1. NOISE & VIBRATION (HYDRAULIC TYPE)

CAUTION:
Do not keep the relief valve operated for five seconds or more at any time or inner parts of the oil pump may be damaged due to rapid increase of fluid temperature.

NOTE:
• A grinding noise may be heard immediately after the engine start in extremely cold conditions. In this case, if the noise goes off during warm up there is no abnormal function in the system. This is due to the fluid characteristics in extremely cold condition.
• The oil pump normally makes a small whining noise due to its mechanism. Even if a noise is heard when steering wheel is turned at stand still, there is no abnormal function in the system provided that the noise eliminates when the vehicle is driving.
• When turning the steering wheel with the brake applied when the vehicle is parked, a screeching noise may be generated by the brake disc and pads. This is not a fault in the steering system.
• There may be a small vibration around the steering devices when turning the steering wheel at standstill, even though the component parts are operating properly.
Hydraulic systems are likely to generate this kind of vibration as well as working noise and fluid noise because of combined conditions, i.e., road surface and tire surface, engine speed and turning speed of steering wheel, fluid temperature and braking condition.
These conditions do not indicate a problem in the system.
Confirm vibration by applying the parking brake on a concrete surface and turning the steering wheel from slowly to rapidly, in steps.

Trouble	Possible cause	Corrective action
Hiss noise (continuous) While engine is running.	Relief valve emits operating sound when steering wheel is completely turned in either direction. (Do not keep this condition for 5 seconds or more.)	Normal
	Relief valve emits operating sound when steering wheel is not turned. This means that the relief valve is defective.	Replace the oil pump.
Rattling noise (intermittent) While engine is running.	Interference with adjacent parts	Check the clearance. Correct if necessary. <Ref. to PS-75, INSPECTION, Pipe Assembly.>
	Looseness of the installation of oil pump, oil tank, pump bracket, gearbox or crossmember	Retighten.
	Looseness of oil pump pulley or other pulley(s)	Retighten.
	Looseness of linkage, play of steering, improper tightening (looseness) of suspension joint or steering column	Retighten or replace.
	Sound generates from the inside of gearbox or oil pump.	Replace faulty parts in the gearbox or oil pump.
Knocking When turning steering wheel in both directions with small angle repeatedly at engine ON or OFF.	Excessive backlash Loosened lock nut for adjusting backlash	Adjust and retighten.
	Insufficient tightening or play in the tie-rod or tie-rod end	Retighten or replace.
Grinding noise (continuous) While engine is running.	Air in vane pump	Inspect and retighten the fluid line connection. Refill the fluid and vent air.
	Vane pump seizing	Replace the oil pump.
	Oil pump pulley bearing seized	Replace the oil pump.
	Folded hose, flattened pipe	Replace.
Squeal, squeak (intermittent or continuous) While engine is running.	Improper adjustment of pulley belt Damaged or over tensioned pulley belt Unequal length of pulley belts	Adjust or replace. (Replace two belts as a set.)
	Runout or dirty V-groove surface of oil pump pulley	Clean or replace.

Trouble	Possible cause	Corrective action
Sizzling noise (continuous) While engine is running.	Fluid aeration	Fix the faulty part causing aeration. Replace the fluid and vent air.
	Damaged pipe of gearbox	Replace the pipe.
	Faulty inside of hose or pipe Flattened hose or pipe	Repair or replace.
	Abnormal inside of oil tank	Replace.
	Removed oil tank cap	Install cap.
Whistle (continuous) While engine is running.	Faulty pipe of gearbox or faulty hose	Replace the faulty parts of the gearbox or the hose.
Whine or growl (intermittent or continuous) While engine is running (with/ without steering turned).	Looseness of oil pump, oil pump bracket attachment	Retighten.
	Fault inside of oil pump or hose	Replace the oil pump or hose, if the noise can be heard when vehicle is running as well as being stopped.
	Torque converter growl, air conditioner compression growl	Remove the power steering pulley belt and check.
Grinding noise (intermittent) While engine is running (with the steering turned).	Fault inside of gearbox	Replace the faulty parts of gearbox.
	Faulty bearing of the column assembly - steering	Apply grease or replace.
	Occurs when turning the steering wheel with brakes (service or parking) applied.	If the noise goes off when brake is released, it is normal.
Vibration While engine is running (with/ without steering turned).	Engine speed is too low.	Adjust, and notify customer.
	Air in vane pump	Repair faulty part. Vent air.
	Damaged valve in oil pump or gearbox	Replace the faulty parts in gearbox and oil pump.
	Excessive play in steering, looseness of suspension parts	Retighten.

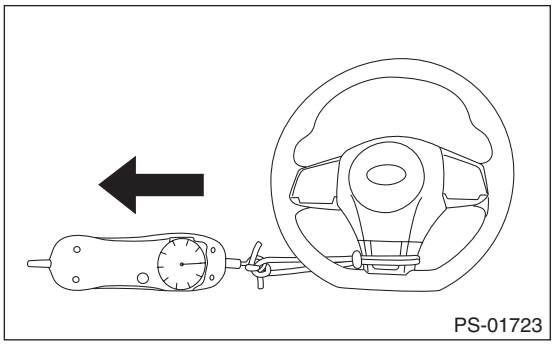
2. NOISE & VIBRATION (ELECTRIC TYPE)

NOTE:

- When turning the steering wheel with the brake applied when the vehicle is parked, a screeching noise may be generated by the brake disc and pads. This is not a fault in the steering system.
- There may be a small vibration around the steering devices when turning the steering wheel at standstill, even though the component parts are operating properly.

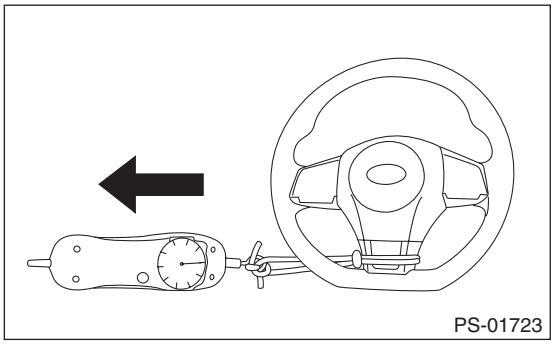
Trouble	Possible cause	Corrective action
Rattling noise (intermittent) While engine is running.	Interference with adjacent parts	Check the clearance. Correct if necessary.
	Looseness of linkage, play of steering, improper tightening (looseness) of suspension joint or steering column	Retighten or replace.
	Noise emitted from inside of the gearbox	Replace the gearbox assembly.
Knocking When turning steering wheel in both directions with small angle repeatedly at engine ON or OFF.	Excessive backlash Loosened lock nut for adjusting backlash	Adjust the backlash. When the noise remains after adjustment, replace the gearbox assembly.
	Insufficient tightening or play in the tie-rod or tie-rod end	Retighten or replace.
Grinding noise (intermittent) While engine is running. (While operating the steering.)	Fault inside of gearbox	Replace the gearbox assembly.
	Faulty bearing of the column assembly - steering	Apply grease or replace.
	Occurs when turning the steering wheel with brakes (service or parking) applied.	If the noise goes off when brake is released, it is normal.
Vibration While engine is running. (with/ without steering turned)	Excessive play in steering, looseness of suspension parts	Retighten.

3. MEASUREMENT OF STEERING EFFORT (HYDRAULIC TYPE)

	Step	Check	Yes	No
1	**CHECK STEERING EFFORT.** 1) Stop the vehicle on paved road. 2) Start the engine. 3) Run the engine at idle. 4) Install a spring scale on the steering wheel. 5) Pull the spring scale at a right angle to the steering wheel, and measure both right and left steering wheel efforts.  PS-01723 NOTE: When turning the steering more quickly than necessary from a direction to the other direction at an engine speed of 2,000 rpm or higher, steering effort may be heavy. This is caused by flow characteristic of the fluid in the oil pump and is not a defect.	Is the steering effort less than 31 N (3.2 kgf, 7.0 lbf)?	Steering effort is normal.	Go to step **2**.
2	**CHECK STEERING EFFORT.** 1) Stop the engine and lift up the vehicle. 2) Pull the spring scale at a right angle to the steering wheel, and measure both right and left steering wheel efforts.	Is the steering effort less than 15 N (1.53 kgf, 3.4 lbf)?	Go to step **3**.	Perform the backlash adjustment.
3	**CHECK STEERING WHEEL EFFORT.** 1) Remove the universal joint assembly - steering. 2) Measure the steering wheel effort.	Is the steering effort less than 2.26 N (0.23 kgf, 0.51 lbf)?	Go to step **4**.	Replace the column assembly - steering.
4	**CHECK STEERING WHEEL EFFORT.** Measure the steering wheel effort.	Is the difference of steering effort between right and left less than 20%?	Go to step **5**.	Replace the column assembly - steering.
5	**CHECK UNIVERSAL JOINT ASSEMBLY - STEERING.** Measure the swing torque of the joint (yoke on the column assembly - steering side). <Ref. to PS-23, INSPECTION, Universal Joint.>	Is the swing torque of the universal joint assembly - steering less than 7.3 N (0.74 kgf, 1.64 lbf)?	Go to step **6**.	Replace the universal joint assembly - steering.
6	**CHECK UNIVERSAL JOINT ASSEMBLY - STEERING.** Measure the swing torque of the joint (yoke of gearbox side). <Ref. to PS-23, INSPECTION, Universal Joint.>	Is the swing torque of the universal joint assembly - steering less than 3.8 N (0.39 kgf, 0.86 lbf)?	Go to step **7**.	Replace the universal joint assembly - steering.
7	**CHECK FRONT WHEEL.** Check the front wheels.	Does the front wheels have unsteady revolution or rattling, or does the brake drag?	Inspect, readjust and replace if necessary.	Go to step **8**.
8	**CHECK TIE-ROD ENDS.** Remove the tie-rod ends from housing.	Does the tie-rod ends have unsteady revolution or rattling?	Inspect and replace if necessary.	Go to step **9**.

	Step	Check	Yes	No
9	**CHECK GEARBOX.** Measure the rotating of gearbox. <Ref. to PS-50, LIMIT, INSPECTION, Steering Gearbox.>	Is the rotational resistance of the steering gearbox less than 21 N (2.1 kgf, 4.7 lbf)? Is the difference between the right and left rotational resistances less than 20%?	Go to step **10**.	Readjust the backlash, and if ineffective, replace the faulty parts.
10	**CHECK GEARBOX.** Measure the sliding of gearbox. <Ref. to PS-50, LIMIT, INSPECTION, Steering Gearbox.>	Is the sliding resistance of the steering gearbox less than 343 N (35 kgf, 77 lbf)? Is the difference between the right and left sliding resistances less than 20%?	Steering effort is normal. Check the suspension.	Readjust the backlash, and if ineffective, replace the faulty parts.

4. MEASUREMENT OF STEERING EFFORT (ELECTRIC TYPE)

	Step	Check	Yes	No
1	**CHECK STEERING WARNING LIGHT.**	Does the STEERING warning light illuminate?	Read the DTC, and inspect according to it.	Go to step **2**.
2	**CHECK STEERING WARNING LIGHT.** 1) Connect the Subaru Select Monitor, and turn the steering wheel. (One lock to lock) 2) Check the “EPS operation flag” in the current data.	Is the EPS operation flag normal without displaying any DTC code?	Go to step **3**.	If the EPS operation flag is “Assist limitation”, stop the engine for approx. 30 minutes and perform the procedures from step 1 again.
3	**CHECK STEERING EFFORT.** 1) Stop the vehicle on paved road. 2) Set the tire air pressure to the specification. 3) Start the engine. 4) Run the engine at idle. 5) Install a spring scale on the steering wheel. 6) Pull the spring scale at a right angle to the steering wheel, and measure both right and left steering wheel efforts.  PS-01723	Is the steering effort less than 31 N (3.2 kgf, 7.0 lbf)?	Go to step **4**.	Go to step **8**.
4	**CHECK STEERING EFFORT.** 1) Stop the engine. 2) Pull the spring scale at a right angle to the steering wheel, and measure both right and left steering wheel efforts.	Is the steering effort less than 294.2 N (30 kgf, 66.2 lbf)?	Go to step **5**.	Perform the inspection or adjustment around the suspension part.
5	**CHECK TORQUE SENSOR OUTPUT VALUE.** 1) Connect the Subaru Select Monitor. 2) Read the output of torque sensor voltage. NOTE: When measuring, place the steering wheel at the center position.	Is the voltage 2.425 — 2.575 V?	Go to step **6**.	Replace the gearbox assembly. <Ref. to PS-56, Electric Power Steering Gearbox.>

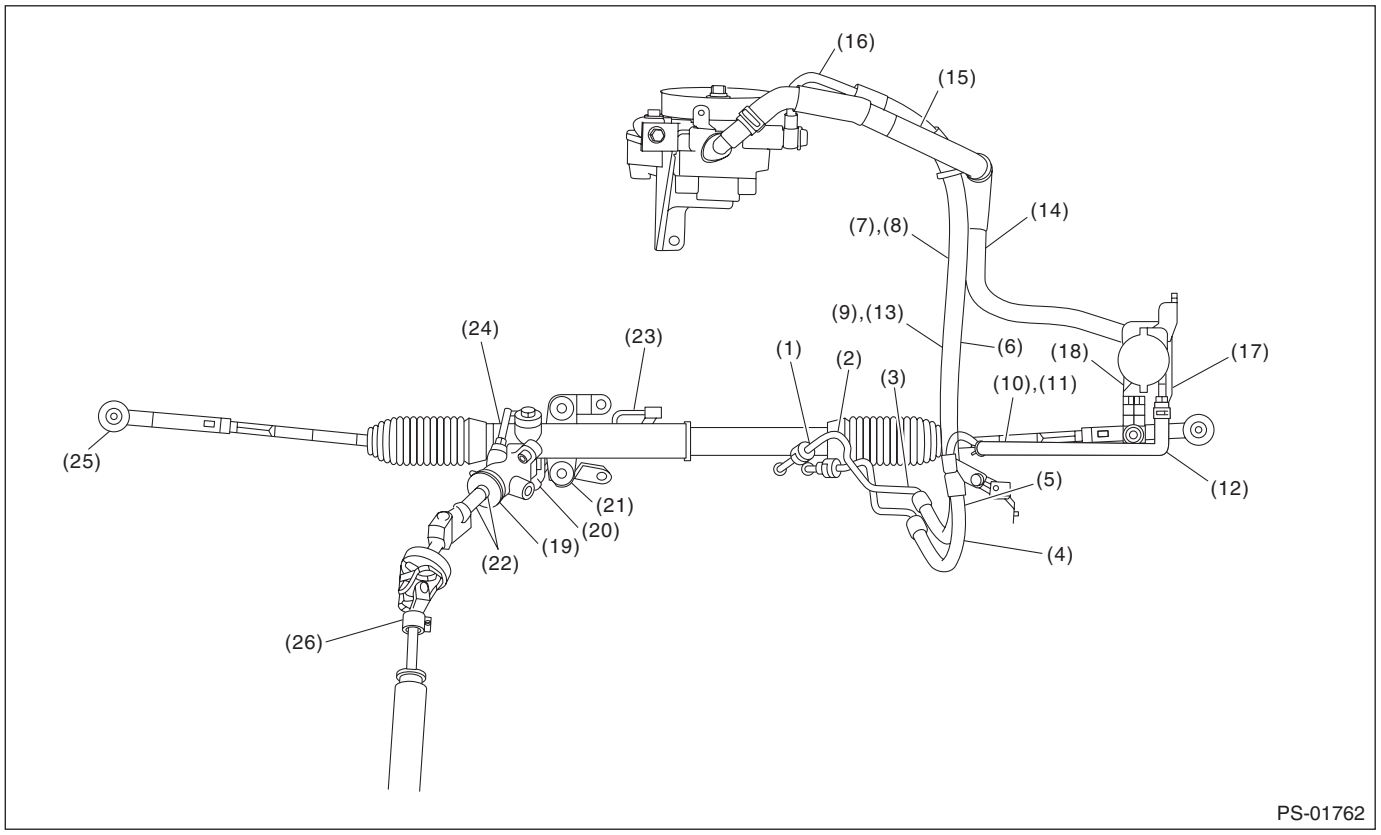
	Step	Check	Yes	No
6	**CHECK TORQUE SENSOR OUTPUT VALUE.** 1) Remove the universal joint assembly - steering. 2) Connect the Subaru Select Monitor. 3) Read the output of torque sensor voltage.	Is the voltage 2.425 — 2.575 V?	Go to step **7**.	Replace the gearbox assembly. <Ref. to PS-56, Electric Power Steering Gearbox.>
7	**CHECK TORQUE SENSOR OUTPUT VALUE.** 1) Remove the universal joint assembly - steering. NOTE: Check that the universal joint assembly - steering moves up and down smoothly without installing the bolt. Then tighten the bolts first on the gearbox side and then on the column shaft side. 2) Connect the Subaru Select Monitor. 3) Read the output of torque sensor voltage.	Is the voltage 2.425 — 2.575 V?	Go to step **8**.	Check the universal joint assembly - steering. <Ref. to PS-56, Electric Power Steering Gearbox.>
8	**CHECK STEERING WHEEL EFFORT.** 1) Remove the universal joint assembly - steering. 2) Measure the steering wheel effort.	Is the steering effort less than 2.26 N (0.23 kgf, 0.51 lbf)?	Go to step **9**.	Replace the column assembly - steering. <Ref. to PS-56, Electric Power Steering Gearbox.>
9	**CHECK STEERING WHEEL EFFORT.** Measure the steering wheel effort.	Is the difference of steering effort between right and left less than 20%?	Go to step **10**.	Replace the column assembly - steering. <Ref. to PS-25, Steering Column.>
10	**CHECK UNIVERSAL JOINT ASSEMBLY - STEERING.** Measure the swing torque of joint. (Yoke of column assembly - steering side) <Ref. to PS-23, INSPECTION, Universal Joint.>	Is the swing torque of the universal joint assembly - steering less than 8.1 N (0.81 kgf, 1.84 lbf)?	Go to step **11**.	Replace the universal joint assembly - steering with a new part. <Ref. to PS-21, Universal Joint.>
11	**CHECK UNIVERSAL JOINT ASSEMBLY - STEERING.** Measure the swing torque of joint. (Yoke of gearbox side) <Ref. to PS-23, INSPECTION, Universal Joint.>	Is the swing torque of the universal joint assembly - steering less than 6.8 N (0.68 kgf, 1.54 lbf)?	Go to step **12**.	Replace the universal joint assembly - steering with a new part. <Ref. to PS-21, Universal Joint.>
12	**CHECK FRONT WHEEL.** Check the front wheels.	Does the front wheels have unsteady revolution or rattling, or does the brake drag?	Inspect, readjust and replace if necessary.	Go to step **13**.
13	**CHECK TIE-ROD ENDS.** Remove the tie-rod ends.	Does the tie-rod ends of suspension have unsteady revolution or rattling?	Inspect and replace if necessary.	Go to step **14**.
14	**CHECK BALL JOINT.** Remove the ball joint.	Does the ball joints of suspension have unsteady revolution or rattling?	Inspect and replace if necessary.	Go to step **15**.
15	**CHECK GEARBOX.** Measure the rotating of gearbox. <Ref. to PS-65, LIMIT, INSPECTION, Electric Power Steering Gearbox.>	Is the turn resistance of the steering gearbox less than 18 N (1.8 kgf, 4.0 lbf)? Is the difference between the right and left rotational resistances less than 20%?	Go to step **16**.	Replace the gearbox assembly. <Ref. to PS-56, Electric Power Steering Gearbox.>

Step		Check	Yes	No
16	**CHECK GEARBOX.** Measure the sliding of gearbox.	Is the sliding resistance of the steering gearbox less than 360 N (36.7 kgf, 80.9 lbf)? Is the difference between the right and left sliding resistances less than 20%?	Steering effort is normal.	Replace the gearbox assembly. <Ref. to PS-56, Electric Power Steering Gearbox.>

5. CLEARANCE CHECK (HYDRAULIC TYPE)

This table lists various clearances that must be correctly adjusted to ensure the normal vehicle driving without interfering noise, or any other faults.

Location	Minimum allowance mm (in)
(1) Crossmember to hose ASSY	3 (0.12)
(2) Front exhaust pipe to hose ASSY	15 (0.59)
(3) Front frame side to hose ASSY	10 (0.39)
(4) Master cylinder to return hose	10 (0.39)
(5) Master cylinder to hose clip	10 (0.39)
(6) VDC H/U to hose ASSY	5 (0.20)
(7) Air cleaner to hose ASSY	5 (0.20)
(8) Air boot to hose ASSY	10 (0.39)
(9) Air cleaner hose to hose ASSY	10 (0.39)
(10) Brake pipe to return hose	10 (0.39)
(11) Front suspension bracket to return hose	5 (0.20)
(12) Front wheel apron to return hose	5 (0.20)
(13) VDC H/U bracket to suction hose	5 (0.20)
(14) Air cleaner case to suction hose	5 (0.20)
(15) Air intake duct to suction hose	10 (0.39)
(16) Air duct to suction hose	10 (0.39)
(17) Front wheel apron to reservoir tank	5 (0.20)
(18) VDC H/U to reserve tank	5 (0.20)
(19) Valve housing to DOJ (MT model)	12 (0.47)
(20) Valve housing to crossmember (hole)	1 (0.04)
(21) Cannon mount to crossmember	There must be no contact
(22) Pipe to crossmember	5 (0.20)
(23) Pipe to stabilizer	15 (0.59)
(24) Pipe to exhaust pipe	18 (0.71)
(25) Tie-rod end to brake dust cover	2.5 (0.10)
(26) Universal joint column side yoke to master cylinder (closest point of approach when the universal joint turns by 360°)	5 (0.20)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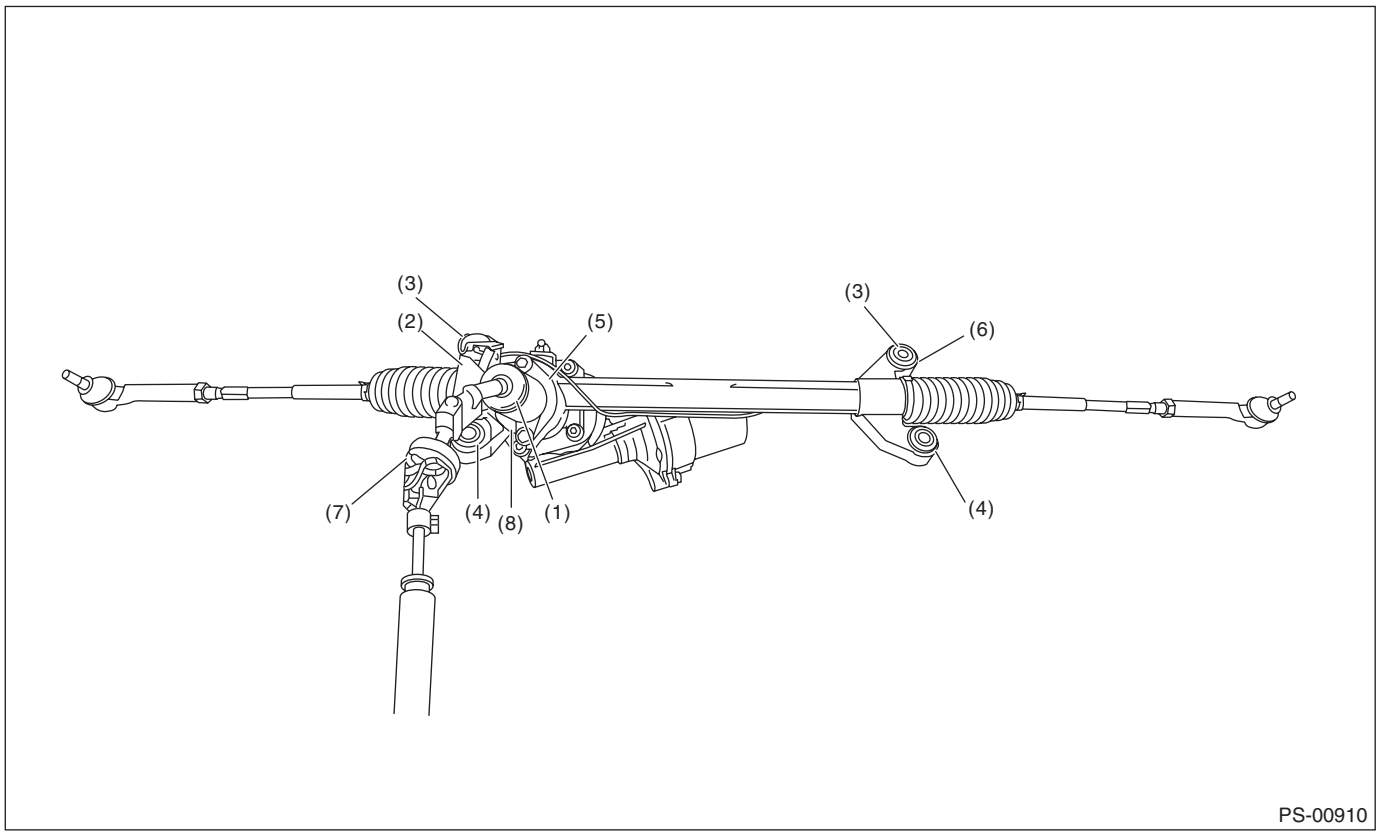
6. CLEARANCE CHECK (ELECTRIC TYPE)

This table lists various clearances that must be correctly adjusted to ensure the normal vehicle driving without interfering noise, or any other faults.

Location	Minimum allowance mm (in)
(1) Stub housing to DOJ (MT model)	15 (0.59)
(2) Torque sensor to crossmember	5 (0.20)
(3) Cannon mount to crossmember	There must be no contact
(4) Cannon mount to crossmember	3 (0.12)
(5) Stub housing to engine mount	15 (0.59)
(6) Canon mount to exhaust pipe	15 (0.59)
(7) Universal joint column side yoke to master cylinder (closest point of approach when the universal joint turns by 360°)	5 (0.20)
(8) Wheel housing to exhaust pipe	13 (0.51)



POWER ASSISTED SYSTEM (POWER STEERING) (DIAGNOSTICS)

PS(diag)