket, be sure to align the holes in the cross beam with the knock pins on the cross beam bracket.



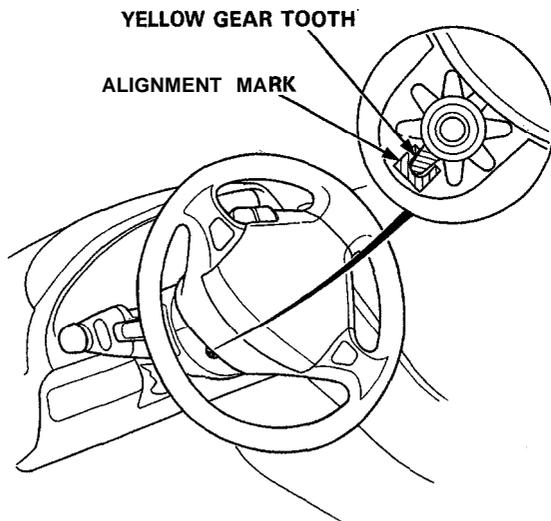


20. installation is the reverse order of removal.
- Install the gearbox assembly and SST holder plate frame.
 - Install the battery.
 - Install the SST holder plate and folding spare tire.
 - Install the steering gearbox joint cover.

Connect the battery positive terminal and then connect the negative terminal.

NOTE: After installation, turn the ignition switch ON and check the Electrical Power Steering warning light for operation. Check and adjust the wheel alignment (Section 18).

- Turn on the ignition to II: the instrument panel SRS warning light should go on for about 6 seconds and then go off.
- Confirm operation of horn buttons.
- Confirm operation of cruise control set/resume switch.
- Turn the steering wheel counterclockwise and make sure the yellow gear tooth still lines up with the alignment mark.



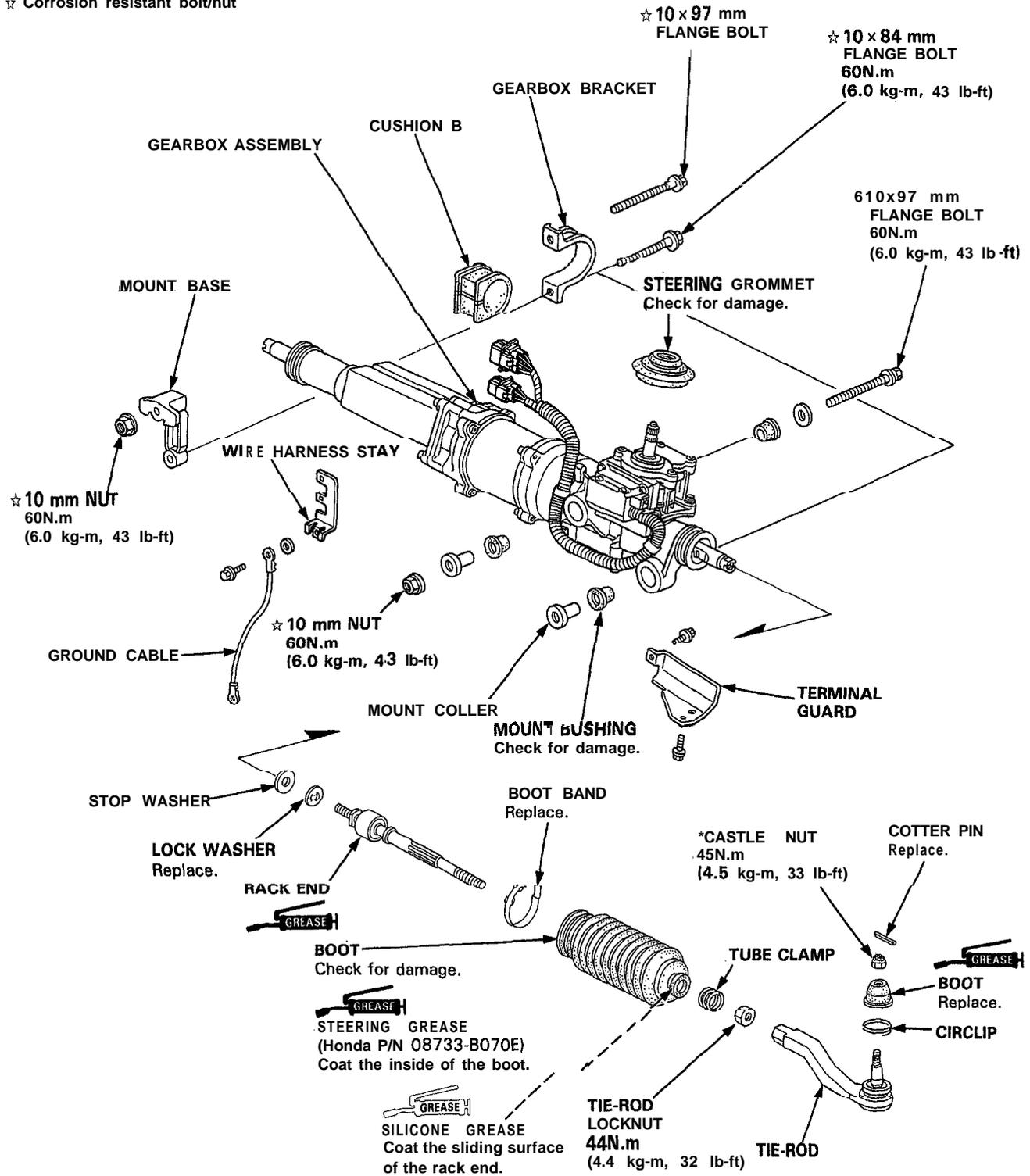
Power Steering

Illustrated Index

CAUTION:

- Do not try to disassemble the EPS gearbox. If the gearbox is faulty, replace it as an assembly.

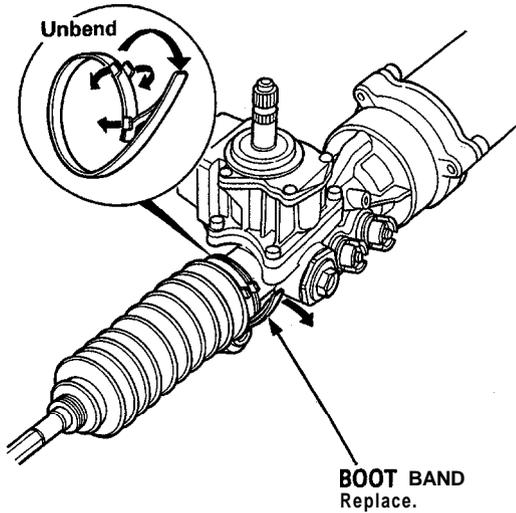
☆ Corrosion resistant bolt/nut



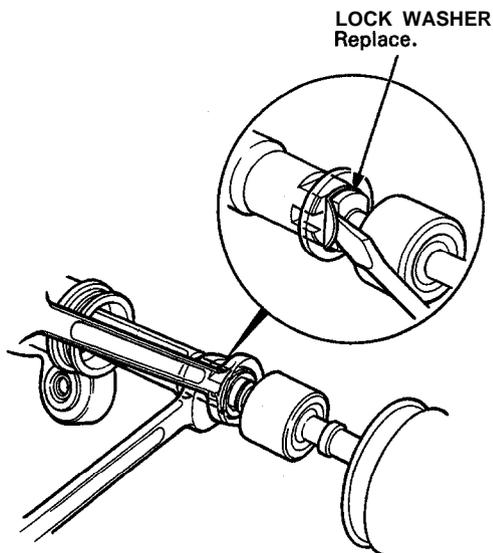


-Inspection

1. Carefully clamp the gearbox in a vise with soft jaws.
2. Remove the boot bands.



3. Pull the boots away from the ends of the gearbox, unbend the tie-rod lock washers.
4. Hold the rack with a wrench, and unscrew the tie-rods with another wrench.

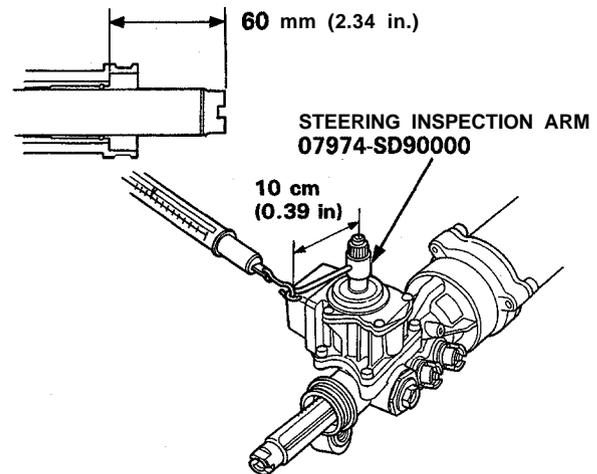


- Preload Inspection:

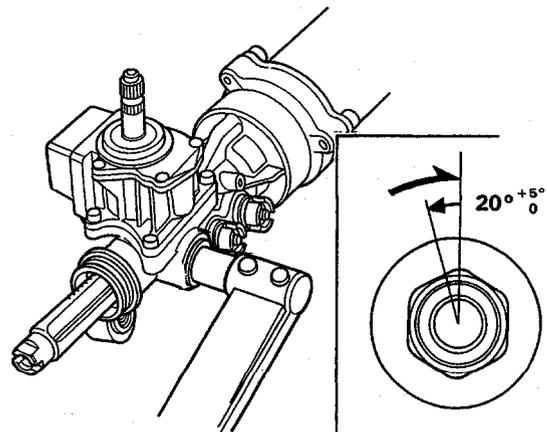
NOTE: Slide the steering rack in the cylinder until the end of the rack projects 60 mm (2.34 in.) from the cylinder end. Inspection is made near this rack position.

Install the special tool on the pinion shaft and check the preload with a spring scale. If the preload is out of the specification, adjust the rack guide.

Preload 30N (3 kg, 6.6 lb)



- Rack guide screw adjustment:
Remove the rack guide screw locknut.
- Tighten, loosen and retighten the rack guide screw two times to 4N.m (0.4 kg-m, 2.9 lb-ft), back it off $20^{\circ} \begin{smallmatrix} +5^{\circ} \\ 0 \end{smallmatrix}$.



(cont'd)

Power Steering

- Inspection (cont'd)

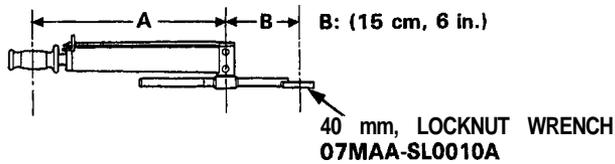
- Install the locknut on the rack guide screw, and tighten the locknut while holding the rack guide screw with a wrench.

NOTE: The above specification is the torque wrench reading (indicated) when the locknut is tightened using a torque wrench 50 cm (20 inches) long. If you tighten the locknut using a torque wrench of a different length, obtain the indicated torque value (torque wrench reading) using the following formulas.

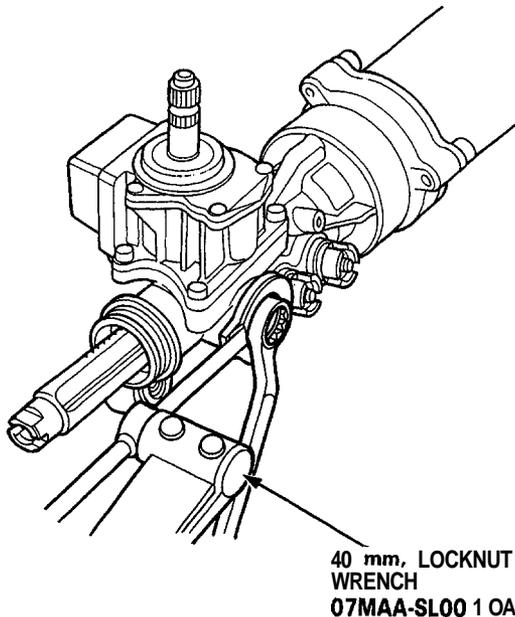
$$A/(A+B) = Y$$

$$Y \times \text{Actual torque} = X$$

X = Torque wrench reading.



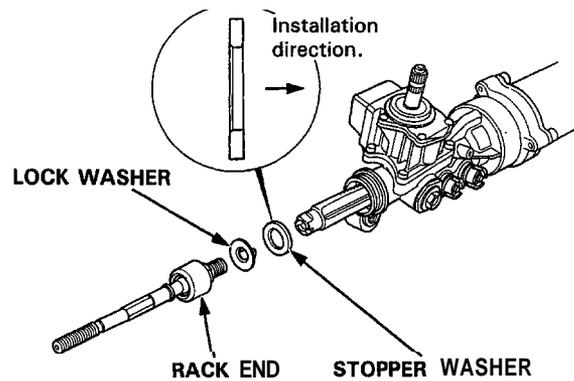
Actual: 25N.m (2.5 kg-m, 18 lb-ft)
Indicated: 19N.m (1.9 kg-m, 14 lb-ft)
Tool length (B): 15 cm (6 in)



Tie-rod installation:

5. Screw each rack end into the rack while holding the lock washer so its tabs are in the slots in the rack end.

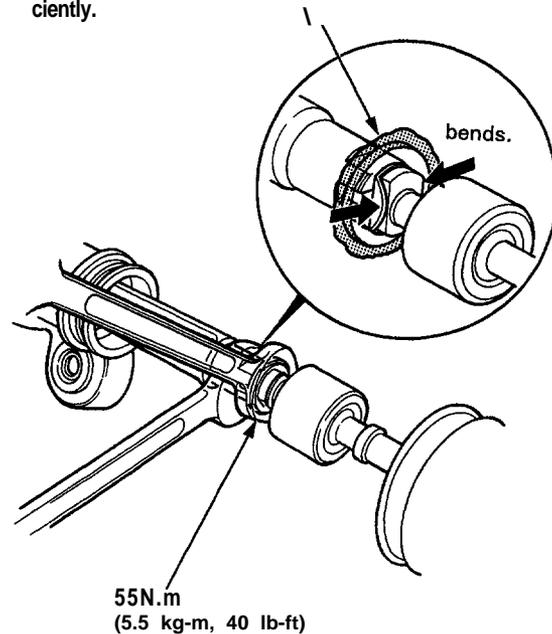
NOTE: Install the stopper washer with the chamfered side facing out.



6. Tighten the rack end securely, then band the lock washer back against the flat on the flange as shown.



NOTE: Coat the stopper washer with grease sufficiently.

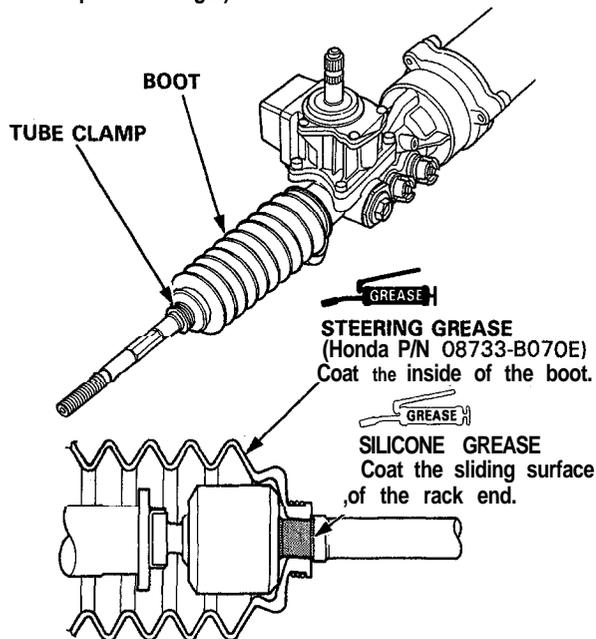




7. install the boots on the rack end with the tube clamps.

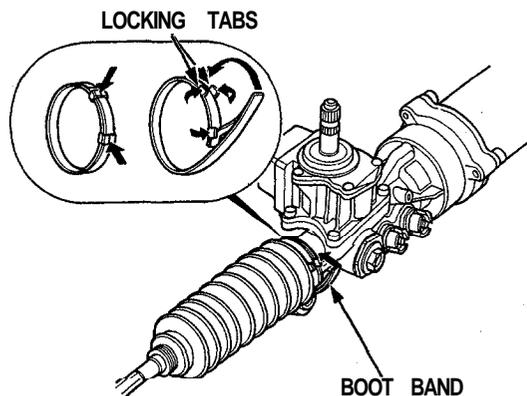
NOTE:

- Coat the rack end and inside of the boot with the grease.
- Before installing the boot, be sure that the pressure inside of the boot is the atmospheric pressure.
- Install the boot band with the rack in the straight ahead condition (i.e. right and left tie-rods are equal in length).

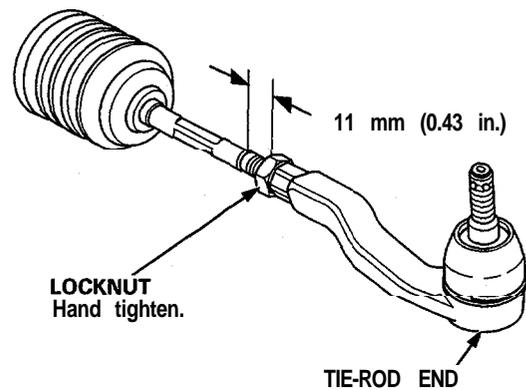


8. Install the new boot bands on the boot and bend both sets of locking tabs.
Lightly tap on the doubled portions to reduce their height.

NOTE: After assembling, slide the rack right and left to be certain that the boots are not deformed or twisted.



9. If the tie-rod ends were removed, install the tie-rods on the right and left rack ends and screw them in until the threaded section is 11 mm (0.43 in.) in length.



10. Install the gearbox and the cross-beam (17-66).
Check the wheel alignment and adjust if necessary (Section 18).

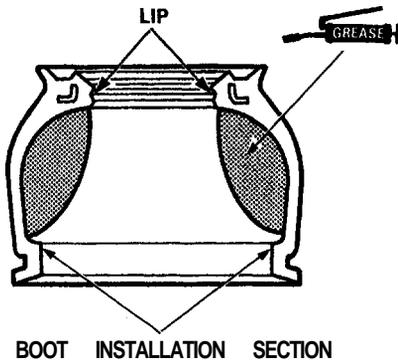
Power Steering

-Ball Joint Boot Replacement

1. Remove the circlip and the boot.

CAUTION: Do not contaminate the boot installation section with grease.

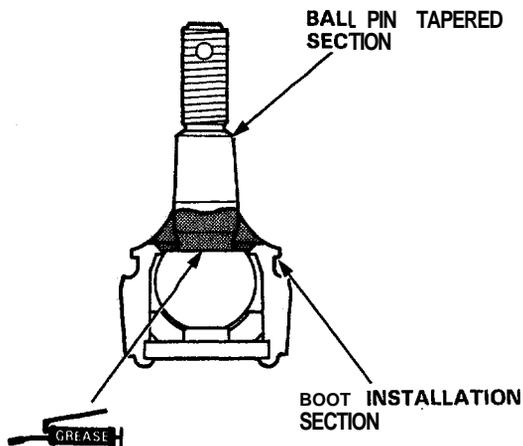
2. Pack the interior of the boot and lip with grease.



3. Wipe the grease off the sliding surface of the ball pin, then pack the lower area with fresh grease.

CAUTION:

- Keep grease off the boot installation section and the tapered section of the ball pin.
- Do not allow dust, dirt, or other foreign materials to enter the boot.

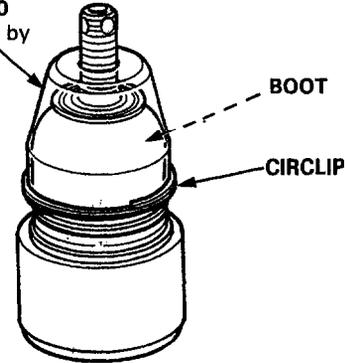


4. Install the boot in the groove of the boot installation section securely, then bleed air.

5. Insert the special tool into the threads in the ball pin and align the end of the tool with the groove in the boot. Slide the clip over the tool and into position.

**BALL JOINT
BOOT CLIP
GUIDE**

07MAG-SL00100
Adjust the depth by
turning the tool.



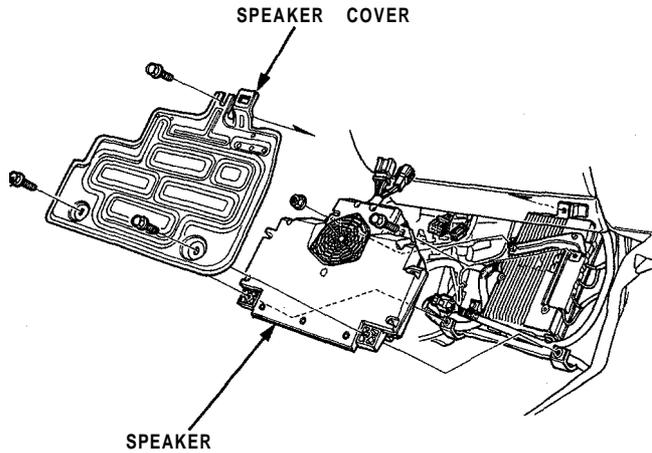
CAUTION: After installing the boot, check the ball pin tapered section for grease contamination and wipe it if necessary.



Power Unit

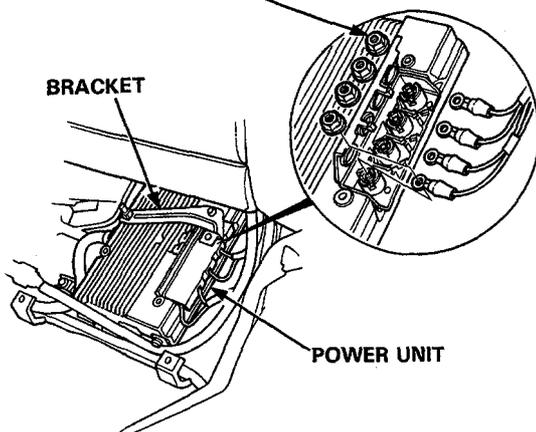
Replacement

1. Remove the floor mat and speaker cover.
2. Disconnect the connector from the speaker and remove the speaker by removing the bolt and nut.

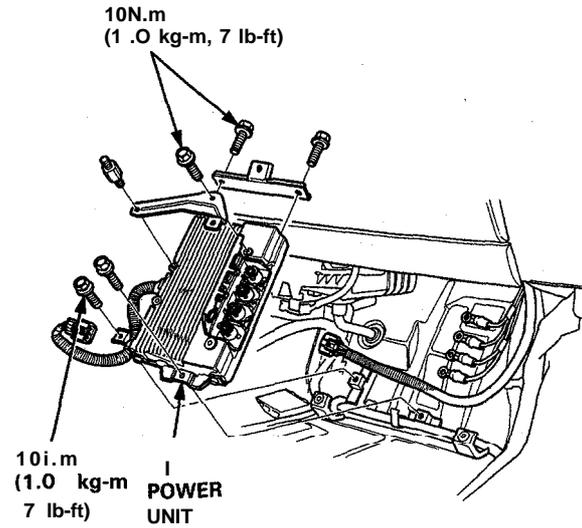


3. Remove the power unit bracket.
4. Remove the terminal nuts and disconnect the cables from the power unit terminals.

TERMINAL NUT
 10 N.m
 (1 .0 kg-m, 7 lb-ft)



5. Remove the power unit by disconnecting the connector.



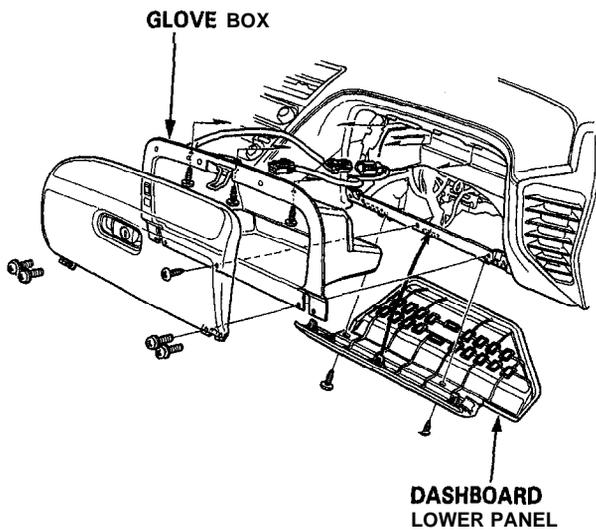
Installation is the reverse order of removal.

NOTE: Turn the ignition switch ON and check the EPS warning light for operation.

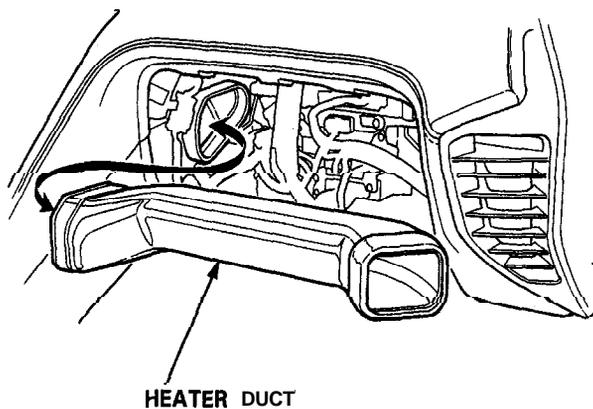
Control- Unit

Replacement

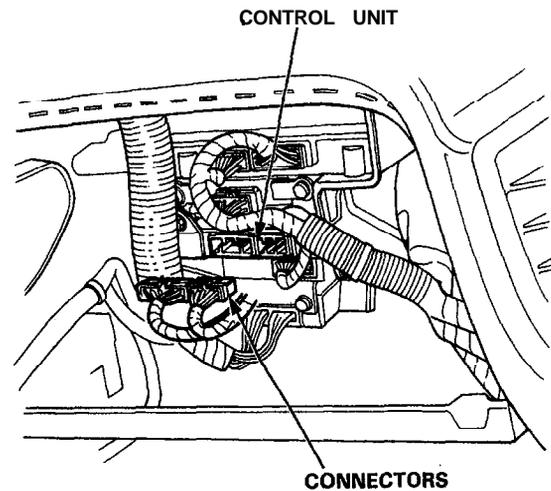
1. Remove the dashboard lower panel and glove box and disconnect the light connector.



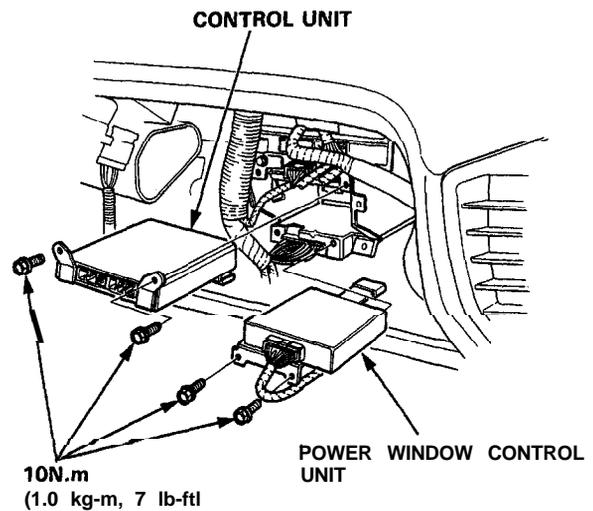
2. Remove the heater duct.



3. Disconnect the connectors from the control unit by removing the wire harness band.



4. Remove the power window control unit by pulling it toward you, then remove the control unit.



Installation is the reverse order of removal.

NOTE: Turn the ignition switch ON and check the EPS warning light for operation.