F4A4-2 Automatic Transmission

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Contents: Mechanical System

Hydraulic System

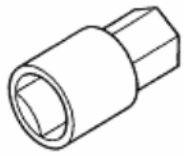
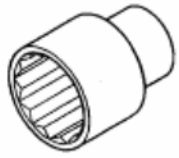
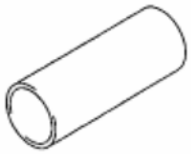
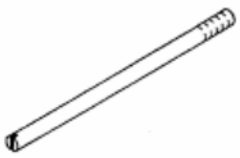
Control System

Troubleshooting

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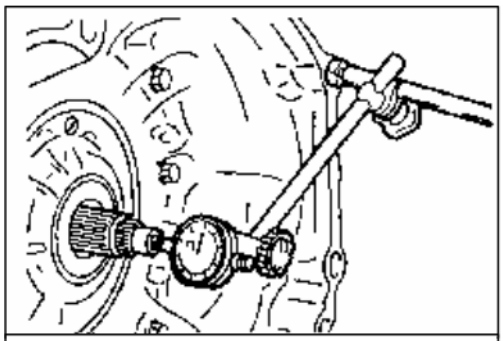
Part One: Mechanical System

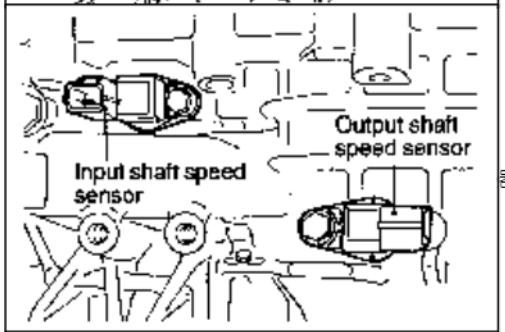
Special tools

Tool	Serial No.	Name	Use
	MB990607	Torque spanner socket	Fix and unfix set bolt of output shaft
	MB991625	Special socket (41)	Fix and unfix set bolt of output shaft
	MB991628	Spring compressor	Fix and unfix the snap ring of low gear – reverse gear brake
	MB991631	Clearance emulator board	Measure the axial clearance between low gear – reverse gear brake and the second brake
	MD998333	Oil pump dismantler	Dismantle oil pump
	MD998350	Bearing fixer	Fix output shaft, sleeve and bearing
	MD998412	Guide rod	Fix oil pump and drive gear of transfer case
	MD998907	Spring compressor	Fix and unfix the snap ring of underdrive clutch

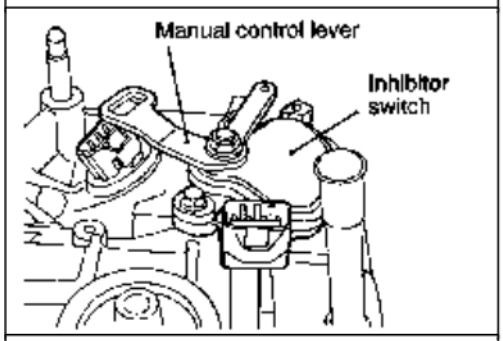
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Disassembly steps:
1. Unfix the hydraulic torque converter.
2. Measure the axial clearance of input shaft with a dial gauge.
3. Dismantle the bracket of left and right toss stopper.
4. Dismantle wire harness bracket.
5. Dismantle the bracket of control cable.
6. Take down oil gauge.
7. Dismantle eyebolt, seal washer and ATF cooler feeder pipe.
8. Dismantle speed sensors of input and output shafts.

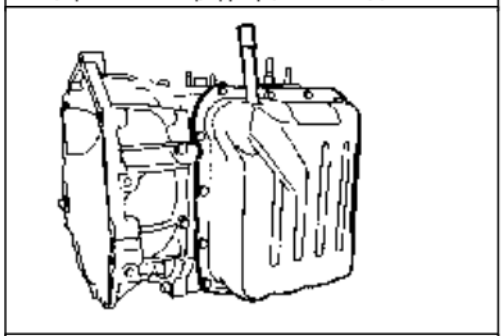




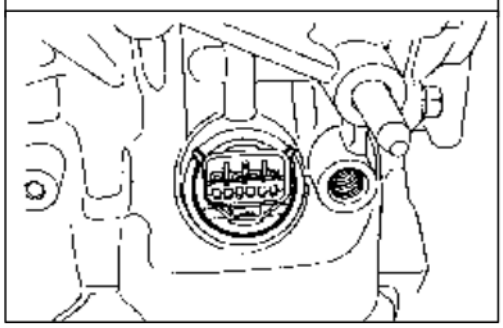
9. Dismantle manual control lever and then the inhibitor switch.



10. Dismantle the valve cover.

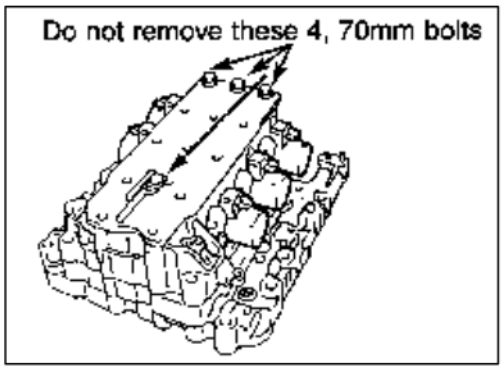


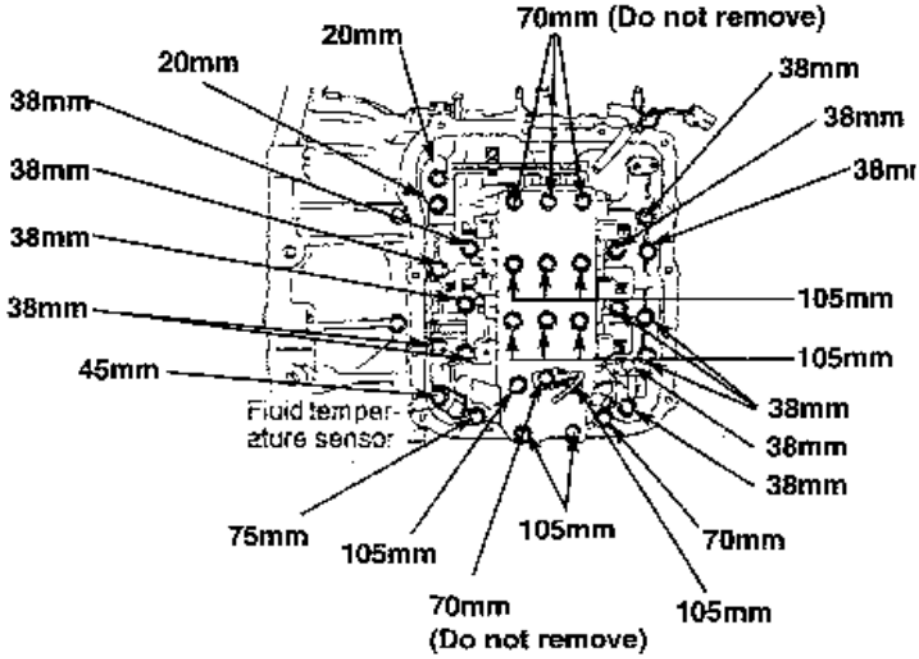
11. Dismantle the manual shaft brake.
12. Dismantle the snap ring and then the solenoid valve coil.



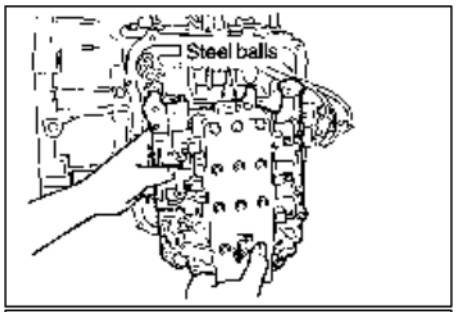
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13. Screw off the 28 set bolts of the valve body; do not screw off the four 70mm bolts. Note: bolts have different lengths. Bolt locations are indicated in the following figure:

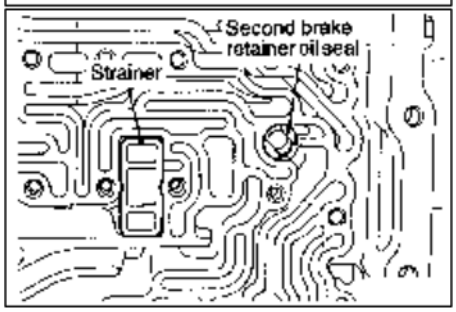




14. Dismantle valve body, seal washer and steel balls (two pieces). Take care not to lose the steel balls.

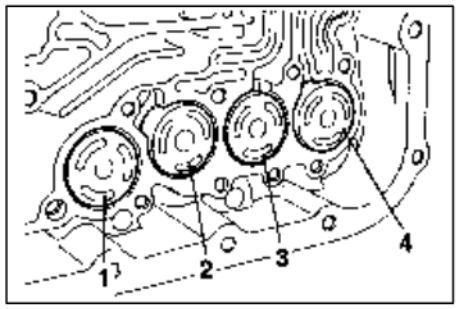


15. Dismantle oil filter
16. Dismantle second brake retainer oil seal. Note: dismantle the second brake retainer before the gearbox transmission, or oil seal will be damaged.



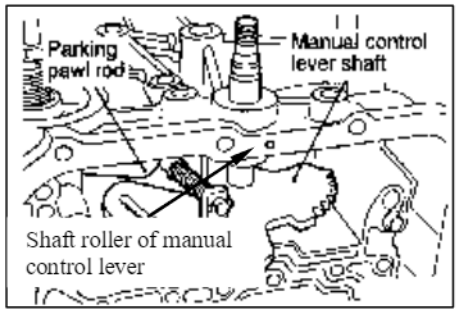
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17. Dismantle 4 accumulator pistons, 4 big springs and 3 small springs.

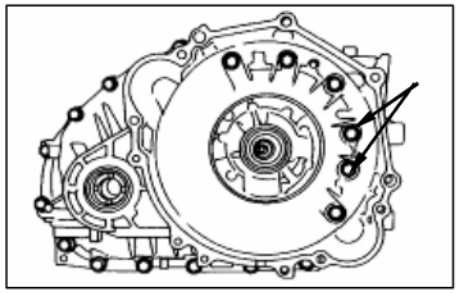


NO	Name
1	For low/reverse gear brake
2	For underdrive clutch
3	For second brake
4	For overdrive clutch

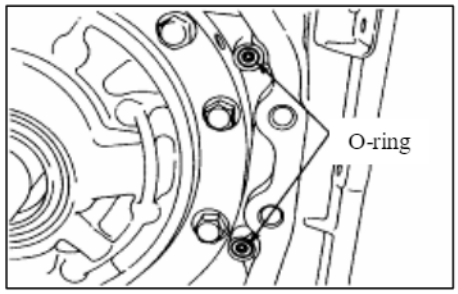
18. Dismantle the shaft roller of manual control lever.
19. Dismantle manual control lever shaft.
20. Dismantle parking pawl rod



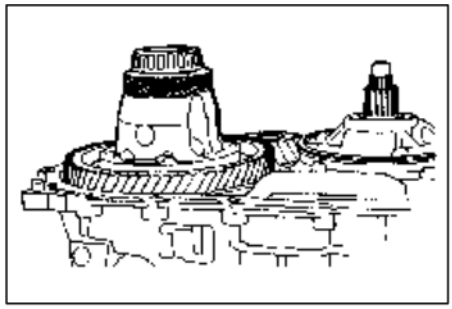
21. Dismantle torqus$_{steel}$s of two short bolts.
Note: the torque converter shall be placed upwards to prevent the torque converter from falling off.



22. Dismantle O-rings (two pieces)

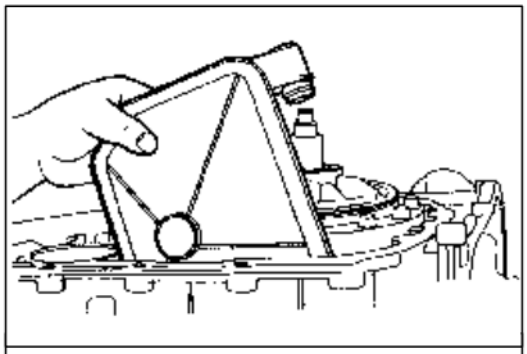


23. Dismantle the differential.

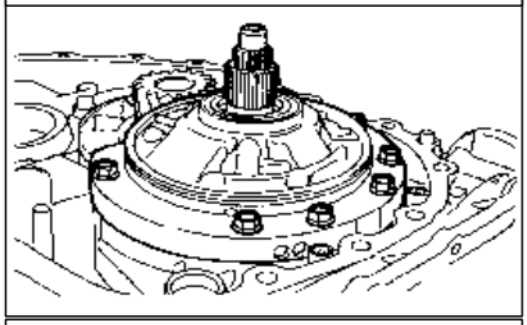


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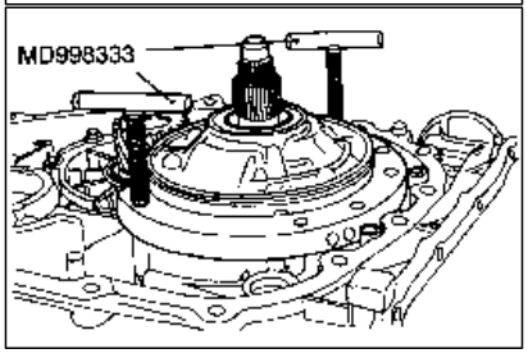
24. Dismantle the strainer



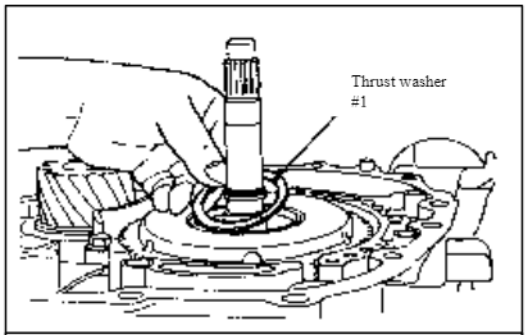
25. Dismantle oil pump set bolts
Note: Oil pump can not be repaired; dismantle it as a whole. The reason why an oil pump can't be disassembled is that any incorrect and inaccurate positioning will disable the oil pump and finally damage the transmission.



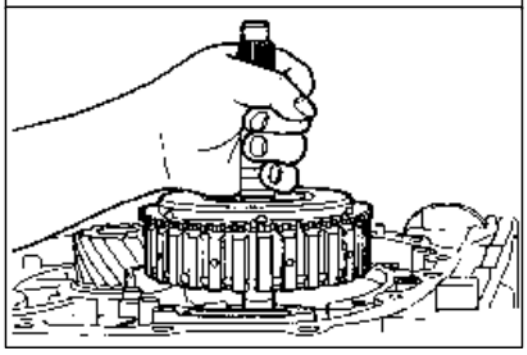
26. Special fixing tool MD998333.
27. Screw off the oil pump with the special fixing tool.



28. Dismantle oil pump seal washer.
29. Dismantle Thrust Washer #1 (plastic).

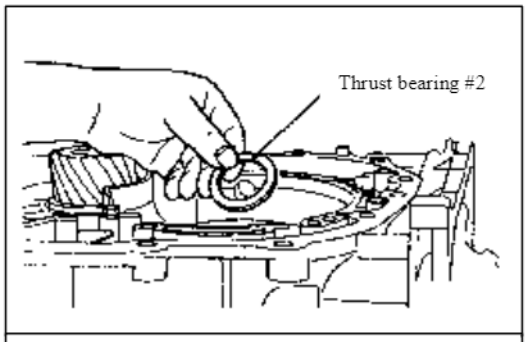


30. Hold the input shaft and take down the underdrive clutch.

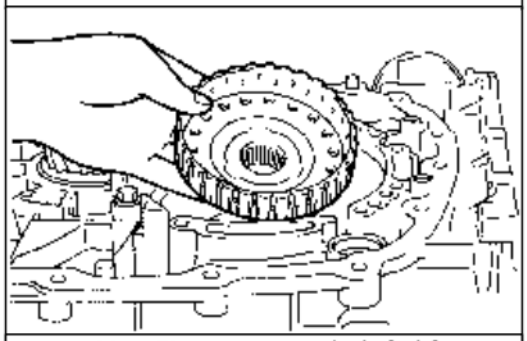


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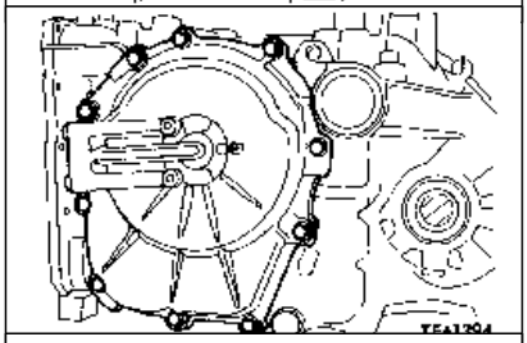
31. Dismantle Thrust Bearing #2.



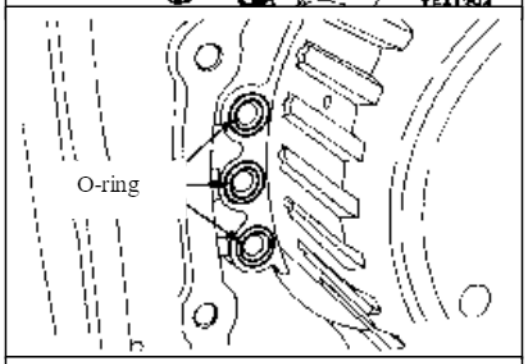
32. Dismantle underdrive clutch hub.



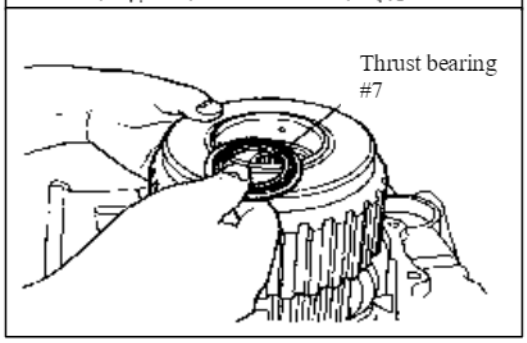
33. Dismantle the rear cover and bolt.
34. Dismantle Thrust Washer #8.
35. Dismantle the seals (4 pieces) off the rear cover.
Note: do not dismantle the rear bearing of input shaft unless otherwise required by the mentor. Replace any rear bearing that is dismantled.



36. Dismantle O-rings (3 pieces)

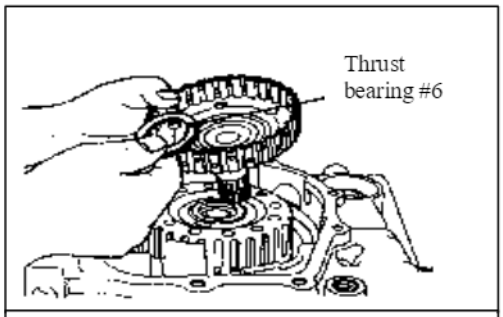


37. Dismantle the Thrust Bearing #7.
38. Dismantle reverse gear and overdrive clutch.

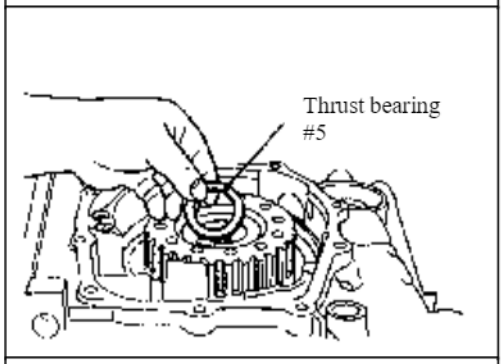


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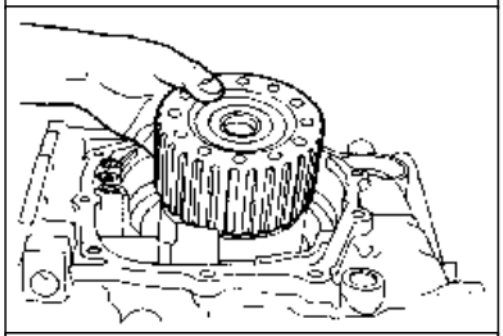
39. Dismantle Thrust Bearing #6.
40. Dismantle the overdrive clutch hub.



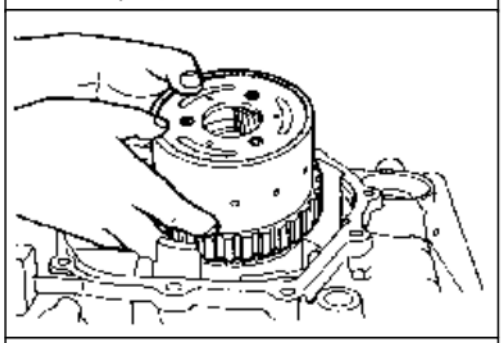
41. Dismantle Thrust Bearing #5.



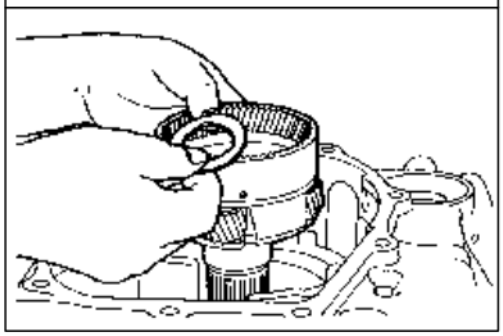
42. Dismantle the central gear of reverse-gear set.



43. Dismantle the overdrive planetary gear frame.

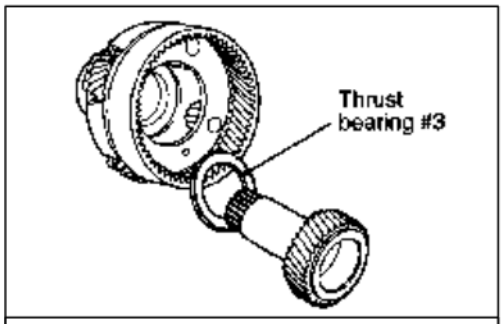


44. Dismantle Thrust Bearing #4.
47. Dismantle the output planetary gear frame

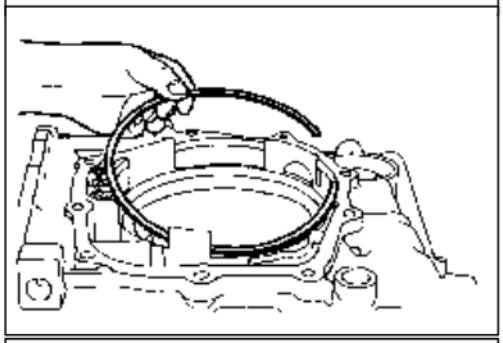


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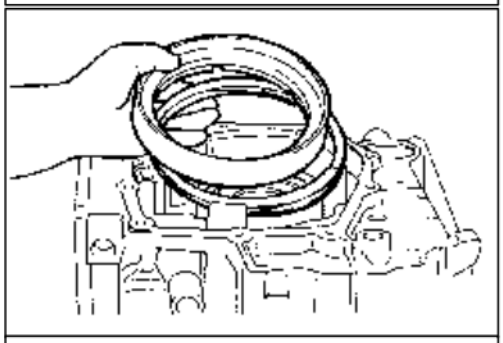
48. Dismantle the low speed central gear off the output planetary gear frame.
49. Dismantle Thrust Bearing #3



50. Dismantle second brake piston snap ring.



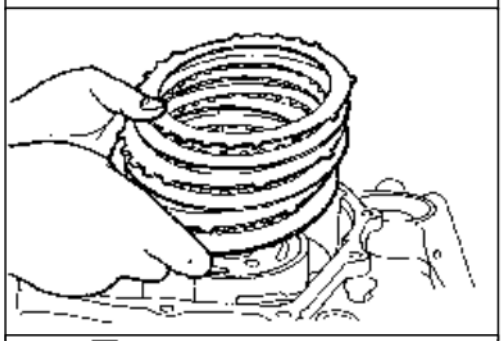
51. Dismantle second brake piston and offsetting spring.



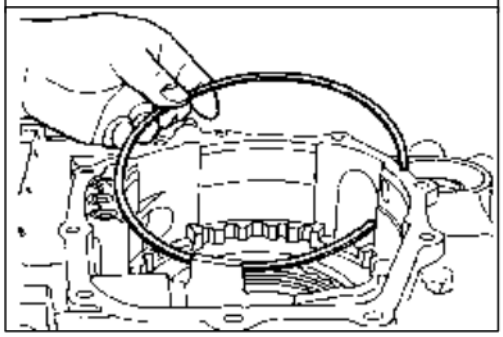
52. Dismantle the second brake pressure plate, linings and discs

Quantity of brake pads and discs

A/T type	Brake pad	Brake disc	Pressure plate
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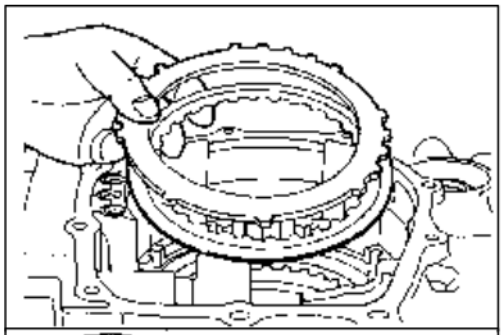


53. Dismantle low/reverse-gear reaction plate snap ring (thick).

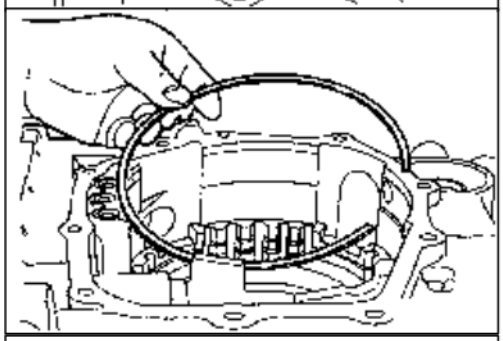


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54. Dismantle low/reverse-gear reaction plate and brake disc.

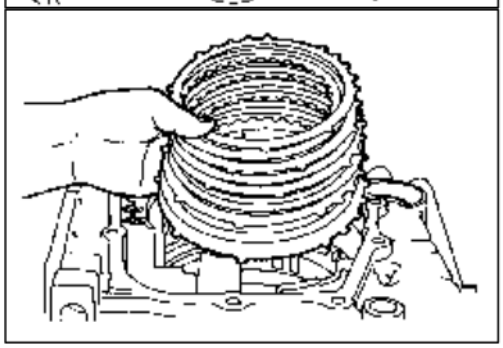


55. Dismantle low/reverse-gear snap ring (thin).

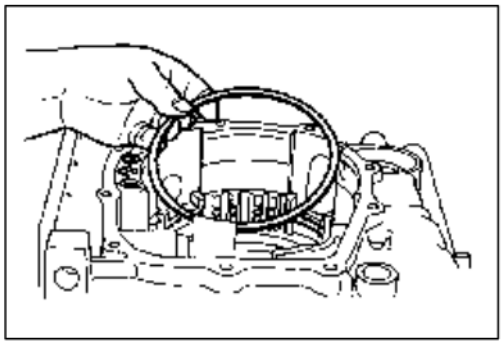


A/T type	Brake pad	Brake disc	Pressure plate
F4A42-2	6	5	1

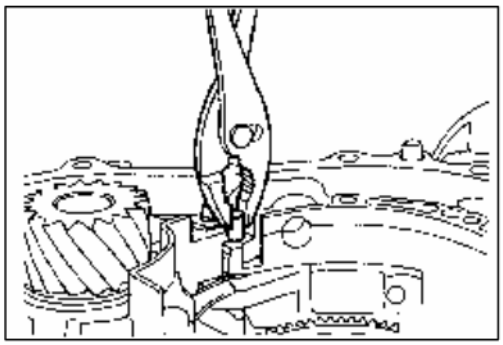
56. Dismantle low/reverse-gear brake disc, brake pad and pressure plate.
Quantity of brake pads and discs



57. Dismantle the ripple spring.

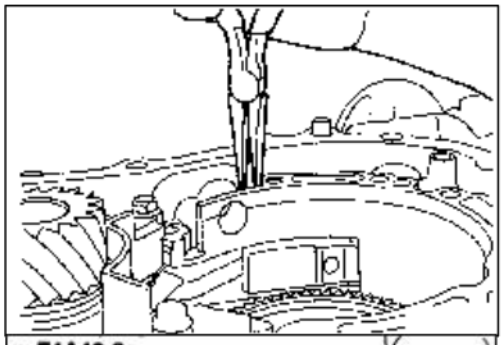


58. Release parking pawl spring and dismantle the parking pawl shaft.
59. Dismantle the spacer.
60. Dismantle the parking pawl spring.
Keep the spring direction in mind for the convenience of assembly.

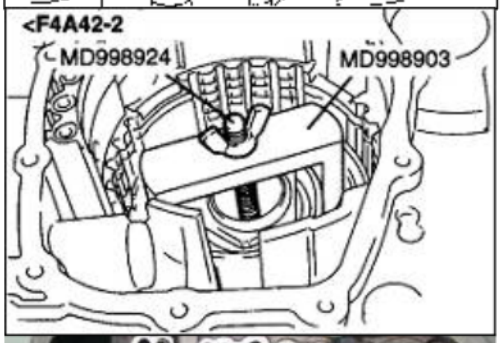


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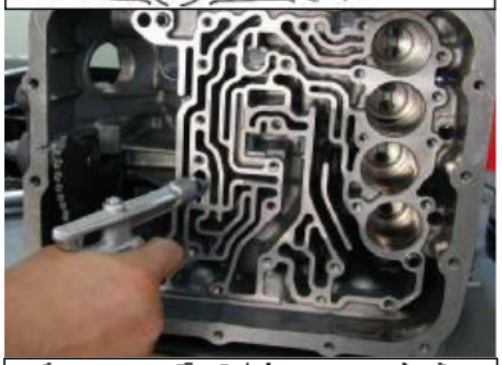
61. Dismantle the two bracing shafts of parking rollers.
59. Dismantle parking pawl cover.
60. Dismantle parking roller bracket.



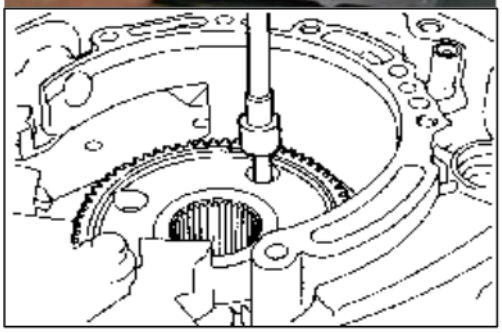
61. Dismantle the snap ring with the special tool. Dismantle the unidirectional clutch and O-ring (with unidirectional clutch gearbox)
62. Dismantle the spring retainer
63. Dismantle the offsetting spring



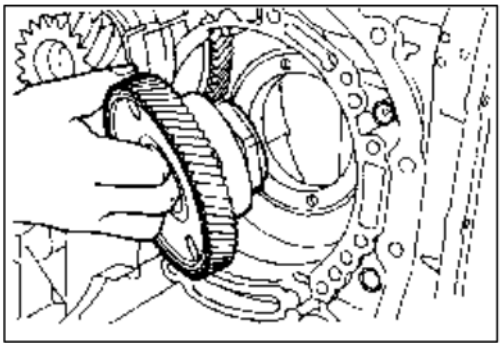
64. Dismantle low/reverse brake piston. As the figure shows, blow compressed air into the valve body passage.



65. Dismantle the set bolts of transfer case drive gear.

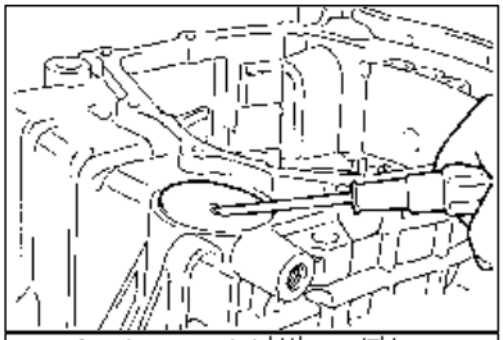


66. Dismantle the drive gear of the gearbox and slightly strike nut ends with a plastic hammer or a piece of wood.

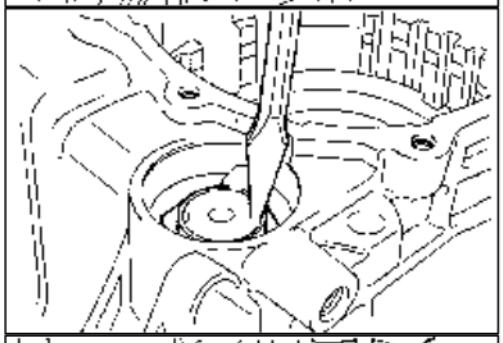


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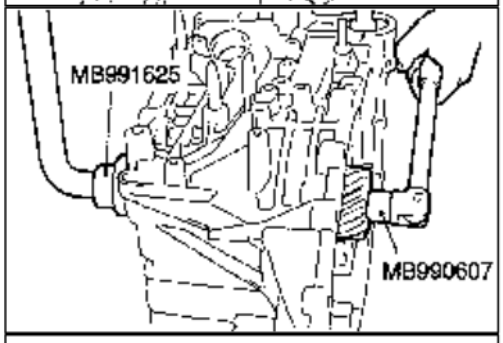
67. Dismantle the cover.



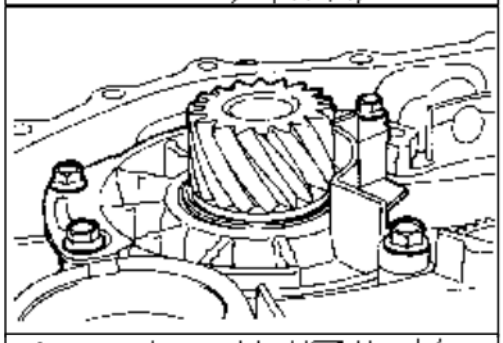
68. Straighten the locking lug of the output shaft lock nut.



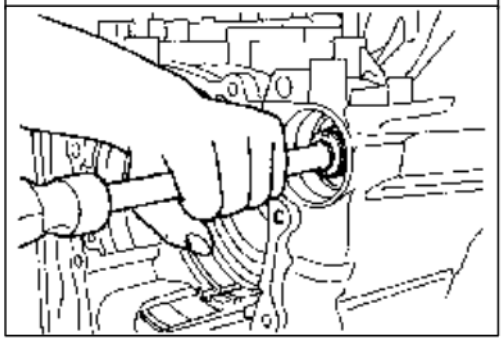
69. Screw off the output shaft lock nut with the special tool.
Note: this lock nut shall be tightened in counterclockwise direction.



70. Dismantle the set bolt of bearing retainer

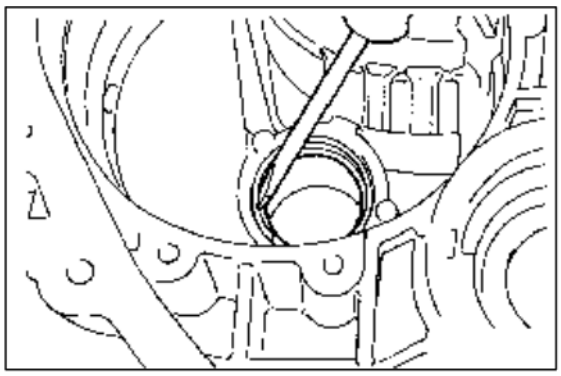


71. Slightly strike the rear end of the output shaft to dismantle the output shaft, roller bearing and sleeve.



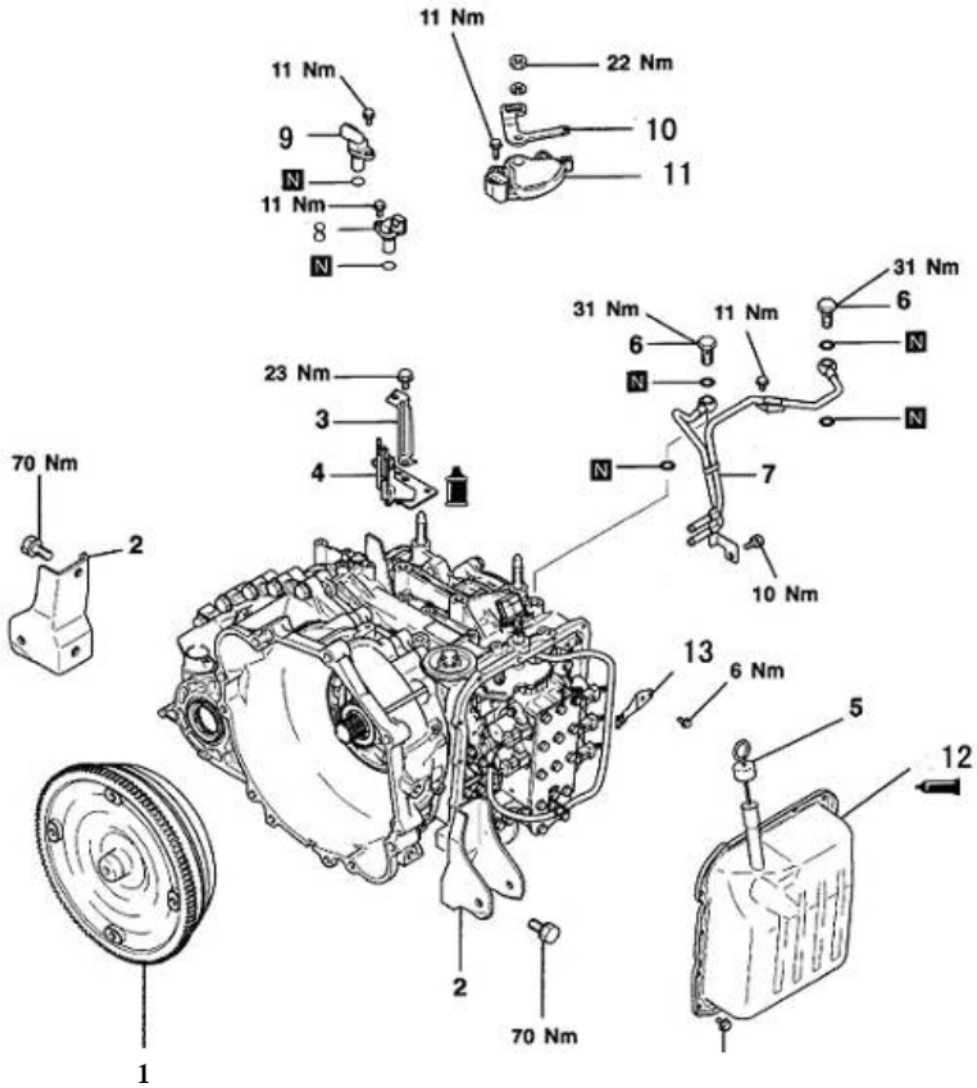
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72. Dismantle the spacer and outer ring.



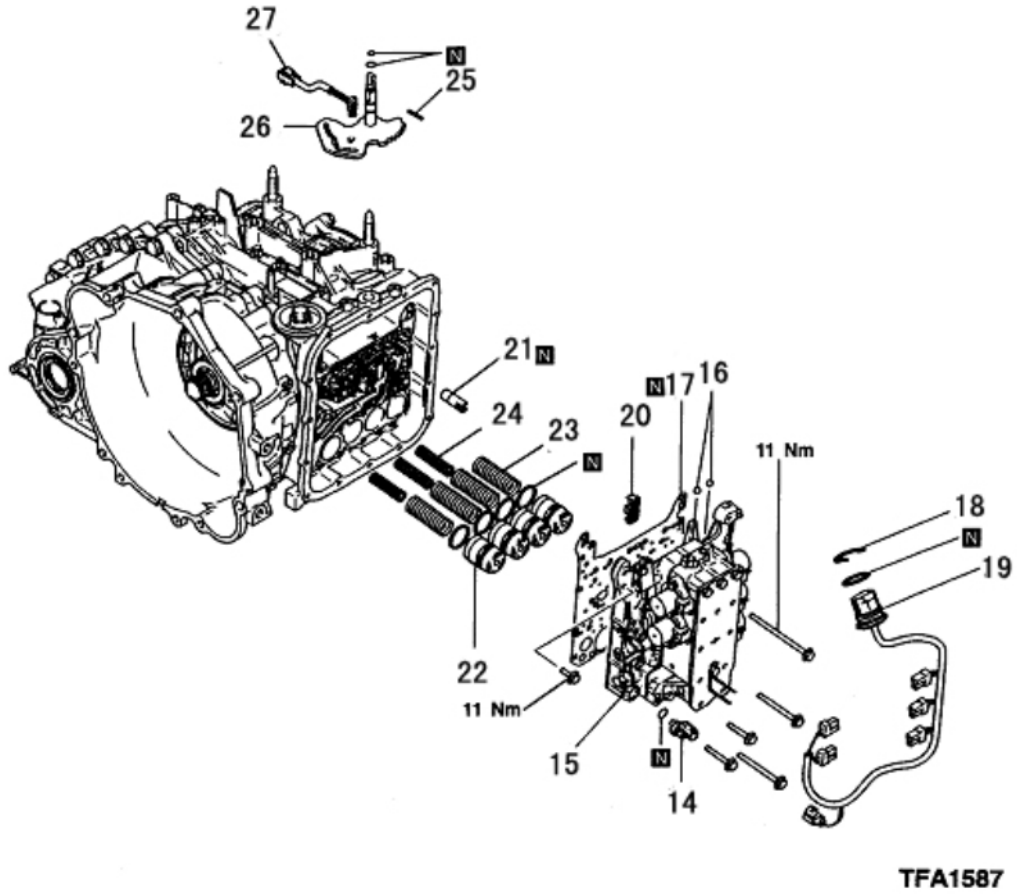
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Gearbox components



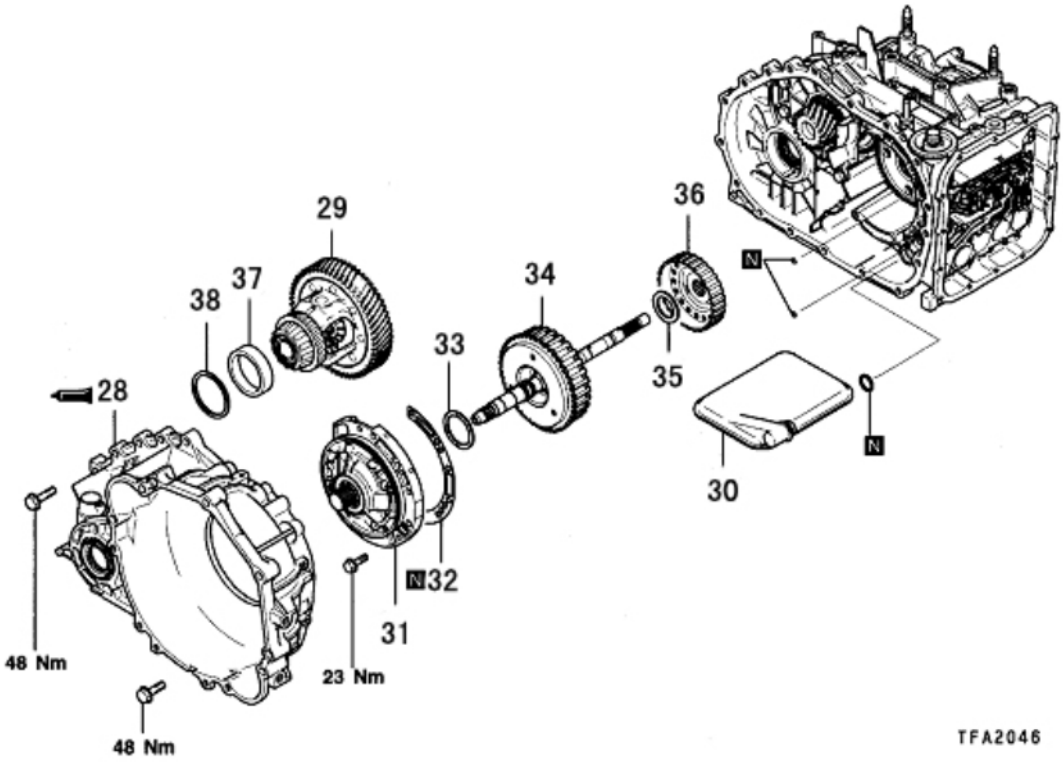
1. Hydraulic torque converter
2. Toss stopper bracket
3. Wire harness bracket
4. Control cable bracket
5. Oil gauge
6. Eyebolt
7. ATF cooler oil pipe
8. Input shaft speed sensor
9. Output shaft speed sensor
10. Manual control lever
11. Inhibitor switch
12. Valve body
13. Manual shaft brake

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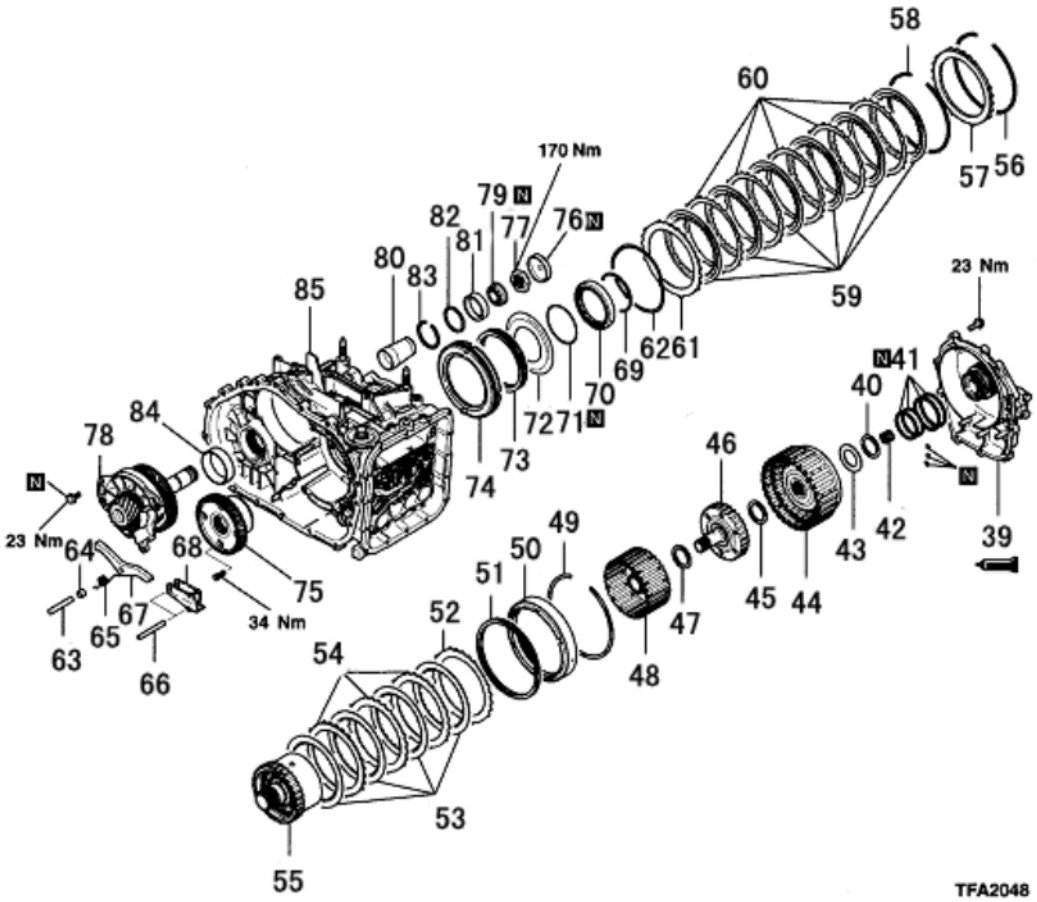
14. ATF temperature sensor
15. Valve body
16. Steel ball
17. Seal washer
18. Spring snap spring
19. Solenoid valve coil
20. Strainer
21. Second brake retainer oil seal
22. Accumulator piston
23. Accumulator spring
24. Accumulator spring
25. Manual control lever shaft roller
26. Manual control lever shaft
27. Parking pawl rod

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28. Hydraulic torque converter
29. Differential
30. Oil strainer
31. Oil pump
32. Seal washer
34. Underdrive clutch and input shaft
35. Thrust Bearing #2
36. Underdrive clutch hub
37. Outer ring38. Spacer

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39. Rear cover
40. Thrust ring #8
41. Seal washer
42. Input shaft rear bearing
43. Thrust bearing #7
44. Reverse-gear and overdrive clutch
45. Thrust bearing #6
46. Overdrive clutch hub
47. Thrust bearing #5
48. Reverse-gear central gear
49. Spring snap ring
50. Second brake piston
51. Offsetting spring
52. Pressure plate
53. Second brake pad
54. Second brake disc
55. Overdrive planetary gear frame
56. Spring snap ring
57. Reaction plate
58. Spring snap ring
59. Low/reverse brake pad
60. Low/reverse brake disc
61. Pressure plate
62. Ripple spring
63. Parking pawl shaft
64. Spacer
65. Parking pawl spring
66. Parking roller bracing shaft
67. Parking pawl
68. Parking roller bracket
69. Spring snap ring
70. Unidirectional clutch inner ring
71. O-ring
72. Spring retainer
73. Offsetting spring
74. Low/reverse brake piston
75. Transfer case drive gear
76. Cover
77.Lock nut
78. Output shaft
79. Roller bearing
80. Sleeve
81. Outer ring
82. Spacer
83. Spring snap ring
84.Outer ring
85.Gearbox cover

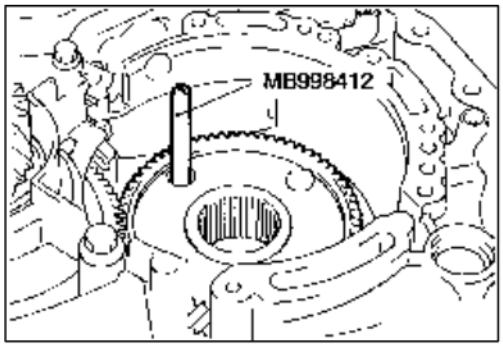
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Assembly Steps:

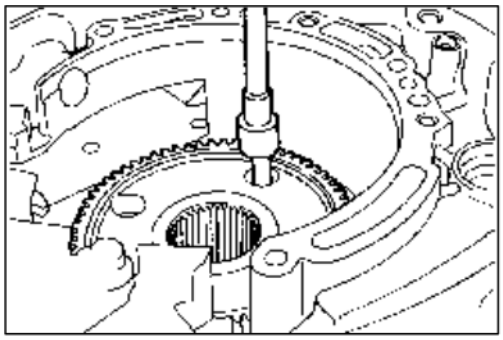
Assembly of main gearbox cover

The schematic drawing after disassembly is attached hereafter for your reference to help distinguish the various parts.

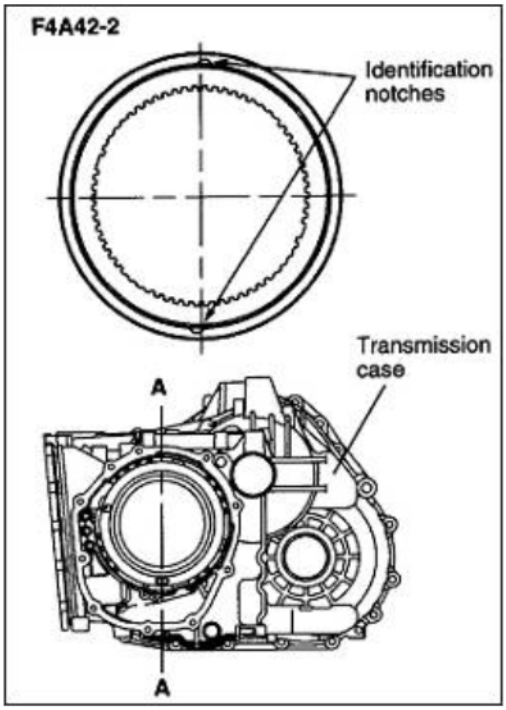
1. Fix the transfer case drive gear with the special tool MB998412.



2. Apply the required tightening torque on the set bolts of the drive gear shaft of the transfer case until they are tightened. Standard torque: 34Nm (1.9kg-m) bolt: 7 pcs. Overturn the A/T and follow the following steps for assembly:



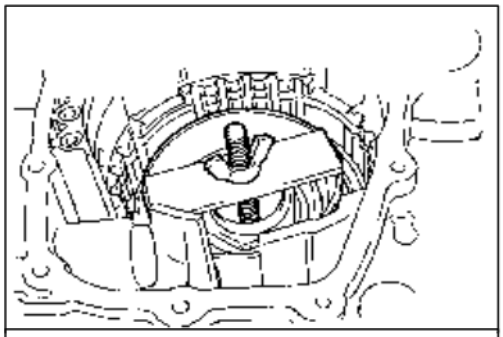
3. Fix low/reverse-gear brake piston, offsetting spring and spring hub. Make sure that the notch is aligned with the fixing notch of the outer cover.
4. Install one new seal washer in the inner ring of the unidirectional clutch.
5. Check the position of identification notches of the unidirectional clutch inner ring. Install clutch inner ring onto gearbox driving wheel bearing and align the notches with the A-A line.



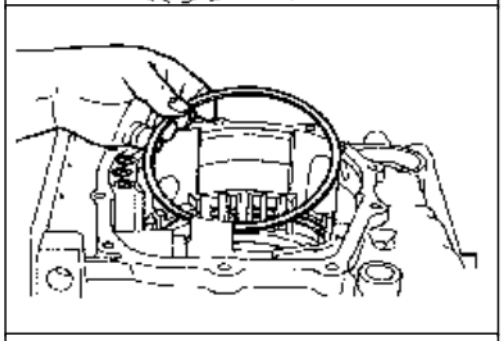
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6. Fix the snap ring with the special tool.
Note: take care not to deform the spring hub.

Type	Special tool
F4A42-2	MB998924 MD998903

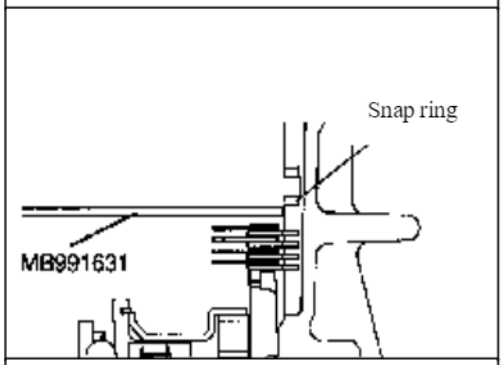


7. Fix ripple spring onto low-gear clutch piston.

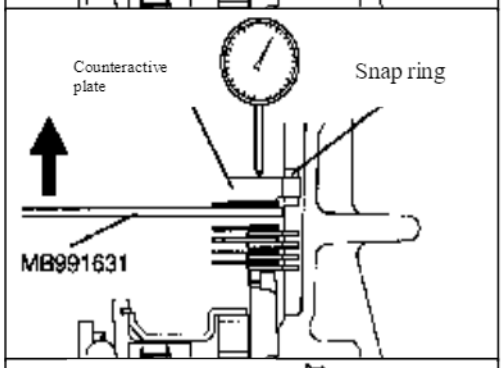


8. Fix the brake pads, brake discs and thick snap rings as the figure shows.
Note: do not install the pressure plate (thick plate) in order to measure the clearance.
Brake disc and brake pad quantity:

Type	Brake pad	Brake disc	Special tool
F4A42-2	6	5	1

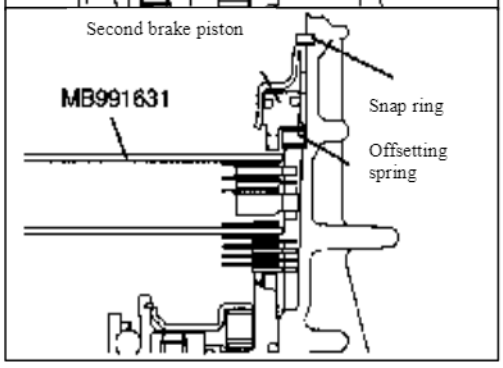


9. Fix the special tool MB991631 onto the brake pads.
10. Fix the reaction plate and snap ring as per the following steps:
11. Measure the axial clearance with a dial gauge and the special tool MB991631. Then replace the snap ring installed in Step 10 to adjust the axial clearance to standard value.
Standard value: 0-0.16mm



12. Fix the brake pads, brake discs and special tool MB991631 (F4A4) as the figure shows. Do not fix the pressure plate with ID marking.
Note: fix the pressure plate as per the following steps:
Quantity of brake disc and brake pads:

Type	Brake pads	Brake disc
F4A42	3	2



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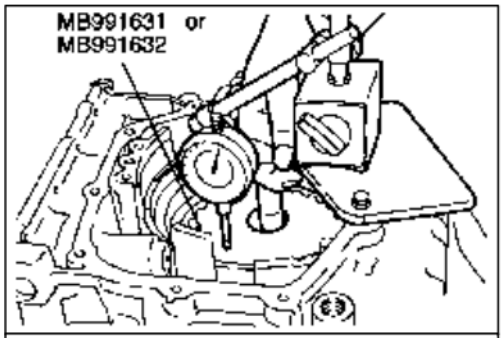
13. Fix the special tool MB991631 onto the brake pads to replace the pressure plate.
14. Fix the offsetting spring, second brake piston and snap ring.
15. Move the special tool MB991631 to measure the axial clearance. Choose the pressure plate with a thickness compatible with the measured results from the following table.
Standard value: 0.79-1.25mm (F4A42 ref.)

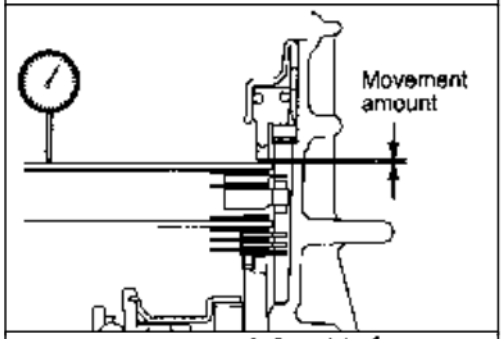
Axial clearance F4A42	Thickness (mm)	ID marking	Part No.
0.6-0.8	1.6	L	MD759567
0.8-1.0	1.8	1	MD759414
1.0-1.2	2.0	0	MD759415
1.2-1.4	2.2	2	MD759416
1.4-1.6	2.4	4	MD759417
1.6-1.8	2.6	6	MD759418

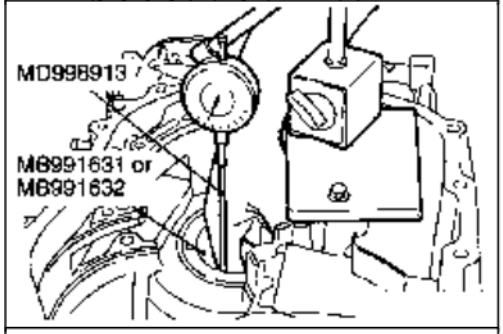
16. Turn over the gearbox
17. Fix the special tool MD998913 onto the dial gauge and then move the special tool MD991631 to measure the axial clearance.
Standard value: 1.65 – 2.11mm
18. Choose the pressure plate with a thickness compatible with the measured results from the following table.
F4A42 pressure plate:

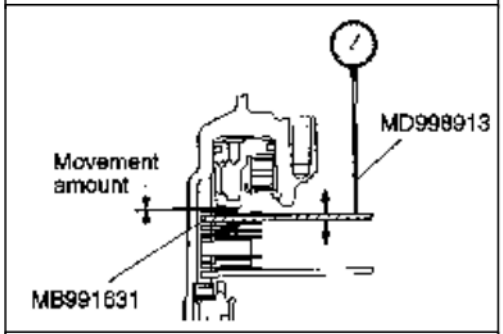
Axial clearance	Thickness (mm)	ID marking	Part No.
1.3-1.5	1.6	L	MD759567
1.5-1.7	1.8	1	MD759414
1.7-1.9	2.0	0	MD759415
1.9-2.1	2.2	2	MD759416
2.1-2.3	2.4	4	MD759417
2.3-2.5	2.6	6	MD759418
2.5-2.7	2.8	8	MD759419
2.7-2.9	3.0	D	MD759420

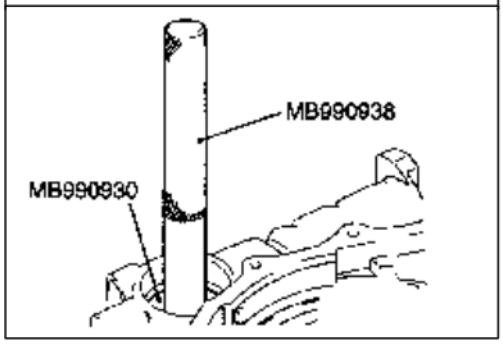
19. Step 7 to 18 refer to all components and special tools fixed for the purpose of clearance measurement.
20. Dismantle and detach the pressure plate and snap ring selected in Steps 8, 15 and 18.
21 Install the output shaft's prestressed adjusting spacer of the minimum thickness (1.88mm); MD756579





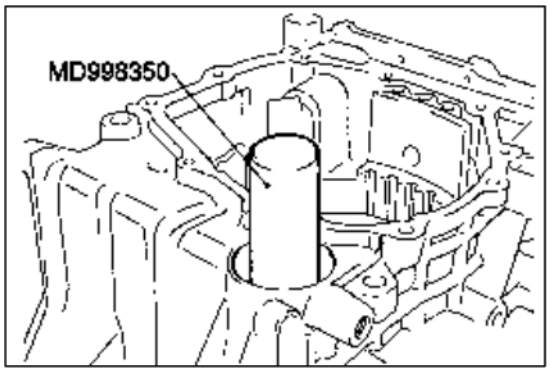


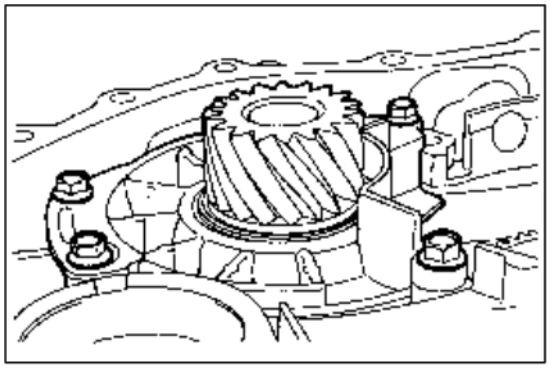


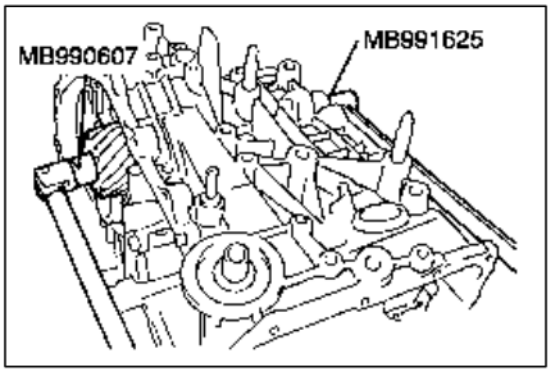


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22. Fix the output shaft outer ring into the gearbox cover with the special tools of MB990930 and MB990938.
23. Install the output shaft in the gearbox with a soft hammer.
Reference: align the output shaft with the cover hole with the special tool MD998412.
24. Tighten the set bolts of output bearing hub with a tightening torque of 23Nm (2.3Kg-m).
25. Fix the sleeve and roller bearing onto the output shaft with the special tool MD998350.
Note: this lock nut shall be tightened in counterclockwise direction.
26. After apply ATF onto the lock nut, tighten the nut with a tightening torque of 167Nm (16.7Kg-m) with the special tool. Release all nuts and retighten them with a torque f 170Nm (17.0Kg-m).
27. Move the output shaft to measure the displacement.
28. Use 1.88mm* and 0.01-0.09mm** to measure the value in Step 28 and choose one spacer of the same thickness. The following table lists the thickness and dimension of adjusting spacers. Please choose the most appropriate one.
* refers to the thickness of spacer fixed in Step 21.
** refers to the thickness of prestressed spacer of output shaft.



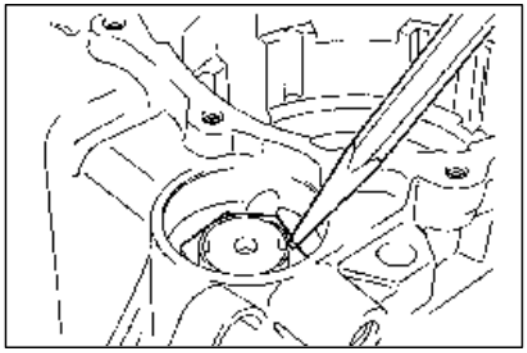




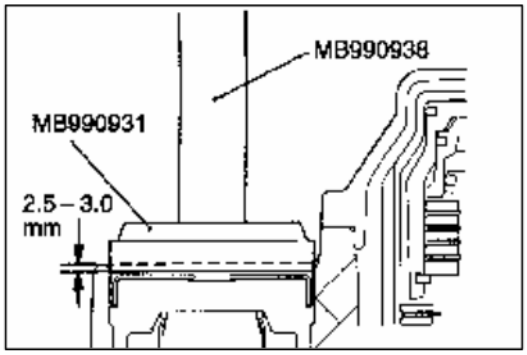
Thickness (mm)	ID mark	Part No.	Thickness (mm)	ID mark	Part No.
1.88	88	MD756579	2.36	36	MD756591
1.92	92	MD756580	2.40	40	MD756592
1.96	96	MD756581	2.44	44	MD756593
2.00	00	MD756582	2.48	48	MD756594
2.04	04	MD756583	2.52	52	MD756595
2.08	08	MD756584	2.56	56	MD756596
2.12	12	MD756585	2.60	60	MD765597
2.16	16	MD756586	2.64	64	MD756598
2.20	20	MD756587	2.68	68	MD756599
2.24	24	MD756588	2.72	72	MD760685
2.28	28	MD756589	2.76	76	MD760686
2.32	32	MD756590			

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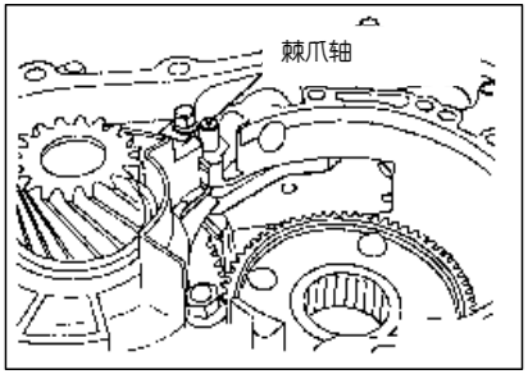
29. Avoid the rotation of lock nuts (two pieces)
Note: do not tighten the released part.



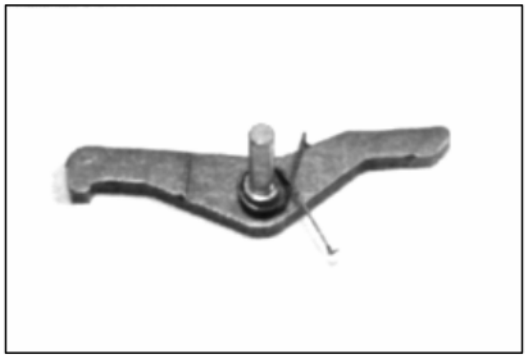
30. Fix the cover as the figure shows. If available, use MB990931 and MB990938.



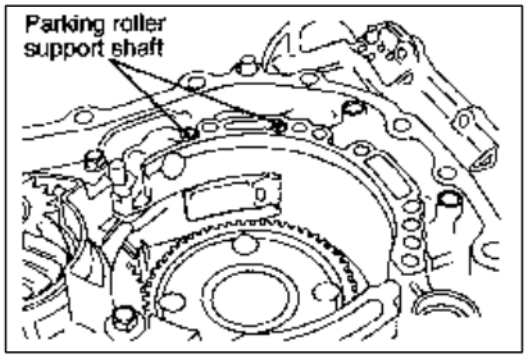
31. Install the parking pawl, spacer and spring. Then install the parking pawl shaft.
Reference: the surfaces of the parking pawl shaft and the cover are different.



Reference: install the spring and spacer as the figure shows.

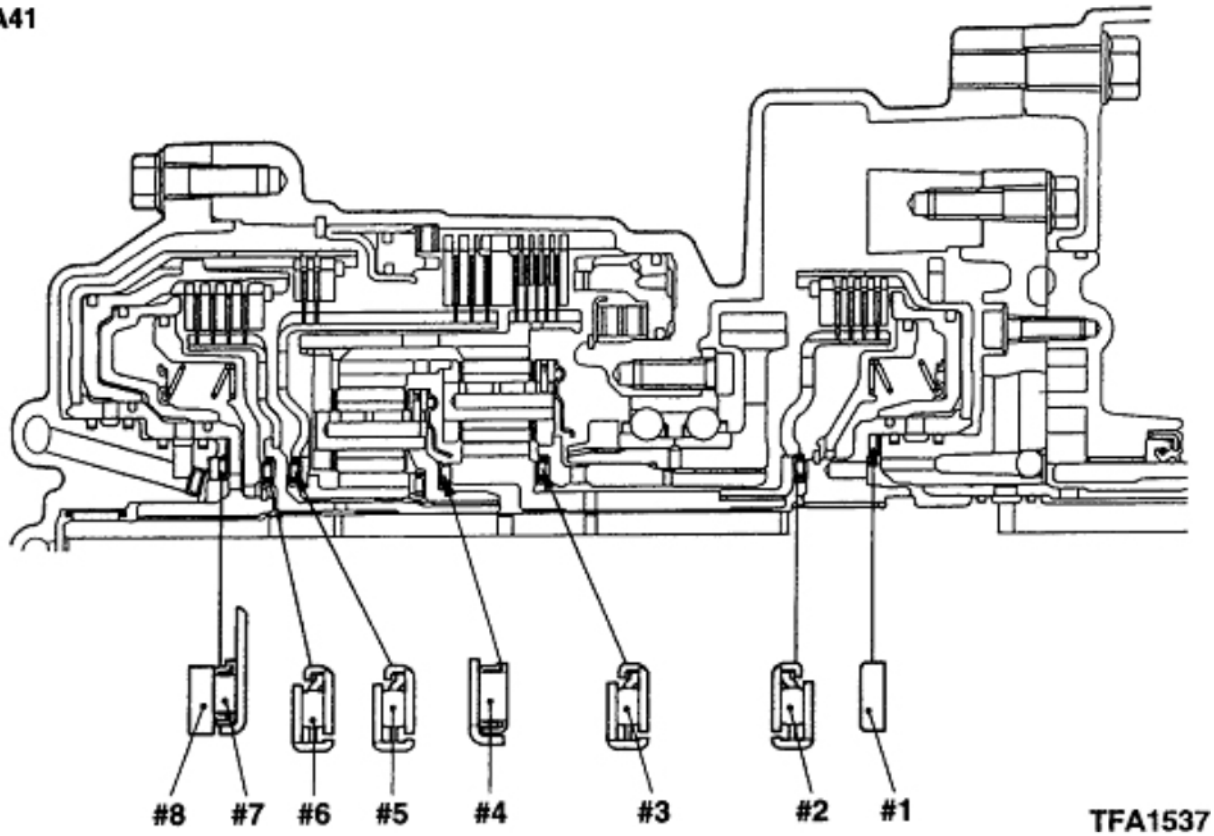


32. Install the parking roller bracket and then the two support shafts of parking roller.
Turn over A/T and complete the following steps:



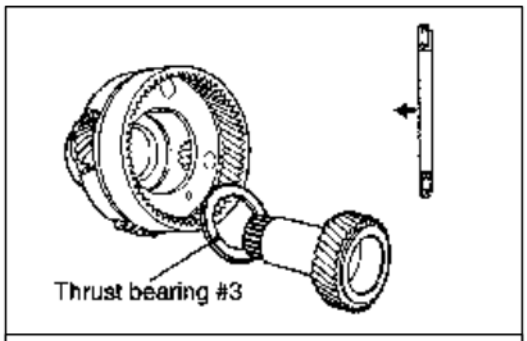
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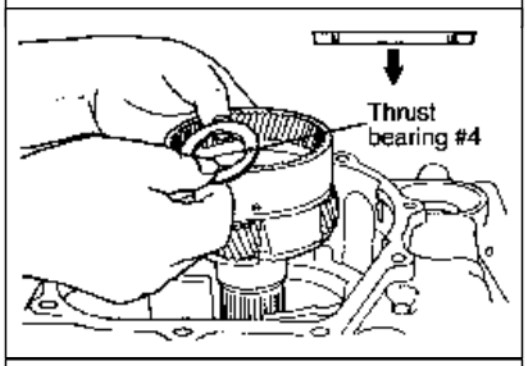


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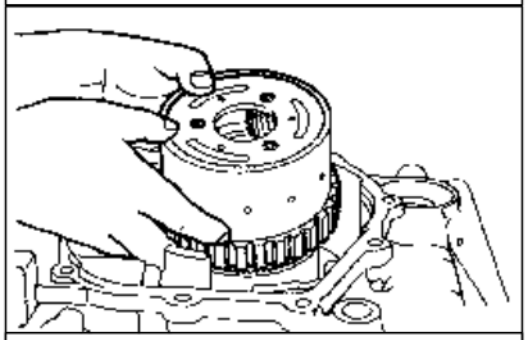
33. Install the low-speed central gear and Thrust Bearing #3 on the output planetary gear frame.
Note: do not install the thrust bearing in the wrong direction.



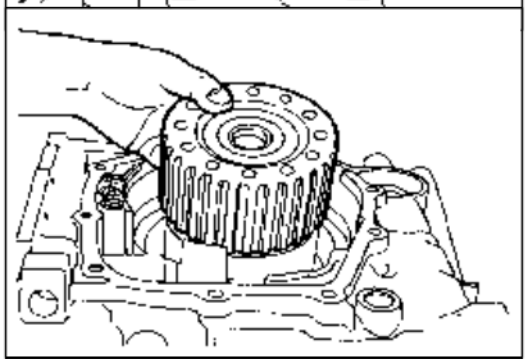
34. Install the output planetary gear frame and Thrust Bearing #4.
Note: do not install the thrust bearing in the wrong direction.



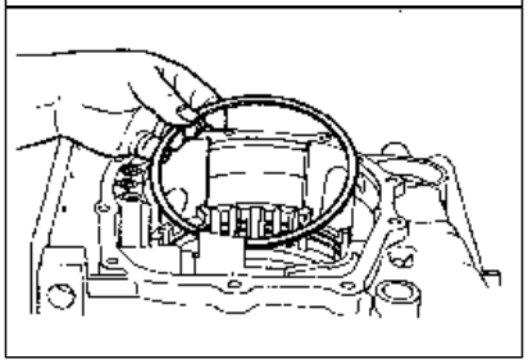
35. Install the overdrive planetary gear frame.



36. Install thhe reverse planetary gear's central gear.



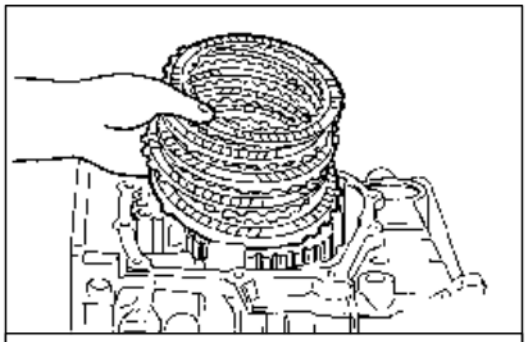
37. Install the ripple spring.



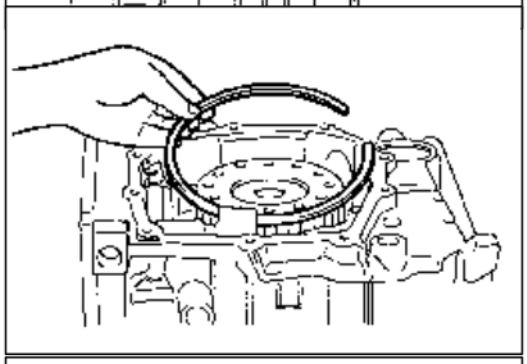
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38. Install the pressure plate, brake pads and brake discs.
Reference:
Make sure all brake pads have a narrow brake lining.

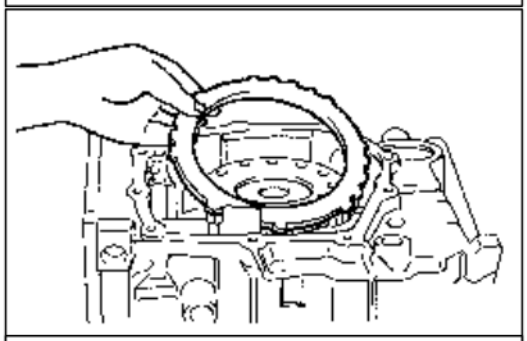
Type	Brake pads	Brake disc	Pressure plate
F4A4-2	6	5	1



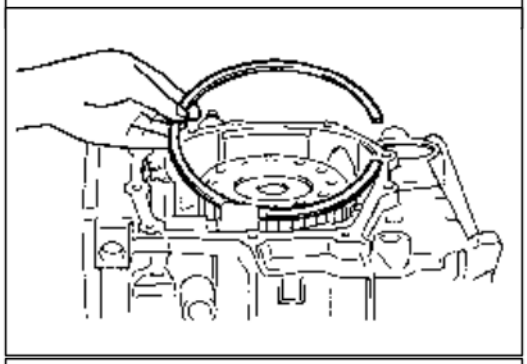
39. Install the snap rnig (thin)



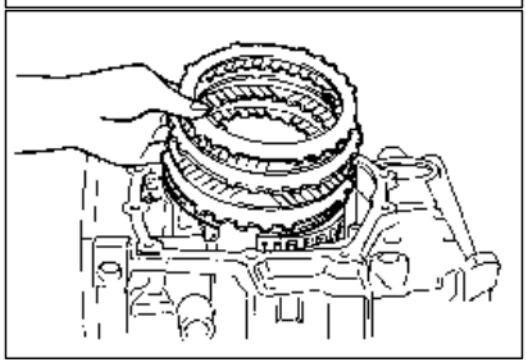
40. Install the reaction plate (with notch facing downwards).



41. Install the snap ring (thick)

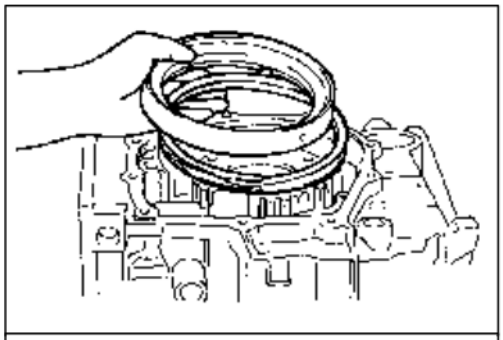


42. Install the brake pads, brake discs and pressure plate.

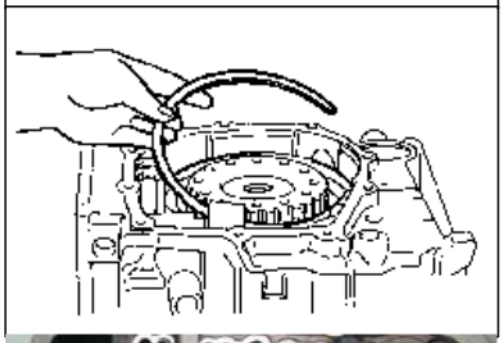


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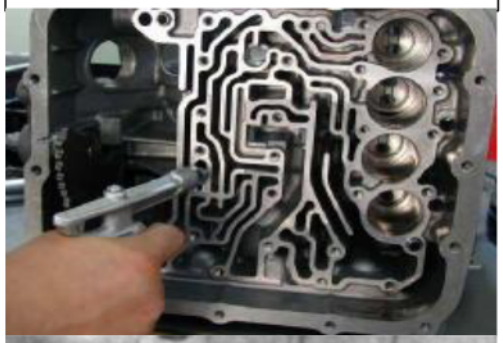
43. Install the offsetting spring and second brake piston.



44. Install the snap ring.



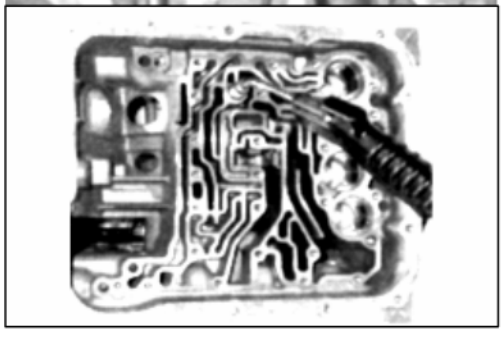
45. Blow a 2kg/cm^2 compressed air into the working hole of reverse brake and make a judgement of clutch operation.



Reference:
A rubber tube can prevent the air from leaking throught the side working hole.

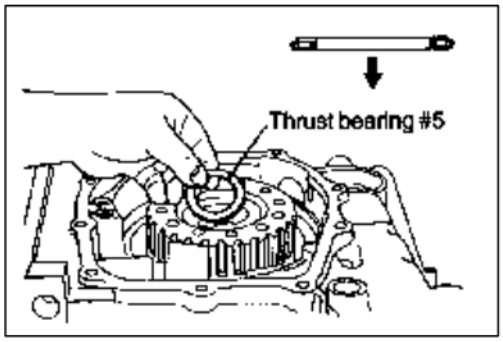


46. Blow a 2kg/cm^2 compressed air into the working hole of second brake and make a judgement of clutch operation.

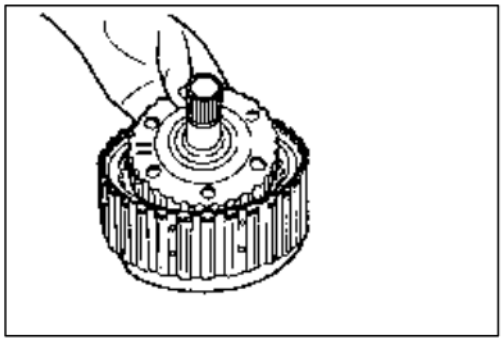


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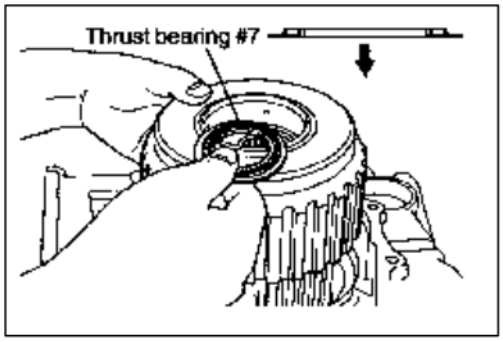
47. Install the Thrust Bearing #5.
Note: do not install the thrust bearing in the wrong direction.



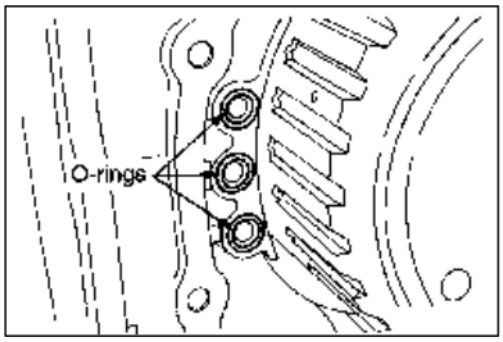
48. Install the overdrive clutch hub and Thrust Bearing #6 in the reverse gear and overrning clutch.
Note: do not install the thrust bearing in the wrong direction.



49. Install the reverse gear and overrning clutch and then Thrust Bearing #7.
Note: do not install the thrust bearing in the wrong direction.

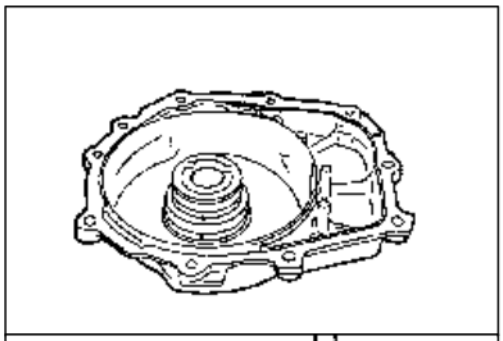


50. Fix three O-rings.

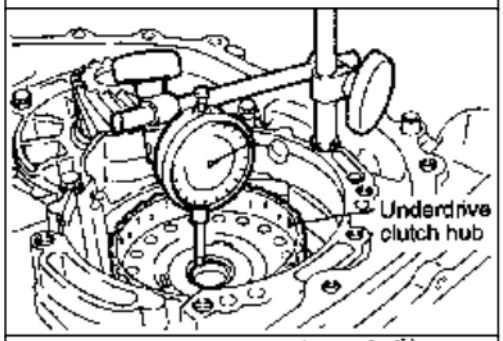


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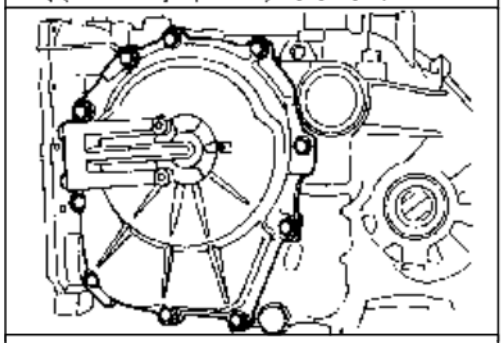
51. Install four seals in the rear cover.
52. Install Thrust Bearing #8 and then the rear cover.



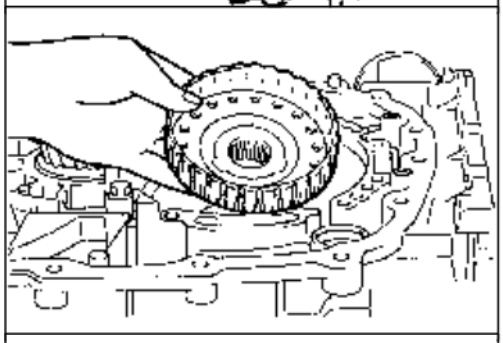
53. Measure the axial clearance of low-speed centrual gear. Replace Thrust Bearing #8 to adjust the clearance to the standard value. Refer to the following table and select the proper component serial number.
Standard value: 0.25-0.45mm
The axial clearance of low-speed central gear may be easily measured by fixing the underdrive clutch hub.



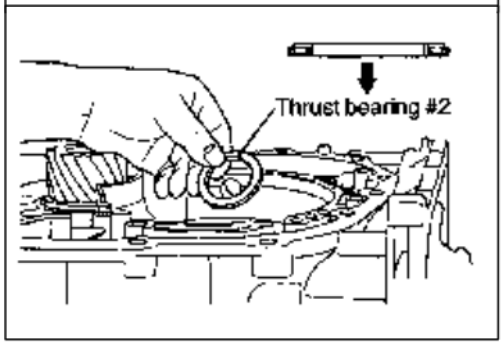
54. After fixing the rear cover, tighten the bolt with a tightening torque of 23Nm (2.3Kg-m).



55. Fix the underdrive clutch hub.

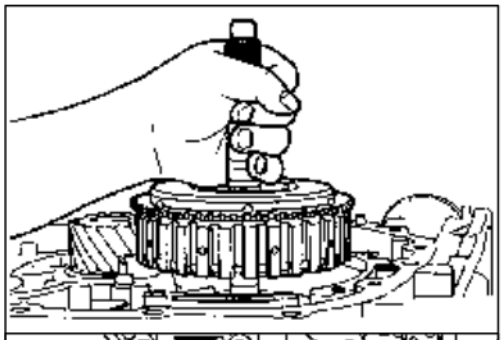


56. Fix Thrust Bearing #2.
Note: do not install the thrust bearing in the wrong direction.

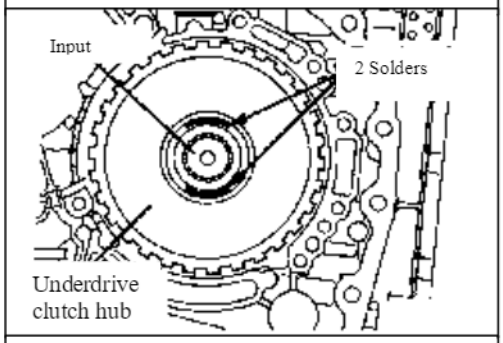


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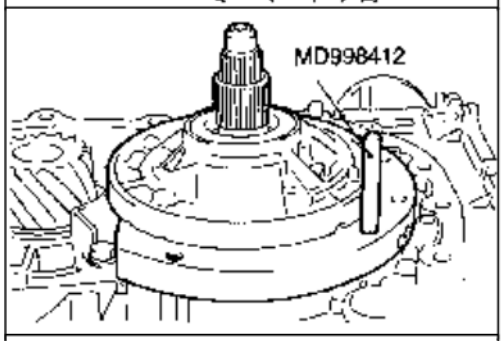
57. Hold the input shaft and instal underdrive clutch.
Reference:
Observe through the fixing hole of input shaft sensor on outer cover and confirm if the underdrive clutch is installed in place.



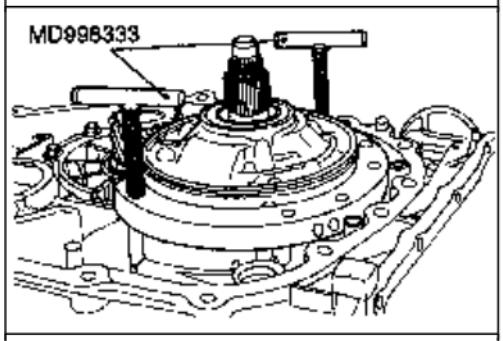
58. Attach the solders (about 10mm long and 3.5mm in diameter) to the underdrive clutch hub.



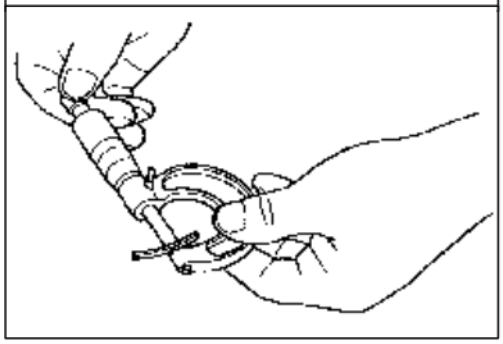
59. Install oil pump and bolts with the special tool MD998412. Tighten the bolts with a tightening torque of 23Nm (2.3Kg-m).
Note: do not fix the oil pump washer then.



60. Dismantle the set bolts, oil pump and solder.



61. Measure the solder thickness with a dial gauge.

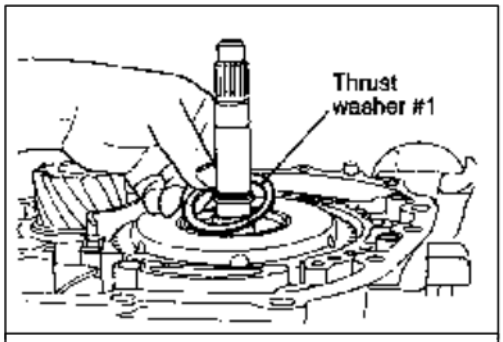


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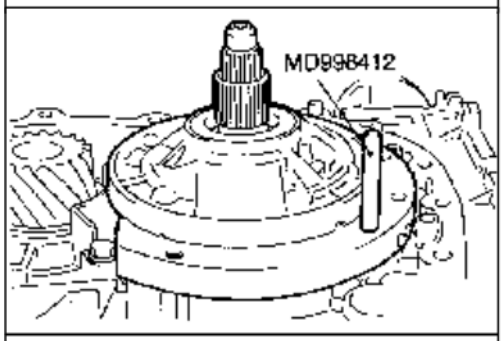
62. Select the Thrust Washer #1 of appropriate thickness from the following table:

Measured result (mm)	Thickness (mm)	ID marking	Part No.
2.25 –2.45	1.8	18	MD754509
2.45-2.65	2.0	20	MD754508
2.65-2.85	2.2	22	MD754507
2.85-3.05	2.4	24	MD753793
3.05-3.25	2.6	26	MD753794
3.25-3.45	2.8	28	MD753795

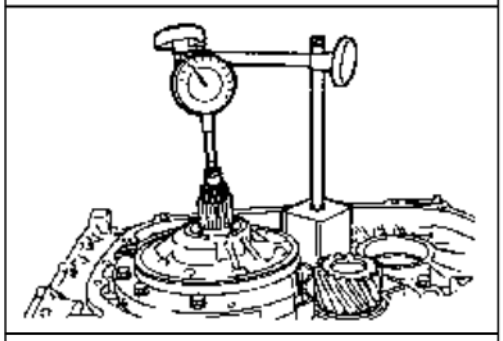
63. Fix the Thrust Washer #1 selected in Step 61.



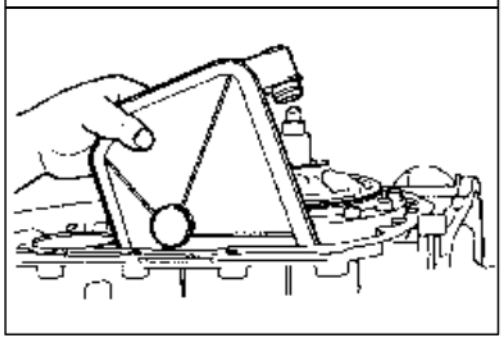
64. Install the oil pump, set bolts and seal washer again with the special tool MB998412. Tighten the set bolts with a tightening torque of 23Nm (2.3Kg-m).
Note: never use an old seal washer.



65. Measure the axial clearance of input shaft with a dial gauge and confirm that the clearance is within the standard value limits.
Standard value: 0.70-1.45mm

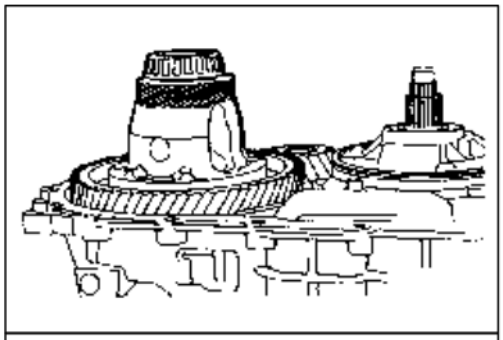


67. Fix the strainer.

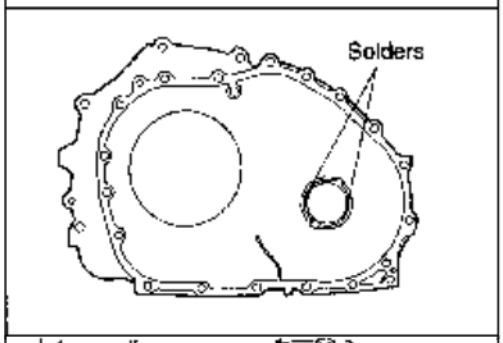


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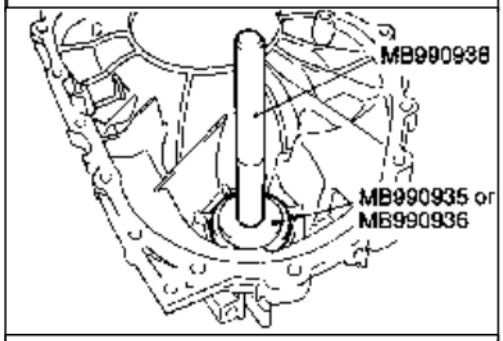
69. Fix the differential.



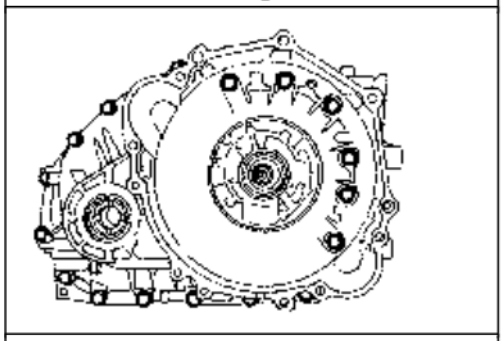
70. Dismantle the differential bearing's outer ring and spacer off the hydraulic torque converter body.
71. Attach the solders (about 10mm long and 3mm in outer diameter) to the hydraulic torque converter body.



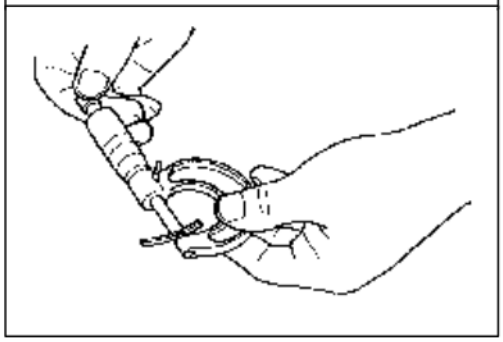
72. Press and fix the differential outer ring with the speical tool MB990338 or MB990935.



73. Fix the hydraulic torque converter onto the differential body without applying any sealant. Tighten the set bolts with a tightening torque of 47Nm (4.7Kg-m).
Note: make sure that the two short bolts are installed as the figure shows.
75. Release the bolts and dismantle the hydraulic torque converter, bolts and solders.



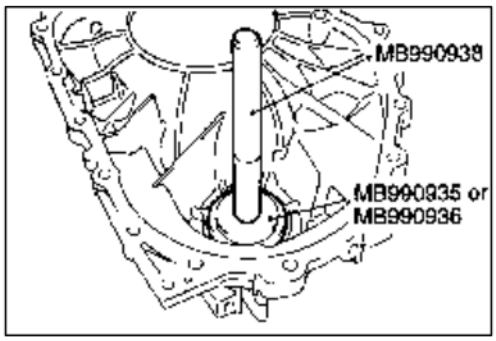
76. Measure the thickness of the flattened solder with a dial gauge. Add the measured value with 0.045 – 0.105mm*, select the appropriate spacer thickness and then select the corresponding spacer from the table below that lists all adjusting spacer thicknesses. Note: * indicates the thickness of differnet differential cover.



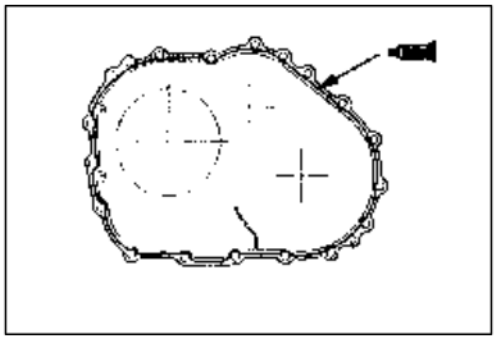
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Thickness (mm)	ID marking	Part No.	Thickness (mm)	ID marking	Part No.
0.71	71	MD754475	1.07	07	MD720945
0.74	74	MD727660	1.10	J	MD710454
0.77	77	MD754476	1.13	D	MD700270
0.80	80	MD727661	1.16	K	MD710455
0.83	83	MD720937	1.19	L	MD710456
0.86	86	MD720938	1.22	G	MD700271
0.89	89	MD720939	1.25	M	MD710457
0.92	92	MD720940	1.28	N	MD710458
0.95	95	MD720941	1.31	E	MD706574
0.98	98	MD720942	1.34	O	MD710459
1.01	01	MD720943	1.37	P	MD710460
1.04	04	MD720944			

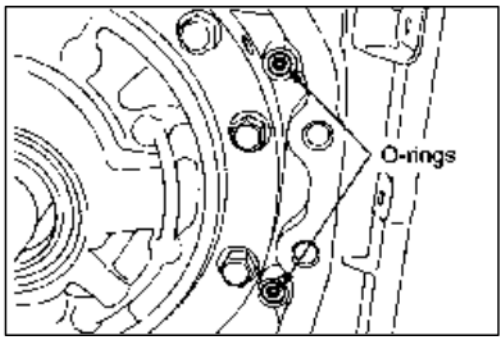
77. Fix the spacer selected in Step 75 onto the hydraulic torque converter body.
78. Press and fix the differential bearing outer ring with the special tool MB990938 or MB990935.



79. Apply the liquid sealant which is 1.6mm in diameter to the spot where the figure shows on the torque converter.
Liquid sealant:
Mitsubishi sealant part number MD974421 or the equivalent.

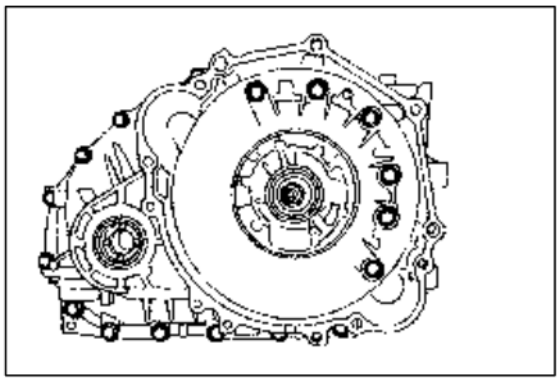


80. Fix two O-rings.

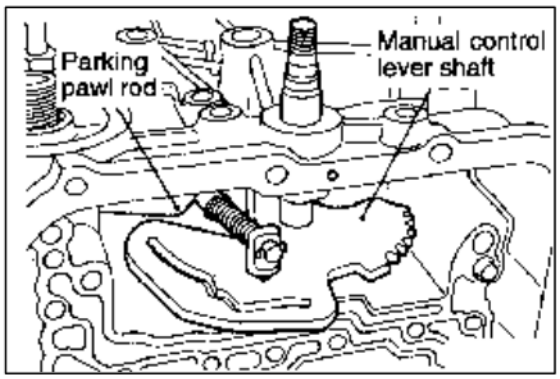


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81. Fix the hydraulic torque converter and screw the 18 bolts with a tightening torque of 47Nm (4.7Kg-m).



82. Fix the manual control lever and parking pawl rod.
83. Fix the manual control lever shaft roller.



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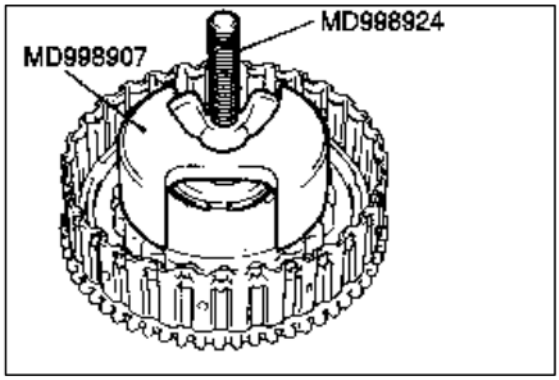
Assembly and Disassembly of Parts

Disassembly of underdrive clutch and input shaft

1. Unfix input shaft snap ring.
2. Unfix input shaft.
3. Unfix 2 seal rings.
4. Unfix the snap ring of the clutch's reaction plate.
5. Unfix the reaction plate of the clutch.
6. Unfix the clutch plates.

Type	Clutch plate	Clutch disc	Reaction plate
F4A42	4	4	1

7. Unfix clutch discs.
8. Press the clutch offsetting spring with the special tool MD998907 and MD998924. Then unfix snap ring of clutch spring hub.
9. Unfix spring hub of clutch.
10. Unfix D seal.
11. Unfix clutch offsetting spring.
12. Unfix underdrive clutch piston with the aid of compressed air.
13. Unfix two D seal rings.

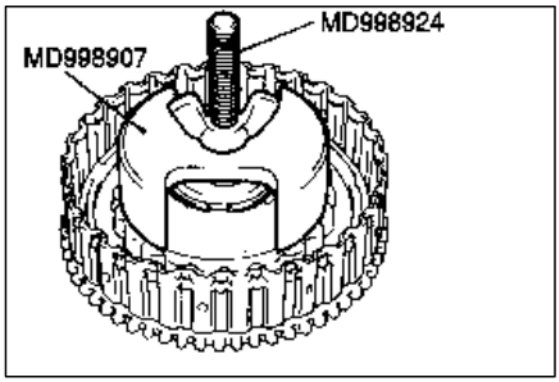


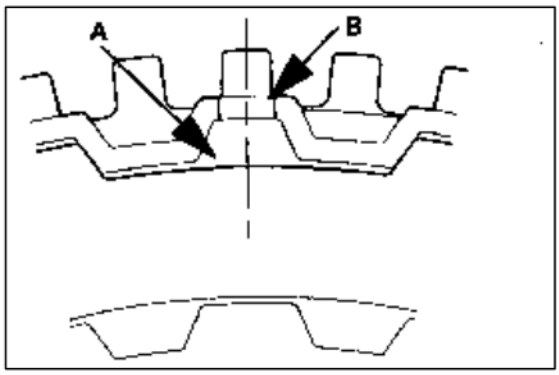
Assembly of underdrive clutch and input shaft

Note:
Before assembly, apply all internal components with lubricating oil. Use Vaseline-lubricated D seal ring.

1. Fix two D seal rings
2. Fix underdrive clutch piston
3. Fix clutch offsetting spring. Confirm that the spring hole is aligned with the fixing mark on clutch bracket.
4. Fix D seal ring.
5. Fix clutch spring hub.
6. Press the clutch offsetting spring with the special tools of MD998907 and MD998924. Then fix the snap ring of clutch spring hub.
7. Align the notch (A) of clutch disc and reaction plate with the outer hole of underdrive clutch bracket.

Note: dip the clutch into ATF before assembly.





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8. Fix clutch plates and clutch discs.
9. Fix the reaction plate in the shear droop's direction towards the clutch.

Type	Clutch plate	Clutch disc	Reaction plate
F4A42	4	4	1

10. Fix the snap ring of clutch reaction plate.
11. Evenly press clutch reaction plate with the special tool as the figure shows. Then check if the clearance between the snap ring and clutch reaction plate complies with the standard value.
Standard value:
1.2-1.4mm (F4A41)
1.6-1.8mm (F4A42, F4A51)

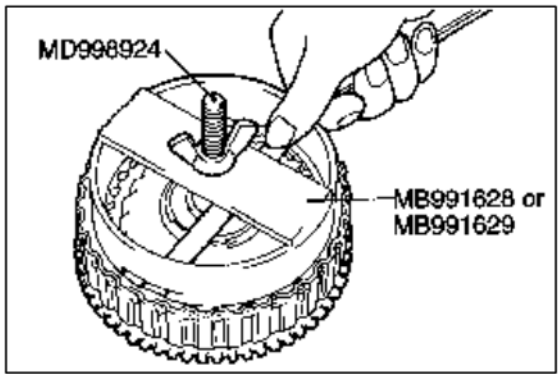
Type	Special tool
F4A42	MB991628, MD998924

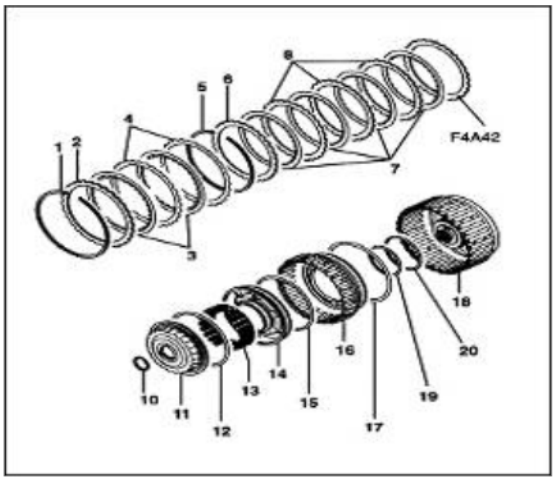
12. If it does not comply with the standard value, measure the original snap ring thickness with a dial gauge and then select the appropriate snap ring with reference to the speculations in the Maintenance Manual (right figure).
13. Fix the seal.
14. Fix the input shaft.
15. Fix the snap ring of input shaft.
16. Actuate the underdrive clutch with 2kg/cm^2 compressed air and the clutch operation shall be smooth and stable with no additional leakage.

Disassembly of reverse gear and overdrive clutch

1. Unfix the snap ring of reverse-gear clutch reaction plate.
2. Unfix the reverse-gear clutch reaction plate.
3. Unfix the reverse-gear clutch plates.
4. Unfix the reverse-gear clutch discs.
5. Unfix the snap ring of overdrive clutch reaction plate.
6. Unfix the overdrive clutch reaction plate.
7. Unfix the overdrive clutch plate
8. Unfix the overdrive clutch disc

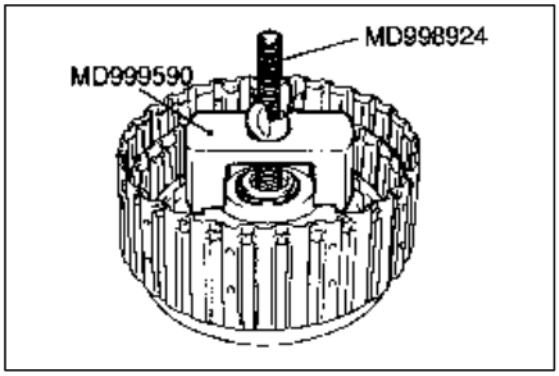
Thickness (mm)	ID mark	Serial No.
1.6	Nil	MD759666
1.7	Blue	MD759667
1.8	Brown	MD759668
1.9	Nil	MD752124
2.0	Blue	MD752125
2.1	Brown	MD752126
2.2	Nil	MD752127
2.3	Blue	MD752128
2.4	Brown	MD752129
2.5	Nil	MD752130
2.6	Blue	MD752131
2.7	Brown	MD752132
2.8	Nil	MD752133
2.9	Blue	MD752134
3.0	Brown	MD754680





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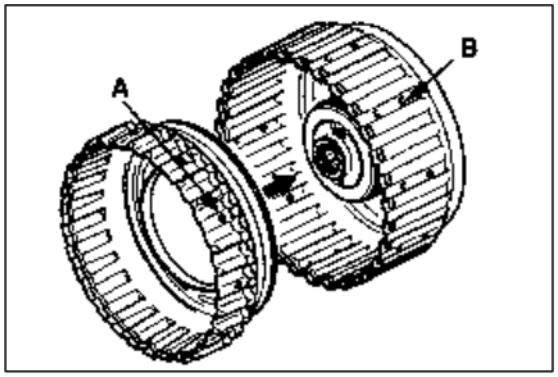
9. Press the clutch offsetting spring with the special tool MD998590 and MD998924. Then unfix snap ring of clutch spring hub.
10. Unfix spring hub of clutch
11. Unfix D seal ring.
12. Unfix clutch offsetting spring.
13. Unfix overdrive clutch piston with the aid of compressed air or manually.
14. Unfix two D seal rings.

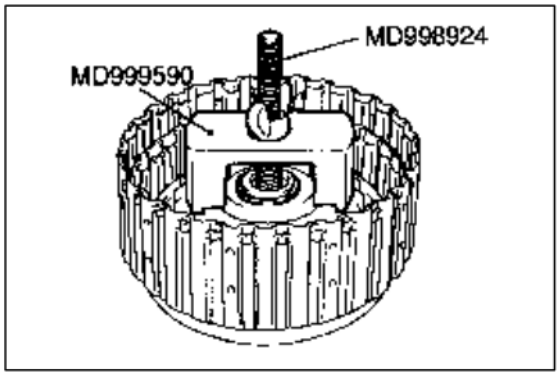


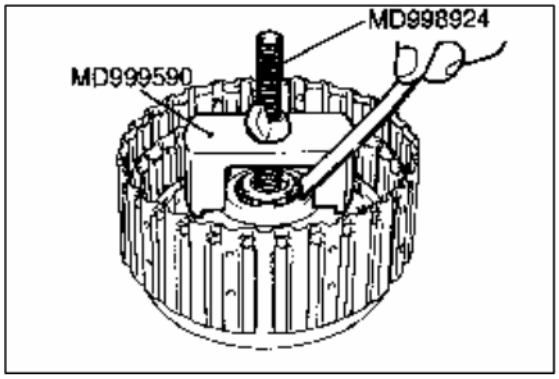
16. Unfix reverse-gear clutch piston with the aid of compressed air or by way of slightly striking the assembly on the worktable.
17. Unfix the three D seal rings.

Assembly of rear-gear and overdrive clutch

Note: Before assembly, apply all internal components with lubricating oil. Use Vaseline to lubricate D seal ring.
1. Fix three D seal ringss (two on reverse-gear clutch bracket and one on reverse-gear clutch piston).
2. Align the holes in reverse-gear clutch piston and outer rim of reverse-gear clutch bracket (A and B)
3. Fix reverse-gear clutch piston
4. Fix D seal ring.
5. Fix overdrive clutch piston
6. Fix clutch offsetting spring and confirm that the hole in the piston is aligned with the fixing mark.
7. Fix D seal ring.
8. Fix clutch spring hub.
9. Press the clutch offsetting spring with the special tools of MD999590 and MD998924. Then fix the snap ring of clutch spring hub.
Note: keep a certain pressure in Step 10.
10. Check if the clearance between snap ring and offsetting spring complies with the standard value.
Standard value: 0-0.09mm
11. If it does not comply with the standard value, measure the original snap ring thickness with a dial gauge and then select the appropriate snap ring with reference to the speculations in the Maintenance Manual



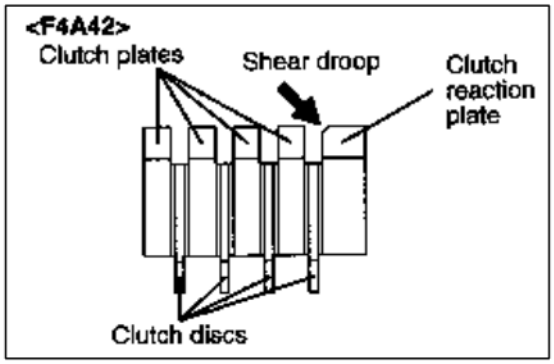




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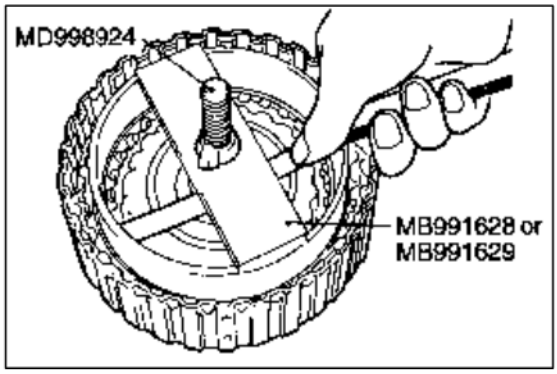
Thickness (mm)	ID mark	Part No.	Thickness (mm)	ID mark	Part No.
1.6	Nil	MD759666	2.4	Brown	MD752129
1.7	Blue	MD759667	2.5	Nil	MD752130
1.8	Brown	MD759668	2.6	Blue	MD752131
1.9	Nil	MD752124	2.7	Brown	MD752132
2.0	Blue	MD752125	2.8	Nil	MD752133
2.1	Brown	MD752126	2.9	Blue	MD752134
2.2	Nil	MD752127	3.0	Brown	MD754680
2.3	Blue	MD752128			

12. Align the notches (A) of clutch plate and reaction plate with the outer hole (B) of reverse clutch bracket.
Note: dip the clutch into ATF before assembly.



Type	Clutch plate	Clutch disc	Reaction plate
F4A42	4	4	1

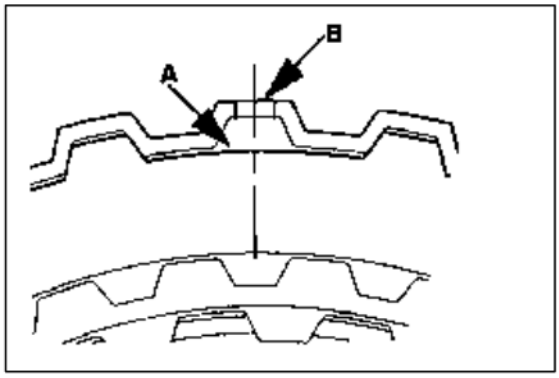
14. Fix the overdrive clutch reaction plate where the figure shows.
15. Fix the snap ring of the overdrive clutch reaction plate.



16. Evenly press clutch reaction plate with the special tool. Then check if the clearance between the snap ring and clutch reaction plate complies with the standard value.
Standard value:
1.2-1.4mm (F4A41)
1.6-1.8mm (F4A42, F4A51)

Type	Special tool
F4A42	MB991628, MD998924

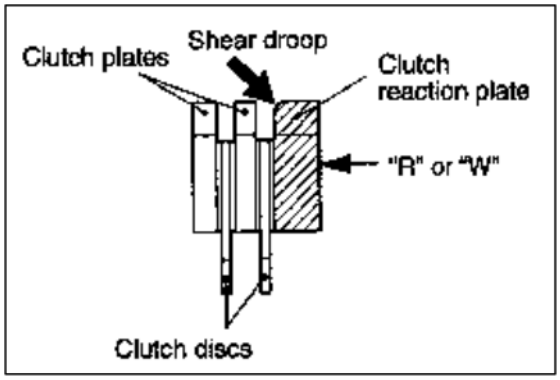
17. Align the notch (A) of clutch plate and reaction plate with the outer hole (B) of reverse clutch bracket.
Note: dip the clutch into ATF before assembly.



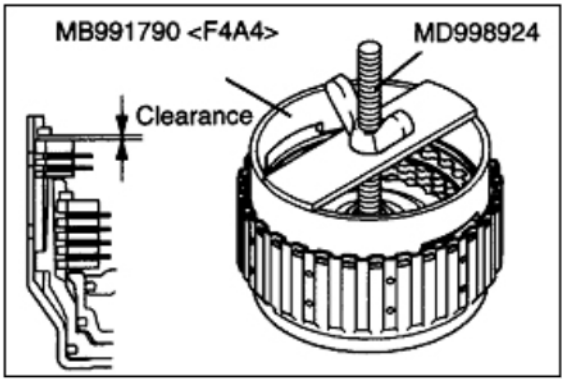
Type	Clutch plate	Clutch disc	Reaction plate
F4A42	4	4	1

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18. Fix two reverse-gear clutch plates and two reverse-gear clutch discs.
19. Fix reverse-gear clutch reaction plate.
20. Fix the snap ring of the reverse-gear clutch reaction plate.

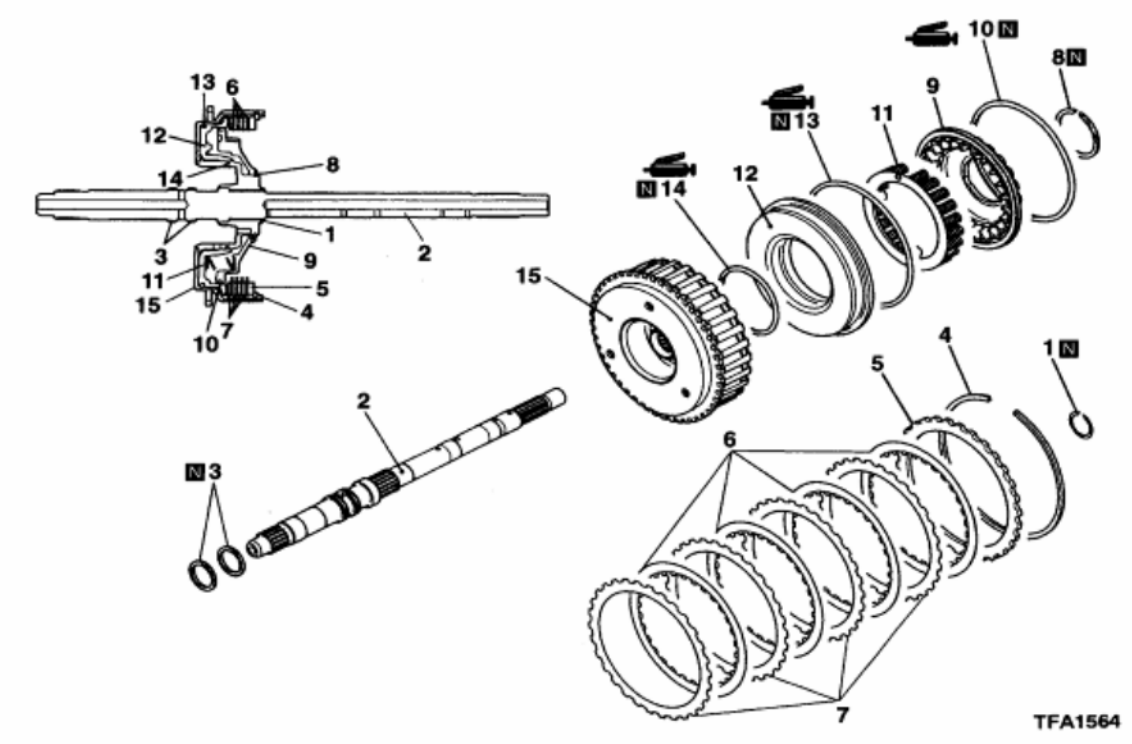


21. Evenly press clutch reaction plate with the special tool. Then check if the clearance between the snap ring and clutch reaction plate complies with the standard value.
Standard value:
1.5-1.7mm (F4A41)
If it does not comply with the standard value, measure the original snap ring thickness with a dial gauge and then select the appropriate snap ring with reference to the speculations in the Maintenance Manual.
22. Fix the seal ring onto the rear cover.
23. Fix the assembly onto the rear body and check the reverse clutch operation with 2kg/cm^2 compressed air.
24. The clutch operation shall be smooth and stable with no additional leakage.



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Components of Underdrive clutch and Input Shaft

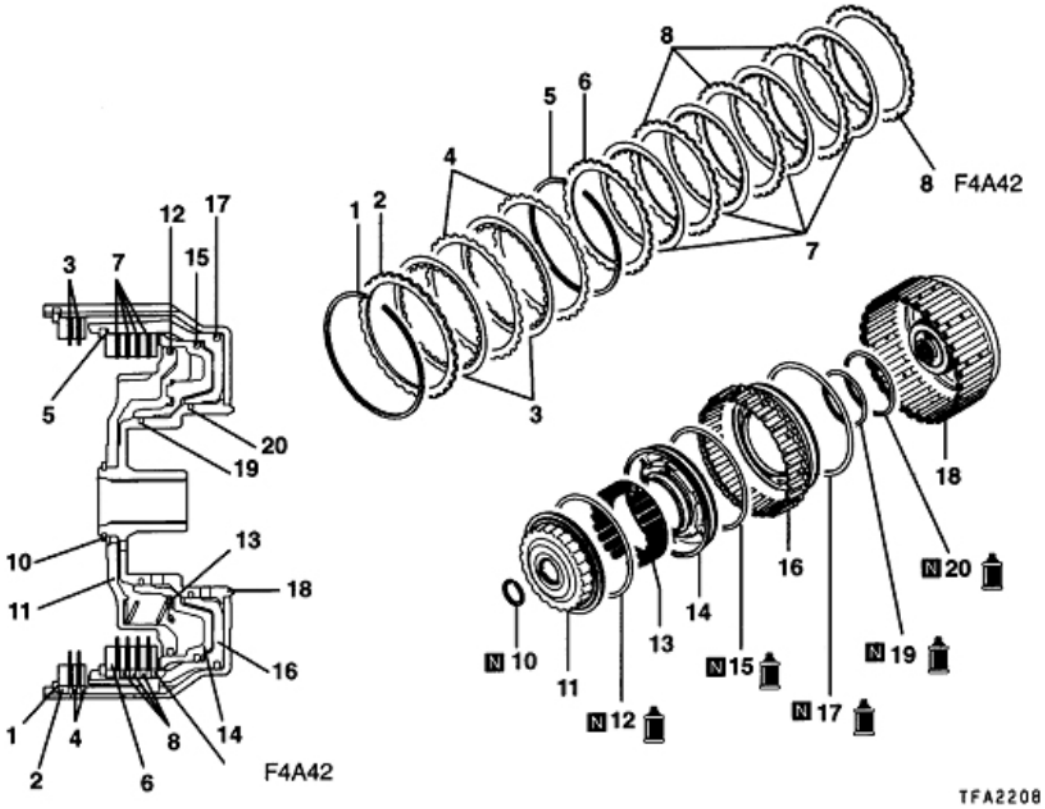


Type	Clutch plate	Clutch disc	Reaction plate
F4A42	4	4	1

1. Snap ring
2. Input shaft
3. Seal ring
4. Snap ring
5. Clutch reaction plate
6. Clutch plate
7. Clutch disc
8. Snap ring
9. Spring hub
10. D seal ring
11. Offsetting spring
12. Underdrive clutch piston
13. D seal ring
14. D seal ring
15. Underdrive clutch bracket

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Components of Reverse gear and Overdrive Clutch



Type	Clutch plate	Clutch disc	Reaction plate
F4A42	4	4	1
Reverse-gear clutch	2	2	1

1. Snap ring
2. Clutch reaction plate
3. Clutch plate
4. Clutch disc
5. Snap ring
6. Clutch reaction plate
7. Clutch plate
8. Clutch disc
9. Pressure plate (F4A5)
10. Snap ring
11. Spring hub
12. D seal ring
13. Offsetting spring
14. Overdrive clutch piston
15. D seal ring
16. Reverse-gear clutch piston
17. D seal ring
18. Reverse-gear bracket
19. D seal ring
20. D seal ring

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Part Two: Hydraulic System

Disassembly and assembly of valve body

Disassembly of inner valve body

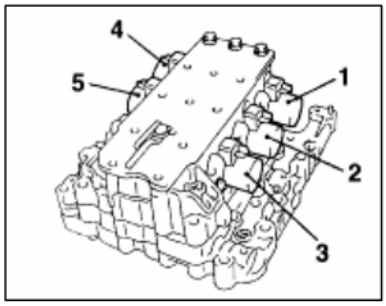
Note:

Take care not to change component positions. Many valve bodies, seal washers and steel balls resemble each other but would cause damage to the gearbox if they are wrongly installed. Please arrange them in order so that you are not going to get confused up.

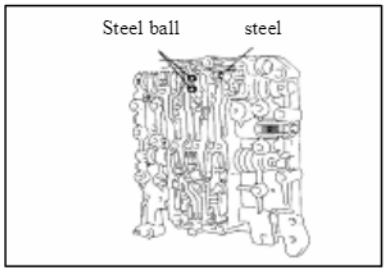
Solenoid valve:

1. Mark on each solenoid valve to distinguish their positions. The left figure shows the position of solenoid valves and the following table makes a description:

Mark	Name
#1	Underdrive solenoid valve
#2	Second-gear solenoid valve
#3	Damp clutch control solenoid valve
#4	Overdrive solenoid valve
#5	Low/reverse-gear solenoid valve

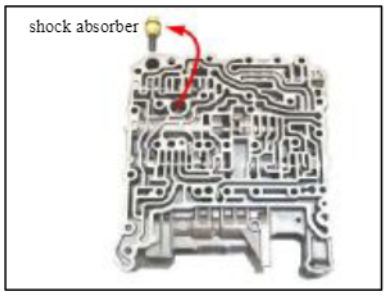


2. Unfix wire harness, bracket and set bolts of the solenoid valve.
3. Unfix underdrive solenoid valve
4. Unfix second-gear solenoid valve
5. Unfix the control solenoid valve of damp clutch.
6. Unfix the overdrive solenoid valve.
7. Unfix the low/reverse-gear solenoid valve.
8. Unfix the manual valve.
9. Unfix the four set bolts on outer valve tank, wire harness bracket and outer valve cover.
10. Separate the inner and outer valve bodies.
11. Unfix outer valve body plate
12. Unfix three steel balls.
13. Unfix two steel ball springs.
14. Unfix valve body plate and set bolts.

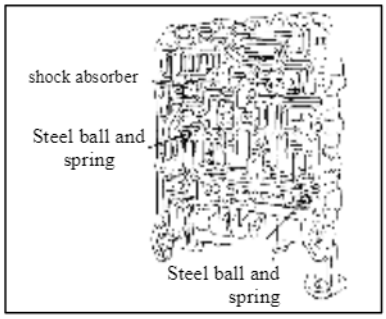


Shock absorber

15. Unfix the shock absorber
16. Unfix the shock absorber spring

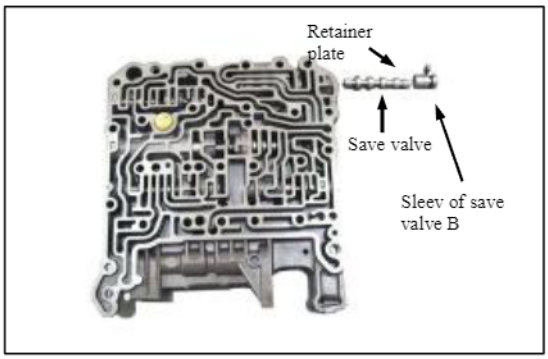


17. Unfix the steel balls for release of pipeline pressure.
18. Unfix the spring.
19. Unfix the throttle steel ball.
20. Unfix the spring.

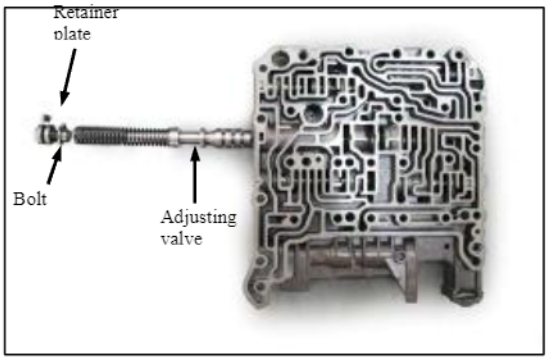


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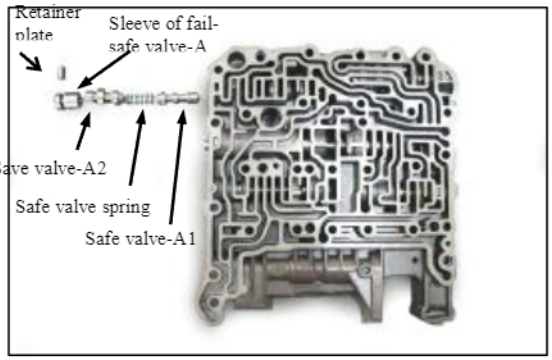
Fail-safe valve
21. Unfix the retainer plate.
22. Unfix the sleeve of fail-safe valve-B
23. Unfix the fail-safe valve-B



Adjusting valve
24. Dismantle the retainer plate
25. Screw out the bolt
26. Unfix the spring of adjusting valve.
27. Unfix the pressure-adjusting valve.

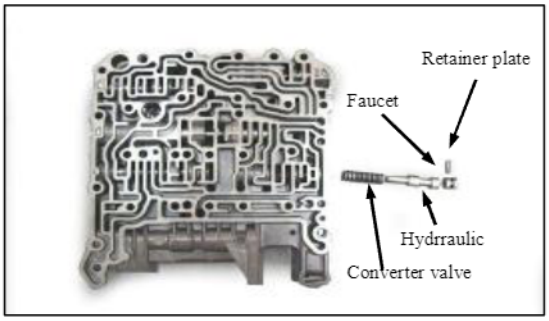


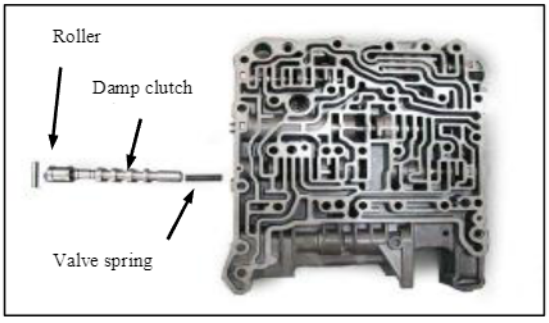
Fail-safe valve-A
28. Unfix the retainer plate
29. Unfix the sleeve of fail-safe valve-A
30. Unfix the fail-safe valve-A2
31. Unfix the spring of fail-safe valve A
32. Unfix the fail-safe valve-A1



Hydraulic torque converter
33. Unfix the retainer plate
34. Unfix the faucet
35. Unfix the hydraulic torque converter valve.
36. Unfix the spring of hydraulic torque converter

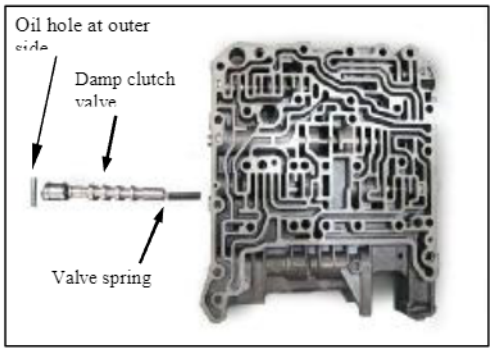
Damp clutch valve
37. Unfix the roller.
38. Unfix the sleeve of control valve of damp clutch
39. Unfix the control valve of damp clutch
40. Unfix the spring of control valve of damp clutch.



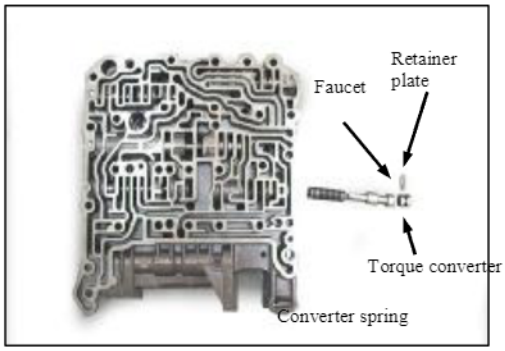


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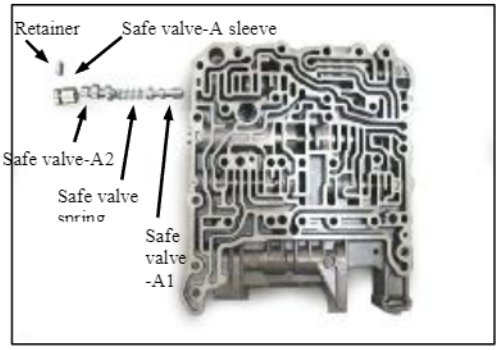
Assembly of inner valve body
Note:
Before assembly, please apply ATF on all inner components.
Damp clutch valve
1. Fix the spring of damp clutch control valve
2. Fix the damp clutch control valve
3. Fix the sleeve of damp clutch control valve



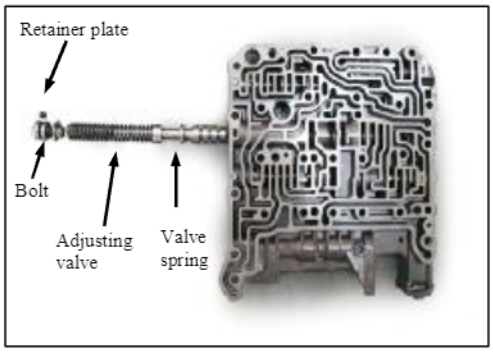
Hydraulic torque converter
4. Fix the hydraulic torque converter spring
5. Fix the hydraulic torque converter valve
6. Fix the sleeve of damp clutch control valve.
7. Fix the roller.



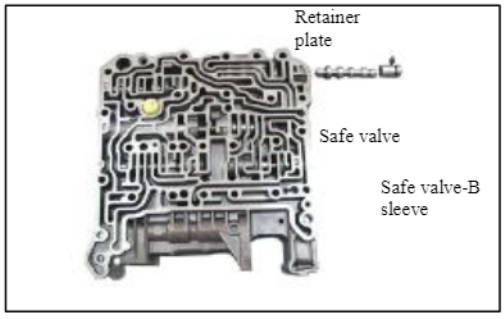
Fail-safe valve A
8. Fix fail-safe valve – A1
9. Fix the spring of fail-safe valve – A
10. Fix fail-safe valve – A2
11. Fix the sleeve of fail-safe valve – A
12. Fix the retainer plate.



Adjusting valve
13. Fix pressure-adjusting valve
14. Fix the spring of adjusting valve
15. Fix screws
16. Fix retainer plate

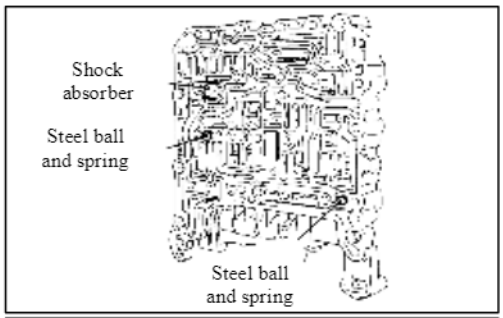


Fail-safe valve B
17. Fix fail-safe valve – B
18. Fix the sleeve of fail-safe valve – B
19. Fix retainer plate

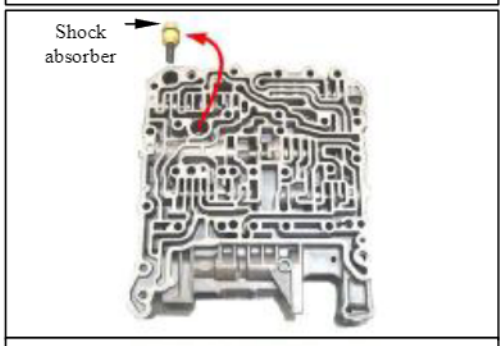


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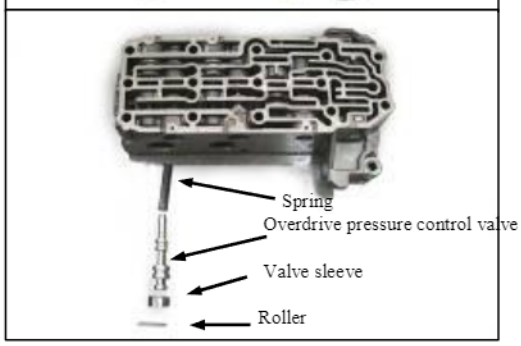
20. Fix the spring
21. Fix the throttle steel ball.
22. Fix the spring
23. Fix the pressure-relief steel balls in the pipeline.



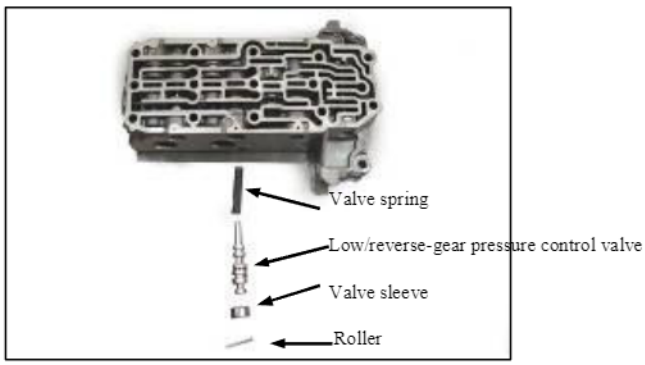
Shock-absorbing valve
24. Fix the spring of shock-absorbing valve
25. Fix the shock-absorbing valve
26. Fix the valve body plate and set bolts and then turn over the valve body



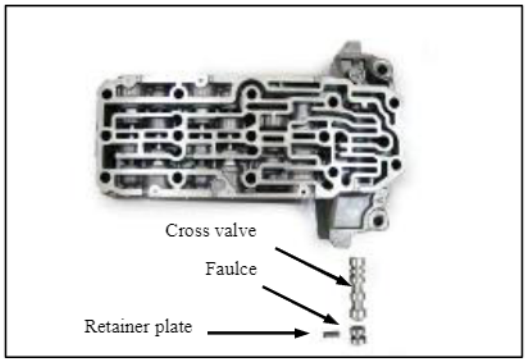
Disassemble the outer valve body
Overdrive pressure-adjusting valve
1. Unfix the roller
2. Unfix the overdrive pressure-control valve sleeve.
3. Unfix the overdrive pressure-control valve
4. Unfix the overdrive pressure-control valve spring.



Low/reverse-gear pressure control valve
5. Unfix the roller.
6. Unfix the low/reverse-gear pressure control valve sleeve.
7. Unfix the low/reverse-gear pressure control valve
8. Unfix the low/reverse-gear pressure control valve spring

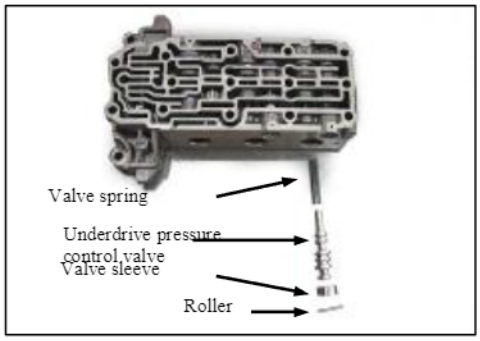


Cross valve
9. Unfix the retainer plate
10. Unfix the faucet
11. Unfix the cross valve

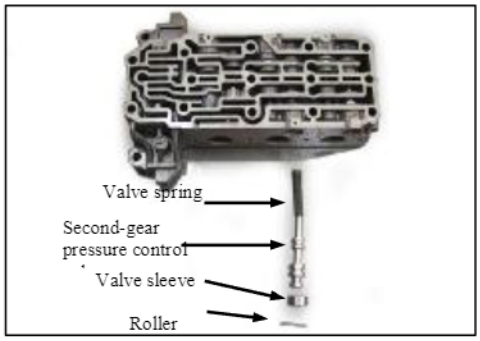


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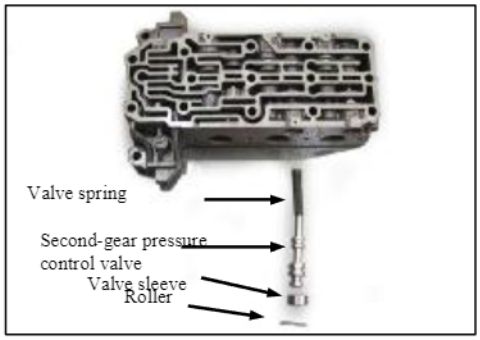
Underdrive pressure control valve
12. Unfix the roller
13. Unfix the underdrive pressure control valve sleeve
14. Unfix the underdrive pressure control valve
15. Unfix the underdrive pressure control valve spring



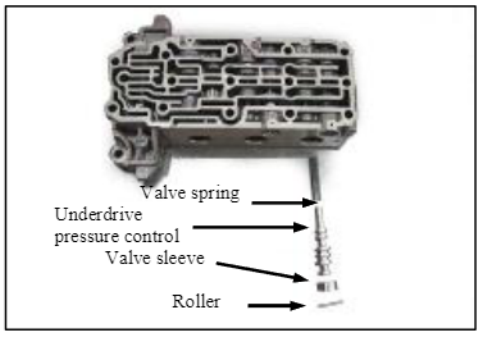
Second-gear pressure control valve
16. Unfix the roller
17. Unfix the second-gear pressure control valve sleeve
18. Unfix the second-gear pressure control valve
19. Unfix the spring.
Assemble outer valve body
Note:
Please apply ATF on all inner components before assembling



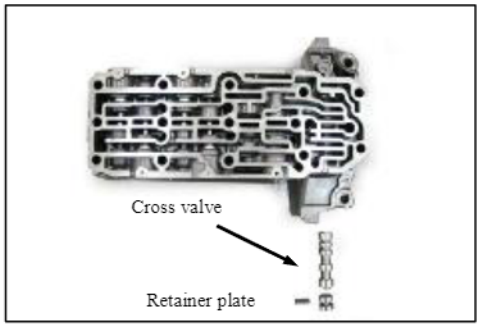
Second-gear pressure control valve spring
1. Fix the second-gear pressure control valve spring.
2. Fix the second-gear pressure control valve
3. Fix the second-gear pressure control valve sleeve
4. Fix the roller.



Underdrive pressure control valve
5. Fix the underdrive pressure control valve spring.
6. Fix the underdrive pressure control valve
7. Fix the underdrive pressure control valve sleeve
8. Fix the roller.



Cross valve
9. Fix the cross valve
10. Fix the faucet
11. Fix the retainer plate



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Low/reverse-gear pressure control valve
12. Fix the low/reverse-gear pressure control valve spring
13. Fix the low/reverse-gear pressure control valve
14. Fix the low/reverse-gear pressure control valve sleeve
15. Fix the roller.

Overdrive pressure control valve
16. Fix the overdrive pressure control valve spring
17. Fix the overdrive pressure control valve
18. Fix the overdrive pressure control valve sleeve
19. Fix the roller

20. Fix the two steel ball springs.
21 Fix the three steel balls
22. Fix the outer valve body plate
23. Assemble the inner the outer valve body together.
24. Fix the outer valve body cover, wire harness bracket and four outer valve body set bolts.
25. Fix the manual valve.
26. Measure the resistance of each solenoid valve.
Standard value: 2.7-3.4 ohm
27. Fix low/reverse-gear solenoid valve
28. Fix the overdrive solenoid valve
29. Fix the brackets and set bolts of both the low/reverse-gear solenoid valve and overdrive solenoid valve
30. Fix the damp clutch control solenoid valve.
31. Fix second-gear solenoid valve.
32. Fix the underdrive solenoid valve.
33. Fix the brackets and set bolts of solenoid valve.

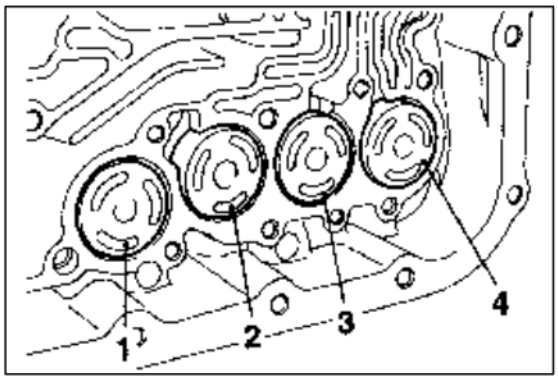
Assemble valve body

34. Fix three small accumulator springs and three big accumulator springs.
35. Refer to the figure for the markings of accumulator springs.

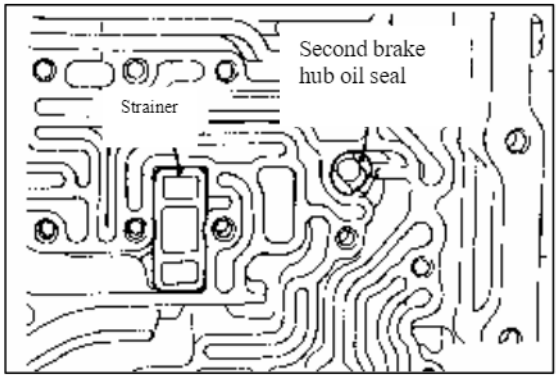
No.	Name
1	For low/reverse-gear brake
2	For underdrive clutch
3	For second-gear brake
4	For overdrive clutch

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36. Assemble accumulator
Reference: the accumulator shall be aligned with the gearbox body.

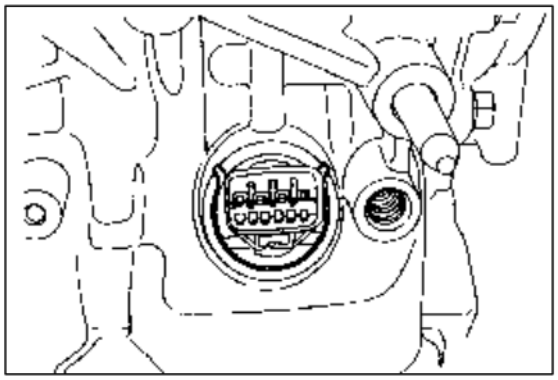


37. Fix the strainer and second brake hub oil seal.



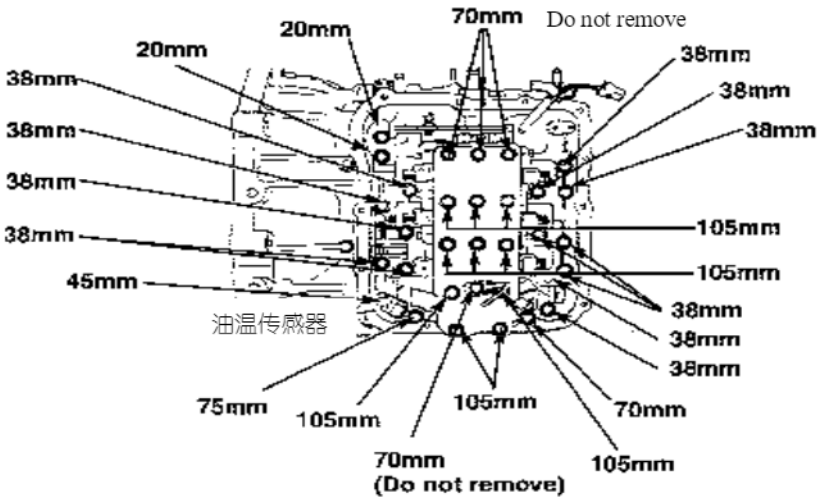
Reference:

No.	Components connected	Wire color	Plug color
1	Underdrive solenoid valve	White, red, red	Black
2	Overdrive solenoid valve	Orange , red	Black
3	Low/reverse-gear solenoid valve	Brown, yellow	Milky
4	Second-gear solenoid valve	Green, red, red	Milky
5	Damp clutch control solenoid valve	Blue, yellow, yellow	Black
6	ATF temperature sensor	Black, red	Black



The fixing direction of oil seal is shown in the figure.
38. Fix the seal washer and two steel balls of the valve body.
Reference: do not fix the valve body then.
39. Please tuck the wire harness of the solenoid valve into the hole in the gearbox cover and then fix the snap ring.

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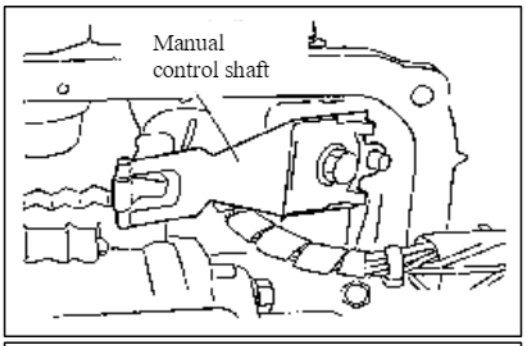




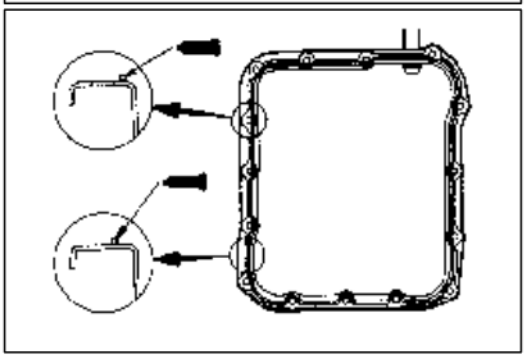
40. Fix 28 valve body bolts and screw them tight with a tightening torque of 11Nm (1.1Kg-m).
41. Fix the ATF temperature sensor and tighten it with a screwing torque of 11Nm (1.1Kg-m).

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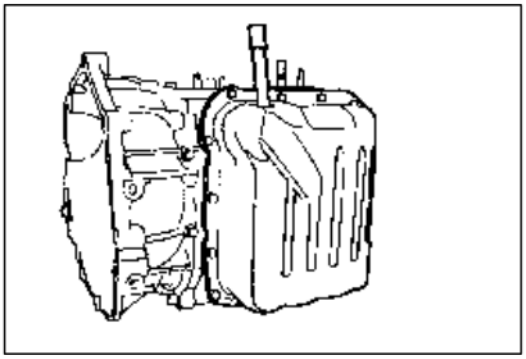
42. Fix the manual control shaft brake and screw the bolts tight with a tightening torque of 6Nm (0.6Kg-m).



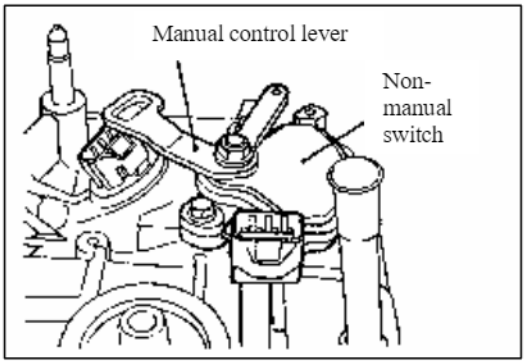
43. Please apply the liquid sealant in the valve body cover.
Liquid sealant:
Mitsubishi sealant Partl No. MD 974421 or equivalent. Note: do not use sealant during operation.



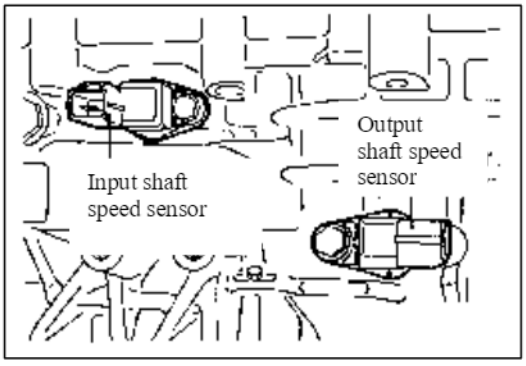
44. Fix the valve body cover and then screw it tight with a torque of 9Nm (0.9Kg-m).



45. Fix the non-manual switch and screw it tight with a torque of 11Nm (1.1Kg-m).
46. Fix the manual control lever and screw it tight with a torque of 22Nm (2.2Kg-m).

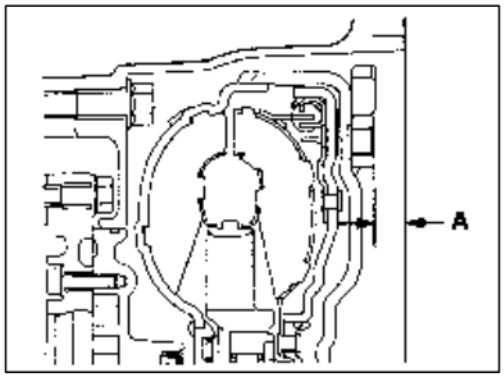


46. Fix input shaft speed sensor and output shaft speed sensor.

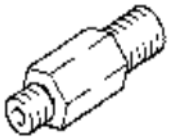


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47. Fix the eyebolt, new seal washer and cooler feeding pipe.
48. Fix the oil gauge.
49. Tighten the bracket with a torque of 23Nm (2.3Kg-m).
50. Fix two brackets and tighten them with a torque of 69Nm (6.9Kg-m).
51. Fix hydraulic torque converter and make the dimension (A) in the figure comply with the reference value.
Reference value: about 12.2mm
Note: before fixing the hydraulic torque converter, apply ATF onto oil pump drive hub. Do not damage oil seal lips while fixing the hydraulic torque converter.



Stall Test and Oil Pressure Test
Special tools

Tool	Serial No	Name	Use
	MB991502	MUT-II accessory	Checking of troubleshooting code
	MD998332	Tie-in	Checking oil pressure
	MD998900	Tie-in	Checking oil pressure

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Stall Test of Hydraulic Torque Converter

First of all, start the automobile and measure and confirm that the gearbox oil temperature has increased to 70—90° C and the water temperature of engine has risen to 80° C—100° C.
Confirm ATF oil level.

1. Park the automobile on a flat and even floor.
2. Shift the gear successively to each position, inject ATF into the torque converter and oil circuit and then place the gear lever on N.
3. Clean all filth around the dip stick and take it out to confirm the ATF oil level.

Note: if ATF smells burned and appears black, there must be something wrong with the gearbox, in which case, the idle speed test shall not be carried out.

4. Check if ATF oil level is at the HOT mark. If the level is lower than the mark, please fill in more ATF until the level reaches the HOT mark.

Stall test:

5. Place two wedges (left and right) under the two rear wheels.
6. Pull up the parking brake rod with the brake pedal fully stepped down.
7. Start the engine.
8. Place the gear lever at D, fully step down the accelerator pedal and read the maxium rotation speed of the engine.

Note: do not keep the throttle fully open for over 8 seconds.
If it is necessary that the idle speed test be done more than twice, then place the gear lever at N and run the engine at a rotation speed of 1,000rmp to cool down the ATF before the second test is carried out.

9. Shift the gear lever to R and carry out the same test again.

Standard value:

	Position D	Position R
Oriental Son (F4A42)	2,100 – 2,600rpm	2,100 – 2,600 rpm

Judgement on the result of hydraulic torque converter idle speed test

Result	Possible cause
Excessive idle speed value in both D and R positions	Low pipeline pressure
	Low/reverse-gear brake skidding
Excessive idle speed value only in D position	Underdrive clutch skidding
Excessive idle speed value only in R position	Underdrive clutch skidding
Low idle speed value in both D and R positions	Trouble in hydraulic torque converter
	Insufficient motor output power

Oil pressure test

Note:
The wheels will turn during oil pressure test. Touch or collide with the turning wheels will result in unnecessary personal injury. Please watch out during test.
The oil pressure gauge is fixed onto various parts of the gearbox so that the pressure value of the hydraulic circuit at each gear position can be measured. The oil pressure test will display many troubles. Make your judgment if the troubles are caused by seal defects or damage, e.g. O-ring, washer and seal ring
First of all, start the automobile and measure and confirm that the gearbox oil temperature has increased to 70—90° C and the water temperature of engine has risen to 80° C—100° C.

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1. Jack up the automobile with a jack so that its wheels may turn freely.

2. Connect the tie-ins of MD998332 and MD998900 and the oil pressure gauge to the special port for oil pressure measurement.

Mark	Speical tie-in for measurement
2ND	Second brake fluid pressure
UD	Underdrive clutch oi pressure
LR	Low/reverse-gear brake fluid pressure
DR	Hydraulic torque converter oil pressure
DA	Damp clutch oil pressure
V	Reverse-gear clutch oil pressure
OD	Overdrive clutch oil pressure

3. Place the gear lever at P position and then measure the oil pressure of low/reverse-gear brake and hydraulic torque converter at an engine rotation speed 2,500rpm.

4. Place the gear lever at R position and then measure the oil pressure of reverse clutch, low/reverse-gear brake and hydraulic torque converter at an engine rotation speed 2,500rpm.

Standard value of oil pressure:

Reverse clutch and low/reverse-gear brake: 1320-1720kPa (13.5-17.5Kgf/cm2)

Hydraulic torque converter 500-700kPa (5.1-5.7Kg f/cm2)

5. Place the gear lever at N position and then measure the oil pressure of low/reverse-gear brake and hydraulic torque converter at an engine rotation speed 2,500rpm.

Standard value of oil pressure:

Low/reverse-gear brake and hydraulic torque converter: 300-390kPa (3.2-4.0Kgf/cm2)

6. In order to check first-gear oil pressure, please place the gear lever at L position (or driving mode position), then measure the oil pressure of underdrive clutch, low/reverse-gear brake and hydraulic torque converter at an engine rotation speed of 2.500rmp.

Standard value of oil pressure:

Underdrive clutch and low/reverse-gear brake: 1010-1050kPa (10.3-10.7Kgf/cm2)

Hydraulic torque converter 500-700kPa (5.1-5.7Kg f/cm2)

7. In order to check second-gear oil pressure, please place the gear lever at 2 position (or driving mode position 2 gear), then measure the oil pressure of underdrive clutch, second brake and hydraulic torque converter at an engine rotation speed of 2.500rmp.

Standard oil pressure:

Underdrive clutch and second brake 1010-1050kPa (10.3-10.7Kgf/cm2)

Hydraulic torque converter 500-700kPa (5.1-5.7Kg f/cm2)

8. In order to check third-gear oil pressure, please place the gear lever at 3 position (or driving mode position 3 gear), then measure the oil pressure of underdrive clutch, overdrive clutch and hydraulic torque converter at an engine rotation speed of 2.500rmp.

Standard oil pressure:

Underdrive clutch and overdrive clutch: 590-690kPa (6.0-7.0Kgf/cm2)

Hydraulic torque converter 450-650kPa (4.6-6.6Kg f/cm2)

9. In order to check fourth-gear oil pressure, please place the gear lever at D position (or driving mode position 4 gear), then measure the oil pressure of overdrive clutch, second brake and hydraulic torque converter at an engine rotation speed of 2.500rmp.

Standard oil pressure:

Overdrive clutch and second brake: 590-690kPa (6.0-7.0Kgf/cm2)

Hydraulic torque converter 450-650kPa (4.6-6.6Kg f/cm2)

10. If the measured result is not within the standard value, then identify the troubles with reference to the following troubleshooting table:

Note:

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Do not unfix the pressure gauge then.

Standard table for oil pressure test – Oriental Son

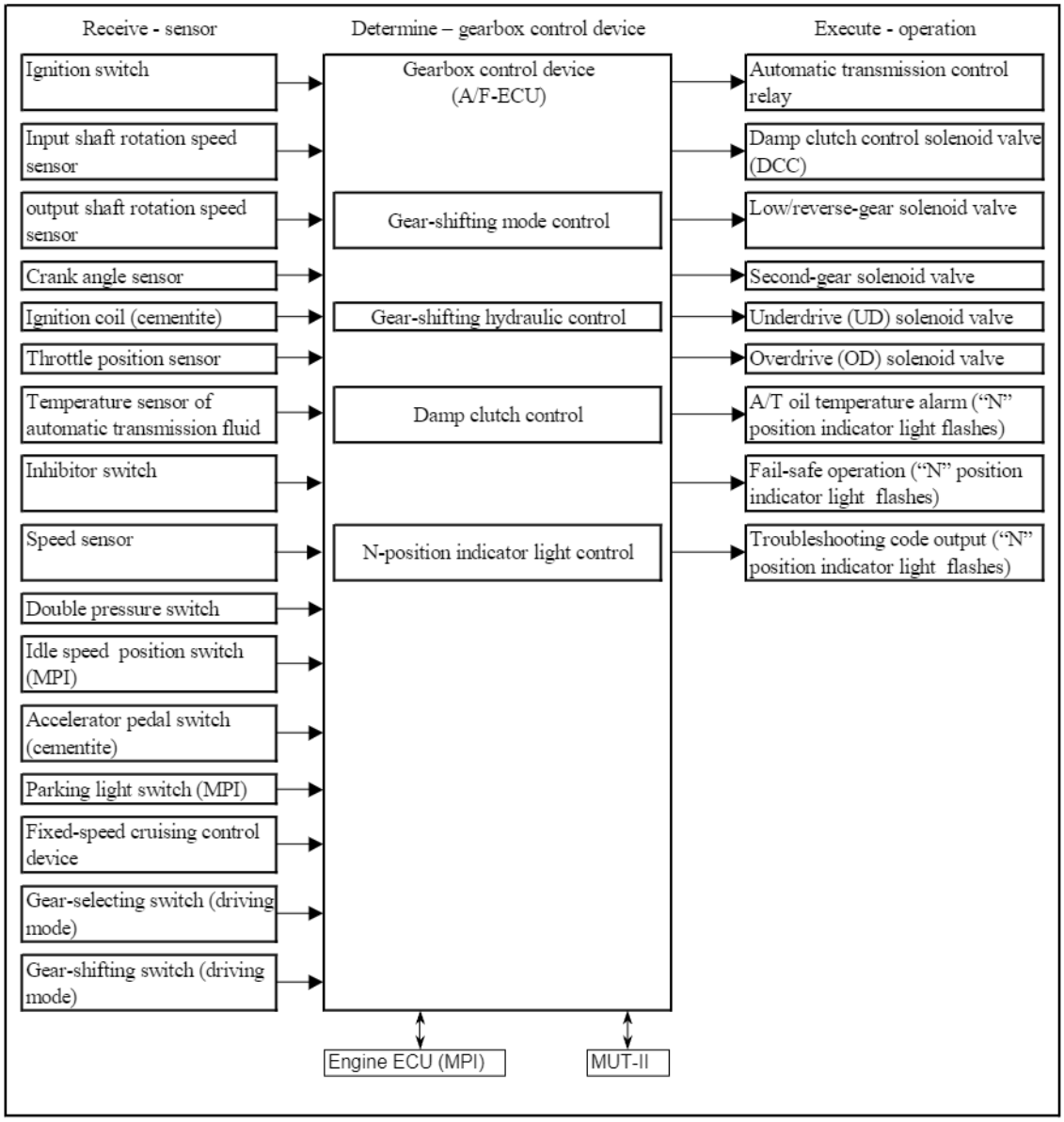
Measurement conditions			Standard hydraulic pressure kPa (Kg/ cm^2)					
Gear lever position	Gear shift position	Motor rotation speed (rpm)	Underdrive clutch oil pressure (UD)	Reverse clutch oil pressure (RV)	Overdrive clutch oil pressure (OD)	Low/reverse-gear brake oil pressure (LR)	Second brake oil pressure (2^{ND})	Hydraulic torque converter oil pressure (DR)
P	-	2500	-	-	-	310-390 (3.2-4.0)	-	310-390 (3.2-4.0)
R	Reverse gear	2500	-	1320-1720 (13.5-17.5)	-	1320-1720 (13.5-17.5)	-	500-700 (5.1-7.1)
N	-	2500	-	-	-	310-390 (3.2-4.0)	-	310-390 (3.2-4.0)
D	First gear	2500	1010-1050 (10.3-10.7)	-	-	1010-1050 (10.3-10.7)	-	500-700 (5.1-7.1)
	Second gear	2500	1010-1050 (10.3-10.7)	-	-	-	1010-1050 (10.3-10.7)	500-700 (5.1-7.1)
	Third gear	2500	590-690 (6.0-7.0)	-	590-690 (6.0-7.0)	-	-	450-650 (4.6-6.6)
	Fourth gear	2500	-	-	590-690 (6.0-7.0)	-	590-690 (6.0-7.0)	450-650 (4.6-6.6)

Please refer to the attached Powerpoint presentation of oil pipelines.

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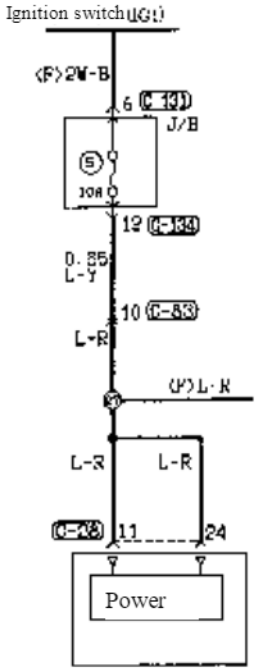
Part Three: Control system

The gearbox control device controls the work of transmission axle. It supervises and analyzes the input signals of various sensors and then controls the relays, solenoid valves, the timing and effectiveness of gear shifting and the operation of damp clutch through the transmission axle.



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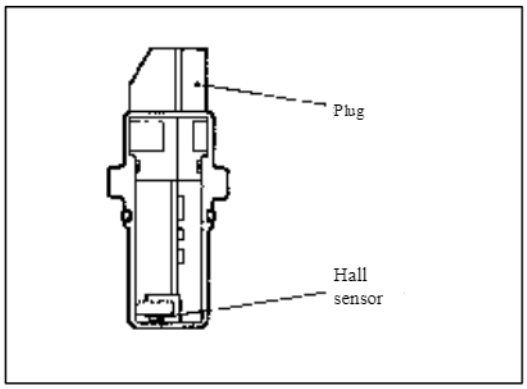
Ignition switch:
The ignition switch transmits the signals to A/T-ECU for the working voltage.



Input/output shaft rotation speed sensor
Both the rotation speed sensors of input and output shafts are located on the transmission axle body. The input shaft rotation speed sensor is on one side of the input shaft, and the output shaft rotation speed sensor is on one side of output shaft..

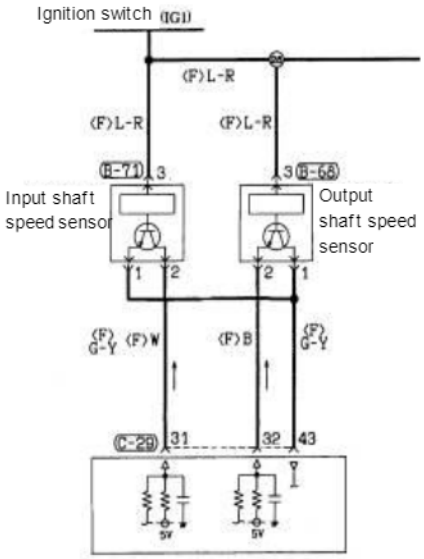


Function: both the input shaft sensor and output shaft sensor shall be Hall sensors. The input shaft rotation speed sensor can measure the turbo speed on UD clutch localizer and output shaft rotation speed sensor can measure the driving gear speed of the transfer case located on the driven gear of the transfer case.

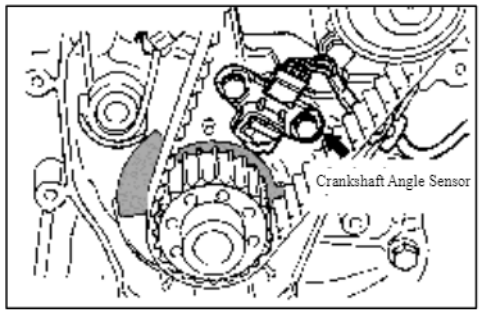


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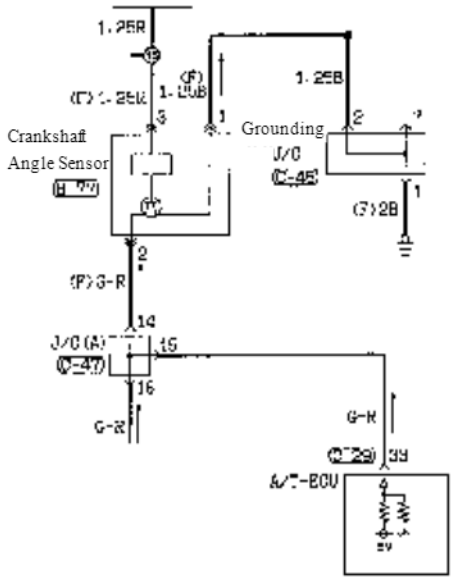
System circuit:
Circuit operation: introduction
As the input and output shaft rotation speed sensors are working in the same way, only input shaft rotation speed sensor is described here.
The input shaft rotation speed sensor is powered by the ignition switch (Terminal 3) and grounded through A/T-ECU.
A/T-ECU provides a 5V voltage to input shaft rotation speed sensor (Terminal 2).
In the case of closed and grounded circuit with the output terminal, the input shaft rotation speed sensor gives out pulse signals.
The sensor will be actuated whenever the tooth of the underdrive clutch localizer passes by the electromagnetic probe of the sensor.



Crank angle sensor



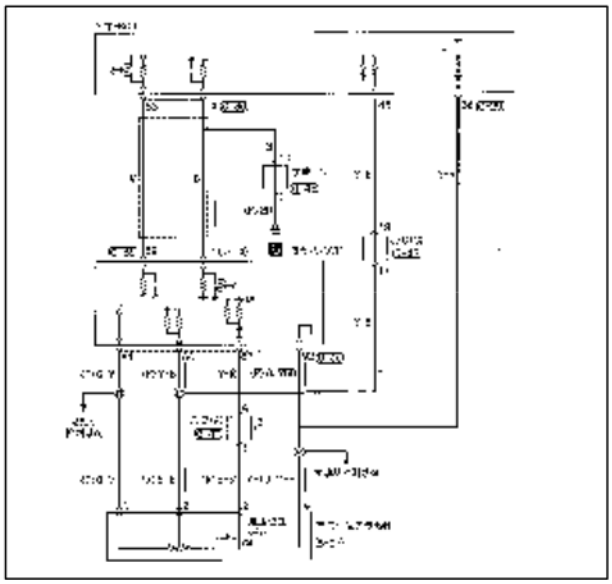
Function:
System circuit
Circuit operation: The crank angle sensor can measure the engine rotation speed by the crank sprocket wheel. It is usually located behind the belt wheel of front crank.
Crank angle sensor is powered by MPI relay (Terminal 3) and grounded through the car body (Terminal 1). A/T-ECU provides a 5V voltage to crank angle sensor (Terminal 2).
When the dial behind the crank sprocket wheel passes, the Hall sensor closes and opens the base circuit on the transistor. When the dial behind the crank sprocket wheel passes, the sensor (transistor) is connected and disconnected.



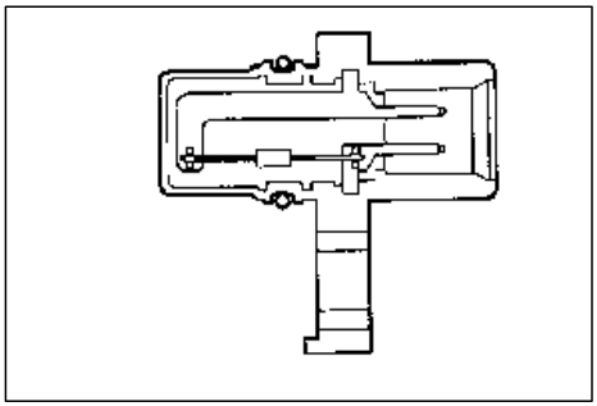
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Temperature	Resistance (kΩ)
0°C	16.7 – 20.5
20°C	7.3 – 8.9
40°C	3.4 – 4.2
60°C	1.9 – 2.1
80°C	1.0 – 1.2
100°C	0.57 – 0.69

Throttle position sensor
By using the potentiometer, the throttle position meter can measure the position of the accelerator pedal.

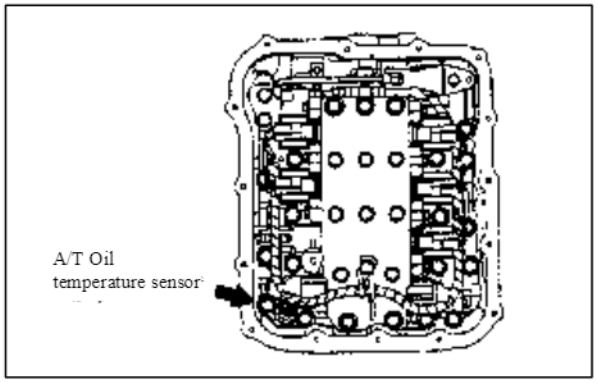


When the throttle shaft turns from idle speed position to fully open position, the resistance between TPS output terminal (Terminal 2) and grounding terminal (Terminal 4) will increase with the rotation speed.
The voltage on Needle 45 will increase from about 0.7V when the throttle is fully closed to about 5V when the throttle is fully open.



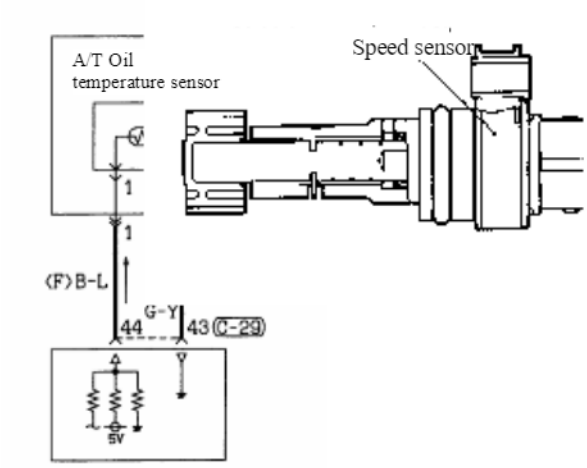
A/T oil temperature sensor
Function:
A/T oil temperature sensor is installed on the valve body and can measure ATF temperature.

A/T oil temperature sensor and its plug form one independent device which uses one negative temperature coefficient (NTC) thermally sensitive resistor. The resistance will decease with the increase of temperature.

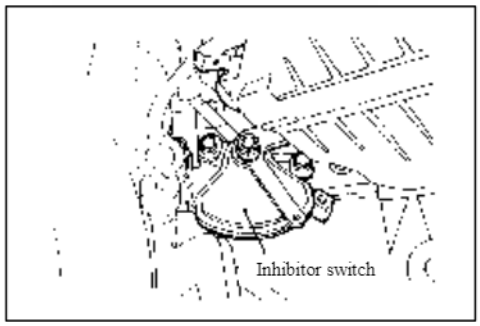


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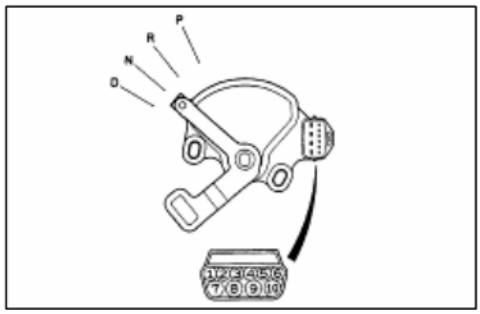
System circuit
A/T-ECU (Terminal 44) provides a 5V voltage to the output terminal (Terminal 1) of gearbox oil temperature sensor.
Grounding terminal (Terminal 2) is grounded through A/T-ECU (Terminal 43).
Gearbox oil temperature sensor is a kind of NTC (negative temperature coefficient) resistor, whose resistance decreases with the increase of ATF temperature.
ATF temperature sensor's output voltage increases and decreases with the resistance.



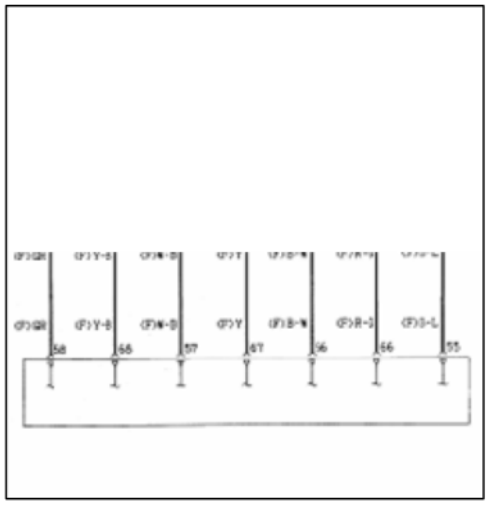
Inhibitor switch:
Function: the inhibitor switch is located on the body of transmission axle and can detect the gear lever position with the help of a contact switch.



4–position swithch (Roadster-type A/T)



System circuit:
When the ignition switch is on, the battery will provide a voltage on the inhibitor switch (Terminal 8).
When the gear lever is at P position, the battery will provide a voltage on A/T-ECU (Terminal 55). When charged, A/T-ECU can recognize that the gear lever is at P position.
When the gear lever is at a different position (R, N, D, 3, 2 or L), A/T-ECU can judge the position of the gear lever with the battery supply a voltage to the corresponding terminal (55, 68, 57, 67, 56 or 66).



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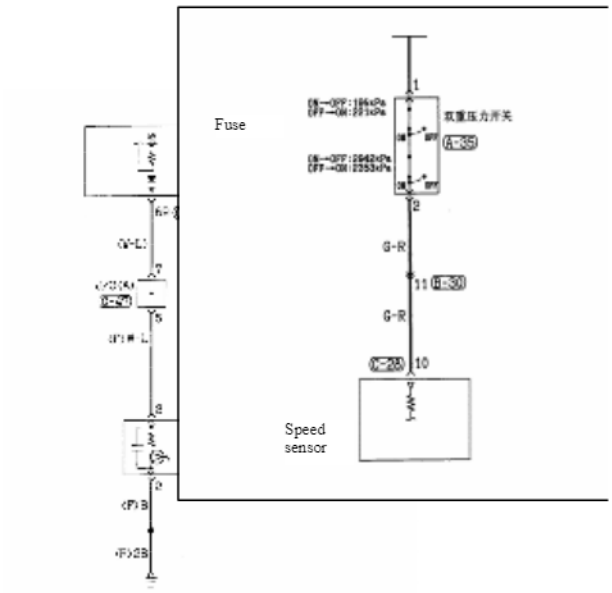
Speed sensor:
The automobile speed sensor is located in the gear chamber of the speed meter and can input signals for A/T-ECU.

Function:
A/T-ECU (Terminal 69) supplies a 5V voltage to the speed sensor output terminal (Terminal 3). The speed sensor will give out a pulse signal when the base terminal of the transistor is electrified.
A/T-ECU can compare the signals of automobile speed sensor with those of the input and output shaft rotation speed sensors. If the automobile speed sensor does not work, the gear shifting will not be carried out properly.

Double pressure switch:
The double pressure switch is located inside the responder/drive and can detect if the automobile air conditioner is on or off.

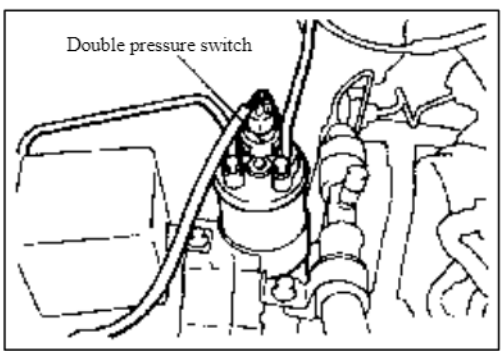
When A/C is on and double pressure switch is closed, A/T-ECU (Terminal 10) can receive system voltage and then determine that A/C compressor has received the startup signal.

When A/C compressor starts, A/T-ECU shifts the gear to compensate for the extra load on the engine.



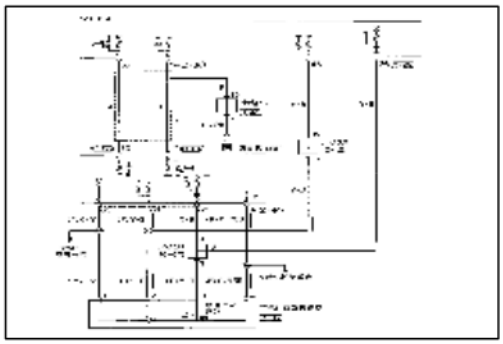
Idle speed position switch:

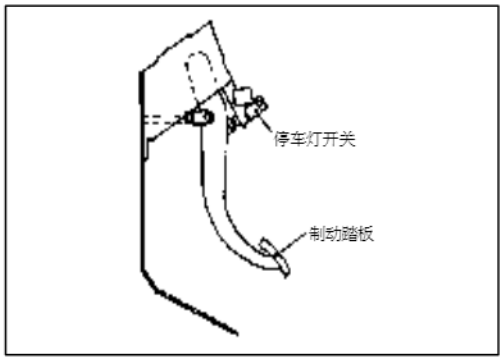
Double pressure switch



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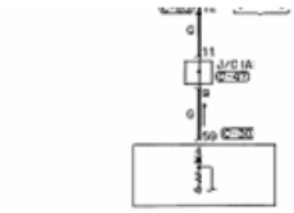
Function: the idle speed position switch can detect the position of fully-closed throttle with the help of the contact switch in the TPS.
Circuit operation:
ECU supplies a 5V voltage (Terminal 87) to the idle speed switch (Terminal 3).
The idle speed switch is grounded (Terminal 4) through ECU (Terminal 92).
When the throttle is higher than the idle speed, the switch will be turned on and A/T-ECU will detect the 5V voltage (Terminal 36).
When the throttle is closed, the voltage is grounded through the switch and A/T-ECU will detect the 0V voltage (Terminal 36).

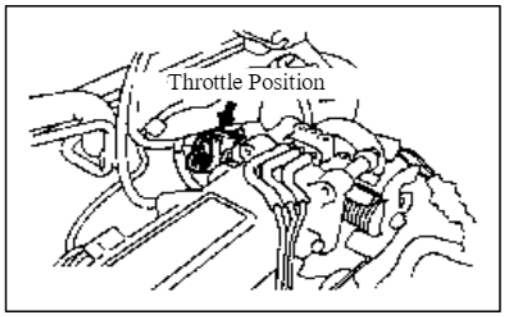




Parking light switch
Function:
The parking light switch can detect if the brake is on or off with the help of the contact switch on the brake pedal.

The battery supplies voltage to the parking light switch (Terminal 2), and supply the battery voltage to A/T-ECU (Terminal 59) when the brake pedal is depressed.
When A/T-ECU (Terminal 59) is supplied with battery voltage, it will determine if the brake pedal is depressed and the parking light is on.



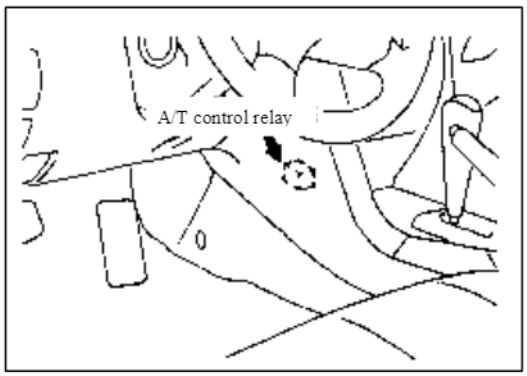


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Gear-selecting switch and gear-shifting switch
The gear-selecting switch and gear-shifting switch are installed in the gear-shifting switch assembly.
When the driver is selecting the gears, the gear-selecting switch can detect if it is a driving mode instruction or an automatic mode instruction.
When the driver is selecting the gears in the driving mode, the gear-shifting switch can detect if it is an instruction to shift to a higher speed gear or a lower speed gear.
Each time the gear lever shifts to the side of (+) or (-), the automobile is geared up or down accordingly.
In automatic mode, the gear-shifting indicator light in the meter panel will indicate the position of the gear lever and the gear within "D" position. However, in driving mode, only the gear will be indicated but not the gear lever position.
System circuit:
If the gear-selecting switch in the gear-shifting assembly is set to the driving mode, the battery's anode voltage will be supplied to A/T-ECU (Terminal 57). If the gear-shifting switch in the gear-shifting assembly is set to the high-speed gear position or low-speed gear position, the battery's anode voltage will be supplied to A/T-ECU (Terminal 56 and 68).

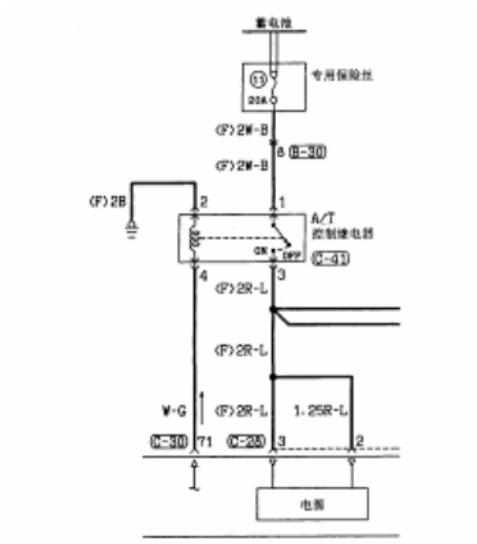


A/T control relay
A/T control relay will supply power to the solenoid valve.

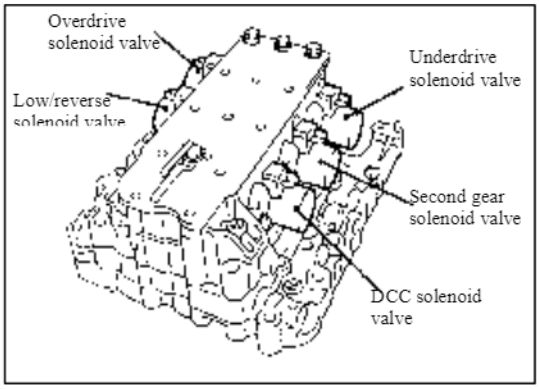


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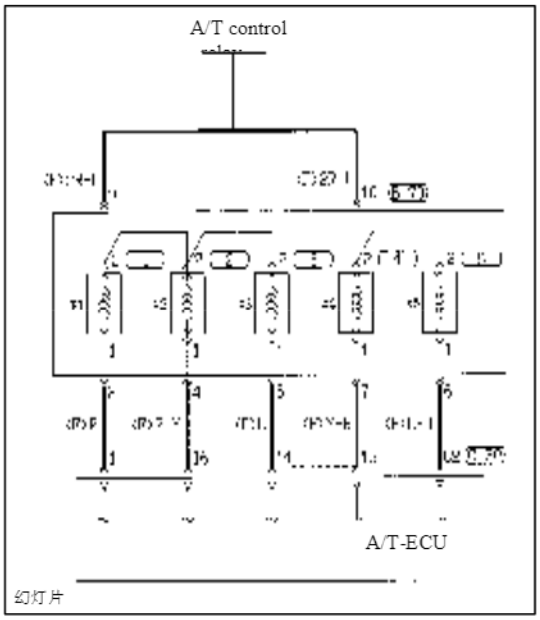
Function:
A/T control relay (Terminal 1) receives the anode voltage from the battery.
When the ignition switch is turned on, A/T-ECU receives the battery anode voltage through the ignition switch (not indicated in the figure).
A/T-ECU (Terminal 71) applies voltage on A/T control relay (Terminal 4) and A/T control relay is on.
When the A/T control relay is on, the battery supplies voltage to A/T-ECU (Terminal 2 and 3).



Damp clutch control (DCC) solenoid valve
Function:
Damp clutch control solenoid valve can adjust the hydraulic pressure of the damp clutch control valve. It carries out load cycles according to A/T-ECU signals. When the solenoid valve is at the status of 70% to 95%, the damp clutch is fully engaged and when the solenoid valve is at the status of 0%, the damp clutch is fully released.

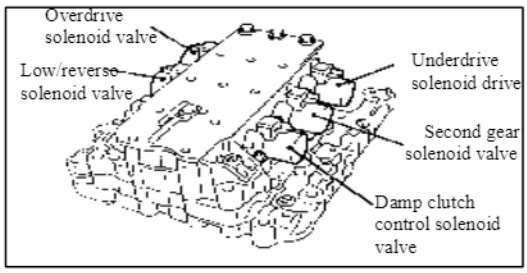


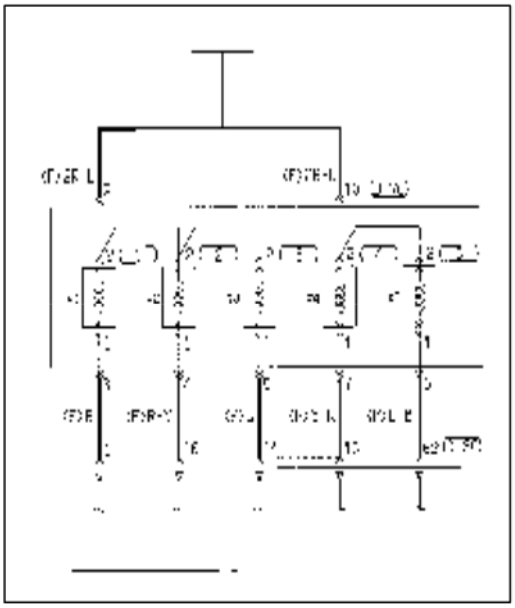
System circuit:
Circuit operation: A/T relay provides system voltage to damp clutch control solenoid valve (Terminal 10). When the load cycle is on, the DCC solenoid valve is closed; when the load cycle is off, the DCC solenoid valve is on.
A/T-ECU determines if the load cycle shall be on or off by the input values from oil temperature sensor, automobile speed sensor, throttle position sensor, input shaft rotation speed sensor, output shaft rotation speed sensor and inhibitor switch.



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LR, UD, Second-gear and OD solenoid valve
Function:
LR, UD, second-gear and OD solenoid valve can regulate the hydraulic pressure of their respective pressure control valve to realize gear shifting.
When there is no power supply, the solenoid valve is of a normally-open type.
A/T-ECU controls the solenoid valve to undertake load cycles within the range of 1% to 100%.
When the solenoid valve is at the status of 0%, all braking parts are engaged; when the solenoid valve is at the status of 100%, all braking parts are released.





System circuit:
Circuit operation: A/T controls the relay to provide system voltage to each solenoid valve (Terminal 9 and 10).
When it is on, each solenoid valve is off; when it is off, each solenoid valve is on. A/T-ECU determines the on/off status of each solenoid valve according to the input data from the parking light switch, automobile speed sensor, input shaft sensor, output shaft sensor and A/T oil temperature sensor, etc.
A/T-ECU provides grounding to turn on each solenoid valve. The grounding time is displayed in the form of percentage on MUT-II.
The actuation of a solenoid valve will affect the hydraulic pressure of the working parts and release parts of the gearbox.

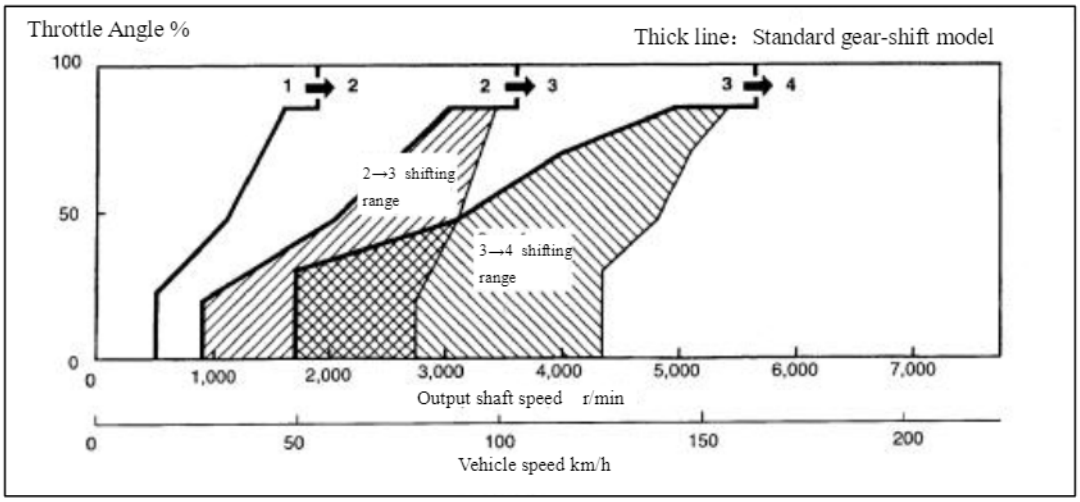
Gear-shifting control:
Solenoid valve
According to INVECS-II, one special solenoid valve controls the hydraulic pressure of each clutch and brake so that the system can directly carry out "clutch-to-clutch" control during gear shifting.

Gear	Solenoid valve				
	LR	Second gear	UD	OD	DCC (reference)
First gear	Off	On	Off	On	Off
Second gear	On	Off	Off	On	On
Third gear	On	On	Off	Off	On
Fourth gear	On	Off	On	Off	On
Reverse gear	Off	On	On	On	Off

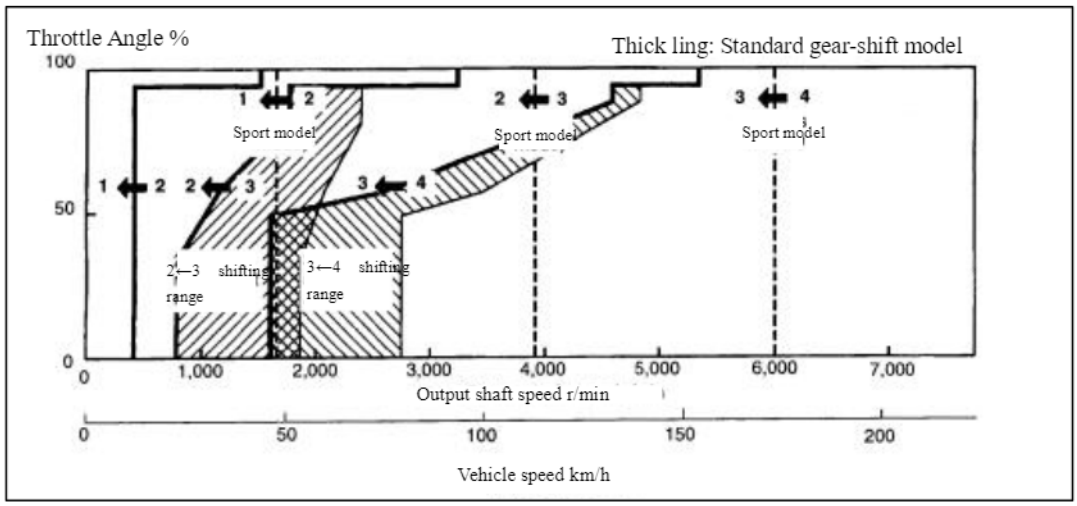
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Gear-shifting mode control
According to road surface situation and the driver's driving mode, INVECS-II optimizes the gear-shifting mode.

Gear-up mode:



Gear-down mode:

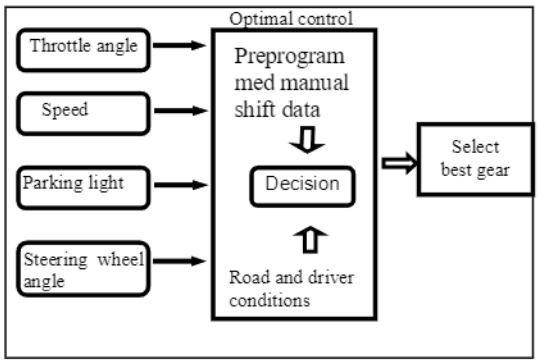


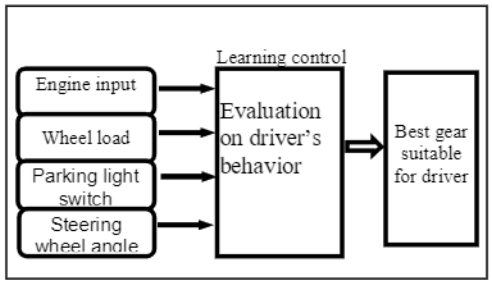
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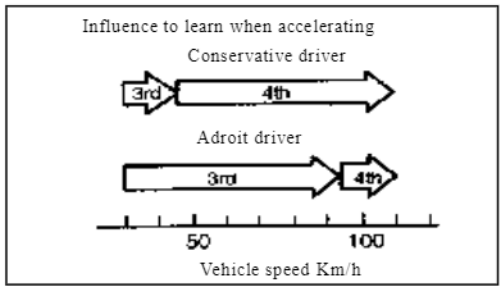
INVECS-II: automobiles equipped with MPI or GDI engine
Application: INVECS-II consists of two parts.
General description: 1. *Optimal overall control* provides the gear selection function, which can satisfy the driver's need in various road surface situations.
2. *Learning control system* can modify the timing of gear shifting as per the driver's behavior features and corrected input.
INVECS-II computer programs according to the manual gear shifting data by various drivers subject to various road surface situations.
Optimal overall control
The computer receives the signals from throttle position sensor, automobile speed sensor and parking light switch during automobile traveling to determine what driving mode shall be adopted. Therefore, INVECS-II always provides the optimal gear selection on whatever road surface it may be.

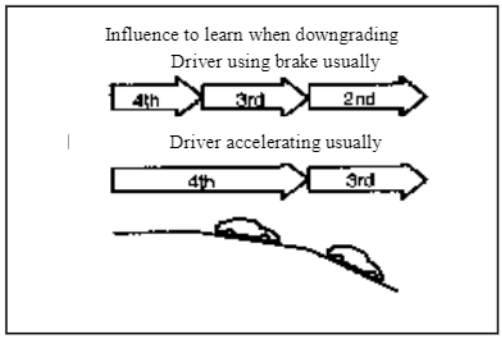
Learning control system:
As the optimal gear-shifting timing changes depending on driving behaviors, driving ability and differences between various drivers, INVECS-II is equipped with one learning control system.
According to the output power of the engine, wheel load and the operation of brake, this system makes an assessment of the driver's driving mode.
The learning control system modifies the gear-shifting timing according to the assessment results to best suit the driving behaviors and habits of the driver.
It is easy to shift to high-speed gear while the automobile is traveling at a low speed; and it feels good and exciting to shift to high-speed gear while the automobile is traveling at a high speed.
If the driver frequently steps on the brake pedal on a downgrade, the computer will shift it to low-speed gear in a timely manner to provide for engine braking.

Hydraulic control during gear shifting:
During gear shifting, F4A4 automatic transmission driving axle series provides simultaneous and independent hydraulic control for each connected and isolated part.
Clutch-on-clutch control:
It can prevent interlocking and instantaneous racing of the engine during gear shifting so that the gear shifting can be more stable and flexible.



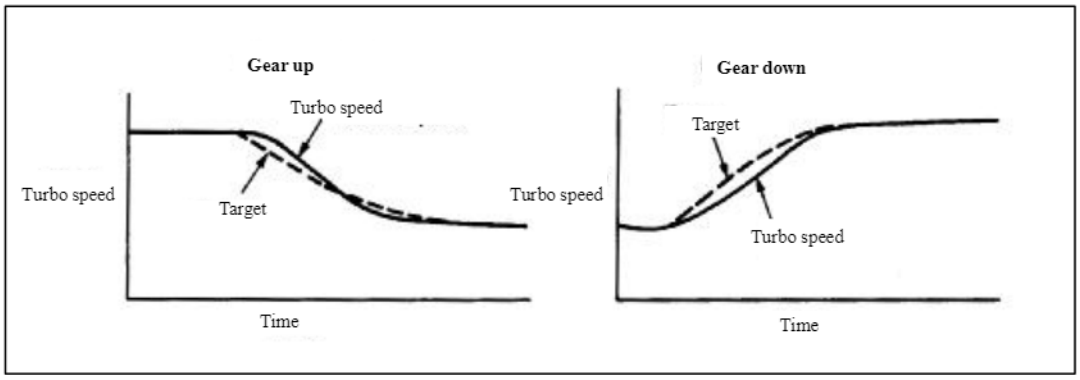






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Feedback control and learning control



Feedback control:
During each gear shifting, the feedback control function will regulate the hydraulic pressure so that the rotation speed changes of gearbox input shaft complies with the target mode. This function can provide the optimal driving axle torque changes and increase gear-shifting quality.
Learning control:
The learning control function can adjust the oil pressure to realize the optimal gear-shifting result according to previous gear-shifting experience.
Integrated engine/gearbox control:
The ECU and A/T-ECU of the engine transmits and receives necessary data for control. These data are transmitted and received through serial communication cables. When shifting to high-speed gear, A/T-ECU gives out a signal for torque reduction to the engine; engine ECU gives a feedback through delayed ignition. A/T-ECU determines the appropriate hydraulic pressure applied onto the clutch and brake during gear shifting according to the input air quantity data from the engine ECU.

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Part Four: Troubleshooting

Case analysis:
1. The user's problem is:
There is noise when the gearbox is at first, second and fourth gear but the noise disappears when the gearbox is at the third gear. Please identify the possible causes:

Possible cause	Checking scheme
Planetary gear set trouble	

2. The automobile has not reverse gear. Please identify the possible causes:

Possible cause	Checking scheme
1. LR brake (skidding, LR pressure control valve is clogged, LR solenoid valve has short circuit) 2. Reverse-gear clutch	If there is no engine braking when the vehicle is traveling at D gear, LR brake may have troubles.

3. It works properly at the first and second gear, but engine rotation speed suddenly increases (racing) at the third gear. Please identify the possible causes:

Possible cause	Checking scheme
Mechanical problems with the overdrive clutch (O-ring damage, OD pressure control valve) Note: The trouble has nothing to do with OD solenoid valve for the following reason: If there is short circuit in OD solenoid valve, the gearbox will only be kept at the second gear; if there is open circuit, the gearbox will only be kept at the third gear.	

4. The vehical can get started at D position; however, the engine rotation speed suddenly increases (racing) after the vehicle travels for some time. And the vehicle encounters the same engine racing problem when it is restarted. Please identify the possible causes:

Possible cause	Checking scheme
Unidirectional clutch damage (In the case of the first gear at D position and a traveling speed of over 10Km/h, LR brake is detached. Therefore, the trouble will occur when unidirectional clutch is damaged and it will only happen to gearbox with a unidirectional clutch	Unidirectional clutch may be damaged when no skidding occurs at L position. (because LR brake works at L position and unidirectional clutch damage does not generate any influence)

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5. Forward gear does not work. Please identify the possible causes:

Possible cause	Checking scheme
Mechanical problems with the underdrive clutch (O-ring damage, UD pressure control valve) Note: The trouble has nothing to do with UD solenoid valve for the following reason: If there is short circuit in UD solenoid valve, the gearbox will only be kept at the fourth gear; if there is open circuit, the gearbox will only be kept at the third gear.	

6. The vehicle is not sufficiently powered at startup and low-speed driving. N position light is flashing once per second. Please identify the possible causes:

Possible cause	Checking scheme
Failure mode (keep at the third gear)	Check if the gear has been shifted; Check fault code with MUT-II

7. The vehicle is not sufficiently powered at startup and low-speed driving. N position light does not flash. Please identify the possible causes:

Possible cause	Checking scheme
Unidirectional clutch damage (free) of the torque converter	Stall test

8. N position light is flashing twice per second. Please identify the possible causes:

Possible cause	Checking scheme
A/T temperature sensor trouble Too much or insufficient ATF oil Clogged ATF cooler DAMP clutch does not work (DCC solenoid valve, DCC control valve)	Use MUT-II to confirm if ATF temperature is too high. Confirm ATF quantity when its temperature exceeds 80 ℃. Confirm the returned oil quantity of ATF cooler. Confirm DA and DR pressure.

9. There is clear impact when it is shifted from the second gear to the third gear, and it is not so clear of the impact caused when it is shifted from the first gear to the second gear and from the third gear to the fourth gear. Please identify the possible causes:

Possible cause	Checking scheme
Second-gear brake skids. Cause: reverse-gear central gear rotates counterclockwise at the first gear; Reverse-gear central gear is stuck at the second gear; Reverse-gear central gear rotates clockwise at the third gear; Reverse-gear central gear is stuck at the fourth gear; If the second-gear brake skids, the reverse-gear central gear will be stuck for a longer period	

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when it is shifted from the first to the second gear and no apparent impact will occur; the reverse-gear central gear will be released earlier and rotate counterclockwise (constitute a provisional first gear) when it is shifted from the second to the third gear; when the overdrive clutch is engaged, the reverse-gear central gear will change quickly from counterclockwise into clockwise rotation and therefore create apparent impact; the reverse-gear central gear will be stuck for a longer period when it is shifted from the third to the fourth gear and no apparent impact will occur. OD clutch accumulator is in trouble OD clutch clearance is improper	

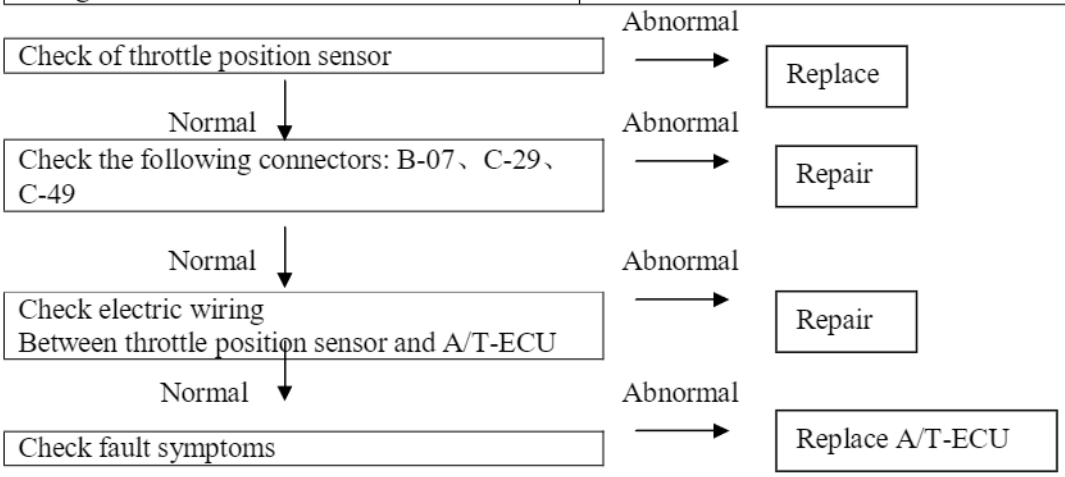
10. Impact is felt when the vehicle is traveling at around 30Km/h and there is no further shifting while N position light flashes; stop the vehicle, restart the engine and there is gear shifting and N position light is off, but the problem is repeated after startup. Please identify the possible causes:

Possible cause	Checking scheme
Input shaft speed sensor trouble (damaged sensor, bad contact of circuit) Output shaft speed sensor trouble (damaged sensor, bad contact of circuit)	Use MUT-II to check the fault code and the data of input shaft speed sensor Use MUT-II to check the fault code and the data of output shaft speed sensor

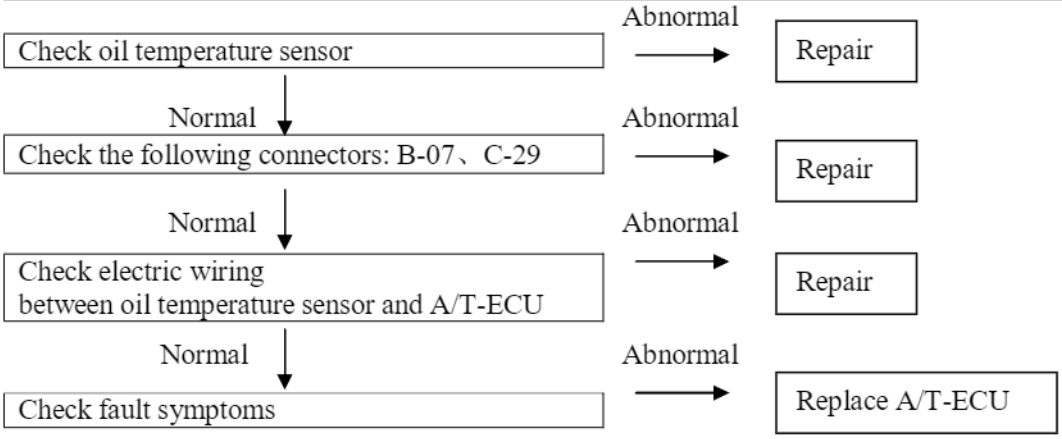
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Troubleshooting

Code 11, 12, 14 throttle position sensor system	Possible cause
If TPS output voltage is over 4.8V in the case of engine idle speed, then the output will be diagnosed to be excessive and the fault code 11 is output. Except for engine idle speed, it will be diagnosed as bad adjustment of TPS and the fault code 14 will be output if TPS output voltage is below 0.2V.	Throttle position sensor trouble Connector trouble A/T-ECU trouble

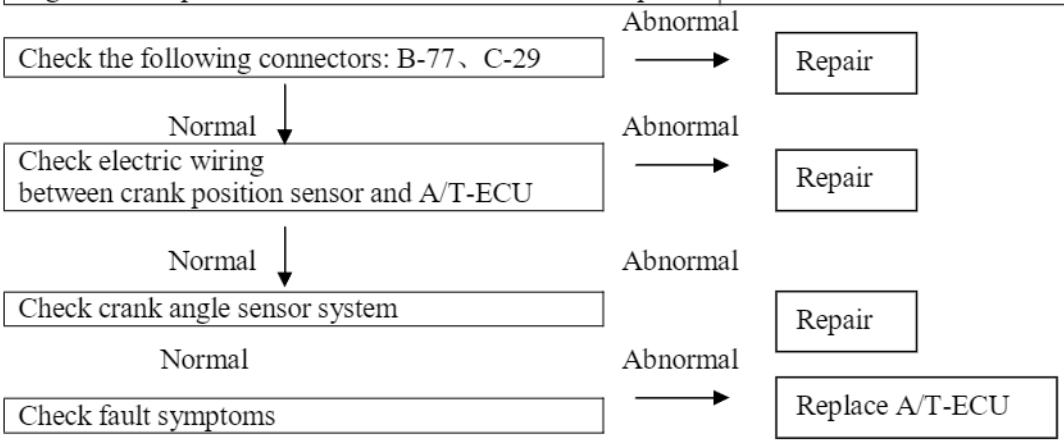


Code 15 Oil temperature sensor system	Possible cause
If the output voltage of oil temperature sensor is still over 2.6V (temperature keeps stable) after more than ten minutes of traveling, this will be diagnosed as oil temperature sensor open circuit and the fault code 15 will be output	Oil temperature sensor trouble Connector trouble A/T-ECU trouble

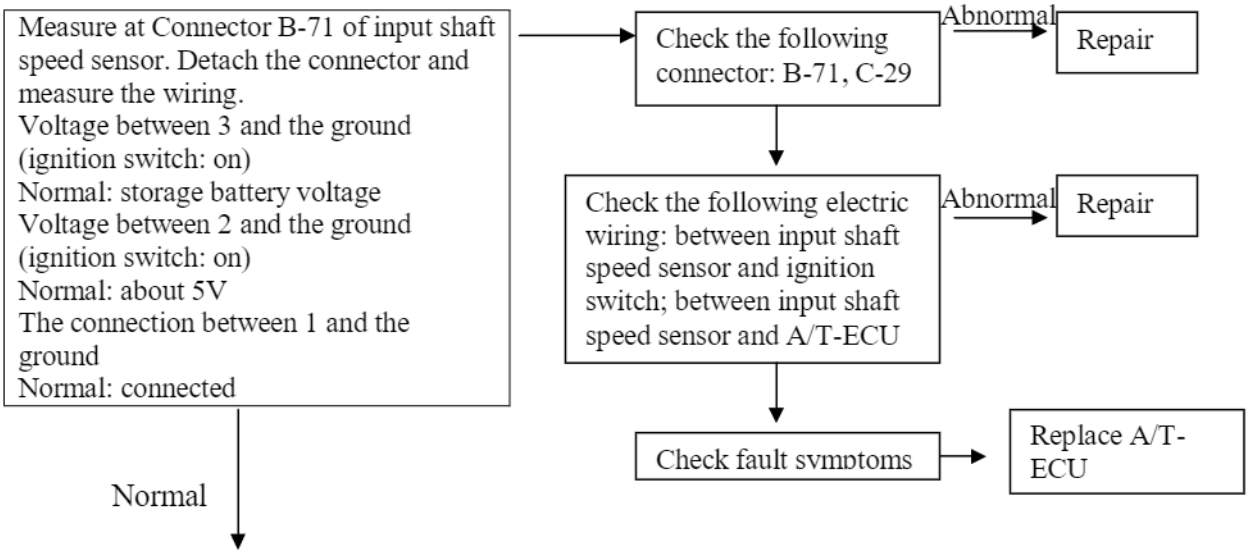


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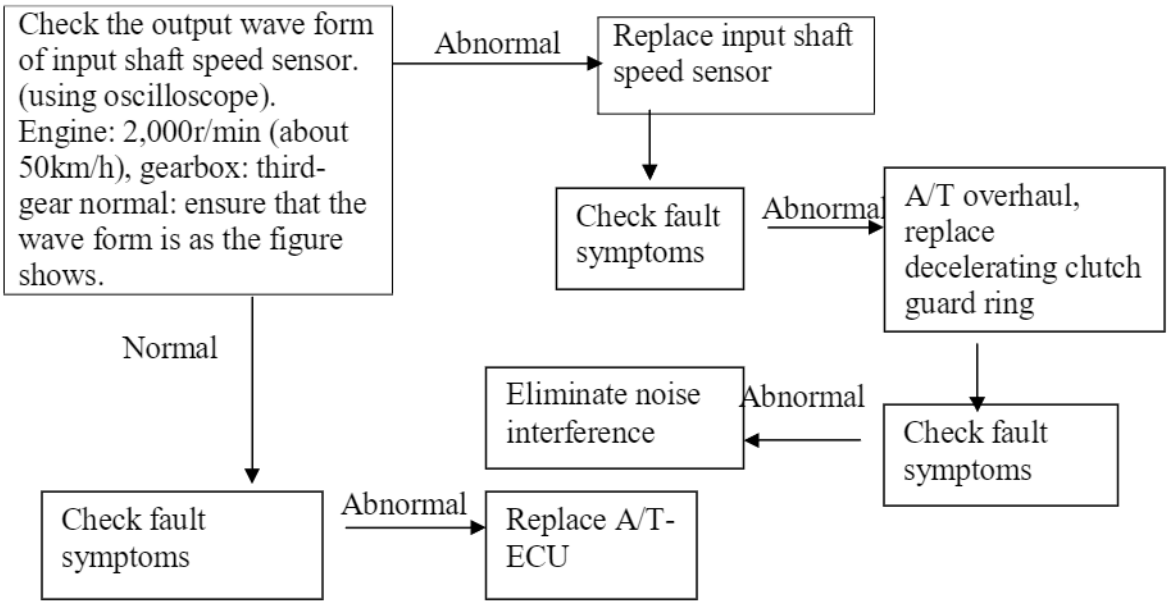
Code 21 Crank position sensor	Possible cause
If no output pulse from the crank position sensor is detected for over five seconds when the vehicle is traveling at a speed of over 25km/h, then it will be diagnosed as crake angle sensor open circuit and fault code 21 will be output.	Crank angle sensor trouble Connector trouble A/T-ECU trouble



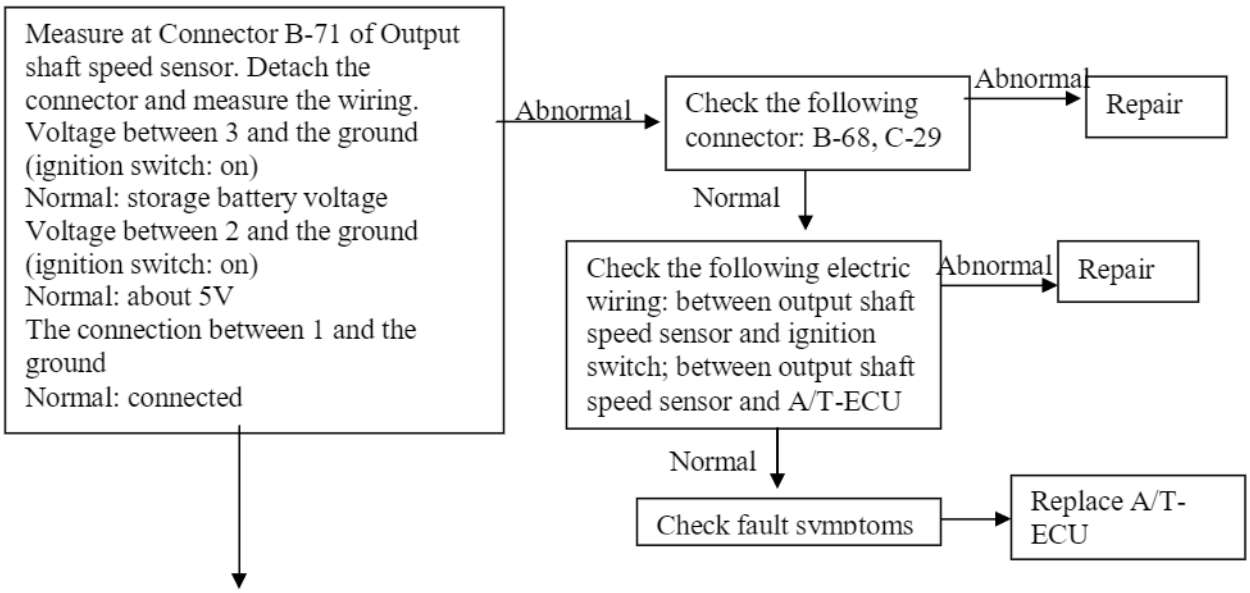
Code 22 Input shaft speed sensor system	Possible cause
If no output pulse from the input shaft speed sensor is detected for over one second when the vehicle is traveling at 30km/h at the third or fourth gear, then it will be diagnosed as input shaft speed sensor open circuit or short circuit and fault code 22 will be output. If the fault code 22 is output for 4 times running, then the gearbox will be fixed at the third gear (D position) or be shifted to a lower gear at driving mode for protection.	Input shaft speed sensor trouble Deceleration clutch guard ring trouble Connector trouble A/T-ECU trouble



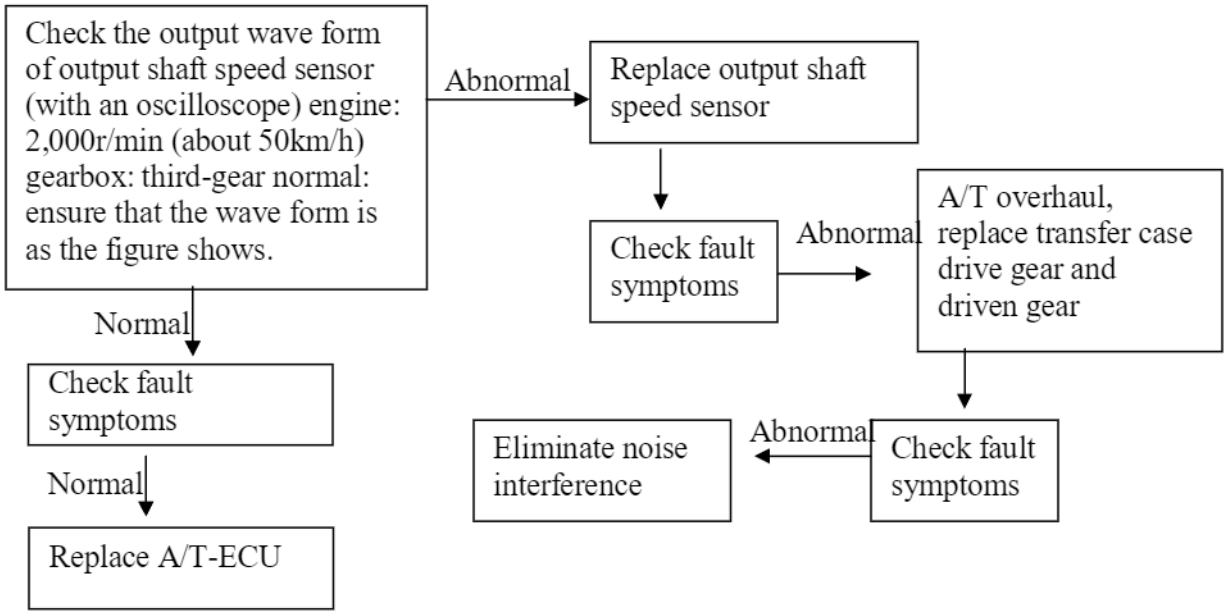
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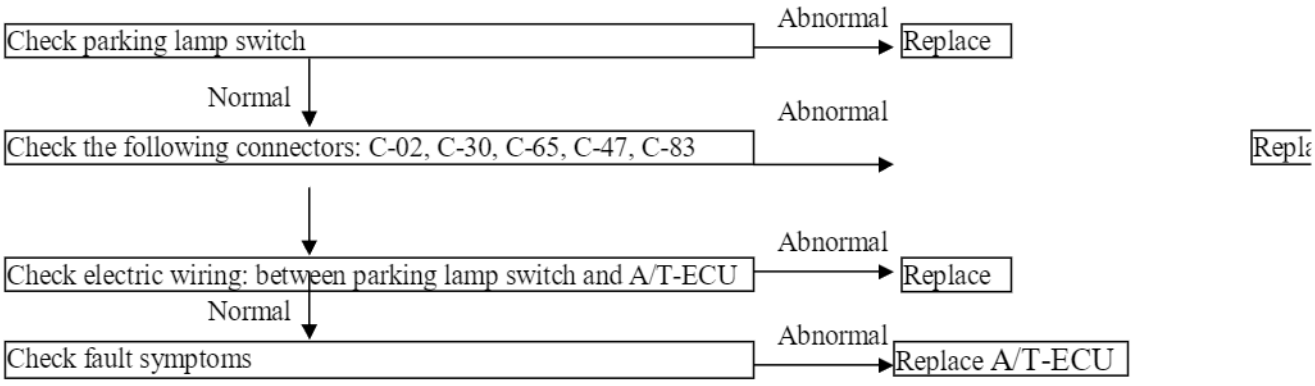
Code 23 Input shaft speed sensor system	Possible cause
If no output pulse from the output shaft speed sensor is detected for over one second when the auto is traveling at 30km/h at the third or fourth gear, then it will be diagnosed as output shaft speed sensor open circuit or short circuit and fault code 23 will be output. If the fault code 23 is output for 4 times running, then the gearbox will be fixed at the third gear (D position) or be shifted to a lower gear at driving mode for protection.	Output shaft speed sensor trouble Deceleration clutch guard ring trouble Connector trouble A/T-ECU trouble



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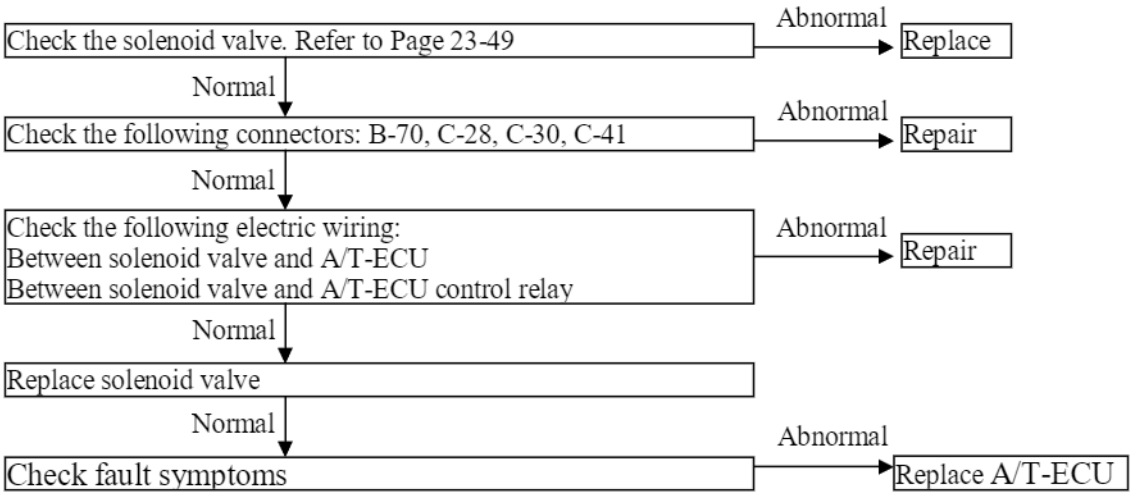


Code 26 Parking lamp switchgear system	Possible cause
Parking lamp is on when the car is driving	Parking lamp switch fault Connector fault A/T-ECU fault

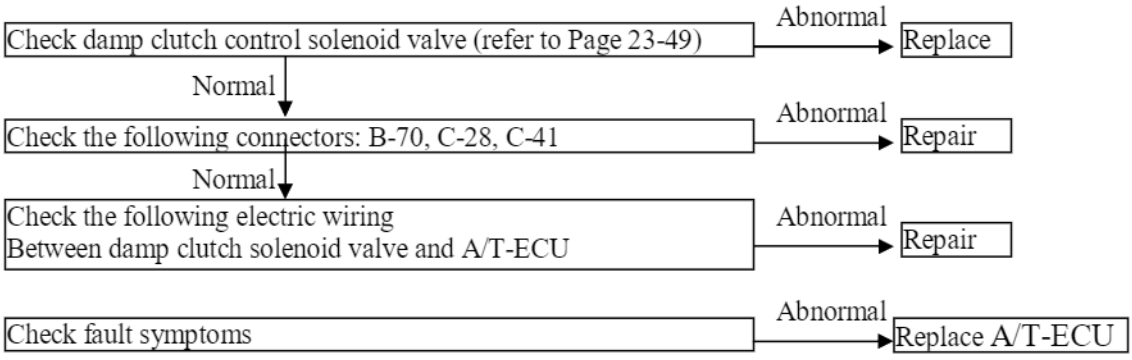


Code 31 Low and reverse-gear solenoid valve system	Possible cause
Code 32 Deceleration solenoid valve system	
Code 33 Second-gear solenoid valve system	
Code 34 Overdrive solenoid valve system	
In the case of overresistance or underresistance of solenoid valve, the solenoid valve will be diagnosed as open circuit or short circuit and corresponding troubleshooting code will be output; the gearbox will be locked at the third gear as a protection.	Solenoid valve fault Connector fault A/T-ECU fault

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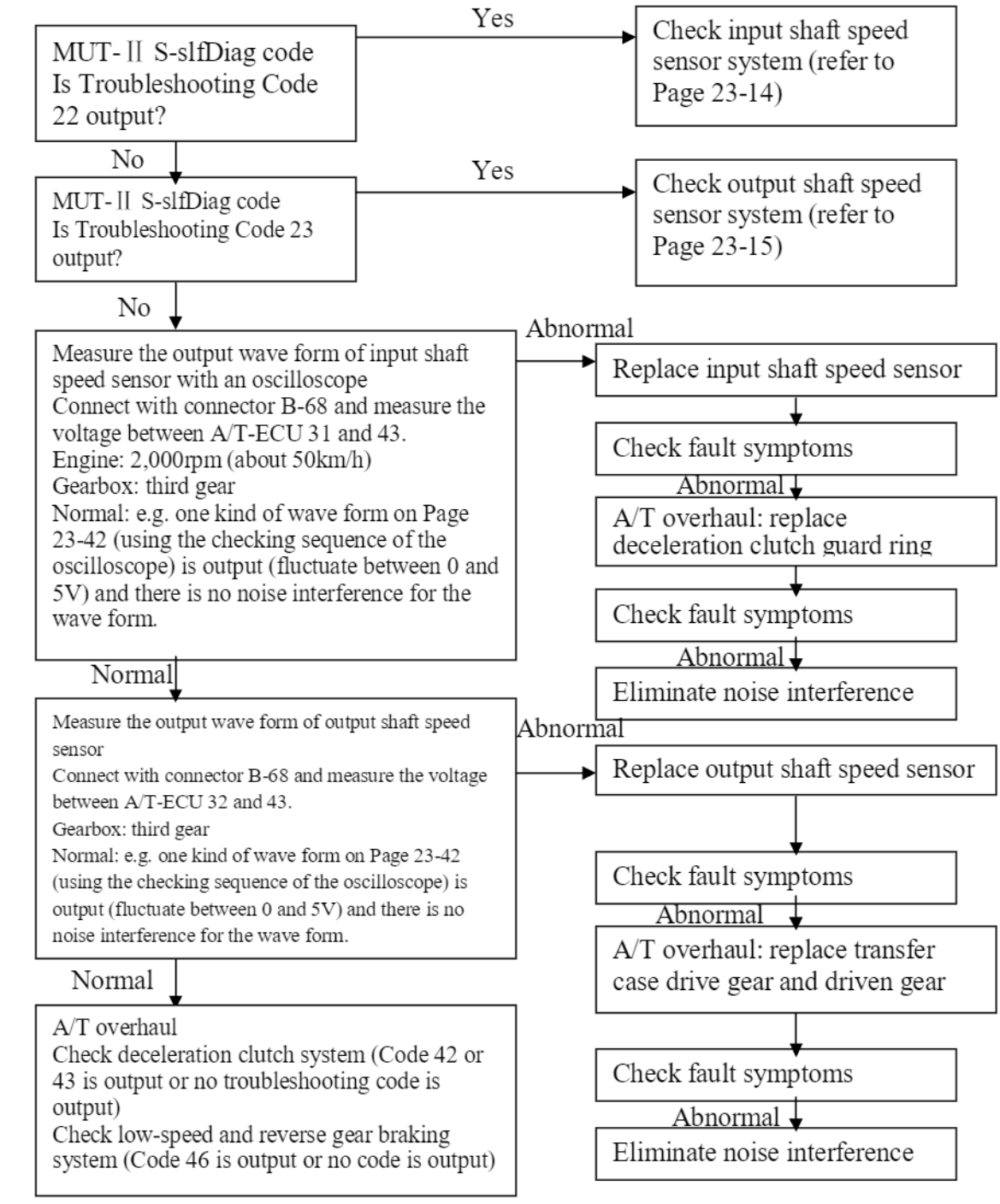


Code 36, 52 Damp clutch control solenoid valve system	Possible cause
In the case of over resistance or under resistance of control solenoid valve of the damp clutch, then the control solenoid valve will be diagnosed as short circuit and Code 36 will be output. If the load ratio of damp clutch control solenoid valve is over 100% for over 4 seconds running, then the control solenoid valve will be diagnosed as short circuit and Code 52 will be output. When Code 36 is output, the gearbox will be locked at the third gear as a protection.	Damp clutch control valve fault Connector fault A/T-ECU fault



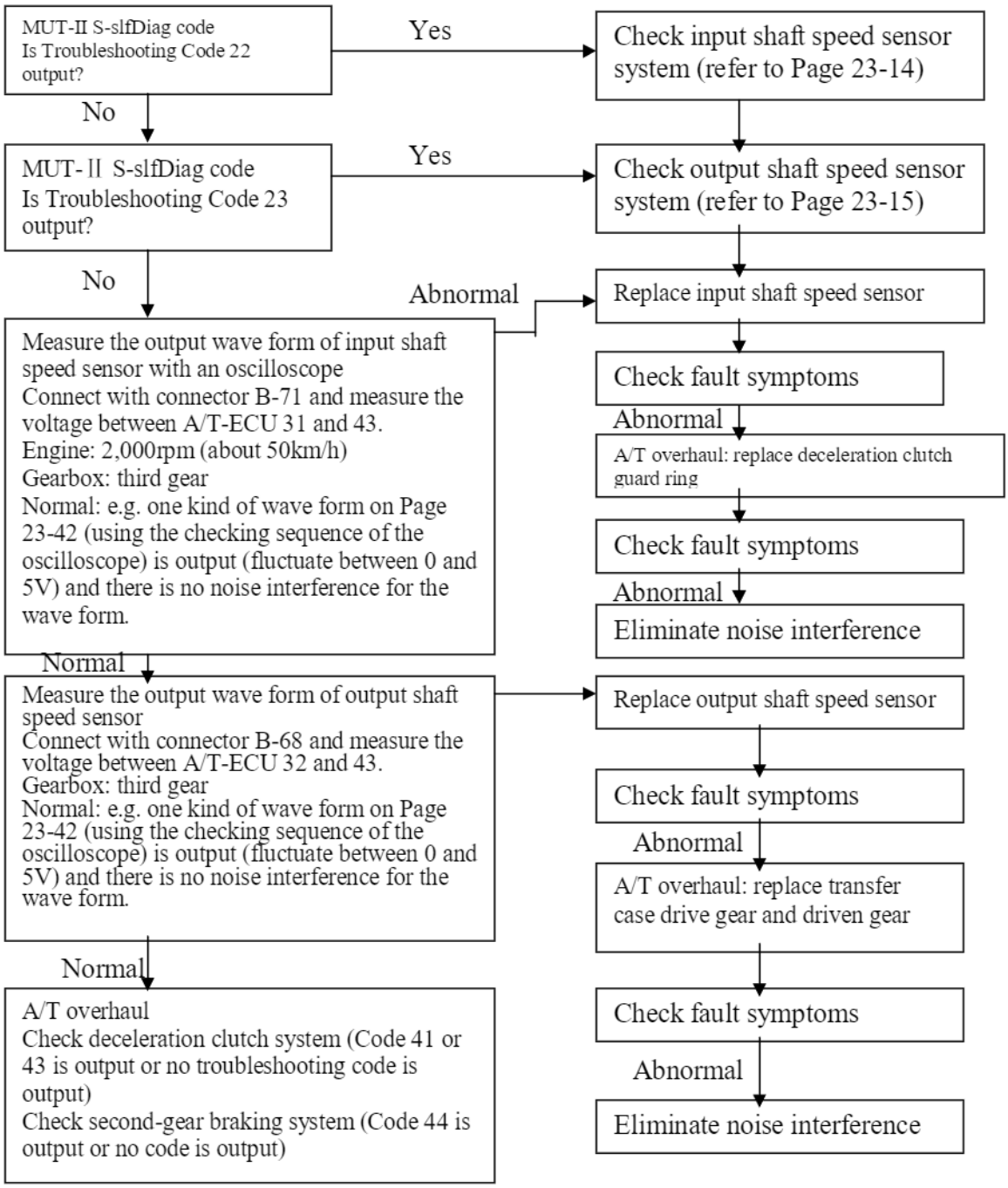
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Code 41 Non-conforming transmission ratio of the first gear	Possible cause
If the transmission ratio of the first gear does not conform to the input of input shaft speed sensor and the output of output shaft speed sensor is increased, then Code 41 will be output. If Code 41 is output for 4 times running, then the gearbox will be locked at the third gear as a protection.	Input shaft speed sensor fault Output shaft speed sensor fault Deceleration clutch guard ring fault Transfer case drive gear or driven gear fault Low/reverse gear braking system fault Deceleration clutch system fault Noise interference



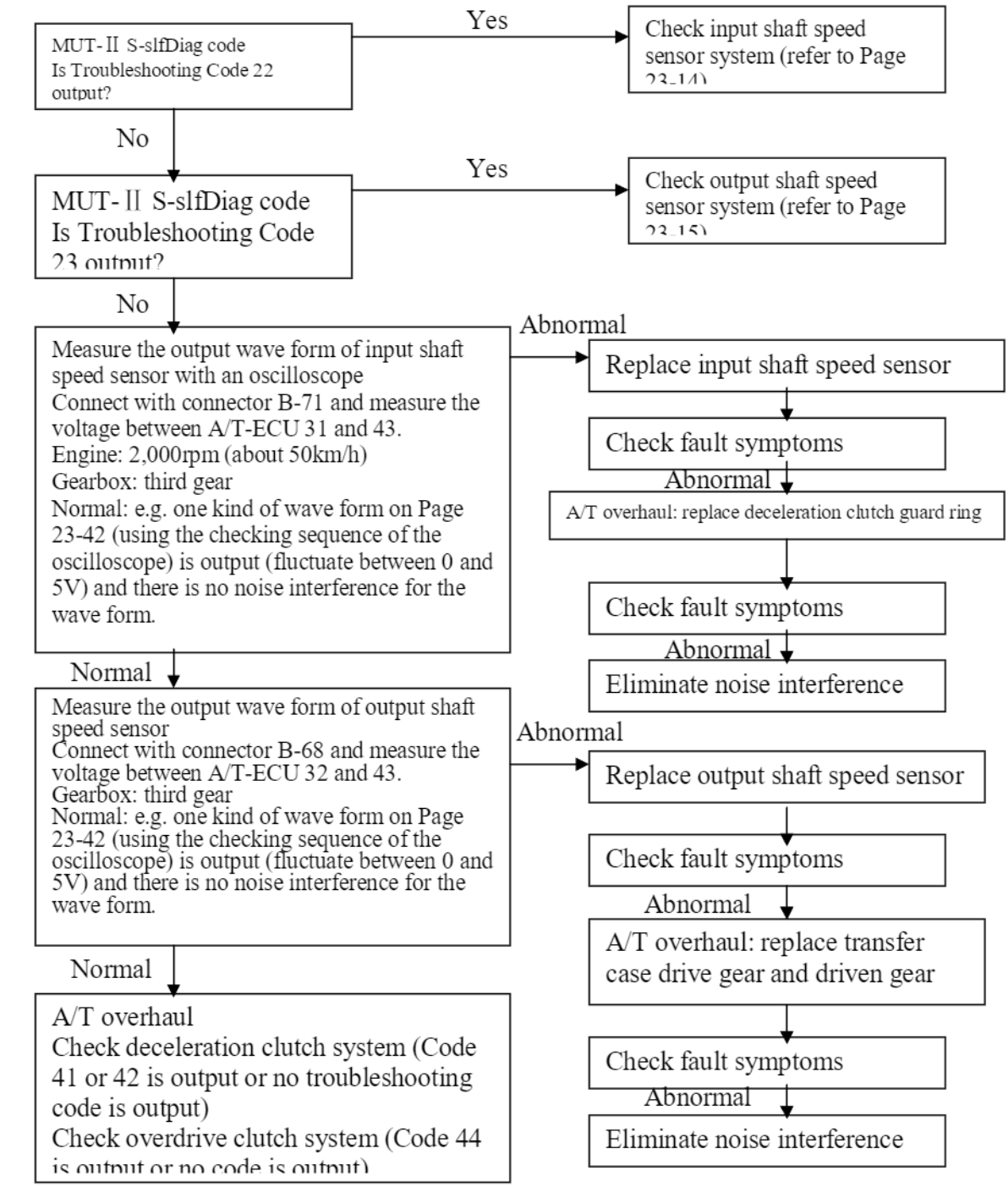
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Code 22 Non-conforming transmission ratio of the second gear	Possible cause
If the transmission ratio of the second gear does not conform to the input of input shaft speed sensor and the output of output shaft speed sensor is increased, then Code 41 will be output. If Code 41 is output for 4 times running, then the gearbox will be locked at the third gear as a protection.	Input shaft speed sensor fault Output shaft speed sensor fault Deceleration clutch guard ring fault Transfer case drive gear or driven gear fault Second or reverse gear braking system fault Deceleration clutch system fault Noise interference



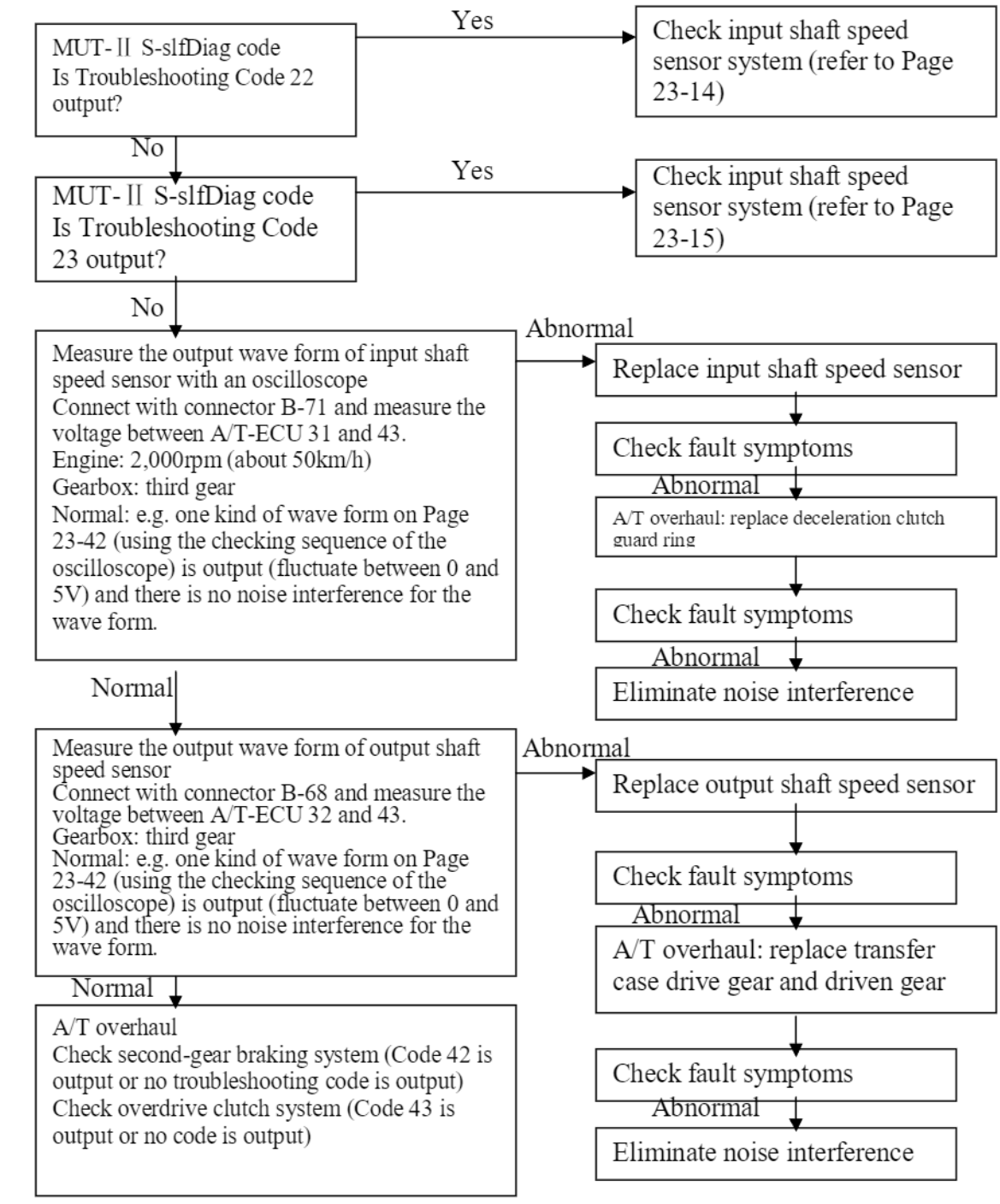
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Code 43 Non-conforming transmission ratio of the third gear	Possible cause
If the transmission ratio of the third gear does not conform to the input of input shaft speed sensor and the output of output shaft speed sensor is increased, then Code 43 will be output. If Code 43 is output for 4 times running, then the gearbox will be locked at the third gear as a protection.	Input shaft speed sensor fault Output shaft speed sensor fault Deceleration clutch guard ring fault Transfer case drive gear or driven gear fault Overdrive clutch system fault Deceleration clutch system fault Noise interference



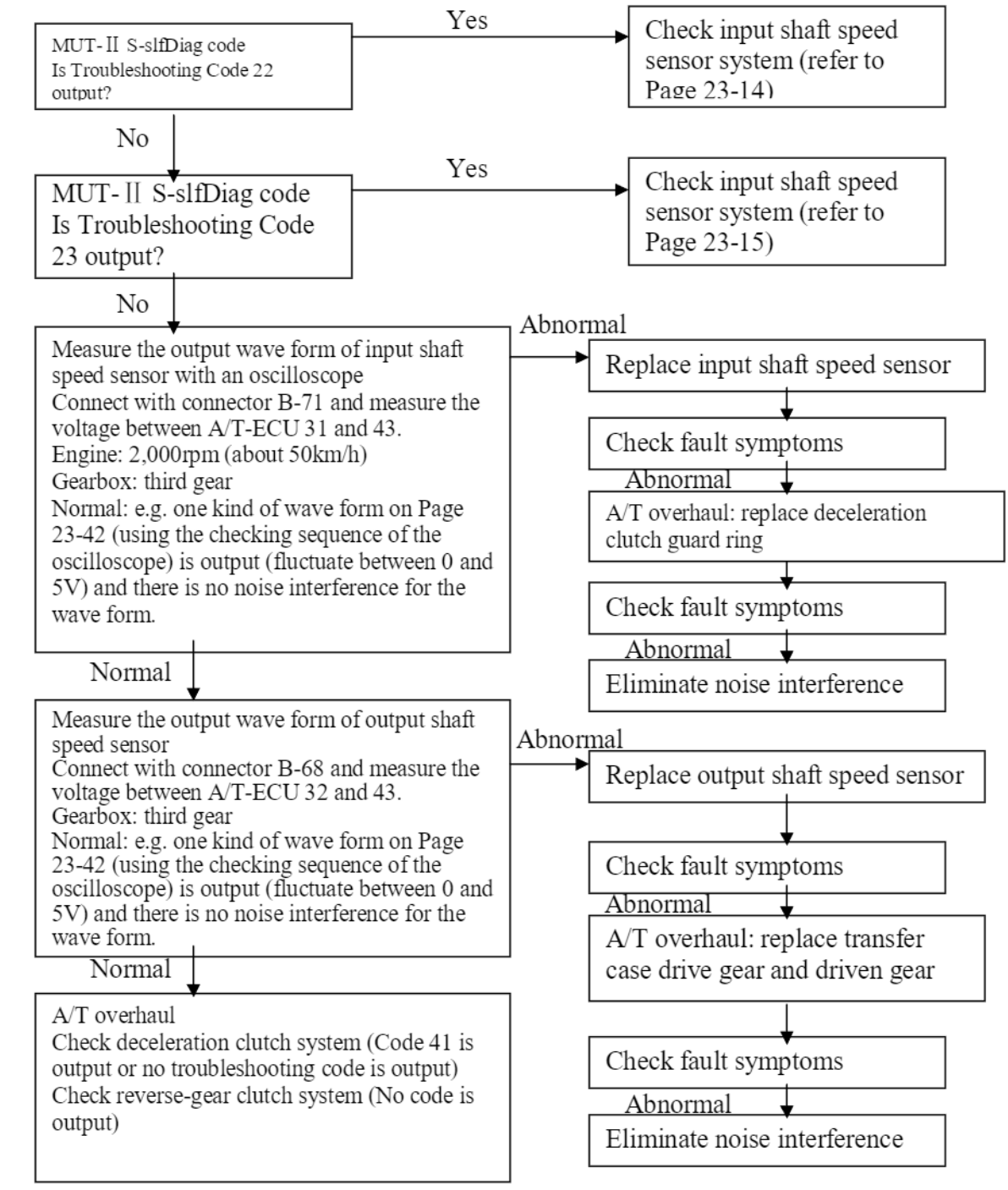
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Code 44 Non-conforming transmission ratio of the fourth gear	Possible cause
If the transmission ratio of the first gear does not conform to the input of input shaft speed sensor and the output of output shaft speed sensor is increased, then Code 44 will be output. If Code 44 is output for 4 times running, then the gearbox will be locked at the third gear as a protection.	Input shaft speed sensor fault Output shaft speed sensor fault Deceleration clutch guard ring fault Transfer case drive gear or driven gear fault Second-gear braking system fault Overdrive clutch system fault Noise interference



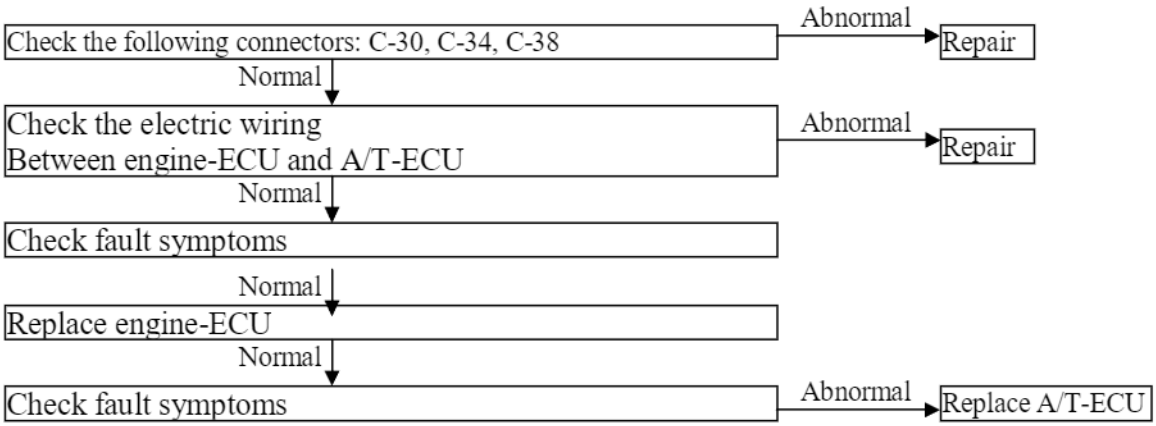
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Code 46 Non-conforming transmission ratio of the reverse gear	Possible cause
If the transmission ratio of the reverse gear does not conform to the input of input shaft speed sensor and the output of output shaft speed sensor is increased, then Code 46 will be output. If Code 46 is output for 4 times running, then the gearbox will be locked at the third gear as a protection.	Input shaft speed sensor fault Output shaft speed sensor fault Deceleration clutch guard ring fault Transfer case drive gear or driven gear fault Low/ reverse gear braking system fault Reverse-gear clutch system fault Noise interference

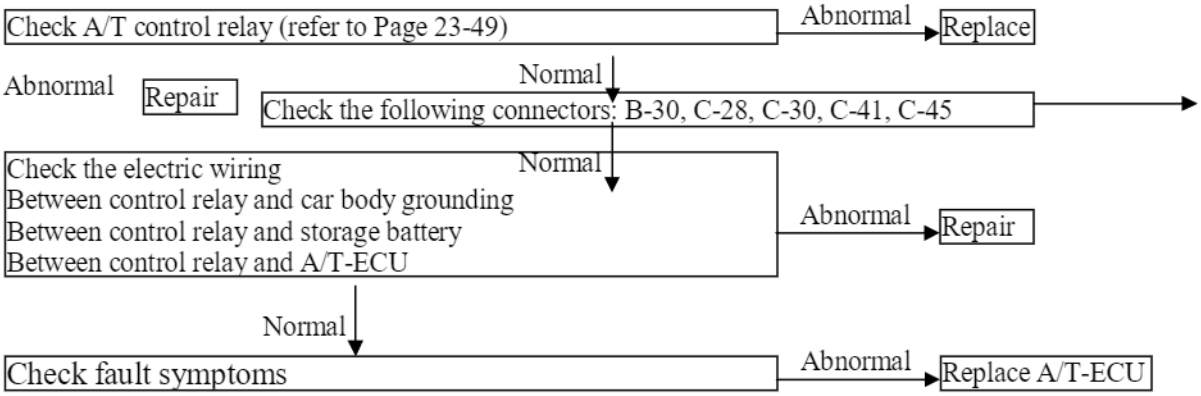


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Code 51 Abnormal communications with engine –ECU	Possible cause
When the ignition switch is turned on, the storage battery is over 10V and engine speed is over 450rpm and there have been abnormal communications for over 1 second running, then Troubleshooting code 51 will be output.	Connector fault Engine-ECU fault A/T-ECU fault



Code 54 A/T control relay system	Possible cause
When the ignition switch is turned on and the control relay voltage is less than 7V, then the A/T control relay will be diagnosed as suffering ground faults and Code 54 will be output. The gearbox will be locked at the third gear as a protection.	A/T control relay Connector fault A/T-ECU fault



Fault Symptoms Check List

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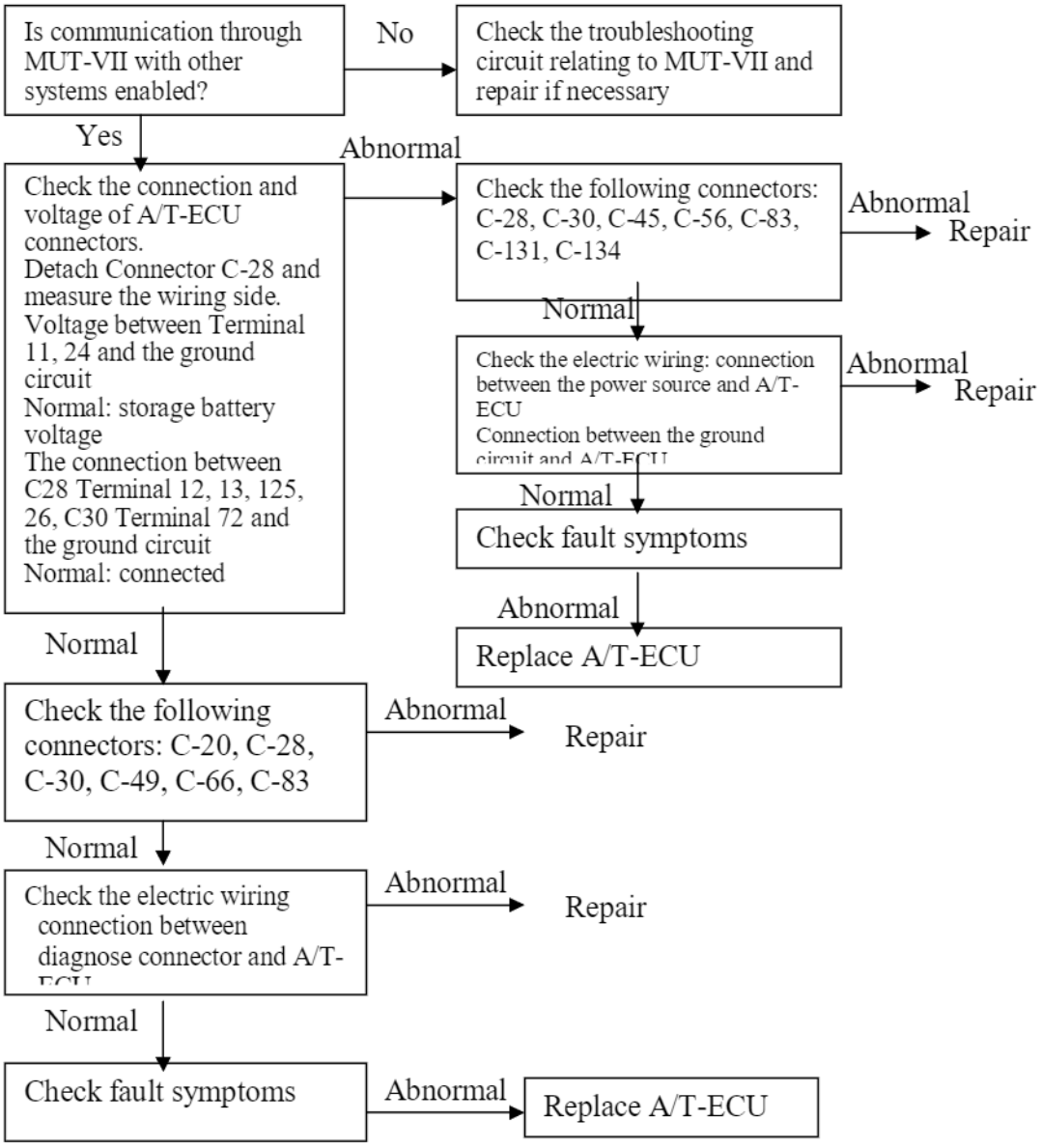
Fault symptoms		Checking Sequence No.
No communications with MUT-II		1
Driving disabled	Startup disabled	2
	Forward traveling disabled	3
	Backup disabled	4
	Traveling disabled (travel forward or back up)	5
Abnormal startup	Engine stops during gear shifting	6
	Impact and delayed response during shifting from N to D position.	7
	Impact and delayed response during shifting from N to R position.	8
	Impact and delayed response during shifting from N to R position or N to D position.	9
Abnormal gear shifting	Impact and high-speed running	10
Displaced gear shifting position	All positions	11
	Some positions	12
Gear shifting disabled	No troubleshooting code	13
Abnormal driving	Poor acceleration	14
	Vibration	15
Manual-gear-shifting-protective switchgear system		16
Mode control switchgear system		17
Idle speed position switchgear system		18
Double pressure switchgear system		19
Car speed sensor		20
Automatic constant-speed –ECU signal system		21

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Fault Symptoms Checking Sequence

Checking Sequence 1

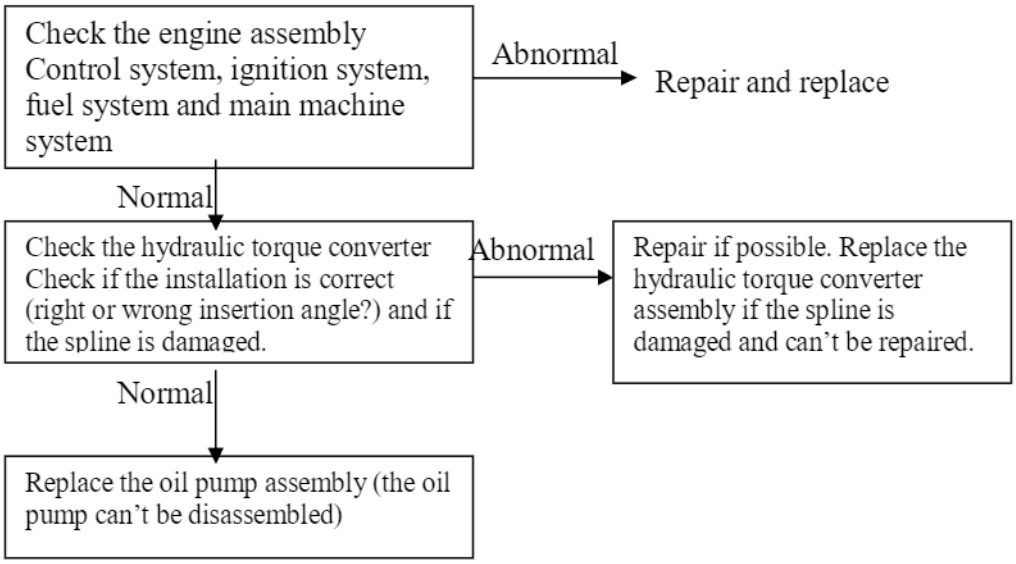
No communications with MUT-VII disabled	Possible cause
The reason is possibly the faults in troubleshooting circuit or A/T-ECU troubles	Troubleshooting circuit fault A/T-ECU fault Connector fault



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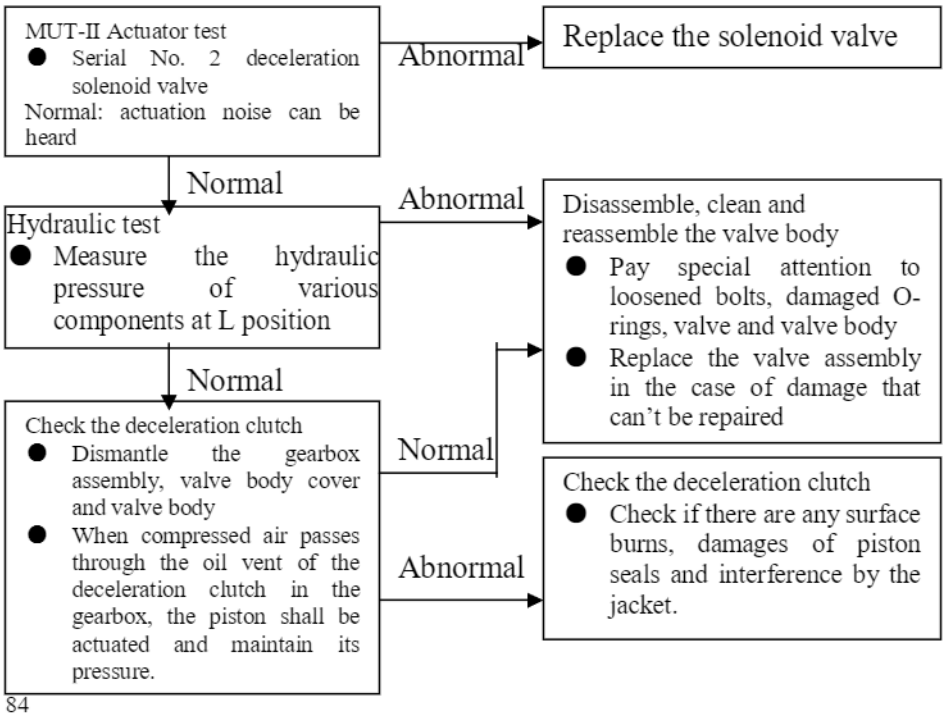
Checking Sequence 2

Startup disabled	Possible cause
Car startup is disabled when the gear lever is at P or N position. The reason is possibly troubles in engine, hydraulic torque converter or oil pump.	Engine trouble Hydraulic torque converter fault Oil pump trouble



Checking Sequence 3

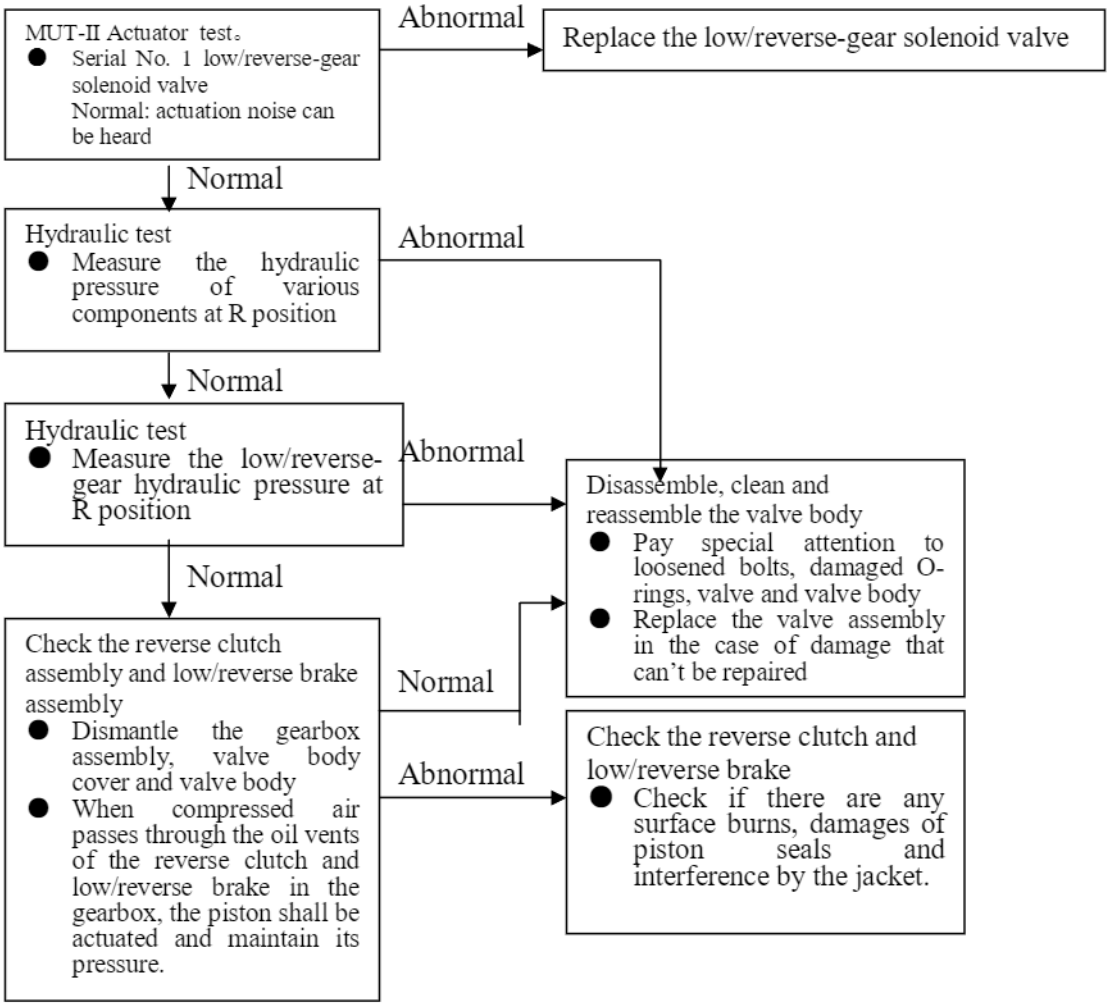
Forward traveling disabled	Possible cause
When the engine is idly running, the car can't move forward even if the gear lever is shifted from N to D, 3, 2, or L position. The reason is possibly abnormal pipeline pressure or troubles in the deceleration clutch rear valve.	- Abnormal pipeline pressure - Deceleration solenoid valve trouble - Valve body trouble



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Checking Sequence 4

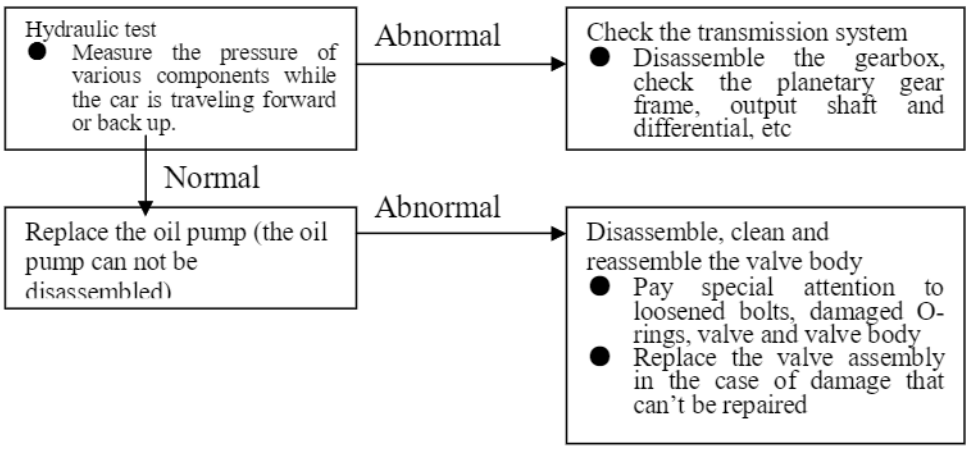
Backup disabled	Possible cause
When the engine is idly running, the car can't back even if the gear lever is shifted from N to R position. The reason is possibly abnormal pipeline pressure in the reverse clutch or low/reverse brake, or troubles in the reverse clutch or low/reverse-gear brake or valve body.	Abnormal pressure of reverse clutch Abnormal pressure of low/reverse-gear brake Trouble in low/reverse-gear solenoid valve Trouble in reverse clutch Trouble in low/reverse brake Valve body trouble



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Checking Sequence 5

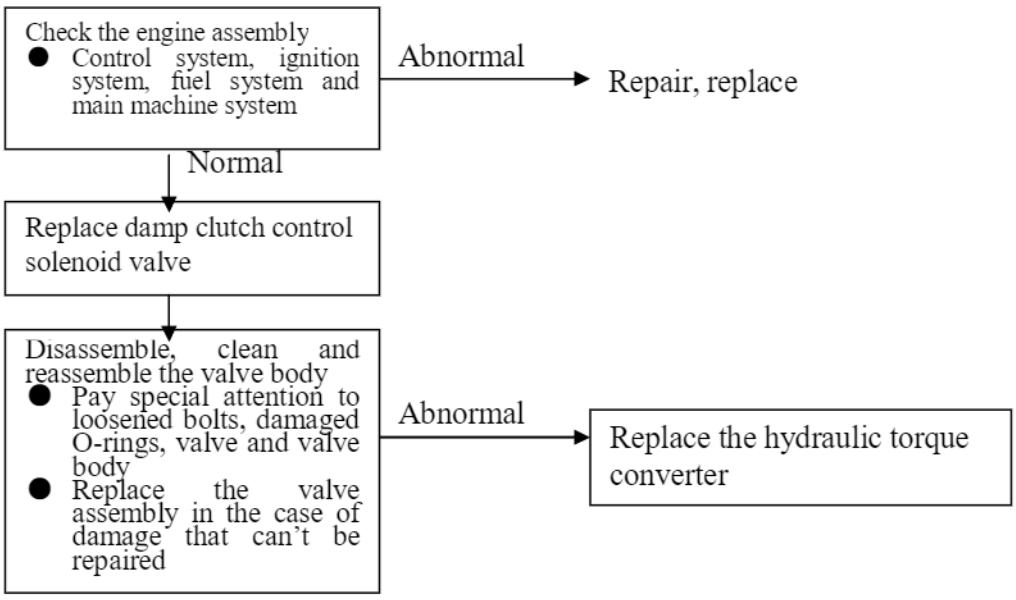
Traveling disabled (forward or backward)	Possible cause
When the engine is idly running, the car can neither move forward nor back up regardless of the gear lever position. The reason is possibly abnormal pipeline pressure or troubles in the transmission system, oil valve or valve body.	Abnormal pipeline pressure Transmission system trouble Oil pump trouble Valve body trouble



Checking Sequence 6

Engine stops during gear shifting	Possible cause
When the engine is idly running, the engine stops when the gear lever is shifted from N to D or R position. The reason is possibly trouble in engine, damp clutch control valve, valve body or hydraulic torque converter (damp clutch).	Engine trouble Damp clutch control valve trouble Valve body trouble Hydraulic torque converter (damp clutch) trouble

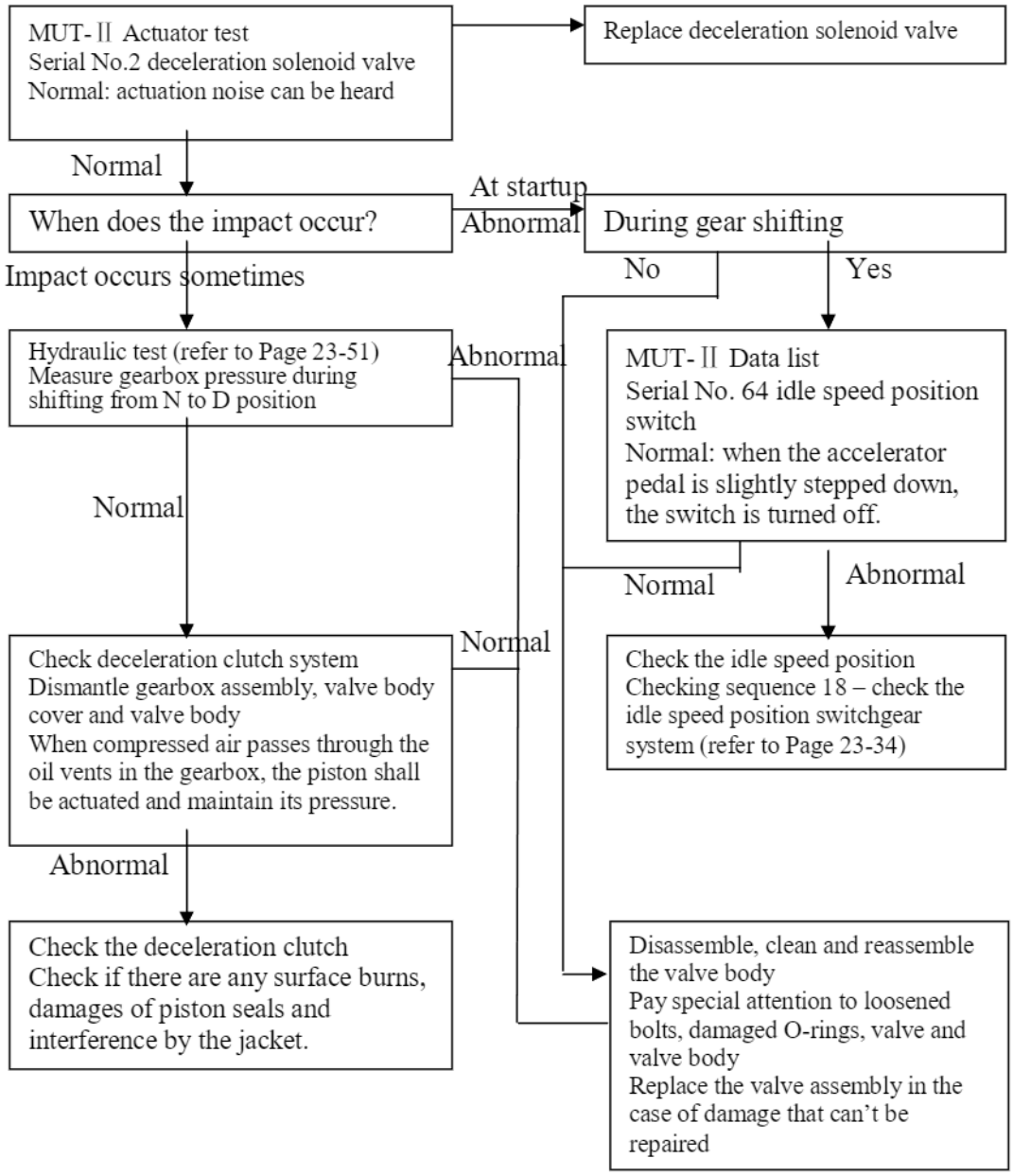
★Refer to the Maintenance Manual of the Gearbox Workshop



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Impact and delayed response during shifting from N to D position.	Possible cause
When the engine is idly running and the gear lever is shifted from N to D position, there is abnormal impact and delayed response for over 2 seconds. The reason is possibly abnormal pressure of deceleration clutch or troubles in deceleration clutch, body valve or idle speed position switch.	Deceleration clutch abnormal pressure Deceleration solenoid valve trouble Deceleration clutch trouble Valve trouble Idle speed position switch trouble

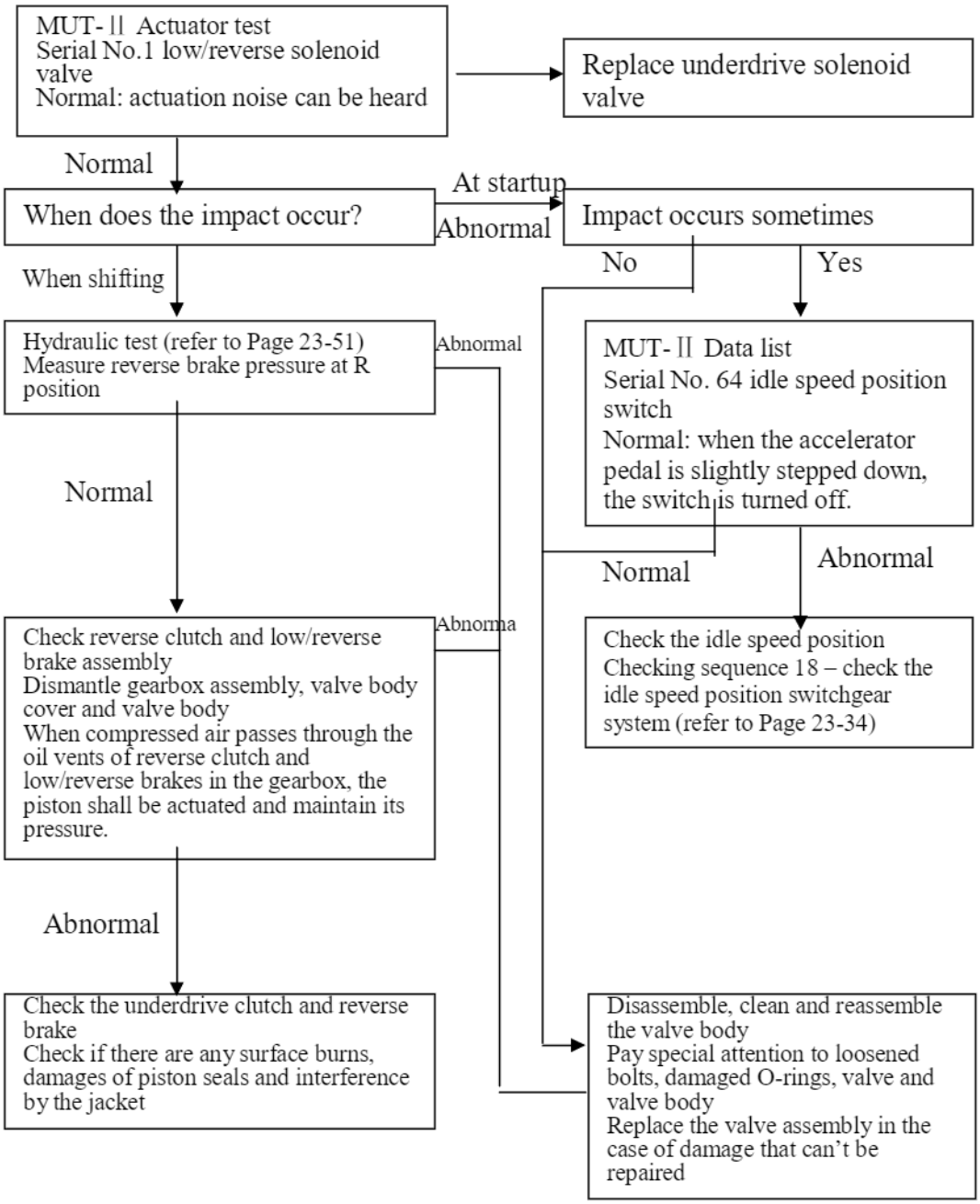
Checking Sequence 7



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Impact and delayed response during shifting from N to R position.	Possible cause
When the engine is idly running and the gear lever is shifted from N to R position, there is abnormal impact and delayed response for over 2 seconds. The reason is possibly abnormal pressure of reverse clutch or underdrive brake, or troubles in reverse clutch, low/reverse brake, body valve or idle speed position switch.	Reverse clutch abnormal pressure Low/reverse brake abnormal pressure Low/reverse solenoid valve trouble Reverse clutch trouble Low/reverse brake trouble Valve body trouble Idle speed position switch trouble

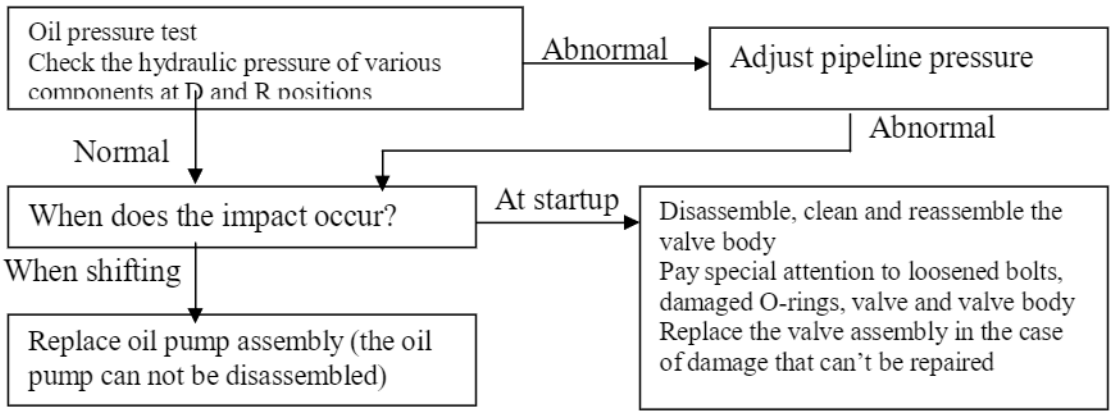
Checking Sequence 8



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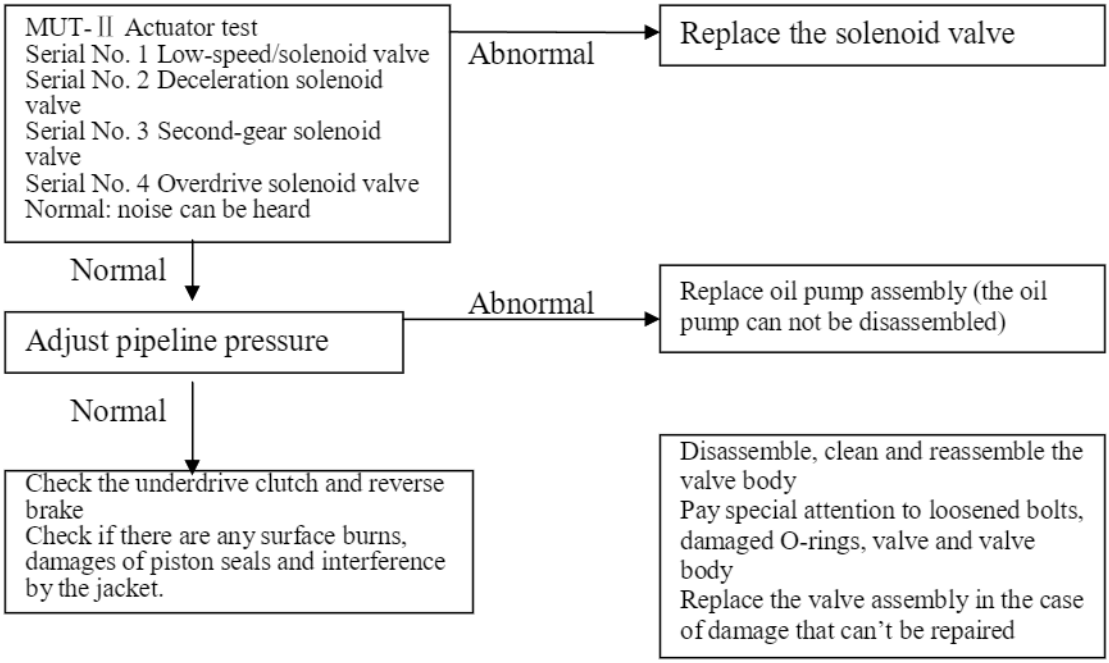
Checking Sequence 9

Impact and delayed response during shifting from N to D or N to R position.	Possible cause
When the engine is idly running and the gear lever is shifted from N to R or N to D position, there is abnormal impact and delayed response for over 2 seconds. The reason is possibly abnormal pressure of pipeline or troubles in oil pump or valve body.	Abnormal pressure of pipeline Oil pump trouble Valve body trouble



Checking Sequence 10

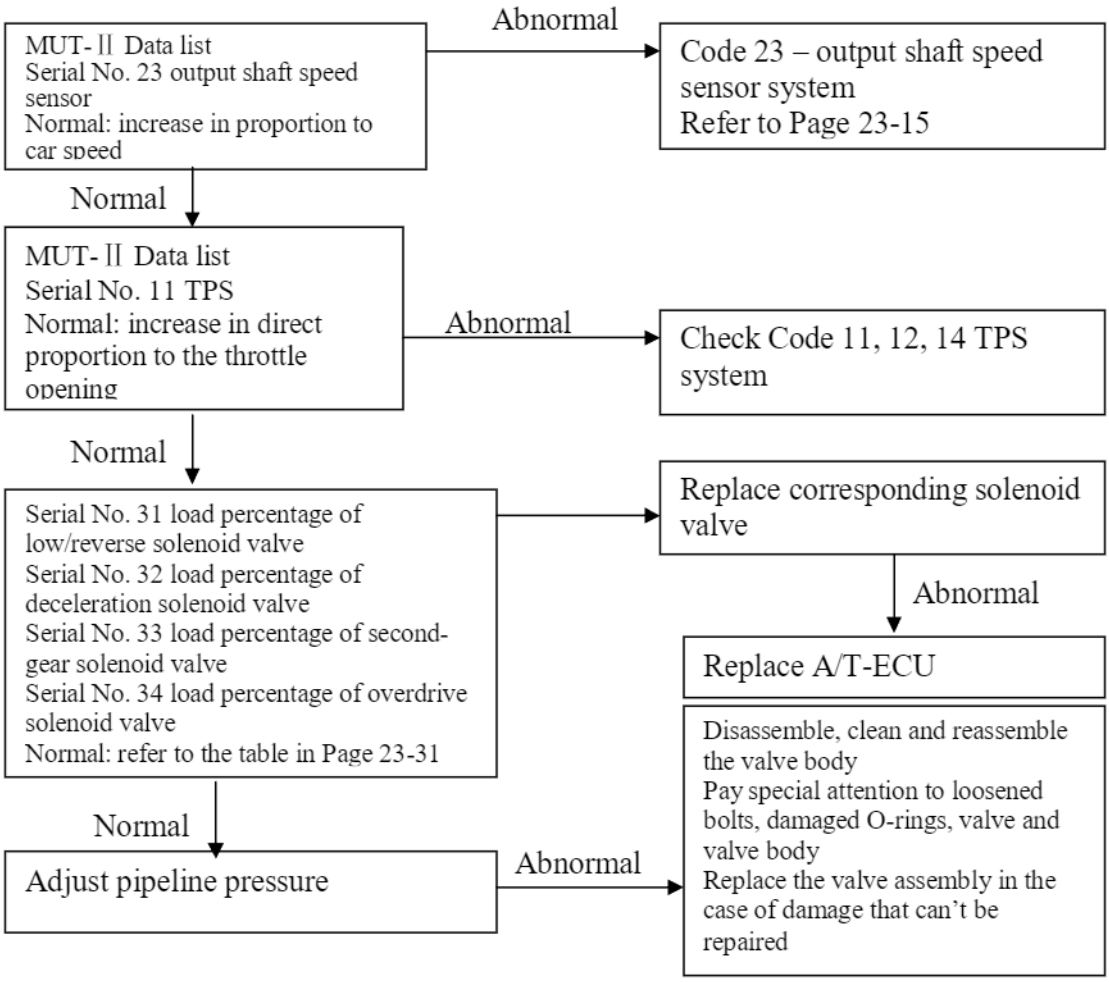
Impact and high-speed running	Possible cause
Impact occurs during gearing up or down and the gearbox speed is higher than engine rotation speed. The reason is possibly abnormal pipeline pressure or troubles in a certain solenoid valve, oil pump, valve body, brake or clutch.	Abnormal pipeline pressure Trouble of each solenoid valve Oil pump trouble Valve body trouble Trouble of each brake or clutch



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Checking Sequence 11

All positions (displaced gear shifting position)	Possible cause
Gear shifting position is displaced during traveling. The reason is possibly trouble in output shaft speed sensor, TPS or a certain solenoid valve	Output shaft speed sensor trouble Throttle position sensor trouble Troubles of various solenoid valves Abnormal pipeline pressure Valve body trouble A/T-ECU trouble

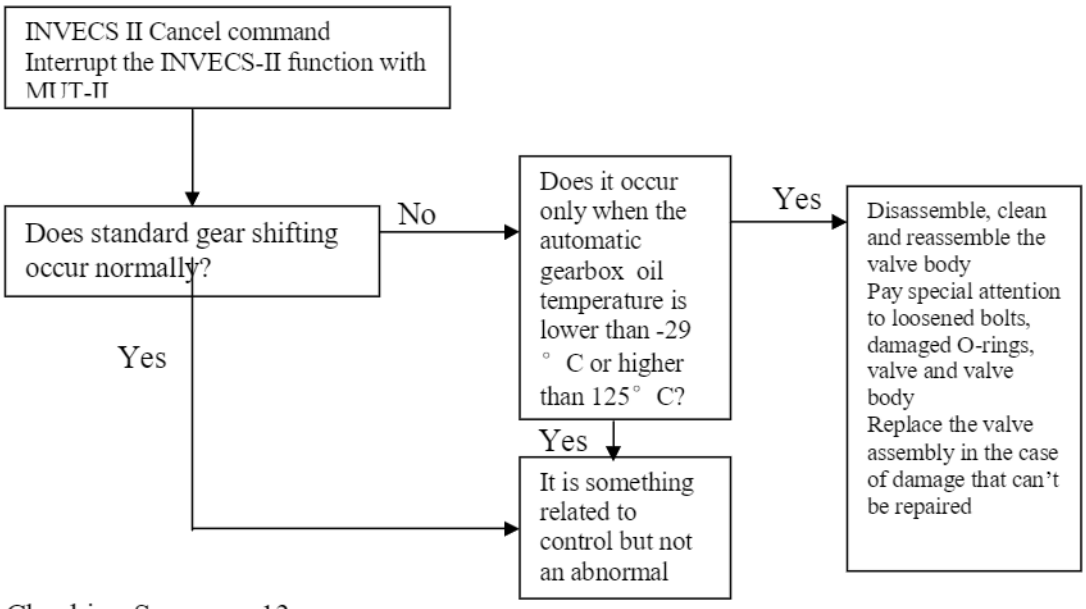


	Serial No. 31	Serial No. 32	Serial No. 33	Serial No. 34
Travel at constant speed at the first gear	0%	0%	100%	100%
Travel at constant speed at the second gear	100%	0%	0%	100%
Travel at constant speed at the third gear	100%	0%	100%	0%
Travel at constant speed at the fourth gear	100%	100%	0%	0%

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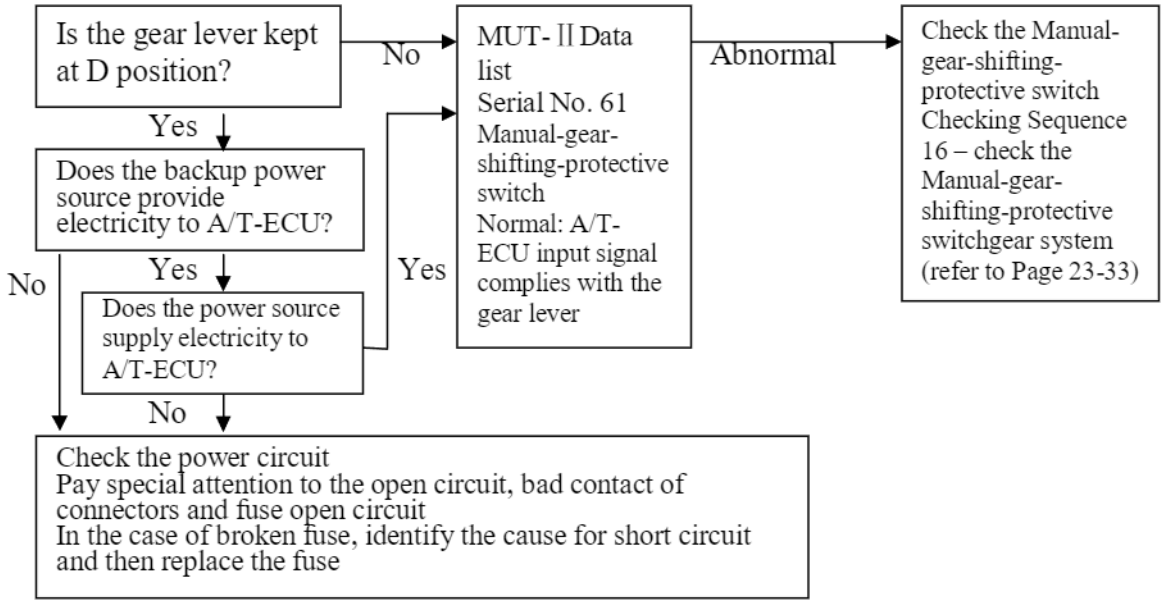
Checking Sequence 12

Some positions (displaced gear shifting position)	Possible cause
Gear shifting position is displaced during traveling. The reason is possibly trouble in valve body or control-related phenomenon, but not an abnormal case	Valve body fault



Checking Sequence 13

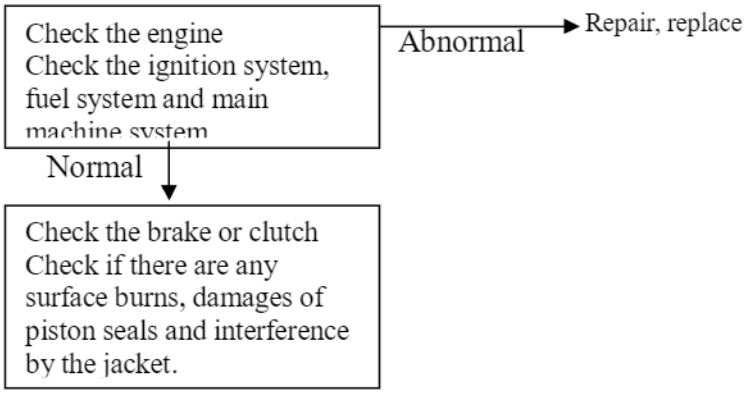
No troubleshooting code gear shifting disabled)	Possible trouble
No gear shifting and no troubleshooting code output occur during driving. The reason is possibly trouble in manual-gear-shifting-protective switch or A/T-ECU.	Manual-gear-shifting-protective switch trouble A/T-ECU trouble



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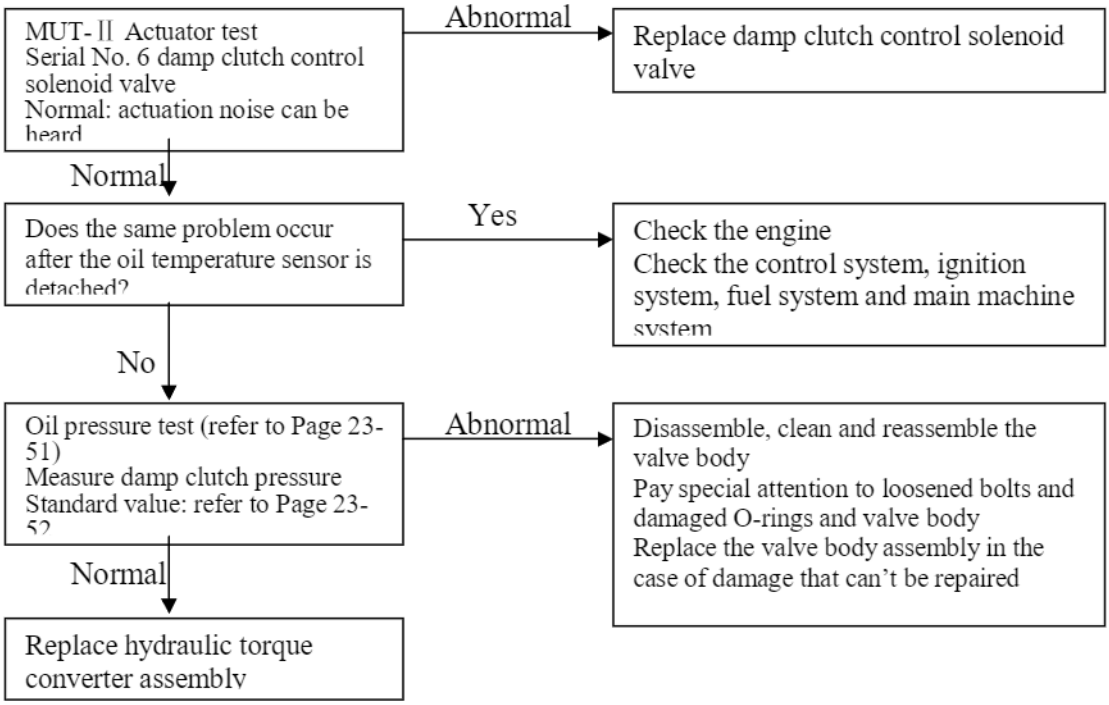
Checking Sequence 14

Poor acceleration	Possible cause
Acceleration ability is poor even if the car is geared down during traveling. The reason is possibly trouble in engine, brake or clutch.	Engine trouble Clutch or brake trouble



Checking Sequence 15

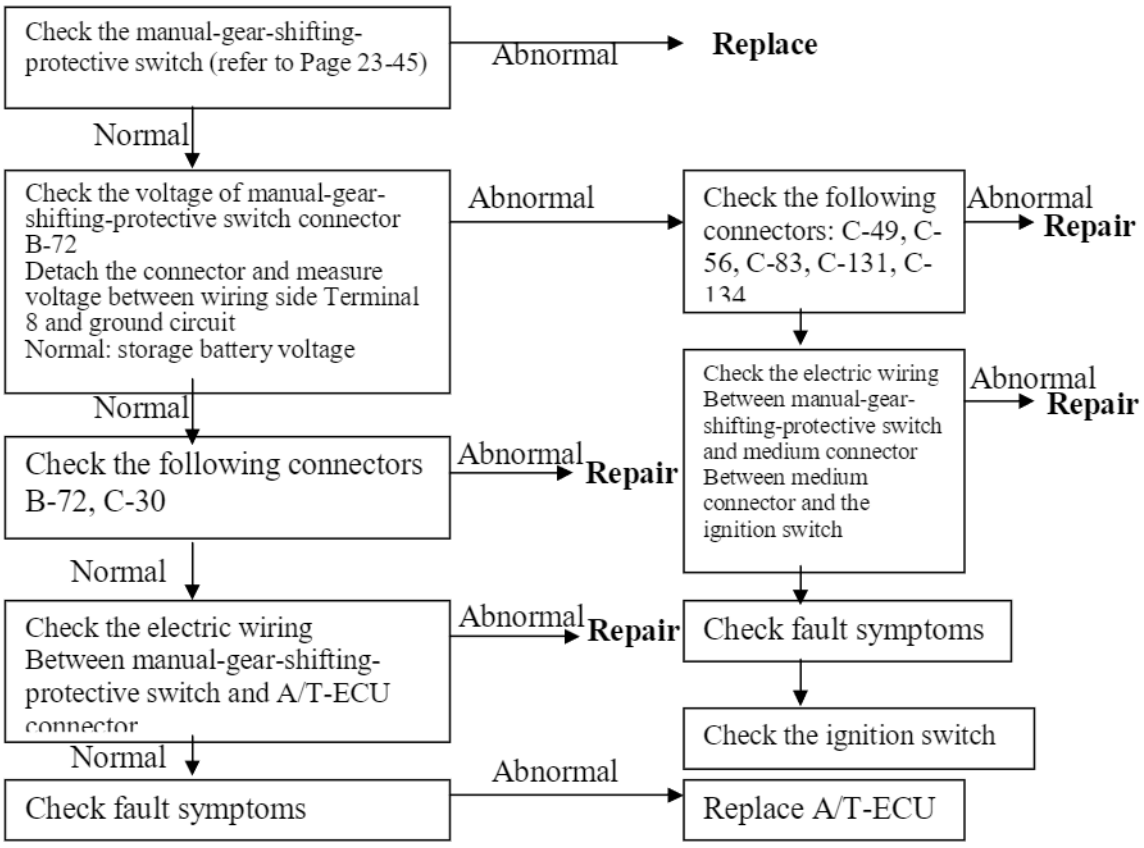
Vibration	Possible cause
There is vibration during constant-speed traveling or acceleration/deceleration at highest gear. In that case, the reason is possibly abnormal pressure of damp clutch or trouble in engine, damp clutch control solenoid valve, hydraulic torque converter or valve body.	Abnormal pressure of damp clutch Engine trouble Damp clutch control solenoid valve trouble Hydraulic torque converter trouble Valve body trouble



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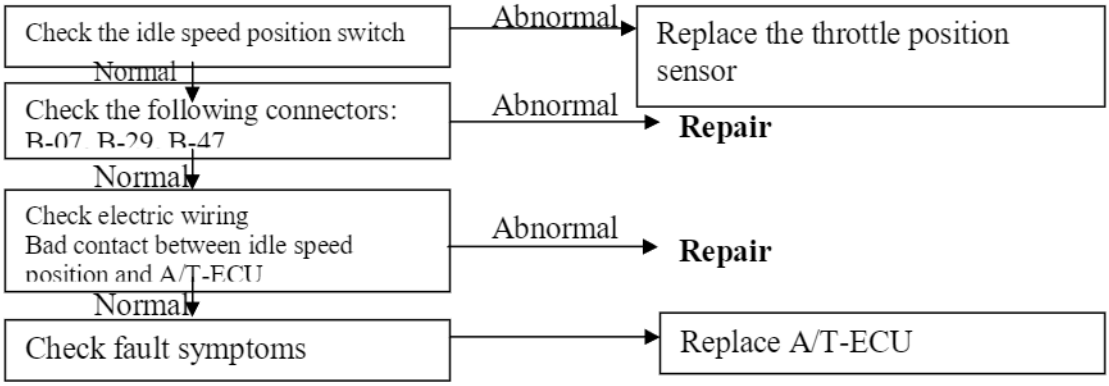
Checking Sequence 16

Manual-gear-shifting-protective switchgear system	Possible cause
The reason is possibly trouble in manual-gear-shifting-protective switchgear circuit, ignition switch or A/T-ECU.	Manual-gear-shifting-protective switch trouble Ignition switch trouble Connector switch A/T-ECU trouble



Checking Sequence 18

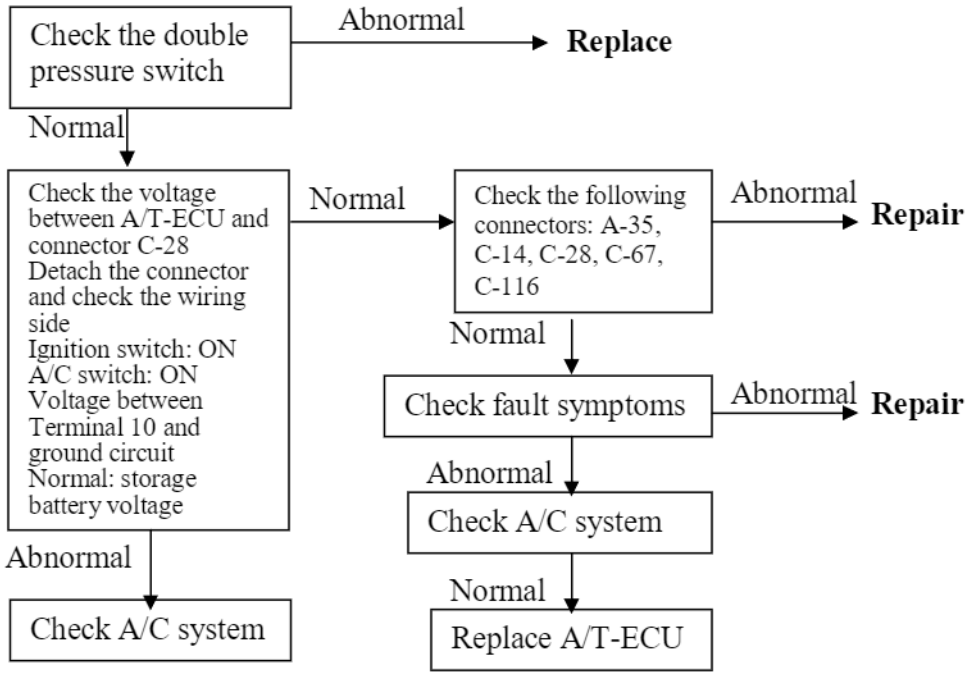
Idle speed position switchgear system	Possible cause
The reason is possibly trouble in idle speed position switch or A/T-ECU.	Idle speed position switch trouble Connector trouble A/T-ECU trouble



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Checking Sequence 19

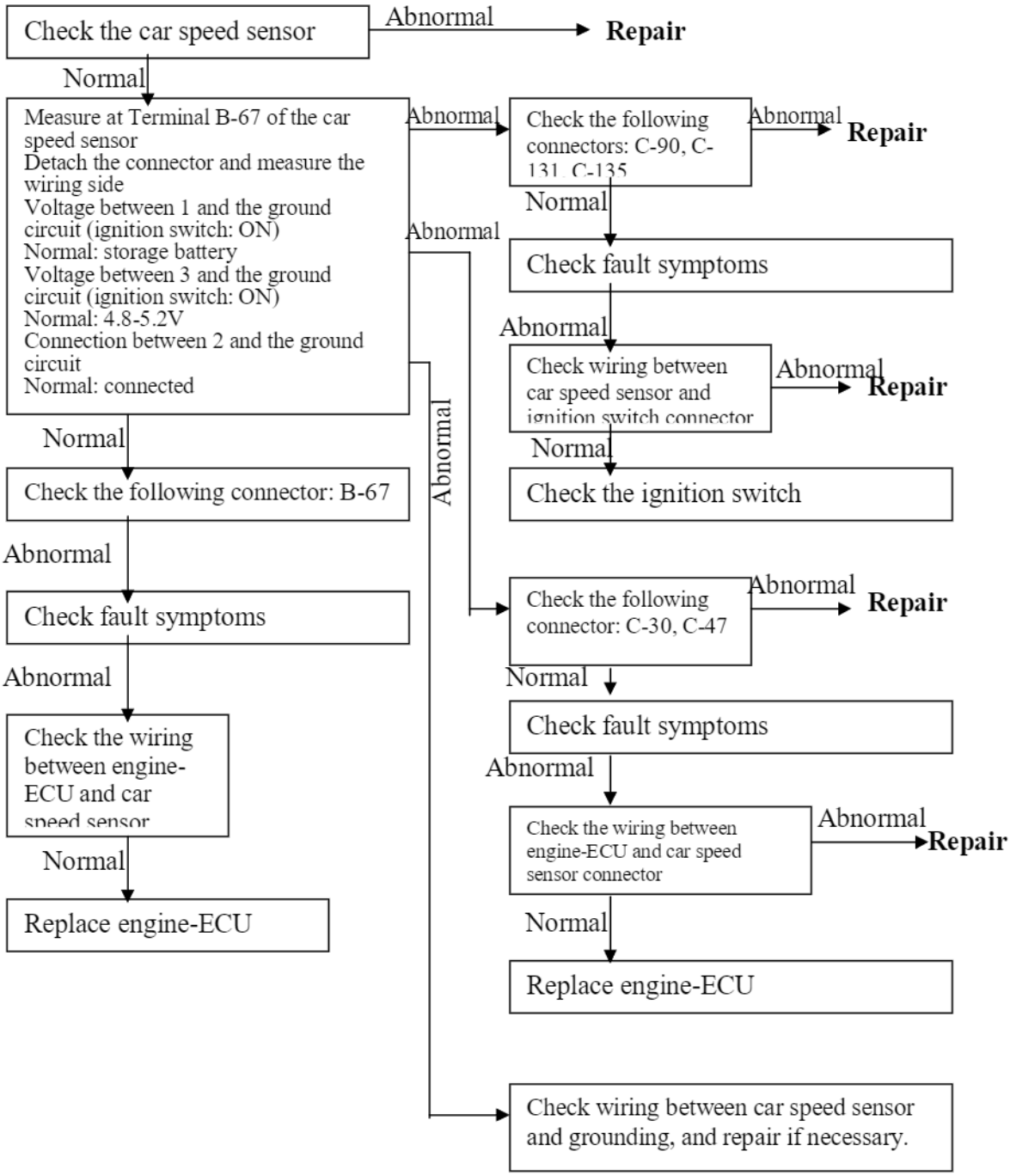
Double pressure switchgear system	Possible cause
The reason is possibly trouble in double pressure switch circuit or bad contact of A/T-ECU	Double pressure switch trouble Connector trouble A/C system trouble A/T-ECU trouble



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Checking Sequence 20

Car speed sensor system	Possible cause
The reason is possibly car sped sensor circuit trouble or bad contact of A/T-ECU	Car speed sensor trouble Connector trouble A/T-ECU trouble



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